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ART. I.—*Thirty Years Retrospect of the progress in our knowledge of the Geology of the Older Rocks*—being an Address to the Geological Section of the British Association at Manchester, September 5, 1861; by Sir RODERICK IMPEY MURCHISON, D.C.L., LL.D., F.R.S., Director General of the Geological Survey of the United Kingdom, President.*

ALTHOUGH I have had the honor of presiding over the Geologists of the British Association at several previous meetings since our first gathering at York, now thirty years ago, I have never been called upon to open the business of this section with an address; this custom having been introduced since I last occupied the geological chair at Glasgow, in 1855.

The addresses of my immediate predecessors, and the last anniversary discourse of the President of the Geological Society of London, have embraced so much of the recent progress of our science in many branches, that it would be superfluous on my part to go again over many topics which have been already well treated.

Thus, it is needless that I should occupy your time by alluding to the engrossing subject of the most recent natural operations with which the geologist has to deal, and which connect his labors with those of the ethnologist. On this head I will only say, that, having carefully examined the detrital accumulations forming the ancient banks of the river Somme in France, I am as complete a believer in the commixture in that ancient

* Communicated to this Journal by Sir R. I. Murchison.

alluvium of the works of man with the reliquiæ of extinct animals as their meritorious discoverer, M. Boucher de Perthes, or as their expounders, Prestwich, Lyell and others. I may, however, express my gratification in learning that our own country is now affording proofs of similar intermixture both in Bedfordshire, Lincolnshire, and other counties: and, possibly, at this meeting we may have to record additional evidences on this highly interesting topic.

But I pass at once from any consideration of these recent accumulations, and, indeed, of all Tertiary rocks; and, as a brief space of time only is at my disposal, I will now lay before you only a concise retrospect of the progress which has latterly been made in the development of one great branch of our science. I confine myself, then, to the consideration of those primeval rocks with which my own researches have for many years been most connected, with a few allusions only, to metamorphism, and certain metalliferous productions, &c.

There is, indeed, a peculiar fitness in now dwelling more especially on the ancient rocks, inasmuch as Manchester is surrounded by some of them, whilst, with the exception of certain groups of erratic blocks and drifts, no deposits occur within the reach of short excursions from hence, which are either of Secondary or Tertiary age.

Let us, then, take a retrospective view of the progress which has been made in the classification and delineation of the older rocks since the Association first assembled at York, in 1831. At that time, as every old geologist knows, no attempt had been made to unravel the order or characters of the formations which arise from beneath the Old Red Sandstone. In that year Sedgwick was only beginning to make his first inroads into those mountains of North Wales, the intricacies of which he finally so well elaborated, whilst I only brought to that, our earliest assembly, the first fruits of observations in Herefordshire, Brecon, Radnor, and Shropshire, which led me to work out an order which has since been generally adopted.

At that time the terms of Cambrian, Silurian, Devonian, and Permian were not dreamt of, but, acting on the true Baconian principle, their founders and their coadjutors have, after years of toil and comparison, set up such plain landmarks on geological horizons that they have been recognized over many a distant land. Compare the best map of England of the year 1831, or that of Greenough, which had advanced somewhat upon the admirable original classification of our father, William Smith, and see the striking difference between the then existing knowledge and our present acquirements. It is not too much to say that, when the British Association first met, all the region on both sides of the Welsh border, and extending to the

Irish Channel on the west, was in a state of dire confusion; whilst in Devonshire and Cornwall many of these rocks which from their crystalline nature were classed and mapped as among the most ancient in the kingdom, have since been shown to be of no higher antiquity than the Old Red Sandstone of Herefordshire.

As to Scotland, where the ancient rocks abound, though their mineral structure, particularly in those of igneous origin, had necessarily been much developed in the country of Hutton, Playfair, Hall, Jameson, and McCulloch, yet the true age of most of its sedimentary rocks and their relations were unknown. Still less had Ireland, another region mainly palæozoic, received any striking portion of that illustration which has since appeared in the excellent general map of Griffith, and which is now being carried to perfection through the labors of the Geological Survey under my colleague Jukes. If such was our benighted state as regarded the order and characters of the older formations at our first meeting, great was the advance we had made when at our twelfth meeting we first assembled at Manchester in 1842. Presiding then as I do now over the geological section, I showed in an evening lecture how the palæozoic rocks of Silurian, Devonian, and Carboniferous age, as well as those rocks to which I had assigned the name of Permian, were spread over the vast region of Russia in Europe and the Ural Mountains. What, then, are some of the main additions which have been made to our acquaintance with the older rocks in the British Isles since we last visited Manchester?

Commencing with the oldest strata, I may now assume, from the examination of several associates on whose powers of observation as well as my own I rely, that what I asserted at the Aberdeen meeting, in 1859, as the result of several surveys, and what I first put forth at the Glasgow meeting of 1855, is substantially true. The stratified gneiss of the northwest coast of the Highlands, and of the large island of Lewis and the outer Hebrides, is the fundamental rock of the British Isles, and the precise equivalent of the Laurentian system of Canada, as described by Sir W. E. Logan. The establishment of this order, which is so clearly exhibited in great natural sections on the west coast of Sutherland and Ross, is of great importance in giving to the science we cultivate a lower datum-line than we previously possessed, as first propounded by myself before the British Association in 1855.*

* See Reports of British Association for 1855 (Glasgow Meeting). At that time I was not aware that the same order was developed on a grand scale in Canada, nor do I now know when that order was there first observed by Sir W. E. Logan. I then (1855) simply put forward the facts as exhibited on the northwest coast of Scotland; viz., the existence of what I termed a lower or "fundamental gneiss," lying far beneath other gneissose and crystalline strata, and containing remains which I even then suggested were of Lower Silurian age. Subsequently, in 1859, when accom-

For hitherto the order of the geological succession, even as seen in the Geological Map of England and Wales or Ireland, as approved by Sir Henry De la Beche and his able coadjutors, Phillips, Ramsay, Jukes, and others, admit no older sediment than the Cambrian of North Wales, whether in its slaty condition in Merioneth and Caernarvon or in its more altered condition in Anglesea.

The researches in the Highlands have, however, shown that in our own islands, the older palæozoic rocks, properly so called, or those in which the first traces of life have been discovered, do repose, as in the broad regions of the Laurentian Mountains of Canada, upon a grand stratified crystalline foundation, in which both limestones and iron-ores occur subordinate to gneiss. In Scotland, therefore, these earliest gneissic accumulations are now to be marked on our maps by the Greek letter *alpha*, as preceding the Roman *a*, which had been previously applied to the lowest known deposits of England, Wales, and Ireland. Though we must not dogmatise and affirm that these fundamental deposits were in the pristine state absolutely unfurnished with any living things (for Logan and Sterry Hunt, in Canada, have suggested that there they indicate traces of the former life), we may conclude, that in the highly metamorphosed condition in which they are now presented to us in North Western Britain, and associated as they are with much granitic and hornblendic matter, they are for all purposes of the practical geologist "azoic rocks." The Cambrian rocks, or second stage in the ascending order as seen reposing on the fundamental gneiss of the North West of Scotland, are purple and red sandstones and conglomerates forming lofty mountains. These resemble to a great extent portions of the rocks of the same age which are so well known in the Longmynd range of Shropshire, and at Harlech in North Wales, and Bray Head in Ireland.

At Bray Head they have afforded the Oldhamia, possibly an Alga, whilst at the Longmynd, in Shropshire, they have yielded to the researches of Mr. Salter some worm-tracks and the trace of an obscure crustacean.

The Highland rocks of this age, as well as their equivalents, the Huronian rocks of North America, have as yet afforded no trace whatever of former life. And yet, such Cambrian rocks are in parts of the Longmynd, and specially in the lofty mountains of the North Western Highlands, much less metamorphosed than many of the crystalline rocks which lie upon

panied by Professor Ramsay, I adopted, at his suggestion, the word "Laurentian," in compliment to my friend, Sir William Logan, who had then worked out the order in Canada, and mapped it on a stupendous scale. I stated, however, at the same time, that, if a British synonym was to have been taken, I should have proposed the word "Lewisian," from the large island of the Lewis, almost wholly composed of this gneiss.

them. Rising in the scale of successive deposits, we find a corresponding rise in the signs of former life on reaching that stage in the earlier slaty and schistose rocks in which animal remains begin clearly to show themselves. Thus, the Primordial Zone of Mr. Barrande is, according to that eminent man, the oldest fauna of his Silurian Basin in Bohemia.*

In the classification adopted by Sir Henry De la Beche and his associates, the Lingula Flags (the equivalent of the "Zone Primordial" of Barrande) are similarly placed at the base of the Silurian System. This Primordial Zone is also classed as the Lowest Silurian by De Verneuil, in Spain; by James Hall, Dale Owen, and others, in the United States; and by Sir W. E. Logan, Sterry Hunt, and Billings, in Canada.†

In the last year, Mr. Barrande has most ably compared the North American Taconic group of Emmons‡ with his own primordial Silurian fauna of Bohemia, and other parts of Europe; and although that sound palæontologist, Mr. James Hall, has not hitherto quite coincided with Mr. Barrande in some details,§ it is quite evident that the primordial fauna occurs in many parts of North America. And as the true order of succession has been ascertained, we now know that the Taconic group is of the same age as the lower Wisconsin beds described by Dale Owen, with their Paradoxides, Dikelocephalus, &c., as well as of the lower portion of the Quebec rocks, with their Conocephalus, Axionellus, &c., described by Logan and Billings. Of the crystalline schists of Massachusetts, containing the noble specimen of Paradoxides described by W. B. Rogers, and of the Vermont beds, with their Oleni, it follows that the Primordial Silurian Zone of Bar-

* I learn, however, that in Bohemia Dr. Fritsch has recently discovered strata lying beneath the mass of the Primordial Zone of Barrande, and in rocks hitherto considered azoic, the fossil burrows of annelide animals similar to those of our own Longmynd.

† In completing at his own cost a geological survey of Spain, in which he has been occupied for several years, and in the carrying out of which he has determined the width of the sedimentary rocks of the Peninsula (including the Primordial Silurian Zone, discovered by that zealous explorer, M. Casiano de Prado), M. de Verneuil has in the last few months chiefly examined the eastern part of the kingdom where few of the older palæozoic rocks exist. I am, however, informed by him, that Upper Silurian rocks with *Cardiola Interrupta*, identical with those of France and Bohemia, occur along the southern flanks of the Pyrenees, and also re-occur in the Sierra Morena, in strata that overlie the great mass of Lower Silurian rocks as formerly described by M. Casiana de Prado himself. The southern face of the Pyrenees, he further informs me, is specially marked by the display of mural masses of Carboniferous strata, which, succeeding the Devonian rocks, are not arranged in basin-shape, but stand out in vertical or highly inclined positions, and are followed by extensive conglomerates and marls of Triassic age, and these by deposits charged with fossils of the Lias.

‡ The Silurian classification was proposed by me in 1835, and in the following year, 1836, Dr. Emmons suggested that his black shale rocks, which he called Taconic, were older than any I described.

§ Nor are the writings of the Professors W. B. and H. D. Rogers in unison with the opinions of the authors here cited.

rande (the lower Lingula flags of Britain) is largely represented in North America, however it may occupy an inverted position in some cases, and in others be altered into crystalline rocks.

In determining this question due regard has been had to the great convulsions, inversions, and breaks, to which these ancient rocks of North America have been subjected, as described by Professors Henry D. and W. B. Rogers.

In an able review of this subject, Mr. T. Sterry Hunt thus expresses himself:—"We regard the whole Quebec group, with its underlying primordial shales, as the greatly developed representatives of the Potsdam and Calciferous groups (with part of that of the Chazy), and the true base of the Silurian system." "The Quebec group with its underlying shales," this author adds (and he expresses the opinion of Sir W. E. Logan), "is no other than the Taconic system of Emmons;" which is thus, by these authors, as well as Mr. James Hall, shown to be the natural base of the Silurian rocks in America, as Barrande and De Verneuil have proved it to be on the continent of Europe.

In our own country a valuable enlargement of our acquaintance with the relations of the primordial zone to the overlying members of the Silurian rocks has been made through the personal examination of Mr. Salter, aided by the independent discoveries of organic remains by MM. Homfray and Ashe, of Tremadoc.

It has thus been ascertained, that the lower member only of the deposit, which has been hitherto merged under the name of Lingula flags, can be considered the equivalent of the primordial zone of Bohemia. In North Wales that zone has hitherto been mainly characterized by Lingula and the crustaceans Olenus and Paradoxides. Certain additions having been made to these fossils, Mr. Salter finds that of the whole there are five genera peculiar to the lower zone, and seven which pass upwards from it into the next overlying band or the Tremadoc slate. But the overlying Tremadoc slate, hitherto also grouped with the Lingula flags, is, through its numerous fossils (many of them of recent discovery), demonstrated to constitute a true lower member of the Llandeilo formation. For, among the trilobites, the well known Llandeilo forms of Asaphus and Ogygia range upwards from the very base of these slates. Again, seven or eight other genera of trilobites, which appear here for the first time, are associated with genera of mollusks, and encrinites which have lived through the whole Silurian series. Such for example are the genera Calymene, Illænus, among crustaceans; the Lingula, Orthis, Bellerophon, Conularia, among mollusks; together with encrinites, corals, and that telling Silurian zoophyte, the Graptolite. By this proof of the community of fossil types, as well as by a clear lithological passage of the beds, these Tremadoc slates are thus shown to be indissolubly connected with the Llandeilo and other Silurian formations above them; whilst, although they also pass down conformably into the *zone primordiale*, the latter is characterized by the linguloid shells (Lingulella, Salter) and by the genera Olenus, Paradoxides, and Dikelocephalus, which most characterize it in Britain as in other regions.*

I take this opportunity, however, of reiterating the opinion I have expressed in my work, "Siluria," that to whatever extent the primordial zone of Barrande be distinguished by peculiar fossils in any given tract from the prevalent Lower Silurian types, there exists no valid ground for differing from Barrande, de Verneuil, Logan, James Hall, and others, by separating this rudimentary fauna from that of the great Silurian series of life of which stratigraphically it constitutes the conformable base. And if in Europe but few genera be yet found which are common to this lower zone and the Llandeilo formation (though the Agnostus and Orthis are common to it and all the Silurian strata), we may not unreasonably attribute the circumstance to the fact, that the primordial zone of no one country contains more than a very limited number of distinct forms. May we not, therefore, infer that in the sequel other fossil links, similar to those which are now known to connect the Lower and Upper Silurian series—which I myself at one time supposed to be sharply separated by their organic remains—will be brought to light, and will then zoologically connect the primordial zone with the overlying strata into which it graduates? Let us recollect, that a few years only have elapsed since M. de Verneuil was criticised for inserting, in his table of the Palæozoic Fauna of North America, a number of species as being common to the Upper and Lower Silurian. But now the view of the eminent French Academician has been completely sustained, by the discovery in the strata of Anticosti, as worked out by Mr. Billings under the direction of Sir W. E. Logan, of a group of fossils intermediate in character between those of the Hudson River and Clinton formations, or in other words between Lower and Upper Silurian rocks. In like manner, a similar interlacing seems already to have been found, in North America, between the Quebec group, with its primordial fossils, and the Trenton deposits which are, as is well known, of the Llandeilo age.

I have thus spoken out upon the fitness of adhering to the classifications decided upon by Sir Henry De la Beche and his associates long before I had any relation to the Geological Survey, and which places the whole of the Lingula-flags of Wales as the

* In the last edition of Siluria the distinction was drawn between the lower and upper Lingula-flags, but the fauna of the latter is now much enlarged.

natural base of the Silurian rocks. For English geologists should remember that this arrangement is not merely the issue of the view I have long maintained, but is also the matured opinion of these geologists in foreign countries and in our colonies, who have not only zealously elaborated the necessary details, but who have also had the opportunities of making the widest comparisons.

On the continent of Europe, an interesting addition has been made to our acquaintance with the fauna of one of the older beds of the Lower Silurian rocks, or the Obolus green sand of St. Petersburg,* by our eminent associate, Ehrenberg. He has described and figured† four genera and ten species of microscopic Pteropods, one of which he names *Panderella Silurica;* the generic name being in honor of the distinguished Russian palæontologist, Pander, who collected them. It is well to remark, that as the very grains of this Lower Silurian green sand seem to be in great part made up of these minute organisms, so we recognize, in one of the oldest strata in which animal life has been detected, organisms of the same nature as, and not less abundant than, those which constitute the deep sea-bottoms of the existing Mediterranean and other seas.

Before I quit the consideration of the older palæozoic rocks, I must remind you that it is through the discovery, by Mr. C. Peach of certain fossils of Lower Silurian age in the limestones of Sutherland, combined with the order of the strata, observed in the year 1827 by Professor Sedgwick and myself, that the true age of the largest and overlying masses of the crystalline rocks of the Highlands has been fixed. The fossils of the Sutherland limestone are not indeed strictly those of the Lower Silurian of England and Wales, but are analogous to those of the Calciferous sand-rock of North America. The Maclurea is indeed known in the Silurian limestone of the south of Scotland; but the Ophileta and other forms are not found until we reach the horizon of North America. Now, these fossils refer the zone of the Highland limestone and associated quartz-rocks to that portion of the lower Silurian which forms the natural base of the Trenton series of North America, or the lower part of the Llandeilo formation of Britain. The intermediate formation—the Lingula-flags or "zone primordiale" of Bohemia—having no representative in the north-western Highlands, there is necessarily a complete unconformity between the fossil-bearing crystalline limestones and quartz-rocks with the Maclurea, Murchisonia, Ophiléta, Orthis, Orthoceratites, &c., and those Cambrian rocks on which they rest.

A great revolution in the ideas of many an old geologist, including myself, has thus been effected. Strengthened and con-

* See "Russia and the Ural Mountains."

† Monats-Bericht d. König. Akad. der Wiss. Berlin, 18 April, 1861.

firmed as my view has been by the concordant testimony of Ramsay, Harkness, Geikie, James and others, I have had no hesitation in considering a very large portion of the crystalline strata of the Highlands to be of the same age as some of the older fossiliferous Silurian rocks, whether in the form of slates in Wales, of graywacke-schist in the southern counties of Scotland, or in the conditions of mud and sand at St. Petersburg. The conclusions as respects the correlation of all the older rocks of Scotland have now indeed been summed up by Mr. Geikie and myself in the Geological Sketch-Map of Scotland which we have just published, and a copy of which is now exhibited.* Not the least interesting part of that production is that which explains the age of all the igneous or trappean rocks of the south of Scotland, as well as all the divisions of the Carboniferous formation, and is exclusively the work of my able colleague.

But if through the labors of hard-working geologists, we have arrived at a clear idea of the first recognizable traces of life and their sequences, we are yet far from having satisfied our minds as to the *modus operandi* by which whole regions of such deposites have, as in the Highlands, been transmuted into a crystalline slate. Let us therefore hope that, ere this meeting closes, we may receive instructions from some one of the band of foreign or British geologists who have by their experimental researches been endeavoring to explain the processes by which such wonderful changes in the former condition of sedimentary deposits have been brought to life; such as that by which strata once resembling the incoherent Silurian clay which we see in Russia have been hardened into such rocks as the slaty grauwacke of other regions, and how hard schists of the south of Scotland have been metamorphosed into the crystalline rocks of the Highlands. But why are British geologists to see any difficulty in admitting what I have proposed, that vast breadths of these crystalline stratified rocks of the Highlands are of Lower Silurian age? Many years ago I suggested, after examination, that some of the crystalline rocks near Christiana in Norway were but altered extensions of the Silurian deposits of that region; and, since then, Mr. David Forbes and Mr. Kjerulf have demonstrated the truth of the suggestion. Again, and on a vastly larger scale, we know that in North America all the noted geologists, however they may differ on certain details, agree in recognizing the fact that the vast eastern seaboard range of gneissic and micaceous schists is made up of metamorphosed strata, superior even to the lowest of the Silurian rocks. Logan, Rogers, Hall, and Sterry Hunt are decidedly of this opinion; and the point has been most ably and clearly set before the pub-

* This map is already on sale in Manchester.

lic by the last-mentioned of these geologists,* who, being himself an accomplished chemist, has given us some good illustrations of the probable *modus operandi* in the bringing about of these changes.

The importance of the inquiries to be made by chemical geologists into this branch of our science was not lost upon the earlier members of the British Association. Even in the year 1833, a committee was appointed to endeavor to illustrate the phenomena of the metamorphism of rocks by experiments carried on in iron-furnaces. After a series of trials on various mineral substances, the Rev. W. Vernon Harcourt, to whom we owed so much at our foundation, has, as the reporter of that committee, been enabled to present to the Association that lucid report on the actual effect of long-continued heat which is published in our last volume. In referring you to that document, I must, as an old practical field-geologist, express the gratification I feel in seeing that my eminent friend has, in the spirit of true inductive philosophy, arrived, after much experiment and thought, at the same conclusion at which, in common with Sedgwick, Buckland, De la Beche, Phillips, and others in my own country, and with L. Von Buch, Elie de Beaumont, and a host of geologists abroad, I had long ago arrived in the field. I, therefore, re-echo their voices in repeating the words of Mr. W. Harcourt, "that we are not entitled to presume that the forces which have operated on the earth's crust have always been the same." Looking to the only rational theory which has ever been propounded to account for the great changes in the crust which have taken place in former periods—the existence of an intense central heat which has been secularly more and more repressed by the accumulation of sediment until the surface of the planet was brought into its present comparatively quiescent condition—our first General Secretary has indicated the train of causes, chemical and physical, which resolve some of the difficulties of the problem. He has brought before us, in a compendious digest, the history of the progress which has been made in this branch of our science, by the writings of La Place, Fourier, Von Buch, Fournet, and others; as well as by the experimental researches of Mitscherlich, Berthier, Senarmont, Daubree, Deville, Delesse and Durocher. Illustrating his views by reference to chemical changes in the rocks and minerals of our own country, and fortifying his induction by an appeal to his experiments, he arrives at the conclusion, that there existed in former periods a much greater intensity of causation than that which now prevails. His theory is, that whereas now, in the formation of beds, the aqueous action predominates, and the igneous is only represented by a few solfataras, in the most ancient times the action was much more

* This Journal, May, 1861.

igneous, and that in the intermediate times fire and water divided the empire between them. In a word, he concludes with the expression of the opinion, which my long-continued observation of facts had led me to adopt, "that the nature, force, and progress of the past condition of the earth cannot be *measured* by its existing condition."

In addition to these observations on metamorphism, let me remind you that, on the recommendation of the British Association, other important researches have been carried on by Mr. William Hopkins, our new General Secretary, and in the furnaces of our President, Mr. Fairbairne, on the conductive powers for heat in various mineral substances. Although these experiments have been retarded by a serious accident which befel Mr. Hopkins, they are still in progress, and I learn from him that, without entering into any general discussion as to the probable thickness of the crust of our planet, we may even now affirm, on experimental evidence, that, assuming the observed terrestrial temperature to be due to central heat, the thickness of this crust must be two or three times as great as that which has been usually considered to be indicated by the observed increase of temperature at accessible depths beneath the earth's surface.

Of the Devonian rocks, or Old Red Sandstone, much might be said if I were to advert to the details which have been recently worked out in Scotland, by Page, Anderson, Mitchel, Powrie and others; and in England, by the researches of the Rev. W. Symonds, and other members of the Woolhope and Malvern Clubs. But confining myself to general observations, it may be stated, that a triple subdivision of that group, which I have shown to hold good over the continent of Europe as in our own country, seems now to be generally admitted, whilst the history of its southern fauna in Devonshire has recently been graphically and ably elaborated by Mr. Pengelly, in a paper printed in our last volume.

In Herefordshire and Shropshire the passage of the upper members of the Silurian rocks into the inferior strata of the Old Red group, has been well shown by Mr. Lightbody, and the fossils of its lower members have been vigorously collected. Whilst in Scotland, Mr. Geikie and others have shown the upward passage of *its superior* strata into the base of the Carboniferous rocks; and Dr. Anderson announces the finding of shells with crustacea in the lower or gray beds, south of the Tay. I may here note, that the point which I have been for some years endeavoring to establish as to the true position of the Caithness flags with their numerous ichthyolites seems to be admitted by my contemporaries. The lamented Hugh Miller considered these ichthyolites as belonging to the lower member of the group, and had good grounds for his views, since at his native place, Cromarty, these fish-beds appear very near the base. But by following them into Caithness and the Orkneys, I have shown that they occupy a middle position, whilst the true base of the group is the equivalent of the zone with Cephalaspis, Pteraspis, and Pterygotus.

And here it is right to state, that the Upper Silurian rocks which are clearly represented in Edinburghshire, and which in Lanarkshire seem to graduate upwards into the Lower Old Red or Cephalaspis sandstone, are wanting in the Highlands; thus accounting for the great break which there occurs between the crystallized rocks of Lower Silurian age and the bottom beds of the Old Red Sandstone.

Of the Old Red Sandstone of Scotland and Herefordshire I may be permitted further to observe, that its downward passage into the uppermost Silurian rock, and the upward passage of its higher strata into the Carboniferous strata has been well developed, the one near Ludlow, chiefly through the labors of Mr. Lightbody; the other in Scotland, through the researches of the Government Geologists, Howell and Geikie, as well as by those of Mr. D. Page and other observers. On this head I may, however, note, what my contemporaries seem now to admit, that the removal of the Caithness flags and their numerous included ichthyolites from the bottom of this group, and their translation to the central part of the system, as first proposed by myself, is correct. In truth the lower member of this system is now unequivocally proved to be the band with Cephalaspis, Pteraspis, &c., as seen in Scotland, England, and Russia. The great break which has been traced in the south of Scotland by Mr. Geikie between the lower and upper Old Red is thus in perfect harmony with the zoological fact that the central or Caithness fauna is entirely wanting in that region, as in England—as it is indeed in Ireland, where a similar break occurs.

It gratifies me to add that many new forms of those fossil fishes which so peculiarly characterize the Old Red Sandstones have been admirably described by Sir Philip de Grey Egerton in the Memoirs of the Geological Survey; and I must remark that it is most fortunate that the eminent Agassiz is here so well represented by my distinguished friend, who stands unquestionably at the head of the fossil ichthyologists of our country.

Very considerable advances have been made in the development of our acquaintance with that system—the Carboniferous—which in the north of England (Yorkshire) has been so well described by Professor Phillips, and with which all practical geologists in and around Manchester are necessarily most interested. The close researches of Mr. Binney, who has, from time to time, thrown new lights on the origin and relations of coal, and the component parts of its matrix, established proofs, so long ago as 1840, that great part of our coalfields was accumulated under marine conditions; the fossils associated with the coal-beds being, not as had been too generally supposed, of fluviatile or lacustrine character, but the spoils of marine life. Professor Henry D. Rogers came to the same conclusion with regard to the Appalachian coalfields in America, in 1842. Mr. Binney believes that the plant Sigillaria grew in salt water, and it is to be remarked that even in the so-called "fresh water limestones" of Ardwick and Le Botwood the Spirorbis and other marine shells are frequent, whilst many of the shells termed Cypris may prove to be species of Cytherea. Again, in the illustrations of the fossils which occur in the bands of iron-ore in the South Welsh coalfield, Mr. Salter, entering particularly into this question, has shown that in the so-called "Unio-beds" there constantly occurs a shell related to the Mya of our coasts, which he terms Anthracomya; whilst, as he has stated in the "Memoirs of the Geological Survey," just issued, the very Unios of these beds have a peculiar aspect, differing much from that of true fresh-water forms. They have, he says, a strongly wrinkled epidermis, which is a mark of the Myadæ, or such burrowing bivalve shells, and not of true Unionidæ; they also differ in the interior, as shown by Professor W. King. Seeing that in these cases quietly deposited limestones with marine shells (some of them indeed of estuary character) rest upon beds of coal, and that in many other cases purely marine limestones alternate frequently with layers of vegetable matter and coal, may we not be led to modify the theory, founded on the sound observation of Sir W. E. Logan, by which the formation of coal has been rather too exclusively referred to terrestrial and fresh-water conditions? May we not rather revert to that more expansive doctrine, which I have long supported, that different operations of nature have brought about the consolidation and alteration of vegetable matter into coal? In other words, that in one tract the coal has been formed by the subsidence *in situ* of vast breadths of former jungles and forests; in another, by the transport of vegetable materials into marine estuaries; in a third case, as in Russia and Scotland (where purely marine limestones alternate with coal), by a succession of oscillations between jungles and the sea; and lastly, by the extensive growth of large plants in shallow seas.

The geological map of Edinburghshire, prepared by Messrs. Howell and Geikie, and recently published, with its lucid explanations, affords indeed the clearest proofs of the frequent alternations of beds of purely marine limestone charged with Producti and bands of coal, and is in direct analogy with the coalfields of the Donetz, in Southern Russia.*

* See Russia in Europe and the Ural Mountains, Vol. 1.

In sinking through the extensive coal tracts around Manchester (at Dukinfield), where one of the shafts already exceeds in depth the deepest of the Durham mines, rigorous attention will, I hope, be paid to the discovery of the fossils which characterize each bed passed through, not merely to bring about a correctly matured view of the whole history of these interesting accumulations, formed when the surface of our planet was first furnished with abundant vegetation, but also for the practical advantage of the proprietor and miner, who, in certain limited areas, may thus learn where iron-ores and beds of coal are most likely to be persistent. In carrying out his survey-work through the northwestern coal-tracts of Lancashire, to which the large, or six-inch, Ordnance-map has been applied, one of the Secretaries of this Section, Mr. Hull, has done good service in accurately defining the tracts wherein the elevated coal-deposits are covered by drift only, in contradistinction to those which are still surmounted by red rocks of Permian and Triassic age. In seeing that these are eagerly bought by the public, and in recognizing the great use which the six-inch survey has proved in the hands of the geological surveyors in Scotland, our friends in and around Manchester may be led to insist on having that large scale of survey extended to their own important district. By referring to the detailed delineations of the outcrops of all the Carboniferous strata in the counties of Edinburgh, Haddington, Fife, and Linlithgow, as noted by Professor Ramsay and Messrs. Howell and Geikie, the coal-proprietors of England will doubtless recognize the great value of such determinations.

Concerning the Permian Rocks, which were formed towards the close of the long palæozoic era, and constitute a natural sequel to the old Carboniferous deposits, it is to be hoped that we shall here receive apposite illustrations from some of our associates.

When Professor Sedgwick, thirty-four years ago, gave to geologists his excellent Memoir on the Magnesian Limestone of our country, as it ranges from Durham, through Yorkshire, into Nottinghamshire, he not only described the numerous varieties of mineral structure which that rock exhibits, noting at the same time its characteristic fossils, but he also correlated it, and its underlying beds, with the Zechstein, Kupferschiefer, and Rothe-todte-liegende, of Germany. But whilst this is the true order in both countries, there is this considerable difference in England, that along the zone where the Magnesian Limestone exists as a mass, and where Sedgwick described it, the inferior member of the group is a thin band of sandstone, usually of a yellow color (the Ponterfact rock of William Smith), which in its southern extremity, near Nottingham, is almost evanescent. In many parts of Germany, on the contrary, and notably in Thuringia and Silesia, the same lower band, with a few intercalated courses of limestone, swells out into enormous thicknesses and even constitutes lofty ridges.

In Russia the series of this age puts on very different mineral arrangement. There the calcareous bands, containing the very same species of shells as the magnesian limestone of Germany and Britain, are intercalated with pebble-beds, sandstones, marls, and copper-ores, so that, although the same lithological order does not prevail as in the Saxon or typical Permian country of the elder German geologists, the group is, through its fossil types, unquestionably the same. It was from the observation of this fact, and from seeing that these deposits, so mixed up, yet so clearly correlated by their animal and vegetable relics, and all superposed to the Carboniferous system, occupied a region twice as large as the British Isles, in which the varieties of structure are best seen, in the government of Perm, that I proposed in 1841, that the *whole group* should have the name of "Permian."

Of late years various British authors, including King, Howse, and others, have ably described the fossil shells of this deposit as it exists on the eastern side of the Penine chain ; and recently Mr. Kirkby has produced a carefully written and well-considered memoir, showing the relations of the whole group, by comparing its structure and palæontological contents in Durham with those in South Yorkshire. Whilst, in addition, my associates of the Geological Survey, particularly Mr. Aveline, have been carefully delineating the area of these beds in their northern range from Nottingham through Yorkshire, much yet remains to be done in correlating the Permian rocks lying to the west of the Penine ridge, or where we are now assembled, with their eastern equivalents.

Already, however, great strides have been made towards this desirable end. Thus, Mr. Binney has indicated the succession in the neighborhood of Manchester, and has shown us that there some of the characteristic fossils of the eastern magnesian limestone, exist in red marl and limestones subordinate thereto, and that these are clearly underlaid by other red sandstones, shales, and limestones, which he terms Lower Permian. He has further followed these Lower Permian beds to the west and northwest, and finds them expanding into considerable thicknesses at Astley, Scarrisbrick, and other places where they overlie the coal measures, and he has also traced them into Westmoreland, Cumberland and Dumfriesshire. In the last case he went far to prove that which I suggested many years ago, that the red sandstones of Dumfriesshire containing the large footprints of chelonians, as described by Sir W. Jardine, are of Lower Permian age.

This view of the relations of the Permian rocks of the northwest has been also taken by Professor Harkness, and this summer he has successfully worked out, and has definitely applied the Permian classification to large tracts in Cumberland, as explained in a letter to myself. He finds that the breccias and sandstones of Kirby-Stephen and Appleby, which at the latter place have a thickness of three thousand feet, extend northward on the west side of the Eden (the breccia being replaced by false-bedded sandstones with footprints), and attain near Carlisle the enormous thickness of about five thousand feet. These beds he classes unhesitatingly as Lower Permian, because he finds them to be overlaid (near Ormside) by a group of clays, sandstones, and magnesian limestones, containing peculiar plant remains and shells of the genus Schizodus, representing in his opinion the marlslate and magnesian limestone of Durham. These again support beds equivalent to the Zechstein, and the last are covered by the Triassic sandstone of the Solway.

A very striking fact, noticed by Professor Harkness, and corroborative of earlier researches made by Mr. Binney, is the existence of foot-prints, in the Lower Permian of Cumberland, similar to those of Corncockle Moor, in Dumfriesshire, where, from my own observations, including those of last year, these Lower Permian sandstones have, I am convinced, a greater thickness even than that which is assigned to them in Cumberland.

Notwithstanding these discoveries, we have still to show the continuous existence of the Lower Red Sandstone of Shropshire, Worcestershire, and Staffordshire, which I have classed as the lower member of the Permian rocks, and to decide whether it be really such lower member *only*, or is to be regarded as the equivalent of the whole Permian group, under differing mineral conditions. With the extension of the Geological Survey this point will, doubtless, be satisfactorily adjusted, and we shall then know to what part of the series we are to attach the plant-bearing red beds of Coventry and Warwick, described as Permian by Ramsay and his associates. We have also to show that, in its northern course, the lower red sandstone of the central counties, with its calcareous conglomerates, graduates into the succession exhibited at Manchester, thence expanding northwards. Already, however, we have learned that our own little England, which contains excellent normal as well as variable types of all palæozoic deposits, there exists proofs that the Permian rocks, according to the original definition of the same, present to the observer, who examines them to the west as well as to the east of the Penine chain, nearly as great diversities of lithological structure, in this short distance, as those which distinguish the strata of the same age in Eastern Russia in Europe from the original types of the group in Saxony and other parts of Germany.

Geological Survey and Government School of Mines, Mineral Statistics and Colonial Surveys.—As I preside for the first time over this Section since I was placed at the head of the Geological Survey of Britain, I may be excused for making an allusion to that national establishment, by stating that the public now take a lively interest in it, as proved by a largely increased demand for our maps and their illustrations—a demand which will, I doubt not, be much augmented by the translation at an early day of many of our field-surveyors from the southeastern and central parts of England, where they are now chiefly employed, to those northern districts where they will be instrumental in developing the superior mineral wealth of the region.

The Government School of Mines, an offshoot of the Geological Survey, is primarily intended to furnish miners, metallurgists, and geological surveyors with the scientific training necessary for the successful pursuit and progressive advancement of the callings which they respectively pursue; but at the same time, the lectures and the laboratories are open to all those who seek instruction in physical science for its own sake, by reason of its important application to manufactures and the arts. The experience of ten years has led the Professors to introduce various modifications into their original programme—with the views adapting the school as closely as possible to the wants of those two classes of students; and at present, while a definite curriculum, with special rewards for excellence is provided for those who desire to become mining, metallurgical and geological associates of the school, every student who attends *a single course of lectures* may by the new rules compete, in the final examination, for the prizes which attach to it only.

Throughout the whole period of the existence of the school, the Professors have, as a part of their regular duty, given annual courses of evening lectures to working-men, which are always fully attended; and during the past year several of them have delivered voluntarily courses of evening lectures, at a fee so small as to put them within the reach of working men, pupils, teachers, and schoolmasters of primary schools. The Professors thus hope to support to the utmost the great impulse towards the diffusion of a knowledge of physical science through all classes of the community, which has been given through the Department of Science and Art by the Minute of the Committee of Privy Council of the 2d June, 1859. * * * *

As I can trace no record of the teachings of the Government School of Mines in the volumes of the British Association, and as I am convinced that the establishment only requires to be more widely known, in order to extend sound physical knowledge not merely to miners and geologists, but also to chemists, metallurgists, and naturalists, I have only to remind my audience that this School of Mines which, owing its origin to Sir Henry De la Beche, has furnished our Colonies with some of the most accomplished geological and mining surveyors, and many a manufacturer at home with good chemists and metallurgists, has now for its lecturers men of such eminence that the names of Hoffman, Percy, Warington Smyth, Willis, Ramsay, Huxley, and Tyndall are alone an earnest of our future success.

In terminating these few allusions to the Geological Survey, and its applications, I gladly seize the opportuuity of recording, that in the days of our founder, Sir Henry De la Beche, our institution was greatly benefitted in possessing, for some years, as one of its leading surveyors, such an accomplished naturalist and skillful geologist, as the beloved Assistant General Secretary of the British Association, Professor Phillips, who by his labors threw much new light on the palæontology of Devonshire, who, in the Memoirs of the Survey, has contributed an admirable Monograph on the Silurian and other rocks around the Malvern hills and who, by his lectures and writings, is now constantly advancing geological science in the oldest of our British universities.

There is yet one subject connected with the Geological Survey to which I must also call your attention, viz., the Mineral Statistics of the United Kingdom, as compiled with great care and ability by Mr. Robert Hunt, the Keeper of the Mining Records, and published annually in the Memoirs of our establishment.

These returns made a deep impression on the statists of foreign countries who were assembled last year in London at the International Congress. The Government and members of the legislature are now regularly furnished with reliable information as to our mineral produce, which, until very recently, was not obtainable. By the labors of Mr. Robert Hunt, in sedulously collecting data from all quarters, we now become aware of the fact that we are consuming and exporting about 80 millions of tons of Coals annually (a prodigious recent increase, and daily augmenting). Of Iron-ore we raise and smelt upwards of 8 millions of tons, producing 3,826,000 tons of pig iron. Of Copper-ore we raise from our own mines 236,696 tons, which yield 15,968 tons of metallic copper; and from our native metallic minerals we obtain of Tin 6,695 tons; of Lead, 63,525 tons; and of Zinc, 4,357 tons. The total annual value of our Minerals and Coals is estimated at £26,993,573, and that of Metals (the produce of the above minerals) and Coals at £37,121,318!

When we turn from the consideration of the home survey to that of the Geological Surveys in the numerous colonies of

Great Britain, I may well reflect with pleasure on the fact that nearly all the leaders of the latter have been connected with, or have gone out from, our home Geological Survey and the Government School of Mines.

Such were the relations to us of Sir William Logan in Canada; of Professor Oldham in India, with several of his assistants; of Selwyn in Victoria; of my young friend Gould in Tasmania, as well as of Wall in Trinidad; whilst Barrett, in Jamaica, is a worthy pupil of Professor Sedgwick. Passing over the many interesting results which have arisen out of the examination of these distant lands, we cannot but be struck with the fact, that whilst Hindostan (with the exception of the Higher Himalayan mountains) differs so materially in its structure and fossil contents from Europe, Australia (particularly Victoria) presents, in its Palæozoic rocks at least, a close analogy to Britain. Thanks to the ability and zeal of Mr. Selwyn, a large portion of this great auriferous colony has been already surveyed and mapped out in the clearest manner. In doing this he has demonstrated that the productive quartzose veinstones, which are the chief matrix of gold, are merely subordinate to the Lower Silurian slaty rocks, charged with Trilobites and Graptolites, and penetrated by granite, syenite, and volcanic rocks, occupying vast regions.* Mr. Selwyn, aided in the palæontology of his large subject by Prof. M'Coy, has also shown how these original auriferous rocks have been worn down at successive periods, one of which abrasions is of Pliocene age, another of Post-Pliocene, and a third the result of existing causes. All these distinctions, as well as the demarkation of the Carboniferous, Oolitic, and other rocks, are clearly set forth. Looking with admiration at the execution of these geological maps, it was with exceeding pain I learnt that some members of the Legislature of Victoria had threatened to curtail their cost, if not to stop their production. As such ill-timed economy would occasion serious regret among all men of science, and would, I know, be also deeply lamented by the enlightened Governor, Sir Henry Barkley, it would at the same time be of lasting disservice to the material advancement of knowledge among the mining classes of the State, let us earnestly hope that the young House of Parliament, at Melbourne, may not be led to enact such a measure.

* While this sheet is passing through the press, we are in receipt of a letter from Walter Mantell, Esq., of New Zealand, dated Auckland, Aug. 30, in which he confirms the discovery of new gold fields in New Zealand. "This discovery," he adds, "is important rather in a political than in a scientific light. In my last conversation with Sir Roderick Murchison, he declared his conviction of its existence—and now no one doubts it. By the last news, we hear of a man and boy getting five lbs. in seven days, &c. Our natives had no metal nor any knowledge of metals despite the quantities of gold now turning up. The non-utilization of this by so observing and ingenious a race is a strange fact."—Eds.

Whilst upon the great subject of Australian geology, I cannot avoid touching on a *quæstio vexata* which has arisen in respect to the age of the coalfields of that vast mass of land. Judging by the fossil plants from some of the carboniferous deposits of Victoria, Prof. M'Coy has considered these coaly deposits to be of the Oolitic or Jurassic age, while the experienced geologist of New South Wales, the Rev. W. B. Clarke, seeing that where he has examined these deposits, some of their plants are like those of the old coal, and that the beds repose conformably upon and pass down into strata with true Mountain-limestone fossils, holds the opinion that the coal is of Palæozoic age. As Mr. Clarke, after citing a case where the coal-seams and plants were reached below Mountain-limestone fossils, expresses a hope that Mr. Gould may detect in Tasmania some data to aid in determining this question, I take this opportunity of stating that I will lay before this meeting a communication I have just received from Mr. Gould, in which he says that in the coalfield of the rivers Mersey and Don, one of the very few which is worked in Tasmania, he has convinced himself that the coal underlies beds containing specimens of true old Carboniferous fossils. Remarking that these relations are so far unlike those which he observed on the eastern coast of the island where the coal overlies, yet is conformable to, the Carboniferous limestone, he adds, that in Tasmania, at least, the coal most worked is unquestionably of Palæozoic age.

Now, as Australia is so vast a region, may not much of the coal within it be of the age assigned to it by Mr. Clarke; and yet may not Prof. M'Coy be also right in assigning some of this mineral to the same Oolitic age as the coal of Brora and the eastern moorlands of Yorkshire?* In his survey of Tasmania, Mr. Gould has also made the important discovery of a resinous shale, termed Dysodile, and which, like the Torbane mineral of Scotland, promises to be turned to great account in the production of paraffine.

* Prof. Dana, in his Geology of the United States Exploring Expedition under Capt. Wilkes (Philad., 1849), expresses the conclusion as the result of his examination of the coal fields of New South Wales (in 1840) that they are either upper Carboniferous or Permian. "While the coal plants point to the upper Carboniferous, or still higher, the fossils below the coal seem to correspond most perfectly with the lower Carboniferous epoch. The conformity and continuity of the series of beds, the frequent occurrence of Coniferous logs, like those of the coal beds, in the sandstones at different localities, together with the characters of the fossil fish, leave little doubt that the whole is one prolonged age, referable to the upper Carboniferous, or partly to the lower Permian era." (Geology, p. 495.) The fish referred to is a true heterocercal form, indicating, according to Agassiz, the upper Carboniferous or a transition to the Permian. This fish (*Urosthenes Australis*) is figured on Plate I, Dana's Australian Fossils, in the folio Atlas accompanying the Report. There is sufficient evidence in the forms of Mollusca figured on the following plates, of the continuation of Palæozoic types beyond their usual limits, indicating a fauna as abnormal for the early age of that most peculiar of continents as now seen in its characteristic types.—Eds.

There are, indeed, other grounds for believing that coal, both of the Mesozoic as well of the old Carboniferous age may exist in Australia. Thus, putting aside the fossil evidences collected in Victoria by M'Coy and Selwyn, we learn from the researches of Mr. Frank Gregory in Western Australia, that Mesozoic fossils (probably Cretaceous and Oolitic) occur in that region; whilst the Rev. W. B. Clarke informs me in a letter just received, that he is in possession of a group of fossils transmitted from Queensland, 700 or 800 miles north of Sydney, which he is disposed to refer to the age of the Chalk; there being among the fossils Belemnites, Pentacrinites, Pectines, Mytili, Modiol, &c. Again the same persevering geologist has procured from New Zealand the remains of a fossil Saurian, which, he thinks, is allied to the Plesiosaurus.*

It would therefore appear that in the southern hemisphere, there is not merely a close analogy between the rocks of Palæzoic age and our own, but further, that as far as the Mesozoic formations have been developed, they also seem to be equivalents of our typical Secondary deposits.

This existence of groups of animals during the Silurian, Devonian, Carboniferous, and even in Mesozoic periods in Australia and New Zealand, similar to those which characterize these formations in Europe, is strongly in contrast with the state of nature which began to prevail in the younger Tertiary period. We know from the writings of Owen that at that time the great continent at our Antipodes was already characterized by the presence of those marsupial forms which still distinguish its *fauna* from that of any other part of the world.

In relation to our Australian colonies, I must also announce that I have recently been gratified in receiving from Messrs. Chambers and Finke, of Adelaide, a collection of the specimens collected by McDouall Stuart, in his celebrated traverse (the first one ever made) from South Australia to the watershed of North Australia. * * *

These specimens are soft, white, chalky rocks, with flints, agates, saline, and ferruginous incrustations, tufas, breccias, and white quartz rocks, and a few specimens of quasi-volcanic rock, but with scarce a fragment that can be referred to the older stages of Lower Silurian age like those of Victoria.† Again, the only fossil shells collected by Mr. Stuart (though the precise latitude is unknown to me) are Mytiloid and Mya-like forms, seemingly indicating a Tertiary age, and thus we may be disposed provisionally to infer that large tracts of the low interior between East and West Australia have in very recent geological periods been occupied by the sea. * * *

* Whilst this is passing through the press, Professor Owen has described this interesting fossil, before this Section, as *Plesiosaurus Australis*.

† It must, however, be noted that the collection sent to me consists of small specimens of rock forming an imperfect series.

ART. II.—*The Heather* (*Calluna vulgaris*) *a Native of the United States: Extracted from an unpublished Report to the Massachusetts Horticultural Society;* by EDWARD S. RAND, Jr.

QUITE a sensation has been created among botanists during the past summer (1861) by the discovery of plants of the Scotch Heather (*Calluna vulgaris*) growing wild in the vicinity of Boston.*

It has been supposed that no true *Ericaceæ* were indigenous to America, though the large and highly ornamental family of *Ericaceæ* is abundantly represented by our beautiful native *Andromedas*, *Cassandra*, *Epigæa*, *Cassiope*, *Clethra*, and many other allied plants.

On Saturday, July 13th, the attention of the writer was first called to a plant exhibited at the weekly show of the Massachusetts Horticultural Society by Jackson Dawson, a young gardener of Cambridge. The plant was growing in a pot, was apparently from about six to ten years old, was half a foot in diameter and a little more in height; it was in full bloom, though the flowers were white rather than pink, owing, as was afterwards ascertained, to its being kept from the light to prevent its drooping from being transplanted at such an unfavorable season. The plant was labelled "Native Heath, found growing wild within twenty miles of Boston."

The writer, as chairman of the Flower Committee, at once called the attention of the committee to this plant, and notified a special meeting to examine the matter. The identity of the plant with the Scotch Heather was obvious enough, but the assertion of its being found wild within twenty miles of Boston naturally met with no believers.

This was so incredible that many were not slow to pronounce it impossible, and looked upon the exhibition as an attempt to deceive the committee. At a meeting of the flower committee, the chairman was instructed to address a note to Mr. Dawson, resquesting him to appoint a time and lead the committee to the locality of the Heather. More than a week having passed, and no answer being received, the committee now convinced that it was an attempt at imposition, passed a vote dismissing the subject from consideration. A few days after, Mr. Dawson called upon the chairman, stated satisfactory reasons for his silence, and promptly appointed an early day for conducting the committee to the habitat of the Heather; and on the morning of Monday, August 5th, the committee took the cars for Tewkesbury (Mass).

It is well known to botanists that the region about Tewkesbury

* See this Journal, xxxii, 290.

is peculiar, and is noted for producing many rare and beautiful plants. The locality of the Heather is about half a mile from the State Alms House, on the farm of Mr. Charles H. Thwing. Leaving the Alms House on our right, we take a narrow sandy road and shortly come near the field; a few minutes walk brings us to the spot, near a lane on the left hand side of the road. The plants occur sprinkled over an extent of perhaps half an acre; there may be in all twenty or more old plants, some, allowing for the slow growth of the plant, from fifteen to twenty years old, others much younger.

The surface of the ground is varied by small hummocks, and is covered with a short close grass, interspersed with numerous plants of *Kalmia angustifolia*, *Spiræa tomentosa*, *Cassandra calyculata*, *Azalea viscosa*, *Myrica Gale*, &c. A rapid brook bounds one side of this field, its banks densely fringed with the common alder (*Alnus incana*), of which shrubs are sparingly scattered over the whole field; in several cases the Heather was found overgrown and shaded by these shrubs. The common Cranberry (*Vaccinium macrocarpon*) occurs somewhat abundantly in the immediate vicinity of the Heather, usually most so on the depressions, while the Heather occurs on the hummocks. From appearances, overflows of the brook are of not unfrequent occurrence, when the greater part of the field would be submerged, and, as it is surrounded by low ground and ditches, a moderate freshet would convert the spot into an island. At the time of the visit of the committee, owing to the continued drought of the past summer, the whole field was parched, and the brook very low. The soil is a sandy peat, just that which a gardener would choose for heaths.

The committee explored the stream on both sides for some distance; but a heavy shower prevented a more satisfactory examination. They also searched for young plants, and found a multitude of seedlings, from one to two years old, and a few somewhat larger. The plants were in full bloom, and presented a most pleasing sight.

About a week later a sub-committee visited the spot, and explored for several miles up and down the stream on both banks, but without finding any farther traces of the heather.

The committee, unable to believe the plant indigenous, started many theories to account for its introduction. Of the existence of the plant in a wild state there was no doubt, and a more unlikely place for it to have been planted could scarcely be found. The question was, whence came it? The first supposition was, that it had been planted or the seed sown there by a Scotchman, Mr. Sutton, who lived near by; but in an interview with Mr. Sutton, he denied all knowledge of the plant till within a few years; said he had never had any heather seed in his possession, had never received any parcels from Scotland, or done anything in any way by which the plant could have been introduced; that he was as much astonished as delighted when, about ten years before, he discovered the plant, which he at once recognized as the Scotch heather, and each year since he had gathered it when in blossom to adorn his house. On being farther pressed by one of the committee as to the possibility of its being introduced by him, he indignantly replied: "Wuld 'na I hae been a fule, mon, to sow it on another mon's land when my ain as good wuld hae grown it as well?" Mr. Sutton's land is on the same stream, adjoining Mr. Thwing's, and in every respect as well adapted to the growth of the heather, yet it occurs only on Mr. Thwing's land. The next supposition was, it might have been planted by Mr. Thwing; but upon questioning him, it was ascertained he had owned the farm for about three years only; had observed the heather in its present locality; but though he noticed it as a pretty plant, and one not found elsewhere on his farm, he knew nothing of its rarity, or had he given the matter a second thought; he had used the land for a peat meadow and for pasturage, and had noticed the cattle would not browse on the plant; he had purchased the farm of Caleb Livingston of Lowell, in whose family it had been for a long time; he believed the field was formerly mowing land.

Mr. Thwing took great interest in the discovery, did everything in his power to aid the committee, and has agreed to protect the plants against injury or removal.

Another ingenious theory was that the seed of the heather had in some way been washed down by the stream from some place above, and being deposited by a freshet in a congenial soil, had vegetated and thriven. It is well known the seed of the heather is minute, and will preserve its vitality for years. The plant not unfrequently springs up in the earth in which imported plants are potted. But it was ascertained that there is or had been no greenhouse and no importers of foreign plants anywhere in the vicinity on the course of the stream, and the nearest greenhouse is five miles distant. The question arises, why should the plant occur in this one spot when there are so many localities all along the stream for miles equally favorable for its development? The neighbors stated they had never observed it elsewhere, except Mr. Sutton, who remembered seeing, several years ago, a plant on the other side of the brook directly opposite the present locality; since attention had been called to the heather he had searched for this plant but unsuccessfully. As the opposite meadow is a mowing field on which the grass is annually cut in August, it is not surprising the plant has been destroyed.

The evidence thus far, proves only that the plant has existed in the same place for about ten years; and the opinion of the committee was adverse to its being considered indigenous. Upon inquiry it was ascertained that until within about a dozen years the field had been used for mowing; but lately it had been pastured; this at once accounts for the occurrence of no decaying clumps and no old dead branches. Mr. Dawson's attention was first attracted to the plant through members of Mr. Sutton's family a few years ago; through whom also its existence has also been known to parties in Salem (Mass.) for some time, and plants of the heather removed from Tewkesbury are now flourishing in a garden in Salem.

The next step in the investigation was to interrogate Mr. Livingston, the former owner of the farm. At an interview with him, he at first could remember no such plant. But, upon being shown a sprig of the heather, he remembered the occurrence of of such a plant many years ago, at a place on the farm which he designated. His account is as follows: Many years ago, say fifty or more, when he was a boy, he remembered helping his father, who then owned the farm, plough up the field in question; it was then more "hummocky," and with deeper depressions than now. They had great trouble in ploughing the field, owing to large patches, "as big as a bushel basket or larger" of a strange spreading plant, which run on the ground like "ground hemlock," and had long and tough roots which caught the plough. He now recognized the heather shown him as the same plant. After a great deal of trouble with the plant, they got a heavy, strong harrow, and tore up roots which were very old, strong and tough, and piled roots and plants in the hollows and covered them deep with soil. They then levelled and sowed the field, and during his father's and his occupancy of the farm the field was until recently used as mowing land. He cannot say how many plants there were, but remembered they were large and gave a great deal of trouble; he has never seen the plant elsewhere, and had forgotten the circumstance, but it recurs vividly to his mind, and he is fully persuaded of the identity of the plant.

During his occupancy of the farm he does not remember the plant; it may have existed, but as that field was mowed each year he thinks the constant cutting would have killed the plants when they grew to any size. In order to assure himself of the identity of the plant he showed a specimen to his mother who is still living at a very advanced age! She at once recognized the plant, told where it grew, said it had grown there for many years, and remembered the trouble it was to plough the field. Mr. Livingston then came to Tewkesbury, and undirected went immediately to the spot where the plant now grows.

The vitality of the seeds of the heather is well known; indeed experience has shown that it is difficult to keep land in pasture which has formerly been covered with it. It is also well known that continual cutting will in time kill any bush or shrub, and there is nothing strange in supposing that the heather may after its original destruction have come up year after year among the grass, and been mowed down unnoticed; indeed it would have been strange if a farmer had noticed such a plant unless its encroachments called his attention to it. Nor is it improbable that the plants now well established in the locality originated from seed of the plants destroyed fifty years ago. Most probably the heather has kept growing all the time, more or less. But allowing that the present plants are only ten years old, and that the original plants were destroyed fifty years ago, say in 1810, this gives us only forty years for the seed to have retained its vitality, by no means an improbable time. Or again, the present plant may have sprung from seed of seedlings from the original plants, for the heather flowers very young, is a low growing shrub and might have flowered year after year unnoticed; indeed to give origin to the present number of plants, it is only necessary for one low branch to have escaped the scythe and perfected seed. This is not only not impossible but very probable. Loudon remarks, "When heathy ground has been subjected to the plough it should never be kept in pasture for many years together, unless it is richly manured, for, as the seeds retain their vitality for many years, plants never fail at the end of a few seasons to make their appearance among the grass."

Now, as to the age of the plants: fifty years ago, say in 1810, there were plants in existence "as large as a bushel basket or larger," the question arises, how old were those plants? Every botanist knows that the growth of the heather is very slow. Loudon remarks, "The plant is of slow growth, seldom making shoots longer than three or four inches in one season even when young; and when of five or six years growth not more than half that length but it is of great duration." We may safely conclude that plants of so large a size and with such tough roots as Mr. Livingston describes are not unlikely to have been in existence for more than a century, which carries it back to about the year 1700. Beyond this we have no evidence and can only assert the probability that the plant existing at so early a date in such an unlikely and out-of-the-way place, was not introduced by man.

The town of Tewkesbury is five miles southeast of Lowell and twenty miles northwest from Boston; it was formerly a part of Bellerica, and was an Indian village called Warressit. The town was set off from Bellerica in 1734. Bellerica was settled in 1653, but very sparcely, and the present population of Tewkesbury is, we believe, less than two thousand.

Early in September the writer had the pleasure of accompanying Professor Gray to the locality of the heather. The ground was carefully examined, but, with the exception of the discovery of innumerable young plants of all ages, from one to five years, no new facts were obtained. From all the evidence adduced it seems much more probable that this is an indigenous locality of the heather, although the only one known in the United States. In this opinion Professor Gray coincides, after an examination of the facts.

May not the heather have once existed in profusion on this continent and have gradually died out owing to some inexplicable, yet perhaps only slight climatic changes? May not this be the last vestige, or one of the last, of what was once an American heath? And if the heather exists in Nova Scotia* and Newfoundland may we not expect that some intermediate stations may yet be discovered?

Every few years botanists are startled by the discovery in what were considered well gleaned localities of new or very rare plants, and we are forced to the conclusion that the botany even of New England and the Canadas is not yet wholly known. The botanical interest of this discovery is very great, both from its unexpectedness, and from the new floral link by which it connects New England with the mother country, but also from its bearing upon mooted questions respecting the geographical distribution or dispersion of species, upon which distinguished naturalists are now at issue.

Although Mr. Dawson cannot be said to be the original discoverer of this locality, yet to him belongs all the credit of appreciating the discovery, and of first directing the attention of botanists to the existence of the plant in the United States.

Art. III.—*Waterglass;* by John M. Ordway.

[Continued from p. 354, vol. xxxii.]

Part III.

Its Precipitation by Alcohol.

Among the few chemists who have made experiments on the precipitation of waterglass by alcohol, no one seems to have distinctly apprehended the fact that the spirit always effects a partial decomposition of the silicate. Fuchs says, in his first me-

[* The authority for the Newfoundland habitat is mentioned in vol. xxxii, p. 290, of this Journal. That *Calluna* also inhabits Nova Scotia is stated by Loudon, in his Arboretum, we know not upon what authority, but should be glad to be informed. If the claim for *Calluna* to be regarded as an American plant rested wholly or mainly upon this Tewkesbury locality, it would not gain acceptance. But its existence in Newfoundland, and still more in Nova Scotia (if verified) does away with all antecedent improbability of its indigenous occurrence in New England.—Eds.]

moir, that alcohol throws down potash waterglass unchanged.* In his later work he mentions that the supernatant liquor retains the undecomposed carbonate of potash, together with traces of sulphid of potassium, chlorid of potassium, and chlorid of sodium, but evidently looks upon the silicate deposited as having been merely stripped of these foreign salts and of the greater part of its water.

Forchhammer did indeed observe that, in one or two instances, "alcohol by precipitation and subsequent washing, removes from waterglass a part of its potash."† But in several other experiments detailed by him, he fails to notice the possible intervention of the same decomposing power, and seems to consider the precipitates as salts of precise and unvarying constitution. He accordingly enumerates the known silicates of potash as follows: "1. The salt formed by H. Rose, by melting together silica and carbonate of potash,—$\dot{K}_3 \dddot{Si}_2$. 2. The salt precipitated by alcohol from a solution containing an excess of potash,—$\dot{K}_3 \dddot{Si}_4$. 3. The waterglass discovered by Fuchs,—$\dot{K}_3 \dddot{Si}_8$. 4. The salt precipitated" [from Fuchs's waterglass] "with spirit of wine and washed with alcohol," [till the spirit no longer showed a decided alkaline reaction]—"$\dot{K}_3 \dddot{Si}_{16}$. 5. The salt separated from the former by washing" [with boiling water, which dissolved out $\dot{K}_3 \dddot{Si}_6$]—"$\dot{K} \dddot{Si}_{12}$. 6. The salt which separates by the cooling of a concentrated solution of silica and carbonate of potash,—$\dot{K} \dddot{Si}_{16}$."

He also determined the formula of soda silicate to be $\dot{Na} \dddot{Si}_2$,—as though there could be but one soda waterglass,—and found the precipitate from a cooling solution of silica in carbonate of soda, to consist of $\dot{Na} \dddot{Si}_{24}$.

Perhaps none of the substances in the list thus given, can properly claim anything more than an accidental existence. As to the products of fusion, it is well known that silica and carbonate of potash may, within certain limits, be melted together in any proportion. And we shall proceed to show by examples selected from a large number of trials, that the variety of combinations which may be thrown down by alcohol, is also unlimited.

There are two obvious methods of prosecuting the subject. The first is to make fractional precipitations from one and the same given silicate solution. The other is to redissolve and reprecipitate *ad libitum*, the successive products of integral precipitation. Sometimes one mode has been followed, sometimes the other, and sometimes both plans have been united.

* "Der Weingeist präcipitirt und scheidet es unverändert aus einer Auflösung ab." "Dieses Mittels kann man sich bedienen, um reines Wasserglas aus einer unreinen Auflösung darzustellen."—*Ueber ein neues nutzbares Produkt aus Kieselerde und Kali.*"—pp. 15, 16.

† *Poggendorff's Annalen*, xxxv, p. 340.

After having made many preliminary experiments on precipitation, I found that all the samples of commercial alcohol to be had, contained traces of acid. This possible source of infinitesimal error had therefore to be removed, and for the trials subsequently made, the spirit was purified by agitating it with caustic soda and redistilling.

In examining the various precipitates obtained, extreme accuracy would have involved an unwarranted waste of time; and there being scores of analyses to make, it was necessary to adopt modes which should be expeditious and without pretending to give figures absolutely exact, might still afford close approximations to the truth. The alkali was generally determined by saturation with a standard sulphuric acid. The neutralized liquor being then dried down in an oven, the silica was washed, ignited and weighed. For a partial control, in most instances, the whole amount of solid matter was ascertained by dissolving some of the silicate in a little water, adding freshly ignited sulphate of lime, and drying the coagulated mass by a heat gradually raised to dull redness. This method of expelling the water is, however, inapplicable when the silicate is excessively alkaline, as in such cases carbonic acid is absorbed from the hot gases of the flame rising round the crucible.

To facilitate comparison, the respective amounts of acid and base are expressed in equivalents instead of unmeaning percentages.

Sesquisilicate of Potash,—with Alcohol of sp. gr. 0·842.

1.—100 parts by weight, of a liquid containing 48 per cent of $\dot{K}_{100}\dddot{Si}_{150}$,—with 38 parts by weight, of alcohol,—gave 81·25 parts of a liquid precipitate differing little from the original solution.

2.—100 pts. of a 25 p. c. solution,—with 41 of alcohol,—gave 44·8 pts. of a liquid precipitate containing 49 p. c. of $\dot{K}_{100}\dddot{Si}_{162}$.

3.—100 pts. of a 17·3 p. c. solution,—with 40 of alcohol,—gave 23·2 pts. of a liquid precipitate containing 49·6 p. c. of $\dot{K}_{100}\dddot{Si}_{163}$.

4.—100 pts. of a 9·3 p. c. solution,—with 39 of alcohol,—gave 4·2 pts. of a solid precipitate not entirely soluble in boiling water, and containing, besides alumina and oxyd of iron, 39 p. c. of $\dot{K}_{100}\dddot{Si}_{195}$.

5, *a*.—100 pts. of a 4·8 p. c. solution,—with 40 of alcohol,—gave 0·9 pts. of an insoluble, pulverulent precipitate containing some alumina and oxyd of iron and 70 p. c. of $\dot{K}_{100}\dddot{Si}_{266}$.

5, *b*.—The supernatant liquor of *a*,—with a further portion of alcohol,—gave 3·6 pts. of a hard, coherent precipitate soluble in water and containing 54 p. c. of $\dot{K}_{100}\dddot{Si}_{185}$.

Bisilicate of Potash,—with Alcohol of sp. gr. 0·824.

6, *a*.—100 pts. of a crude solution containing 10 p. c. of $\dot{K}_{100}\dddot{Si}_{188}$,—with 10 of alcohol,—gave 2·13 pts. of a hard precipitate which was not analyzed.

6, *b.*—94 pts. of the supernatant liquor of *a*,—with 19 of alcohol,—gave 10·3 pts. of a hard, soluble precipitate containing 52 p. c. of $\dot{K}_{100}\,\overline{Si}_{210}$.

6, *c.*—100 pts. of the supernatant liquor of *b*,—with 20 of alcohol,—gave 2·13 pts. of a soft precipitate containing 54 p. c. of $\dot{K}_{100}\,\overline{Si}_{180}$.

7, *a.*—100 pts. of a solution made from the product of 6, *b*, and containing 10 p. c. of $\dot{K}_{100}\,\overline{Si}_{210}$,—with 10 pts. of alcohol,—gave 0·6 pts. of a solid precipitate which was not analyzed.

7, *b.*—102 pts. of the supernatant liquor of *a*,—with 20 of alcohol,—gave 12·8 pts. of a hard, soluble precipitate containing 53 p. c. of $\dot{K}_{100}\,\overline{Si}_{239}$.

8, *a.*—100 pts. of a solution made from the product of 7, *b*,—and containing 10 p. c. of $\dot{K}_{100}\,\overline{Si}_{239}$,—with 8 of alcohol,—gave 0·55 parts of a precipitate which was not analyzed.

8, *b.*—97 pts. of the supernatant liquor of *a*,—with 17 of alcohol,—gave 12·2 pts. of a hard, soluble precipitate—containing 53 p. c. of $\dot{K}_{100}\,\overline{Si}_{270}$.

9.—100 pts. of a solution made from the product of 8, *b*, so as to contain 10 p. c. of $\dot{K}_{100}\,\overline{Si}_{270}$,—with 25 of alcohol,—gave a very hard precipitate containing 49 p. c. of $\dot{K}_{100}\,\overline{Si}_{313}$.

This substance, while new, dissolved completely in cold water, yielding a perfectly clear solution; but exposure to the air for several days, rendered the superficial portions insoluble.

Sesquisilicate of Soda mixed with Caustic Soda,—with Alcohol af sp. gr. 0·825.

10.—100 pts. of a mixture made to contain 18 p. c. of $\dot{N}a_{100}\,\overline{Si}_{33}$—with 32 of alcohol,—gave 61·3 pts. of a very thin precipitate containing 24 p. c. of $\dot{N}a_{100}\,\overline{Si}_{43}$.

This precipitate,—as well as the four following,—retained the coloring matter and a part of the foreign salts which were present in the crude solutions used.

11.—100 pts. of a mixture containing 20 p. c. of $\dot{N}a_{100}\,\overline{Si}_{40}$,—with 36 of alcohol,—gave 64·3 pts. of a thin precipitate containing 25 p. c. of $\dot{N}a_{100}\,\overline{Si}_{50}$.

A 22 p. c. caustic soda solution is itself thrown down by alcohol; but that no such complication could occur with the weaker liquors used in this experiment and the preceding, was proved by a special trial with the omission of the silicate. 100 pts. of a solution containing 14·5 p. c. of NaO, was mixed with 38 pts. of alcohol. There was no precipitate; and even 81 pts. of alcohol caused no change.

12, *a.*—100 pts. of a mixture containing 10 p. c. of $\dot{N}a_{100}\,\overline{Si}_{40}$,—with 30 of alcohol,—gave 11·8 pts. of a thin precipitate containing 32·6 p. c. of $\dot{N}a_{100}\,\overline{Si}_{89}$.

12, *b.*—The supernatant liquor of *a*,—with 20 pts. of alcohol,—gave 5·3 pts. of a precipitate containing 34 p. c. of $\dot{N}a_{100}\,\overline{Si}_{78}$.

13.—100 pts. of a mixture containing 9 p. c. of $\dot{N}a_{100}\,\overline{Si}_{70}$,—with 26 of alcohol,—gave 15·4 pts. of a liquid precipitate containing 37 p. c. of $\dot{N}a_{100}\,\overline{Si}_{110}$.

Monosilicate of Soda—with Alcohol of sp. gr. 0·840.

14.—100 pts. of a solution containing 4·2 p. c. of $\dot{N}a_{100}\,\overline{Si}_{105}$,—with 40 of alcohol,—gave 5 pts. of a liquid precipitate containing 42 p. c. of $\dot{N}a_{100}\,\overline{Si}_{150}$.

15, *a*.—100 pts. of a solution containing 5 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{105}$,—with 20 of alcohol,—gave 2·16 pts. of a flocculent, insoluble precipitate, containing, besides earthy matters, 18 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{241}$.

15, *b*.—108 pts. of the supernatant liquor of *a*,—with 21 of alcohol,—gave 6·3 pts. of a liquid precipitate containing 41·5 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{136}$.

Sesquisilicate of Soda,—with Alcohol of sp. gr. 0·840.

16.—100 pts. of a solution containing 23 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{153}$,—with 40 of alcohol,—gave 42·5 pts. of a liquid precipitate containing 46 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{160}$.

17.—100 pts. of a solution containing 4·6 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{153}$,—with 40 of alcohol,—gave 4·4 pts. of a soft precipitate containing 48 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{192}$.

Sesquisilicate of Soda,—with Alcohol of sp. gr. 0·870.

18, *a*.—100 pts. of a clear crude waterglass solution containing 14 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{148}$,—with 10 of alcohol,—gave a bluish gray precipitate in which there were 4 pts. of mother liquor and 0·5 pts. of $\dot{C}a\,\ddot{F}e_3\,\bar{\bar{A}}l_4\,\dot{N}a_{28}\,\dddot{S}i_{42}$.

a′.—104 pts. of the filtrate of *a*,—with 25 of alcohol,—gave 28·2 pts. of a thin liquid precipitate containing 42·3 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{153}$.

b.—111 pts. of a solution made from the product of *a′*, and containing 10·5 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{153}$,—with 10 of alcohol,—gave a white precipitate in which there were 2·6 pts. of mother liquor and 0·45 pts. of $\bar{\bar{A}}l_4\,\dot{N}a_5\,\dddot{S}i_{22}$ with traces of lime and iron.

b′.—119 pts. of the filtrate of *b*,—with 33 of alcohol,—gave 19·4 pts. of a liquid product containing 45·4 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{165}$.

c.—75 pts. of a solution made from the product of *b′*, and containing 11·3 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{165}$,—with 9 of alcohol,—gave, after standing some hours, a very white precipitate in which there were 0·519 pts. of mother liquor and 0·11 pts. of $\bar{\bar{A}}l\,\dot{N}a_4\,\dddot{S}i_8$ with a trace of lime.

c′.—83 pts. of the filtrate of *c*,—with 20·5 of alcohol,—gave 12·75 pts. of a thick liquid product containing 51·4 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{178}$.

This precipitate was free from chlorid and showed but a very faint trace of sulphate, while the original solution used in *a*, contained 0·7 p. c. of dry sulphate and 1·4 p. c. of chlorid of sodium.

d.—49 pts. of a solution made from the product of *c′*, and containing 12·85 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{178}$,—with 5 of alcohol,—gave at once a slight white precipitate in which there were 0·327 pts. of mother liquor and 0·038 pts. of $\bar{\bar{A}}l_2\,\dot{N}a_{11}\,\dddot{S}i_{33}$ with a slight trace of lime.

d′.—53 pts. of the filtrate of *d*,—with 16 of alcohol,—afforded 12 pts. of a soft solid product containing 43·6 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{185}$.

e.—46·5 pts. of a solution made from the product of *d′*, and containing 11 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{185}$,—with 16 of alcohol,—gave 0·5 pts. of a solid product containing 45·5 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{211}$.

Sesquisilicate of Soda and Nitric Acid,—with Alcohol of sp. gr. 0·849.

20.—59 pts. of a solution containing 19 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{148}$, were mixed with 41 pts. of 5 p. c. nitric acid so as to neutralize one third of the alkali. Before any farther change ensued, 23 pts. of alcohol were added. The hard, soluble deposit amounted to 20·4 pts.

This was subjected to three purifying fractional precipitations,—as in 19,—and two subsequent integral precipitations, and finally yielded three parts of a very hard product which afforded a clear solution with four times its weight of cold water,—all being taken up except a thin external film of silica. The clear liquor gave with chlorhydric acid 10·161 p. c. of silica and 4·504 p. c. of chlorid of sodium, indicating 62·2 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{302}$ in the final precipitate.

In rendering waterglass more silicious by a partial neutralization of the base, it is necessary to precipitate with alcohol very soon after the addition of the dilute acid; otherwise, under the influence of the neutral salt formed, the silicate gradually undergoes a change of state and finally gelatinizes. Nitric acid is peculiarly suitable for withdrawing the alkali, because the nitrates have less modifying power than most other salts.

7 : 4 *Silicate of Soda,—with Alcohol of sp. gr.* 0·842.

21, *a.*—100 pts. of a solution containing 9·3 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{175}$,—with 10 of alcohol,—gave 4·55 pts. of a flocculent soluble precipitate containing 45 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{263}$.

b.—99 parts of the supernatant liquor of *a*,—with 10 of alcohol,—gave 8 pts. of a hard precipitate containing 50·5 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{217}$.

c.—100 pts. of the supernatant liquor of *b*,—with 10 of alcohol,—gave 2·24 pts. of a soft precipitate containing 50 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{194}$.

d.—105 pts. of the supernatant liquor of *c*,—with 20 of alcohol,—gave 0·67 pts. of a very soft precipitate containing 57 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{160}$.

e.—123 pts. of the supernatant liquor of *d*,—with 24 of alcohol,—gave 0·76 pts. of a liquid precipitate containing 52 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{154}$.
The remaining alcoholic liquor contained 0·5 pts. of $\dot{N}a_{100}\,\dddot{S}i_{12}$.

Bisilicate of Soda,—with Alcohol of sp. gr. 0·824.

22, *a.*—100 pts. of a solution containing 10 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{191}$,—with 7 of alcohol,—gave 0·5 pts. of a hard precipitate insoluble in water.

b.—102 pts. of the supernatant liquor of *a*,—with 10 of alcohol,—gave 12·8 pts. of a hard, soluble precipitate containing 47·4 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{231}$.

c.—98 pts. of the supernatant liquor of *b*,—with 10 of alcohol,—gave 2·75 pts. of a soft precipitate containing 47·4 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{185}$.

23, *a.*—100 pts. of a solution made from 22 *b*, and containing 10 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{123}$,—with 7 of alcohol, gave 1·7 pts. of an insoluble precipitate containing, besides earthy matter, 73 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{279}$.

b.—95 pts. of the supernatant liquor of *a*,—with 9 of alcohol—gave 11·2 pts. of a hard, soluble precipitate containing 42 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{255}$.

c.—83 pts. of the supernatant liquor of *b*,—with 9 of alcohol,—gave 2·1 pts. of a soft precipitate containing 65 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{220}$.

d.—The supernatant liquor of *c*,—with 9 pts. of alcohol,—gave 0·7 pts. of a soft precipitate containing 48·5 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{200}$.

24.—100 pts. of a solution made from 23 *b*, and containing 10 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{255}$,—with 20 of alcohol,—gave 16·5 pts. of a soluble precipitate containing 44 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{296}$.

Bisilicate of Soda,—with Alcohol of sp. gr. 0·840.

25.—100 pts. of a solution containing 1 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{214}$,—with 50 of alcohol,—gave a slight, insoluble, pulverulent precipitate containing $\dot{N}a_{100}\,\dddot{S}i_{414}$.

26.—100 pts. of a solution containing 1·9 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{214}$,—with 40 of alcohol,—gave 1·1 pts. of a hard precipitate containing earthy matters and $\dot{N}a_{100}\,\dddot{S}i_{478}$. Out of this boiling water dissolved nearly all the soda and one fourth of the silica.

27.—100 pts. of a solution containing 3·45 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{214}$,—with 40 of alcohol,—gave 4·6 pts. of a hard precipitate, soluble in cold water, and containing 51 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{237}$.

28.—100 pts. of a solution containing 34·5 p. c. of $\dot{N}a_{103}\,\dddot{S}i_{214}$,—with 40 of alcohol,—gave 63·5 pts. of a hard precipitate containing 52 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{217}$.

Ferruginous Silicate of Soda,—with Alcohol of sp. gr. 0·824.

29, *a.*—Into 40 pts. of a solution containing 23·5 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{169}$ were stirred 60 pts. of a solution containing 1·1 p. c. of dry protosulphate of iron. The protoxyd of iron was almost entirely taken up. The filtered liquor was perfectly transparent and of a very deep blue black color.

98 pts. of this filtrate,—with 10 of alcohol,—gave 4·7 pts. of a blue gray precipitate containing, besides the silicate of the mother liquor soaked up, 41·7 p. c. of $\dot{F}e_4\,\dot{N}a_6\,\dddot{S}i_{15}$.

b.—80 pts. of the colorless supernatant liquor of *a*,—with 11 of alcohol,—gave 7 pts. of a soft, soluble precipitate containing 45 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{191}$.

c.—84 pts. of a supernatant liquor of *b*,—with 21 of alcohol,—gave 3·5 pts. of a very soft precipitate free from iron, and containing 47 p. c. of $\dot{N}a_{100}\,\dddot{S}i_{173}$.

In investigating the nature of alkaline silicates it is, for some purposes especially important to eliminate the last traces of foreign matters. For instance, a crude article which is already more or less charged with lime, alumina, or iron, has its power of dissolving metallic oxyds greatly impaired. And again, one may be easily deceived as to the highest possible relative proportion of silica capable of entering into complete solution. Thus Fuchs could not get much beyond $\dot{K}_2\,\dddot{S}i_5$, and even this he describes as being usually somewhat lacking in clearness—"gewöhnlich etwas trübe oder opalisirend."* And Forchhammer says:—"Silicate of potash in which the oxygen of the acid is eight times as great as that of the base, is still soluble; but the slightest additional quantity of silica is no longer dissolved."† They both evidently overlooked the disturbing influence of minute portions of earthy matter. For in reality, by operating

* Op. supra cit.—p. 15. † Poggendorff's Annalen,—xxxv, p. 341.

with a well purified silicate, it is possible to get at least as far as $\dot{K}\dddot{Si}_3$ or $\dot{Na}\dddot{Si}_3$, and have a solution perfectly transparent.

Crude waterglass, unless it is made in unalterable vessels and from absolutely pure materials, is sure to contain more or less saline and earthy impurities. But it appears from the foregoing experiments that these contaminations may be got rid of by several properly conducted precipitations,—the salts remaining in the alcoholic liquors while the earthy and metallic oxyds are withdrawn by the first small fractional deposits. We have therefore in this process a ready means of obtaining a waterglass of the utmost purity and of almost any required composition. And it is far easier thus to separate the extraneous substances from a roughly made silicate than to observe the many precautions required in preparing a pure product with pure ingredients. Considering the small proportion of alcohol needed, and the ease of recovering even this by distillation, the cost appears so moderate that the manufacturer might be warranted in resorting to a single precipitation when a nice waterglass is wanted for use in the arts. In such a case it will do to operate on a tolerably strong solution, say one containing twenty per cent of solid matter. But it should be observed that weaker liquors allow of a more intimate commingling of the alcohol and are more likely to retain the foreign salts. Therefore when the chemist would suit his own rigorous demands, he may advantageously take solutions containing not more than ten per cent of dry silicate. To ten parts of the liquor may be added, at first, one part by weight of strong alcohol, and before filtering, the mixture should be allowed to stand several hours in order to give the reluctant precipitate a chance to get fully segregated. Rejecting this first deposit which contains most of the earthy matters and very little of the alkaline silicate, add to the filtrate twenty parts of alcohol, and the larger part of the waterglass will be thrown down. When the product is rich in silica, it is quite voluminous at first but gradually contracts and becomes more or less coherent. After a rest of six hours or more, the alcoholic liquid being carefully decanted, the silicate, if solid, may be spread on absorbent paper and allowed to drain as long as it will remain without adhering to the paper. The mass thus deprived of mother liquor, can then be dissolved in four times its weight of water and carried through the same round of treatment as before. The result of this second series of operations will, in most cases, be found almost entirely free from impurities; but, if need be, a third or even a fourth course of fractionizing, may be resorted to.

Liquid precipitates are often milky at first, on account of the incomplete separation of the last portions of mother liquor, but they soon become clear by standing in a warm place. Solid products are commonly opaque and acquire their proper transparency only on being thoroughly drained.

The quantity of silicate which remains dissolved in the supernatant alcoholic liquid, is always exceedingly small but is somewhat increased by heat. For often a mother liquor which is quite milky when first decanted, becomes perfectly transparent by being warmed a few degrees, and the opacity reappears on cooling. Indeed a nicely balanced solution of this kind, is quite sensitive to changes of temperature in the room. The nearer we get to an entire precipitation of the silica, the more apt is the remaining liquid to exhibit such alternations of opacity and clearness.

The silicates containing less than 170 eq. of silica to 100 eq. of alkali, are usually thrown down in the liquid state; those more silicious yield solids of greater and greater firmness as the relative proportion of silica increases. But all these hard products belong to the same class of solids as pitch,—that is, heaped up fragments will, in the course of time, flatten themselves out and form one united cake.

It is obvious from the above examples that the more any given waterglass solution is diluted before adding alcohol, the greater will be the relative amount of silica in the precipitate. And thus by mere precipitation under varied conditions, we may get an unlimited number of differently constituted silicates. But while the ratio of acid and base admits of an infinite diversity, the quantity of water in the principal products appears to be nearly constant, generally amounting to not far from fifty per cent.

In this respect waterglass differs from the proper salts, many of which alcohol throws down combined or associated with an amount of water varying according to the proportion of spirit used. Thus 100 parts of a solution containing 10 p. c. of dry carbonate of potash, on being treated with alcohol of sp. gr. 0·820, gave with

60 of alcohol		no precipitate.					
70	"	a slight "					
100	"	17·8 p'ts of a liquid containing				26 p. c.	$\dot{K}\ddot{C}$
120	"	20·8	"	"	"	29	"
140	"	21·7	"	"	"	30	"
190	"	23·2	"	"	"	32	"
200	"	23·1	"	"	"	33	"
400	"	38·	"	"	"	38	"

Carbonate, sulphate, and stannate of soda afford liquid products with a certain amount of alcohol, but with a larger quantity they yield crystals.

Solutions containing even as much as ten per cent of any of the salts commonly occurring in the crude alkaline silicates, are not immediately affected by a moderate addition of alcohol. Hence it is not at all strange that the greater part of these salts remains in the supernatant liquor while the waterglass is almost wholly precipitated.

I have not yet made a sufficient number of experiments to determine whether alcohol withdraws a part of the alkali from such weak combinations as the stannates, aluminates, and zincates; but so far as is known at present, the silicates are altogether peculiar in their susceptibility of partial decomposition. Their behavior with alcohol bears a remote resemblance to that of the bismuth salts with water. On the one side, however, amorphous substances give indefinite products; on the other crystallizable bodies yield definitely constituted precipitates.

Considering the large proportion of silica capable of being retained permanently in solution by a little alkali, the disturbing influence of foreign matters such as earths and neutral salts, and the gummy character of the silicates,—we find in the waterglasses a reverse parallelism to the soluble basic salts of the sesquioxyds and binoxyds;—the excess of base in the latter having the same effect as the excess of acid in the former. And instead of being regarded as real salts or mixtures of salts, they ought perhaps to be looked upon as combinations of active silica with some normal silicate,—like NaO, SiO_2, which one or two chemists have obtained distinctly crystallized.

As many of the supposed chromates of chrome, have vanished under the critical examination of Messrs. Eliot and Storer,* so it will doubtless be found that not a few other amorphous precipitates commonly laid down as definite substances, are mere chance combinations. And to avoid a needless multiplication of such encumbrances to the records of science, it would be best not to attribute a rational formula to any of the silicates of potash or soda till it can be shown to be crystallizable or to have a constant composition under varied influences.

Manchester, New Hampshire, Sept. 1861.

ART. IV.—*On the Unity of Geological Phenomena in the Solar System;* by L. SÆMANN.

[From the Bull. de la Soc. Geologique de France for Feb. 4, 1861; translated by T. STERRY HUNT, M.A., F.R.S.]

THE observations upon the solar eclipse of July 18, 1860, have given rise among astronomers and physicists to some interesting discussions upon the nature of the sun, which seem to merit the attention of geologists. The opinion hitherto generally adopted is founded upon the view suggested by Arago from his observations concerning the spots upon the sun. This great as-

* Proc. American Academy (1861), v. p. 192.

tronomer conceived that by admitting a dark nucleus surrounded by a luminous atmosphere or photosphere, it would be easy to explain the luminous phenomena presented by the sun.* On the other hand Leverrier from the observations made in Algiers by the scientific commission from the Paris Observatory maintains that the sun is luminous from the incandescence of its nucleus, and that the variations in the intensity of the light at its surface may be explained by atmospheric perturbations similar to those of our own atmosphere. Mr. Leverrier is led to admit for the sun, at least two atmospheres different in nature and in density, and it is principally with regard to the external envelope, or rose-colored atmosphere, which gives rise to the flames or luminous protuberances, that there exists a difference of opinion among observers.

Other observations of a very different nature give a strong support to the conclusions of Leverrier; the remarkable discoveries of Kirchhoff and Bunsen upon the dark lines in the solar spectrum, have enabled us to submit the solar atmosphere to an optical analysis which makes known its chemical composition, and shows it to contain several alkali-metals, including sodium and calcium, which can only exist there in the state of gas or vapor. The discussion of this interesting subject belongs especially to chemists and physicists, but geologists may be permitted to express their sympathy for that view which accords the best with the theory that forms the basis of their science, and is, moreover, entitled to a certain authority among mathematicians and astronomers, inasmuch as it bears the name of the illustrious Laplace.

All modern geological theories implicitly admit the unity of our planetary system, in so far as that they suppose the sun, the planets and their satellites, to have been formed from one primitive substance; their very variable densities only show that the constituent elements are grouped in varying proportions.† It is not necessary to suppose that each body of the system presents exactly the same chemical combinations as are known on our globe, for affinities will vary with the temperature and the densities of the elements, but we may admit that a portion of any one of these celestial bodies brought to the surface of our earth and there subjected to terrestrial influences, would in obedience to the chemical affinities which here prevail, be at length converted into *a portion of earth.*

This unity of origin once admitted there is no longer any reason for denying the analogy if not the identity, of the phe-

[* This view of the constitution of the sun, so ingeniously defended by Arago, (see *Annuaire du Bureau des Longitudes* for 1842, p. 510,) is by him there called the theory of William Herschel, who appears to have first clearly defined it.—*Translator.*]

† [Or in different degrees of condensation.—*Translator.*]

nomena which have accompanied the formation of the sun and the planets, at least of those whose density approaches the nearest to that of the earth. All of them must have passed by cooling from a state of igneous fluidity to a solid condition, and their present state will depend upon the greater or less facility which their volume and their composition will have offered to the passage of heat. The chemical composition being the same, the duration of the geological epochs upon each planet will have been nearly in a direct ratio to its volume, setting aside certain corrections of which it is not necessary at present to discuss the elements. The low density of the sun, which is little greater than that of water (0·252 that of the earth,) would lead us to suppose the existence there of a peculiar condition of things; science has, however, as yet no means of appreciating the action of a heat so excessive as that which is required to maintain the alkali-metals in a gaseous state, and it appears possible that if the temperature of the sun were reduced to that of the earth its density would also be approximated to that of our planet. However this may be, the analogies of Leverrier's theory with the observations of geologists are too important as showing the connection between the two great branches of natural science, not to encourage geologists to further inquiry in the same direction, and it is with this object in view that we have been led to the following reflections.

We admit a similar geological (or chemical) constitution for the various bodies of the solar system, and from this conclude that the phenomena which have accompanied their formation and their successive transformations, must have been similar. Thus the planets and satellites whose density is near to that of our earth may be supposed to have passed through the different stages of liquid and solid incandescence, of the successive liquefaction of portions of their gaseous envelopes, and to have finally been the seat of an organic creation.

Of these planetary bodies the best known to us is the moon, and we shall now inquire to what extent our slight knowledge of it is in accordance with the observations made on our earth, and with the present state of the sun as supposed by Mr. Leverrier. It is well known that astronomers, so soon as they became possessed of good telescopes, discovered mountains and plains (or seas) on the surface of the moon, and the immediate application of these names shews the great resemblance which was supposed to exist between the surfaces of the moon and the earth. It does not appear surprising that the form of the lunar mountains should be met with among only a small number of those on our planet, and physicists easily explain the greater elevation and the steep declivities of the former by the comparatively feeble action of the centripetal force at the moon's surface. But one of the gravest objections to the idea of a common origin of the moon and the earth is the apparent absence of water and air from the surface of our satellite, thus seriously embarrassing those geologists who attribute terrestrial volcanic phenomena to the intervention of these expansible elements.

If however we admit for the earth and the moon an identical and simultaneous point of departure we can understand that their cooling has taken place at a rate nearly proportioned to their volume. That of the moon being about two hundredths the volume of the earth, its temperature, if we admit an equal conductibility, will have decreased with a rapidity fifty times greater, so that the geological epochs of the moon will have been in the same proportion shorter than the corresponding epochs on the earth, up to the time when the solar heat began to be an appreciable element. The moon has then advanced much more rapidly than the earth in the series of phenomena through which both must pass, and we may therefore logically suppose that our globe will one day offer the same general characters as are now presented by the moon.

We believe then that the water which covers the surface of the earth and the air which surrounds it will one day disappear, as a necessary consequence of the complete cooling of the interior of our planet. Rocks, with few exceptions, readily absorb moisture, and the more crystalline varieties are the most porous; we need not, however, consider the quantity of water which rocks may imbibe in this way, for the total amount of this element on the earth's surface is so small when compared with the whole mass of the globe, that the ordinary processes of chemical analysis would not detect its presence. If we take the mean depth of the ocean at 600 meters* (=1968 feet), its weight will be equal to one twenty-four-thousandth of the earth, which being reduced to decimals, would give for 100 parts,

Earth, - - - - - - - - - - -	99·9958
Water, - - - - - - - - - - -	·0042

In the Bulletin of the Geol. Society of France, (2d series, vol. x, p. 131,) Durocher has published a series of experiments made to determine the quantity of water in those minerals which enter into the structure of rocks, such as the feldspars, micas, hornblende and pyroxene, and which are regarded as anhydrous in composition. These minerals were reduced to coarse powder and exposed to moist air, the proportion of water being determined both before and after; it will be sufficient for our purpose to give the amount of water found after exposure. The orthoclase of Utoë absorbed in this way 0·41 for 100 parts, while the mean

* This depth is deduced from the comparison of the relative areas of land and water which are taken as 1:3, the elevation and depression of the surface being assumed as proportional to the square roots of their surfaces. (Saigey, *Physique du Globe*, 232.) The depth of the Pacific Ocean as deduced by Bache from the earthquake wave of Dec. 1854, was about 13,000 feet.—(This Jour. [2], xxx, 83.)—Eds.

of seven other varieties of the same species was 1·28, and that of thirty specimens of various substances 1·27. We have already seen that if the whole of the ocean were to be equally distributed throughout the earth this would contain only 0·0042, or 100 times less than the least hygrometric of the feldspars. It is probable that the water of the ocean thus absorbed would enter into chemical combination; at all events it would occupy a space much less than the pores produced by the shrinking of the rocks.

If, now, we attempt a similar calculation for the atmosphere, we find that in supposing a height of eight kilometers, the total volume of the air which surrounds our globe, brought to the density which it has at the surface, would be about four millions of cubic myriameters, the volume of the earth being equal to 1083 millions, or 270 times that of the air, so that a contraction of the primitive volume producing a vacuum of four thousandths ($\frac{1}{250}$) would be more than sufficient to absorb the whole of the atmosphere. (In calculating the volume of the atmosphere we have multiplied the surface of the globe in square myriameters, by 0·8, which gives a sufficiently accurate result, the more so that the density of the air in the interior of the earth will be everywhere greater than at the surface.)

It now remains to be seen whether the assumption of a shrinking of four thousandths can be justified by analogies. In the want of direct determinations of the porosity of crystalline rocks, upon which subject I am not aware of any published experiments, the observations upon the fusion of rocks, and the determinations of their densities in the crystalline and vitreous states admit of an indirect application to the question before us. The experiments of Charles Ste. Claire Deville in the *Comptes Rendus* for 1845, and of Delesse in the *Bulletin* for 1847, agree so closely in this matter that we give them the preference over those of Bischoff, published in 1842. Deville and Delesse found that the fusion of rocks yields glasses whose density is generally inferior to that of the rock in the crystalline state. This diminution for granite is equal to from nine to eleven hundreths, and it is evident that such a glass passing to a crystalline state and retaining its volume must present vacant spaces in direct proportion to the augmentation of density, that is to say, equal to about one-tenth of its volume. If we take the mean density of granite at 2·60, it might with such a degree of porosity imbibe 3·9 parts in 100·0 of its weight of water. This shrinking of one-tenth is no exaggeration, and such a rock would still be a good building material, although containing twenty-five times more vacant space than our calculation requires.

The vitreous state of a body is nothing more than a fixing of its molecules in the positions which belong to them in the liquid state, and probably represents the liquid in its greatest degree of density. The crystallization of barley sugar, of wrought iron, and of Reaumur's porcelain, are striking examples of the tendency of molecules to group themselves in crystals even in the midst of solid masses, and we can thus readily understand the absence of vitreous substances among the older crystalline rocks. The great difficulty is to determine with exactness the proportion of the vacant spaces resulting from this change, since these will vary for each body, and probably also with the volume of the mass. Sulphur fused in an open vessel crystallizes slowly, the level of the liquid sinks a little, and after complete solidification the surface is covered with hollows resulting from the shrinking, whereas if cooled in a spherical shape these cavities would naturally be formed at the centre. Water and bismuth as is well known, behave in a very different and remarkable manner, the first dilating eight or ten hundredths at the moment of congelation, and the second one fifty-third. The only conclusion to be drawn from these facts is that each body in solidification behaves in a different manner, and that for the solution of the question before us, we can only take into account the well known porosity of rocks. The problem, however, appears to me one of great importance in connection with theoretical geology; if we admit with Deville that at the moment of crystallization, the density of rocks is in all cases augmented, we are forced to conclude that all the crystalline masses formed at the surface of the liquid globe must have sunk and accumulated at the centre. The effect of a similar action has been shown by physicists, who have demonstrated that the cold of winter would freeze our lakes and rivers from the bottom if the ice sunk at the moment of its formation, as would the solidified parts of a lake of molten sulphur. We should then have in place of a liquid globe surrounded by a solid shell, a mass solidified to the centre, a conclusion which is perhaps more in harmony with the feeble and local action which the interior is known to exert on the surface. Since then the data are wanting to fix the amount of shrinking in the crystallization of rocks, we may find in an analogous phenomenon some terms of comparison. The difference between the density of cast metals, and the same after hammering, can only arise from a contraction similar to that which takes place in igneous rocks. The surface becoming solid while the interior is yet liquid, the natural contraction of this portion is prevented, and from this necessarily result vacant spaces in the mass, which are afterwards compressed by the action of the hammer. In calculating from the differences in density the volume of the vacant spaces thus produced, we find for iron a contraction of 0·075, for nickel 0·045; for aluminum 0·041; for copper 0·011; for gold 0·005, while the contraction of the earth necessary to absorb the whole atmosphere, would be only 0·004. From this it results that an ingot of gold, the most solid obtained by the fusion of a metal, contains more vacant space in proportion to its volume than would be required in the globe for the absorption of its gaseous envelope; it is scarcely possible that any crystalline rock should be wanting in this slight degree of porosity.

From the preceding considerations, the successive absorption of the air and water by the solid portions of the globe becomes in the highest degree probable, and we may conclude that our earth will one day present that same total absence of ocean and atmosphere which we now remark in the moon. It is evident that this progress of the waters towards the earth's centre must have long been in operation, and it becomes interesting to consider the effect which this must have had upon the level of the ocean. Let us suppose that the rocks near to the surface of the earth contain one hundredth of water, a proportion which from the above calculation will not be regarded as excessive, and that the water moreover does not exist in this proportion at a depth beyond that at which the terrestrial heat equals 100 degrees centigrade. If we take the augmentation of heat in descending to be one degree for thirty-three meters this will give a depth of about 3000 meters, while one part of water by weight in one hundred parts of a rock whose density is equal to 2·5, will correspond to a volume of one-fortieth. We shall now calculate the volume of this external layer which we have supposed to be thus impregnated with water, regarding it as a prism having for its base the surface of the earth, with a height of 3000 meters, which would give a mass of 1,530,000 cubic myriameters, containing 38,000 cubic myriameters of water. The total volume of the ocean being one forty-eighth thousandth that of the globe, or 225,000 cubic myriameters, it follows that this layer of 3000 meters of earth would contain a volume of water equal to one-sixth of the present ocean. Whatever may be the real value of these figures which we have adopted to render the demonstration more clear, the interest and importance of this inquiry is evident.

I am convinced that the ultimate complete cooling of the interior of the earth is inevitable. We may affirm on general principles that between two media of different temperatures separated by a layer of rock which is a conducter of heat, an equilibrium will at length be established. It is probable that this cooling is however to a great extent, effected by the innumerable currents of water and gases which circulate in every direction through the interior of the globe, and of which volcanic eruptions, hot springs and *suffioni* are only the more violent manifestations attaining the earth's surface. The recent ingenious experiment of Daubrée has shown us that water may be drawn by capillary force towards spaces heated much above its boiling point. The water thus conveyed, in passing into the state of vapor does not everywhere produce volcanic phenomena, for these probably require the concurrence of conditions which are not often found. The aqueous vapor will ordinarily ascend to colder portions of the earth's crust and there yielding its heat to the walls of the fissures will flow back in the liquid state to the source of heat to repeat the same process, while on the other hand currents of cold water will absorb the heat thus conveyed to the rocks and bring it to the surface by thermal springs.

The general permeability of rocks is so well admitted by most geologists that I have not thought it necessary to seek for proof of it in the discussions of the present question; the brilliant conception of the metamorphism of rocks by the humid way, which has been so well maintained by the ablest chemists, is only possible on this condition. The permeability of rocks also explains in a satisfactory manner the formation of agates, and of zeolites, arragonite and other minerals in the midst of the most compact basalts, and of geodes of quartz in the Norwegian granites. We may also recall the artificial colors which are given to agates. Mr. Damour has even shown by a series of curious experiments that the water which is ordinarily considered as chemically combined in certain hydrated silicates, such as zeolites, may be in part extracted from them, and again restored without any apparent alteration in these minerals.

ART. V.—*Berberin in Hydrastis Canadensis;* by F. MAHLA, Ph.D., Chicago.

HYDRASTIS canadensis L., commmonly termed Orange-root, or Yellow Puccoon grows in rich woods from New York to Wisconsin and southward. It is a low perenniel herb, which belongs to the natural family of the Ranunculaceæ. The root of this plant contains a large quantity of a yellow coloring matter and its juice has indeed been used by the Indians to color their clothing yellow. It has been asserted also, that the Cherokees used to employ it for the cure of cancers and other diseases. In regular medical practice the root itself was but little used, until the so-called eclectic and botanic physicians began to employ it largely in their prescriptions. Of late even our regular physicians have begun to use an article, which was introduced by several parties under the false name of *hydrastin.* This so-called hydrastin is, as some experiments lead me to believe, not an isolated organic principle, but merely a dissicated alcoholic extract of the Orange-root and must accordingly be so denominated.

Hydrastis, however, contains an alkaloid and there are several methods mentioned by which it may be most conveniently extracted. The eclectic Dispensatory gives one of those methods, according to which the powdered root should be extracted with alcohol. The tincture thus obtained is then evaporated, the residue mixed with water, the whole filtered and a quantity of hydrochloric acid added to the watery liquid, when a beautiful crystalline precipitate makes its appearance, which was *assumed to be the pure hydrastin.*

The circumstance, that this substance is precipitated from its solutions by a mineral acid, at the first glance makes its basic nature a little improbable. This circumstance combined with the fact, that an organic elementary analysis of this substance does not exist, seemed to make it desirable to have its properties a little better investigated.

In preparing the body in question, I followed in general the above given directions. I modified the process merely by effecting the extraction in a hot-water percolator so that the alcohol was always in boiling condition. I found, that by this modification, the process was finished in a much shorter time and that less quantities of alcohol were necessary. The crystalline body, formed by the addition of hydrochloric acid, was collected on a calico filter, pressed and redissolved in boiling alcohol. The hot filtered solution readily deposits on cooling such an amount of crystals, that the whole seems to form one solid mass. These crystals were again pressed and once more crystallized from alcohol, after which they were considered pure.

This substance forms, when dry, a light yellow powder, which presents under the microscope the appearance of prismatic crystals. It has a bright yellow color and a very intense bitter taste. It is inodorous and little soluble in cold water, to which it imparts, however, a deep yellow color. Cold alcohol dissolves also very little but it is readily soluble and in large proportions both in boiling water and in alcohol. These hot solutions exhibit a brown-yellow tint, while the cold diluted solutions are purely yellow. Neither litmus nor curcuma paper is affected by them.

Concentrated sulphuric acid dissolves it with olive green color and disengages hydrochloric acid.

Concentrated nitric acid produces a deep red solution under disengagement of nitrous acid vapors.

It does not emit any trace of ammonia, when boiled with a diluted solution of caustic potassa, but clots together and is transformed into a brown resinous substance, which adheres strongly to the sides of the vessel. This resinous body is insoluble in water but soluble in alcohol, to which it imparts a bitter taste.

Heated with soda-lime it emits ammonia.

Dry chlorine gas transforms it into a red body, which is readily soluble in water.

Polysulphid of ammonium, when mixed with a hot solution of this so-called hydrastin produces immediately a red brown precipitate.

Sulphate of copper is precipitated with a yellowish green; nitrate of silver, chlorid of zinc, corrosive sublimate, chlorate of potassa, and chlorid of platinum with a yellow color. A solution of bichromate of potassa when mixed with a solution of this body throws down an orange-yellow, cyanid of potassium an ochre-yellow and ferrocyanid of potassium a greenish-yellow precipitate.

When moderately heated it exhibits a deeper yellow tint; the original bright yellow color is, however, restored on cooling; if heated to a higher temperature it melts like a resin and leaves finally a light coaly residue.

All these reactions coincide so completely with the reactions of muriate of Berberin, that I should not have hesitated a moment on this evidence alone to declare its identity with that alkaloid.

(The fact that berberin is precipitated from its solutions by hydrochloric acid explains the peculiar method of preparation of hydrastin.)

To quiet, however, all doubts, I undertook an elementary analysis of it, which lead to the following results:

1. The nitrogen was determined by Will and Varrentrapp's method. Before commencing the experiment, I dried the substance for 10 hours at a temperature of 100° C. The quantity of material employed amounted to 0·416 grammes. It yielded 0·236 ammonia-chlorid of platinum. This corresponds to 3·563 per cent of nitrogen. Muriate of berberin dried at 100° C. requires 3·57 per cent.

2. The combustion for the determination of carbon and hydrogen was made with bichromate of lead.

0·440 substance dried at 100° C. yielded:—

Carbonic acid	= 1·0450	which corresponds to carbon	= 64·77 per ct.
Water	= 0·2035	" " hydrogen	= 5·138 per ct.

Muriate of berberin dried at 100° C. requires in 100 parts 64·20 carbon and 4·841 hydrogen.

3. The quantity of chlorine was found by precipitating the boiling solution of the substance with nitrate of silver. This mixture was filtered, when still quite hot, and washed on the filter with boiling water.

The material also in this instance was dried at a temperature of 100° C.

0·497 substance yielded 0·1725 chlorid of silver; this corresponds to 8·579 per cent of chlorine.

Muriate of Berberin requires 9·03 per cent chlorine.

Berberin has been discovered thus far in different species of the Berberideæ and in one or two speics of the Menispermeæ. This occurrence was one of the principal arguments, with which the union of these two families in one under the name of Cocculineæ was justified.

It is, as far as I am aware, the first instance that this interesting body has been found in a plant, which belongs to the Ranunculaceæ. This circumstance is, therefore, a proof, that even true alkaloids may occur in *several* plants which belong to *different* families.

Chicago, Illinois, October, 1861.

ART. VI.—*Remarks on the Age of the so-called "Leclare Limestone" and "Onondaga Salt-Group" of the Iowa Report;* by A. H. WORTHEN.

IN the very able report on the Geology of Iowa, Prof. Hall separates the limestones at Leclare from the Niagara group with which they might seem to be connected, and, mainly on lithological grounds, assigns them to higher positions as additional members of the Upper Silurian series; expressing the opinion at the same time, that they are the stratigraphical equivalents of the limestones of Gault in Canada, and of the Onondaga Salt Group of the New York Series.

We desire at this time to offer some reasons which seem to us conclusive, for including all the limestones at Leclare in Iowa, and Port Byron on the opposite side of the river in Illinois, as a part of the Niagara Group.

While engaged in constructing a section along the eastern shore of the Mississippi in the Autumn of 1858, in the prosecution of the Geological Survey of Illinois, we made an extensive collection of the fossils which characterize these limestones both at Port Byron and Leclare, and from the hurried examination we were enabled to give them while upon the ground, we were led to seriously doubt the correctness of Prof. Hall's conclusions in relation to the age and true position of these beds. But the subsequent loss of the entire collection made at that time, by the burning of the freight depot at Springfield where they were stored, prevented any comparison of these fossils with those from other localities of Niagara age, and thus arriving at a satisfactory determination of the true position to which these limestones should be assigned.

Subsequently, on visiting the quarries at Bridgeport near Chicago, we were strongly impressed with the marked resemblance which the rocks presented at this point, to those at Leclare and Port Byron. At both localities the rock appears as a concretionary or amorphous mass of limestones, somewhat brecciated, without any regular lines of bedding or stratification, but presenting planes of cleavage or false stratification at every conceivable angle to the horizon. It possesses a porous or vesicular structure, resulting mainly from the decomposition of its numerous fossils, and has an ashy gray color inclining to buff. At Bridgeport the rock contains casts of *Caryocrinus ornatus*, *Ichthyocrinus lævis*, *Eucalyptocrinus decorus* and *Myalina mytiliformis* in abundance, clearly establishing its age to be the same as the Niagara Group of the New York series.

During the past season we have revisited the localities on the Mississippi, and at the lime kiln quarries just above Port Byron, we found *Pentamerus oblongus* in abundance in the lower part of the bed, and although this fossil does not seem to occur in every portion of the mass, there is a Bryozoid form associated with it, resembling the *Dictyonema retiformis* of the New York Report, which is found throughout the mass both at Port Byron and Bridgeport. We also found *Myalina mytiliformis, Strophomena depressa*, a small *Pentamerus* like *P. galeatus* and three or four species of chambered shells belonging to the genera *Orthoceras* and *Cyrtoceras*, common to both localities. Indeed on placing the fossils from Bridgeport and Port Byron together, it seems to us that no palæontologist could resist the conviction that the beds at these localities belong to the same horizon. The fact that the crinoids of Bridgeport have not been found at the other localities does not appear to us to militate greatly against the conclusion to which we arrive in relation to the equivalence of the beds, inasmuch as this class of fossils is more generally restricted to certain localities from the gregarious habits of these animals, than the Mollusca and the Corals.

The evenly bedded limestones which Prof. Hall refers to the age of the Onondaga Salt Group, although appearing in considerable force on the Iowa shore, have not yet been met with in Illinois, and they appear to be intercalated in the irregular bedded portions of the mass, instead of being distinct from, and overlying the same, as he supposed. They appear at two localities on the west side of the river, one exposure being near the centre of the town on the main street running parallel to the river, and the other on a small creek about half a mile above. At both these localities, the regularly bedded brown magnesian limestones are overlaid by the irregularly bedded, ash colored rock already described. The regularly bedded layers present the usual lithological characters of the Niagara Limestone as it appears in Northern Illinois and Iowa, and according to the analysis of Prof. J. D. Whitney, (see Vol. i, Part 1, Geology of Iowa, p. 369 and 370,) does not differ materially in its composition from that rock. The entire thickness of the beds exposed at Port Byron and Leclare does not appear to greatly exceed a hundred feet.

We regard the correct determination of the geological horizon to which these beds belong as the more important, inasmuch as it greatly simplifies the geological structure of the state, leaving the following subdivisions of the Devonian and Silurian systems in regular order of sequence:

Devonian, ...	Black Slate. Hamilton Limestone. Oriskany Sandstone.
Silurian, ...	Niagara Limestone. Hudson River Shale. Galena and Trenton Limestone. St. Peters Sandstone. Calciferous Sandstone.

These beds appear wherever the proper horizon is exposed, at nearly every locality examined, except along the northern borders of the Illinois Coalfield, where the upper members are wanting. No beds referable to the Primordial or Taconic series have yet been observed during our investigations in Illinois.

Springfield, Illinois, Nov. 1861.

ART. VII.—*The Gorilla;* by LEONARD J. SANFORD, M.D.

(Read before the Connecticut Academy of Arts and Sciences, December 18th, 1861.)

SOME writer has observed that "Africa every year produceth some strange creature before not heard of, peradventure not extant." In this spirit, many have contemplated the Gorilla Ape—an incredulity not to be wondered at, for it must be acknowledged that its antecedents and history are bad. Too often in the past, has the world heard the cry, 'gorilla,' when there was no gorilla, and the public faith now is hardly equal to accepting the veritable animal, though as an inducement to recognition, he presents to us his very bones. But unfortunately, with this otherwise indubitable proof in 1846, came innumerable fictions which attributed wonderful achievements and superhuman intellectual as well as physical power to the animal. Those who were permitted the vision, said the bones were bones, but of what creature, who could tell.—The conjectures on this question have ranged the newly arrived animal from a specimen of monkey, up to Mr. Harris's Pre-Adamic Man.

Gradually however, fiction has given place to fact; the change has been working through a period of fifteen years, and now, we are in possession of the animal's zoological position and know him tolerably well, in temperament and habits.

In the present article we propose to 'show him up' so far as the sources of information at our command will suffice.

The natives of Africa have always regarded the gorilla with a feeling of superstitious dread. To some of them, he is a mysterious demon. Those who believe in the transmigration of souls, consider him as a compound of man and brute—their explanation being, that at the death of a wicked man, his spirit enters the body of a lesser ape, which immediately becomes a gorilla, and which, when so inhabited, can neither be killed nor conquered. Others see so much of human attributes about the animal that they acknowledge him as a kinsman, one however so superior to themselves, that they dare not cultivate any intimacy or even acquaintance with him. These, and so many other superstitions and traditions are believed in by the various human tribes of Africa, that comparatively few among them, can know the gorilla as simply the immense ferocious ape that he is.

We have no means of knowing when this species was first recognized. The name Gorilla was applied to some animal of the ape kind, longer ago than the beginning of the Christian era, for, in the *Periplus* of the Carthaginian voyager Hanno, who was sent to circumnavigate the African continent, in the sixth century before Christ as it is supposed, is the following passage: "On the third day after our departure thence, having sailed by those streams of fire, we arrived at a bay called the Southern Horn; at the bottom of which lay an island like the former, having a lake, and in this lake another island, full of savage people, the greater part of whom were women, whose bodies were hairy, and whom our interpreters called Gorillæ. Though we pursued the men, we could not seize any of them; but all fled from us, escaping over the precipices, and defending themselves with stones. Three women were however taken; but they attacked their conductors with their teeth and hands, and could not be prevailed on to accompany us. Having killed them, we flayed them, and brought their skins with us to Carthage. We did not sail farther on, our provisions failing us."* According to Pliny, these skins were placed in the temple of Juno, and the name *gorillas* was changed to *gorgones.* Two of them yet remained in the temple at the time Carthage was taken by the Romans. "Penetravit in eas (Gorgades Insulas) Hanno Pænorum imperator, prodiditque hirta feminarum corpora, viros pernicitate evassisse, duarumque gorgonum cutes argumenti et miraculi gratia in Junonis templo posuit, spectatas usque ut Carthaginem captam."

Hanno's gorilla, may have been the progenitor of the animal known at the present time by the same name, but this is improbable unless the race has wonderfully improved in its later generations, for, the gorilla with which we are acquainted is non-

* Voyage of Hanno (Falconer's translation). page 13.

gregarious, and the males are not so cowardly and ungallant as to forsake their females in time of peril, and again, even the females could hardly be captured by hand alone. The above reference better applies, we think, to the Chimpanzee—an ape which is common on the banks of the Gambia and Congo rivers.

Purchas, in his "Pilgrims," published in London in 1623, records the adventures of the African traveller Andrew Battel, who had met with two species of apes—he quotes concerning them from Battel, in Part II of the work, p. 984, as follows, "The greatest of these two monsters is called (by the Portuguese) *pongo* in their language, and the lesser is called *engeco.* The pongo is in all proportions like a man, for he is very tall, and hath a man's face, hollow eyed, with long haires upon his brows. His body is full of haire, but not very thicke, and it is of a dunnish color. He differeth not from man but in his legs, for they have no calfe. He goeth alwaies upon his legs, and carrieth his hands clasped on the nape of his necke when he goeth upon the ground. They sleepe in trees, and build shelter for the raine. They feed upon the fruit that they find in the woods, and upon ants, for they eate no kind of flesh. They cannot speake, and have no understanding more than a beast. The people of the countrie, when they travaile in the woods, make fires where they sleepe in the night, and in the morning, when they are gone, the pongos will come and seat about the fire till it goeth out, for they have no understanding to lay the wood together. They goe many together, and kill many negroe that travaile in the woods. Many times they fall upon elephants which come to feed where they be, and so beat them with their clubbed fists and pieces of wood that they will runne roaring away from them. The pongos are never taken alive, because they are so strong ten men can not hold one of them; but they take many of their young ones with poisoned arrows. The young pongo hangeth on his mother's belly with his hands fast clasped about her, so that, when the country people kill any of the females, they take the young which hangs fast upon the mother. When they die among themselves, they cover the dead with great heapes of boughs and wood, which is commonly found in the forests."

This description savors considerably of the fabulous, for no species exists among all the apes we venture to assert, making so near an approach to humanity as Battel's Pongo;—what that word means in the Mayomba dialect, we have been unable to ascertain; but, in the report of him just quoted, we see more of the gorilla in what pongo *is*, than in what he *does*.

It is thought by many, that the ape referred to by T. E. Bowditch, in his account of a mission from Cape Coast Castle to Ashantee, published in London in 1819, is the gorilla; but his description is too meagre in details to admit of a decision; the name, however, by which he calls it, *ingena*, suggests that animal, for this is the Mpongwe name for the gorilla. In that part of the work where he relates his visit to the Gaboon, he says: "The favorite and most extraordinary subject of our conversation on natural history was the ingena, an animal like the orang-œtang, but much exceeding it in size, being five feet high, and four, across the shoulders. Its paw was said to be even more disproportioned than its breadth, and one blow of it to be fatal. It is seen commonly by them when they travel to Kaybe, lurking in the bush to destroy passengers, and feeding principally on wild honey, which abounds. Among other of their actions reported without variation by men, women and children of the Mpongwe and Sheekaï [Shekiani], is that of building a house in rude imitation of the natives, and sleeping outside on the roof of it."*

We might cite numerous accounts of apes more or less anthropoid, which have been seen in Africa in the earlier centuries of our era, but they are all so vague as to render it impossible to decide in any instance, on a particular species;—we learn this much from them however, that there were in Africa, in the olden time, apes innumerable, and of many grades, from those of large size, power and intelligence, to diminutive monkeys that were more than liliputian. The tribes of men in the African wilds, though surrounded by these animals and always aware of their existence, have learned but little concerning their peculiarities and habits; acknowledging them as rightful cohabitors of the country, and hence possessing inalienable rights which should be respected, they have not ventured on much interference—not even for purposes of investigation;—and for the more ferocious specimens, they have entertained so profound a respect and dread, as to be unwilling to incur any risks of danger for the sake of a better acquaintance. For reasons such as these, the Africans have been slow in acquiring information about their neighbors, the apes, and that most formidable one, the gorilla, they have known scarcely at all, except by tradition. Their traditions accord to him wonderful powers, and achievements *ad libitum;* in story too he is perpetuated, and thus, many of the poor deluded inhabitants have come to regard the creature, either as a demi-god or demon, having no kindly purposes towards them—in fact they imagine him to be their direst and most dangerous enemy.

When the gorilla stories were first divulged abroad, the subject of them was regarded as an improbability; but his existence was placed beyond a doubt, before the world, in 1846. Towards the close of that year, the Rev. J. Leighton Wilson, a missionary in the Gaboon region of Western Africa, came in

* Mission to Ashantee, p. 440.

possession, accidentally, of the skull and some other portions of the skeleton of a species of ape which he was convinced was unknown to zoologists. These remains he forwarded to the Society of Natural History at Boston, in whose proceedings they were subsequently described by Dr. Savage and Professor Jeffries Wyman. The new animal was found to belong to the genus *Troglodytes*, and these gentlemen proposed as his distinguishing cognomen, *gorilla.* Whether they thus named him on the supposition that he was the same species as seen by Hanno, the old Carthaginian navigator, we are not informed.

The term Troglodytes (from τρώγλη, a cavern, and δύω, to inhabit,) was first applied to the apes by Linnæus, we believe, and it now includes four varieties, viz: The chimpanzee (*Troglodytes niger*), the kooloo-kamba* (*Troglodytes kooloo-kamba*), the nshiego-mbouvé (*Troglodytes calvus*) and the gorilla (*Troglodytes gorilla*). The chimpanzee was originally known as the *Homo sylvestris* or Pigmy, which name was given by Tyson in 1699. Linnæus calls it, in his "Systema Naturæ," the *Homo-Troglodytes.* It became more generally known, however, as the *Simia Troglodytes*, from Blumenbach. The name it now bears, *Troglodytes niger*, was given in 1812, by Geoffroy St. Hilaire of Paris.—It is proper to add here, that this naturalist makes a new genus for the gorilla, which he has named Gorilla, and has called the only species of the genus thus named *ngina.* All the above species inhabit equatorial Africa. Besides them, six other varieties of tail-less apes are known to naturalists, *viz;* two species of the orang-outan (*Simia Satyrus*) found in Borneo and Sumatra; and four species of the gibbon (*Hylobates*), including the siamang, which are distributed through Java, Borneo, Sumatra, Malacca and Siam.

Since 1847, at which time the gorilla was fairly introduced to the world, our knowledge of him has been gradually increasing. In 1853, Prof. Owen, of London, received from the Gaboon, a gorilla's carcass, in a cask of spirit,—it was in so imperfect a state of preservation however, that but little more than its skeleton was available for examination; the results, together with such meagre accounts of the appearance and habits of the animal as had been obtained from the natives, formed a very interesting paper which Prof. Owen subsequently published. With this memoir, the subject rested until the latter part of the year 1859, when the enterprising American traveller, Paul B. DuChaillu, returned to this country, bringing a full collection of gorilla skeletons and stuffed carcasses, which he had obtained during his four years exploration tour in equatorial Africa. Mr. DuChaillu claims to be the first white man who has seen the gorilla and studied its habits, in its native jungles; the facts are

* Kooloo, the sound which it utters, and Kamba, a native word signifying *to utter.*

recorded in an interesting way in his published volume.* We shall take the liberty of using some of the author's statements, in a report of the animal, which we now undertake.

In its size, the fully developed gorilla is the largest anthropoid ape known—it varies though, in this particular, as much as does man; the range, among adult males, is said by DuChaillu to be from five feet two inches, to six feet two inches. One specimen, whose proportions are given, measured in length, five feet nine inches; the chest had a circumference of sixty-two inches, and the arms extended, spanned nine feet.†

The bones comprising the skeleton, are massive, and they possess a greater density of structure than in animals generally. In number, position, and form, they approach human bones closely, and when articulated in the skeleton, are quite suggestive of that higher animal. For convenience of description and comparison, the skeleton may be divided into 1. The vertebral column, or central axis. 2. The head and face, or superior development of the central axis. 3. The thoracic arch and upper extremities. 4. The pelvic arch and lower extremities.

The number of pieces in the *vertebral column*, both in man and the gorilla, is twenty-four, and in their division into classes they correspond, except in the dorsal and lumbar regions; to the former, the ribs are attached, and there are twelve, thirteen or fourteen, in that series, according as there are twelve or more pairs of ribs. In the processes of the several vertebræ, there is little to contrast; the cervical group departs most, from that of man. The vertebral *column* however, is far from being conformable: In man it presents three, opposite curvatures, which are compensating. In all the apes, there is a single curvature in the form of a bow, which, acting like a spring, protects the animals from sudden shocks in leaping, or running on all fours; the same purpose is answered in man, by a combination of curvatures, which the better adapts him to maintain the upright posture. Moreover, out of deference to position in walking, is doubtless owing the difference which exists in the place of connection of the head with the vertebral column. In the gorilla, the articulating point is so far back on the base of the skull, that the animal could not well support his head if standing erect—the labor of doing it would make him conversant with a most intractable ailment—headache.

In the conformation of the *skull*, a great difference is apparent between all the apes and man. In the latter, the bones of the face are arranged perpendicularly, or nearly so, under those of the cranium. So that the facial angle (the angle formed between

* Adventures in Equatorial Africa by Paul B. DuChaillu—published by Harper and Bros. N. Y. 1861.

† For the dimensions of the gorilla as given by Dr. Gray, see this Journal, vol. xxxii, p. 437.

a line drawn from the projecting part of the forehead to the incisor teeth of the upper jaw, and another, drawn horizontally backwards from the jaw to the opening into the ear), is large, measuring 75° or more; while in the apes, as in all brutes, the facial bones retreat anteriorly from the perpendicular, from the forehead towards the chin—giving a comparatively small angle.

This bestial characteristic is not very prominent in the quadrumana; in the gorilla, we should say that the slant of its face is such that the entire outline of the skull, viewed laterally, would very nearly represent a rhomb.

The gorilla has not many manlike features about its skull: The anterior part, or face, is quite large; the *cranium*, or head proper, comparatively small;—and the two are separated by immense *supra-orbital* ridges, which deprive the animal almost entirely, of a forehead: The cranium is also terminated with equal abruptness behind—the *occipital* bone making nearly a right angle, at its junction with the parietal. The cranium is still further peculiar, in the male, in possessing a large bony crest upon the exterior, which extends its whole length along the median line—it is formed by the union of the *parietal* bones with each other. The *lower jaw*, is shaped much like man's; but in size, it is another thing altogether. The difference in this particular is indicated by a comparison of weights, which the writer made of two adults skulls, of man and the male gorilla, in his possession. The skulls—lower jaw not included—weighed the same, within a fraction of an ounce, (viz., 18 oz's.); while the jaws weighed,—the gorilla's, *ten* ounces,—man's, *two and a half* ounces.

The *teeth* again, are analogous. Their number we believe is the same in all the anthropoid apes, with that in the human species; but the gorilla has the advantage over all, in respect to size and strength. They are of exceeding hardness and whiteness, and are firmly implanted by long fangs. The *molar* teeth, or grinders, are probably more subservient to crushing food, than comminuting it,—the articulation of the lower jaw with the *temporal* bone not favoring so free a lateral motion, as the grinding process requires. Correspondent with this massive organ, are the muscles which move it: The *temporal* takes origin from the entire side of the head as high up as the median line; the *masseter* and *pterygoid* muscles also, are large and powerful.

The skull of the gorilla, as we have seen, differs widely from that of the human species; so are there many points of contrast between it, and those of other apes. In cranial capacity, all these animals are far below man, and when compared among themselves, *two* certainly, the chimpanzee and kooloo-kamba, have a larger brain cavity than the gorilla,—consequently, if mental development has any relation to the amount of brains possessed, they would take rank above him. The bony crest which surmounts the cranium of the male gorilla, is another non-human endowment, and it places the possessor retrograde among his congeners, for they are without it, excepting only the orang-œtan. In the quadrumana generally, the top of the head is regularly round and smooth. Again, in the gorilla, the face is not so broad in proportion to length, as in the kooloo-kamba. In this species, the peculiar development of the cheek (*malar*) bones, gives a great breadth to the face, and this, in conjunction with a more symmetrical nose and mouth, enables the animal to wear a countenance which is strangely human. A plump-faced member of the genus homo, with a convict crop of hair, a slight forehead, high cheek bones, flat nose, wide mouth and a moderate supply of whiskers, may have the satisfaction of knowing that, in so far, he impersonates an African kooloo-kamba.

In the gorilla, the orbital cavities are larger, and nearer together, than in the chimpanzee; his nose too, is compressed, and the jaws are more projecting, and quadrate in outline. These peculiarities make up an expression of countenance more beastly and savage, than any of his fellows could offset; they give to the face a decidedly carnivorous look, to which, among the apes, the orang-œtan makes the nearest approach—though he is amiable in the comparison. It is due the gorilla however, to state, that when young, he has not so markedly these brutish features; but after the infantile period is passed, the face undergoes a wonderful metamorphosis which brings them out. In infancy, his skull, and that of the chimpanzee and its allies, have most of human resemblances; and at this period, like all babies, they are scarcely distinguishable from each other.

In leaving the skull, we may remark, that if the ape class of the mammalia were ranked according to the approach which their skulls make to the human standard, several species would take precedence of the gorilla.

An extraordinary feature in the skeleton of the troglodytes, and one which is almost generic, is the *great length of the anterior extremities as compared with the posterior*. In the human species, the lower limb is the longest, by an inch or two. In the kangaroo, and other animals whose mode of progression is largely by *leaping*, the lower extremities very much exceed in length the upper; while in quadrupeds generally, the locomotive organs correspond very nearly with each other, both in length and size. The arms are most extensive in apes and monkeys, for the reason that these creatures lead, chiefly, an arboreal life, and so they require greater length and strength in that member. The longest arms are found in the siamang (the highest of the gibbons) and orang-œtan, in whom they reach the ground, when the animals stand erect. The chimpanzee, erect, reaches a little below the knee, and the gorilla, a little above it, he therefore comes nearest to man, whose reach is to the middle of the thigh,—and considerably near it is too, if their arms, in the measurement from shoulder to hand, be compared. If judged of by the position at the side, there is a greater discrepancy, for the reason that its much shorter thigh, brings the hand to a lower level in the gorilla: Also it has affinity with the human arm in another particular, for the arm bone (*humerus*), sustains to those of the fore arm (*radius* and *ulna*), the relative proportions of these bones in man. In both, the fore arm is shorter than the arm; in apes generally, it is as long, or longer. The humerus, in the gorilla, is longer than the same bone in the chimpanzee; yet in the latter, the anterior extremity is the longest, on account of its more extended fore arm.

The motions of *pronation* aud *supination* are performed very readily and perfectly in the gorilla, we think, judging from the character of the elbow articulation, and the muscles which subserve those movements.

The gorilla's *hand* exalts him in the quadrumanous series; the siamang is his only competitor in an approach to the human hand; theirs represents it almost, on a more elongated scale.* In most of the apes, this member is little better than a paw, in consequence of the *great length and narrowness of the palm, and the length of the fingers with the comparative shortness and backward position of the thumb.* The *thumb* it is, chiefly, which impresses perfection on the hand of man: Its articulation with the *wrist* is such as to permit great range and freedom of motion; it may be brought in apposition with any of the fingers, thus qualifying the hand for the most delicate manipulations. The bone which unites the thumb to the *carpus* (wrist), is the *os-trapezium;* its surface for the articulation is, in man, the gorilla and siamang, a rounded, but not deep concavity. In other species, it is so deep and angular, that the head of the *metacarpal* (thumb) bone, is more fixed, and its motions restrained.

The entire number of carpal bones in man, the gorilla, and chimpanzee, is *eight;* the orang-œtan, gibbons, and most of the lower monkeys, have *nine.*

The bones uniting the anterior extremity with the body, are the *scapula* (shoulder-blade bone) and *clavicle* (collar bone). The former, is broader in the gorilla than in the chimpanzee, and comes nearer to the proportions of that bone in man. But in the clavicle there is a yet greater similarity, both in form and

* DuChaillu gives the following measurements of the hand and foot of a large female gorilla, viz: length of the hand, $7\frac{1}{2}$ inches; length of the foot from the hair comprising the heel, $8\frac{1}{2}$ inches; round of hand above the thumb, $9\frac{1}{4}$ inches; do. do. under the thumb, 9 inches. *Length of the fingers;* thumb, $1\frac{2}{5}$ inches; first finger, 4 inches; second do., $4\frac{1}{4}$ inches; third do., $3\frac{3}{4}$ inches; fourth do., $3\frac{1}{2}$ inches. *Circumference of the fingers;* thumb, $2\frac{3}{4}$ inches; first finger, $3\frac{1}{2}$ inches; second do., 4 inches; third do., $3\frac{1}{3}$ inches; fourth do., 3 inches. *Circumference of the toes;* thumb, $3\frac{1}{3}$ inches; first finger, $2\frac{3}{4}$ inches; second do., $2\frac{1}{4}$ inches; third do., $2\frac{1}{5}$ inches; fourth do., $1\frac{3}{4}$ inches. See Du Chaillu's "Adventures," &c., p. 301.

size. This bone, as its name imports, is a key or brace to the shoulder, and in this function it is very important in all *climbing* or *flying* animals. In those not thus addicted, it is more rudimentary, and in those where the anterior extremity is employed merely as an instrument of progressive motion on a plane surface, it is entirely wanting.

The *pelvis* (basin) in the gorilla, is decidedly anthropoid. In no other ape do the *iliac* (hip) bones bend forward enough to produce a pelvic concavity. Their apish characteristics, are, great length, straightness, and narrowness in proportion to length. The tuberosities of the *ischia* are broad, thick, and curved outwards; the *pubic* bones are broad and deep, but flattened from before backwards. The whole pelvis is placed more in a line with the spine than in man, and the *sacrum* and *coccyx* which complete it behind, have a much less concavity. Moreover, the diameters of its superior aperture, are below the average in the human subject. In all these points the gorilla deviates from man less than any of his allies.

The *posterior extremities* of the gorilla, are characteristically short; in this feature they seem to outdo all other nether limbs among the quadrumana. The relative length of the thigh, to the leg, is about the same as in man; in both, the thigh is longest by about *two* inches (average). In the other apes we have been comparing, the two divisions of the posterior extremity preserve a corresponding relationship—and in conjunction, they make a longer limb than the gorilla's, without an exception the writer thinks, among the larger species. In man, the lower extremity tapers gradually, and gracefully, from the groin to the foot. In the gorilla, the large muscles which invest the thigh bone give to that part a square and massive form, while the leg is so devoid of them, that it has no calf, and hence no volume or symmetry. Plainly it is of little account to its owner for walking in the erect position, and we should apprehend his downfall, even if he attempted to maintain it at rest, very long. According to Professor Owen, the *glutæi* muscles, which form the buttock, and lift and rotate outward the thigh in walking, are most developed, in a quadrumanous series, in the gorilla. But this does not prove him any more a biped. We think with Mr. B. G. Wilder,* of Boston, that the form and direction of the glutæi, in apes, is more favorable to leaping, than continuous walking.

Nor does the structure and articulation of the *foot*, favor pedal locomotion. The foot is not sufficiently plantigrade to allow it, and a yet greater interference lies in the position of the great toe. By position, this member, in the chimpanzee and gorilla, is a true thumb, being situated posteriorly and inferi-

* Contributions to the Comparative Myology of the Chimpanzee by B. G. Wilder, p. 371. From Proceed. Bost. Soc. Nat. Hist., April 17, 1861.

orly to the other toes—according to Owen it diverges from them, in the latter animal, at an angle of 60° from the axis of the foot; hence the feet are well adapted to grasping and climbing. The small size of the foot, and its articulation with the leg at the expense of the heel in the apes, excepting only the gorilla, present other hindrances to upright walking. The gorilla has a well formed heel, and a foot so large that it exceeds the hand in size,—herein, he obtains another human characteristic. The contrary relationship between the two organs, subsists in other apes.

For the various reasons above set forth, we now assert, without hesitation, that the mode of progression in the anthropoid apes, the gorilla included, is on all fours; they may assume at will, in the case of many species, an upright posture, and even may be able in some instances, to maintain it a short time in walking or rather waddling, but their true method of locomotion is quadrupedal.

The anthropoid apes take rank in relation to man, according to the degree of approach of their skeletons to his. By this criterion the gorilla has a high, perhaps the highest position. His skull as we have seen, has fewer human resemblances than those of some other species, but in the rest of his bony framework he stands much nearer the archetype. A comparison of the entire skeleton, among the series, leaves us in some doubt as to the exact place he should occupy. Professors Wyman and St. Hilaire put the chimpanzee first, and the gorilla second; while Prof. Owen states, that the tailless quadrumana recede from the human type, in the following order: viz., gorilla, chimpanzee, orang-œtan, gibbon.

The muscular system of the apes, throughout its entire structure and arrangement, conforms very closely to that of man. So also the structure and form of the *lungs* and *heart*, and the distribution of the *blood vessels* and *nerves*, are all but identical with the corresponding organs in man. But the *brain*, though having the elliptic form of its human congener, differs from it considerably in size* and points of structure. In bulk, and in the number and size of its convolutions, the discrepancy is great. The *cerebellum*, relatively to the *cerebrum*, is larger than in man. This disparity of size, consequent upon the larger cerebellum, is a characteristic of the brute creation, and it increases up to a certain limit, as we recede from man in a descending series. It is indicative of excessive animalism, or rather of a preponderance of the purely animal functions.

* The weight of brain, in a full grown gorilla, is from 10 ounces to 12 ounces, troy: in the chimpanzee and kooloo-kamba, it is somewhat greater than this. In the full grown negro, it ranges from 3 pounds 1 ounce, to 3 pounds 9 ounces 4 drams, troy.

The brain of anthropoid apes is distinguished from that of other brutes, in possessing a process of structure known as the *hippocampus minor*—this is a minute, nipple shaped, body, which is found in the posterior cornu or horn of each *lateral* (the largest cavities of the brain) *ventricle*. Its existence in the apes, to the exclusion of all other animals except man (for this, so far as known, is a fact), is the more remarkable, inasmuch as the posterior lobes of the brain, which contain the cornua, are very inconsiderably developed in them.

In the circle of their functions, and in the phenomena of periodicity, the apes, again, make a close approach to the human species.

The dissections which have been made of the gorilla's carcass, show an identity almost, in character and relations of the soft parts, with those of the other species of the Troglodytes.

The *skin* of the gorilla, in the young as well as in the adult, is of jet black color, and is very thick and firm. The skin of the female, is generally darker than that of the male. Black, with few exceptions, appears to be the skin-color of apes, though some do not obtain it till after the period of adolescence. The face of the chimpanzee, when young, is yellow, while that of the young nshiego-mbouvé, is astonishingly white. The skin of each is clothed all over with hair, which also is black or gray. The hair of a fully grown, but not aged gorilla, is said to be of iron-gray color—the black hair is intermixed with gray, and so ringed, as to produce this particular shade. The longest and darkest hair—sometimes over two inches long—is on the anterior extremity; from the shoulder to the elbow, it grows downwards; on the forearm, upwards. The back of the hand is hairy to the division of the fingers, which have a more downy coating. The posterior extremities, likewise, are covered with coarse hair, which is thickly set, except upon the toes.

The gorilla, in general configuration, is quite like the apes, but his larger size, and more compact organization, deprive him of their agility of motion—and so, by good right, of their name. In motion and manner, he must be an awkward and ungainly ape. He is accomplished, however, by possessing great strength—in this particular, as also in ferocity of disposition, we conceive him to be something terrible. His *physique*, judged of by man's, is graceless and shabby in the extreme; in the comparison, we are justified in characterizing him, as Buffon has done the sloth, "a bungled composition of nature."

The gorilla is supposed to have originated in Africa—at any rate he makes his abode in the equatorial belt, of that continent. According to DuChaillu, his range of migration is between 3° north, and 3° south latitude, and as far into the interior, as Captain Barton's Lake Tanganyika. Over this region of country the animal holds undisputed sway; not even the elephant and lion are competitors with him there; they and all lesser beasts, flee before him. The adult male gorilla has no sense of fear; he runs from no enemy, and is not the aggressor, usually, in an encounter. When the hunter comes in his way, he rises erect and opens wide upon him his fiendish eyes, giving utterance at the same time, to deafening and protracted roars of warning; and by way of bidding defiance, he distributes upon his massive drumlike chest, blows, whose vibration can be heard, it is said, "at least a mile off."(!) If the hunter then makes no retreat, the brute advances towards him, repeating as he moves, the terrific roar and thumps. The right shooting distance is six or eight yards. If a ball takes effect in the head or chest, the animal falls and dies quickly,—for, like man, he has not a strong tenacity of life. If the hunter misses the mark, woe be to him, for the alternative is, to kill or be killed; before he can reload, the beast is upon him, and one blow of his large fist, suffices to crush in the unfortunate man's skull, or frightfully lacerate his trunk.* The female gorilla is not thus fearless and courageous; she seeks to escape when pursued, unless the safety of her young is imperilled; for them, it is said, she will resist, even unto death.

The *roar* of the male gorilla to which we have referred, is described by DuChaillu, as the most singular and awful noise heard in the African forest, he says, "it begins with a sharp *bark*, like an angry dog, then glides into a deep bass *roll*, which literally and closely resembles the roll of distant thunder along the sky, for which I have sometimes been tempted to take it, where I did not see the animal. So deep is it that it seems to proceed less from the mouth and throat, than from the deep chest and vast paunch."

In his *diet*, the gorilla is reported as being a strict vegetarian. If this is true, we must regard his canine teeth as rudimentary tusks, and as such, useful either for purposes of

* This statement concerning the way in which the gorilla attacks his foe, is made on the authority of Mr. DuChaillu. We question its authenticity however, for the reason that the gorilla having *nails* instead of *claws* at the extremities of the fingers, would hardly be able to make an extensive *lacerated* wound with his hands. On this ground Mr. Charles Waterton denies that the animal is at all pugilistic in an encounter. Mr. Waterton says, in the London Athenæum for Oct. 19th, 1861, "Let me remark here (notwithstanding what anatomists may teach to the contrary), that the gorilla and every other ape have received their long and brawny forelegs, *not* for offensive or defensive measures, but solely, like the sloth, to enable them to pass from branch to branch with a rapidity like unto that of an arrow from the hunter's bow, —their hinder legs acting as mere props in the transit. Anatomists ought to know that the gorilla, being an ape, has *non retractile claws; so that it never attacks its foe, or defends itself, with the forefeet, but invariably with the mouth.* Wherefore, I condemn unhesitatingly Mr. DuChaillu's description of a gorilla giving the negro a 'tremendous blow with its immense open paw.'" (See the narrative cited on p. 63 of this Journal).

prehension, or as weapons of offense. DuChaillu states that his favorite diet consists of, "the wild sugar cane; pine apple leaves; certain berries which grow close to the ground; the pith of some trees, and a kind of nut with a very hard shell." Such food seems quite insufficient for so large and powerful an animal,—most vegetable food, as compared with animal, containing a comparatively small proportion of nutritive substance. If this kind suffices, he must, like herbivorous animals generally, require to spend a great deal of time in feeding. His large paunch or stomach is much like theirs, and is peculiarly adapted to the digestion of vegetable aliment.

The gorilla, in his mode of life, is said to be a restless and nomadic creature, not remaining stationary, long, in any locality, but roaming about in many forests; this is not improbable, for a moderate region of country would not supply him with a sufficiency of food for a very long time.

He is *non-gregarious*—only the members of the same family live and move together. DuChaillu met, and heard of, no exceptions to this; he tells us also, that they are usually found in dark and gloomy places, preferring the jungles to open woods. At night, the young animals lodge in trees, while the old ones sleep and keep guard near by, below.

It is not yet known whether the gorilla is tameable. DuChaillu is convinced that it is not, but we think he decides the question on insufficient evidence. His observations with reference to this point were limited to *three* young animals,—the first of which survived his capture but about a month, the second lived only three days, and the third, died on the tenth day. He says concerning them, "no treatment of mine, kind or harsh, subdued the young monsters from their first and lasting ferocity and malignity." To the sin of untameability they added the vice of treachery, and so long as they lived, these little brutes requited all their master's kind efforts, with obstinacy and rebellion.

But Mr. DuChaillu's declaration that the gorilla is untameable, vanishes, if the following biography of a young animal is true.—We extract it from a letter by R. B. Walker, which is published in the London Athenæum for Sept. 21st, 1861.—Mr. Walker is the proprietor of a mercantile agency located near the Gaboon, in Western Africa,—he says, "The statement of the untameability of the young of the gorilla, is untrue. In proof whereof, let me ask Mr. DuChaillu, whose memory, usually so very good, seems to have failed him signally in this particular instance, if he has forgotten the young female gorilla, of from two to three years of age, called Seraphine, which lived at my factory for four months in 1859, and which he repeatedly saw there? I assert, without fear of contradiction by Mr. DuChaillu or any other person (and I could name scores of Europeans who saw it), that this animal was perfectly tame, docile and tractable,—far more so, indeed, than many Negro children of the same age. Not only was she on perfectly good terms with all grown up people in and about the factory, but was exceedingly attached to her keeper Curtis, whom she could not bear to be out of her sight, but regularly accompanied him about the factory and in his walks in the town and neighborhood. She was familiar and quiet with myself and clerks, and was only displeased when children approached her; and for these she seemed to have, in common with most large apes and monkeys, a very great dislike. She was seldom tied up, and even then only by a very small cord, which she could easily have broken or cut with her teeth had she felt so inclined. She allowed herself to be clothed, seeming to like it; and actually went to breakfast with a friend of mine, Mr. Barbotin, commandant of the steam transport, *le Rénaudin;* upon which occasion she conducted herself to the admiration of everybody. When at times put on the table, or amongst vessels of glass or earthen ware, she was most careful not to break anything. She finally died from dysentery and chagrin,—the latter caused by her keeper being prevented by his other occupations from paying her so much attention as she had been in the habit of receiving."

We think Mr. Walker's young animal must have been more docile than the average of her species, for it is certain, that as a race, gorillas are, in very constitution, stubborn and rebellious. But if the animals were taken young, and properly cared for and kindly treated for a term of months or years, we see not why their native ferocity of disposition should not be subdued,—kindness and patience are able to conquer almost any animal.

Concerning DuChaillu's experiments, we are convinced that they were insufficient to warrant any conclusions.

We close this article with an extract or two from DuChaillu's work, which illustrate the romance and the danger of gorilla hunting. The author describes, in the following graphic style, his first meeting with an old male, and the results:

"Suddenly Miengai (a native guide) uttered a little *cluck* with his tongue, which is the native's way of showing that something is stirring, and that a sharp look-out is necessary. And presently I noticed, ahead of us seemingly, a noise as of some one breaking down branches or twigs of trees. This was the gorilla, I knew at once, by the eager and satisfied looks of the men. They looked once more carefully at their guns, to see if by any chance the powder had fallen out of the pans; I also examined mine, to make sure that all was right; and then we marched on cautiously.

"The singular noise of the breaking of tree branches continued. We walked with the greatest care, making no noise at all. The countenances of the men showed that they thought themselves engaged in a very serious undertaking; but we pushed on, until finally we thought we saw through the thick woods the moving of the branches and small trees which the great beast was tearing down, probably to get from them the berries and fruits he lives on. Suddenly, as we were yet creeping along, in a silence which made a heavy breath seem loud and distinct, the woods were at once filled with the tremendous barking roar of the gorilla.

"Then the underbrush swayed rapidly just ahead, and presently before us stood an immense male gorilla. He had gone through the jungle on his all-fours; but when he saw our party he erected himself and looked us boldly in the face. He stood about a dozen yards from us, and was a sight I think never to forget. Nearly six feet high (he proved four inches shorter), with immense body, huge chest, and great muscular arms, with fiercely glaring large deep gray eyes, and a hellish expression of face, which seemed to me like some nightmare vision: thus stood before us this king of the African forests.

"He was not afraid of us. He stood there, and beat his breast with his huge fists till it resounded like an immense bass-drum, which is their mode of offering defiance; meantime giving vent to roar after roar.

"His eyes began to flash fiercer fire as we stood motionless on the defensive, and the crest of short hair which stands on his forehead began to twitch rapidly up and down, while his powerful fangs were shown as he again sent forth a thunderous roar. And now truly he reminded me of nothing but some hellish dream creature—a being of that hideous order, half man half beast, which we find pictured by old artists in some representations of the infernal regions. He advanced a few steps—then stopped to utter that hideous roar again—advanced again, and finally stopped when at a distance of about six yards from us. And here, as he began another of his roars and beating his breast in rage, we fired and killed him.

"With a groan which had something terribly human in it, and yet was full of brutishness, it fell forward on its face. The body shook convulsively for a few minutes, the limbs moved about in a struggling way, and then all was quiet—death had done its work, and I had leisure to examine the huge body. It proved to be five feet eight inches high, and the muscular development of the arms and breast showed what immense strength it had possessed."*

Having heard how Mr. DuChaillu killed gorillas, let us learn how a huge specimen killed one of his men,—he and his aids came upon one of the party, wounded on the ground—he thus describes the encounter.

"Our little party separated, as is the custom, to stalk the wood in various directions. Gambo and I kept together. One brave fellow went off alone in a direction where he thought he could find a gorilla. The other three took another course.

"We had been about an hour separated when Gambo and I heard a gun fired but a little way from us, and presently another. We were al-

* Adventures in Equatorial Africa, p. 98.

ready on our way to the spot where we hoped to see a gorilla slain, when the forest began to resound with the most terrific roars. Gambo seized my arms in great agitation, and we hurried on, both filled with a dreadful and sickening fear. We had not gone far when our worst fears were realized. The poor brave fellow who had gone off alone was lying on the ground in a pool of his own blood, and I thought at first quite dead. His bowels were protruding through the lacerated abdomen. Beside him lay his gun. The stock was broken, and the barrel was bent and flattened. It bore plainly the marks of the gorilla's teeth.

"We picked him up, and I dressed his wounds as well as I could with rags torn from my clothes. When I had given him a little brandy to drink he came to himself, and was able, but with great difficulty, to speak. He said that he had met the gorilla suddenly and face to face, and that it had not attempted to escape. It was, he said, a huge male, and seemed very savage. It was in a very gloomy part of the wood, and the darkness, I suppose, made him miss. He said he took good aim, and fired when the beast was only about eight yards off. The ball merely wounded it in the side. It at once began beating its breasts, and with the greatest rage advanced upon him.

"To run away was impossible. He would have been caught in the jungle before he had gone a dozen steps.

"He stood his ground, and as quickly as he could reloaded his gun. Just as he raised it to fire, the gorilla dashed it out of his hands, the gun going off in the fall, and then in an instant, and with a terrible roar, the animal gave him a tremendous blow with its immense open paw, frightfully lacerating the abdomen, and with this single blow laying bare part of the intestines. As he sank, bleeding, to the ground, the monster seized the gun, and the poor hunter thought he would have his brains dashed out with it. But the gorilla seemed to have looked upon this also as an enemy, and in his rage flattened the barrel between his strong jaws.

"When we came upon the ground the gorilla was gone. This is their mode when attacked—to strike one or two blows, and then leave the victims of their rage on the ground and go off into the woods."*

Our traveler's negro associates seem to have exhibited less courage in the presence of live gorillas, than he did. Unless the game was a young animal, or a solitary female, they were loth to encounter it.

To kill an adult male, is regarded as a great achievement among the natives, "it gives the hunter a life long reputation for courage and enterprise, even among the bravest of the negro tribes." Mr. DuChaillu states, that "the hunters are their most valued men. A brave and fortunate one is admired by all the women; loved—almost worshiped—by his wives; and enjoys many privileges among his fellow villagers. But his proudest time is when he has killed an elephant or a gorilla and filled the village with meat. Then he may do almost what he pleases."

New Haven, Dec. 1861.

* Ibid., p. 342.

ART. VIII.—*On the investigation of Microscopic forms by means of the Images which they furnish of external objects, with some practical applications;* by Prof. O. N. ROOD of Troy, N. Y.

IT would hardly occur to a physicist, who was requested to determine whether a certain disc of glass was a convex or a concave lens of slight curvature, to attempt a solution of the question by glancing along the two sides; on the other hand, neglecting even to look at the glass, he would at once bestow his undivided attention upon the *images* of external objects formed by it, and thus with ease and certainty decide upon the nature, degree, and regularity of its curvature.

The simple idea here enunciated seems hardly to have been applied to the study of microscopic forms, though from some experiments lately made in this direction, I am firmly convinced that this method of determination is destined hereafter to play a most important part in microscopic observation. To the microscopist it will prove as powerful a means of investigation as it now is in the hands of the optician.

The most convenient and effective mode of proceeding in this case which has occurred to me is the following: the microscope is brought into a horizontal position, the mirror removed, and the illumination supplied by a candle or lamp placed in the axis of the compound body at a distance of not more than three inches from the stage. If now a small sphere of glass be properly supported on the stage, it forms behind itself a very minute inverted image of the flame of the candle: upon drawing back the compound body slightly this image comes into focus and is seen of course in an erect position. When a rod of $\frac{1}{10}$th of an inch in thickness is moved up and down between the flame and the globule, an image of it is seen in the microscope with great distinctness, and it is observed that the motion of this image follows in all respects the motion of the hand. Upon replacing the sphere by a minute concave lens, as an air bubble in water, the reverse takes place; to gain distinct vision of the flame it becomes necessary to move the compound body within the focus, the image of the flame is seen to be inverted, and what is practically more important, the motion of the rod seems reversed. It will happen very generally in applying this method that the image of the flame is not sufficiently perfect to decide whether it is erect or inverted; the *motion of the rod* then furnishes us with a certain means of deciding this point: if its motion is natural the image is erect and the curvature convex, &c. After some practice it becomes easy to obtain the best focal adjustment for distinct vision of the rod, and in extreme cases where the image is very badly defined the focal adjustment is best made while the rod is in gentle motion. I now adduce one or two applications of this method.

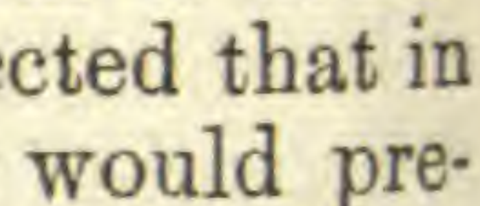
Examination of the nature of the markings on the Coscinodiscus Triceratium, &c.

It is well known among microscopists that the controversy regarding the nature of the marking on these shells, after being carried on for several years with spirit cannot even yet be considered as settled, one party contending that the areolæ are depressions, while their antagonists see them as elevations. Compare Carpenter on the Microscope, page 280, American edition.

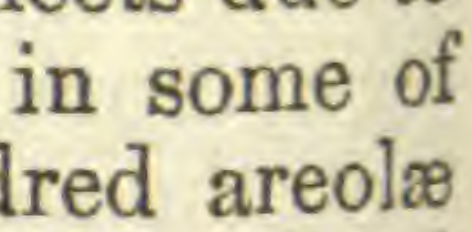
Fine specimens of these shells mounted in water were examined by a power of from 600 to 800 diameters; on moving the compound body within the focus, each hexagon was found to contain a small distinct image of the flame, the motion of the rod showed that the images were inverted, and consequently formed by *concave lenses.* As the index of the refraction of water is much less than that of silica, its effect is merely to diminish the action of the curved surfaces, but in no case to reverse it. These shells were now mounted in Canada balsam and observed. As the index of refraction of the balsam is somewhat greater than that of silica, it was to be expected that in the compound lenses of silica and balsam, the latter would predominate and reverse the action, so as to present effects due to convex lenses. This was found to be the case, and in some of the valves the eye could readily follow in a hundred areolæ at a time, each flickering motion of the flame as it was stirred by the wind. The valves when mounted in balsam of tolu, which has a still higher index of refraction, gave like results. These experiments, which are not difficult to repeat, prove that the areolæ are well formed *concave* lenses.

A similar mode of experimenting, which must be conducted on large valves and with some delicacy, shows that the border, or setting, so to speak, has the opposite curvature, viz: is convex; whether it is convex as a cylinder or beset with several convex markings I have not had leisure to determine, though in some large specimens the latter seemed to be the case. Indications also were observed in some large specimens, that would lead to the deduction of a form optically equivalent to that seen in fig. 1; and certain allied forms readily furnished the curve seen in fig. 2, the small depressions being pits.

1.



2



This mode of experimenting often furnishes us the means of determining whether certain appearances are really due to *openings* or to some other cause; thus the small circles at the middle and ends of the *Pinnularia viridis* have been mistaken by some eminent observers for openings. Prof. Bailey proved by the action of hydrofluoric acid that they are in reality thicker portions of the shell, and examination by the method here described shows that they are convex lenses, giving often very well defined images of the flame. The dots characterizing the Coniferæ furnish images of the flame indicating two or more curvatures, the ribs of the Pinnularia and the spaces between them have opposite curvatures, &c., but the examples already given may be sufficient to show the usefulness of the proposed method.

Index of refraction of the Silica composing the valves of the diatoms.

This point is closely connected with the foregoing, and it may not be amiss to detail a few experiments that were made to determine it.

Although Canada balsam has the same index of refraction as quartz, still the valves of the diatoms which are composed of silica are seen almost as distinctly in balsam as when mounted in water!

To ascertain the relation between the index of refraction of quartz and Canada balsam independently of optical tables or laborious experiment, I combined a convex quartz lens of one inch focus, cut at right angles to the optic axis, with unheated fluid balsam placed on a glass slide; the two opposite refractions balanced with each other so perfectly that the combination acted like a plate of glass with plane parallel sides, and with ordinary means I was at a loss to discover any tendency to convexity or concavity. Balsam which had been heated was now combined with the quartz lens in the same manner; the balsam proved to have gained in refractive power, so that the combination now acted distinctly as a concave lens of weak curvature.

Diatoms were then mounted in this unheated fluid balsam, in which properly they should have been invisible owing to the coincidence of refractive indices, but as had been anticipated they appeared beautifully, though perversely distinct. A casual remark from Alex. S. Johnson, Esq., concerning a certain chemical difference he had often noticed between ordinary silica and that composing the diatom valve again turned my attention to this point. Experiments were made upon a sample of the Rappahannock infusorial earth, which had been given to me by Prof. Wm. B. Rogers, in its natural state. By immersing the valves in various liquids, I finally ascertained that in strong sulphuric acid they became either *invisible* or very nearly so, while the grains of sand on the slide retained their distinctness perfectly. It was curious to observe how by diluting the acid with water, the valves again became visible and distinct in outline markings. By igniting this earth I produced a slight change in the index of refraction of the silica composing the valves, so that afterwards they were visible with tolerable distinctness in the same sample of sulphuric acid.

Index of refraction of water, - - - -	1·336
" " " sulph. acid, - - - -	1·435
" " " diatoms, - - - -	1·435
" " " quartz, - - - -	1·548
" " " Canada balsam, - - -	1·548

This table shows that the index of refraction of the diatoms is about half way between that of water and Canada balsam, thus explaining the fact that they appear about equally distinct in both of these media.

Troy, Nov. 26th, 1861.

ART. IX.—*The Primordial Sandstone of the Rocky Mountains in the Northwestern Territories of the United States;* by Dr. F. V. HAYDEN.

WE have attempted in this paper to present as clear and connected an account, as the known facts will permit, of the Primordial rocks west of the Mississippi, more especially those of the northwest, west of longitude 96°. The Potsdam sandstone of the New York series is the division of the Primordial zone of Barrande, mainly represented in the Rocky Mountain district and is that part alluded to unless otherwise mentioned.

In speaking of the geographical distribution of the Potsdam sandstone reference will be made to localities to the eastward where it has furnished most abundant and satisfactory testimony in regard to its age. We will in the first place, present more in detail, such facts as we have been able to obtain by personal observation in the field, and by the aid of these and the statements of reliable explorers we hope to give some idea of the geographical extension of this wide spread formation in the West.

Our first knowledge of Primordial rocks west of the Missouri river, was obtained in the summer of 1857, during the exploration of the Black Hills of Nebraska, by an expedition under the command of Lieut. G. K. Warren, Top. Eng. The more important facts with the determination of the fossils, were published by Mr. Meek and the writer in March, 1858.*

By reference to the general map of the country west of the Mississippi, recently published under the auspices of the War Department, we find that the Black Hills lie between the 43d and 45th degrees of latitude, and the 103d and 104th degrees of longitude, and occupy an area about 80 miles in length, and from 30 to 50 in width. According to Lieut. Warren the shape of the mass is elliptical and the major axis trends about 20° west of north. The base of these Hills is about 2,500 to 3,000 feet, and the highest peaks 6,700 feet above the ocean. The entire range is clasped, as it were, by the north and south branches

* Proceedings of the Academy Nat. Sci. Pa., March, 1858.

of the Shyenne river, the most important stream in this region. The north branch passes along the north side of the range, receiving most of its waters from it, but taking its rise far to the westward near the sources of Powder river, in the 'divide' between the waters of the Yellow Stone and those of the Missouri. The south branch also rises in the same 'divide,' flows along the southern base of this range, receiving the waters of numerous tributaries which have their sources in it.

Again, by referring to the map above alluded to, we ascertain that the Black Hills form the most eastern outlier of the great Rocky Mountain range as well as the first point where rocks older than the Carboniferous are exposed to the eye after leaving the Missouri westward. These Hills would seem to constitute an independent elevation, so far are they removed from other ranges, were it not for a low anticlinal which may be traced across the plain country southward connecting them with the Laramie Mountains near Laramie Peak. The central portion is composed of red feldspathic granite and stratified Azoic rocks, and resting unconformably upon, and forming a zone or belt around, the ellipsoidal nucleus, are a series of variable, reddish ferruginous sandstones which by their organic remains, furnish the most reliable evidence that they belong to the Potsdam period.

As observed in and around the Black Hills, the Potsdam sandstone presents a great variety of lithological characters. In many localities it is composed of a conglomerate of more or less water worn pebbles, mostly whitish crystalline quartz, but representing to a greater or less extent, the different varieties of the changed rocks beneath. The pebbles vary in size from an eighth of an inch to four inches in diameter cemented together with a silicious paste. Some of the pebbles are scarcely worn, while others are quite smooth. At the locality where the following section was taken, the sandstone is of a gray color tinged with red at the base, but ascending it becomes more ferruginous until its color is a dark dull red, and its texture, a coarse grained friable sandstone with many quartzose and micaceous particles and some calcareous matter. Seams two to four inches in thickness are very nearly composed of shells of the genera *Lingula*, *Obolella*, &c., which, though quite fragile in their nature, are so well preserved as to be easily identified. The following section taken near the central portion of the Black Hills exhibits Carboniferous rocks and the Potsdam sandstone conforming to each other, but the latter resting discordantly upon the Azoic stratified and granitic rocks.

1. A hard, compact fine grained yellowish limestone of an excellent quality; passing down into a yellow calcareous sandstone, quite friable. Fossils: *Spirifer Rockymontana*, Marcou, an *Athyris*, like *A. subtilita*, *Cytoceras*, &c. - - - 50 ft.

2. Loose layers of very hard yellow arenaceous limestone with a reddish tinge, underlaid by a bed, six to eight feet in thickness of very hard blue limestone; the whole contains great quantities of broken crinoidal remains with cyathophylloid corals and several species of brachiopoda. - - - - 40 ft.
3. Variegated sandstone, of a gray and ferruginous red color, composed chiefly of grains of quartz and particles of mica cemented with calcareous matter. Some portions of the bed are very hard, compact, silicious; others a coarse friable grit, others a conglomerate. Fossils: *Lingula prima*, *L. antiqua*, *Obolella nana*, and fragments of a trilobite, *Arionellus? Oweni.* 50 to 80 ft.
4. Stratified azoic rocks standing in a vertical position for the most part.

Leaving the Black Hills in a direction, a little west of south, we follow an anticlinal valley to the Laramie Mountains with which the Black Hills seem thus obscurely connected. The evidence, so far as it goes, appears to indicate that the same force which elevated the one raised the other, and that the events were synchronous. We do not observe the lower rocks after leaving the Black Hills until we reach the source of the Niobrara river, where we find a series of horizontal strata resting upon the vertical edges of Azoic clay slates and schists, which from their lithological characters and position, doubtless belong to the age of the Potsdam sandstone, though no organic remains could be found. The following section shows the descending order of the beds.

1. Quartzose sandstone, some parts filled with pebbles, - - 22 ft.
2. Red argillaceous slate, - - - - - - - - 5 "
3. Sandstone, dull reddish ferruginous, like bed 1, above, - - 37 "
4. A series of strata more or less inclined, composed of gneiss with silvery mica in large plates, micacous and talcose slates, white quartz, &c.

We have no doubt that the Potsdam sandstone occurs in the form of an outcropping belt all along the Laramie range of mountains, though, after a thorough search we were unable to discover any organic remains. Having once fixed the position and age of a formation, as the Potsdam sandstone is established in the Black Hills, we may rely with considerable confidence upon the physical characters and stratigraphical position to determine the age of rocks in the same district of country. We have on these grounds regarded certain rocks along the Laramie range as of this age. In the first ridge of elevation west of the trading post on La Prele creek, about sixty miles northwest of Fort Laramie, is a series of rocky layers, fifty feet in thickness, reposing unconformably upon red feldspathic granites, mica schists and clay slates. The lower portion is a fine grained subcrystalline quartzose rock, partially metamorphosed, passing up into a friable sandstone arranged in thin layers, with the laminæ quite oblique, overlaid by a considerable thickness of conglomerate. The dip is about 20° east. Resting upon these supposed Potsdam rocks at this point and inclining at about the same angle are layers of limestone, containing numerous fossils which prove them to belong to the Carboniferous age.

Again, farther southward along the same range, near the source of the Chugwater river we find the same limestones, well developed, containing some Carboniferous fossils, and underneath them and inclining in the same direction is a group of strata of a brick red color, more or less changed by heat, holding the position of the Potsdam sandstone in other localities. In some places these rocks are so metamorphosed by heat from beneath as to appear like a red feldspathic granite, and in others, like a reddened granular sandstone containing numerous unchanged masses of quartz.

At the Shyenne Pass, we observe the well known Carboniferous rocks, inclining about 13°. Beneath them is a considerable thickness of red marls and laminated sandstone, and still farther down and inclining 26° is a quartzose sandstone, full of water-worn pebbles, passing down into layers which at a distance look like indurated clay, but which, on a closer examination, proved to be an aggregation of quartz and feldspar crystals cemented with an aluminous paste. At another locality we have the following characters: 1st, a greyish quartzose sandstone, 12 inches; then descending, 2d, laminated granitoid rock, 2 feet; 3d, compact reddish ferruginous granitoid material, 8 feet; 4th, a considerable thickness, perhaps 50 feet of feldspar crystals cemented with an aluminous paste, inclining 13°. Though we could find no organic remains in these supposed Potsdam rocks along the Laramie range of mountains, yet their stratigraphical position and physical characters leave very little room for doubt as to their age.

Although we think that the known facts justify the inference that the Potsdam sandstone is revealed in an outcropping belt all along the margins of the Big Horn range, resting unconformably upon the Azoic rocks beneath, yet we were unable to make a careful examination except in a few localities. We could see, however, in the loose material scattered along the foot of the mountains, washed down by the streams, masses of sandstone closely resembling the rock under consideration. Near the sources of Powder river we penetrated to the nucleus of the mountains and found a series of sandstones underlying the Carboniferous limestone and resting unconformably upon the schistose and clay slates of the Azoic series, in very nearly the same manner as in the Black Hills before described. The Potsdam sandstone in this region is quite well developed, attaining a thickness of 200 feet, and exhibiting its usual variable lithological characters. Near the base, the rock is of a reddish flesh color, very compact, composed of an aggregation of quartz pebbles, varying in size from a minute grain of quartz to masses half an inch in diameter, cemented with silicious matter. Portions of the rock contain many pebbles of jasper which appear to have been slightly worn before being enclosed in the silicious paste. Passing up we find the rock to be arranged in thin ferruginous layers, slightly calcareous but mostly silicious, with many small particles of mica. These thin layers are also charged with fossils, as *Lingula antiqua*, *Obolella nana*, *Theca gregarea* and *Arionellus? Oweni*. Many of the slabs were covered with fucoidal markings and what appear to be tracks or trails of worms. The upper part of this formation as seen in the Big Horn mountains, is a rust colored granular sandstone, the small silicious grains being held together by a calcareous cement which causes the rock to effervesce briskly on the application of an acid. In tracing the different fossiliferous rocks, at this locality, from the nucleus outward, we can see a good illustration of the strict conformability of all the formations from the Potsdam sandstone to the summit of the Lignite Tertiary. We see here the evidences of only two great periods of disturbance, the one occurring prior to the deposition of the Primordial sandstones which inclined the Azoic rocks, and the other at the close of the accumulation of the true Lignite Tertiary deposits when the mountain nuclei began their elevation above the surrounding country.

Along the Wind-river mountains which extend far northward and form the dividing crest of the great Rocky range, the Potsdam sandstone is quite thinly represented and yielded no organic remains to a somewhat hasty examination. Near the junction of the three forks of the Missouri, alternate strata of clay, limestone, and compact silicious rock, occur beneath well marked Carboniferous beds. These rocks are evidently of ancient date, and were deposited in quite shallow water, as is shown by numerous thin layers of rock covered with trails of worms and fucoidal plants. These facts thus enumerated would seem to indicate with considerable certainty that this rock once spread over the area occupied by the central range of the Rocky Mountains, doubtless extending far north beyond the limits of the territories of the United States. The predominance of eruptive rocks as we pass northward along the main range of the Rocky Mountains greatly increase the difficulty in tracing out the lower fossiliferous beds.

The following list of fossils from the Primordial rocks of the Rocky Mountains, with the accompanying remarks is taken from a paper by F. B. Meek and the writer published in the Proceedings of the Acad. Nat. Sci. Pa.

Lingula prima, Conrad.

Our specimens are generally more or less exfoliated, but as near as can be determined, they seem to agree with the well known New York species in every respect. Quite abundant in the Primordial sandstone of the Black Hills, lat. 44°, lon. 104°.

Lingula antiqua, Hall.

There are amongst our specimens several varieties of forms, some being much more elongated and more attenuate towards the beaks than others. Some of the latter agree quite nearly with Dr. Owen's figures of *Lingula pinnaformis*, which is generally regarded as a variety of *L. antiqua* (though it may be distinct) while others are in all respects like the typical forms of *L. antiqua* from New York.

Locality.—Black Hills and Big Horn Mountains.

Obolella nana, **Meek and Hayden, Proc. Acad. Nat. Sci. Phila., Dec. 1861.**

The genus *Obolella* has been recently established by Mr. Billings, the able Palæontologist of the Canadian Geological Survey. It consists of a group of small shells allied to *Obolus* of Echwald, but presents fundamental diffferences in the form and arrangement of its muscular impressions. The type of the genus is closely allied to the form here figured, though specifically distinct.

1, *a*. *b*.

The figures here given are enlarged three diameters. No. 1, *a*, represents the outside of the dorsal valve, and No. 1, *b*, the inside of the ventral valve, showing the muscular scars. There are also some appearances of another small scar on each side between those represented and the margins of the valve. The radiating striæ represented on the exfoliated portion of fig. 2, *a*, are too numerous and crowded in the cut.

2, *a*. *b*.

Theca (Pugiunculus) gregarea, **(M. and H.) Proc. Acad. Nat. Sci. Philad.**

This species resembles in form *Pugiunculus striatulus* of Barrande (Neues Jahrb., pl. 9,) but differs in being very much smaller, and much more convex on the ventral side, as well as in being destitute of striæ. This little shell must have existed in vast numbers, since on a single slab not more than six by eight inches across, we have counted nearly two hundred individuals. Occurs in rocks equivalent to the Potsdam sandstone of the New York series, in the Big Horn Mountains, near lat. 43°, lon. 107°.

3.

Arionellus? Oweni, (M. and H.) Proc. Acad. Nat. Sci. Philad.

4.

The only specimen of this species we have seen is a cast, retaining none of the shell, and of course giving no idea of the nature of the external markings if there are any. Nor is it in a condition to enable us to determine whether or not the posterior lateral extremities of the buckler are pointed though they appear to be. At a point nearly opposite the middle of the glabella, there is on each cheek less than half way down the slope from the furrow between the check and the glabella, what appears to be some remains of small eyes, though the specimen being unfortunately a little defective here on both sides, the nature of these prominences cannot be clearly made out.

As near as can be determined from a shadowy medal ruled figure of an imperfect specimen, this *Trilobite* seems to be nearly related to a form represented by Dr. Owen on plate 1, A (fig. 13) of his Report on the Geology of Wisconsin, Iowa and Minnesota under the name *Crepicephalus;* though the anterior margin of its head is more narrowly rounded, and its glabella less tapering. Until specimens showing its facial sutures can be obtained, its generic relations will have to remain somewhat doubtful.

Near the central portion of the Black Hills, and at the Big Horn Mountains.*

We have now described this member of the Primordial zone as far as it has occurred within the limits of our own observations. It now becomes an interesting point to determine its geographical extension in the West, and for that purpose we propose to summon all the evidence at our command. The proof will not, however, be as satisfactory as could be desired owing to the general absence of organic remains.

If we now extend our examinations far north into the Hudson's Bay territory we find that much interesting information has been obtained in regard to the Silurian rocks of that region, but not accompanied by the evidence which gives to the knowledge acquired that definiteness which is desirable. It is probable, however, that when not eroded away or concealed by more recent deposits, the Potsdam sandstone and perhaps rocks of more recent Silurian age occur all along the margins of the Rocky Mountains to the Arctic Sea. To what extent still more recent or Upper Silurian occur over this vast region, our present knowledge will not enable us to determine, but the few fossils which have been collected indicate that the great Silurian Sea extended over much of the northwest. Sir John Richardson

* The fossils referred to in the present paper are to be found in the Museum of the Smithsonian Institution.

mentions the existence of conglomerates and sandstones to which succeed limestones and clay slates probably of Silurian age, and granite. We know that in many localities in the mountains, about the sources of the Missouri, the rocks of the Potsdam period are composed of sandstones and more or less coarse conglomerates. Underneath are clay slates and very hard limestones of Azoic age and to these succeed granite. As we proceed northward, the evidence of true Lower Silurian rocks, gives place to those of Upper Silurian age which have furnished a good supply of organic remains. According to Mr. Isbister these rocks are well developed around Hudson's Bay, Great Slave Lake and River, Lake Winnepeg, &c. He cites numerous fossils as belonging to Silurian types, but the species are too numerous to mention here. We may simply state that so far as our knowledge extends, there is no evidence which renders it certain that any portion of the Primodial zone of Barrande occurs north of lat. 49° though it is quite probable that when carefully sought after, it will be found revealed along the margins of the mountain elevations to the Arctic Sea.

As we proceed southward along the line of the mountain ranges toward New Mexico, though no fossils have been found, we feel safe, acting upon our previous knowledge, in regarding the evidence as quite clear, that this sandstone occurs in numerous localities. In our investigations of the geology of the West, we have relied on three tests of evidence, viz.: 1st, Palæontological evidence, which is the most important, and in most instances the only conclusive proof; 2d, Stratigraphical position; 3d, Lithological resemblance. The last two tests are all we have to rely upon to determine the extension of the Lower Silurian rocks as we proceed southward from the Black Hills. Having traced rocks which we regard of this age south to a point on a parallel with the Salt Lake district, we present the following resemblances in lithological characters as probable evidence of their existence in Utah territory.

Prof. Hall in Stansbury's Report, in several places describes a bed of sandstone, corresponding in its lithological characters and geological position to the Potsdam sandstone in the Black Hills. Stansbury Island, (Great Salt Lake) the summit of which is three thousand feet in height, is capped with Carboniferous limestones which rest upon a coarse sandstone or conglomerate. Again, north of Great Salt Lake City, the limestone overlies a coarse sandstone or conglomerate which almost invariably accompanies it. In several localities as at Promontory Point and near Mud Island, the metamorphic strata appear to be overlaid by a coarse conglomerate or coarse sandstone which is partially altered and assumes the character of a quartz rock. Marcou in the third volume of Pacific R. R. Reports, page 156, mentions a sandstone occurring near the Aztec Mountains. He says: "We traveled seven miles upon the granite, then a bed of red sandstone. Above this the beds of limestone and grey sandstone, belonging to the mountain limestone." The following day "we traveled three miles on the granite, the remainder on the Old Red Sandstone." An excellent diagram illustrating a section of the rocks near the mountains above alluded to, accompanies Mr. Marcou's remarks, which would apply equally well to similar beds in the Black Hills. The great uniformity in the physical characters of the different formations over large areas which have been examined with care and definite knowledge obtained leads us to place some degree of confidence in the above statements. From lat. 49° to 40° south and east of the dividing crest, we have the Potsdam sandstone, then immediately above it with remarkable uniformity, a series of beds of limestones, containing true Carboniferous fossils. We infer, therefore, that both northward and southward the same uniformity of geological structure continued unless we have evidence to the contrary.

The observations of Dr. J. S. Newberry render it quite probable that rocks of Lower Silurian age occur along the valley of the Colorado. The following paragraphs from a letter addressed to the writer by Dr. N., are extracted by permission. "I have never collected any unmistakable Silurian fossils in the far west. I am perfectly satisfied that the lower stratified rocks of the Colorado section are Silurian, but the only fossils they contain are too much changed to be satisfactorily identified.

The lower rocks above the granite are coarse red sandstones—lithologically and stratigraphically corresponding to your Potsdam of the Black Hills. Above these, a great thickness, over 300 feet of shales, limestones and sandstones and then the first Carboniferous fossils.

Just above the Potsdam (?) is a limestone filled with corals, apparently *Chœtetes lycoperdon* or rather the same with that so common in the Trenton with branching stems, formerly included in *C. lycoperdon*, but evidently distinct. On the mountains bounding the Colorado basin the Carboniferous rocks rest directly upon the granite."

We have now considered the Potsdam sandstone in its geographical extension over the West as far as we are acquainted with its existence, and have pointed out the localities where it is revealed. Along the Mississippi Valley and eastward, most important discoveries are made annually, which show it to be developed every where, when the conditions are favorable for its exhibition. It is true that in some localities beds of more recent age repose directly upon Azoic rocks, but in these cases may not the Primordial sandstones lie concealed or be eroded away? The researches of Dr. B. F. Shumard in Texas, have shown that the

Primordial zone attains a considerable thickness in the southwest, and is charged with an interesting group of its peculiar fossil forms. The examination of others proved its existence all along the Atlantic coast extending westward from Canada to Wisconsin, Iowa and Minnesota, and thus a great period in the world's geological history formerly supposed to possess but a meagre fauna, the first representatives of life on our globe, has already yielded very abundant and varied forms. The following is a summary of the principal facts and conclusions from our knowledge of the Potsdam sandstone in the far West.

1. We have the most undoubted evidence of the existence of that division of the Primordial Zone which is the equivalent of the Potsdam sandstone of the New York series, in two important ranges of mountains, outliers of the great Rocky Mountain chain. All the fossils are well known Primordial types and at least two species are identical with forms occurring at the typical localities of this period in the Eastern States. The others are forms closely allied to species found in the equivalent rocks both in this country and in Europe.

2. This division of the Primordial Zone, as a rule, appears as an underlying formation when the conditions are such as to expose it to view, from the Atlantic coast to the crest of the Rocky Mountains, and probably farther. Localities doubtless do occur where rocks of more recent age than the Potsdam sandstone rest directly upon the Azoic or granitic rocks below, but these facts do not militate against the general rule. Having proved its existence in two important ranges of mountains from its organic remains, by means of lithological resemblance and stratigraphical position, we have with considerable confidence, traced it by personal observations throughout the mountainous district comprised within lat. 40° and 49°, and lon. 103° and 112°. From these facts and the observations of reliable explorers in different parts of the West, we think we are warranted in the belief that this rock is exposed all along the margins of the Rocky Mountain range when not eroded away or concealed by overlying formations. How far westward of the dividing crest of the Rocky Mountains it extended we have no data for determining, nor can we hope to have where eruptive rocks seem to predominate. As yet we have not known the Potsdam sandstone to be exposed except along mountains with a true granite nucleus.

3. Wherever this rock occurs we are struck not only with the singularity of the organic remains, but also with the remarkable uniformity in the nature of the sediments and the general lithological appearance, compared with its equivalents in more eastern localities. We do not believe this to be due to currents of water bearing the materials from far eastern lands, but that the

sediments were obtained from the vicinity and that the uniformity in their character arises from the nature of underlying rocks from which they were derived.

The Potsdam sandstone is everywhere composed of calcareous and silicious matter, granular quartz, ferruginous material in great quantities, also pebbles of various kinds worn and unworn, with now and then seams and layers of argillaceous material. We find in the Azoic rocks below an abundance of limestone, clay slates, mica schists, seams of white quartz, granite composed largely of feldspar and we can readily detect the source of the fragmentary masses which form the conglomerates. We also know that while nuclei of certain mountain ranges on the eastern slope are composed of a massive feldspathic granite, a great thickness of more recent or overlying rock, forming the lower and smaller ridges are composed of a kind of "rotten granite" which is so full of the hydrated oxyd of iron that it readily decomposes on exposure to the atmosphere. We therefore believe that the source of all the sediments composing the Primordial rocks in the west can be traced to the underlying rocks in the vicinity.

4. There are no indications of long continued deep water in the Primordial sea so far as the West is concerned. If we examine the lower part of the Potsdam sandstone we find that the physical conditions which ushered in this period were quite violent, as is shown by the conglomerate character of the rock. Passing upward this conglomerate graduates into a rock composed of granules of quartz and small plates of mica cemented with calcareous matter, and about midway in the formation we have a fine, very ferruginous calcareous sandstone, in thin layers, filled with fossils in a very good state of preservation. The condition of the organic remains, the fineness of the sediment and the perfect horizontality of the laminæ of deposition indicate a short period at least, of quiet water. As we continue upward the rocks begin to show the shifting nature of the currents, shallow water and perhaps a proximity to land, by oblique laminæ of deposit, ripple markings and fucoidal remains. The upper portion of this rock contains no fossils, nor were the physical conditions such as to have preserved them even if they had existed.

5. There seem to be evidences of a gradual thining out of the Primordial sandstone in its far western extension, as also of all the Palæozoic formations. According to Dr. Owen the Protozoic sandstones in Minnesota are at least 500 to 600 feet in thickness, and in Iowa, Professor Whitney estimates them at from 250 to 400 feet. In Tennessee Prof. Safford finds several thousand feet of rocks, which he refers to this age, and in Texas where they seem to be quite well exhibited and to yield a large number of

fossils, Dr. Shumard gives them as only about 500 feet. In the Rocky Mountain district they are seldom more than 80 feet and never over 200 feet. Indeed all the Primary fossiliferous rocks are but thinly represented there, while the lower Secondary formations begin gradually to increase in force until all along the eastern slope we have an enormous development of the upper Secondary and Tertiary with an aggregate thickness of from 8000 to 10,000 feet.

6. So far as we yet know there is no unconformability in any of the fossiliferous sedimentary rocks of the northwest from the Potsdam sandstone to the summits of the true Lignite Tertiary. There are proofs of two great periods of disturbance which had a marked influence upon the physical geography of the West. The one occurred prior to the deposition of the Potsdam sandstone when the Azoic or granitic rocks were elevated into a more or less inclined position and the other and most important period took place at the close of the accumulation of the great Lignite Tertiary deposits when the great lines of fracture were produced and the massive nuclei of the mountain ranges were raised above the surrounding country.

7. What changes took place in the physical geography of the West during the long period which must have elapsed after the deposition of the Potsdam sandstone until the commencement of the Carboniferous age, we have very few data to determine. We are inclined to think that this portion of the West at least was elevated above the water level during the greater part of that period; the numerous indications of shallow water during the accumulation of the Potsdam sandstone, and the almost entire absence of rocks of intermediate age over so large an area further strengthens that opinion. It is true that in the far Northwest we have proofs that the hiatus is partially filled, but in the South and Southwest the evidence is still more meagre. Near the Humboldt mountains in Utah Messrs. Meek and Engelmann have detected proofs of Devonian rocks but they are not known to be largely developed, and on the western declivity of the El Paso mountains Dr. G. Shumard found "well marked strata of the inferior Silurian system corresponding in age to the Blue Limestone of Cincinnati and the Hudson River group of the New York series."* But so far as our present knowledge extends, rocks of intermediate ages do not form a prominent feature in the geology of the west.

Smithsonian Institution, Washington, Nov., 1861.

* Transactions of the Academy of Sciences, St. Louis, vol. i, No. 2, page 288.

ART. X.—*On the Reactions of Ethylamine and Diethylamine;* by
M. CAREY LEA, Philadelphia.

THE materials for the following examinations were prepared by the action of nitrate of ethyl upon ammonia in sealed tubes, in the manner which I have described in a previous number of this Journal. The bases were separated from each other by means of picric acid.

ETHYLAMINE.

In order to ascertain the purity of the ethylamine used, and further to test the exactness of the separation by means of picric acid, another platinum determination was made with great care. It gave the following results.

1·3911 grms. substance gave, platinum, ·5457

This corresponds to, per cent	39·23
Theory requires	39·29

A result which taken in connection with analyses already published seems conclusive.

Reactions of Ethylamine.

The reactions of ethylamine with metallic solutions have been more studied than those of the other ethyl bases; the following however do not seem to have been previously described.

Gold, terchlorid,	reddish precipitate, easily soluble in excess of precipitant.
Ruthenium, sesquichlorid,	no precipitate, either immediate or by standing 48 hours. The action of ethylamine differs from that of ammonia not only in producing no precipitate, but also in this, that the liquid after treatment by ammonia, acquires a lilac or lilac brown color, whereas after treatment with ethylamine it assumes a greenish brown or olive shade.
Palladium, protochlorid,	an immediate highly crystalline precipitate which redissolves in part, in excess of the precipitant, forming a colorless solution.
Uranium, nitrate,	yellowish precip. insoluble in excess of precipitant.
Cerium, protochlorid,	perfectly pure protochlorid of cerium prepared according to Holtzman's modification of Hermann's method, gave a dirty precipitate insoluble in excess of the precipitant.

Cerium, nitrate of protoperoxyd,	light brown precipitate, insoluble in excess of the precipitant.
Glucinum, sulphate of glucina,	white, insoluble in excess.
Zirconium, chlorid of zirconia,	white, insoluble in excess.
Molybdenum, protochlorid,	reddish brown, insoluble in excess.
" bichlorid,	reddish brown, insoluble in excess.

While the analogies which unite ethylamine to ammonia are extremely well marked, the differences in their reactions are also very well defined. Like ammonia, ethylamine redissolves its precipitates from salts of copper, of zinc and of silver, but it also redissolves precipitates from solutions of gold, ruthenium and aluminum which ammonia does not. It is, on the other hand, incapable of redissolving the precipitates from solutions of cobalt, nickel and cadmium. Towards protosalts and salts of protoperoxyd of cerium, glucinum, zirconium, protochlorid and bichlorid of molybdenum, peroxyd of uranium, bismuth and antimony, its behavior is similar to that of ammonia.

It was a matter of interest to observe whether the substance produced by the reaction of ethylamine on solution of terchlorid of gold would exhibit any analogy with that resulting from treatment by ammonia, viz., fulminating gold. The precipitate caused by ethylamine readily dissolved as above stated in excess of the precipitant, this at a gentle heat dried up to a yellow mass, which when heated, melted, turned red, emitted dense white fumes and left a brown spot. No sudden decomposition took place.

The following is a well marked distinctive reaction between ammonia and ethylamine. If bichlorid of tin be treated with ammonia, a precipitate is obtained which scarcely shows any disposition to redissolve in even a large excess of the precipitant. But with ethylamine the precipitate redissolves easily. In the case of ammonia the presence of salammoniac renders the precipitate from a stannic solution, according to Rose, altogether insoluble, whereas in the case of ethylamine, a considerable proportion of chlorhydrate of ethylamine may be added without diminishing the solubility of the precipitate.

Ethylamine, like ammonia, has the property of reddening an alcoholic solution of dinitronaphthaline.

Diethylamine.

The action of nitrate of ethyl upon ammonia is particularly well suited for obtaining diethylamine on account of the relatively large proportion obtained at once. Further experience, since I published that process, has shown me that the product is even larger than I supposed. The quantity of diethylamine produced is fully as great as that of ethylamine.

Diethylamine obtained by that process was purified by solution of its picrate in ether. A specimen of platinum salt analyzed gave, Pt 35·45 per cent, theory requires 35·45.

Reactions of Diethylamine.

The reactions of diethylamine with metallic solutions have not hitherto been examined. The following were observed:

Cerium, protochlorid,	dirty white precipitate, insoluble in excess of the precipitant.
" nitrate of protoperoxyd,	light brown precipitate, insoluble in excess of the precipitant.
Zirconium, chlorid of zirconia,	white precip., insoluble in excess.
Gold, terchlorid,	brownish red precipitate, easily soluble in excess of precipitant.
Ruthenium, sesquichlorid,	no precipitate. The color of the solution presents the same characteristics as in the case of ethylamine.
Palladium, protochlorid,	no precipitate from a somewhat dilute solution, but the deep red liquid is instantly decolorized.
Platinum, protochlorid,	no precipitate from a moderately concentrated solution. Hydrochlorate of diethylamine dissolves in protochlorid of platinum to a clear solution, so that if a diethylamine base analogous to Magnus' Green Base exists, it must be very soluble.
" bichlorid,	No precipitate unless both solutions are very concentrated.
Molybdenum, protochlorid,	red brown, insoluble in excess of precipitant.
" bichlorid,	red brown, insoluble in excess of precipitant.
Copper, sulphate,	Blue precipitate, very sparingly soluble in excess of the precipitant.
Silver, nitrate,	Brown, easily soluble in excess of the precipitant.
Zinc, sulphate,	White, insoluble in excess of the precipitant.
Cadmium, sulphate,	Same reaction.
Nickel, sulphate,	Pale green, insol. in excess of the precipitant.
Cobalt, protochlorid,	Blue, insoluble in excess of the precipitant.
Aluminium, alum,	White, soluble in excess.
Chromium, chrome alum,	Bluish grey, insoluble in excess.
Lead, acetate,	A small quantity produces no precipitate, a large quantity a white precipitate insoluble in excess.

Lead, nitrate,	An immediate precipitate insoluble in excess.
Mercury, protochlorid,	White, insoluble in excess.
Tin, protochlorid,	Same reaction.
" bichlorid,	White, soluble in excess.
Glucina, sulphate,	White, insoluble in excess.
Manganese, protosulphate,	Pale brown, insoluble in excess.
Magnesia, sulphate,	White, insoluble in excess.
Iron, sesquioxyd, ammonia alum,	Brick red, insoluble in excess.
Antimony, chlorid,	Brick red, insoluble in excess.
" tartar emetic,	At the first moment no precipitate, then a cloudiness and finally a heavy precipitate.
Bismuth, nitrate,	White, insoluble in excess of precipitant.
Uranium, nitrate,	Yellow, insoluble in excess.

Some of these reactions are highly interesting. It has been already shown under the head of ethylamine that in addition to the differences already known to exist between its reactions, and those of ammonia, its behavior towards solutions of gold and ruthenium is highly characteristic. We now see that diethylamine, not only resembles ethylamine in these properties, but shares with it its remarkable capability of redissolving precipitates of alumina. Ethylamine and diethylamine moreover resemble each other and differ from ammonia in their reactions with cadmium, nickel, cobalt, and bichlorid of tin. They both act like ammonia towards solutions of glucina, zirconia, protoxyd and protoperoxyd of cerium, peroxyd of uranium, protoxyd and deutoxyd of molybdenum and many other metals. The only oxyds which all three are capable of redissolving are those of silver and copper. Silver dissolves abundantly in all three; copper much more sparingly in ethylamine than in ammonia, while in diethylamine this property almost disappears, a faint blue color indicates the solution of a mere trace. Unless the aqueous solution of diethylamine is strong, not even a trace of copper is taken up by it.

The action of diethylamine on terchlorid of gold was further examined to ascertain if the resulting compound had any properties corresponding with those of fulminating gold. The clear yellow solution obtained from solution of terchlorid of gold by treatment with diethylamine, dried up to a somewhat crystalline deliquescent mass which when heated, decomposed without the slightest explosion.

It is evident from the above that the relations which exist between ethylamine and diethylamine are much closer than those between ethylamine and ammonia. In fact, in all the above reactions, they differ in their behavior to palladium and zinc salts only. Protochlorid of palladium is precipitated by ethylamine and not by diethylamine: zinc precipitates are redissolved by ammonia and ethylamine, but not by diethylamine. In view of this remarkable analogy, all clearly distinctive reactions acquire an interest, and the following which I have observed, is very well marked.

If protochlorid of mercury be precipitated with a very large excess of ammonia, the precipitate readily dissolves on the addition of a little acetic acid, the liquid remaining very strongly alkaline. Ethylamine behaves in the same way, but the precipitate caused by diethylamine does not redissolve under the same circumstances. Acetic acid may be added, in fact, until the liquid acquires a decidedly acid reaction without causing a solution.

Diethylamine shares the property of ethylamine and ammonia of reddening alcoholic solution of dinitronaphthaline.

The analysis of the platinum salts of the ethyl bases requires great circumspection in the application of heat, as they decompose at a far lower temperature than the chloroplatinate of ammonium. The diethylamine salt blackens at a temperature at which the upper part of the porcelain crucible remains cool enough for it to be lifted by the fingers.

Action of Iodine on Ethylamine and Diethylamine.

When aqueous diethylamine is poured over iodine in powder, it becomes milky and there collects at the bottom of the vessel a black substance in thick oily drops. These when heated in a platinum spoon give off first violet vapors of iodine, then thick white clouds and finally leave a carbonaceous residue. If this black substance be boiled a few minutes with a large excess of caustic soda, it emits an odor not unlike that produced by the combustion of phosphuretted hydrogen, diminishes in volume, and becomes thicker, so much so as to solidify on cooling. It then when heated, gives off no violet vapors, but only thick white clouds, swells up and leaves an enormously bulky residue of carbon. Ethylamine exhibits a nearly similar reaction. In neither case has the resulting substance the slightest explosive properties, as might be expected from the reaction of ammonia under similar circumstances.

The compound formed in the case of ethylamine has been examined by Wurtz and found to have the formula $C_4H_5I_2N$. By this result, the researches of Gladstone into the constitution of the so-called iodid of nitrogen, reliable in themselves, are supported. The latter chemist found for the explosive substance formed by the action of iodine on ammonia, the constitution

HI_2N. The action of iodine is consequently in both cases exactly analogous, two atoms of hydrogen are replaced by two of iodine.

Gilm therefore seems to be in error in asserting that no substitution-product from ethylamine analogous to so-called iodid of nitrogen (biniodamine) can be obtained.*

This iodine substitution-product from ethylamine and diethylamine, cannot, unfortunately, be obtained in a state of purity sufficient for reliable analysis, otherwise the examination of the diethylamine product would be interesting. For in ethylamine, there are two atoms of the hydrogen of the ammonia type remaining,

$$\left.\begin{matrix} C_4H_5 \\ H \\ H \end{matrix}\right\} N$$

and there is no difficulty in supposing them to undergo a substitution by iodine. But in diethylamine there remains but one—

$$\left.\begin{matrix} C_4H_5 \\ C_4H_5 \\ H \end{matrix}\right\} N$$

Nevertheless diethylamine under the action of iodine affords a substance exactly resembling that produced from ethylamine. To effect the analysis of a substance having an equivalent in the neighborhood of 300 so as to speak with confidence of the presence or absence of a single equivalent of hydrogen, it would need to be obtainable in a state of perfect purity. This however has not so far been possible.

Isomorphism of Ammonias.

A few experiments made in this direction gave the following results:

Ethylamine alum.—Octahedra of sulphate of ethylamine and alumina were obtained.

Tartrate of diethylamine and soda.—In order to determine whether diethylamine was capable of replacing ammonia in the magnificent crystalline forms of the double tartrates, this salt was formed, but whether crystallized from water or from weak alcohol, only needles could be obtained.

Sulphate of diethylamine and zinc.—In order to determine if diethylamine was capable of replacing ammonia in Mitscherlich's group of double sulphates, $RO, SO_3+MO\,SO_3+6HO$; with the characteristic crystal-form, the double sulphate of zinc and diethylamine was formed. A deliquescent solution was obtained which in vacuo over sulphuric acid afforded a crystalline mass, from which no conclusion as to isomorphism could be drawn.

* Jahresbericht der Chemie, 1858, p. 340.

Reaction of Ethyl bases with Dr. Knop's new hydrofluosilicic acid, $2HFl + Si_2Fl_3$.

In the *Chemisches Centralblatt* for August 21, 1861, Dr. Knop publishes an account of a very interesting combination which he has obtained by the action of peroxyd of copper and metallic copper on silicofluoric alcohol, and subsequent removal of the copper by sulphydric acid. He thereby obtains an acid $2HFl+Si_2Fl_3$ which exhibits different properties from ordinary hydrofluosilicic acid, $3HFl+2SiFl_3$ and which he thinks may prove a valuable reagent. It precipitates according to its discoverer, potash and soda completely from their solutions, while with sulphate, chlorhydrate, phosphate and oxalate of ammonia, it gives no precipitate. It appeared to me to be of interest to examine the behavior of this reagent with some of the ethyl bases. I prepared some by Dr. Knop's process; with it obtained immediate precipitates with carbonated and caustic alkalies, hydrochlorate of ammonia afforded no precipitate—results in accordance with his.

Caustic ammonia, afforded the following results: When the acid was in excess, no precipitate was formed, but where the ammonia was in excess, a very abundant caseous precipitate was obtained, which showed little disposition to dissolve in an excess of precipitant, even by standing and with the application of heat. Chlorhydric acid dissolved it somewhat better but still left a considerable portion undissolved.

Ethylamine, when the acid was in excess did not give a precipitate, but when the ethylamine was in excess, the mixture by standing a while, coagulated to a jelly so stiff that the test glass could be inverted, and this with scarcely any loss of transparency. In an excess of the new acid, this jelly redissolved with the exception of a few flakes.

Diethylamine exhibited almost the same reaction as ethylamine, except that the jelly was less transparent, and the solution in excess of the reagent less complete. The acid gives no precipitate with either the chlorhydrate of ethylamine or that of diethylamine. In this respect therefore these ethyl bases resemble ammonia.

ART. XI.—*On Nitrate of Ethyl;* by M. CAREY LEA, Philadelphia.

Action of Reducing Agents. Acetic Acid and Iron.—Acetic acid mixed with nitrate of ethyl was made to act on iron filings. On the application of a gentle heat a violent action set in, and most of the nitrate of ethyl was driven off undecomposed. The tube of a Liebig's condenser was therefore attached so that the distillate might constantly flow back, and heat was applied until the whole of the nitrate of ethyl was acted on. A considerable quantity of deutoxyd of nitrogen was evolved and some nitrite of ethyl. Finally caustic soda was added and the gaseous products were conducted into water. A very considerable quantity of ammonia was thus obtained but no ethyl bases could be distinguished.

From a considerable number of experiments I am disposed to think that the ethyl bases are produced in but a limited number of reactions, and that in many cases when they would seem to be possible products, ordinary ammonia is alone formed. For example, it appeared not improbable, that by acting on dry ethylosulphate of ammonia* $C_4H_5(NH_4)O_2 2SO_3$; with caustic lime, ethylamine would be formed simultaneously with hydrated sulphate of lime $CaO\,SO_3+2HO$, according to the equation

$$C_4H_5(NH_4)O_2\,2SO_3+CaO=(CaO\,SO_3+2HO)+\left.\begin{matrix}C_4H_5\\H_2\end{matrix}\right\}N,SO_3\dagger$$

but experiment showed that this was not the case, ammonia alone was disengaged.

Sodium.—The evolution of both deutoxyd of nitrogen and nitrite of ethyl indicate that by the reaction of iron and acetic acid the nitric acid in combination with the ethyl may be deprived not only of one, but even of three atoms of oxygen. In view of this easy and far reaching reduction, it is curious to find that nitrate of ethyl is scarcely acted upon by metallic sodium which even retains its lustre for some time when immersed in the ether. If a few drops of alcohol be added to the nitrate of ethyl, the sodium attacks the alcohol and when this is exhausted the sodium remains in the liquid for hours, as brilliant as a piece of silver.

Production of a Saccharoid Substance?—When nitrate of ethyl is made to act upon ammmonia in sealed tubes, secondary products appear to be also formed. When the hydrochlorates of ethyl bases obtained in this way are evaporated down previously to final distillation with caustic alkali, they are brownish and have a strong odor of burnt sugar. The residue after distillation was examined for sugar or allied substance, but it could not then be detected and the odor had disappeared.

Boutlerow has lately described‡ a remarkable reaction which indicates the probable production of a sugar for the first time by complete synthesis. It was obtained by the action of alkalies on dioxymethylene $\Theta_2H_4\Theta_2$. It seems possible that dioxyethylene might, in the reaction of nitrate of ethyl on ammonia,

* By exposure over sulphuric acid in vacuo for several weeks, crystals of ethylosulphate of ammonia near an inch in length and diameter were obtained.

† Ethylamine is capable of forming an anhydrous carbonate and probably also an anhydrous sulphate.

‡ Bulletin de la Soc. Ch. de Paris, No. 5, Seánce du 26 Juillet, 1861.

be found in small quantities and lead, when the crude contents of the pressure tubes are first distilled with caustic alkali, to the formation of a substance analogous to Boutlerow's methylenitane in the ethyl series.

Further remarks on the preparation of the Ethyl bases by means of Nitrate of Ethyl, and their separation.

Frequent repetition of the process which I have previously described* confirms me in my opinion of its advantages. Nitrate of ethyl is obtained easily and abundantly. From 480 grammes of alcohol of 40° Baumé, I have obtained 231 of nitrate of ethyl, and even a still larger proportion. It is essential in operating upon quantities of half a litre or over, of the mixture of alcohol and nitric acid to first raise the alcohol to a boiling heat and dissolve the urea in it, and then add the nitric acid, otherwise it may attack the alcohol while the urea remains undissolved at the bottom of the vessel, and thus cause the whole process to fail. I have prepared six or seven pounds of nitrate of ethyl in this way with very little trouble.

In acting upon the nitrate of ethyl with ammonia, it is necessary that the pressure tubes should be extremely strong and should never be more than one-half full. Saline baths are not to be used.

Triethylamine appears to be only an occasional product of this reaction.

In employing the process which I have recommended for removing the ammonia, viz: converting the mixed bases into sulphates and exhausting with absolute alcohol, it does not answer well to add sulphuric acid to the crude products obtained from the pressure tubes, because it is impossible to know the exact quantity of sulphuric acid required to expel the nitric acid. If too little be employed, some nitrate of ammonia might remain and dissolve in the alcohol. If too much, bisulphate of ammonia may be formed, and this likewise would dissolve to some extent in the alcohol and contaminate the product. It is therefore necessary to distil the crude products with caustic alkali, neutralize exactly with SO_3 and then evaporate to dryness and exhaust with alcohol as described in the paper here referred to.

In employing picric acid to separate the ethyl bases, each picrate, after having been purified by recrystallizations, is to be treated with chlorhydric acid. The greater part of the picric acid separates, and a further portion by evaporating the liquid. Some however remains, and it is important to get rid of it, because picric acid when distilled with aqueous caustic alkali evolves ammonia, which would thus contaminate the ethyl base.

* This Journal, July, 1861.

This is effected as follows. After the chlorhydrate of the ethyl base has been evaporated as far as possible without crystallization, a very little carbonate of potash is to be added and the solution stirred at intervals. Almost every trace of picric acid is thus precipitated.

In the final distillation of the chlorhydrate with caustic alkali, if there remains any trace of picric acid, an infinitesimal quantity is apt to be carried over, imparting a yellow tinge to the distillate. This may be prevented by adding before distillation a very small quantity of animal charcoal.

Art. XII.—*The Distinguishing Features of Comets considered as Phases of an Electrical Discharge resulting from Excentricity of Orbit;* by Benj. V. Marsh.

In the number of this Journal for May, 1861, I endeavored to show that an auroral streamer is a current of electricity, which originating in the upper portions of the atmosphere and following upward the magnetic curve which passes through its base, sometimes extends to a height of at least five or six hundred miles, thus reaching far beyond the supposed limits of the atmosphere, and that the current carries up with it, *at nearly its own velocity*, particles of matter which being rendered luminous by it serve to show its position. Assuming this to be true, I ventured the suggestion that the tail of a comet is probably of the same nature, it being simply an electric current rendered visible by its own illumination of a stream of particles which it is continually transporting with nearly the velocity of electricity itself from the atmosphere of the comet. The object of this paper is to present some considerations which seem to confirm this view.

Comets must either be peculiar in their constitution, or else the features which so remarkably distinguish them from other members of the solar system must be the result of some peculiar influence acting solely upon them. The former seems highly improbable because, with the exception only of the planets, every considerable mass which is known to belong to the solar system, or even to visit it temporarily, is found to be a comet, and we can scarcely imagine that all these masses of matter moving about the sun in every possible direction and approaching from every variety of distance and thus likely to include every variety of material to be found in the solar system should all agree in any peculiarity of composition not to be found in any one of the planets. In viewing the whole solar system the cometary condition appears to be the rule and the planetary the exception—indicating that all the members of the system are capable of putting on the cometary condition, but that in the planets circumstances have not favored its development. Now, excepting the peculiar cometary appearances, the only feature in which it is known that all comets agree with one another and differ from the planets is the excentric form of orbit—*the distance of a planet from the sun is almost constant, that of a comet variable*—and it is to the *variation* in the comet's distance from the sun, and the resulting *contrast of condition* whilst in different parts of the orbit that I would attribute the development of the cometary phenomena.

A planet revolves about the sun at a nearly uniform distance and the action of the sun's rays upon it is nearly constant throughout the whole of its revolution, and, so far as their effects are concerned, it must attain a condition of permanent and stable equilibrium. On the other hand the aphelion distance of a comet is many times as great as its perihelion distance—its motion being virtually a vibration to and from the vicinity of the sun, rather than a revolution about it—and since the amount of light and heat received from the sun diminishes as the square of the distance increases, the comet must alternately be subjected to conditions of the most extreme contrast. For example, the distance of Halley's comet when in perihelion is 56 millions of miles—in aphelion 3370 millions; so that in the former position it receives in a given time 3600 times as much heat and light as in the latter. But the lengths of time during which these exposures continue also differ as widely. In aphelion the motion is so slow that it takes 6½ years to pass over one heliocentric degree of its orbit, while in perihelion the same angular distance is passed in 15·7 hours—so that during a long series of years this comet remains exposed to the cold of these distant regions (the temperature of which may perhaps descend to a point of which we have no conception) while it is receiving but little light and heat from the sun. This cooling process must continue long after it has passed its aphelion because its return is at first so exceedingly slow that it must continue to lose by radiation more heat than it receives from the sun. So that it is only when the time for its perihelion passage approaches quite nearly that the lowest temperature of the mass is attained. It then rushes towards the sun with rapidly accelerated velocity and in a condition contrasting most strongly with that which it must assume when in perihelion. This contrast may not be confined to difference of temperature, but the long deprivation of the solar rays may lead to the attainment of a different condition in reference to the other forces of which the sun seems to be the source. Being precipitated into the immediate vicinity of the sun in this extremely negative condition the solar action upon it must produce changes of the most violent kind, and since all change tends to evolve heat, electricity and light, we need scarcely be surprised that these are developed on a scale of grandeur far surpassing anything with which we are acquainted upon the earth.

That small perihelion distance is not the controlling element is shown by the total absence of the cometary character in the inferior planets, whose orbits lie wholly within the perihelion of many of the comets. Even the great comet of 1825 came but little within the orbit of Mars; and that of 1729 had a perihelion distance of 4·04310, being thirteen times that of Mercury and almost equal to that of Jupiter. So that we see in Mercury a near approach to the sun without the cometary character—and in the comet of 1729 we see the cometary character without a near approach to the sun. Excentricity on the other hand seems to be absolutely essential. All comets move in excentric orbits, and we have no instance of great splendor without great excentricity. Size, perihelion distance and, perhaps, difference of constitution are *modifying* elements, and we may, therefore, have comets moving in very excentric orbits without becoming conspicuous, but inspection of the table below will show that all the most splendid comets have orbits of extremely great excentricity.

Whilst the contrast of condition above referred to evidently originates from excentricity and cannot have place without it, it is equally clear that it must be modified by perihelion distance—and that the excentricity remaining the same, the less the perihelion distance the greater must be the contrast—the proportionate loss of heat by radiation increasing with the temperature of the mass—and a diminution of perihelion distance being equivalent to an increase in the power of the sun's rays, and, consequently, adding to the brilliancy of the results. We must therefore expect the greatest splendor when extreme excentricity is combined with very small perihelion distance. The comets of 1843 and 1680, two of the most splendid on record, afford examples of this combination.

In order to ascertain whether these views harmonized with observed facts, I have prepared the annexed table in which will be found,

1st. The planets, with the extremes and mean of the Asteroid group to No. 55 inclusive.

2d. All the comets the periods of which are known.

3d. Donati's comet, and seven others, being the only conspicuous comets the excentricities of which are given in J. R. Hind's "Catalogue of the Orbits of all Comets hitherto computed," published in 1852.

In the following figure ACBD represents the elliptic orbit of a comet—S the sun's place. AB the major axis—CD a double ordinate through

S.—ab a straight line passing through S and meeting the curve in the points a and b, and making but a very small angle with AB.

Let $t =$ time occupied by the comet in passing from a to A.
$t' =$ " " " " " b to B.
$l =$ light and heat received in a given time by the comet at a.
$l' =$ " " " " " b.

Then since the angle BSb is very small we may without material error assume that Sb = SB, Sa = SA, and that the sectors BSb and ASa are to each other as the triangles BSb and ASa. Also consider l and l' constant during the times t and t' respectively.

Then since the radius vector describes equal areas in equal times,

$t : t' ::$ sector ASa : sector BSb :: triangle ASa : triangle BSb :: Sa^2 : Sb^2.

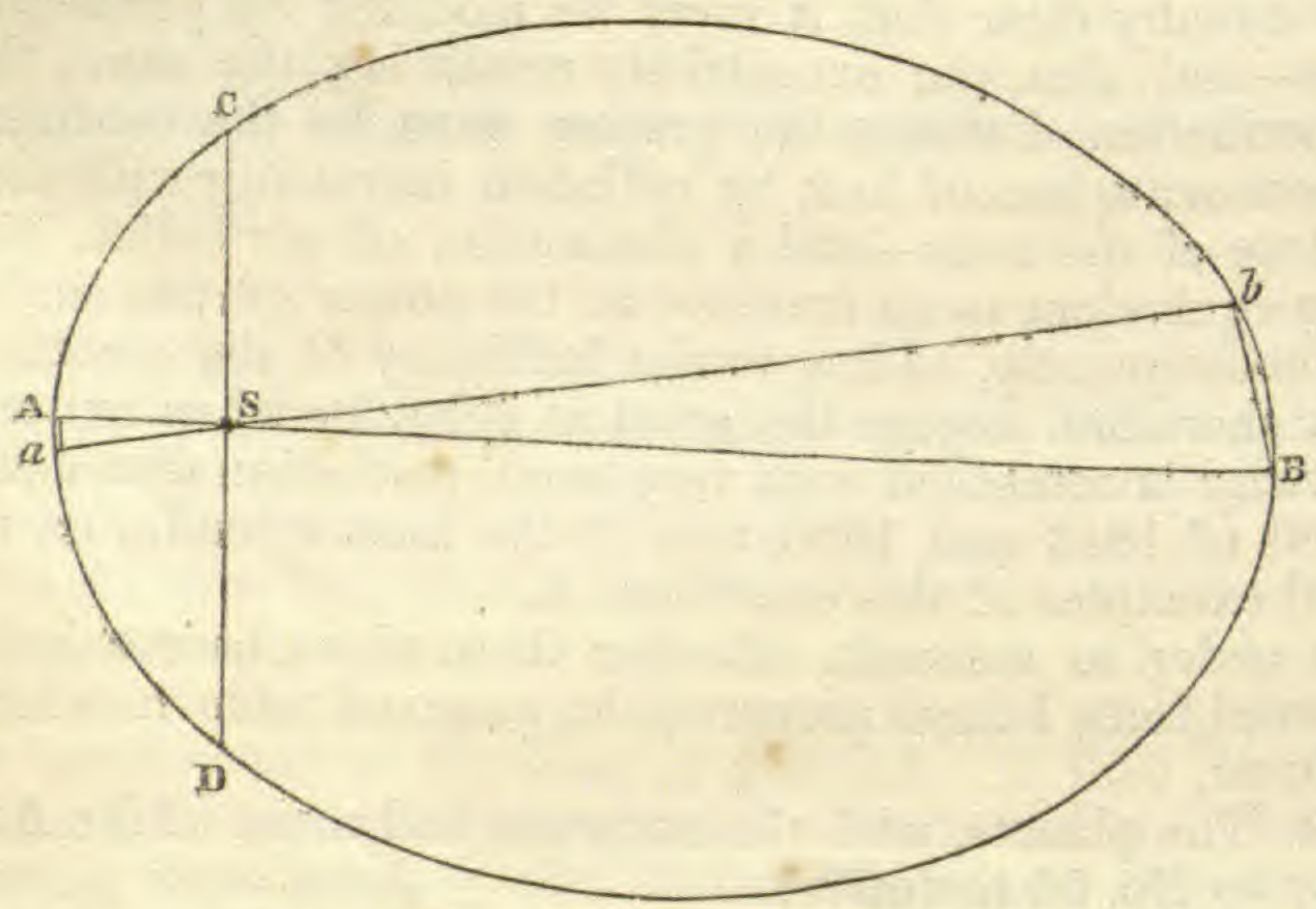
Therefore $t : t' ::$ Sa^2 : Sb^2. But since the light and heat received in a given time vary inversely as the square of the distance,

$$l' : l :: Sa^2 : Sb^2$$

Therefore, $\quad t : t' :: l' : l$

and hence, $\quad tl = t'l'$

But tl represents the total amount of light and heat received by the comet in passing from a to A; and $t'l'$ represents the total amount of light and heat received by the comet in passing from b to B, and since, if for AB and ab we substitute any other two straight lines intersecting each other at a very small angle in S, the same reasoning will apply, it follows that the whole amount of light and heat received by the comet while passing from D, through its perihelion at A, to C, is equal to that which it receives



during its passage from C, through the aphelion point B, to D—and since the times occupied are to each other as the areas of the segments DAC and CBD, the ratio which these areas bear to each other affords a measure of the *average* contrast in the amount of light and heat received by the comet in a given time on the two sides of the line CD,—that is, in what we may for convenience term the aphelion and perihelion parts of its orbit respectively. So that this ratio seems to furnish the fair-est measure of the effects to be anticipated from excentricity of orbit. I have, therefore, given this ratio in the table—as well as that of the aphelion to the perihelion distance—and the square of the latter ratio, representing the relative amounts of light and heat received in a given time in perihelion and aphelion.

		Excentricity.	Perihel'n distance.	Ratio of aphelion to perihelion distance.	Ratio of Light and Heat received in a given time in perihelion to same in aphelion.	Ratio of time spent in aphelion part of orbit to same in perihel'n	Remarks.
Planets.	Venus, - -	0·00682	0·7184	1·02	1·04	1·02	
	Neptune, - -	0·00872	29·7744	1·02	1·04	1·02	
	Earth, - -	0·01678	0·9832	1·09	1·20	1·04	
	Uranus, - -	0·04660	18·2885	1·10	1·21	1·1	
	Jupiter, - -	0·04822	4·9519	1·10	1·21	1·1	
	Saturn, - -	0·05603	9·0044	1·12	1·25	1·2	
	Mars, - -	0·09325	1·3816	1·21	1·45	1·3	
	Mercury, - -	0·20562	0·3075	1·52	2·30	1·7	
Asteroids.	Harmonia—least excentric of group.	0·04608	2·1627	1·10	1·20	1·1	
	Mean of group to No. 55 inclusive.	0·16430	......	1·39	1·94	1·5	
	Polyhymnia-most excentric of group.	0·33699	1·9009	2·	4·07	3·5	Period.
Comets of short period.	Faye's Comet,	0·55502	1·7000	3·5	12	5·	7½ years. Telescopic.
	De Vico's " -	0·61765	1·1864	4·2	17	6·5	5½ " do.
	Biela's " -	0·75700	0·8564	7·2	52	13	6¾ " do.
	Brorsen's " -	0·79446	0·6500	8·7	75	17	5½ " do.
	Encke's " -	0·84767	0·3374	12	147	28	3¼ " do.
Seventy-five year group.	Olbers's " 1815	0·93122	1·2129	28	790	92	74 "
	Pons's " 1812	0·95454	0·7771	43	1849	172	70½ " Visible to naked eye—conspicuous tail.
	DeVico's " IV, 1846	0·96225	0·6637	52	2735	227	73¼ " Just visible to naked eye.
	Halley's "	0·96739	0·5866	60	3636	283	76½ " Brilliant — tail 30° long.
	Brorsen's " V, 1847	0·97256	0·4879	72	5169	367	75 "
Conspicuous comets to which elliptic orbits have been assigned, but the periods of which are uncertain.	Comet of 1811—II	0·98271	1·5821	115	13133	733	3065 " Fine.
	" 1846—VII.	0·98836	0·6334	171	29381	1336	401 " Pretty conspic's.
	" 1825— IV.	0·99537	1·2408	433	188165	5271	4386 " Bright, with conspicuous tail.
	" 1811— I.	0·99541	1·0354	434	188625	7132	875 " A splendid object—tail 25° long, 6° broad.
	" 1858— V.	0·99679	0·5785	624	389376	8925	2000 " The splendid comet of Donati.
	" 1769.	0·99925	0·1227	2662	7087043	108000	3090 " Tail 100° long.
	" 1843— I.	0·99989	0·0056	18673	348686158	2000000	376 " Tail 65° long—seen in daytime near the sun.
	" 1680.	0·99999	0·0062	137173	18816489884	40000000	8800 " Object of universal attention—tail 70° to 90° long.

From the above table it appears that of the comets of short period, all of which are inconspicuous, the highest ratio of the time spent in the aphelion to that spent in the perihelion part of its orbit is 28, whilst the lowest figure for a comet of any considerable brilliancy is 283 for that of Halley, and for the great comets of 1843 and 1680, the ratios are two millions and forty millions respectively. So far then as can be judged from the limited data at my command, the proposition that splendor is never found without great excentricity is fully confirmed.* It is, perhaps, worthy of remark that the asteroid Polyhymnia approaches in excentricity so near to the comets of short period as to suggest the suspicion that some of the asteroids may yet be found to partake somewhat of the cometary character, and to furnish a connecting link between the planets and comets.

One result of the preceding views as to the origin of cometary phenomena, is that brilliant comets must be expected to have long periods—and such is found to be the fact. Halley's comet has a period of only seventy-six years, but to no other, with any claim to be regarded in the first rank has been assigned a period which is not measured by centuries. Indeed Halley's is the only great comet that is known certainly to have reappeared at all.

* Since the above has been in the hands of the printer, I have seen in the North British Review for November, 1861, the following notice of a work "On the Physical Constitution of Comets. By Olinthus Gregory Downes, F.R.A.S. 4to, pp. 45. London, 1860," viz.:

Page 280. "A hypothesis with a higher claim to notice has been brought forward by Mr. Downes in his work *On the Physical Constitution of Comets.* He assumes 'that comets are of a like physical constitution to the earth, and that the effects which are produced may be due to the operation of laws which are known to prevail upon the earth, viz., the laws of heat and the laws of matter.' He then proceeds to consider what changes the laws of heat would produce on our earth moving in a very excentric orbit. The water would, by the extreme cold at the aphelion, be converted into a powdery cohering mass; and the atmosphere, when congealed also, would occupy the interstices of that mass; and what they could not contain would be deposited on its surface, 'the deposit consisting of crystals of air and water mutually entangled.' On approaching the perihelion, the air crystals would explode, scattering the undissolved crystals in streams of expanding air, the explosions increasing when near the perihelion, and the rejected matter issuing in different degrees from different parts of the nucleus. The attraction of the nucleus will now draw the expanded matter back to itself, and act as a repulsive force carrying it towards the back of the nucleus; and forming a tail, not merely of vapor but of matter. By the issue of jets from the nucleus, Mr. Downes thinks that a rotatory motion may be produced and periodically accelerated. In this way Mr. Downes proceeds to explain the phenomena exhibited in Donati's comet, as observed by Bond and Chacornac; but however much we may admire the ingenuity of the author, we must regret that it has been expended on a speculation which the astronomer and the mathematician alone can bring within the domain of science."

Again. "It has been suggested by some philosophers, that comets are habitable worlds; and Mr. Downes has maintained that they are bodies in the act of preparation for the reception of inhabitants."

Not having any knowledge of Mr. Downes's work except that derived from the above notice, I cannot tell to what extent my course of reasoning may coincide with his. Whilst he anticipates me in insisting upon the *cometizing* effect of excentricity of orbit, our conclusions in other respects appear to be widely different.

Another result is that comets which are destined to become very splendid must begin to show indications of it while yet at a great distance from the sun, their appearance showing the kind of journey from which they are returning.

Prof. Bond remarked this in Donati's comet of which he says: "Up to this time (the middle of August, and six weeks before its perihelion passage) it had remained a faint object, not even discernible by the unassisted eye. It was distinguished from ordinary telescopic comets only by the extreme slowness of its motion, in singular contrast with its subsequent career, and *by the vivid light of the nucleus; the latter peculiarity was of itself prophetic of a splendid destiny.*"

Assuming that probable cause has been shown for believing that the splendor of comets results directly from the excentric form of orbit which produces violent changes attended with the evolution of heat, electricity and light, I would propose to extend the analogy to the aurora still further, and to suggest that whilst the tail corresponds to the auroral streamer the envelopes appear to be the exact counterparts of the concentric envelopes which were observed to surround one of the terminals in some of Mr. Gassiot's experiments referred to on page 315, vol. xxxi, of this Journal*—the whole cometary phenomena being like the aurora, examples on a grand scale of the "stratified electric discharge" in vacuo.

Prof. Peirce states that Donati's comet had a dense nucleus of 150 miles in diameter surrounded by an atmosphere having a diameter of 40,000 miles, and he seems to consider this to be a type of the whole class, the dense nucleus and immense atmo-

* The following quotations from an article "On the Luminous Discharges of Voltaic Batteries when examined in Carbonic Acid Vacuo, by J. P. Gassiot, Esq., F.R.S.," published in the "Proceedings of the Royal Society, vol. x, No. 39," show the character of these envelopes:

Page 394.—Vacuum-tube "No. 146 is 24 inches long and 18 inches in circumference, and has a copper disc 4 inches diameter at one terminal, and a brass wire at the other."

Page 399.—"In 146, with Grove's nitric acid battery, 400 cells, on the completion of the current, the discharges of the battery passed with a display of magnificent strata of the most dazzling brightness. On separating the discs by means of a micrometer screw, the luminous discharges presented the same appearance as when taken from an induction coil but brighter. *On the copper plate in the vessel there was a white layer, and then a dark space about one inch broad; then a bluish atmosphere curved like the plate, evidently three negative envelopes on a great scale.*"

Page 399.—In 187 and 196 (with carbon-balls in the tubes) the discharge of the nitric acid battery elicits intense heat, and probably changes the condition of the vacuum. On the 5th of August, 1859, the discharge in 187 presented a stream of intolerable brightness (I again quote from Dr. Robinson's notes), in which, through the plate of green glass, with which he observed the phenomena, strata could be observed. This soon changed to a sphere of light on the positive ball, which became red hot, *the negative being surrounded by magnificent envelopes*, whilst with the horseshoe magnet the positive light was drawn out into strata."

Page 401.—"When the heating of the potash was further increased, four or five cloud-like and remarkably clear strata *came out from the positive.*"

sphere being always present. The above views harmonize with this conclusion, but require that we consider the atmosphere to be transparent, and invisible, except as different strata are illuminated by electric light—the observed development of the envelopes not necessarily involving any change whatever in the dimensions of the atmosphere, but simply showing the progress of luminous strata which traverse it, coming out from the nucleus just as in Mr. Gassiot's experiments they came out from the positive terminal—whilst the tail is made up of currents of electricity, similar to auroral streamers, rendered visible by their own illumination of streams of particles which they are continually transporting from the nucleus at near the velocity of electricity itself—the light of the tail and envelopes as well as the most of that of the nucleus itself being electric. The failure to detect a nucleus does not prove its non-existence, because, if the whole cometary light be principally electric we should expect the solid nucleus to be slower to assume the luminous condition than its surrounding atmosphere, and hence in all but those in which the development is extreme the electric light will be confined principally to the envelopes and tail so that a small nucleus may readily escape detection.

Doubtless comets derive a portion of their brilliancy from their reflection of the sun's light, but there are strange discrepancies between the observed and calculated brightness which can only be explained by admitting that they are principally self-luminous. If we consider their light electric, we shall cease to be surprised at sudden and irregular variations. As regards the tail, we know that the total amount of matter contained in it must be extremely small—whence, as it occupies an immense space, it must be inconceivably rare—so rare that it can scarcely be supposed capable of reflecting enough of the sun's light to render itself visible even under the most favorable circumstances—so that its being self-luminous seems to me scarcely to admit of doubt.

Recurring to the analogy between the comet's tail and the auroral streamer we find the two identical in appearance, in motion and in proportions, and not very unlike in form—and both are traversed by waves of light which in each case have their origin in the base and travel outwards with great rapidity to the extremity.* The auroral streamer has been proved to be an

* The following quotations from Commr. Gilliss's article in the last number of this Journal, not only furnish an instance of this pulsation, but contain abundant proof of such rapid movements and changes in the different parts of the luminous sectors, streams composing the tail, &c., as seem necessarily to involve electrical velocities, and afford striking analogies to the movements of streams of electricity.

"The constancy of the light near the nucleus was interrupted at intervals by *flashings or pulsations, closely resembling those of the aurora.*"

"The whole appearance of this sector, at first brilliant and well defined, *under-*

illuminated column several miles in diameter and five or six hundred miles in length, which originating in the upper portions of the atmosphere projects itself far beyond its limits, and whilst revolving about the magnetic axis of the earth maintains its rectilinear form. Now it can scarely be doubted that these are electrical currents, and as the visibility of such currents is believed to be due solely to the presence of illuminated matter, we must conclude that the auroral streamer carries up from the atmosphere particles of matter, its illumination of which shows its position. This, of itself, is not a matter of surprise, because the experiments of Plücker and Gassiot have repeatedly shown that electrical currents are not only capable of transporting particles of matter, but that even the hardest metals are unable to resist them. In a recent series of experiments upon electric discharges in vacuo, Mr. Gassiot has shown that with

went various modifications as the night progressed. When first observed, it was nearly symmetrical with respect to the comet's axis. The eastern wing was perhaps a little the longer of the two. There was a dark oval spot near the middle of the fan and a little to the east of the axis; then a faint curved line or lines, concentric with the outer convex boundary, divided the mass into upper and lower strata, each with a cusp on either side. Afterwards the lines appeared broken, giving a mottled appearance to the central zone of the sector, and finally the western cusps seemed to break, and the fan-shape was transformed into a spiral whose centre was in the nucleus. *Meanwhile, during the hours of observation, the dimensions of the whole mass had increased to at least double of the original size*, while the outlines had become so indistinct that it was only with difficulty the general shape could be recognized."

"It was not, at any time, as brilliant as during last night, nor was the dark central line near the axis as marked, but was, as then, *subject to fitful pulsations*, at which periods the increase of light sometimes seemed wholly confined to within 12° or 14° of the nucleus, *at others to flash to the utmost extremity of the coma almost instantly, and again at others, the whole volume appeared to be bent to the westward as a willow branch by the wind.*"

"The great volume of light was within 10° of the nucleus, and at 20° the brilliancy of the coma did not exceed that of the milky way, west of γ Aquilæ. *But its intensity was subject to great changes, when it seemed to flow from the nucleus in a stream steadily increasing for some minutes, and again as slowly fading away.*"

"The coma continued in two distinct branches, of which the western one was curved, and constantly traceable to within a degree of θ Bootis. *During the pulsations it could be seen a degree or two beyond that point.*"

The article on Comets in the North British Review for November, already referred to, contains the following which seems strongly to confirm the electrical character of the phenomena:

"There can be no doubt, that sudden changes of brightness, and slower changes of magnitude, take place in comets. Kepler informs us that the tail of the comet of 1607 then at first short, became long 'in the twinkling of an eye.' Wendelin, Snellius and Father Cysatus saw the tail of the comet of 1618 undulating, as if driven by the wind. Hevelius saw similar movements in the tail of the comets of 1652 and 1661; and Pingrè saw in the tail of the comet of 1769, undulations like those of the aurora, the tail sometimes covering certain stars, and then retiring from them. M. Arago was at first disposed to ascribe these sudden changes to atmospheric vapors passing between the comet and the eye of the observer; but he found in Halley's comet of 1835 satisfactory evidence that the nucleus, the whole or part of the nebulosity, and the tail of a comet, may exhibit almost instantaneous changes of brightness."—p. 274.

electrodes of platinum, silver and several other metals whenever the current from the negative terminal impinged upon the inner surface of the glass vacuum tubes made use of, a deposit was made of whatever metal composed the electrode, the terminal wire presenting the appearance of being corroded by the disruption of the particles carried off by the current. (See "Proceedings of the 31st meeting of the British Association for the Advancement of Science, held September, 1861," wherein it is stated that Mr. G. succeeded in thus obtaining deposits of 14 different metals.) Of the ability of the current to transport particles of matter there can be no doubt—the only question is as to the velocity.* Since the particles can only be supplied by the atmosphere, the formation of a column must be from its base upward —and by carefully noting the time required for a streamer to attain its full height, and knowing that height, we must ascertain its velocity. But we find that the streamer frequently appears to attain its full height instantaneously—the time occupied by its projection to the height of 500 miles being too small a fraction of a second to permit the eye to detect even the direction of the motion. This evidently involves a velocity of many thousand miles per second, and affords great reason to suppose that the particles have a velocity approaching to, if not equalling that of electricity itself—a conclusion which may the more readily be admitted since it cannot be shown that this velocity is in itself less probable than any other. Of course the velocity of the transported particles can never exceed that of the transporting current, but there seems to be no lower limit which it may not be supposed to attain. If we admit this electrical velocity, the phenomena presented by the comet's tail are easily explained, since only a few minutes are occupied in transporting a particle from the nucleus to the end of the tail, that is to a point so distant from the nucleus that the intensity of the current is not sufficient to continue its illumination farther, it disappears finally from our sight and is lost; so that the tail of to-day not only occupies a different position from that of yesterday but they have not a particle of matter in common. The particles which issued yesterday are scattered and lost, and we now see a new tail made up of a new set of particles constantly emitted from the comet. The position and form of the tail at any moment therefore depend solely upon the form and position of the electric currents, and these again must be controlled, either directly or indirectly, by the great disturbing cause of the whole phenomenon, the sun, probably through the agency of a magnetic condition excited in the comet, the existence of which was first suggested, I believe, by Bessel.

* Dr. Hare's views (stated in former volumes of this Journal, and elsewhere), of the convective electrical discharge may be worth consulting in this connection.

The waves of light originating at the nucleus and extending to the end of the tail are doubtless nothing more than unusually large clouds of particles the whole flight of which we can trace. Similar phenomena sometimes take place in the auroral streamer, the eye being able to detect with certainty the upward direction of the motion, showing that in these instances the velocity although so far exceeding any movement of matter with which we are acquainted upon the earth that it may fairly be termed electrical, still falls much below the velocity of electricity itself. The slowest motion of this kind appears to be in the "auroral flashes," which are probably identical with streamers except in that they are spread out laterally (in an East and West direction) thus occupying what Prof. Plücker calls a "magnetic surface." It may be said that if we admit the height of 500 or 600 miles claimed for auroral streamers, it may indicate that the atmosphere extends to that height rather than that particles are carried up by the current. But if the comet's tail is admitted to be identical with the streamer, it affords an answer to this argument, because it cannot be claimed that the comet can possibly have an atmosphere co-extensive with its tail. So that the explanations of the two phenomena support each other.

Again it may be objected that a stream of particles constantly issuing from the comet with the velocity of electricity must speedily dissipate the mass. But this depends upon the rarity of the matter emitted, which may be such that the whole amount lost during a perihelion passage may be very inconsiderable. Some effect of this kind has been suspected by Professors Peirce and Mitchel, who conclude that the decrease in the periodic time of Encke's comet may be due to this cause.

The foregoing considerations seem to establish a pretty strong probability that comets differ from other members of the solar system merely in the form of their orbits—and that if Donati's comet could exchange orbits with an asteroid of equal size there would also be a complete exchange of all the attendant phenomena. The comet before completing a single revolution in its circular orbit would have gone through its paroxysm of electrical excitement, attained a condition of permanent and stable equilibrium with reference to all the effects of the sun's rays and having no longer any other than reflected light would become an inconspicuous object visible only with the aid of a powerful telescope—whilst the asteroid on its return from aphelion would suddenly burst forth as a comet of great splendor.

Philadelphia, Nov. 26th, 1861.

ART. XIII.—*Further observations on the age of the Red sandrock formation* (*Potsdam group*) *of Canada and Vermont;* by E. BILLINGS, F.G.S., Palæontologist of the Geological Survey of Canada.

1. QUESTIONS OF PRIORITY.

AT the time of writing the note on the Red sandrock formation of Vermont in this Journal, last September ([2], xxxii, 232), I was not aware that Prof. C. B. Adams had previously recognized the resemblance of the Highgate trilobites to *Conocephalites.* Shortly afterwards while searching for some of the earlier published documents on the older rocks of North America I met with his paper and published it in full in the Canadian Naturalist and Geologist in an article on the Rocks and Fossils of Phillipsburgh (Can. Nat. and Geol., vol. vi, p. 324). Mr. Hitchcock's note in this Journal, ([2] xxxii, 454) shews that Prof. Z. Thompson was the original discoverer of the trilobites in question. He also states that these fossils were sent to Prof. Hall in 1847, who then gave them the name of *Conocephalus* and further that he (Mr. Hitchcock) again shewed them to Prof. Hall in 1858, and that he was not then able to give more definite information respecting them. I have never seen the Third Annual Rept. Geol. Vt. to which Mr. Hitchcock refers. I did not assume to have discovered the fossils, but so far as is known at present, I was the first to decide the age of the Red sandrock series on palæontological evidence alone. Dr. Emmons has long held that these rocks belong in part to the Calciferous and in part to the Potsdam formations. My observations only go to show that he is right.

I must also state that Barrande first determined the age of the slates in Georgia in Vermont holding *P. Thompsoni* and *P. Vermontana.* At the time I wrote the note on the Highgate trilobites it was not known that these slates were conformably interstratified with the Red sandrock. This discovery was made afterwards by the Rev. J. B. Perry and Dr. G. M. Hall, of Swanton. As to the Taconic rocks, it should always be borne in mind that since Emmons first published his Taconic System both Sir Roderick Murchison and Barrande have extended the Lower Silurian downwards so as include the Primordial zone. The Taconic rocks are thus made the base of the Lower Silurian, not by Prof. Hall but by Sir R. I. Murchison and Barrande. Emmons correctly determined their age in a general way by placing them below the Lower Silurian as it was defined in 1839, or in the base of the Lower Silurian as the formation is now limited. The age of the limestones at Point Levi opposite Quebec was determined by me in 1860.

2. Additional evidence on the age of the Red sandrock.

During the last summer Mr. J. Richardson, of our Survey, was engaged under the direction of Sir W. E. Logan in making an examination of the rocks on both shores of the Straits of Belle Isle, the object being to find if possible a section in which the sequence of the lower formations might be seen to better advantage than they can be in the disturbed region of Canada East. He returned in October, having been completely successful. On the North shore of the Straits he found at the base of the series 141 feet of sandstone holding *Scolithus linearis* resting upon the Laurentian formation; and lying upon the sandstone 231 feet of limestone with *P. Thompsoni*, *P. Vermontana*, and a number of other species of which I shall give a list farther on. On the south shore of the Straits he found a great series of limestones, the lower part of which undoubtedly belongs to the Calciferous sandrock formation. The upper portion may belong in part to the Chazy and Black River, but the fossils appear to be all new species and have not yet been studied sufficiently to decide with certainty from their aspect alone. The sandstones and limestones on the north shore of the Straits appear to be of the age of the Potsdam of Pennsylvania and Tennessee. The form of the *Scolithus* is identical with that which occurs in these two States, and some portions of the rock is a coarse red sandstone exactly like specimens sent to me about a year ago from Tennessee, by Prof. Safford.

Since the date of my former note published in this Journal in September last (before quoted), the Red sandrock of Vermont where it extends into Canada near Phillipsburgh, has been examined more in detail by Sir W. E. Logan and myself. At Herrick's Mills in the Township of St. Armand where the formation is cut through by the valley of the Rock River it is overlaid on the east side by a series of black slates and thin-bedded limestones holding *Bathyurus Saffordi*, the most abundant trilobite of the upper part of the Calciferous sandrock. The same rocks in the same relation extend into Vermont. *B. Saffordi* was found in several places in the limestone interstratified with the slate near the junction of the two formations in the first mile south of the boundary line, beyond which the rocks were not examined. Dr. P. J. Farnsworth of Phillipsburgh also collected fragments of trilobites one mile east of the sandrock and about a mile south of the boundary in Vermont. These appear to belong to a species of *Asaphus*. On the west side of this exposure of the Red sandrock, three-fourths of a mile south of the line, I found another locality of *Conocephalites*, but the species is different from that noticed in my former communication. I have described it under the name of *C. arenosus*.

But the most important and interesting locality is 1½ miles east of Swanton, discovered by the Rev. J. B. Perry and Dr. G. M. Hall. The black slates holding *Palæophycus incipiens*, *Obolella cingulata*, *Orthisina festinata*, *Camerella antiquata*, *Paradoxides Thompsoni*, *P. Vermontana* and *Conocephalites Teucer*, are here seen conformably interstratified with the Red sandrock. Four of these species occur in the limestone which immediately overlies the sandstone with *S. linearis* on the north shore of the Straits of Belle Isle, and it therefore seems quite clear that the rocks of these two localities (860 miles distant from each other) are of the same age.

Taking all these facts together scarcely anything more is necessary to show that the Red sandrock of Vermont is of the age assigned to it by me from the examination of the *Conocephalites* at Highgate in July last. The independent discoveries of Mr. Richardson at Belle Isle and of Dr. G. M. Hall and Mr. Perry at Swanton are quite conclusive as to the geological position of *P. Thompsoni* and *P. Vermontana*. Barrande's opinion founded altogether upon the aspect of these trilobites is thus completely verified.

My object in making these researches was to ascertain with as much certainty as possible the age of the sandstone at Phillipsburgh, and, in prosecution of that design, I examined the rocks at St. Albans, Burlington, and Snake and Buck mountains, (the last two localities in Addison county, Vermont). At the promontory called Sharpshins, on the lake shore near Burlington, the cliff consists of black slate at the base, overlaid by what appears to be a whitish magnesian limestone. This place has been several times described, but what struck me as particularly worthy of notice, is that the under side of the limestone, where it is in contact with the slate is smoothed, presenting very much the appearance of slickensides. I infer from this that either there is a fault here, or, that the limestone has moved on the surface of the slate. The limestone appears to be either Potsdam or Calciferous.

Snake and Buck mountains have often been appealed to by the advocates and opponents of the Taconic System. The first mentioned of these two hills is capped by sandstone and magnesian limestone beneath which there is to be seen a great formation of black slate. Emmons calls the latter Taconic slate, and the upper rocks Calciferous sandrock. He also holds that there is a fault running along the face of the mountain by which the sandrock is thrown up, so that its base is 700 feet above the Trenton limestone. In this I think he is right, but the rock which constitutes the top and eastern slope is not Calciferous; it is the Potsdam. I crossed the mountain from west to east about three-fourths of a mile from its northern extremity, and found the sandstone with the interstratified magnesian limestone to be of great thickness. In the last exposure in the fields at the eastern side, I found the same form of *Scolithus* in abundance which characterizes the upper beds of the Potsdam in Canada. I could not find the exact position of the fault in this mountain, but at Buck mountain, which is of exactly the same structure, I think its existence can be positively determined. This mountain is cut in two by a narrow valley crossing it obliquely near the southern extremity. The road through this valley runs to Vergennes. Following this road from the south, after passing through the gorge in the mountain we cross a level meadow several hundred yards in width. Where the road leaves the meadow there is a small ascent caused by an exposure of the Chazy or Black River limestone. On reaching this point the observer should turn to the right and go straight to the base of the mountain. Here the exact position of the fault can be seen. The sandstone rises in a nearly vertical wall to the height of about 80 feet. At the base the blue fossiliferous limestone dips towards the cliff, but is separated from it by an interval of about 15 or 20 feet—covered with broken stones. Here there is positive evidence of a dislocation, because in following along the base of the cliff, lower beds of the sandstone continually rise from below above the limestone. This occurs in consequence of the strata of the two formations, not being tilted up in the same plane, the sandstone on the east side of the fault dipping more to the south than the limestone on the west side. While upon the spot I thought I could see the edge of the fissure on the west side. I have pointed out this locality thus particularly with the hope that some other geologist may be directed to the spot who may have more time to study the details than I had.

The fault at Snake Mountain must have an upthrow on the east side of about 3000 feet, for it is equal to the whole thickness of the 700 feet of black slates, the whole of the Potsdam Calciferous, Chazy, Black River, and part of the Trenton. The mountain itself is at present only about 1000 feet higher than the surrounding plain, having, no doubt, been reduced by denudation. It appears to me quite certain that there must be a great deposit of slate beneath the Potsdam in this region, otherwise, this enormous fault would have brought up the Laurentian gneiss. But no trace of it is seen anywhere about the mountain except in the the usual forms of loose boulders.

I shall conclude with a list of the fossils discovered at the localities above mentioned. I place the sandstone and limestone of Belle Isle and the red sandrock of Phillipsburgh and Vermont in the Potsdam group provisionally, leaving it for those who are more interested in the nomenclature of the formations than I am to decide upon any other name that may be found to be just and more generally satisfactory.

Table showing the geographical and geological distribution of the species mentioned in this paper in Vermont and Belle Isle, so far as is known at present.

	Geographical distribution.			Geological distribution.	
	Belle Isle.	Vermont.		Potsdam group.	Calciferous Sandrock.
1	*		Scolithus linearis (Hall),	*	
2	*	*	Palæophycus incipiens (Billings),	*	
3	*		" congregatus "	*	
4	*		Archeocyathus Atlanticus "	*	
5	*		" Minganensis, "	*	*
6	*		Obolus Labradoricus "	*	
7	*		Obolella chromatica "	*	
8	*	*	" cingulata "	*	
9	*		Orthis (undescribed) "	*	
10	*		" " "	*	
11		*	" " "	*	
12		*	Orthisinia festinata "	*	
13		*	" (undescribed) "	*	
14	*		" " "	*	
15		*	Camerella antiquata "	*	
16	*	*	Paradoxides Thompsoni (Hall),	*	
17	*	*	" Vermontana "	*	
18	*		Conocephalites miser (Billings),	*	
19		*	" Adamsii "	*	
20		*	" Teucer "	*	
21		*	" Vulcanus "	*	
22		*	" arenosus "	*	
23	*		Bathyurus senectus "	*	
24	*		" parvulus "	*	
25	*		Salterella rugosa "	*	
26	*		" obtusa "	*	
27	*		" pulchella "	*	

Upon the above table I beg to make the following remarks: The two genera of trilobites *Paradoxides* and *Conocepholites* are undoubtedly Primordial types. Bathyurus makes its first appearance in the Potsdam group, is most abundant in the Calciferous sandrock, and becomes extinct in the lower part of the Trenton, where it is represented by one rare species, *B. spiniger*, the *Acidaspis spiniger* of (Hall) Pal. N. Y., vol. i, p. 241, pl. 64, fig. 5.

OBOLELLA is a new genus closely allied to *Obolus.* There are four species known to me, one in the Potsdam of Wisconsin, another in the limestone near Troy in New York, (apparently either Calciferous or Potsdam) and the two mentioned in the above list. One of these, *O. cingulata*, may constitute a distinct genus. I have proposed to call it *Koturgina* but retain it for the present in *Obolella.*

ORTHISINA FESTINATA is about the size of the well known *O. Verneuli.* Externally it has more the aspect of a Trenton limestone fossil than that of a Primordial form. The casts of the interior however show that the dental plates of the ventral valve are totally absent, while in the species of the upper part of the Lower Silurian they are largely developed. This difference is so great that some naturalists would make a new genus for the reception of this species.

CAMERELLA ANTIQUATA is very like the Chazy *C. varians.*

The species of *Orthis* are of the fine ribbed type like *O. perveta* (Conrad) Chazy, Black River and Trenton.

ARCHEOCYATHUS, is a remarkable new genus with a radiated poriferous structure and I am not yet quite certain whether it should be referred to the Sponges or to the true Corals. One of the species, *A. Minganensis,* resembles a huge *Cyathophyllum* two feet in length and four inches in diameter, but with the cup so deep that only about half an inch at the base is solid, the whole resembling a curved hollow cylinder narrowed to a point and closed at one end. This species occurs in the limestone of Belle Isle and also in rocks which seem to be the bottom of the Calciferous sandrock at the Mingan Islands.

SALTERELLA. I have proposed this genus for the reception of some species of small conical fossils composed of several hollow sheaths inserted one within the other. They resemble *Tentaculites. Serpulites Maccullochi* (Salter) in SILURIA, and also in the Jour. Geo. Soc., vol. xv., pl. 13, fig. 31, of the Lower Quartz Rock of Scotland, is a species of the same genus.

The new species are all described in a brochure recently published by the Geological Survey. (NEW SPECIES OF LOWER SILURIAN FOSSILS. By E. Billings. Montreal, Nov. 21st, 1861.)

Montreal, Canada E., Nov. 25, 1861.

ART. XIV.—*Letter from Sir* WM. E. LOGAN, *Director of the Canadian Geological Survey, on Sir Roderick Murchison's reference to the determination of the age of the Quebec Rocks.*

Montreal, November 27, 1861.

To the Editors of the American Journal of Science:

Dear Sirs,—In his address to the Geological Section of the last meeting of the British Association, Sir Roderick Murchison has placed the name of my friend Prof. Hall in such a relation to the Quebec group of rocks, as might lead to the inference that to him was due the credit of having determined its horizon, as adopted by the Geological Survey of Canada. Nothing I am persuaded can be farther from the mind of this distinguished palæontologist than a wish to put forward any claim of this description, as the credit is wholly due to Mr. Billings the Palæontologist of the Canadian Survey.

In 1848 and 1849, founding myself upon the apparent superposition in Eastern Canada of what we now call the Quebec group, I enunciated the opinion that the whole series belonged to the Hudson River group and its immediately succeeding formation; a *Leptœna* very like *L. sericea* and an *Orthis* very like *O. testudinaria* and taken by me to be these species being then the only fossils found in the Canadian rocks in question. This view supported Professor Hall in placing, as he had already done, the Olenus rocks of New York in the Hudson River group, in accordance with Hisinger's list of Swedish rocks as given in his Lethæa Suecica in 1837* and not as he had previously given it. But the discovery in 1860 of the Point Lévis fossils enabled Mr. Billings to prove that the rocks of the Quebec group must be placed near the base of the Lower Silurian series instead of at its summit, and it thus became necessary to discover some other interpretation of the physical structure than the one suggested by the visible sequence of the strata.

Although there may be difficulties in regard to detail, the interpretation given in my letter to Mr. Barrande of the 31st December, 1860,† will, I am persuaded, turn out to be the right one. Prof. Emmons long ago asserted that the rocks in question in Vermont were older than the Birdseye and Black River formation. In this I now agree with him; while however his interpretation of the structure would make them all older than the Potsdam sandstone, mine would not. But whatever the value of my present interpretation, it might have been some time before I should have been urged to look for it, had it not been for the palæontological skill which Mr. Billings brought to bear on the question. I am dear Sirs, very truly and respectfully yours,

W. E. LOGAN.

ART. XV.—*Letter from* JAMES HALL, *Esq., on the Potsdam Sandstone and Hudson River Rocks in Vermont.* To the Editors of the American Journal of Science and Arts.

IN the November number of this Journal,‡ there is a letter from C. H. Hitchcock in reference to the occurrence of *Conocephalus*, in the Potsdam Sandstone in Vermont. In a pamphlet lately published by the "*Geological Survey of Canada,*" *Sir W. E. Logan, Director*, Mr. Billings has copied this notice, p. 12, and remarks upon what he terms "the astonishing part of the communication."

* See this Jour. [2], xxxii, 429. † This Jour. [2], xxxi, 216. ‡ Vol. xxxii, 454.

It is only necessary for me to mention in this place, that in the years 1844 and 1845 I made several sections from the Hudson river and Champlain valleys eastward, with a view to determine whether the slates of the Hudson river valley were identical with those farther to the east; and I recognized the Potsdam sandstone in its position, and by the presence of *Scolithus*, at several localities in Vermont and within the limits of Massachusetts.

These sections were brought, by me, before the American Association of Geologists at their meeting in 1845 and 1846, and were then fully discussed, more particularly in reference to the Taconic system, since my sections showed the contorted shaly rocks of the Taconic system to lie above the sandstone.

In vol. I, Palæontology of New York, I have cited *Scolithus linearis* from the Potsdam sandstone of Western Massachusetts; and I considered the *Conocephalus* shown me by Prof. Adams to be from the same rock. But the views of Prof. Adams in regard to the position of the sandstone did not coincide with my own, and the meagre information then possessed of the genus Conocephalus did not, as I conceived, warrant a geological inference on the fragment alone.* Since that period, the views of Prof. Adams have been entertained by other geologists, and these rocks have been placed in the horizon of the Oneida Conglomerate and Medina Sandstone by some of the best authorities in the country.

I do not recollect the occasion when Mr. Hitchcock showed me the *Conocephalus* in 1858, but it is very true that I had no new information to give him; he knew my original views regarding the age of this sandstone, and he had my sections in his possession. Other and imperative duties have prevented me from reviewing my work of 1844 and 1845, while the later views advanced by geologists who had examined that country had been generally adopted. But I believe the opinion I then held independent of other influences, both in regard to the sandstone and its fossils, is sufficiently recorded; and the determination of the Potsdam sandstone in Vermont was known and recognized more than fifteen years since.†

* It would appear from my letter to Prof. Adams that I compared this fossil with something in the Clinton Group of New York; but as there is nothing known in the Clinton Group having a similar character, I can only suppose that the sentence had reference to some other fossil, and that some error may have arisen, perhaps in copying even before the letter was sent to him.

† I have retained the impression that Profs. W. B. and H. D. Rogers coincided with me in regard to the age of this sandstone. Copies of my sections were placed in the hands of Prof. Adams, Prof. Hitchcock and other geologists as early as 1846 and 1847, and my views of the position of the sandstone then entertained were well known to these gentlemen. In later correspondence with Prof. Adams I am aware that he recognized the Potsdam sandstone at other localities, and in 1850 he sent to me fossils from Salisbury, Vt., from a metamorphosed sandstone which he regarded as Potsdam (see Foster and Whitney's Report on the Lake Superior Land District, p. 205).

It should be recollected that the Hudson river group, in its typical localities in the Hudson river valley, are still the slates under discussion; and so long as the investigations were from this line eastward, we were working upon rocks of the same age, viz: the "first grawacke" and the "slates of the first grawacke" and "sparry limestone" of Eaton. The errors that have arisen have not been from the identification of the Hudson river group in its typical localities with the slates on the east, but from regarding the rocks on the *west* as identical with those of the Hudson river valley at and below Albany.

In order to a correct understanding of the questions at issue, an impartial historical sketch of the progress of the investigations would be of much service at this time.

I am very respectfully yours, JAMES HALL.

Albany, N. Y., Dec. 19, 1861.

ART. XVI.—*Correspondence of Jerome Nicklès, dated Nancy, France, Nov.* 6, 1861.

Obituary.—PIERRE BERTHIER, the oldest of French mineralogists, died at the age of 79 years, on the 29th of August last, of paralysis, which for more than four years has interrupted his labors. Every chemist and mineralogist is familiar with his "*Traité des Essais par la Voie Sèche*" which rendered great service to analytical chemistry and metallurgy and led to his appointment as Professor of metallurgy at the School of Mines; a position which he continued to hold until 1845, when he resigned his office both as Professor and as Inspector General of Mines.

The analytical labors of Berthier are well known; although he has, with a trifling exception, published nothing for twenty-six years. His vanity in being a member of the Academy of Sciences was often the subject of ridicule among his associates, who affirm that at every academic election he threw a blank vote as if adjudging no one worthy of a seat by *his* side. He was born (where he died) at Nemours, July 3d, 1772. He entered as a student the Polytechnic School, and afterwards the School of Mines, which he left in 1801.

JOBARD.—This most zealous defender of the rights of intellectual property, died at Brussels, October 26, 1861, at the age of 79 years. He was born at Baissey, a village of the department of Haute-Marne in 1792. He was Director of the Industrial Museum, (*Musée de l'Industrie,*) an office created after Belgium separated from Holland, soon after the French revolution of 1830.

When Belgium revived her constitution new men became necessary, and for the most part new ideas. Jobard drew up the plan for a Museum of Industry and presented it to the Chamber of Representatives. They accepted it and intrusted the author with the execution of the plan. The Belgian Bulletin of Industry was founded, Jobard was appointed Director of the Museum, and after a life of struggles acquired thus a position which furnished him a support for his latter days.

Jobard was first employed as a surveyor at Groningen in Holland. Being driven away in consequence of the invasion, he was recalled at the return of peace by the King of Holland, who granted him the title of citizen of Holland. He remained some years in this position, but soon relinquished it and retired to Brussels where he established a lithographic printing office. This was one of the first lithographic establishments undertaken, and in 1828 it took the first prize from the Société d'Encouragement.*

Jobard was then placed at the head of the *Lithographie Royale*, where he surrounded himself with a company of young and active artists, and soon brought out several serial works, such as "*Les Annales d'Histoire Naturelle de Bory de St. Vincent*," but the revolution of 1830 ruined the establishment and its director.

Being then appointed director of the Museum of Industry, to which he rendered important service, at the same time he gave effect to inventions which had been for a long time known. Among the number may be mentioned the *water gas*, known also under the name of Selligue gas, a designation given it by Jobard from the name of his associate, the chemist so well known in connection with his History of Coal Oils.† This gas is readily obtained by the decomposition of water by means of ignited carbon, yielding oxyd of carbon and light carburetted hydrogen. Strasburg and many other cities have been illuminated by this gas, but its use has been abandoned on account of the poisonous properties of the carbonic oxyd; there is, however, a remedy for this defect, and we are persuaded that this gas, so valuable for its calorific powers will yet be utilized. About this time Jobard signalized himself as well by his discoveries as by his writings. He rediscovered the process of artesian boring by cords [lifting the borer by a cord instead of by a rod] for a long time practiced by the Chinese, and introduced its use in mining. He invented the lamp called *lampe du pauvre*, (poor man's lamp) useful on account of its simplicity and economy. He also made known the hydraulic sling, (frondes hydraliques) a pump without a piston, a fountain pen, an elliptic press, a pistol with fourteen charges which was patented in 1826, and of course anterior to Colt's revolver; the India rubber valve; the hydraulic telegraph, the atmospheric express which has been recently revived, the electro-pneumatic railway, the sub-marine omnibus, boat carriages, (*les bateaux-voitures*) swimming rockets, &c., &c. Jobard did not, however, acquire a fortune; on the contrary, he died poor. His was the history of most inventors, impoverished by infringers of his inventions or by dishonest associates. The Belgian government also repeatedly reduced his salary, and seemed to anticipate the day when he should be retired from his position. Common humanity only, and his recognition by the French government which awarded to him the cross of the legion of honor, prevented this. The director of the Museum of

* In 1799, Senefelder, the inventor of lithography, received a patent from the king of Bavaria. But he had obtained only characters in relief until accident put him upon the track of lithography, properly so called. He took a patent at London, in 1800, and at Paris in 1802, where Bergeret, the painter, made some trials with it. In 1807, Chozon purchased the right to apply it to the printing of music. In 1816, Engelmann, printer, at Mulhouse, engaged actively in lithography, and thus merited the honor of having introduced this art into France.—J. N.

† See this Jour., xxx, 112, 254.

Brussels was still more remarkable in the economical sciences. In his work *Le Monautopole*, he advocated strongly the rights of the inventor, and considered intellectual property entitled to as much respect as any other. All his published writings for fifteen years claim this right, and Jobard has thus become the principal advocate of the rights of property in the labors of the mind. Many details might be given of the life and labors of this useful man.

He is open to animadversion as a critic at once too profuse and caustic. He often exercised his merciless criticism upon those Belgian infringers who lived at the expense of French inventors. He became at the last a devotee to the delusions of Spiritualism—but fortunately his important discoveries had been made before 1852, although he afterwards pretended that his inventions had been dictated by Spirit rappers! Good, generous, loving youthful students, he was always attached to workers in science and the arts, and more than one Belgian savant was indebted to Jobard for aiding him over his early difficulties. No cost deterred him from an experiment, and this spirit of discovery, and perfecting what he undertook led to his pecuniary troubles—to which, as before intimated, the Belgian government contributed its full share. Even in his last days, the poor inventor sought to obtain additional resources by the sale of his valuable library—a sacrifice from which death alone delivered him.

The Works of Roger Bacon.—We have already stated* that the Ministry of Public Instruction is engaged in publishing the works of some of our most eminent savans, such as Lavoisier, Lagrange, &c. Mr. Emile Charles, a private individual, is about to undertake a similar enterprise in reference to the works of Roger Bacon, one of the greatest philosophers of the thirteenth century. He does not undertake to reproduce *in extenso* all that has emanated from the pen of this great man; for his writings are far too voluminous to be published by private enterprise. But the volume published by Hachette, for Mr. Charles, (1 vol. 8vo.), gives us for the first time a complete idea of the influence which Roger Bacon exercised upon the spirit of his times. If this act of justice has been but recently performed it is because it was rendered very difficult by the circumstances under which Bacon lived. This philosopher was born in England, it is true, but being persecuted by religious fanaticism he passed a great part of his life in France, where he composed most of his works, and where, it is proper to say, he no longer suffered from religious persecution. The writings of Roger Bacon have not all been published, the manuscripts are scattered through many public libraries; this has made it a great undertaking to examine all his writings, to translate them, and discover their general purport.

Mr. Charles has undertaken this task upon which he has spent many years; he has been greatly aided by a distinguished scholar, Mr. Fortoul, for a time Minister of Public Instruction, who has assisted him with all his influence, and it was by the aid of his recommendation that he was enabled to visit the principal libraries in France and England, and thus to make the researches indispensable to the proposed enterprise. From these researches, it appears that Roger Bacon was not only learned in the sciences of his time, that he was a mathematician, a physicist, and that he practiced alchemy, but that he was the first who appealed to experiment.

* This Journal, [2] xxxii, p. 98.

Whether he conversed with theologians, astrologers or scholastics, he always took observation and experiment as the basis of his reasoning. If Roger Bacon did not invent the telescope, the steam engine, the compass, or phosphorus, which have been sometimes falsely attributed to him, he has, as Mr. Charles has said, done much more than this, he invented *a method*, the method of experiment, and thus anticipated by several centuries the system of philosophy which has immortalized his namesake, the Chancellor Francis Bacon.

Cournot—*des idées fundamentales.*—The works of this renowned genius of the middle ages, remind us of a philosophic work (published also by Hachette) whose author is a contemporary scholar—Mr. Cournot. This work is entitled, "*Traite de l'enchainement des idées fundamentales, dans les Sciences et dans l'Histoire.*" Mr. Cournot is known for his mathematical labors, researches upon the calculus of probabilities, the theory of functions, the infinitesimal calculus, &c., and also for his works upon philosophical criticism. Mr. Cournot has for a long time performed the duties of Inspector General of the Studies at the University of France. At present he is Rector of the Academy of Dijon, where he employs his leisure in philosophical labors of the class mentioned above.

The following are some of the principal topics embraced in this remarkable work, viz:

Of order and form in general—the characteristics of the logical and mathematical sciences.

Of the transition from order purely intelligible to phenomenal order—the ideas of time and space.—Geometrical ideas.

Of Kinematics or general theory of motion.—The idea of types.

Of the measure of time and principles of the infinitesimal calculus.

Of the doctrine of chances and of probabilities and their logical and mathematical applications.

Of the synoptical arrangement of ideas which pertain to order and form.

Of the ideas of matter, mass and inertia.

Of the subordination of characteristics and classification of physico-chemical theories.

Of the ideas of unity, individuality, space and type, in their application to physical and cosmological sciences.

Of life and organization in general.

Of the characteristics of the natural sciences, natural history and natural philosophy.

Of the mode and conditions of vital action.

Of the origin of species and the idea of organic creation, &c. &c. &c.

Proposed Statues of distinguished men.—In France as well as among every civilized people homage to distinguished men has always been in high esteem. Every city and town aspires to the honor of having given birth to some great man, and insists on erecting his statue. This ambition, very honorable without doubt, may be carried too far. In France, at least, it often selects for its objects questionable celebrities. This was especially true some ten years since, when the public attention was directed to *military glory.* Of late years, there has been a happy reaction. We begin to understand that the science which invigorates is better than the art which kills, and that it is possible to render service to humanity otherwise than by shedding human blood.

While Lorraine erected statues to Mathieu de Dombasle, the agriculturist, and to the historian Dom Calmet; and Alsace to the poets Pfeffel and Andrieux, and is about to erect one to the chemist Gerhardt, the city of Sens contemplates erecting one to the chemist Thénard. The *Société Zoologique d'Acclimation* has set on foot a subscription to erect two statues; one to the celebrated naturalist Daubenton, the master of Haüy; the other to Parmentier, at once a chemist and a naturalist, one of whose principal merits consisted in having introduced the potatoe into France. The following brief biographical sketches of these two distinguished men may not be without present interest:

Daubenton was born at Montbard, May 29, 1716. About the year 1742, Buffon called him to Paris as demonstrator in the cabinet of natural history, and associated him afterwards in his own labors. Although we cannot know what part of these works was performed by him, we well know that Buffon was indebted to him for a considerable part of his fame; and it is said with reason that without Daubenton, Buffon would not have been able to accomplish his work; while without Buffon, Daubenton would have been able to compose his useful works.

The mind of Daubenton was directed towards useful and practical objects, and he was early engaged in acclimation: to him we owe the only important applications of zoology to practical life which were made in France in the 18th century; the improvement of the varieties of sheep by a series of experiments worthy to be used as models for all efforts of this kind, also the acclimation of fine-wooled sheep from Spain, previously attempted without success. He began his experiments of this kind in 1766 and continued them until his death in 1799. He consumed his fortune in this enterprise, but success crowned his efforts. In 1794 the National Convention directed a republication of his work on the improvement of sheep, a work which has been translated into the principal languages of Europe.

Daubenton was ever a lover of plants. In 1797, by order of the Executive Directory, he drew up a plan for the embellishment of the garden of Luxemberg, which he called the "*Grove of all the months.*" This plan consisted in uniting in separate groups the shrubs which flower in the same months; this is a kind of floral zodiac which has been more or less realized to the present time. This savant was the real founder of the Cabinet of Natural History of the *Jardin des Plantes*, which originally contained little else than a collection of shells, and which served afterwards to amuse the early years of Louis XV. Many of the specimens still bear the marks of the caprice of the royal infant. By the care of Daubenton this cabinet in a few years entirely changed its appearance. Minerals, fruits, woods, and shells were gathered from all parts of the world. Then also were discovered and perfected the means of preserving all parts of organized bodies. A complete description and catalogue of the Museum was also then begun.

Cuvier tells us that Daubenton was the first who applied the knowledge of comparative anatomy to the determination of fossil species. He was moreover the means of introducing to science that great naturalist, Etienne Geoffroy St. Hilaire, upon the recommendation of Haüy. It is worthy of remark that Daubenton was initiated into science by Buffon, Etienne Geoffroy by Daubenton, and Cuvier by Etienne Geoffroy St.

Hilaire. Three of these great naturalists have their statues; Daubenton alone awaits his. In 1778 Daubenton occupied the chair of General Zoology at the College of France. In 1783 he delivered a course of lectures upon rural economy at the veterinary school at Alfort. In 1793, he was called to the chair of Mineralogy at the Museum of Natural History. In 1795 he was appointed Professor at the Normal School. Elected member of the Senate, he was struck with apoplexy the first time he appeared in that assembly, and expired Dec. 31, 1799, at the age of 84 years.

PARMENTIER devoted 40 years of his life to advocating the use of the potato, in opposition to a general prejudice that it was only suitable to be used as food for pigs. We will not mention the numerous well known and frequently repeated anecdotes which pertain to this part of the labors of Parmentier, who is so popular in France, where they frequently give the name of *Parmentière* to the precious tuber of ***solanum tuberosum***. He also studied all those vegetables which appear useful for food. After wheat, maize and the chestnut, he analyzed the stems and the roots of a great number of vegetables. Chemistry, physics, botany and vegetable physiology were all by turns placed under contribution by him, as well for researches upon alimentary substances as for making them most useful. By improving the grinding of wheat, he was enabled to extract a greater amount of flour, the bread became better, more nutritious and more savory. The art of the baker was also studied by this indefatigable philanthropist. His works upon the art of grinding wheat and of making bread were of such importance that Cuvier said: "Perhaps Parmentier has rendered no less service by making known improved processes of grinding flour and baking, than by extending the culture of the potato."

Parmentier was born in 1737, at Montdidier, and died in 1813. He passed through the wars of the Republic and of the Empire in the capacity of military apothecary. Afterwards he was Apothecary in Chief of the Hospitals.

Artificial Production of Protein Substances.—For a considerable time much attention has been given in France to the possibility of preparing albuminous substances synthetically. For this purpose the processes generally adopted for obtaining amids and nitrils have been employed. But while on the one hand Paul Thénard ascertained that starch absorbed a considerable proportion of ammonia when heated in a current of this gas, yielding matters analogous to protein substances; Schutzenberger, Professor in the Faculty of Medicine at Strasbourg, independently, and almost at the same moment, reached the same result not only for starch but also for the sugars, and even for coloring matters.

Some analogous results were published (May 7, 1860) by Schoonbrodt, who obtained artificially a protein substance which he considered as a *sucro-nitrile*. Without disputing the merit of these observers, we remark that they cannot lay claim to priority, for long before 1860, (in June 1856,) Dusart, a young chemist, showed that by heating in a close vessel, at a temperature of about 150° C. either glucose, lactine, or starch with aqua ammoniæ, there was obtained a nitrogenous substance, which alcohol precipitates in elastic filaments and which gives with tannin an imputrescible material. In these experiments, Dusart fixed fourteen per cent of nitrogen by maintaining the mixture for fifteen days in an oven, at a temperature varying from 150° to 200° C. The product obtained under these conditions resembles gluten in physical properties. Unfortunately, it did not possess any of the chemical reactions which characterize the natural protein substances, except the odor of burned flesh, which it contracted by decomposition under the influence of heat.

Dusart has then the manifest priority over his rivals. But the chemist is to be remembered who first occupied himself with this question and considered protein substances as amids or nitrils. This chemist was T. Sterry Hunt, and the reader will recall with no less pleasure that it was in this Journal* (in Jan. 1848) that the memoir of Mr. Hunt was published, and that he therein for the first time suggested the possibility of preparing the protein substances synthetically.†

[In the *Comptes Rendus* (T. LII, 247, Fevrier, 1861) Hunt has made reclamation as against Messrs. Williamson and Gerhardt, of the Theory of Chemical Types commonly awarded to these chemists, basing his claim on the prior promulgation of those ideas which form the basis of this theory in his papers in this Journal ([2], v, 265, 1848; vi, 173; viii, 82; ix, 65; (1850)). Gerhardt, to Hunt's mortification, adopted his (Hunt's) ideas four years after date without any allusion to their authorship, while Wurtz in 1858 revived for the first time (as Hunt believes) his ideas of condensed types and of hydrogen as the fundamental type in organic compounds. In the *Répertoire de Chimie pure et Appliquée*, for Nov., 1861, Wurtz notices this claim of Hunt in a style at once courteous and critical, acknowledging that the historian of science must ever accord to Hunt the credit of having independently in 1848 announced the idea that water and hydrogen might serve as types of a great number of combinations. Wurtz adds, "he (Hunt) will permit me nevertheless to say to him in this regard that he is not the first who has announced this idea. He himself cites Laurent and should have cited Griffin who published similar notions long before Laurent. For all this neither can Laurent or Griffin any more than Hunt pass as the authors of the theory of types; and this as I think is just. Those who discover the facts which give prominence to an idea, and who, thanks to those facts, introduce the idea into science and who render it fruitful—these are the true discoverers. Now the discoverers of the mixed ethers, of the organic anhydrids and I may add, of the compound ammonias, are they who have really brought to light the molecular types which characterize modern chemistry. This is why Messrs. Williamson and Gerhardt have general credit as the authors of this idea. If they are cited in

* [2], v, 74; vi, 259; and vii, 108.

† Hunt has himself reclaimed his original observations of 1848, on occasion of the first publication of a notice (in the *Comptes Rendus* of May 7, 1860,) of Schoonbrodt's paper. See *Comptes Rendus*, L, 1186, June 25, 1860. Hunt's views have been very widely circulated in the Elementary Chemistry of Silliman, the organic part of which Hunt contributed.—Eds.

preference to their predecessors, it is in virtue of the authority of facts and of that sort of supremacy which discoveries properly so called, exert over pure speculations." Prof. Wurtz goes on to support his argument by illustrations drawn from the polyatomic results of modern chemical research at greater length than our space now permits us to copy.—Eds.]

Documents relating to the History of Amorphous Phosphorus.—Considering questions of priority, we may be allowed to establish a historical fact which has been for a long time misapprehended. All the world unite in according to Schrœtter, of Vienna, the merit of having discovered *amorphous phosphorus.* The Academy of Sciences at Paris confirmed this opinion by decreeing to Schrœtter a prize for this discovery. We do not intend to contest with Schrœtter the merit of having successfully studied this allotropic element. By his labors it became doubtless better understood, and he pointed out its utility and economic importance. But it is proper also to show that amorphous phosphorus was already well known when Schrœtter published his work, in 1848. Not only was it already known, but it was recognized as such, by Berzelius, in his Annual Report, presented March 31, 1845; also by Marchand, who examined it carefully, taking it at first for iodid of phosphorus (*Jour. fur Praktisch. Chem.* 1844, vol. xxxiii, p. 182). Hence, the real discoverer of amorphous phosphorus was not Schrœtter; this merit belongs to Emile Kopp, who was then principal chemist to the Faculty of Medicine at Strasbourg. The memoir in which he spoke of this red powder was presented to the Academy of Sciences in 1844 (*Comptes Rendus*, T. xviii, p. 871), from whence it passed into the principal scientific Journals of Europe. It was in a research upon iodhydric ether that Kopp made us acquainted with the red phosphorus, its preparation and its more important properties. It is there stated that: "In preparing the iodhydric ether by means of alcohol, phosphorus and iodine, there remained, as a residue, a solid pulverulent substance of a deep red color; this substance, when well washed, is insipid, inodorous, and is but feebly attacked by the oxygen of the air; this is nothing but *phosphorus in its red state.* It can be dried over the water bath, without being sensibly oxydized, but it is difficult to drive away the last traces of moisture. By distillation it turns black and is transformed into ordinary phosphorus which is condensed," &c. &c.

We thus see that amorphous phosphorus was duly recognized, and its individuality perfectly established, by Kopp, in 1844; it had even passed the ordeal of the critics, and remained as a simple body, so that it is justly recognized, notwithstanding Marchand at first regarded it as iodid of phosphorus. The principal French and foreign scientific Journals mentioned it in 1844 and 1845, so that this result of Mr. Kopp has obtained all necessary publicity. It is true that nothing in the title of the memoir set forth the important fact which has occupied our attention, but it is none the less true that four years previous to Schrœtter, Emile Kopp had already shown the existence of phosphorus in its red state, had made known a method for obtaining it, and had recognized its most essential properties. It is proper, therefore, to give to each observer his due, to Kopp the *discovery* of amorphous phosphorus, to Schrœtter its *application.*

Oxygenated Beverages.—Mr. Maumené is Professor of Chemistry at Reims, the centre of the manufacture of Champagne wine. He has recently made a series of curious experiments upon wine, into which he has forced oxygen gas under a pressure of seven or eight atmospheres. He ascertained that when wine was sufficiently old, that is, when it no longer gave a deposit, it underwent no chemical modification from the presence of compressed oxygen, even when the contact of the oxygen was maintained for almost a year. In that case the oxygen was not absorbed and the acid power of the wine was not increased. The wine thus prepared is much more sparkling, or foams more, than the other kinds of common champagne. When opened it disengages pure oxygen, which rekindles an extinguished taper, and contains only such traces of carbonic acid as the wine contained before the experiment, and of which it could not be freed under a vacuum over a solution of potassa.

The taste of the wine charged with oxygen is not changed, but it produces, a little time after being drunk, a very sensible heat, like the better kinds of old wine, a general and well marked agreeable sensation. Mr. Maumené inquires whether the physician may not avail himself of this observation.

Oxygen *ozonized* did not oxydize wine. Although oxygen is but slightly soluble in water, it is dissolved in sufficient quantity, under a pressure of eight atmospheres, to produce a strong effervescence. Such water has no taste; but by drinking it many days Maumené thought he experienced a real improvement in the functions of respiration and digestion. The preparation on a great scale of water and of wine charged with oxygen can be accomplished without difficulty. Oxygen is received in a gas-holder, a proper aspirator and a pump conduct it into a condenser where it is compressed to the extent of ten or twelve atmospheres. To be sure that this oxygen is sufficiently purified, it is passed through two cylinders, one of which is filled with caustic soda, and the other with ordinary charcoal in coarse powder. From the condenser it is forced into the liquid by means of the apparatus of Savaresse, which is tinned if the liquid is water, or silvered if wine or other acid or saccharine liquids are to be oxygenated.

If the pump is worked slowly, the oxygen does not act upon the oil of the piston and the oxygen contracts no odor, even under a pressure of fifteen atmospheres.

Maumené has made some experiments with protoxyd of nitrogen prepared pure, from nitrate of ammonia free from chlorine. Wine charged with this gas possesses in a high degree the power of producing the hilarious effects attributed to the gas itself. This fact Maumené determined by experiment, for the purpose it required only half a glass of the wine saturated with NO at six atmospheres.

Electricity.—Effects of powerful tension.—At a recent meeting of the Academy of Sciences at Paris, Mr. Faye exhibited an experiment in which two plates of crown glass were pierced through and through by the electric spark of the great induction machine recently constructed by Ruhmkorff. One of these plates was four centimetres and the other six centimetres in thickness: (one and a half and two and a half inches nearly).

On examining the path left by the spark, it is seen to consist of a white and opake fillet extremely slender, the whole length of which presents bright places of two or three millimetres directed successively like a spiral in different azimuths. It shows no metallic deposit. In the thicker plate this track bifurcates at a depth of about one-third of the thickness. Almost at the opposite face it again subdivides into many fillets, very fine and almost destitute of the bright places.

During the experiment, Ruhmkorff demonstrated, by the appearance of Haidinger's colored rings, that the passage of the spark was accompanied by an energetic compression of the substance of the glass. No trace of fusion was discovered in these plates at the points where it was traversed by the spark. Mr. Faye thought nevertheless that it would be possible to produce on a small scale true fulgurites by the aid of this powerful machine, if the spark were forced to pass through a certain thickness of some pulverulent substance a little more fusible than crown glass.

Electro-Magnetism; New Experiments.—Mr. Leroux, Assistant Professor at the Polytechnic School, has recently made some very curious experiments upon the current of the pile by the use of very fine connecting wires. For the purpose of producing incandescence, Leroux prefers a wire of platinum. A wire one-fifteenth of a millimetre in diameter was thus maintained at a red heat through a length of fifteen or twenty centimetres, and there was required for this purpose only a dozen elements of Bunsen's battery. When it is desired to avoid incandescence and to have a very long conducting wire, it is better to employ silver, which offering less resistance causes less diminution of the current. With a silver wire of one-fifteenth of a millimetre in diameter, ten elements of Bunsen's battery are sufficient to produce through a length of forty or fifty centimetres the interesting results we are about to consider.

Presenting such a platinum wire, rendered incandescent, to the poles of a powerful magnet or an electro-magnet, the wire if rendered sufficiently flexible, assumes a series of configurations depending on the direction of the current, and whether the line joining the extremities has an axial or an equatorial position. Such a conducting wire is attracted by a mass of iron: this is the counterpart of the original experiment of Arago that a conjunctive wire attracted iron filings when it was traversed by a current. The experiment of Leroux generally succeeded best when the mass of iron presented a large surface; the conductor was then attracted to it and remained adherent.

Lastly, Leroux showed how a fine conjunctive wire could be made to coil itself spontaneously around the pole of a magnet when it was placed in a suitable position.

Upon one of the poles of a horse-shoe magnet,* he fixed an armature of soft iron, eight or ten centimetres in length, turned and polished. To this armature he attached the extremity of a silver wire, holding the other extremity in his hand, but so loosely that the wire could constantly obey the forces which solicited it. This wire when traversed by a current coiled itself around the armature and there formed a helix wound in a direction opposite to that which would be required to give to the armature the same magnetism which it already possessed. For the more convenient performance of this experiment, and to render it, so to speak, more gen-

* *Aimant bifurqué;* this Journal, [2] xv, p. 381.

eral, a small metallic bobbin upon which the wire is wound may be suspended above the magnet. In this way the experiment may proceed without the aid of the operator; the more constant the length of the wire passed over by the current the less danger is there of burning it, as sometimes happens. We observe thus a new kind of motion obtained by the action of the pile. To regulate this motion and to prevent its undue acceleration, there may be placed upon the axis of the bobbin a much smaller cylinder, upon which a silk thread, stretched by a suitable weight, winds up in an opposite direction.

[The experiment of Leroux appears to us not different in principle from the well known oscillating helix of Ritchie. The spontaneous coiling of a thin conjunctive wire about a magnetic bar is curious and so far as we remember, new, but the use of a long thin wire of platinum or silver, between the electrodes of a voltaic pile, to regulate and render sensible the heating power of the pile, has been a familiar lecture room demonstration in the United States, since the first introduction of Hare's Deflagrators more than forty years ago (this Journal, [1] iii, 105, 1821) first supplied to the demonstrator the means of obtaining a measurable control over the currents of powerful voltaic combinations. In demonstrations of this kind, it has been usual to ignite to full whiteness a wire of platinum a millimetre or more in diameter and from one to two metres in length.—Eds.]

Electric Telegraphy :—Submarine communications.—The telegraphic cables which unite England and France are quite insufficient for the wants of the two countries and now more than ever is it important to increase the number of these lines of communication. Soon the two nations will be united to each other by thirteen wires, namely: four from Calais to Dover, four from Boulogne to Falkstone, four from Dieppe to New Haven, in Sussex, designed to communicate severally between London, Marseilles, Lyons and Bordeaux. Lastly, there exists a communication between the two countries by the Jersey and the Guernsey islands. This line, which is composed of only one wire, starts from the vicinity of Coutances.

Trans-atlantic communications are more than ever the order of the day. While the Russians are actively engaged with the long line which ought hereafter to unite the ports of the South of China to those of America, remarkable efforts are being made in France as well as in England to unite Europe and America. The project which finds most favor in England is that of Col. Schaffner, who proposes to correspond with America by the north of that continent and the north of Europe. The cable will start from the coast of Scotland and proceed by way of the Faroe islands, Iceland, Greenland, Labrador, Newfoundland, and Canada to New York.

In France there is little sympathy for this northern line. The low temperature may become an obstacle in those desolate regions frequently agitated by snow storms and traversed by auroras which are well known to cause disturbance of the telegraph; this inconvenience is not compensated by the sub-marine lines in waters covered with ice and disturbed by volcanoes as in the neighborhood of Iceland. This project therefore offers less prospect of success than that which has been but imperfectly executed between Valentia and Newfoundland.

The French project proposes a line to start from the shores of Brest and touching at the island of Flores, one of the Azores, to terminate at

St. Pierre Miquelon near Newfoundland. The distance across is without doubt greater, but the cable would be placed in more favorable conditions.

We may mention that the cable from Malta to Alexandria has been laid without obstruction; there are intermediate stations at Tripoli and Bengazi. The completion of this line will enable us to hold communication with India in 13 days.

At the same time a new cable is being laid between France and Algeria; this new cable starts from Port-Vendres; the first section is already laid, reaching to Mahon.

New system of cables.—Sub-marine communications are easily established where they are to operate only for distances comparatively small. The length of the cable between Malta and Alexandria is 1400 miles. Great distances are attended by difficulties which have been so frequently mentioned that it is not necessary to repeat them here; we will merely say that the cables in use are much too heavy, and hence the iron wire twisted upon the outside as a protection by stretching (with no fault of the manufacturers) ruptures the conducting wire.

The new cables are much lighter: the spiral armature of iron is there replaced by a simple envelope of textile material, so that it resembles very much an ordinary ship cable. The weight does not much exceed that of the volume of water which it displaces, so that descending slowly it does not acquire that prodigious tension which caused fractures of the earlier cables surrounded with a metallic covering. The interior wires are insulated by layers of caoutchouc and gutta-percha applied in a vacuum, so that the interior may be as much as possible freed from air.

Physiological effects of the Electric Telegraph.—It appears that constant watching of the needles of electric dial-plates begins at length to produce an unpleasant effect upon the eyes of some of the operators. After laborious service, and especially after service at night, the retina is frequently so affected that for a considerable time all objects appear double and shrouded in a haze. This affection is developed only at those stations where the needle telegraph is employed. This telegraph is no longer used in France, it is but little used in England, except the needle telegraph of Wheatstone. In France the printing telegraph is preferred. Two new systems are about to be adopted; the first that of Hughes, an American, the other that of Caselli, of Florence. The first prints the Roman letters with a velocity which permits the transmission of twenty or thirty words per minute; the second, called the *pantelegraph*, reproduces everything autographically, writing, linear drawings, portraits, landscapes, &c. &c., with a velocity of eight to ten words of ordinary writing or 60 words written with the characters of Morse.

Army Telegraph.—In July last the French Minister of War caused some experiments to be made in the Champ de Mars with the *army telegraph*. Let us see in what these experiments consisted: A certain number of mounted artillerists were followed by a vehicle properly attached, in which were placed lances designed to serve as telegraph posts, and also the electric conducting wire. At a given signal they quickly extended themselves over the line; this signal was given as soon as the extremity of the conductor was fixed to the earth by means of a stake. At the distance of thirty metres a horseman dismounted, took a lance given him by an artillerist in the carriage, and set up the lance in the earth, causing it to make half a turn so that the head of the lance should be encircled by the electric wire. The horseman then made the lance fast by means of two guys fixed to it, and fastened to the earth with two stakes. The same operation was performed rapidly by other horsemen, but it was found that the lances were required not more than once in one hundred metres.

These experiments demonstrated that a telegraphic line may be improvised, in case of necessity, for armies in the field for example, and that too in the time strictly necessary for men and horses to move from the point of departure to the point of destination. In case of obstacles to the carriages, resulting from irregularities of the ground, each horseman charged with the duty of planting a lance, carries it in his hand and at the stirrup as practiced in the regiments of lancers.

Military Photography.—The Minister of War always interested in the aid which the art of destruction may draw from scientific discoveries decided, some months since, that in each *corps d'Armée* there should be an officer skilled in photography. In every campaign he is to follow the expeditionary corps. To this officer are assigned two subordinates, in the capacity of photographic aids, and six soldiers are detailed to serve as assistants. The apparatus employed is necessarily limited, consisting of objectives adapted to long distances, and which can be easily packed in a single wagon.

Guano and Artificial Pearls.—Artificial pearls were invented in the fifteenth century by a Parisian artist by the name of Jaquin. These are small beads of thin glass lined in the interior with *Essence d'Orient* and then filled with wax. But what is the substance called "Essence d'Orient"? This pompous name was invented for the sole purpose of concealing the true nature of the material from which it was prepared. But this material is furnished by a small white fish, the *ablette*, very common in the rivers of continental Europe. It accompanies the scales of this fish and is detached when the scales are rubbed up for a considerable time and thrown into a vase of water. To collect the "*essence d'orient*," the water is poured off from the vase upon a fine hair seive which retains the scales and allows the water and the product sought to pass through it. The latter sinks to the bottom and is obtained pure by decanting the water. A little ammonia is added to prevent its decomposition.

In one small river, in the department of Meurthe, not far from Nancy, they collect each year 25000 kilograms of the *ablette*, producing 600 kilograms of scales, worth 25000 francs; all this is employed exclusively in the preparation of artificial pearls.

Nothing is known concerning the chemical nature of this substance which is attached to the scales of this little fish, and no one appears to have devoted any attention to that point. Mr. Barreswil, has however discovered that it is identical with a principle extracted directly from guano by Bodo Unger, which he called *Guanine*. Guano being an excrement of sea birds, it follows on the one hand that the guanine might be met with in other species of fish besides the *ablette*—a thing which was to have been expected. Interesting in a physiological point of view, is the question, what is this proximate principle which is not digested and which is found unchanged in the excrements after they have been for many ages exposed to the action of the air?

SCIENTIFIC INTELLIGENCE.

I. PHYSICS AND CHEMISTRY.

PHYSICS.

1. *Depth of the Ocean.*—On page 39 of this volume, Mr. Sæmann has quoted Laplace's inference of 600 meters (near 2000 feet) for the mean depth of the ocean. All researches tend to show that this depth is very greatly less than the actual depth; the data on which Laplace's conclusion was based are also quite conjectural. The area of land to sea is now stated as 3 : 8, and not as formerly, 1 : 3—this would render the ocean even shallower than was stated by Laplace—while every modern observation in deep soundings, and above all the discussion of waves of translation in earthquakes—proves it vastly deeper.

The discussion of the Japan earthquake wave in 1854 (quoted in a note on p. 39) by Prof. Bache,* gave for the depth of the Pacific Ocean in the path of the Simoda waves to San Diego and San Francisco (34° 40′, 32° 42′, 37° 48′) a depth of 2,230 to 2,100 fathoms (13,380 to 12,600 feet).

Young estimates the average depth of the Atlantic at about 15,000 feet, and of the Pacific about 20,000 feet.

Guyot† derives from the law of the relief of continents about 15,000 feet for the South Atlantic, which he suggests may be too little.

Herschel‡ derives from the velocity of the tide wave, according to Airy's table, 22,000 feet for the Atlantic basin from lat. 50° S. to lat. 50° N. He thinks that an average depth of four miles is rather above than below the true depth.

Klöden§ assumes a probable average of three and a half miles or about 18,000 feet.

There is certainly a wide difference of statement among these authorities, but we seem authorized in assuming a mean depth for the great oceanic basins of 15,000 to 18,000 feet. The greater of these numbers would still leave Mr. Sæmann's conclusions on the absorbability of the waters of the globe by its rocky mass quite within the range of probability.

CHEMISTRY.

2. *On some of the double salts of Cyanid of Mercury: Preliminary notice of a Memoir upon this subject;* by W. P. DEXTER. (From the Proceedings of the American Academy, Dec. 10, 1861.)—An investigation of some of the compounds of cyanid of mercury having already occupied me for a considerable time, I would beg leave to communicate the conclusions at which I have thus far arrived: and would state that I am still engaged in the prosecution of the subject.

For several of these compounds my analyses have led me to infer a composition differing from that assigned to them by previous investiga-

* Coast Survey Report for 1855, p. 342.
† Guyot, Earth and Man.
‡ Herschel, Physical Geography, p. 72, English edition.
§ Klöden, Phys. Geog. (*Erdkunde.*)

tors. For example, the salts of cyanid of mercury with the chlorids of nickel and cobalt, to which Poggiale* gives the formulæ

$$NiCl, HgCy, 6HO$$
$$2COCl, HgCy, 4HO$$

I have found to be expressed by

$$NiCl, 2HgCy, 7HO$$
$$CoCl, 2HgCy, 7HO$$

thus removing a difference which was certainly not to be expected in bodies so nearly related, and showing their conformity in constitution with the other salts of this class.

The salt to which Desfosses † gives the formula

$$KCl, 2HgCy, HO$$

I find to contain *two* equivalents of water: and for the analogous salt with chlorid of barium, which according to Poggiale contains but 4HO. I get the formula $BaCl, 2HgCy, 6HO$.

It then agrees in composition with the corresponding salts of SrCl and CaCl.

The cyanid unites also with chlorids of the type R_2Cl_3: I have formed and analyzed the compound with perchlorid of iron. Its formula is $Fe_2Cl_3, 4Hg\,Cy, 7HO$.

I hope to get similar salts with Al_2Cl_3, Be_2Cl_3 and perhaps with Cr_2Cl_3.

For the salt of cyanid of mercury and chromate of potash, first described by Caillot and Podevin,‡ Rammelsberg § has found the formula

$$2(KO\,CrO_3), 3HgCy$$

which was changed by Poggiale ‖ to

$$KO\,CrO_3, 2HgCy.$$

An analysis of this salt has given me results agreeing very nearly with those of Rammelsberg, with the addition of one equivalent of water, which has been hitherto overlooked. Its formula would then be

$$2(KO\,CrO_3), 3HgCy, HO.$$

The analyses of the compound which has been mentioned as consisting of

$$BaCl, 2HgCy, 6HO$$

have shown that *the composition of this salt is not constant, and is not in exact accordance with the laws of chemical proportion.*

The above formula requires 16·73 Ba, and 48·77 Hg in the hundred. In the salt as I have obtained it, the barium is always deficient in quantity and the mercury in excess. The barium has been found as low as 13·4 and I have never found it higher than 15·69: while the mercury varied from 54·3 to 50·5. In general, the smaller the excess of chlorid of barium in the solution from which it crystallizes, the less barium, and the more mercury will be found in the salt. In some of the cases, those which gave the extreme numbers, this may very probably be owing to a mechanical admixture of cyanid of mercury, the crystals of which formed

* Compt. Rend., xxiii, 762.

† Gmelin, Handbuch d. Org. Ch., Bd. 1, S. 417. The original memoir in Journ. Chim. Méd., vi, 261, is not accessible to me.

‡ Berzelius, Jahrsb., vi, 183.

§ Pogg. Ann., Bd. 42, S. 131 and Bd. 85, S. 145.

‖ Loc. cit.

at the same time with those of the double salt, and, as I shall on another occasion show, cannot always be distinguished from them. It is likewise not impossible that there may be a compound of chlorid of barium with more than two equivalents of cyanid of mercury, and that the analyses were made upon mixtures of the two salts. But the existence of such a body has never been shown, nor do we know an instance of a chlorid, iodid or bromid combining with cyanid of mercury in any other proportion than one equivalent to two. The salts of chlorid of nickel and chlorid of cobalt which I have mentioned, and a salt said, also on the authority of Poggiale, to be composed of

$$2NH_4Cl, HgCy$$

are the only exceptions to this statement which I have been able to find. In other instances, as in that of the subjoined analysis, which was made upon large, perfectly defined, and carefully chosen crystals, deposited by spontaneous evaporation from a liquid containing a considerable excess of chlorid of barium, such an explanation seems to me entirely inadmissible. The analysis gave

	Calculated.	Found.
Ba	16·73	15·69
Cl	(8·66)	(8·12)
2Hg	48·77	51·32
2Cy	(12·68)	(13·34)
6HO	13·17	11·53 (by difference.)
	100·	100·

a direct determination of the water upon another portion gave 6HO = 11·63.

The above is one of thirteen analyses of this salt, and is chosen for no other reason than that the crystals were carefully selected, and that its accuracy is vouched for by the agreement of the direct determination of the water with the determination by difference.

The water was determined directly in two other cases and the variation from the determination by difference found to be less than one-tenth of one per cent. To control still further the exactness of the analyses and the purity of the double salt, the chlorine was in one instance determined; the analysis gave 7·98, the quantity required by the barium present was 8·01. The cyanid of mercury used was also analyzed by the same process and with the addition of the same reagents which had been employed in the analysis of the double salt; the result differed from the calculated composition only by one in the hundredths of a per cent. In all of these analyses the deviation from the composition of the theoretical or *normal* salt is unmistakable; and is the more striking when the perfect crystalline structure of the body is considered. I have observed a similar abnormal composition in the salt of chlorid of strontium, while the salt of chlorid of potassium, for example, even when crystallized in the most confused manner, has a composition agreeing completely with theory.

Reserving further discussion for another occasion when the subject shall have been more thoroughly investigated, the following is the view which I am at present inclined to take of this, as well as of some other instances of similar nature.

The body in question may be regarded as composed of ***normal*** salt of definite atomic constitution, to which is added a certain ***excess***, variable in amount, of cyanid of mercury; ***which latter is not combined chemically with the normal salt, but enclosed like a foreign body in the interstices of its crystalline structure.***

If this view be correct, the water and barium should be present in the *abnormal* in the same relative proportion in which they exist in the *normal* salt: and if the excess of cyanid of mercury be deducted from the total salt analyzed, the barium found should be in the same proportion in the residue, as it is in the *normal* salt. The one of which conditions is virtually included in the other.

The abnormal crystals of this salt, which I have examined, agree pretty well with these conditions. Omitting the details for the present, it may be stated that the water thus calculated on the barium found, is, in general, deficient by about 0·5 per cent; is agreed in one case very nearly with the theory, and was found once to be 0·7 per cent in excess. In this case unusual and perhaps inadmissible means had been taken to remove adhering moisture. The salt is permanent in a not too dry air, but in the air of a heated room or in air kept dry by means of sulphuric acid it effloresces and loses at last nearly the whole of its water of crystallization. When it is considered that the only means we possess of drying such a salt without expelling the water essential to its crystalline constitution, is the mechanical operation of pressure between paper, the above mentioned deviation from theory, amounting to six or seven milligrammes on the quantity taken for analysis, may not be thought to exceed the limits of the unavoidable errors of observation.

Should this view be borne out by further investigation, and should it be admitted that crystalline bodies may hold certain of their constituents, or even foreign substances, in a state not of chemical but of physical or *crystallographic* combination, this property may serve to explain the apparent inexactness of some chemical analyses, as well as facts in mineralogy which at present are not easily reconcilable with the laws of atomic proportion; and may show that where a deviation from these laws is coexistent with crystalline structure, such deviation may be merely apparent, and the crystalline form in reality dependent upon the presence of a body possessed of a definite atomic constitution.

TECHNICAL CHEMISTRY.—

3. *American Process of Working Platinum.*—Ever since the ready fusibility of platinum in the flame of the oxyhydrogen blowpipe was demonstrated by the late Prof. Hare of Philadelphia, at the beginning of the present century,* the experiment of melting this metal has been a familiar one in American lecture rooms.

The fact that the forging of platinum upon a manufacturing scale, has

* Annales de Chimie, xlv, 135; compare *ibid.* xl, 81, from American Phil. Trans. vi, 99. See also this Journal, [1] ii, 295.

According to Bergmann (in his *Essays*, London, 1788, ii, 179) platinum was first fused by Delisle who, having exposed chloroplatinate of ammonium "to a most violent degree of heat in a blast-furnace," obtained a malleable metallic globule. Bergman himself repeated the experiment, with success when the quantity of ammonium salt taken was small and the heat of the furnace very intense. Bergman first succeeded in fusing platinum with the common mouth blowpipe (*ibid.* p. 180.)—F. H. S.

been for several years an established branch of industry in this country, appears, however, to be less generally known among chemists.

That the metal could readily be worked in this manner was repeatedly urged by Hare. Thus, for example, in 1837, in a letter to Dalton,* he says, "I have succeeded in fusing into a malleable mass more than ¾ of a pound of platinum. In all, I fused more than 2 pounds 14 ounces into four masses averaging of course nearly the weight above mentioned. I see no difficulty in succeeding with much larger weights. The benefit resulting from this process is in the facility which it affords of fusing platina scraps or old platina ware into lumps, from which it may be remodeled into new apparatus."†

In Philadelphia large masses of platinum have been, for years, worked in this way by Mr. Bishop, formerly assistant to Dr. Hare, (see Journal of the Franklin Institute, 1860, [3], xl, 123). The process has also been employed in New York.

We copy the following account of its details from Mr. J. T. Hodge's excellent article upon Platinum in vol. xiii, p. 382 of Appleton's New American Cyclopædia, New York, 1861:

"Platinum has been successfully worked in New York upon a considerable scale by Dr. E. A. L. Roberts, who employs the oxyhydrogen blowpipe for melting the metal. His object is chiefly to convert crude platinum and scraps into plates and wire for the use of dentists. To obtain the metal soft and tough and without flaws, he finds thorough melting and welding at a white heat essential. The welding is a delicate process, requiring that the platinum should be perfectly clean and be heated in a muffle until the surface is too hot to be distinctly seen. If visible the metal is too cool to be welded, and hammering upon it will have the effect of shattering the piece. The metal should be handled with tongs plated with platinum, and hammered first with a clean hammer, weighing not more than a pound, upon a clean anvil; and both hammer and anvil should be as hot as possible without drawing the temper of the steel. The metal cools very quickly, and it is with difficulty kept at the high heat required. After being welded a heavier hammer may be used for forging. Dr. Roberts, having condensed the scraps or sponge by partially melting them very compactly together into a square block of 10 or 20 ounces weight, places two of these blocks in the muffle together; and as soon as they attain the high temperature required he removes one speedily to the anvil, and gives it 3 or four quick sharp blows in rapid succession and returning it to the muffle treats the other in the same way, and so alternately till both are thoroughly welded. By long hammering the metal is made tough and fibrous; but if thrown into the water while hot, it becomes crystalline and brittle. The partially melted cakes before forging are crystalline and sonorous, and break easily like spelter."

The following additional remarks descriptive of the blowpipe used, and the mode of employing it, are quoted from the article Blowpipe in the third volume of the N. A. Cyclopædia, p. 385.

* This Journal, [1] xxxiii, 195.

† In a subsequent note (this Journal, xxxv, 328) Hare mentions an experiment in which he melted 25 ounces of platinum to a state so liquid that the containing cavity not being sufficiently capacious, about 2 ounces of the metal overflowed leaving a mass of 23 ounces. "I repeat," says Hare, "that I see no difficulty in extending the power of my apparatus to the fusion of much larger masses."—F. H. S.

"An apparatus of great efficiency and simplicity of construction has recently been constructed in New York city by the Drs. Roberts, dentists, for remelting platinum scraps, and converting them into merchantable plate. They employ 2 copper gasometers of cylindrical form, 1 for each gas, that for hydrogen of the capacity of 220 gallons, and that for oxygen of 80 gallons. The pressure of the Croton water, which is about 60 lbs. to the square inch, forces the gases through metallic pipes to the apparatus connected with the burner. Each pipe connects with a short brass tube, which is closely packed with wire, and these unite in another brass tube which is also closely packed in the same way. From this, by a pipe of only about a quarter of an inch diamater, the mixed gases are then conveyed to the burner. This is a small platinum box inserted in a lump of plaster of Paris and asbestus, the aperture in the disk making its extremity being 21 little holes in 3 rows, such as might be made by the point of a pin. The platinum disk in which these holes are perforated is only about ½ by ¼ inch in size. It is found that copper answers the purpose quite as well as platinum. The lump of plaster is constructed like the water-twere of a forge or furnace, and is kept cool by a current of cold water constantly flowing through it. The supply of the gases is regulated by stop-cocks, one for each gas, placed near the point of their coming together. The jet points downward. The platinum scraps are first compressed in an iron mould into cylindrical cakes of the weight of 3 or 4 ounces each. Two or three of these are set upon a thin flat fire-brick, and heated in a furnace to a white heat. Being then transferred with the fire-brick to a large tin pan like a milk pan, which is well coated within with plaster of Paris, and brought under the jet, this is instantly ignited, and the platinum at once begins to melt. Its surface assumes a brilliant appearance of the purest white, like that of silver, and soon the whole is melted into one mass; but so great is its infusibility, that it chills before it can flow off the flat surface of the fire-brick. It cannot, therefore, be cast in a mould. For the uses to which platinum is applied, this, however, is of no consequence, as the cake of metal is easily hammered into any desired shape, or may be rolled at once into plates, or cut and drawn into wire. With the apparatus of the Drs. Roberts 53 ounces of platinum were melted into one cake at one operation, lasting only 13 minutes, in April, 1858. This was hammered down without waste, and drawn out into a plate over 40 inches long, and about 3 inches in width."

4. *Arsenic Eating in Styria.*—For the benefit of those interested in this question, which was discussed in our columns some time since, (this Journal, [2] xxx, 209,) we would record the fact that Profs. Roscoe of Manchester (Trans. of the Manchester Lit. and Phil. Soc., Oct. 30, 1860; in Newton's London Journ. of Arts, [N. S.] xiii, 43, and London Chem. News, Nov. 10, 1860,) and E. Schæfer of Gratz (Sitzungsberichte der Akademie d. Wissenschaften zu Wien, vol. xli; in Journal für praktische Chemie, lxxxii, 101,) have recently brought forward so large a mass of definite, well authenticated evidence tending to show that arsenious acid is habitually eaten, by many persons in Styria and in quantities usually considered sufficient to produce immediate death that no reasonable doubt can any longer be entertained of the prevalence of the practice.

F. H. S.

II. GEOLOGY.

1. *Prof. Hall's rejoinder to the criticisms of this Journal on his Contributions to Palæontology.*

[We have received from Prof. Hall the following communication which we publish with two foot-notes and a closing commentary. We do not recognize the right of an author whose works are reviewed by us to reply to our criticisms in our own pages—on the contrary, while we are always ready to rectify errors when they are pointed out, we accept the reticence usual in such cases as the only safe rule. In the present case, for reasons which appear in the conclusion, we print Mr. Hall's communication exactly as he sent it to us.—Eds.]

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

In this Journal, vol. xxxi, p. 292 (March, 1861), there is a notice of the Thirteenth Annual Report of the Regents upon the State Cabinet of Natural History. To legitimate and honest criticism I make no objection, but I am constrained to dissent from the tone of this article.

I will confine myself at this time to a brief notice of some of the more salient points. The first issue is in regard to the date of publication. The reviewer says, Appendix F has a "separate title page." This title is what printers term a *half title*, and is printed in the same *form* with the other matter, so that no change could be made afterwards, as might have been, had there been a "separate title page."

In order to avoid misapprehension, I sent to the printer a notice to be inserted at the end, as follows:

"When the Appendix F (Contributions to Palæontology) was originally reported, it was intended to embrace only the new forms of Graptolideæ, the observations on Rhynchonella, and the new genera Skenidium, Ambocœlia, and the observations on Athyris, Merista, etc., with descriptions of some new species of Brachiopoda, subjects which had been determined some time previously. The delay in publishing the Report has enabled the author to add other matter since its date. To the title page, therefore, should be added '*with additions during* 1860.'"

This notice I regarded as sufficient to prevent all mistakes of date. The title should have been "*from investigations made during* 1858 *and* 1859;" and, still farther, I had printed on the cover of my own copies "*with additions during* 1860." Moreover, there is upon every leaf "*No.* 89 *Senate*," which furnishes the actual date, were there only a single sheet circulated.

I have sought no priority by claiming date of presentation or communication of the Report. If it be requisite to place the day of the month on a publication, I can only say that it is not usual, except for periodicals. What is intended by "original text," I am at a loss to know. Is it *original manuscript?* Has the public a right to anything beyond what is printed and published? Is the author precluded from proof-corrections?

I had originally communicated, for the Thirteenth Report, an article on the genera Athyris = Spirigera, Merista, Camarium and Meristella, retaining *Camarium*, and proposing *Meristella* for those now called *Leiorhynchus*. When I returned from Wisconsin in the autumn of 1860, I found a letter from Mr. Davidson, to whom I had before communicated my views, stating that *Merista* (*Atrypa*) *tumida*, cited by him as a type of the genus *Merista*, did not possess the shoe-lifter process, as in *M. scalprum* and others. In this letter, Mr. Davidson says the term "*Merista must be retained for those having the shoe-lifter process*;"—and, desirous to avoid all confusion, I went at once to see if the Report were published, in order that, if not, I might add a note. Finding that the Report still waited for the plates of Mr. Cheeney's part, I obtained permission to reprint a few pages, which I regarded as a more sure way of avoiding confusion than an explanatory note. Concluding that the septum shown in CAMARIUM might be only a greater development of the shoe-lifter process than shown by Süss and Davidson, I decided to relinquish that genus, and to place the species under MERISTA, making the necessary changes. These changes were made in November, 1860.

If those sheets are what the reviewer refers to as the "original text," they contain nothing of which I am ashamed, or which I am afraid to have made public.

In regard to changes, I claim it to be the right of an author to make changes before publication, unless the rights of others are infringed; and the changes in this were not of that character. As to the charge of changes made in the Twelfth Report after it had been in part circulated, I am not aware of them, and shall feel obliged to the reviewer to point them out. The pages circulated by me are the same that now constitute a part of the Report, without the change of a line or a word. Will the editors correct the erroneous impression they have given?

On the subject of the criticisms upon the new genera proposed, the interests of science demand a correction through the pages of the Journal.

Of AMBOCŒLIA the writer says:

"2. AMBOCŒLIA. The types of this group are said to be *Orthis umbonata*, Conrad, and *Spirifer unguiculus*, Sowerby. It is therefore the same as McCoy's genus MARTINIA (see McCoy's British Palæozoic Fossils, p. 371)."

The type of this genus AMBOCŒLIA is *Orthis umbonata* of Conrad, not "*said to be*." Perhaps the reviewer was not aware that the genus MARTINIA was proposed by McCoy, in 1844, for species very unlike AMBOCŒLIA; but that he did place AMBOCŒLIA (*Spirifer*) *unguiculus* under the same genus ten years later does not affect the limits of the genus as first established by the author, upon typical species of quite another character.*

I quote below what the reviewer says of the genera LEIORHYNCHUS, MERISTELLA, ATHYRIS and SPIRIGERA.

"4. LEIORHYNCHUS. Shell with the general form of RHYNCHONELLA, but with the plications more rounded, and rarely or never continued to

[* We think Prof. Hall is wrong here. McCoy included in his genus such species as *S. decora*, *S. elliptica* and *S. glabra*. These are all of the same character as *S. unguiculus*. Prof. Hall may see that this is Davidson's opinion by referring to his late papers on the Carboniferous Brachiopoda of Scotland (Geologist, vol. ii, p. 18, 19). He there makes *S. unguiculus* identical with *S. Urei*, and the latter congeneric with *S. glabra*. If therefore the genus Martinia were to be restored, it would include *S. unguiculus*, and as Prof. Hall considers this latter to be congeneric with *O. umbonata*, then AMBOCŒLIA must fall into MARTINIA.]

the lateral margins, which are more compressed than in Rhynchonella proper. The internal structure appears, so far as ascertained, to be the same as in MERISTELLA = '(*Athyris pars*).'

"5. MERISTELLA. Intended to include that group of species of *Athyris*, McCoy, which has *A. tumida*, Dalman, for the type. It is not probable that this proposal will be accepted, because, if McCoy's genus is to be divided, then we have three names (long in use) to be accommodated, that is to say, ATHYRIS, SPIRIGERA and MERISTA. No new names can be admitted until all the old ones shall have been provided for.

"*Athyris* must be retained for the group with the beak of the ventral valve imperforated, and closely incurved, and with the mesial septum in the dorsal valve (type *A. tumida*)." This remarkable assertion will doubtless astonish palæontologists.

"*Spirigera* must include those with the beak of the ventral valve perforated, and a rudimentary mesial septum in the dorsal valve (type *S. concentrica*)."

The writer here seems to have fallen into the same error as before regarding ATHYRIS, which he says has *A. tumida as its type*.* The type of ATHYRIS is *A. concentrica;* and *A. tumida* of Dalman was, ten years

[* If the reader will take the trouble to compare this sentence with the three preceding paragraphs, he will perceive that Prof. Hall misunderstands or misinterprets the original statement. The reviewer does not aver that *A. tumida* is the type of the genus ATHYRIS, but that it is the type of "*a group of species of* ATHYRIS." This genus as originally recognized by McCoy is composed of several groups of species. *A. tumida* is the type of one of those groups, and the writer maintains that "*if the genus is to be divided*" and each group provided with a separate generic appellation, then the name ATHYRIS must be retained for that particular cluster of species of which *A. tumida* is the central and typical form.

In order to show that the position taken by the reviewer is the correct one, we shall give a short history of the facts.

1. McCoy was the first to point out that certain species of Brachiopoda which had been commonly referred to *Terebratula* should be separated from that genus on account of their possessing internal spiral appendages. His definition is as follows: "*Athyris*, McCoy (fig. 19), in which there is no vestige of either foramen, cardinal area or hinge-line. This remarkable genus is frequently confounded with those shells usually named *Terebratula* in the older rocks, but is distinguished by the large spinal appendages, which are wanting in the other group." (Syn. Car. Foss. of Ireland, p. 128, 1844.)

On the same page he figures a species (but without a specific name) and refers to it (fig. 19) as an illustration of his idea of the typical form of his genus. It shows no perforation in the beak. He does not point out any particular species by name as the type of his genus. The first species described by him he refers to *A. concentrica*, but in this he was probably mistaken. His description is not that of *A. concentrica*, and further, we do not believe that that species occurs in the Carboniferous limestone of Ireland at all. He did not at that time place *A. tumida* in the genus, as he was then engaged with Carboniferous species only, but he did so afterwards, when he described the Palæozoic fossils of England, including the Silurian, Devonian, and Carboniferous. In judging of the opinions of a naturalist as to the extent of a genus, we must study all that he has written about it, and not confine ourselves to one part. It is of no importance when McCoy placed *A. tumida* or *A. concentrica* in his genus, as Prof. Hall seems to think. The real question is: did he understand the genus as including both the groups of which these two species are the respective types? All his writings on the subject show clearly that he did, and no attempt to quote his opinions otherwise will be successful in convincing any well informed palæontologist to the contrary. His only mistake was in supposing later, placed under the genus by McCoy, and has been subsequently cited by Davidson as one of the types of MERISTA.

The most charitable explanation that can be offered for the reviewer is his ignorance of what has been done among the Brachiopoda, by McCoy and Davidson, in treatises not rare or obscure. This question has been so fully discussed and clearly settled, by Davidson, and other writers, that it would scarcely seem necessary to introduce it here; but, since this Journal has been the medium of an erroneous view, it is but justice that the true one should find a place in its pages. The writer who will have the names of ATHYRIS, SPIRIGERA and MERISTA "accommodated," and says that no new names can be admitted "till all the old ones shall have been provided for," knows very well, if he understands the subject, that his arguments are false.

that all the species had the beak imperforate, whereas in many of them it is distinctly perforated.

2. In 1847, D'Orbigny proposed to change the name of the genus to SPIRIGERA, on the ground that ATHYRIS, which implies the absence of a foramen, was inappropriate for species which have the beak distinctly perforated. But he fell into a mistake in the opposite direction, for while he defined his genus as composed of perforated species, he placed in it a number of forms which are clearly imperforate, such as *A. Ceres*, *A. vultur*, *A. Circe*, *A. passer* and *A. tumida*. He names *A. concentrica* as the type. (See *Paléontologie Française*, vol. iv, p. 359, and also *Prodrome de Paléontologie*, vol. i, p. 43.)

3. SPIRIGERA was adopted by several of the leading palæontologists in Europe. Prof. Hall adopted it in 1857. (See *Description of Palæozoic Fossils*, 10th An. Rep. Reg. N. Y., Appendix C, p. 153.) The two genera were no doubt intended by their authors for the same general group of fossils, but according to the literal meaning of the words made use of by them in their definitions only those with imperforate beaks could be placed in ATHYRIS, while SPIRIGERA would include only the perforated species. The writings of naturalists however must not be interpreted according to this narrow principle, but much allowance must be made for imperfections in descriptions of species and genera.

4. In his Introduction to the Classification of the Brachiopoda (1851–1854), Davidson settled the conflicting descriptions of McCoy and D'Orbigny by dividing the genus into two groups, retaining the name ATHYRIS for that sub-group which has the beak imperforate, and SPIRIGERA for the other with the beak perforated. The former has *A. tumida* for its type, and is precisely equivalent to Hall's genus MERISTELLA, proposed several years afterwards.

This is the classification which the writer of the criticism maintains should be sustained, and we cannot see any reasonable objection to it. It is perfectly just towards both McCoy and D'Orbigny. It inflicts no injustice on any other author. It is not inconsistent with purity of zoological nomenclature, or in any way injurious to science. It does not require any modification in either of the original definitions. The typical species are central and dominant forms of two different groups of species which together form one larger general group. ATHYRIS, under this arrangement, is the generic name of that group which has *A. tumida* for its type. SPIRIGERA is a perfectly unexceptionable name for the other group, of which the typical form is *S. concentrica*. Prof. Hall's proposed genus MERISTELLA is precisely identical with the genus ATHYRIS in its restricted sense (as above explained), and cannot be admitted until some good reason is shown for setting aside Davidson's arrangement. It belongs to Prof. Hall to place this reason before the public in a clear and unsophisticated manner. If he succeed in maintaining his point, then he will establish a classification for this group of fossils far inferior to that proposed by Davidson. SPIRIGERA must be suppressed, and ATHYRIS must take its place, and thus stand as the generic appellation of a group of fossils for which it is not appropriate. We hold that this change is not necessary, and as it would if adopted be injurious to science by affecting the purity of zoological nomenclature it cannot be maintained.]

Athyris and Spirigera have been proved to be entirely synonymous. The same species are cited as typical, both by McCoy and D'Orbigny, under these two generic names. McCoy proposed the genus Athyris in 1844, and D'Orbigny the name Spirigera in 1848. In British Palæozoic Fossils, page 192, 1852–55, we find "Genus Athyris (McCoy) 1844: Syn. Spirigera (D'Orbigny) 1848;" here the author himself cites Spirigera as a synonym.

Athyris has precedence of date over Spirigera; but, from the contradiction of fact implied by the name, it has been objected to;* so much so that Davidson, in his English edition of the Introduction to the Study of the Brachiopoda, adopts the name Spirigera for the typical species of McCoy's genus, and places under Athyris such forms as *A. tumida* for those before placed under Spirigera.

The species enumerated by McCoy under his genus, in 1844, were *A. concentrica*, *A. decussata*, *A. expansa*, *A. fimbriata*, *A. glabristica*, *A. globularis*, *A. hispida*, *A. planosulcata*, *A. squamosa*, and *A. triloba.* All these are true Athyris, as the genus is now understood and accepted. The fact that Prof. McCoy, nine years later, cited *Atrypa tumida*, Dalman, as an Athyris, cannot be used to sustain a genus founded upon other types; and *Athyris tumida* of McCoy is free to be used for the establishment of any other genus, whenever it is proved to possess characters differing from the typical forms of Athyris. The fact that McCoy cited this as an Athyris no more renders it an Athyris, than it was made an Atrypa by being thus described by Dalman; and it was just as much free for the foundation of a genus after the citation of McCoy as before.

The genus Merista was proposed by Edward Süss, and is founded upon important and peculiar characters not possessed by *A. tumida.*

When the reviewer says that *S. concentrica* must be the type of Spirigera, is he aware that this identical species, *A. concentrica*, is the type of McCoy's genus Athyris?

Furthermore, the reviewer goes on to cite Davidson, and says: "These two genera are limited as above by Mr. Davidson in his Introduction to the Classifiation of the Brachiopoda, pp. 84–87; and by F. Rœmer in the last edition of Bronn's *Lethea geognostica*, vol. i, pl. 2, p. 330–331. It is quite clear that if Meristella be retained, then either Athyris or Spirigera must be suppressed in order to make a vacancy for it. There is no probability of this being agreed to by Palæontologists. The other genus Merista will, no doubt, hold good for those species which have the shoe-lifter process in the ventral valve."

In a previous paragraph the reviewer cites a late publication of McCoy (British Palæozoic Fossils), ignoring his Synopsis of Carboniferous Fossils, 1844, where the generic descriptions of both Martinia and Athyris were first published. In the paragraph just quoted he cites Davidson

* In 1847, Mr. D'Orbigny objected to the name of Athyris, stating it to be "in complete contradiction with zoölogical characters," and proposed as a substitute the name Spirigera, *S. concentrica* being his type, the same species which in 1844 had been proposed by McCoy as the type of his genus Athyris. See Davidson, Introduction to the Study of the Brachiopoda, English edition, page 85; also the French edition, 1856; also McCoy's Synopsis of the Carboniferous Fossils of Ireland, 1844.—J. H.

1851–1854, ignoring his later edition, 1856, where he gives his reasons for regarding ATHYRIS and SPIRIGERA as precisely synonymous, and merging both in ATHYRIS on account of the priority of date of that name.

Mr. Davidson in the same edition adopts the genus MERISTA of Süss, citing *M. tumida* or *M. Herculea* as types; but as the original description is given for those species having the shoe-lifter process, and as Mr. Davidson agrees that the name must be retained for those having this process, the *M. tumida* cannot be included, for it has not such a process, while it possesses other important differences from both ATHYRIS and MERISTA; and for this and similar forms I have proposed the name of MERISTELLA.

If any one has been aggrieved by the description of species which they have published during 1860, the question is readily settled by showing the date of publication. For my own part, I am ever ready to adopt all such names as have legitimate priority, whosesoever they be; and it is not to be supposed possible that several persons can be working in the same field, with no concert of action, without at some time describing "under different names" identical species. It would have been a simple process for the reviewer to point out the species thus described, and then the question would not have been left in doubt. JAMES HALL.

As Mr. Hall has seen fit to call this subject up again, we avail ourselves of the occasion to record some points of scientific ethics which do not appear to command the attention in all quarters to which they are entitled.

Most scientific disputes arise from questions of *priority.* Naturalists are peculiarly liable to anticipation of their labors by others working in the same line of investigation. Hence, all agree that *publication* alone can entitle an investigator to priority. However hard the rule may be in a given case, it is the only safe one, and its force is universally acknowledged. But, what is publication? The answer is equally definite, although not, perhaps, so generally accepted. It is the actual distribution of the results claimed in a printed form to the principal workers in the same department—whether by means of a scientific journal, a scientific society which publishes a Journal or Transactions, or in a separate memoir. The latter case alone requires any care on the part of the author to see that copies are placed in proper hands, since the public nature of the other means of publication leaves no excuse for ignorance. Merely *printing* a memoir, without a reasonably general distribution of it, is not publication, neither is an oral or written communication to some non-publishing Society publication, since the chief end of publication is not thus gained, the matter does not thus come to the knowledge of others who are engaged in kindred pursuits. Publication, then, is not printing alone, but it is *distributing* a printed memoir or communication. It is easy in any case of importance to make the *date* of publication definite, by printing it upon the cover, taking care that the *date* and the *actual issue* correspond as nearly as possible.

In cases of Reports communicated to public bodies—e. g. to the N. Y. Senate by the Regents of the University—the presumption is that the Report given in at a particular date contains a showing of progress *to that date, and since* the date of the last published Report. Being made and accepted by the public body at a given date, it is closed, and cannot be open to essential changes in the original matter without the permission of the body to whom it is made—nor even then without indicating the changes made by a new date affixed thereto. This is such very common sense and usage that we should never have thought of enunciating it so formally had not the language of Mr. Hall's communication led us to suppoose that he, at least, did not recognize this well established principle.

Let us now apply these principles to the case in hand. On the 10th of April, 1860—as appears from its title page—the "Thirteenth Annual Report of the Regents of the University of N. Y." "was made to the Senate." Appendix F, of this Report contains Mr. Hall's "Contributions to Palæontology," always looked for with so much interest by palæontologists the world over. It was not, however, until early in 1861, that this Thirteenth Report, in its present form, was distributed—our own copy came to hand Feb. 18, 1861, or about ten months after the date of its presentation to the Senate—a month earlier (Jan. 19th) we received Mr. Hall's memoir ('Contributions, &c.') in a separate brochure—from the author. We look in vain in the Report for the 'Notice' quoted above by Mr. Hall, and which, 'to avoid misapprehension,' he 'sent to the printer to be inserted at the end.' 'This notice I regarded as sufficient to prevent all mistakes of date,' he adds: but, we ask, where is the notice? It certainly formed no part of either of three copies of the Report which we received from different sources—one from Mr. Hall himself. There is nothing whatever in the document to lead any one to suppose that it is in any respect different from the Report made to the Senate, April 10th, 1860. But in the foregoing communication Mr. Hall tells us, now for the first time, that certain "changes were made in Appendix F, in November, 1860"—and he states what in general these changes were. This is all that our criticism of last March charged. "Such changes," we said at that time, "should have been indicated by an appropriate date, either in the text or on the cover of the Report." As Mr. Hall admits the changes in question, we have nothing farther to say on that point, as this was the very subject of animadversion. Mr. Hall appears, however, to overlook the important fact that such changes, unless indicated, tend to vitiate the authenticity of date of the whole document, and naturally lead to the inquiry what part of the palæontological contributions *was* made to the Senate April 10, 1860?*

In answer to Mr. Hall's enquiry, if the public has any right to know anything beyond what is published? it is sufficient to say, a public document on the principles above stated cannot be changed from the original manuscript without permission, and plainly indicating the parts changed. Mr. Hall seems to have persuaded himself that 'a notice' sent to the printer, to be inserted at the end, was sufficient to prevent all mistakes of date. Unfortunately this 'notice' nowhere appears in the Report, and we are for the first time apprised of its existence in the present communication. Mr. Hall affirms that he does not know what we mean by the expression 'original text,' which he has found in a foot note to our criticism, where it plainly has reference to an original MS., lodged with a scientific society, or public body, for publication, and which all the world knows is no longer subject to the changes

* We would ask, was not the whole chapter on the *Goniatite limestone* (p. 95 and following) added as late in the year as the other changes admitted by Mr. Hall?

of the author without permission and indication. Who would think of confounding the suppression or replacing of several printed pages, in such a document, with "proof-corrections?" We will not believe that Mr. Hall thus intends to trifle with things too plain for comment. When in February last we compared the suppressed pages (those which Mr. Hall says he suppressed in November), a copy of which is now before us, with the XIIIth Report, we were naturally startled to find such discrepancies in a public document, with nothing whatever to indicate when or why they were made. As stated in our critical notice, we "could not permit the recurrence of this practice to pass without our earnest protest." That the criticism was not unmerited or out of place we had good reason to know; and now we may add to the testimony of others, Mr. Hall's own confession as to its essential accuracy, however he may declare that there is nothing in the suppressed pages to cause him shame.

To show that the delay of ten months (from presentation) in the distribution of these Reports, as well as the changes introduced, leads to confusion, annoyance, and liability to error, we cite the following examples:

Leiorhynchus multicostata, of Hall, fig. 14 and 15, p. 94, is described on p. 85, in the early sheets, under the name of *Meristella multicostata*. By reference to the Canadian Journal for May, 1860, p. 273, we find the same fossil described by Billings as coming from the Hamilton shales of Canada West, and there named *Rhynchonella* (?) *Laura*; there is a trifling discrepancy in the two descriptions, as is natural, but no one will question the identity of the fossils. Now if there was a question of priority in this case, it must be decided by a reference to dates of publication—thus

Leiorhynchus (= *Meristella*) *multicostata*, Hall, April, 1860.
Rhynchonella (?) *Laura*, Billings, May, 1860.

This gives Mr. Hall a month's priority, as judged from the dates on the covers of the two authorities, while by Mr. Hall's own admission he in Nov. 1860 changed the generic name from *Meristella* to *Leiorhynchus*—as appears also by a comparison of the early sheets already quoted, with the official issue of December following.

A case still more evenly balanced is that of *Goniatites Hyas*, Hall, p. 102. This species was published Nov. 24, 1860, by Meek & Worthen, as *G. Lyoni* (*Proceed. Acad. Nat. Sci. Phil.*, Oct. 1860, p. 471).

The *Megambonia Lyoni*, (n. s.) Hall, p. 110, is also described in the last quoted paper of Meek & Worthen, under the name *Cardiomorpha radiata*. They have since made a new genus of it, under the name Cardiopsis.

Again—*Spirifer semiplicata*, (n. s.) Hall, p. 111, was described by Prof. Swallow as *S. Cooperensis*, (n. s.) on p. 643, *Trans. Acad. St. Louis*, in the summer of 1860.

We might extend this list, but enough has been cited to show that the inconveniences alluded to have actually occurred, and to justify the assertion made in March, "that Prof. Hall has introduced into this paper under new names several species which have been described by other authors during the year 1860." It is not that "any one has been aggrieved" by this that gives it importance, so much as the needless confusion and complexity in scientific nomenclature which thus arises.

As regards the XIIth Report, our remark that "changes had been made in it after it had been in part circulated and noticed in this Journal" was not intended to apply to the 18 pages then noticed, which are reproduced in the final Report with only a few mechanical changes, but to the evident introduction of new matter at a date later than its accredited date. This we presume Prof. Hall will not deny, and as the proof would extend this article, already too long, we will not cite it now. It is enough for the interests of science that the justness of our criticism is acknowledged by Mr. Hall's own admission, that he made the very changes to which we objected, many months after date of presentation of the Report. That, moreover, our recommendation has had its proper effect, in securing in the case of the XIVth Report a regard for the date of publication, we have before had the satisfaction of remarking.*—Eds.

Dec. 20, 1861.

Postscript.—Since the foregoing remarks were on the press we have seen (Dec. 27th) a copy of the XIIIth Regents Report, sent from Albany, Dec. 4th, to a gentleman in New Haven, on the last page of which appears the 'Notice' quoted above by Mr. Hall. That this *notice* does not appear in either of the copies sent to us we have already stated. One of these copies we received on the 6th of May last, from the Secretary of the Board of Regents. Plainly therefore the appending of this notice to the Report is subsequent to the official issue of the Document, and, of course, since our critical notice of it in March last. In order to append it, the last sheet of the Report (of which it forms an integral part) has been reprinted.

It is not our duty to reconcile these discrepancies. This '*Notice*,' however, does not in our judgment meet the case at all (even had it appeared on the first page of every copy of Appendix F), since it leaves the reader wholly uninformed in respect to the nature of the changes which have been made (although these changes involved the reprinting of pages 73, 74, 75, 76, 84, 85, 86, and 113) while it is itself likewise without a date.

2. *Note on the Taconic System of Emmons;* by T. Sterry Hunt, M.A., F.R.S.—In a notice of the Taconic rocks in the last number of this Journal, (p. 428,) it was explained that in going eastward from the line of fault which brings up the Taconic group to overlie the Trenton and Loraine formations, Mr. Emmons asserts that we meet successively with lower rocks, all dipping eastward, until in the Green Mountain gneiss we have a rock which is older than the Taconic group, so that the newest rocks appear to be at the base, and the oldest at the summit of the series. It was however maintained in opposition to this view, that the apparent order of superposition from the great fault, going eastward to the Green Mountains, is in the main, the true one, and that the black slates of Emmons, which he regards as the newest rock of his series, are really among the oldest, while the Green Mountain gneiss is a rock higher in the series than any of those to the west of it.

These propositions we still maintain, but in explaining what we conceive to be Mr. Emmons's error, we have said that in order to explain this

* This Journal, [2], xxxii, 430.

supposed inversion in the succession of the rocks he imagines a great overturn of the whole series in question. In this we have been misled by the language of Mr. Emmons, which has caused him to be misinterpreted by others as well as by ourselves. In speaking of the succession of rocks he uses the term "inverted strata," and Mr. Barrande has spoken of the "overturn (*renversement*) of the whole systsm." Mr. Marcou, apparently as the interpreter of Emmons, speaks of the strata in question as having been "overturned (*renversées*) on each side of the crystalline and eruptive rocks which occupy the centre of the chain, presenting thus a fan-shaped structure, and all the accidents which accompany a complete overturn of a whole system of strata," so that in going eastwards towards the centre of the chain, we find that the most recent strata appear to be placed beneath the most ancient, "in consequence of an overturn (*renversement*)."—*Comptes Rendus de l'Acad.*, liii, 804.

Now in justice to Mr. Emmons it should be said, that despite his use of the expression "inverted strata," he has never maintained any inversion or overturn, as a careful examination of his description will show. (*Taconic System*, p. 17). He supposes that during the accumulation of the Taconic rocks the gneiss which formed the eastern limit of the basin was progressively elevated, so as to bring successively the older members above the ocean from which the sediments were being deposited, and that the upper parts of the formation, such as the black slates, were thus confined to a narrow basin and never extended far eastward; at the same time he conceives that denudation may have removed large portions of the upper beds. At a subsequent period a series of parallel faults, with upthrows to the eastward, is supposed to have broken the strata, given them their eastward dip, and caused the older beds to appear to overlie the newer, thus giving rise not to an inversion of the strata, but to an apparent inverted succession. Now we find in Canada evidence that the slates which Emmons regards as the newest are really near the base of the series, and consequently cannot admit his hypothesis to explain an order of things which we conceive to have no existence.

The careful study of the region in question shows that although such a great upthrow and overlap does bring the Quebec group to the surface from beneath the higher rocks, to the eastward of this fault, undulations, overturns and downthrows to the eastward, diversify with eastern upthrows the structure of this complicated region. The gneiss of the Green Mountains like that of the Scottish Highlands and the granite of the summits of the Alps, is the newest rock of the chain; the structure of all these mountain regions being synclinal as we have endeavored to show in the case of the Alps, (this Journal [2], xxix, 118,) and as Sir Roderick Murchison has beautifully represented in his late section across the Scottish Highlands. (See his new Geol. Map of Scotland.)

3. *New species of Lower Silurian fossils;* by E. Billings, F.G.S., Palæontologist G. S. Canada. Montreal, Nov. 1861, pp. 24, 8vo.—We have received under the above title an interesting bulletin recently issued by the Geological Survey of Canada,—so ably conducted by Sir W. E. Logan. This memoir contains descriptions by Mr. Billings, (with some thirty excellently executed wood cuts) of four new genera, and twenty-five new species.

Most of these fossils are from the Potsdam Group, or Primordial zone, at this time receiving so much attention from geologists. It is worthy of note too that a portion of them came from a distant locality, at the Straits of Belle Isle, on the far northeastern coast of America. The following is a list of the species described from the Potsdam Group at this place, viz:—*Palæophycus incipiens*, *Archeocyathus Atlanticus*, *A. Minganensis*, *Obolus Labradoricus*, *Obolella chromatica*, *O. cingulata*, *Conocephalites miser*, *Bathyurus senectus*, *B. parvulus*, *Salterella rugosa*, *S. obtusa*, and *S. pulchella*.

Mr. Billings also identifies amongst the fossils from this group at the Straits of Belle Isle, *Scholithus linearus*, and two species of trilobites described by Prof. Hall, from Vermont, in 1859, under the name *Olenus Thompsoni* and *O. Vermontana*. Prof. Hall supposed these two trilobites to belong to the Hudson River Group, but the great Bohemian geologist, Barrande, on seeing Prof. Hall's figures, at once pronounced them Primordial types, which view is clearly established by Mr. Billings's investigation of their associates both in Vermont and at Belle Isle. Mr. Hall has since created from them a new genus, BARRANDIA.

From rocks of the same age in Vermont the paper under review contains descriptions of the following species, viz:—*Palæophycus congregatus*, *Orthisina fistinata*, *Camerella antiquata*, *Conocephalites Adamsi*, *C. teucer*, *C. arenosa* and *C. vulcanus*.

It likewise contains descriptions of the following new species from rocks of the age of the Trenton, Chazy and Black River limestones in Canada and Vermont, viz:—*Eospongia Roemerii*, *E. variens*, *Astylospongia parvula*, *Lingula Perryi*, *Lituites Fainsworthi*, *L. imperator*, and *Ampyx Halli*.

The new genera established in this memoir are *Eospongia*, *Archeocyathus*, *Obolella*, and *Salterella*. The first two of these genera seem to belong to the *Amorphozoa*,—the second includes small *Brachiopods*, allied to *Obolus* of Echwald, but differing internally; while the fourth is for the reception of a group of small conical bodies, possibly belonging to the *Pteropoda*, and related to *Theca*, Morris, and *Puginuculus*, Barrande.

It is an interesting fact that Meek and Hayden have recently identified from the Primordial rocks at the Black Hills, and in the Rocky Mountains west of there, a species of the new genus *Obolella*, very closely allied to the typical Belle Isle species; and that it was found at these far western localities, associated with *Lingula primea*, *L. antiqua*, an *Arionellus*, and numerous small conical bodies very like some of those referred by Mr. Billings to his genus *Salterella*.* The occurrence of such similar groups of organic remains in the Primordial rocks, at such widely distant localities and latitudes, both in this country and in Europe, indicates the prevalence of a remarkable uniformity of climatic and other physical conditions over immense areas, if not indeed throughout the entire world, during these early periods of our earth's history.

In addition to its great usefulness in developing the natural resources of the country, the Canadian Survey is making important additions to science, and richly deserves the liberal government patronage it is receiving.

* See Dr. Hayden's article on page 68 (and following), of this volume, for a notice of the facts here alluded to.

4. *Highly interesting discovery of new Sauroid Remains.*—Mr. O. C. Marsh, a student in the Sheffield Scientific School of Yale College, procured last summer from the Coal Formation of the Joggins in Nova Scotia, where he has for several seasons spent his long vacation in mineralogical and geological observations, two Saurian vertebræ, of which Agassiz writes to us thus:

"*My Dear Silliman*—A student of your Scientific School, Mr. Marsh, has shown me to-day two vertebræ from the Coal Formation of the Joggins, which have excited my interest in the highest degree. I have never seen in the body of a vertebra such characters combined, as are here exhibited. At first sight they might be mistaken for ordinary Ichthyosaurus vertebræ; but a closer examination soon shows a singular notch in the body of the vertebra itself such as I have never seen in Reptiles, though this character is common in Fishes. We have here undoubtedly a nearer approximation *to a synthesis between Fish and Reptile* than has yet been seen. * * * * The discovery of the Ichthyosauri was not more important than that of these vertebræ; but what would be the knowledge of their existence without the extensive comparisons to which it has led. Now these vertebræ ought to be carefully compared with the vertebræ of bony Fishes, with those of Sauroid Fishes, of Selachians, of Batrachians, of the Oolitic Crocodilians, of the newer Crocodilians, of the Ichthyosaurians, and of the Plesiosaurians, and all the points of resemblance and difference stated; because I do not believe there is a vertebra known thus far, in which are combined features of so many vertebræ, in which these features appear separately as characteristic of their type. Whatever be the fate of these remains, be sure that they are preserved where nothing can happen to them, and where they will be duly appreciated. Ever truly yours, L. AGASSIZ.

Museum of Comparative Zoology, Cambridge, Dec. 23d, 1861."

5. *Discovery of Saurian Remains in the Keuper of the Jura.* (Extract from the "Sentinelle du Jura.")—In making a section for the railroad now in construction in the neighborhood of Poligny, remains of a gigantic Saurian have been discovered. With great care and precaution the following fragments were obtained. Three claws of eight to twelve centimetres in length, several other phalanges with fine articular surfaces, a part of the tarsus and meta-tarsus, two joined vertebræ, and several other fragments. The dimensions of these bones is such that the whole length of the animal cannot be less than thirty to forty metres. [?]

"These remains lay in the upper strata of the Keuper, visibly overlapped by the lower Lias. These formations have heretofore been considered as devoid of organic remains in this country (France) where they contain gypsum and rock salt. Nevertheless, some years ago, Mr. Pidancet, a geologist of the Francs-comté, found in these same strata large bones, which he deposited in the museum of Besançon, and which he considers as belonging to the same species. Besides, a few months ago, near Domblans, while opening a ditch for the railroad, a similar fragment was found, and Mr. Lauckardt, one of the employées, has seen at the same place other bones, much larger, which he could not displace on account of their fragility." * * *

"Another discovery, not less important, was made by Mr. Froment, mayor of Saint Lothaire, in strata younger than the Keuper formation. The bones found there belong to the Elephas primigenius and to a kind of stag; among them are two molar teeth beautifully preserved. This deposit of bones is in a layer of sands, marl containing boulders of quartz and numerous fragments of terrestrial and freshwater shells, but no trace of human remains." (The correspondent of the "Sentinelle" is a railroad engineer, Mr. Chapard.)—*Translated and sent to this Journal by A. F. Bandelier, Jr., Highland, Ia.*

III. BOTANY.

1. *Mémoire sur le Cynomorium coccineum* . . . . par H. A. WEDDELL, M.D., etc. (*Extrait des Archives du Muséum*, tom. X.) Paris, 1860. Imp. 4to., with four plates.—An admirable memoir upon the longest known Balanophoreous plant, the only one which inhabits Europe and its confines on the Mediterranean, but which still needed the prolonged and searching investigation which Dr. Weddell has given it. The results of his studies of the living plant, in Algeria and elsewhere, complete the account in Dr. Hooker's monograph of its parasitism and anatomical structure, explain the nature of the inflorescence, confirm and extend our knowledge of the flowers, seed, and embryo, ascertaining (as Hofmeister had independently done) that the ovule has a proper integument and the seed a testa, instead of being as simple as Dr. Hooker had supposed; that the embryo, a depressed globular body at the micropylar extremity of the albumen, is properly acotyledonous, being essentially an axis, "*tigelle*," from the micropylar extremity of which in germination the forming root develops; and this, singularly enough, instead of turning downward in the normal manner, uniformly turns upwards, and grows towards and even beyond the surface of the soil with which the seeds were covered! This was equally the case when Melilots, and other plants upon the roots of which *Cynomorium* is commonly parasitic were made to germinate along with the latter; and even when the rootlet of the germinating *Cynomorium* was placed in contact with the seedling foster-plant which it is known to affect, it still turned upwards from the foster-plant it needed and towards the light. In consequence, Dr. Weddell, when obliged to interrupt his experiments, had not succeeded in observing the formation of the parasitic attachment of a seedling to its nurse. He recommends the future experimenter to bury the seeds more deeply under seedlings of the foster-plant, when, perhaps, this remaining and most interesting point in the history of the development of the parasite may be determined. A. G.

2. *Monographia Betulacearum hucusque cognitarum, auctore* E. REGEL. Moscow, 1861.—A separate issue from the 13th volume, new series, of the Memoirs of the Imperial Society of Naturalists, Moscow. It occupies 129 pages, and is well illustrated by outline figures which fill 13 plates, quarto. Dr. Regel,—now the Director of the Imperial Botanic Garden at St. Petersburgh, which, as a botanical establishment, ranks next to that of Kew and the Jardin des Plantes,—is adding to his very high reputation as a scientific horticulturist, that of an acute and active systematic

botanist. We have not yet been able to test this monograph by revising under its light the Birches and Alders of the North American continent, but the work evidently embodies the results of a prolonged and careful study of ample collections, and appears to be most faithful and judicious. Judging from the view taken of *Betula alba*, the author certainly cannot be charged with taking too narrow views of species; since under *B. alba* he includes (with Spach) not only *B. populifolia* (which appears unavoidable), but also *B. papyracea.* Yet surely no person could readily confound our Paper Birch or Canoe Birch with the White Birch of this country. A. G.

3. *Dr. C. Müller's* continuation of Walpers' *Annales Botanices Systematicæ,*—of which two volumes (the fourth and the fifth of the entire series) have been published, has now proceeded to the first fasciculus of the sixth volume. This continues the Monocotyledons as far as to the *Juncaceæ*; and this volume is to complete the present undertaking, viz: the compilation of the genera and species which have appeared in manifold works or scattered publications during the years 1851 to 1855, inclusive. A. G.

4. *Journal de Botanique Neerlandaise, redigé par* F. A. W. Miquel, Professor de Botanique à l'Université d'Utrecht. Année, 1861. 1er Cahier. 8vo. pp. 96, with one plate (Amsterdam and Utrecht.)—Prof. Miquel, it will be seen, is as active at the University of Utrecht as he formerly was at Amsterdam; and this new botanical journal will secure a wider circulation for being published in the French language. The principal original articles in this journal are furnished by the editor himself. They are a detailed account of the Palms of Sumatra; A notice of *Elodea Canadensis* established in the waters of Utrecht, and likely to become a pest in Holland; New plants cultivated in the Botanic Garden of the University of Utrecht; and Remarks on the Flora of Southern China. The plate represents a new *Nepenthes.* A. G.

5. *Tropical Fibres; their Production and Economic Extraction;* by E. G. Squier, formerly minister of the U. S. in Central America, etc. New York, Scribner & Co. 1861. 8vo. pp. 64, with 16 plates.—Although it is true enough that the author in this work can "lay but little claim to scientific accuracy, either of classification or expression," yet he has here brought together a considerable amount of general information about the principal textile fibres of the tropics and the plants that produce them. The great desideratum is some economical method of extracting and cleaning such fibres by machinery; and Mr. Squier states that "a machine has now, however, been invented and put in operation, which, in my opinion, combines the desired conditions, and which, I have little doubt, is destined to augment very largely the present supply of tropical fibres, if, indeed, it does not entirely revolutionize, on both continents, the present modes of production. I refer to a machine invented and patented by a Mr. G. Sanford, designed to operate under a process patented by Mr. J. E. Mallory." * * * "I feel safe in saying that by the aid of a machine not exceeding in cost $100, one expert hand can extract in a single day (say from the *Agave Sisilana* or *Hennequin*) a greater quantity of fibres, in better condition, than one hundred men can obtain through the primitive modes now in use." All depends upon

this machine, of which no particular information is given. The plants are abundantly to be had, at small cost.

Mr. Squier pays a well-deserved tribute to the late Dr. Henry Perrine, who nearly thirty years ago took up this subject with great zeal and ability, establishing a plantation of Agaves, &c., on the Cape or Keys of Florida, where, just in the inception of the enterprise, he was murdered by the Seminole Indians.

The plates contain lithographs of several sorts of *Agave* (among these one bears the name of *A. Virginica*, but there is some mistake about it, as well as in the expectation that *A. Virginica* will produce "useful fibres" to any amount), *Bromelia*, *Banana*, (called "*Musa rosacea*,") *Yucca*, a couple of Palms, and the *Phormium tenax* or New Zealand Flax.

A. G.

6. *Carices.*—The following are determinations, by the author of Illustrations of the Genus Carex, of certain species recently published in this Journal, as well as in the Botany of the Mexican Boundary Survey:—

Carex monticola, Dewey, in Mex. Bound. Surv., p. 229, and in this Journal, is *C. triquetra*, Boott in Linn. Trans., vol. xx, and has three stigmas.

C. umbellata, Dewey, l. c., is *C. alpestris*, Allioni, not before detected in this country, and a strange plant to find in Western Texas!

C. Haydenii, Dewey, l. c., is the *C. aperta* of Gray's Manual.

C. lævi-conica, Dewey, is the *C. trichocarpa*, var. *β.* of Boott's Illustrations.

C. Wrightii, Dewey, is *C. microdonta*, Torr.

C. Thurberi, Dewey, is *C. hystricina*, Willd.

C. Nebraskensis, Dewey, is *C. Jamesii*, Torr.

C. Emoryi, Dewey, is a variety of *C. stricta*, Lam.

C. Barbaræ and *C. Schotii*, Dewey, are described from specimens quite too young for proper determination.

No. 881 of Fendler's New Mexican collection is *C. Gayana*, Desvaux.

A. G.

7. *Musci Cubenses Wrightiani*, coll. 1856–1858.—The Mosses proper of Mr. Charles Wright's collection in the eastern part of Cuba, have been studied by Mr. Sullivant, who has published an account of them in the Proceedings of the American Academy of Arts and Sciences, vol. V, under the date of August, 1861. The species and varieties enumerated are 131, of which the goodly number of 42 are characterized as new species, and several others are not less interesting. The specimens of this collection have now been made up into sets, with printed tickets, title-page, &c., for distribution among the subscribers to Mr. Wright's collection. These sets being more numerous than those of the Phænogamous plants (though less so than the Ferns, of which several sets are still unsold), a limited number can be supplied to those specially interested in Muscology, if early application be made to Mr. Sullivant, at Columbus, Ohio, or to Prof. Gray, at Cambridge, Mass. Mr. Sullivant's published enumeration, with descriptions of the new species, will be supplied with the sets.

A. G.

8. *Rocky Mountain Flora: a Collection of Dried Plants from the head-waters of Clear Creek, and the alpine ridges lying east of Middle Park, Colorado Terr.*, made last summer by C. C. Parry, M.D.—This beautiful collection contains a considerable number of species either new

to botanists or new to the Flora of this country, and many more which are very rare in herbaria;—a full account of which is nearly ready for publication. The collections, not being sufficiently copious to supply the demand, were at once taken up. It is to be hoped that Dr. Parry may be encouraged to repeat and extend his explorations among those alpine solitudes during the ensuing summer. The plant-hunter must here penetrate far beyond the gold-hunter, and endure greater privations. But it is evident from Dr. Parry's gleanings in a field barely reached by Dr. James, in Long's Expedition, that the botanical riches of this region are by no means exhausted. A. G.

9. *Aroideæ by Dr. Schott.*—It is well known to botanists that Dr. Schott of Vienna has now for a long time specially studied this striking and at the same time most difficult family of plants. He has thoroughly reformed the order, and produced on the one hand magnificent illustrations of the genera and of many species, which must find a place in all considerable botanical libraries, and, on the other a Synopsis and Prodromus which are within the reach of the means of almost every cultivator of the science. We add a list of these publications now before us, viz.—

Aroideæ auctore H. Schott. Fasc. 1–6 (Vienna, 1853–1857): A sumptuous publication, in imperial folio, 30 plates, partly colored, with 20 pages of letter-press.

Icones Aroidearum editæ H. Schott. 1857. Forty plates, imp. folio, even more magnificently executed, with a few leaves of letter-press.

Synopsis Aroidearum complectens Enumerationem Systematicam Generum et Specierum hujus Ordinis. Auctore H. Schott. I. 1856. pp. 140, 8vo. Includes the *Aroideæ diclines.*

Genera Aroidearum exposita a H. Schott. 1858.[–1860.] Imperial 4to, 98 plates filled with analytical details, admirably executed, and 90 leaves of letter-press. This illustrates nearly all the genera, and needs only an Index, &c., which we suppose will be given with a supplementary fasciculus.

Prodromus Systematis Aroidearum: auctore H. G. Schott, 1860, pp. 602, 8vo. Contains the characters of 108 genera and nearly 1000 species. The monograph of this order by Kunth in his Enumeratio Plantarum, vol. 3 (issued twenty years ago) contains 40 genera and 256 species. Dr. Schott's labors upon this order, persevered in for forty years, are highly estimated and gratefully received by the botanical world. Being still continued with undiminished zeal and with unequalled advantages, all new Aroideous collections should be shared with him, or at least submitted to his examination. It is evident that he has not been well supplied with our few and most common species of the United States, the fruit and seeds of *Peltandra* and *Symplocarpus* being unknown to him, although both would surely flourish in the climate of Vienna without care. Having only dried specimens of our Skunk-Cabbage to work upon, Schott has not well made out the structure of the ovule. Describing that of the subtribe as anatropous or half-anatropous, he characterizes that of *Symplocarpus* as pendulous and "*micropyle fundo spectante,*" which would make it orthotropous. Here he has mistaken the chalaza for the micropyle. The ovule was first correctly described by Dr. Torrey in his Flora of the State of New York. Then, of the related genus

Lysichitum (founded, as is *Arctiodracon*, Gray, in Mem. Amer. Acad., vi, p. 409, ann. 1859, which it antedates, upon the *Symplocarpus Camtschatcensis*, Cham.) Schott, in his Genera, describes and plainly figures the "*micropyle fundum respiciente*," thus representing the ovule as orthotropus, which is the case, while in his Prodromus we have "*ovulum anatropum*," contrary to the figure. In the plant from Japan we found the ovule orthotropous, but horizontal, depressed-globose, and nearly sessile, not pendulous on a recurved and fimbriate funiculus, as in Schott's plate, a difference which might be held to confirm our notion of two species in the genus. But, having since seen (but not investigated) good specimens of the plant of N. W. America, we suppose that it does not specifically differ from that of Japan, and that the difference in the ovules is attributable to their lesser development in the flowers we examined. A. G.

10. *Journal of the Proceedings of the Linnæan Society*, No. 21.—The Botanical part contains an article by Dr. Hooker "On the Vegetation of Clarence Peak, Fernando Po, founded on the collections made in two ascents to the summits of this insular mountain, 10,700 above the sea, off the mouth of the Niger, by G. Mann, the successor of the late Mr. Barton as Botanist of Dr. Baikie's Niger Expedition. An isolated bit of temperate climate near the coast of equatorial Western Africa, was naturally expected to have a flora related to those of Cape de Verd, the Canaries, and St. Helena: whereas, in fact, so far as this collection goes, the curious results are:—"1. The intimate relationship with Abyssinia, of whose flora that of Clarence Peak is a member, and from which it is separated by 1800 miles of absolutely unexplored country. 2. The curious relationship with the East African islands, which are still further off. 3. The almost total dissimilarity from the Cape Flora. 4. With the West African islands, there is no marked relationship whatever." An account of the ascent of Clarence Peak, in a letter by Mr. Mann to Sir William Hooker, forms a separate article. Mr. Masters contributes a Note on an unusual mode of Germination in the Mango. Prof. Babington, who has worthily succeeded the late Prof. Henslow in the chair of Botany in Cambridge University, announces the discovery in England of *Carex ericetorum* of Pollich, not Pollick, as it is misprinted. Mr. Caruthers describes some species of Oak from Northern China, collected by Dr. W. F. Daniell. The last, and the most important article is, On the identification of the Grasses of Linnæus's Herbarium, by Col. Munro, the distinguished Agrostologist. Having "carefully examined every Grass in the herbarium," and recorded the results in a very clear and satisfactory form, the author "trusts that the list may be of some little use to botanists who are unable to consult the herbarium itself." We would assure him that it is of very great use indeed; and the Linnæan Society, "as the envied possessors of the original authenticated collections of Linnæus himself," could hardly do a better thing than to institute similar reports upon other portions of this herbarium by equally competent hands. Col. Munro, having rejoined his regiment, has not been able to revise the proofs or he would have corrected the misprint of the second specific name of the list. We are puzzled to know how *Paspalum dissectum* came to be ticketed "From North America, Kalm." The close of the number, p. 48, leaves this article unfinished. A. G.

IV. ASTRONOMY AND METEOROLOGY.

1. *New name proposed for Asteroid* (60).—Mr. Ferguson, the discoverer of the planet (60) hitherto called *Titania*, has written to Mr. Hind, Superintendent of the English Nautical Almanac, stating that this name was proposed without remarking its previous appropriation by Sir John Herschel for one of the satellites of Uranus, and intimating his intention to change it forthwith for *Echo*. It is announced that this name will appear in the Nautical Almanac for 1865.

2. *Elements of Asteroid* (71) *Niobe.*—The following elements of Niobe were computed by F. Tietjen from observations of Aug. 14, Aug. 28 and Sept. 12.

Epoch 1861. Aug. 28·0.

L, Mean longitude at epoch,	317° 12′ 32″·8
π, Longitude of perihelion,	221 9 4 ·1
☊, Longitude of ascending node,	316 11 52 ·6
i, Inclination of orbit,	23 8 34 ·6
e, Eccentricity of orbit,	0·1645225
μ, Mean daily motion,	780″·574
a, Semi-major axis,	2·74407

The inclination of the orbit of this asteroid is remarkable; only two asteroids, Pallas and Euphrosyne, having a greater inclination.

3. *Re-appearance of Encke's Comet.*—Encke's comet has again made its appearance, and will reach its perihelion Feb. 6, 1862. It will pass nearest to the earth Jan. 31, 1862.

It was discovered at Cambridge Observatory, Oct. 24th, and the following observations have been communicated by the Director, Prof. G. P. Bond.

M. T. Cambridge.	Comet's A. R.	Comet's Dec.	C.—O. Δα	C.—O. Δδ
d h m s	h m s			
1861, Oct. 24 7 13 15	23 27 58·67	+15° 9′ 5″·7	− 1s·61	+1′ 53″·1
29 9 18 21	23 15 35·06	13 55 5 ·2	− 3 ·86	+1 8 ·9
31 9 58 1	23 10 53·38	13 24 19 ·4	− 3 ·07	+1 15 ·4

The column with the heading *c-o*, contains a comparison with the Ephemeris published in the Astronomische Nachrichten, No. 1326.

The following ephemeris will enable observers to follow the comet's course without difficulty.

Berlin mean noon.	R. A.	Dec.	Berlin mean noon.	R. A.	Dec.
	h m s	° ′ ″		h m s	° ′ ″
1862. Jan. 1,	22 17 7·22	+3 7 35·8	1862. Feb. 18,	20 26 42·66	−25 7 54·1
5,	22 16 29·28	+2 38 55·9	22,	20 33 54·11	−25 25 16·6
9,	22 15 9·19	+2 2 15·9	26,	20 42 41·51	−25 20 36·9
13,	22 12 34·78	+1 11 43·5	March 2,	20 51 58·24	−25 3 23·4
17,	22 7 58·22	−0 1 45·9	6,	21 1 11·99	−24 38 58·3
21,	22 0 9·44	−1 51 54·8	10,	21 10 7·55	−24 10 31·5
25,	21 47 35·62	−4 37 29·3	14,	21 18 38·15	−23 39 59·2
29,	21 28 53·80	−8 35 30·7	18,	21 26 41·14	−23 8 36·0
Feb. 2,	21 4 56·87	−13 35 40·9	22,	21 34 15·90	−22 37 12·6
6,	20 41 42·87	−18 32 23·6	26,	21 41 22·58	−22 6 25·2
10,	20 27 9·75	−22 9 7·3	30,	21 48 1·57	−21 36 39·7
14,	20 23 16·54	−24 11 38·1	April 3,	21 54 13·45	−21 8 16·5

The following table shows the relative brightness of this comet for several dates during the period of its visibility, computed on the supposition that this brightness varies as $\frac{1}{R^2 r^2}$; where R and r represent the distances of the comet from the earth and sun.

Date.	Brightness.	Date.	Brightness.	Date.	Brightness.
Oct. 24	0·31	Jan. 21	7·24	Feb. 21	3·61
Nov. 15	0·45	Jan. 27	13·04	March 1	1·63
Dec. 1	0·59	Feb. 1	18·88	March 11	0·78
Dec. 15	0·83	Feb. 4	20·07	March 21	0·45
Jan. 1	1·64	Feb. 7	17·98	April 1	0·29
Jan. 11	3·06	Feb. 11	12·38	April 11	0·22

Dec. 25th, the comet as observed at Yale College, appeared as a tolerably conspicuous nebula, nearly circular, about three minutes in diameter, and sensibly condensed towards the centre.

At the time of greatest theoretical brightness, the comet will be nearly in conjunction with the sun, so that it cannot possibly be seen. Throughout most of the month of January, the comet will be in a favorable position to be seen immediately after the evening twilight; but unfortunately the full moon will interfere just at the time which otherwise would be the most favorable for observations.

4. *The Solar Eclipse of July* 18, 1860.—In vol. xxx, pp. 281–288, we have given a report of the expedition sent to Labrador, for the purpose of observing the eclipse of July 18, 1860; as also of the observations made on the western coast of the United States, by Lieut. J. M. Gilliss. We have recently received, through Prof. Bache, Superintendent of the U. S. Coast Survey, a fuller report of these expeditions, from which we gather some further particulars.

(1.) Expedition to Labrador.

The latitude of the place of observation was 59° 47′ 49″ N. and longitude 4^h 16^m 53^s W. of Greenwich. Its elevation above the level of the sea was 110 feet.

Beginning of the eclipse.

Time.	Observer.	Color of screen.
8^h 8^m 5^s·0	Alexander.	Green.
7·6	Ashe.	Orange.
9·6 estimated. / 12·6 certain.	Barnard.	Compound / Red and green.
16·1	Smith.	Neutral.
16·6	Venable.	Green.

Beginning of total obscuration.

9 13 28·6	Smith.	Neutral.
29·6	Barnard.	
30·6	Venable.	Bare eye.
31·4	Alexander.	No screen.
33·6	Ashe.	No screen.
33·6	Murray.	No screen.

End of total obscuration.

9 16 30·4	Ashe.	No screen.
31·6	Alexander.	No screen.

End of the eclipse.

10 25	1·9	Murray.	Red.
	2·6	Ashe.	Orange.
	2·6	Smith.	Neutral.
	2·6	Venable.	Orange.
	3·3	Alexander.	Neutral.
	3·6	Barnard.	Compound red and green.

The declination of the magnetic needle at the same station was found to be 51° 23′·1 W. of N.

The Dip of the magnetic needle was 82° 14′·5, and the total magnetic intensity was found to be 12·519.

(2.) Observations near Steilacoom, Washington Territory, by Lieut. J. M. Gilliss, U. S. Navy.

The station at which the eclipse was observed, was in lat. 47° 2′ 54″ N. and longitude 8^h 10^m $29^s·6$ W. of Greenwich.

The moon had advanced far upon the sun's disc when the sun rose above the horizon. The following are the

Times observed during the eclipse.

First internal contact of limbs,	4^h 47^m $29^s·9$
Second internal contact of limbs,	4 49 25·3
Duration of the total eclipse,	1 55·4
End of the eclipse,	5 42 28·2

METEOROLOGY.

5. *Report on the Meteors of November*, 1861, *by the Standing Committee appointed by the Connecticut Academy of Arts and Sciences on Meteors of November and August, in each year.*—There being no sufficient time for preparation of Circular Instructions to observers, the best that could be done, in that respect, was the introduction of a few of the most important suggestions into a publication upon the August meteors which certain of the Committee had occasion to make in the Am. Journal of Science and Arts. This publication is herewith presented to the Academy, and attention is invited to the computations and conclusions of Prof. H. A. Newton. Copies were distributed in advance of the November No. of this Journal, with a view, partially, to awaken interest in these observations.

From information received before and since the November period just past, it is believed that observations were made in several places at a distance from New Haven. Farther reports, if hereafter received, will be presented to the Academy.

(1.) At New Haven two of the Committee—Messrs. Newton and Twining—kept watch on the morning of Nov. 12, 1861, the latter from 2^h 15^m A. M. to 3^h 30^m A. M., and the former from 2^h 45^m A. M. to 3^h 30^m A. M. The number seen by both before 3^h was 10, and after that 22;—making 32 meteors in an hour by two observers,—not, however, fully two, since both observed, for much of the time, the same spaces. Five stars were definitely located and timed. Eight or nine only were conformable to the radiant in Leo. The morning was brilliantly clear. On the same morning Mr. Herrick, of the Committee, observed 15 between 4^h and 5^h,—of which about two-thirds radiated from the vicinity of Leo.

The morning of the 13th was also clear. Between 3^h and 5^h A. M.

130 different shooting stars were observed by a corps of four persons stationed on a high tower, viz., Messrs. E. C. Herrick, W. Haskell, W. W. Johnson and H. W. Thayer, as follows:

3^h–4^h A. M.	N.W. 15,	S.W. 10,	S.E. 17,	N.E. 16	= 58.
4–5 "	" 25,	" 9,	" 18,	" 20	= 72.

Prof. Newton, present most of the time, was chiefly engaged in recording, yet saw four meteors not seen by the others and not reckoned above. Prof. Twining was present part of the time occupied mostly in locating tracks and estimating times. About two-thirds of all conformed to a radiant, not very narrowly marked, in Leo. The paths of about 20 were determined, and the time and duration of flight recorded.

The mornings of the 11th and the 14th, unfortunately, were overcast.

(2.) At Germantown, near Philadelphia, the morning of the 13th was obscured. On the 14th Mr. B. V. Marsh observed

from 3^h 15^m to 4^h 1^m	3 meteors;	45 minutes.	Moon shining.
" 4 0 " 5	" 17 "	; 60	"
" 5 23 " 5 38	3 "	; 15	"

being 23 meteors by one observer in two hours. Thirteen of the number were bright and with trains—10 were faint and without trains. Of the bright meteors ten were conformable, and three approximately so,—of the faint meteors only one was strictly conformable—about half the others partially conformable.

The following is Mr. Marsh's determination of the radiant: "If from the centre of the line joining Epsilon and Gamma Leonis we describe a circle passing through those stars [a circle of nine degrees diameter] 10 of the bright ones had paths which traced back would, I think, cross the circle—of the remaining three one passed perhaps 10 degrees from it, and the other two about 5°."

It is remarkable that this determination of Mr. Marsh coincides as exactly as possible with that of November 13th, 1833, given to Prof. Olmsted by the chairman of your Committee in a letter from West Point, dated November 15th of that year, and appearing in the 25th vol. of the Am. Journal of Science and Arts, as follows, "As a definite point I should select, as near the truth, a small star in the Lion's neck which I find on the celestial globe at the bisection of a line, from ϵ to γ and also nearly at the bisection of a line from μ to η of that constellation." On the morning of the 11th, although overcast, the chairman, watching 15 minutes, observed through a partially open space near and around the zenith one meteor of great brightness and length of train.

(3.) At Burlington, N. J., Mr. Samuel J. Gummere observed alone as follows, viz.:

Nov. 13, 3 to 4½ A. M., 15 meteors, mostly faint.
" 14, 3 " 5½ " 19 " " "

The following observations made by Mr. Herrick, watching alone, on various mornings preceding the regular period, afford a valuable comparison with the mornings of the 13th and 14th as above reported, viz:—

Oct. 15, sky clear; from 4^h to 5^h A. M., 17 meteors seen—the majority if extended backwards would intersect in a region of 5° or 10° diameter of which Epsilon Geminorum was near the centre. The radiant was as definite as on the morning of Nov. 13.—Oct. 31, sky clear, 4^h to 5^h A. M.; 5 meteors—no well marked radiant.

Nov. 4, sky clear, 5^h A. M.; in 15 minutes 3 meteors.
Nov. 7, do. do. do.; do. 1 meteor.

On the whole, therefore, the observations of the current year, conjoined with those of the year 1860, may be held to indicate a probability that the recurring meteoric phenomena of November have recommenced; and we may entertain some expectation of an increase henceforth in definiteness—and perhaps in mass—until the proper period of the great display of 1833 shall have arrived. At present, however, it is the 14th instead of the 13th of the month that exhibits best the known characteristics:—as if the last twenty-eight years had produced some change of position in the nodes of the meteoric ring. Such a change, however, should appear in the radiant position if determined with sufficient certainty and precision.

(4.) *Addendum.*—The following observations are communicated by Mr. F. W. Russell of Natick, Mass. Place of observation, lat. 42° 18′, long. 71° 21′. On the mornings of Nov. 1st, 3rd and 7th, Mr. Russell observed from two to eight an hour—average five per hour. On the 4th, in two hours 12 small meteors, one half radiating from A. R. 15° N. Dec. 45°.

11th, 1^h to 3^h A. M. 11 meteors. Radiant A. R. 156° 30′ N. Dec. 40° 40′.
12th, 2^h 15^m to 4^h 40^m A. M. 32 meteors. Radiant about γ Leonis.
13th, morning cloudy.
14th, 2 hours before and 1 hour after midnight. 15 meteors, by three observers, the sky partly overcast. The meteors radiated from the zenith.

The meteors observed on mornings previous to the 13th were much larger than those of August. The meteors of the 12th radiated from a circle of $3\frac{1}{2}$° about γ Leonis—but the majority exactly from that star.

It is further noted that Mr. Russell, assisted by G. W. Hanchett and E. L. Pray, found, on the 23d, 25th, 26th, 28th and 29th of September last, an average of five meteors per hour to each observer.

Prof. Daniel Kirkwood of the Indiana State University, in a letter to the editors of this Journal, communicates the following particulars.

(5.) At Blomington, Indiana, the night of November 12th was quite cloudy; but from 11^h 15^m to 12^h 15^m, 11 meteors were seen, also from 3^h 20^m to 4^h 20^m of the 13th, 27 meteors, by four observers, Messrs. D. J. Bridge, N. M. Givan, J. Hood, and W. L. McCord, students of the University. The night of the 13th was too cloudy for any observation.

(6.) It is also noted that in the August previous, Mr. John Roberts of Madison, Ind., assisted by a friend, observed from 8^h 15^m to 10^h 15^m P. M. of the 11th of that month, 52 meteors; 20 in the first hour, and 32 in the second.

Respectfully submitted, ALEX. C. TWINING, *Chairman.*

New Haven, Nov. 20th, 1861.

6. *Meteoric observations in December*, 1861.—Shooting stars are in some years numerous about the 6th of December (see this Journal, 1st ser., vols. xxxv and xxxvi), but the characteristics of this meteoric display

are little known. At this period in 1861, the observations attempted at New Haven, were nearly frustrated by clouds. On the morning of the 3d inst., I saw but *four* shooting stars during half an hour ending at $5^h\ 30^m$. The evening of the 4th was cloudy. On the evening of the 5th the sky was clear, but the moon four days old was up. From $7^h\ 10^m$ to $8^h\ 10^m$ P. M. Messrs. G. W. Biddle, W. W. Johnson, H. W. Thayer and myself, stationed together on the S. tower of the Alumni Hall, saw only 14 shooting stars, viz., in N.E. 4; S.E. 1; S.W. 6; N.W. 3; or classified by magnitudes of stars, 2 of 1st, 7 of 2d, 5 of 3d and less. There was no well marked radiant. Dec. 6th and 7th the sky was overcast morning and evening. After this for several days the moon interfered in the evening, and clouds in the morning.

Mr. B. V. Marsh of Philadelphia informs me, that Mr. George Wood, while riding from that city to Haverford College, 8 miles west, between about 4½ A. M. and daylight of December 12th, observed numerous brilliant shooting stars, not less probably than *twenty-five*, chiefly in the northwest. E. C. HERRICK.

New Haven, Conn., Dec. 18, 1861.

V. MISCELLANEOUS SCIENTIFIC INTELLIGENCE.

(1. *Letter from our Paris Correspondent.*)

OBITUARY.—*Isidore Geoffroy St. Hilaire.*—The scientific world grieves at the sudden and lamented death of this learned zoologist. The author of "*L'Histoire Générale des Regnes Organiques*" and the "*Traité de Tératologie*," was born at the Jardin des Plantes (where his mother still lives) Sept. 16th, 1805, and there he died, Nov. 10th, 1861, at the age of 56 years. Isidore Geoffroy St. Hilaire was a member of the Academy of Sciences, Professor and Director at the Museum of Natural History, Professor of Zoology at the Sorbonne, Member of the Imperial Council of Public Instruction, and the principal promoter of the establishment of the Zoological Garden of Acclimation. It is not for me to judge the merits of this illustrious savant, but I may be allowed to repeat what all the world say of the private character of a man distinguished for benevolence and an ardent defender of the interests of the great scientific establishment in which he passed his whole life.

M. de Grateloup died at Bordeaux in the month of August, to the great regret of his numerous friends in the domain of science. He was one of those ardent natures who in the midst of the absorbing duties of medical practice found means of advancing by numerous labors his favorite science, Conchology. His work on Conchology is a resumé of the memoirs which he had published from time to time, but unfortunately he has republished only the first part, embracing the Univalves.

He has shown himself an excellent authority in the Tertiary fauna, which is especially difficult to the palæontologist, on account of the extensive knowledge required to fully explain existing malacology. The imperfect execution of the plates of his great work rendered the recognition of his species often difficult, and created a prejudice against his first volume, so that the second has never been published, although he some years since proposed to have the engraving done at Paris, his drawings and the text having been completed. The inconvenience of the journey to Paris, and of a long enough stay there, doubtless prevented the execution of the plan, which is much to be regretted, as there is no one in France so well prepared for such a work unless it is Deshayes, who is fully employed upon a supplementary work on the fossils of the basin of Paris. The description of the Acalephs is completed, but it is probable that the Gasteropods and the remainder of the work by Deshayes will require some years for completion.

I cannot refrain from extolling the good fortune of a savant who after having produced such a classic and important work as the "*Description des Coquilles Fossiles du Bassin de Paris*" is able after more than thirty years to republish the work, being from beginning to end his own critic, and to give to it that position of preëminence which it has held from its first appearance. Deshayes is fond of tracing back the origin of his scientific opinions to 1830, and their gradual enlargement. We cannot but admire this spirit in the critic, as vigorous as it was thirty years ago, which has enabled him to appreciate and assimilate all that science has produced good and durable for so long a period of time, so that he still retains the first place among all those who have taken his work as a point of departure.

The death of *Berthier* at a very advanced age is well known.* The place which he has left vacant at the Academy of Sciences will probably become the heritage of Henry St. Claire Deville, and although his position in the hierarchical scale of the learned world has not been proportioned to his talents, I am pleased to mention that it was only on account of the happy longevity of chemists: the same is true of a place in the Section of Mineralogy which he will occupy. He will then be attached to us by a new tie, and the day of his nomination will be a time of rejoicing to his numerous friends.

Daubrée has taken the chair of Geology at the Jardin des Plantes. What a complete revolution! Cordier, his predecessor, did not believe either in metamorphism, or in the existence of glaciers, [in the geological period ?] or in the multiplicity of species of feldspar, and felt constrained to restrict as much as possible the investigations of chemists in mineralogy and geology.

I do not think there is much evil in this; in science all methods are good which are founded upon a scientific principle, and a Professor of Geology at the *Jardin des Plantes* who vigorously combats all the extravagance and aberrations which follow in the train of metamorphism, for example, renders to science great and signal service. Cordier had not however a controversial nature and his opposition was habitually limited to the circle of his pupils and intimate friends. He devoted himself to the chair of Geology at the *Jardin des Plantes* and took but a small part in the great geological labors which were executed in France during the first half of the present century. Coming up from the School of Mines, deprecated by some and opposed by others, yet rarely confuted, his reputation was established by the execution of a geological chart of France, and by the vigor of his instruction which he exhibited in a special school. Public lectures like those delivered at the *Jardin des Plantes* have but

* See a notice of Berthier on p. 108.

little success in France, but this is rather the fault of the public than of the Professors. The attendance of 3000 of the common people upon a course of lectures on embryology, delivered by Agassiz, which we saw at Boston, in 1849, is a spectacle which even Cuvier himself was not able to secure at Paris. Daubrée has now a vast field open before him, and no one doubts that he will apply himself vigorously to his work.

The Artesian Wells of Passy flow at length with floods of water. This great work which has raised questions and theories of great practical importance, in regard to which I hope to address you on a future occasion, has given entire satisfaction in regard to the experiments there instituted.

The Civic Museum at Milan.—On a visit to Milan one has first to admire the riches of the collections in herpetology, at the Museum of that city, collected by the care of Prof. Jan, the Director, who has commenced the publication of a monograph upon serpents, comprising about a thousand species. Almost all the museums of Europe with the exception of the British Museum, and that of the Smithsonian Institution, (exceptions much to be regretted,) have furnished specimens of their serpents, and the figures drawn with uncommon accuracy and elegance by Prof. Jan are all prepared. Sacrifices of all kinds are made with alacrity to aid the preparation and publication of this great work. The plates are engraved at Paris. There will be 300 quarto plates, published in sections of six each, with the corresponding text, at 12 francs for each section. All interested in this department of natural history will be desirous to contribute to its success. This work is destined to supply a lack long known in this department of science. [We have received the first fasciculus.—Eds.]

The Museum of Florence.—Since we are speaking of the scientific movements now going on in Italy, we may mention, that the visit of King Victor Emmanuel to the Exhibition at Florence has caused the young Professors of that city to redouble their diligence in putting their Museum into a condition worthy the attention of the numerous visitors by whom it is frequented.

Under the intelligent direction of Mr. Cocchi, the Museum of Florence has had its palæontological treasures put in order, among the most remarkable of which are the fossil bones of the mammifers of the Val d'Arno. Cuvier studied them in place during his travels in Italy, and it appears that since that period they have not been much disturbed.

The Museum of Bologna, founded by Aldrovandus, is fully worthy of the high reputation of being the most ancient, and for a long time the most important museum in Europe. The collections in Comparative Anatomy are remarkably rich, and palæontology is represented by species very important in relation to the history of the science. Mr. Capellini has found some objects figured by Aldrovandus and others, of the existence of which we were entirely ignorant. Among them is the *Cervus euryceros*, and the fragment of a skull preserved at the Museum of Bologna will prove probably that classifying it with the great stag of the peat bogs of Ireland is an error.

Geological Map of Italy.—The Italian geologists have assembled at Florence to deliberate upon the practical means of executing a geological map of Italy. The Exhibition at Florence suggested the idea of this reunion, and I am happy to be able to transmit some information in regard to its deliberations upon all that is interesting to science. I am not sufficiently familiar with botany to be able to speak of the exhibition in horticulture. You are not unacquainted with the fact that the beautiful plain of Florence is one vast garden and that it ought to afford a magnificent spectacle when a horticultural exhibition unites both the riches of the public gardens and of private conservatories.

The Italian Exhibition at Florence, in 1861.—These great national expositions are interesting to science in more than one relation, but there is no department of science more directly represented than that of geology and mineralogy. Geological maps and the collections of mineral products always occupy an important place. Italy is not in this respect poor in comparison with other countries, and it will not be uninteresting to recount some of the first impressions of a rapid visit made during the first days of the opening of the Exposition, and to add some details collaterally communicated by the Commissioners of the Exhibition. The scientific department includes under the title, Mineralogy, Metallurgy and Machinery, all that relates to applied geology. At the head of the geological maps is placed the topographical and geological map of Etna, by Sartorius de Waltershausen. Next are the charts of Central Italy, by Gius. Ponzi, maps of Tuscany and of Monti Pisani, by Messrs. Savi and Meneghini; that of A. Sismondi, comprising the continental provinces of Sardinia, the fruit of long years of indefatigable labor; and some others of minor importance, among which we notice the mineralogical chart of the island of Elba, by Enrico Grabau. A great number of geological, mineralogical and palæontological collections were exhibited alone, or by the aid of charts, or in connection with the industrial products to which they are related.

The collection of Cretaceous fossils of the Marquis Strozzi gives an entirely new and definite date to the *pietra-forte* (travertine) of the neighborhood of Florence, which furnishes the flagstones used for paving the city. These fossils, collected during a period of years, by diligent and laborious research, are of great rarity, and they demonstrate incontrovertibly that they belong to the White Chalk, adding a new instance, to those already numerous, of the diversity of lithological characters.

Italian authors have long considered the *pietra-forte* as belonging to the Eocene rocks, and it appears that the Eocene rocks of Messrs. Savi and Meneghini have the same fossils which the numerous examples at the Exposition of Florence cause us to recognize as the *Inoceramus Cripsi* of Mantell and Goldfuss. The naked rock is gray, calcareous, micaceous, and dark gray, which the geologists of Northern Europe distinctly recognize as the graywacke of the transition-rocks rather than a representative of the White Chalk.

The island of Elba is represented by many metallurgic collections and by an admirable series of beautiful tourmalins of all colors.

Other exhibitors have presented the sulphurs of Sicily, ores of copper from Montecatini, boracic acid from the Soffioni, anthracites from the Alps, lignites from Cadibona, Sarzanello and Monte Camboli: nickeliferous pyrites of the Alps, manganese from St. Marcel, antimonial ores from Montanto, cinnabar from the mine of Siele in Tuscany; also the earthy pigments and the kaolins; and last but not least the beautiful marbles which are an unfailing source of wealth to Italy.

We will now consider briefly the economic importance of these different industries:

Sulphur.—The annual product of all the sulphur mines of Italy is estimated at 300,000 tons, valued at thirty millions of francs. In 1830 the product was only one-tenth part what it is at present. Sicily produces the greater portion, while the Romagna produces 8000 tons, and this amount is constantly increasing. The employment of large furnaces of a new form is considered an important improvement, increasing the product by one-fifth and considerably diminishing the disengagement of sulphurous acid.

Iron.—The production of iron in Italy which does not probably exceed 35,000 tons of cast iron per annum, is restricted chiefly by the scarcity of fuel. The charcoal employed is of excellent quality, and the wrought iron made with it sells for from twenty-eight to forty-five francs per 100 kilograms, according to the distance of the market from the place of production.

Lead.—The production of lead is about 7000 tons; the island of Sardinia alone furnishes 17,000 tons of galena. They have recently undertaken to remelt the old scoriæ which are found in immense quantities in the same island and which furnish even now about 1000 tons of metal per annum.

Copper.—The annual production of copper is 1500 tons, obtained principally from the mines of Montecatini and Capanne-vecchi in Tuscany, Agordo in Venetia, and the Val d'Aosta. The ores of copper are generally diffused throughout Italy, but the deposits are seldom sufficiently rich to be wrought with profit.

Boracic Acid.—The product of the Suffioni, in the province of Pisa, is two millions of kilograms, of which 1,800,000 are derived from the establishments founded by Count Francesco dè Larderell, the founder of this industry, of so much importance at the present time.

Combustibles.—The mineral coal, properly so called, found in Italy, is only the anthracite of the Alps, a combustible of little value on account of its impurity. The lignites, on the contrary, are of excellent quality, but the amount mined does not exceed 60,000 tons per annum.

Nickel.—Nickeliferous pyrites are abundant in the Alps; they contain on an average five per cent of nickel, and the reducing works of Varallo in the province of Novara furnish 50,000 kilograms of metallic nickel annually, for which a ready market is found.

Gold.—The auriferous pyrites of the Alps, treated by amalgamation, produce nearly 500,000 francs in gold per annum.

Manganese.—The mines of St. Marcel and Framura are the principal sources of manganese, the production of which amounts to 1000 tons per annum.

Antimony.—Tuscany produces more than 50 tons of antimony per annum.*

Mercury.—The depreciation of the price of this metal has considerably diminished its production in Tuscany. The annual product is 3500 kilograms.

* The ton of the metric system is 1000 kilograms, and the English long ton (of 2240 lbs.) is 1016 kilograms.

These details have been taken from a Report by the Commission of Jurors of the Exposition, of which Chevalier Quintius Sella is President, and Messrs. Cocchi and Fienzi are the reporters.

These gentlemen conclude their Report as follows:—"The Italian Exposition of 1861 gives satisfactory proof of the advancement of the science of geology and of mineral and metallurgic industry. It belongs to the government to encourage by efficient means the examination of the soil of Italy, for the construction of a geological and mineralogical chart on a grand scale; and to aid mineral and metallurgic industry by opening schools calculated to increase the productiveness of labor, by developing the scientific intelligence of laborers." L. S.

Paris, Nov. 15, 1861.

2. *Cannonading at Bull Run.*—The cannonading at the battle of Bull Run was heard in Preston county, Virginia, 125 miles distant. At a place called The Glades, a few miles south of Kingwood, Preston county, Va., on Sunday, July 21, 1861, Rev. E. O. Dunning (our informant), and many others, heard the low booming of cannon for several hours, say from 11 A. M. to 3 P. M. The sounds heard were faint, yet distinct, and so obviously due to artillery as to attract the attention of people and produce the conviction that a battle was going on, though it was supposed at the time to be at no great distance—somewhere in the mountains, perhaps, or at Harper's Ferry, at farthest. Two persons in particular, spoken of by Mr. D. gave attention to the reports during most of the time mentioned. Two young ladies, also, of the family of Mr. Freeland, where Mr. D. was staying, went after dinner to the top of a hill near by, where they heard the reports more distinctly, and remained there listening an hour or more. At night people came in from the neighborhood to learn where the battle had been.

At Kingwood, the county seat, the cannonading was heard more distinctly than at The Glades, the place being on higher ground.

Army officers at Oakland, some 15 miles west of Kingwood, on the Baltimore and Ohio railroad, heard the same, and said a battle was going on.

The subject was matter of common remark that day, and the next, before news of any battle had been received. Mr. D. knows personally many of the people who heard and spoke of the occurrence. There could be no possible mistake, Mr. D. thinks, as to the reality or nature of the reports. There was no cannonading that day, that could have caused them, nearer than that at Bull Run. Some persons also noticed and remarked at the time, that the sound came from the east or southeast.

The day was clear and calm, with little or no wind, or if any, Mr. D. did not notice it. The next day the wind was from the east, with rain.

The places named are nearly at the summit of the Alleghanies. Kingwood is about 125 miles from Bull Run in an air line.

These statements were communicated to me in conversation by Rev. Mr. Dunning himself, who graduated at Yale College in 1832, and has spent many years in Virginia as Agent of the Am. Bible Society.

New Haven, Oct. 5th, 1861. C. S. LYMAN.

[*Note.*—It is a commonly received opinion that sound travels farther and more loudly on the earth's surface than through the air—thus the cannonading at Jena in 1806 was very feebly heard in the open fields about Dresden—distant 92 miles—but very distinct in the casemates of the fortifications of Dresden. The Glades are nearly at the height of land of that part of Virginia, probably not less than 2500 feet above the sea. It is certain that at a great number of places within a radius of 125 miles from Stone Bridge, where the Bull Run cannonading occurred, the sound was not heard—and it seems probable that its distinctness at The Glades was due chiefly to the elevation of that place. It is well known from the experience of aeronauts that sounds are heard with much greater distinctness *from* the earth to a balloon than on the earth from the balloon. In deep vallies sound may be cut off by reflection, the mountains acting as screens—while the same sounds are distinctly heard on eminences at greater distances. We ask our correspondents residing within the radius here named to send us their experiences on this subject.—EDS.]

3. *The California Survey.*—Mr. W. M. GABB, distinguished for his critical knowledge in palæontology, has joined the California Geological Survey in the capacity of Palæontologist. We learn by private letters that the collections of fossils and minerals already arrived in San Francisco are very large and valuable. The exploring parties closed their labors for the winter in December, and will remain at headquarters in San Francisco until March before again taking the field. We shall probably be able in an early issue to give an outline of what has already been accomplished in the first year's labors now closed.

4. *Copley Medal and Royal Medals awarded.*—Prof. AGASSIZ is the recipient for the year 1861 of the Copley Medal, in the gift of the Royal Society of London, in consideration of his scientific investigations generally.

One of the Royal Medals has been awarded to Dr. Carpenter for his researches on the Foraminifera and other works on Physiology and Comparative Anatomy.

The third medal was awarded to Prof. J. J. Sylvester, of Woolwich, for his important contributions to Mathematical Science.

5. *Prof. August De LaRive*, of Geneva, has sent us a communication reclaiming the explanation of the electrical origin of the Aurora, given by Mr. B. V. Marsh, in our No. for May last. We had proposed to publish Prof. De LaRive's letter in this number but it is unavoidably postponed to our next.

6. *Personal.*—Mr. WILLIAM PHIPPS BLAKE and Mr. RAPHAEL PUMPELLY, M.E. have been commissioned by the Japanese Government to proceed to Japan and make an exploration into the economic geology and mineral resources of that kingdom of which we now know almost nothing. These gentlemen sailed from San Francisco for Japan, Nov. 23d.

VI. BOOKS RECEIVED.

Annual Report of the Board of Regents of the SMITHSONIAN INSTITUTION, showing the operations, expenditures, and condition of the institution for 1860. 8vo, pp. 448. U. S. Senate Doc. No. 21. G. W. Bowman, Printer, Washington, 1861.

Smithsonian Contributions to Knowledge, vol. xii, contains—Art. I. Introduction, &c. Art. II. Astronomical Observations in the Arctic Seas; by ELISHA KENT KANE, M.D., U. S. N., made during the second Grinnell Expedition in search of Sir John Franklin, in 1853–4–5, &c. Reduced and discussed by CHAS. A. SCHOTT, Asst. U. S. Coast Survey, p. 56, and 1 plate. Art. III. On Fluctuations of Level in the North American Lakes; by CHAS. WHITTLESEY. p. 28, and 2 plates. Art. IV. Meteorological Observations made at Providence, R. I. (28½ years, ending May, 1860); by

ALEXIS CASWELL, Prof. Nat. Phil. and Theology in Brown University. pp. 188. Art. V. Meteorological Observations made near Washington, Arkansas, (20 years, ending in 1859); by NATHAN SMITH, M.D. pp. 96. Art. VI. Researches upon the venom of the Rattlesnake, with an investigation of the Anatomy and Physiology of the organs concerned; by S. WEIR MITCHELL, M.D. p. 156, and 12 wood cuts.

Philosophical Transactions of the Royal Society of London, for the year 1860. Vol. 150, Part II. London: Taylor & Francis. 1861. 4to, pp. 185–620.

Report of the Thirtieth Meeting of the British Association for the Advancement of Science; held at Oxford, June and July, 1860. London: J. Murray. 1861. 8vo, pp. 236–262.

First Biennial Report of the Progress of the Geological Survey of Michigan, embracing observations on the Geology, Zoology and Botany of the Lower Peninsula. Made to the Governor, Dec. 31, 1860. By Authority. Lansing: Hosmer & Kerr, Printers to the State. 1861.

Researches in the Southern Gold Fields of New South Wales. By the Rev. W. B. CLARKE, M.A. Sydney: Reading & Wellbank, Bridge street. 1860.

Topographischer und naturwissenschaftlicher Atlas zur Reise durch Java. Von Dr. FR. JUNGHUHN. Magdeburg, 1845.

Topographische und naturwissenschaftliche Reisen durch Java, von Dr. FRIEDRICH JUNGHUHN, Mitglied der Kaiserl. Leop.-Carol. Akademie der Naturforscher. Für die Kaiserl. Leopold.-Carol. Academie der Naturforscher zum Druck befördert und bevorwortet durch Dr. C. G. NEES VON ESENBECK, Präsidenten der Akademie. Mit einem aus 38 Tafeln und 2 Höhenkarten bestehenden Atlasse. Magdeburg, 1845. Verlag von Emil Baensch.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, rédige par les Secrétaires de la Société, MM. COMBES et PELIGOT. 4to. Paris: Imprimerie de Mme. Ve Bouchard-Huzard, Rue de l'Eperon, 5. 1861.

Jahresbericht über die Fortschritte der reinen, pharmaceutischen und technischen Chemie, Physik, Mineralogie und Geologie. Berichte über die Fortschritte der Chemie und verwandter Theile anderer Wissenschaften. Von KOPP und WILL. Für 1860. Giessen: J. Ricker'sche Buchhandlung. 1861.

Jahresbericht über die Wirksamkeit des Werner-Vereins zur geologischen Durchforschung von Mähren und Schlesien im Vereins-Jahre 1851–1860. Brünn: Druck von Georg Gastl. 1861. 4to.

Uebersicht der geologischen Verhältnisse von Mähren und österr. Schlesien. Von OTTO FREIHERRN VON HINGENAU. Wien, 1852. 8vo, pp. 82.

Leitfaden der allgemeinen Literaturgeschichte. Für Lehrer und zum Selbstunterrichte herausgegeben von Dr. J. G. TH. GRASSE, Königl. Sächs. Hofrath. Dritte verbesserte Ausgabe. Leipzig: Verlag von Gustav Gräbner. 1861. 8vo, pp. 357.

Blicke in das Universum, mit specieller Beziehung auf unsere Erde. Bearbeitet von L. GRUSON, Königlich-Preussischem Ingenieur-Major a. D. Mit 42 Holzschnitten und 3 lithographirten Tafeln. Neue Ausgabe. Leipzig: Verlag von Gustav Gräbner. 8vo, pp. 351.

Tropical Fibres: their Production and Economic Extraction. By E. G. SQUIER, formerly Minister of the United States in Central America, etc. New York: Scribner & Co., 124 Grand st. 1861. 8vo, pp. 61.

BROCHURES.—GEOLOGY AND MINERALOGY.

Etudes sur le Métamorphisme des Roches, par M. DELESSE. Ouvrage Couronné par l'Académie des Sciences. Paris: Imprimerie Impériale. 1861. 4to, pp. 95.

Recherches de l'Azote et des Matieres Organiques dans l'Ecorce Terrestre. (Suite.) Par M. DELESSE. Extracted from Annales des Mines.

Sur l'Unité des Phénomènes Géologiques dans le Système Planetaire du Soleil par M. L. SÆMANN. Extrait du Bulletin de la Société Géologique de France, 2e série, t. xviii, p. 322, séance du 4 février 1861. Paris: Imprimerie de L. Martinet, Rue Mignon, 2. 1861. (Translated on p. 36, this volume.)

On the recent discoveries of Gold in Nova Scotia. By J. W. DAWSON, LL.D., F.G.S., &c. From the Canadian Naturalist and Geologist, December, 1861.

On the Pre-Carboniferous Flora of New Brunswick, Maine, and Eastern Canada. By J. W. DAWSON, LL.D., F.G.S., &c. From Canadian Naturalist for May, 1861.

Geological Survey of Canada, Sir W. E. Logan, F.R.S., Director.—New Species of Lower Silurian Fossils. By E. BILLINGS, F.G.S., &c. Montreal: John Lovell, S. Nicholas street. 21st November, 1861.

Géologie Pratique de la Louisiane. Par M. R. THOMASSY. Par HENRI DE SAUSSURE. Tiré de la Bib. Univ. 1861.

Synopsis of the Mollusca of the Cretaceous Formation, including the Geographical and Stratigraphical Range and Synonymy. By W. M. GABB. March, 1861. pp. 201.

Review of Mr. Barrande on the Primordial Zone in North America, and Taconic System of Dr. Emmons. By T. STERRY HUNT, M.A., F.R.S.

Descriptions of new Cretaceous Fossils from Texas. By B. F. SHUMARD. From the Proceedings of the Boston Society of Natural History, September 4, 1861. Boston: Press of Geo. C. Rand & Avery. 1861.

Contributions to Palæontology. Continuation of Appendix C. Descriptions of New Species of Fossils, from the Upper Helderberg, Hamilton and Chemung groups, continued from page 109 of the Fourteenth Annual Report of the Regents of the University upon the State Cabinet. Albany: C. H. VanBenthuysen. 1861.

On some of the Rocks and Fossils occurring near Phillipsburgh, C. E. By E. BILLINGS, F.G.S., of the Geological Survey of Canada.

On the Devonian Fossils of Canada West. By E. BILLINGS, F.G.S. Extracted from the Report of the Geological Survey of Canada for 1860, in preparation.

Notes on the history of Petroleum or Rock Oil. By T. STERRY HUNT, M.A., F.R.S., of the Geological Survey of Canada.

Mineralogie. From Jahresbericht der Chemie, Phisik, Mineralogie und Geologie, für 1860. Geissen, 1861.

A Description of the Imperial State Crown, preserved in the Jewel House at the Tower of London. By Prof. TENNANT, of King's College. Read before the London and Middlesex Archæological Society at Islington, July 7, 1858.

Mineral Veins: an Enquiry into their Origin, founded on a study of the Auriferous Quartz Veins of Australia. By THOMAS BELT. London: John Weale, High Holborn. Newcastle-upon-Tyne: A. Reid, 40 and 65 Pilgrim st. 1861.

Notes on the Geology of the coast of Labrador, by OSCAR M. LIEBER, Esq., August, 1860.

PHYSICS AND CHEMISTRY.

On some of the Relations of Salts of Zinc and Alumina to Soda and Potassa. By E. N. HORSFORD. From Memoirs Am. Acad., Sept., 1860.

On the Chromate of Chromium, and analogous Chromates. By FRANK H. STORER and CHAS. W. ELIOT. From the Proceedings of the American Academy of Arts and Sciences, Vol. V.

On the Detection of Strychnia as a Poison, and the influence of Morphia in disguising the usual color-test. By JOHN J. REESE, M.D., of Philadelphia.

On the Sources of the Nitrogen of Vegetation; with special reference to the question whether Plants assimilate Free or Uncombined Nitrogen. By JOHN BENNETT LAWES, Esq., F.R.S., F.C.S., JOSEPH HENRY GILBERT, Ph.D., F.R.S., F.C.S., and EVAN PUGH, Ph.D., F.C.S. (Abstract.) From the Proceedings of the Royal Society of London for June 21, 1860. London: Taylor & Francis, Red Lion Court, Fleet Street. 1860.

Les Aurores Boréales. Tiré de la Bibl. Univ., Nov. 1859. Genève: 1859.

De l'Aurore Boreale du 29 Aout 1859. Par M. le professeur A. DE LA RIVE. Tiré des Ar. des Sc. de la Bibl. Univ., Sept., 1859.

Abstract of a Discussion of the Influence of the Moon on the Declination of the Magnetic Needle, from the observations at the Girard College, Philadelphia, between the years 1840 and 1845. By A. D. BACHE, Superintendent U. S. Coast Survey. From the Am. Jour. Sci., Jan. 1861.

General Account of the Results of Part II of the discussion of the Declinometer Observations made at the Girard College, Philadelphia, between 1840 and 1845, with special reference to the Solar Diurnal Variation and its Annual Inequality. By A. D. BACHE, Supt. U. S. Coast Survey. From the Am. Jour. Sci., March, 1861.

Lecture on the Gulf Stream, prepared at the request of the American Association for the Advancement of Science. By A. D. BACHE, Supt. U. S. Coast Survey. From the Am. Jour. Sci., Nov., 1860.

Discussion of the Magnetic and Meteorological Observations made at the Girard College Observatory, Philadelphia, in 1840, 1841, 1842, 1843, 1844, and 1845. Part I. Investigation of the Eleven Year Period in the amplitude of the Solar-diurnal Variation and of the Disturbances of the Magnetic Declination. By A. D. BACHE, LL.D. Smithsonian Contributions to Knowledge. Washington City: Published by the Smithsonian Institution. November, 1859. New York: D. Appleton & Co.

MATHEMATICS AND ASTRONOMY.

On the Geometrical Construction of certain Curves by Points. By H. A. NEWTON, Professor of Mathematics in Yale College. Math. Month., Vol. III.

On the Theory of the Polyedra. By the Rev. T. P. KIRKMAN, M.A., F.R.S., and Hon. member of the Literary and Philosophical Society of Manchester.

Continuation of Account of the Comet II, 1861. By G. P. BOND, Director of the Observatory of Harvard College.

Report to the Superintendent of the United States Coast Survey on the expedition to Labrador to observe the total eclipse of July 18, 1860, organized under act of Congress approved June 15, 1860. By Prof. STEPHEN ALEXANDER, LL.D., of the College of New Jersey.

An account of the total solar eclipse of July 18, 1860, as observed for the United States Coast Survey near Steilacoom, Washington Territory. By Lieut. J. M. GILLISS, U. S. Navy.

J. F. ENCKE: Sur la différence de Longitude des Observatoires de Bruxelles et de Berlin, déterminée en 1857, par des signaux galvaniques. (Traduction.)

NATURAL HISTORY.

Iconographie générale des Ophidiens. Par M. le Professeur JAN, Directeur du Musée de Milan. Première livraison. Décembre, 1860. VI plates.

Annals of the Botanical Society of Canada. Vol. I, Part II. From 8th March, 1861, to 28th March, 1861.

Erster Bericht des Offenbacher Vereins für Naturkunde über seine Thätigkeit von seiner Gründung am 10 März, 1859, bis zum 13 Mai, 1860. Offenbach am Main: Druck von Kohler & Teller. 1860.

Der Bakonyerwald. Eine pflanzengeographische Skizze. Von Dr. A. KERNER.

Notes on New Species of Microscopical Organisms from the Para River, South America. By LORING W. BAILEY. From the Boston Jour. Nat. Hist., vol. vii, No. iii. Cambridge: H. O. Houghton. 1861.

Contributions to the Comparative Myology of the Chimpanzee. By BURT G. WILDER. From the Bost. Jour. Nat. Hist., vol. vii. Cambridge: H. O. Houghton. 1861.

On the Geographical Distribution of the Genera and Species of Land Shells of the West India Islands, with a Catalogue of the Species of each island. By THOS. BLAND, F.G.S., London, Member of the Lyceum of Natural History, N. Y.; Corresponding Member of the Academy of Natural Sciences, Philad., &c. Reprinted from the Annals of the Lyceum of Natural History, New York, Vol. VII.

Smithsonian Miscellaneous Collections.—Classification of the Coleoptera of North America. Prepared for the Smithsonian Institution, by JOHN L. LECONTE, M.D. Part I. Washington: Smithsonian Institution. May, 1861. pp. 214.

MEDICAL.

Report of a Committee of the Boston Society for Medical Improvement, on the Alleged Dangers which accompany the Inhalation of the Vapor of Sulphuric Ether. Boston: David Clapp, 334 Washington street. 1861.

The Modus Propagandi of the Human Species, physiologically explained. By JOHN O'REILLY, M.D. New York: Hall, Clayton & Co., 46 Pine st. 1861.

Zeitschrift für Medicin, Chirurgie und Geburtshülfe, herausgegeben von Dr. A. W. VARGES. Leipzig, 1861.

MISCELLANEOUS.

La Psychologie et les Sciences d'Observation. Discours prononcé a la Séance Publique de l'Académie de Stanislas, le 30 Mai, 1861. Par M. J. NICKLÈS, President. Nancy, 1861.

The Position of our Species in the Path of its Destiny; or, the Comparative Infancy of Man, and of the Earth as his Home. New York: Charles Scribner, 124 Grand st.; Chas. B. Richardson, Bible House, Astor Place.

Extrait du Programme de la Société Hollandaise des Sciences à Harlem, pour l'Année, 1861.

Denkrede auf Christian Samuel Weiss. Von Dr. CARL FRIEDR. PHIL. v. MARTIUS, Sekretär der mathematisch-physikalischen Classe. München, 1856.

Denkrede auf Alexander von Humboldt. Von CARL FRIED. PHIL. v. MARTIUS, Sekretär der mathem.-phys. Klasse. München, 1860. Verlag der Königl. Akademie.

VII. PROCEEDINGS OF SOCIETIES.

PROC. OF ACAD. NAT. SCI. OF PHILAD. 1861, (continued from vol. xxxi, p. 308.)—JANUARY—p. 2, Food of the Shad; *Dr. Leidy.*—Development of freshwater shells; *Dr. Lewis.*—3, Description of a new species of Anableps, of Gronovius; *Theo. Gill.*—6, On the classification of the Eventognathi or Cyprini, a suborder of Teleocephali; *T. Gill.*—9, Note on Ants in Texas; *S. B. Buckley.*—10, Descriptions of new species of Scolopendra, in the collection of the Academy; *H. C. Wood, Jr.*—15, Observations on Cottus Copei, Abbott; *Chas. C. Abbott.*—16, Appendix to the "Monograph of the Philypni," and description of the genus Lembus of Günther; *T. Gill.*—18, Synopsis of American Cretaceous Brachiopoda; *W. M. Gabb.*—FEBRUARY.—21, Geological formations of the Far West, with reference to the identity of *Gryphæa Pitcheri* with Marcou's *G. dilatata* var. *Tucumcarii; W. M. Gabb.*—22, On a sudden fall of temperature experienced at Mohawk, N. Y.; *Dr. Lewis.*—25, Synonymy of the Cyclades, a family of Acephalous Mollusca. Part 2; *Temple Prime.*—33, Synopsis of the Subfamily of Clupeinæ, with descriptions of new genera; *T. Gill.*—38, Descriptions of twenty-five new species of Unionidæ from Georgia, Alabama, Mississippi, Tennessee and Florida; *I. Lea.*—41, Descriptions of new recent shells from the coast of South Carolina; *Edmund Ravenel.*—44, Synopsis of the Subfamily of Percinæ; *T. Gill.*—52, Synopsis generum Rhyptici et affinium; *T. Gill.*—54, Descriptions of new species of Schizostoma, Anculosa and Lithasia; *I. Lea.*—55, Description of a new species of Neritina, from Coosa River, Alabama; *I. Lea.*—56, Descriptions of two new species of Anodontæ, from Arctic America; *I. Lea.*—MARCH.—57, On the habits and growth of Unionidæ; *Dr. Lewis*, of Mohawk, N. Y.—58, Remarks on a species of Osmerus taken in the Schuylkill, below Fairmount Dam; *Thad. Norris.*—59, Descriptions of twelve new species of Uniones, from Alabama; *I. Lea.*—61, Notes on new and rare species of Diatomaceæ of the United States seaboard, with two plates; *F. W. Lewis.*—71, separate paging 1-63, Catalogue of the Fishes of the eastern coast of North America, from Greenland to Georgia; *T. Gill.*—72, On a new species of Goose from Arctic America; *Mr. Cassin.*—APRIL.—73, On certain required changes in the nomenclature of the Reptiles; *E. D. Cope.*—75, On two genera of Reptilia not previously known; *E. D. Cope.*—77, On several new generic types of fishes contained in the museum of the Smithsonian Institution; *T. Gill.*—79, Revision of the genera of North American Sciæninæ; *T. Gill.*—89, On the Liostominæ; *T. Gill.*—93, On the identity of the genera Neomænis of Girard, and Lutjanus of Bloch; *T. Gill.*—95, Notes on the habits of Aphredoderus Sayanus; *C. C. Abbott.*—96, Description of a new genus (Strephobasis) of the family Melanidæ, and three new species; *I. Lea.*—97, On the marine shells brought by Mr. Drexler from Hudson's Bay, and on the occurrence of a Pleistocene deposit on the southern shore of James' Bay; *W. Stimpson.*—MAY.—98, On two new species of marine fishes; *T. Gill.*—100, On the Haploidonotinæ; *T. Gill.*—105, On the genus Anisotremus, Gill; *T. Gill.*—108, Synopsis of the Uranoscopoids; *T. Gill.*—117, Descriptions of forty-nine new species of the genus Melania; *I. Lea.*—JUNE.—124, Two of the young of the *Kalemys Muhlenburgii*, exhibited by *Mr. Ennis.*—125, Descriptions of new species of Cyrena, Corbicula and Sphærium; *T. Prime.*—128, Descriptions of new Palæozoic fossils from Illinois and Iowa; *F. B. Meek* and *A. H. Worthen.*—148, Descriptions of new fossil Mollusca, from the Cretaceous formation at Haddonfield, New Jersey; *I. Lea.*—JULY.—150, On the sex of Cynipidæ; *Baron Osten Sacken.*—153, Description of a new species of the genus Pitta; *D. G. Elliot.*—154, On Cyprinus Corporalis, Mitch., referring it to the genus Semotilus, Rafinesque; *C. C. Abbott.*—156, Descriptions of new Pteropine Bats from Africa; *Harrison Allen.*—160, Descriptions of certain species of Diurnal Lepidoptera, found within the limits of the United States and of British America; *Wm. H. Edwards.*—164, Notes on some genera of Fishes of the western coast of North America; *T. Gill.*—168, On a new type of Aulostomatoids, found in Washington Territory; *T. Gill.*—170, A monograph of the Tringeæ of North America; *Elliott Coues.*—AUGUST.—206, On three new forms of Rattlesnakes; *Robert Kennicott.*—208, Notes and descriptions of Anoles; *E. D. Cope.*—215, Notes on the Ornithology of Labrador; *Elliott Coues.*—SEPTEMBER.—258, On the genus Podothecus; *T. Gill.*—261, Description of a new generic type of Blennoids; *T. Gill.*—263, Monograph of the Tridigitate Uraniscopoids; *T. Gill.*—271, Synopsis of the Polynematoids; *T. Gill.*—282, Homoptera of the North Pacific Exploring Expedition under Com'rs. Rodgers and Ringgold; *P. R. Uhler.*—284, Descriptions of four species of Hemiptera collected by the N.W. Boundary Survey; *P. R. Uhler.*—286, Rectification of the paper upon the Hemiptera of the North Pacific Expedition; *P. R. Uhler.*—287, Descriptions of Nine North American Limnobiaceæ; *Baron R. Osten Sacken.*—292, Contributions to the Ophiology of Lower California, Mexico and Central America; *E. D. Cope.*—306, List of the Mollusca inhabiting the neighborhood of Philadelphia; *W. M. Gabb.*—OCTOBER.—312, Description of a new species of the genus Thelyphonus; *Horatio C. Wood, Jr.*—312, On the Reptilia of Sombrero and Bermuda; *E. D. Cope.*—314, Description of a new species of Rodent of the genus Spermophilus, from Texas; *J. H. Slack.*—314, Descriptions of new Cretaceous fossils collected by the Northwestern Boundary Commission, on Vancouver and Sucia Islands; *F. B. Meek.*—318, Description of new species of Cretaceous fossils from New Jersey, Alabama and Mississippi; *W. M. Gabb.*—330, Catalogue of land and freshwater univalve Mollusks collected in British America by Messrs. Ross, Kennicott and Drexler, and deposited in the Smithsonian Collection; *W. G. Binney.*—331, Notes on the Terrestrial Mollusks of the Peninsula of California; *W. G. Binney.*—333, Description of two new species of Helix; *A. D. Brown.*—NOVEMBER.—335, Notes on the Coleopterous Fauna of Lower California; *John L. LeConte.*—338, New species of Coleoptera inhabiting the Pacific district of the United States; *John L. LeConte.*—359, Description of a new Mexican Bat; *Harrison Allen.*—361, Note on the Bartram Oak (*Quercus heterophylla*); *S. B. Buckley.*—Description of a new species of North American Grouse; *George Suckley.*—363, Notes on Cretaceous Fossils with descriptions of a few additional new species; *W. M. Gabb.*—367, Descriptions of new species of American Tertiary Fossils and a new Carboniferous Cephalopod from Texas; *W. M. Gabb.*—372, Notes on certain Decapod Crustacea; *Wm. Stimpson.*—373, A Monograph of the genus Ægiothus, with descriptions of new species; *Elliott Coues.*

PROCEEDINGS BOSTON SOC. NAT. HIST. (continued from p. 310, vol. xxxi) 1861. Vol. viii.—MARCH.—1, On the supposed identity of the Paradoxides Harlani, Green, with the Paradoxides spinosus, Boeck; *Albert Ordway.*—5, On the Occurrence of other Fossil Forms at Braintree, Mass.; *Albert Ordway.*—6, On the genus Raphidophora, Serville; with descriptions of four species from the Caves of Kentucky, and from the Pacific Coast; *Samuel H. Scudder.*—14, Descriptions of Shells collected by the North Pacific Exploring Expedition; *A. A. Gould*, (continued.)—APRIL.—40, Observations of the genus Cottus, and descriptions of two new species (abridged from the forthcoming Report of Capt. J. H. Simpson); *Theodore Gill.*—43, Description of a new species of the genus Tigoma of Girard (abridged from the forthcoming Report of Capt. J. H. Simpson); *T. Gill.*—Descriptions of new species of Pimelodinæ (abridged from the forthcoming Report of Capt. J. H. Simpson); *T. Gill.*—46, Synopsis of the genera of the sub-family of Pimelodinæ; *T. Gill.*—55, Catalogue of the Mineralogical species Allanite; *Wm. Sharswood*, (with an analysis of the Allanite from Franklin, N. J., by *T. S. Hunt.*)—58, Discussion on the Primordial Fauna in Massachusetts, Vermont, New York, &c.; *J. Marcou* and *Agassiz.*—60, Limiting depth for oceanic species; discussed by *Marcou, Gould*, and *Agassiz.*—61, Catalogue of the Marine Shells of Nova Scotia; *T. R. Willis*, of Halifax.—62, On the occurrence of Massive Datholite in the mines of Lake Superior; *A. A. Hayes.*—MAY.—65, Remarks on some of the Birds that breed in the Gulf of St. Lawrence; *Henry Bryant.*—75, Descriptions of new Ophiuridæ; *Theodore Lyman.*—36, Notes on the Cretaceous and Carboniferous rocks of Texas; *J. Marcou.*—100, Examination of a specimen of Ichthin; *B. J. Jeffries.*—On the rate of increase and other characters of freshwater shells, Unios; *Prof. Agassiz.*—102, Rock borings by *Saxicava rugosa;* discussed by *Jackson, Agassiz, Wyman* and *Storer.*—103, On the respiration of the Fishes of the Blenny family and genus *pholis*; *Dr. Kneeland.*—An account of a monstrosity; *The President.*—105, Micro-Photography, or the Photographic Delineation of Microscopic Objects; *A. M. Eaton*, of Providence, read by *L. W. Bailey.*—107, Remarks on the variations of plumage in *Buteo borealis*, Auct., and *Buteo Harlani*, Aud.? *Henry Bryant.*—JUNE.—119, Organisms found in the Mud from the bottom of Mystic Pond, Medford, near Boston; *R. C. Greenleaf* and *Chas. Stodder.*—122, Notes on the described species of Holconoti, found on the western coast of North America; *A. Agassiz.*—JULY.—134, Monograph of the genus Catarractes, Moehring; *Henry Bryant.*—AUGUST.—145, On the Red Zinc of New Jersey; *F. Alger.*—146, Notice of a munificent donation to the B. S. N. H. by Dr. W. J. Walker; *The President.*—150, Catalogue of several genera of the Tenthredinidæ in the United States; *Edward Norton.*

(*To be continued.*)

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[SECOND SERIES.]

ART. XVII.—*A Sketch of the History of Conchology in the United States.**

THE history of Conchology in America is necessarily brief—yet it is adorned with names which compare favorably with those of any of its cultivators in the old world. Indeed, where-ever Conchology is studied, the works of Say, Lea, Conrad, the Binneys, Adams, Gould, and numerous other of our authors, are referred to as standard authorities. With so much perseverance and skill have our Conchologists worked up certain genera of shells, that almost all new species in those genera, are placed in their hands for determination and description.

In the earlier years of our scientific history there were almost no libraries, authentically named specimens, or well informed naturalists in America; hence the student was compelled to rely entirely upon himself; and his descriptions, published necessarily in an obscure manner, were inaccessible to, or generally neglected, or entirely unnoticed by Europeans, who continually re-described the same species under different names, without regard to the prior claims of American authors, and frequently without the slightest attempt to study out their writings.† It was during these years of neglect that the science of Conchology was first cultivated in this country. Its votaries were men whose whole

* List of American writers on Recent Conchology. With the Titles of their Memoirs and dates of publication. By GEORGE W. TRYON, Jr., Member of the Academy of Natural Sciences of Philadelphia. 8vo. 68 pp. Baillière; New York, London, Paris and Madrid. 1861.

† See the chapter "*Of the ignorance and neglect of American Labors in Zoology, exhibited by European Naturalists.*" Binney's Terrestrial Mollusks, i, p. 56.

hearts were in their work, and they were continually urged by a noble ambition to new discoveries and achievements.

It must be acknowledged that notwithstanding adverse circumstances, the field was inviting to our naturalists; they were working in a new world, a vast continent whose varied and prolific natural objects, scattered as they were, over the broad expanse, from the ice-bound confines of the polar sea to the tropical regions of South America, had rarely or never met the eyes of civilized man. The abundance of material to be worked up, must in itself have proved a great inducement to commence the study of Conchology; in which even at the present time, there is vastly more yet to be elucidated in the United States than in Europe.

C. A. LE SUEUR, a native of France, who resided for some years in Philadelphia, where he published numerous papers on Ichthyology and other branches of Natural Science, is the author of the first article on Mollusca published in America. Mr. Le Sueur's paper, which was printed in the first number of the Journal of the Academy of Natural Sciences of Philadelphia (May, 1817), is entitled "Description of six new species of Firola, observed in the Mediterranean Sea by Messrs. Le Sueur and Péron in the months of March and April, 1809." It is illustrated. Mr. Le Sueur followed this at short intervals, with descriptions of various new species of Cephalopoda and Pteropoda, all in the same Journal.

THOMAS SAY. In the same number of the Journal of the Academy which contains Le Sueur's first paper, and of equal date with it, is the first conchological paper by Say, the greatest of our earlier naturalists—a man who, without the advantage of a liberal education or the means which have since been brought into the study of natural history, made for himself an undying reputation in almost every branch. With a quick eye for distinguishing differences, and a remarkably sound judgment of their proper values, most of his descriptions are models of accuracy combined with brevity. Very few of his species have been set aside. Mr. Say had also the merit of appending to most of his descriptions of species, their prominent distinctive characters from nearly allied forms—a very important part of a natural history description, too generally neglected. Mr. Say's principal writings on Conchology consist of—

1. Ten articles in the Journal of the Academy of Nat. Sciences, vols. i, ii, iv, and v, (1817–1826) describing a very large proportion of the marine shells of our Atlantic coast, a majority of the Helices of the Middle States, together with many from the South and West, and many fresh water species.

2. Article "Conchology" in Nicholson's Encyclopedia, American editions. Published also separately, with the title "Descriptions of the land and fresh water shells of the United States." Philadelphia, 1818.

3. Numerous descriptions of terrestrial and fluviatile shells in the "Disseminator," a weekly paper published at New Harmony, Ind., (1829–1831). These were subsequently issued in pamphlet. New Harmony, Ind. pp. 26. 1841.

4. A short paper in the Transylvania Journal of Medicine. Lexington, Ky., 1832, (included in the last named pamphlet).

5. An Appendix to the Narrative of Long's Expedition to Lake Winnepeg, containing descriptions of Mollusca, &c.; published in 1824.

6. American Conchology; or "Descriptions of the Shells of North America." Issued in 6 numbers, 8vo, with sixty colored plates. New Harmony, Ind., 1830–4. A 7th (posthumous) number has been published by Mrs. Say.

The "American Conchology" contains a large number of our common Mollusca, of which very many are either nowhere else figured, or only in expensive monographs. The descriptions are very full and accurate, and the plates characteristic, though not well finished.

In the above publications Mr. Say has introduced one hundred marine, one hundred fluviatile, and seventy-five terrestrial species. A large number of types of these, labelled by the author, are preserved in the Collection of the Academy of Nat. Sciences at Philadelphia.

The demand for the "American Conchology," and other papers long out of print, had become so great, as to induce, in 1858, their republication, with colored plates, as the "Complete writings of Thomas Say, on the Conchology of the United States." This work is ably edited by Wm. G. Binney, who has revised the nomenclature of the genera and species, and added many valuable notes.

C. S. Rafinesque, added to his other attainments in Natural Science, a considerable knowledge of Conchology; and he pursued its study with great ardor after his arrival in this country. Unfortunately, his earlier descriptions are too short and indefinite, and nearly all of his figures are too rude, for satisfactory recognition; later, his love of fame and insatiable speciesmongry induced him to mingle these with descriptions of objects which never existed; and finally, we are compelled to believe, that he put full confidence himself in the existence of these imaginary objects, as the dark cloud settled on his mind, which made him in fact a mad naturalist. During this period Rafinesque frequently redescribed his own species under different names, and ignored entirely the works of other American naturalists, appropriating their species with an audacity which can only be excused by charitably conceding his mental aberration.

Under these perplexing circumstances, most of our Conchologists, after vainly endeavoring to identify his descriptions, have discarded them almost entirely. The following are Mr. Rafinesque's principal publications, referring to our Mollusca:

"Discoveries in Natural History made during a Journey through the Western Region of the United States." Published in the American Monthly Magazine and Critical Review, vols. iii and iv. New York, 1818–19.

"Prodrome de 70 nouveaux Genres d'Animaux d'Amerique, durant l'Annèe, 1818." In the *Journal de Physique*, Paris, Juin, 1819.

"Monographie des Coquilles Bivalves Fluviatiles de la Rivière Ohio, contenant douze Genres et soixante huit Espèces." In *Annales Générales des Sc. Physiques*, Tome iii. Bruxelles, Sept. 1820.

C. A. Poulson, of Philadelphia, in 1832, translated this last paper of Rafinesque's and published it in a small volume entitled:

"Monograph of the bivalve fluviatile Shells of the River Ohio."

D. H. Barnes was the next American writer on Shells. He published in this Journal ([1], vi, No. 1, 1823,) an important paper "On the genera Unio and Alasmodonta, with introductory remarks." This article, which contains descriptions of several supposed new species, bears evidence of considerable knowledge of the Naiades. Some of his species were, however, anticipated by Lamarck, who became early acquainted with a number of our Uniones.

In vol. xiii, of this Journal, Mr. Barnes made a reclamation of his species of Naiades. He also contributed a paper describing five new species of Chiton in vol. vii, No. 1. 1824. Mr. Barnes was one of the earliest contributors to the "Annals" of the New York Lyceum of Natural History, of which Society he was an efficient member. He published three papers in the first and second volumes of the Annals, 1824–28. He was accidentally killed, Oct. 27, 1828.

Dr. Jacob Green (deceased) was one of the earliest workers in this department of Natural Science. The following papers by Dr. Green are in the Contributions to the Maclurian Lyceum:

1. "Description of Helix Pennsylvanicus." *Note* to a Memoir on Salamander, p. 8. Read Oct. 23, 1826.

2. "Some Remarks on the Unios of the United States." Read April 23, 1827.

3. "Description of two new species of Achatina from the Sandwich Islands." Read May 14, 1827.

4. "Remarks on Achatina Stewartii." Read Sept. 27, 1828.

His papers in the Transactions of the Albany Institute consist of—

1. "Monograph of the Cones of North America, including three new species."

2. "The Dolia of the United States," and

3. "Notes on American Shells figured in the Supplement to the Index Testaceologicus." All read June 7, 1830.

He also contributed papers at various times to Doughty's Cabinet of Natural History. Vols. i, ii, iii. Philadelphia, 1830–33.

Dr. S. P. HILDRETH, of Marietta, Ohio, a well known contributor in other departments to this Journal, published in the first series, vol. xiv, 1828, an interesting paper on the shells inhabiting the vicinity of that town.

ISAAC LEA, President of the Academy of Natural Sciences, contributed his first paper on Conchology to the Philadelphia Philosophical Transactions, vol. iii, 1828; and from that date to the present time, a period of thirty-four years, he has given unceasing attention to the science, and particularly to his chosen speciality, the Naiades, with whose history he has become perfectly identified, having described five-sixths of all the recent species published.

There are but few authors who have so patiently, indefatigably and successfully, worked up the subject of their studies as Mr. Lea. He has contributed two hundred papers to the Proceedings of the Academy, and of the Philosophical Society, describing about 550 species of Naiades, 400 species of Melanians and other fresh water shells, and 50 species of Terrestrial shells.

These papers are elaborated in the Transactions of the Philosophical Society, and Journal of the Academy of Natural Sciences, 2d series, and are illustrated by excellent figures, many of them colored.

They have also been issued in *eight quarto volumes*, containing in all 850 pp. and 198 plates, as follows:

Vol.	I.	1832, pp. 230.	From Philos. Trans. III, IV, V.
"	II.	1838, pp. 152.	" " " VI.
"	III.	1842, pp. 88.	" " " VIII.
"	IV.	1845, pp. 75.	" " " IX, X.
"	V.	1852, pp. 62.	" " " X.
"	VI.	1858, pp. 96.	From Trans. Acad. Nat. Sci. III, IV.
"	VII.	1859, pp. 90.	" " " " IV.
"	VIII. (Part I.)	1860, pp. 56.	" " " " IV.

Mr. Lea has also published three editions of his "Synopsis of the Family of Naiades," a work containing a list of the species and their synonymy; the shells being grouped according to obvious external characters, in order to facilitate their determination. There is also a table of geographical distribution, and a very full index and bibliography of the subject; making the book an indispensable aid to those studying this interesting family of shells.

The third edition of the Synopsis was issued in 1852. (4to, pp. 88.) Since that time many new species of Naiades have been described, rendering a new edition necessary; and on this useful work, Mr. Lea is now engaged.

He has also attentively studied the Melanians of America, besides describing many exotic species for the Zoological Proceedings, London, 1850.

His last paper in the Proceedings of the Academy contains diagnoses of forty-nine new species of these shells, from Alabama. Mr. Lea is still actively engaged in his favorite pursuits, and we may expect many able papers yet from his hands. We hope that he will find leisure to monograph the Naiades, with the same fulness of description and excellence of illustration, which distinguishes Binney's Terrestrial Mollusks. Such a work would be the crowning glory of a life nobly and usefully spent in the pursuit of science.

T. A. CONRAD, the eminent geologist, in the same year in which Mr. Lea printed his first article on the Naiades, gave to the world through the Journal of the Philadelphia Academy, (1st ser., vol. vi, p. 205: Aug. 1830,) an article on the Geology of Maryland, containing a list of recent shells of the coast of that State. This was followed, all through the first series of the same Journal by papers on recent and fossil mollusca. The most important of these is one containing "Descriptions of new Marine Shells from Upper California," vol. vii; 1837. This article gives descriptions and figures of eighty species. In the *second series* of that Journal are several papers, by this author, on marine and fluviatile mollusca. Several of them are beautifully illustrated. A noticeable article is the "Monograph of the genus Argonauta, with descriptions of five new species;" vol. ii, p. 331: 1854.

Mr. Conrad has also contributed to this Journal for a period of over twenty years, and to the Proceedings of the Academy of Natural Sciences. His most important paper in the Proceedings is an able "Synopsis of the Family of Naiades of North America." Unfortunately, the author, with a sincere desire to do justice to Rafinesque, has preferred the doubtful identification of many of his obscure species, to the well characterized descriptions of Lea and others; thus placing as synonyms specific names which will always stand good among the majority of Conchologists.

Mr. Conrad also did an unintentional injustice to Mr. Lea, by a want of care in affixing dates of publication to several species. The errors in these dates were however corrected by Mr. Lea, a short time afterwards, in the Proceedings of the Academy for the same year. On the other hand, the "Synopsis" establishes the priority of Mr. Conrad's description of several southern species of Naiades, over those of Mr. Lea. It is worthy of remark, that Say, Conrad, and Dr. Jay, each of whom retain a number of Rafinesque's names, and who by long study of this family should be considered competent to make a final determination of the validity of his species, have differed greatly in their conclusions. Messrs. Say and Conrad have several times changed their opinion of the species *intended* by Rafinesque's descriptions. Rafinesque deposited in the cabinet of his friend, C. A. Poulson, Esq., of Philadelphia, a collection of Naiades, and named them;

but this was years after the publication of his papers, and meanwhile he had evidently forgotten many of the characters of his own species; those who have worked most ardently in his cause, are therefore compelled to declare that they are unable to reconcile some of his descriptions with Mr. Poulson's shells bearing the same names.

Mr. Conrad has described the shells collected by Lieut. Lynch's Dead Sea Expedition, and he also edited Part 7th (posthumous) of Say's American Conchology.

We have purposely left till the last, in order to bring them together, Mr. Conrad's most important publications—three of the most useful volumes on Conchology issued in America. They are all out of print, and are highly valued by those fortunate enough to possess copies. They consist of—

1. "American Marine Conchology." Philadelphia, 1831. 17 colored plates. 8vo, pp. 72.

This volume contains descriptions and figures of many of our common coast shells. The species, however, are different from those contained in the "American Conchology" of Thomas Say.

2. "New fresh water shells of the United States, with colored illustrations, and a monograph of the genus Anculotus, *Say*. Also, a Synopsis of the North American Naiades." 16mo, pp. 76. Philad. 1834.

This little volume contains descriptions of many new species of Uniones and Melanians collected by the author, in the Alabama River, &c. The book is poorly printed and illustrated, but its contents are very valuable.

3. "Monograph of the Family Unionidæ, or Naiades of Lamarck, of North America." Issued in 12 8vo numbers, 1835–38, and illustrated by colored plates.

This is Mr. Conrad's most elaborate work. Its great value consists in its illustrations of our most common and best known species, but which are nowhere else figured in American publications. Mr. Conrad may be considered, next to Lea, the best informed of living men, on our Uniones. Although he early chose Geology as his life-time study, he has nevertheless made for himself a reputation in recent Conchology.

Mr. Conrad's descriptions, unfortunately, are generally quite too brief, and bear evidence in many instances of haste or carelessness in their composition; being sometimes so devoid of characters, that the species would be totally unrecognizable were it not for the accompanying plates.

Amos Binney. While Lea and Conrad worthily succeeded Say, in the investigation of the American Uniones, the late Dr. Amos Binney, of Boston, continued the labors of our first great zoologist among the Terrestrial Gasteropoda of this country. To the study of these interesting shells he devoted the leisure moments of his active life, for many years; and in his "Terrestrial Mollusks of the United States," he has left us a noble monument of his love of the science.

Dr. Binney became early identified with the progress of Conchological science in America; he was one of the founders of the Boston Society of Natural History, and became its president. He traveled much, in the cause of science, and made large collections; and being a man of wealth, he employed much of his means in the accumulation of a library on Conchology, which, at the time of his death, was unequalled in America.

Dr. Binney was not only a student, but a passionate lover of nature, and his more elaborate papers show that he possessed a genuine love of his subject, which carried him much farther than the mere details of scientific description, into the investigation of the habits and mode of life of the Terrestrial Mollusca.

Dr. Binney's published papers consist of five articles in the Proceedings, and five in the Journal of the Boston Society of Nat. History. The most important of these is, "A monograph of the Helices inhabiting the United States." This elaborate and excellently illustrated paper appeared in several successive numbers of that Journal, and was afterwards expanded into a separate work, entitled "The Terrestrial air-breathing Mollusks of the United States," &c. This work occupied several years of its author's life, in its preparation, and dying before its completion, his will was found to contain liberal provisions for the continuation and publication of the work in expensive and magnificent style. At the request of the executors, Dr. A. A. Gould assumed and excellently fulfilled the task of arranging the material, completing the descriptions, and editing the work; which was soon completed so far as to permit the publication of the two volumes of text, in 1851; but so many delays occurred in the production of the magnificent plates, that the third volume did not appear until 1859. The large sum of ten thousand dollars was expended on the four hundred copies issued of this splendid work, which were *given away*, an offering for science; all the prominent Conchologists and scientific libraries here and in Europe receiving copies. They are the best epitaph of their lamented author, and will keep his memory green in the hearts of men, long after the storied marble shall have crumbled to the earth.

At Dr. Binney's death, his collection of Terrestrial Mollusks, and library, came into the possession of his son, W. G. Binney, who has happily inherited and well sustains his father's love for their study.

Joseph G. Totten, Gen. U. S. Top. Engineers, is one of the oldest cultivators of the science. Many years ago, he made himself acquainted with the marine Mollusca of the New England States, and was one of the first to dredge and describe new species from that region. He contributed two papers to this Journal, [1], xxvi and xxviii, 1834–5.

J. P. COUTHUOY, a Conchologist of considerable reputation, described a large number of our shells, principally marine, in the Boston Journal and in this Journal, 1838–9. He accompanied Wilkes' Exploring Expedition, as Conchologist, collecting large numbers of Molluscous animals and their shells. Many of the species contained in Dr. Gould's Mollusca of the Expedition, are described by him.

JOHN CLARKSON JAY, M.D., of Mamaroneck, Westchester Co., N.Y., has amassed a very large and valuable collection of shells; of which he has published several catalogues. The first edition was issued in 1835; second edition in 1836, with descriptions of new shells; third edition, 4to, 1839, with descriptions of new shells—illustrated with ten colored plates; fourth edition, 1850, 4to, containing 10,874 species, with a supplement (1852) containing 191 additional names.

These catalogues are arranged on the Lamarckian system. As all the synonyms are given besides the correct specific names, and references constantly made to figures and descriptions, this catalogue, (4th edit.) embracing as it does, so large a proportion of all the known species of shells, is invaluable as a work of reference, or as a guide to the formation of cabinets, and the exchange or cataloguing of specimens. The amount of labor on the last edition of this work must have been immense; the list extending to 480 pages and embracing 40,000 names, including synonyms; each accompanied by a reference to a figure and description. This could not be accomplished without years of preparatory study, and a familiar knowledge of all existing authorities on the subject.

Exception has been frequently taken to portions of Dr. Jay's Synonymy. To expect perfection throughout so extensive a subject, would be to look for impossibilities—but Dr. Jay has certainly a claim to be heard in this matter. With a magnificent collection of authentic specimens, embracing in many cases numerous varieties, and possessing, besides, a very complete library of works on Conchology, his deliberate conclusions certainly should have great weight among naturalists.

J. P. KIRTLAND, M.D., of Ohio, a zealous naturalist, has given considerable attention to the study of the Mollusca of his State. Various articles from his pen, relating to the Naiades, &c., are contained in this Journal for 1834, '37, '40.

Dr. Kirtland also gives a list of shells, in his Zoological Report of the State of Ohio. His latest publication on Conchology is a paper read before the American Association for the Advancement of Science, in 1851, and published in their Proceedings for that year. It is entitled, "Remarks on the sexes and habits of some of the acephalous Bivalve Mollusca."

Charles B. Adams (deceased 1851) was one of the most indefatigable and accurate of our Conchologists. His published papers, in thirteen years, amounted to about sixty, containing descriptions of 700 species of shells.

Of these articles, nine were printed in this Journal, six in the Boston Proceedings and Journal, four in the Proceedings of the American Association, and nine in the New York Lyceum Annals. The most important are—

"Descriptions of new species of shells." This Journal, [1], vol. xxxix, 1840.

"Catalogue of the Mollusca of Middlebury, Vt., and vicinity; with observations." This Journal, vol. xl, 1841.

"Description of twenty-five new species of New England shells." Bost. Proc., ii, 1844–5. This was written in conjunction with Dr. Mighels.

"Specierum Novarum Conchyliorum in Jamaica repertorum, Synopsis." Bost. Proc., ii, Jan. 1, 1845.

"Descriptions of new species of marine shells of New England." Bost. Journ., ii, 1840.

"On the nature and origin of the species of Testaceous Mollusca in the Island of Jamaica." Proc. American Assoc., iv, 1851.

Descriptions of a great number of Jamaica Shells, in the Lyceum Annals, 1850–1.

"Catalogue of shells collected at Panama." Annals Lyceum, 1852; also published separately in a thick 8vo volume.

"Mollusca," in Thompson's History of Vermont; also issued in a pamphlet, 20 pp.

Two small quarto tracts containing monographs of the genera Stoastoma and Vitrinella.

"Contributions to Conchology." 8vo, 258 pp. Issued in twelve numbers, from 1849 to 1852.

The study of the Mollusca of Jamaica occupied Prof. Adams' principal attention, and he was eminently successful in his researches among them.

Prof. Adams described numerous new species among the shells collected by him at Panama. The number of Jamaica shells that he has described is also very large—namely, 260 terrestrial, 20 fluviatile, and 200 marine species.

Prof. Adams also gave much attention to the habits and geographical distribution of these shells, and has illustrated the subject in several able papers. The large collections made by Prof. Adams at Panama and Jamaica, were properly named, and a full series placed in the Cabinet at Amherst College; the remainder were offered for sale by the trustees of the College, on whose account he visited those regions. A very large number of specimens were thus distributed among the lovers of the science in America and Europe, so that many private cabinets contain good collections of them.

The descriptions, of this author, are very minutely accurate, dwelling on every slight peculiarity of the shell before him; hence, a number of his species have proved to be merely well marked varieties, undue importance being attached to all their minor differences.

The writings of Prof. Adams are, however, very valuable, as they are distinguished by their marked ability, and fill up a gap in the history of American Mollusca; no other author having described any considerable number of the shells of Jamaica—an island which contains an almost isolated molluscous fauna—very few only of its species being common to the other islands.

Augustus A. Gould, M.D., of Boston, is one of our most voluminous writers on Conchology, his papers covering almost the entire range of the science.

His first publication was a translation of the generic descriptions by Lamarck, entitled, "Lamarck's Genera of Shells; with a catalogue of species." (Boston, 1833.) He has since that time had the good fortune to be connected with some of the most elaborate works on the subject, published in America.

Dr. Gould contributed several short papers to this Journal, in 1840 and 1848; and he has also a paper in the London Zoological Proceedings for 1857, "On the Nautilus umbilicatus of Lister." With these exceptions, the whole of his shorter papers have appeared in the Boston Journal and Proceedings. The Journal contains:—

"A monograph of the species of Pupa found in the United States."

"Descriptions of shells from the Gulf of California, and the Pacific Coasts of Mexico and California."

Also, articles describing shells from Burmah, Cuba, and Africa.

The contributions of Dr. Gould to the Boston Proceedings number over forty, and embrace descriptions of terrestrial, fluviatile and marine species from all parts of the United States, Burmah, Liberia, Sandwich Islands and Brazil; those of Wilkes' U. S. Exploring Expedition, and the North Pacific Exploring Expedition. Besides these, Dr. Gould's "Remarks" made before the Boston Society, and published in their Proceedings, embrace a running commentary on recent publications, criticisms of new species, details of the habits and anatomy of the Mollusca, and many other interesting subjects.

The paper "On the shells collected by Wilkes' U. S. Exploring Expedition," contains short descriptions of the hundreds of species which have since been published in complete and beautiful style, as a Government Report.

The plates of this Report have just been issued, their preparation having occupied several years. They are very carefully drawn and splendidly colored.

Dr. Gould has been lately engaged on the Mollusca of the North Pacific Expedition—short diagnoses of species appearing in the numbers of the Boston Proceedings, to be followed at some future time by the publication of an elaborate Government Report.

When the State of Massachusetts added a Zoological Department to their Geological Survey, to Dr. Gould fortunately was assigned the Invertebrata of the State, comprising the Mollusca, Annelida, and Radiata. The result of his investigations appeared in a thick octavo volume published in 1841. This work is distinguished for the critical accuracy of its descriptions, and has become a standard authority on our marine shells, of which it describes many new species. While it is the first work embodying the complete molluscous fauna of any portion of our country, it still remains the *best.*

Dr. Gould was chosen by the executors of the will of Dr. Amos Binney, to edit the work on the "Terrestrial Mollusks," which was left incomplete by the death of that author. This labor he performed with great skill and judgment. The illustrations were continued in the same magnificent style as they were commenced under the direction of Dr. Binney, and the literary contents are augmented by descriptions of many new species discovered prior to the publication of the third volume, at the commencement of which they are inserted. Dr. Gould has also contributed to the first volume, a valuable memoir of Dr. Binney. Dr. Gould is an accurate and critical observer and describer of natural objects. His pages exhibit to the eye the individuality of his subject with the same clear analytical precision with which it impressed his own mind. He has been very successful in his investigations, adding nearly one thousand species to the recent Mollusca.

John G. Anthony, of Cincinnati, has for years devoted his attention to the study of the Melanians of the United States; and he has divided with Mr. Lea the honor of working up the many species of this interesting family.

Mr. Anthony's principal papers are, one in the Boston Proceedings, vol. iii, describing sixteen species of Melania, one in the New York Lyceum Annals, vol. vi, April 1854, describing fifty species collected by himself in the Southern States, and another in the Proceedings of the Philadelphia Academy, Feb. 1860, describing fifty-eight species.

S. S. Haldeman. Our fluviatile Gasteropoda, other than Melanian, are best known through Prof. Haldeman's "Monograph of the Limniades, and other fresh water univalve shells of North America," published in eight numbers—1840–44. The descriptions of species in this work are very full, and admirably illustrated by the colored plates.

Prof. Haldeman has published in Chenu's "Illustrations Conchyliogiques," a "Monographie du genre Leptoxis, Rafinesque; (Anculosa, Say.)" Folio, Paris, 1847, with beautiful plates. He has also contributed several papers to the scientific Journals, among which is an "Enumeration of the Recent Fresh-water Mollusca which are common to North America and Europe, with observations on species and their distribution," in the Boston Journal, iv, p. 468, 1844. This paper, together with the comparisons instituted by Prof. Adams with our marine species, and by Dr. Binney in the terrestrial shells, has furnished much valuable information in regard to the geographical range of species over parts of two continents.

HENRY C. LEA, son of Isaac Lea, has evinced considerable talent in the sciences of Conchology and Geology. He has a short paper in the first series of this Journal; and a more extensive one in the Boston Journal, entitled "Descriptions of some new species of marine shells inhabiting the coast of the United States." He also assisted his father in the determination and description of the exotic Melanians in the collection of Mr. Cuming.

CHARLES M. WHEATLEY, M.A., of Phœnixville, Pa., who has formed an excellent private collection of shells (now the property of Union College), published, in 1842, the first general "Catalogue of the Shells of the United States, with their localities."

New species of shells from Maine are described by Dr. J. W. Mighels, in the Bost. Journal, iv, p. 37, January 1842.

These Catalogues are very useful in stimulating research, and also afford much information regarding the geographical distribution of species.

The following Catalogues have been published:

Maine. By Dr. Mighels.

Vermont. By Prof. C. B. Adams.

Massachusetts. By A. A. Gould, Gen. J. G. Totten, Samuel Tufts, W. Prescott, J. M. Earle, Thomas A. Greene, J. L. Russell, Wm. Stimpson, and Jos. True.

Connecticut. By Rev. J. H. Linsley and Dr. A. A. Gould.

New York. By Dr. J. E. DeKay, Sanderson Smith, and Dr. James Lewis.

Pennsylvania. By Prof. S. S. Haldeman, Wm. Hartman, R. M. S. Jackson and Wm. M. Gabb.

Maryland and Virginia. By T. A. Conrad and Charles Girard.

North and South Carolina. By J. D. Kurtz and Lewis R. Gibbes.

Florida. By T. A. Conrad.

Mississippi. By B. L. C. Wailes.

Louisiana. By Geo. C. Shumard and C. B. Adams.

Tennessee. By Gerard Troost.

Ohio. By Jno. G. Anthony, Frank Higgins, S. P. Hildreth, and J. P. Kirtland.

Indiana. By J. T. Plummer.
Illinois. By Robert Kennicott.
Michigan. By Dr. Abraham Sager.
Wisconsin. By I. A. Lapham.
Washington Territory. By Wm. Cooper.

Lists of the Terrestrial, Fluviatile and Marine Shells of the United States have been drawn up by Messrs. W. G. Binney, Temple Prime, Isaac Lea, P. P. Carpenter and Wm. Stimpson, and published by the Smithsonian Institution.

JAMES E. DEKAY, M.D. The Zoological Department of the New York Geological Survey was committed to Dr. DeKay, (deceased,) who in 1843 published a voluminous Report in quarto, on the Mollusca and Crustacea. The Mollusca comprise 277 pages with forty colored plates. This work has been carelessly compiled, and many of the species are almost unrecognizable from the descriptions. A number of new species are proposed, which would never have been brought forward, if Dr. DeKay had made himself as thoroughly acquainted with his subject as he should have done, before undertaking a work of such magnitude. Still, despite its numerous faults, this volume is necessarily an important addition to conchological literature. In nearly every genus, short descriptions of the extra-limital species are given, so that over six hundred species of American shells are contained in it. The plates are roughly executed, and poorly colored.

WYMAN and LEIDY. Our knowledge of the anatomy of our terrestrial Mollusca is due almost entirely to the labors of Drs. Jeffries Wyman and Joseph Leidy.

The former has published in the fourth volume of the Boston Journal, papers "On the Anatomy of *Tebennophorus Caroliniensis*," and "On the Anatomical Structure of *Glandina truncata*, of Say."

Dr. Leidy, of Philadelphia, has carefully investigated the anatomical structure of our Terrestrial Gasteropoda, and has published the results of his labors in the first volume of Binney's Mollusks and in pamphlet. This paper, the preparation of which must have cost immense study, is illustrated by some of the finest anatomical plates ever published in America.

For the last ten years Dr. Leidy has occasionally described new forms of American Marine and Fluviatile Polyzoa, (Bryozoa), and we understand that he is preparing a monograph of our fluviatile species.

LOUIS AGASSIZ has given some attention to the anatomy and embryology of our Mollusca. He has several short papers in the Boston Proceedings, 3d vol., and an important article on the Embryology of Ascidia in the second volume of Proceedings of the American Association for the Advancement of Science.

It is understood that a coming volume of Agassiz's "Contributions" will contain an elaborate account of the embryological development and anatomy of the animals of the North American Naiades.

JOHN H. REDFIELD, late of New York, now of Philadelphia, has published in the Annals of the Lyceum, several papers on marine and terrestrial shells. Among them are descriptions of several new species of Marginella—of which genus Mr. Redfield has made an especial study.

WILLIAM STIMPSON, M.D., has become a familiar name to Conchologists from his extensive study of our Atlantic coast shells. He has, probably a profounder practical knowledge of our marine molluscous fauna, and their bathymetrical and geographical distribution than any other naturalist. Dr. Stimpson's principal work is entitled "Shells of New England—a revision of the Synonymy of the testaceous Mollusks of New England." 8vo. Boston, 1851. This work is intended to be a companion to Gould's Invertebrata of Massachusetts—the nomenclature of which is corrected in accordance with the present arrangement of the mollusca.

Dr. Stimpson has contributed several interesting papers to the Boston and Philadelphia Proceedings and to this Journal. The extensive dredging operations conducted by this naturalist are deserving of much praise: numerous portions of our coast have been explored by him; and recently while accompanying the North Pacific Exploring Expedition, as zoologist, he obtained in this way an exceedingly rich collection of marine shells from the Japanese and Arctic seas. These are now being described by Dr. Gould, in the Boston Proceedings.

TEMPLE PRIME, of New York, is our great authority on the family of Cyclades, having confined his attention almost entirely to them. Besides descriptions of new species, Mr. Prime has done much good service in working up the synonymy of the several genera whose history he has investigated.

He has published the following papers:

"Descriptions of new species of Cyrena and Corbicula," and "Synonymy of the Cyclades," in Proceedings of the Academy Nat. Sciences; "Descriptions of new species of Cyclas and Pisidium," a "Synonymy of Pisidium," and "Descriptions of two new species of the genus Batissa, with notes on that genus," in Annals N. Y. Lyceum.

Several descriptive papers and Synonymy of Cyrenella and Rangia, in the Boston Proceedings; "Monograph of the species of Pisidium found in the United States of North America," illustrated, in Boston Journal; and "Descriptions of new shells (Cyclades) from the collection of Hugh Cuming, Esq.," in the London Zoological Proceedings.

In these papers, Mr. Prime has increased the number of known species of Cyclades nearly one-half.

THOMAS BLAND, of New York, first became known to Conchologists as an efficient co-laborer with Prof. Adams, in the West

Indian Terrestrial Mollusca. He contributed several papers to the "Contributions to Conchology," cataloguing the species of St. Thomas, W. I., and New Granada. He has also an article in this Journal, Nov. 1852, entitled, "Facts and principles relating to the origin and Geographical Distribution of Mollusca."

Mr. Bland's most important papers are the "Remarks on certain species of North American Helicidæ, with descriptions of new species," of which two parts have appeared in the 6th and 7th volumes of the Lyceum Annals. The third part is now ready for publication. These papers form a valuable addition to our critical knowledge of the Helices of the United States. Mr. Bland has also just issued a paper (see p. 158, this vol.) on the Geographical distribution of the Genera and Species of Land Shells of the West Indies, which gives many curious and important facts in reference to the range of species. Mr. Bland is thoroughly familiar with these shells, and is perhaps better fitted to pursue this important line of investigation than any other conchologist.

WESLEY NEWCOMB, M.D., formerly of Troy, N. Y., now of Oakland, California, during a residence at the Sandwich Islands, for many years, studied the beautiful terrestrial genus Achatinella. He has described a large number of species in the New York Lyceum Annals, the Boston Proceedings, and the London Zoological Proceedings. His papers in the latter are illustrated with fine colored plates.

The Achatinellæ have also been studied and described by Dr. Mighels, Prof. Adams, Dr. Gould, and Mr. Gulick.

The genus Argonauta has been studied by Dr. J. C. Parkinson, who has added two new species.—Bost. Proceed., Sept. 1856.

William A. Haines, of New York, the possessor of one of the finest private conchological collections in the world, has a paper in the New York Annals, vol. vi, Oct. 1855, describing several new species of terrestrial shells from Siam.

JAMES LEWIS, M.D., of Mohawk, N. Y., has industriously studied the Mollusks of that vicinity, making many valuable additions to our knowledge of the habits and mode of growth of many of the fluviatile species. His numerous brief papers are contained in the Boston and Philadelphia Proceedings.

J. B. TRASK, M.D. The only papers on Conchology published as yet west of the Rocky Mountains, are two by Dr. Trask, describing new species of Naiades of California, published in the Proceedings of the California Academy of Nat. Sciences, vol. i, 1855; and Descriptions of Terrestrial and Fluviatile Shells, by Dr. Newcomb, in the Proceedings of the same Society for 1859 and 1860.

WILLIAM G. BINNEY, of Burlington, N. J., has continued the investigation of the Terrestrial Shells, commenced by his father. He published in 1859, in the Boston Journal of Natural History, and also separately, a "Supplement to the Terrestrial Mollusks," forming vol. iv of that work in 8vo, pp. 207, with six colored plates. This volume, which exhibits great ability and an intimate knowledge of his subject, placed its author at once in the foremost rank of American conchologists. It not only describes all the more recent species, but also includes a thorough revision of those contained in his father's work, giving additional synonymy and localities.

Mr. Binney has published a number of papers in the Proceedings of the Academy of Natural Sciences, 1857–61, under the general title of "Notes on American Land Shells." These papers contain descriptions of many new species, and a complete synonymy of our Helices. He has prepared for the Smithsonian Institution lists of the Terrestrial and Fluviatile Gasteropoda of North America. He also edited, recently, in an able manner, a new and splendid edition of the conchological writings of Say. See ante, page 163.

Mr. Binney is at present engaged in an extensive work for the Smithsonian Institution. He is preparing for them descriptions of our Terrestrial and Fluviatile Gasteropoda, for cheap publication and free distribution. He has also just completed a work on the Synonymy of American Shells, forming a very large paper—the MSS. extending to several hundred pages.

The publication of these works will mark a new era in the progress of Conchology among us, as it is believed that their distribution will very much enlarge the number of students of the science; the scarcity and high cost of works of reference having hitherto proved a discouraging barrier to persons of limited means. Now, however, the Smithsonian Institution intends providing the proper works of reference, free of cost.

Mr. Binney is very methodical in his writings—which, without any pretension, reveal the utmost deliberation and profound study on the part of the author. He possesses a nice discrimination of specific values, and is exceedingly well informed in the general history and bibliography of the science.

Philip P. Carpenter, of Warrington, England, well known by his comprehensive Report to the British Association, on our West Coast Mollusca, prepared a list of those shells for the Smithsonian Institution. It has also published, recently, a volume of "Lectures on Mollusca," by this gentleman.

A. D. Brown, of Princeton, N. J., has just published in the Proceedings of the Academy of Nat. Sciences, descriptions of new species of Helix. Mr. Brown is a close student of the Terrestrial Mollusca, and will doubtless become one of our leading conchologists.

We have thus noticed the principal writers on shells, in America, to the present time. We must regret that want of space has compelled the omission of much that would be of interest to the reader, who is referred, for a more complete list of Authors and their Papers, together with accurate dates of publication, to the work at the head of this article, which has furnished us with most of the material for the foregoing pages.

It will be seen that our several scientific Journals have contained a very large number of papers by our best authors—thus, the publications of the Boston Society have those of Adams, A. Binney, Couthuoy, Gould, Prime, &c. The New York Annals those of Adams, Anthony, Bland, Newcomb, Prime and Redfield. The Journal and Proceedings of the Philadelphia Academy have the valuable papers of Say, Conrad, Anthony, Lea, W. G. Binney, Leidy, Prime, Stimpson, &c. The Philosophical Transactions contain many of Lea's extensive articles; while papers by many of these authors have also appeared in this Journal.

There are many fine public and private collections of shells in the United States. That of the Academy of Natural Sciences embraces about eleven thousand species. In the arrangement of the Academy's Cabinet, Pfeiffer's system is followed for the terrestrial species, while with the fluviatile and marine shells, the Lamarckian system is generally adhered to, with the introduction, however, of many of the more recent genera.

The splendid collection belonging to Amherst College is a noble monument of the unflagging assiduity and scientific attainments of the late Prof. C. B. Adams, who formed it. It embraces types of all his species and full suites of the shells of the various West India islands, and of Panama. It is esteemed by competent judges the most valuable collection for study in the United States.

The Boston Society of Natural History, the New York Lyceum, the Mercantile Library Co. of Cincinnati, Union College, Schenectady, N. Y. (formerly collection of C. M. Wheatley, of Phœnixville, Pa.), the Agassiz Museum and the Smithsonian Institution, each possess valuable collections.

The largest private collection in this country is that of Dr. John Clarkson Jay, of Mamaroneck, N. Y., numbering 13,460 species and numerous varieties. They are arranged according to the Lamarckian system. We have already alluded (p. 169) to his extensive and useful catalogues of his collection.

Wm. S. Haines of New York possesses twelve thousand species of shells, including many rare and unique ones.

Mr. Binney has a small but exceedingly valuable collection of the terrestrial shells of the United States, including many types of species, and also geographical series. The same may be said of the cabinet of Mr. Bland of New York.

Mr. Lea's cabinet of Unionidæ is unequalled in the world. It includes many thousands of carefully selected specimens from all parts of the world, exhibiting all the variations from specific types so common in this family.

Dr. Gould possesses a valuable collection, containing many types of species.

The most valuable cabinet of West India terrestrial shells is that of Mr. A. D. Brown, of Princeton, N. J., formerly the property of Thomas Bland. Mr. Bland's extensive correspondence in the West Indies, and especially with Prof. Poey, Dr. Gundlach, M. Sallé, R. J. Shuttleworth, &c., his own collections in St. Thomas, Jamaica and Bermuda, and his intimate relations with the late Prof. C. B. Adams, gave him extraordinary advantages and opportunities. Mr. Brown also has a large number of species of terrestrial mollusca from other countries—the whole amounting to three thousand species.

John G. Anthony of Cincinnati has a fine collection of American freshwater shells, principally Melanians, collected by himself.

The finest cabinet of operculated land shells is that of Mr. J. H. Redfield, late of New York, now of Philadelphia; he has also a large collection of Marginellidæ, which he has made his especial study.

The collections of Temple Prime and Wm. Stimpson are exceedingly rich in their respective specialities, the Cyclades, and American marine mollusca.

Dr. E. Ravenel, of Charleston, S. C., an experienced conchologist, and one who has done much to further the study among us, possesses a valuable cabinet, rich in marine and other species, determined by Thomas Say.

There are numerous private collections in this country containing from one to five thousand species; among these may be mentioned those of Hon. E. Cowan of Pennsylvania, U. S. Senator; Theodore Gill, containing three thousand species; Dr. E. R. Foreman of Washington, D. C., thirty-five hundred species; and R. L. Stewart of New York.

The cabinet of Geo. W. Tryon, Jr., of Philadelphia, embraces over four thousand species, and many varieties. It includes a large number of American Unionidæ and Melaniadæ, supplied by Isaac Lea, Mr. Binney, and numerous others: a good suite of American terrestrial shells from Mr. Binney, many West Indian land shells, including a number of Adams' Jamaica species, and of Pfeiffer's (author's examples), and a fine Cuban suite from Prof. Poey; a splendid collection of Achatinellæ from Dr. Newcomb, a series of European terrestrial shells (several hundred species) from Terver of Lyons, besides numerous American and foreign marine shells, including a suite of Carpenter's Mazatlan shells.

Mr. D. Jackson Steward of New York, has also an extensive cabinet. It embraces that of the late Mr. Lounsbury, and the interesting collections, especially of marine species, made for Mr. Steward in Trinidad, Barbadoes, &c., by Mr. Theodore Gill.

It would much transcend the limits of this article to enumerate the numerous excellent conchologists and collectors, who though writing but little or nothing themselves, have yet, by furnishing *materiel* to our authors, and by the distribution of specimens, much aided the progress of the science. Among these are men of high attainments, such as the late Dr. R. E. Griffiths, P. H. Nicklin, and John S. Phillips of Philadelphia, Dr. Lewis of Mohawk, N. Y., Mr. Theodore Gill, Dr. E. R. Showalter, Uniontown, Ala., Bishop Elliot, of Georgia, Edmund Ravenel and Lewis R. Gibbes of Charleston, S. C., Thomas Nuttall, &c. The works of Messrs. Lea, Binney, Conrad, Stimpson, and others, contain many acknowledgments of specimens sent and information rendered by these and numerous other persons in all parts of the Union.

The present condition and prospects of conchological science in America are very encouraging, and its pursuit offers a fine field for the investigation of our young naturalists. The largest part of this continent is still unexplored for Mollusca, and rich discoveries will continue for years to reward the labor of investigators.

It may be asked—what benefit to mankind has resulted from the pursuit of this science? We might perhaps answer, that its great merit consists in affording an innocent recreation to the mind of man. But there is surely a nobler object to be gained by the study of conchology. God, who created man in His own image, has also placed around us a host of living things, each after its own kind, an exemplification of divine wisdom, in the admirable adaptation of means to ends, as shown in their organism and mode of life; and who shall say that it is profitless for man to examine these animals, endeavor to indicate among them groups approaching each other in various degrees of relationship, and to learn, as far as we may know it, the plan of the Creator in their formation. As God has not considered these animals unworthy His attention, surely they are worthy of our earnest study.

Besides this ethical view of our science we must not forget to what a wonderful degree Conchology has become the handmaid of Geology. Through every geological horizon, from the earliest dawn of life to the deposits now forming, the palæontologist is of necessity a conchologist. If certain organic forms merit the distinction of 'Medals of Creation'—Mollusca, from their abundance in all geological ages, may be called its current coin.

ART. XVIII.—*Physics and Hydraulics of the Mississippi River.**

THE volume with the subjoined title constitutes No. 4, of Professional Papers of the Corps of Topographical Engineers, United States Army, and is published by authority of the War Department, Bureau of Topographical Engineers. It requires but a cursory examination to authorize the conclusion that this work is the most important one ever issued by this Bureau, and one of the most profoundly scientific publications ever published by the U. S. Government. The authors, commencing with a quotation from one of Franklin's letters to the Abbé Souliave as their motto,—"I approve much more your method of philosophizing which proceeds upon actual observation, makes a collection of facts, and concludes no further than those facts will warrant,"—seem to have adhered to it literally, collecting a mass of facts and statistics which must ever remain a monument to their unwearied industry and patient accuracy. But we cannot present a better idea of the object and scope of the work before us than by citing the following extracts from the able introductory letter of Capt. Humphreys:

"Some reference to the state of the question of protection against inundation, at the time when the survey of the Mississippi Delta was begun, appears to be proper here, in order that the necessity of such extended and laborious investigations as were made may be appreciated, and that it may be understood how absolutely essential it was in every division of the subject to collect fact upon fact, until the assemblage of all revealed what were and what would be the true conditions of the river in every stage that it had passed through or could attain, and thus to substitute observed facts, and the laws connecting them, for assumed or imperfectly observed data and theoretical speculations.

A wide discretion was necessarily entrusted to the officer in charge of the Mississippi Delta Survey. I entered upon the execution of that duty with an apprehension that the laws of flowing water in natural channels, as enunciated in treatises upon the hydraulics of rivers, were not based upon sufficiently extended experiments upon natural streams, and hence that the

* Report upon the Physics and Hydraulics of the Mississippi River; upon the Protection of the Alluvial Region against overflow; and upon the Deepening of the Mouths; based upon surveys and investigations made under the acts of Congress directing the Topographical and Hydrographical survey of the Delta of the Mississippi River, with such investigations as might lead to determine the most practicable plan for securing it from inundation, and the best mode of deepening the channels at the mouths of the river. Submitted to the Bureau of Topographical Engineers, War Department, 1861. Prepared by Capt. A. A. HUMPHREYS and Lieut. H. L. ABBOT, Corps of Topographical Engineers, United States Army. 4to, pages 456, with an appendix of 146 pages and a large number of maps and charts. Philadelphia, J. B. Lippincott & Co.

formulæ found in them, could not be relied upon for the solution of the questions upon which the plans of protection against inundation from overflow depended. The system of measurements and investigations carried on at Carrolton, Louisiana; Vicksburg, Mississippi; and Columbus, Kentucky; while it was intended to render the solution of the problem of the protection of the alluvial region of the Mississippi against inundation independent of the laws and formulæ of the books, was at the same time designed, in connection with other parts of the Survey, to afford the means of determining, by experiments on a far more extended scale than any ever before attempted, the laws governing the flow of water in natural channels, and of expressing them in formulæ that could be safely and readily used in practical applications. The success that has attended this part of the work has even exceeded my expectations. Laws have been revealed that were before unknown; new formulæ have been prepared, possessing far greater precision than the old; and improved methods of gauging streams have been devised.

But the imperfect state of the science of hydraulics as applied to rivers was not the only difficulty to be encountered in the execution of the duty imposed upon the officer in charge of this work. The much agitated question of the best method of protection against inundation had been always discussed upon assumed data, and the truth of the very groundwork upon which these discussions rested had to be experimentally investigated by this Survey. For instance, the Mississippi had always been regarded as flowing through a channel excavated in the alluvial soil formed by the deposition of its own sedimentary matter. So important an assumption was inadmissible; and great pains were accordingly taken to collect specimens of the bed wherever soundings were made, and by every means to ascertain the depth of the alluvial soil from Cape Giradeau to the Gulf. This investigation has resulted in proving that the bed of the Mississippi is not formed in alluvial soil, but in a stiff, tenacious clay of an older geological formation than the alluvion, and that the sides of the channel do not consist of homogeneous material; facts that have an important bearing upon all plans of protection.

Further, it was held by the advocates of the exclusive use of artificial embankments that the levees of Louisiana had already lowered the bed and floods of the Mississippi river, and that their extension throughout the alluvial region above would still further lower the floods by deepening the bed and reducing the slope of the river. The advocates of outlets, on the contrary, contended that the experience of many centuries, on the Po, proved that levees had raised the bed and floods of that river—to such an extent, indeed, that it was impracticable any longer to protect the country, except by opening new channels to the sea. This conclusion appeared to be sustained on the authority of two distinguished names, Cuvier and de Prony. While the investigations of the Delta Survey have rendered untenable that position of the advocates of the exclusive use of levees on the one hand, the investigations of the Chevalier Elia Lombardini have shown the supposed facts advanced by the latter class to be entirely erroneous, and their apprehensions to be unfounded.

The effects of cut-offs were likewise the subjects of controversy among engineers, a controversy which the measurements of the Delta Survey must set at rest, since they demonstrate that cut-offs raise the floods below them, a conclusion sustained by the well-established effects of such works upon the Po and Adige.

Outlets were advocated by some engineers because they were considered a ready and inexpensive means of reducing the floods. On the contrary, they were objected to by others because, as they claimed, outlets would raise the bed and floods of the river. The investigations of the Delta Survey prove that outlets, in the few localities where they are practicable, may be made to reduce the floods to any desired extent in certain divisions of the river; but that they would not be inexpensive, and would entail dangers and disasters which should not be risked. These conclusions, it is shown, are sanctioned by the experience of Europe, upon the Po, the Rhine, and the Vistula.

The effect of a great swamp like that of the Yazoo upon the floods of the Mississippi, a subject that has formed the theme of speculation for at least thirty years, has also been established by the collection of facts; as likewise the law governing the rise, fall, and discharge of the river throughout the alluvial region; the manner in which the flood is propagated; the modifications introduced by tributaries; the succession of river stages; the drainage of its basin and that of its tributaries; the proportion of drainage to downfall; and the discharge of outlets: in fact, every river phenomenon has been experimentally investigated and elucidated.

Thus every important fact connected with the various physical conditions of the river and the laws uniting them being ascertained, the great problem of protection against inundation was solved.

At the mouths of the river, a similar course has resulted in the development of the law under which the bars are governed, the depth upon them maintained, and the regular advance into the gulf continued; and, as a consequence, the principles upon which plans for deepening the channels over them should be based, and the best mode of applying them. The rate at which the river progresses into the gulf, and the extent, thickness, and relative level of the alluvial formation having been ascertained, its probable age has been estimated; and the ancient form of the coast, and the changes that have taken place in the present geological age, have been surmised.

The Report exhibits in detail the investigation of each of these subjects, and many others not enumerated in this letter. Based upon extended survey and investigation in the field, made at times under circumstances of great exposure, it contains the results of many years labor, comprising laborious office work, extended research, patient investigation, and exhaustive mental effort."

The first chapter treats of the great basin of the Mississippi River as well as the basins of its numerous tributaries, their slope, dimensions of cross-section, range, navigation, succession of stages, topography, geology and growth of the bottom lands, floods, &c.

"The Mississippi drains the greater part of the territory of the United States lying between the Alleghany and the Rocky Mountains. Its basin, more than equal in area to the whole continent of Europe, exclusive of Russia, Norway, and Sweden, is greatly diversified in features, in soil, in climate, and in productions. A knowledge of the hydrographic relations of the different parts of this basin to the main river is essential to a full appreciation of all the elements of the problem, the solution of which forms the subject of this report. The region is too vast and diversified to be treated under a single head, and some convenient and natural subdivision is therefore to be sought.

The true Mississippi river begins at the confluence of the Missouri and Upper Mississippi. It has eight principal tributaries, which, in the order of the magnitude of their basins, are the Missouri, the Ohio, the Upper Mississippi, the Arkansas, the Red, the White, the Yazoo, and the St. Francis. It may excite some surprise that the two latter are included in this category, but it will be hereafter seen that, although comparatively small streams, they are important from their position and volume of discharge. Just below the confluence of Red River is found the first of the bayous which, fed by the Mississippi, discharge into the gulf. Below this point the Mississippi receives no appreciable increase from tributaries; it may, therefore, for these two reasons be considered the head of the delta.

The delta and the basins of the eight tributaries form natural subdivisions of the great basin. They include the whole area except the small basins of several comparatively unimportant branches which may be classed together under one general heading. As it is proposed to state, in this chapter, such facts in relation to these several subdivisions as shall exhibit their hydrographic relations to the main river, it is, in some sort, an introduction to the report.

Missouri Basin.—This is much the largest of any of the tributary basins of the Mississippi, and differs from all the rest in containing a large area covered by lofty mountain chains. The river issues from the Rocky mountains in many branches, which form a series of large rivers that flow through the great uncultivated plains. Comparatively little rain falls upon the mountains and the plains, and hence the size of the main river is disproportionately small, when the drainage area alone is considered. Its annual discharge is only about three-quarters of that of the Ohio, although its basin is nearly two and a half times as large. After passing the 98th meridian, the banks of the river become more and more fertile, and the region through which it passes gradually changes from an uncultivated waste to a populous country. The total area of the basin, including the mountains, the plains, and the fertile region, is 518,000 square miles.

Missouri River.—Ascending the river, the Missouri is found to divide at Fort Union into two main branches of about equal size, the Yellowstone and the Upper Missouri. About 265 miles above its mouth, the former again divides into two nearly equal branches, the Big Horn and the Upper Yellowstone. The Upper Missouri remains a single stream to within about 100 miles of its sources, where it divides into three forks, named Jefferson, Madison, and Gallatin. It was first explored to the sources of Jefferson fork by Captains Lewis and Clarke, U. S. A., in 1806. When returning, Captain Clarke followed up Gallatin's fork a short distance, crossed over to the Yellow Stone near where it issues from Snow mountains, and passed down the river in canoes to its mouth. The next expedition was conducted in 1833 by Captain Bonneville, who then explored a portion of the Big Horn river. The maps of this region made by these early explorers have been superseded by more accurate surveys, conducted chiefly upon the Upper Missouri branch by detachments of Governor Stevens' Pacific Railroad party, in 1853; but so far as a knowledge of the sources of the Missouri river are concerned, very little additional information had been acquired previous to the year 1859. At this date, a party under Capt. W. F. Raynolds, U. S. Topl. Engrs., was organized by the War Department, to explore the region. This party accurately mapped the Yellowstone from its mouth to the point where it issues from the Snow mountains; the Big Horn to its sources; the Madison fork to its sources; and acquired definite information respecting the Gallatin fork and the Upper Yellowstone. The report has not yet been published, but through the kindness of Captain Raynolds, with the sanction of the War Department, the following facts have been communicated:

In lat. 43° 30′ and long. 110° 00′ a mountain rises to some

14,000 feet above the level of the sea. It is named by Capt. Raynolds, Union Peak, because water trickling from its northern side flows into the Mississippi, from its southern side into the Great Colorado, and from its western side into the Columbia. Within one degree of longitude westward and about one degree of latitude northward from this peak are four of the sources of the Missouri, where the Big Horn, the Yellowstone, and the Madison and Gallatin forks take their rise.

The Big Horn (here called Wind river) flows south-eastwardly to long. 108° 30′, through a narrow bottom land, varying from one to three miles in width, bounded on the south side by the impassable Wind-river chain, and on the north by an elevated prairie rising into mountains. It is then joined by the Popo Agie and turning abruptly toward the north, forces its way through the Big Horn mountains, here forming a double chain, to the prairies bordering upon the Yellowstone.

The Madison fork flows northward, chiefly through a rugged defile, to the junction of the three forks, where it is joined first by the Jefferson fork. This is rather the larger river of the two, and heads among beautiful Rocky mountain valleys, about two degrees of longitude farther to the westward. Neither of these streams is fordable near its mouth. About half a mile below their junction, the Gallatin fork, smaller than either of the others, enters from the southeast. These three forks unite in an extensive plain surrounded by lofty mountains. The united waters soon enter, and for nearly a degree of latitude traverse a succession of mountain valleys and enormous cañons.

Between the Big Horn and Upper Missouri branches, in long. 110° 30′ and lat. 44° 30′, the Upper Yellowstone has its source in a lake, as yet only visited by trappers and Indians, whence it plunges through an impassable gorge to the highest point visited by Capt. Raynolds' party. From this point, where it is two hundred yards wide and six feet deep, it winds to the northeast, through a narrow valley, to the mouth of Clarke's fork. In this distance it is characterized by many islands, and by bold, sweeping curves, frequently impinging upon the hills. Between Clarke's fork and the mouth of the Big Horn, the river is from 500 to 600 yards in width, unobstructed by rapids, and flowing with a swift current of some three or four miles per hour.

Below Big Horn river, to Powder river, the width increases to 800 or 900 yards, and the river becomes turbid, resembling the Missouri.

From Powder river to the Missouri the banks are low and caving, and the river assumes the characteristic appearance of the Missouri, containing numerous sand bars, densely timbered islands, &c. There are also some rapids and shoals.

Capt. Raynolds is of the opinion that the Yellowstone can be navigated with boats drawing three feet of water, up to the point where it issues from the mountains, from the middle of May to the first of August. The floods are neither sudden nor excessive, and the river is probably better adapted to steamboat navigation than the Missouri, although there are difficult rapids at the mouth of Powder river."

The second chapter, which is also one of great interest to the geologist, is confined more especially to the valley of the Mississippi below the junction of the Missouri. It treats of its geology—the artesian well at New Orleans—growth of the river banks—changes of the bed—oscillations of the Gulf, and their effects upon the lakes and river—tidal oscillations of the river—hurricanes and their effects—range of the Mississippi between high and low water—elevation above the gulf—of the surface of the river—usual succession of stages—dimensions of cross-section—yearly amount of rain in the basin—annual discharge of the Mississippi and its principal tributaries—ratio between rain and drainage in the basin—sedimentary matter in the Mississippi water—matter rolling along upon the bottom—temperature of the water—history of the progress of levees in the Mississippi valley—levee organization in the different states—dimensions and cost of existing levees—the earlier floods and those of 1828, 1844, 1849, 1850, 1851, 1858, and 1859. But we have room for the following extract only, from page 178:

"The last and greatest rise in the flood of 1858 occurred at the head of the alluvial region, in the month of June. About the middle of May, extensive rains prevailed in the Ohio valley, and occasioned much damage by flooding the small streams. They also prevailed west of the Ohio basin and caused a rapid rise in the lower tributaries of the Upper Mississippi and Missouri. These rains continued, especially in the states of Ohio, Indiana, Illinois, and Missouri, raised the Miami, Wabash, and Illinois rivers to unprecedented heights, and filled all the lower tributaries of the Missouri. The usual June rise of the latter river, occasioned by the melting of snow in the Rocky mountains, and the spring and early summer rains along its course, arrived just in time to contribute its waters to the general flood. With the Ohio and Mississippi both in full flood, the torrent which poured into the alluvial region by the river itself and through the swamps above Columbus, was immensely greater than in any of the earlier rises of the year, and second to none of which we have records. For seven days (June 16–22) it amounted to 1,475,000 cubic feet per second. It inundated the city of Cairo. It washed away miles of the insignificant levees along the St. Francis front, and poured rapidly into the bottom lands of that river, which were already deeply overflowed from heavy rains and from the crevasses of the April rise. So small was the actual reservoir capacity of that region that the channels of the six large bayous, and of the St. Francis itself, were insufficient to give water-way to the flood, returning to the Mississippi. For miles above Stirling, it poured over the banks themselves, washing the remains of the levees into the river. It passed like a great wave through the swamp, causing the deepest overflow ever known. Collecting again, in this manner, at Helena, in about two weeks after it entered the alluvial region, it poured with renewed force upon the lower country. In the White-river swamps, the same conditions existed as in the St. Francis bottom. The Yazoo and Tensas bottoms, on the contrary, were comparatively empty, owing to the general resistance of their levees in the former rises, and served in some degree as reservoirs to diminish the height of the flood below. The former was deeply inundated, although the Yazoo river was returning more than 125,000 cubic feet per second during the whole rise. The latter escaped almost entirely, its bayous being sufficient to carry off the limited amount of crevasse water, and discharge it into Black river, whence it passed down bayou Atchafalaya. Below Red river landing, the levees remained unbroken except at the Belle and LaBranch crevasses which submerged the country between the Mississippi and bayou LaFourche. Fortunately, the upland tributaries below the Ohio were all low during this great rise, for to this circumstance alone is due the escape of the lower country from general overflow.

The June rise terminated the flood. At the head of the alluvial region, the river fell rapidly to low-water mark, being only retarded by a slight rise which occurred in July. The water that drained from the great St. Francis and Yazoo bottoms maintained the flood discharge at points below them for about six weeks; after which the lower river also subsided rapidly to its lowest stage for the year."

The third chapter presents the state of the science of Hydraulics as applied to rivers. The topics are the early history of hydraulics—epoch of Gugliemini—era of modern experimental investigation—new system of notation—various methods of measuring the velocity of rivers—velocity below the surface in any given vertical plane—horizontal curves of velocity—true mean velocity, and the methods of various authors for obtaining the true mean velocity of rivers.

"The solution of that great problem, the best method of preventing the overflows of the Mississippi, exacted difficult measurements and extremely intricate computations. In connection with it, a careful examination of all writings upon hydraulics that were within reach was made, to ascertain precisely the present state of that science; a list of the principal publications upon the subject, with a brief synopsis of those parts of their contents that are connected with the present problem, has been prepared for future reference. It will be found from this that the laws which govern the flow of water in natural channels were only partially and imperfectly developed; but, as a knowledge of those laws was essential to the determination of the plans of protecting the Mississippi valley from inundation, the investigations of the Delta Survey, conducted with that object, in accomplishing it, have necessarily contributed to the advancement of hydraulics. An account of these investigations will be presented in full detail in the two following chapters. This chapter is devoted to a brief notice of published works, which is partly original and partly compiled from similar notices by Rennie, Lombardini, Storrow, and others, and from various encyclopædias."

The following are some of the subjects discussed in the fourth chapter on the method of guaging the Mississippi, its tributaries and its crevasses:—Method of determining dimensions of cross-section—method of conducting velocity measurements—computation of discharge, neglecting change of velocity below the surface—investigation of sub-surface curve of velocity—same of the horizontal curve—parameter law deduced—equation for mean of whole vertical curve—locus of maximum velocity below the surface—system of interpolating discharges—method of transferring measured discharges, &c.

Chapter fifth treats of the experimental theory of water in motion—application of the new laws to the guaging of rivers by measurement—application of the new laws to the guaging of rivers by formulæ, &c.; chapter sixth, protection against the floods of the Mississippi; chapter seven, Delta of the Mississippi; chapter eight, mouths of the Mississippi—bars at the mouth and plans for increasing the depths of the bars, &c.

The preceding extracts convey but an inadequate idea of the extent and importance of this work. Many portions of it cannot be properly appreciated except by those who possess a profound knowledge of mathematics and general physics. We shall take care to transfer to our pages under the proper heads the new physical constants and formulæ which the Report contains. There is much however in regard to the floods, velocity of currents, amount of sediment conveyed by the river, and the superficial deposits of the Valley of the Mississippi and its tributaries, which cannot fail to aid greatly the researches of the geologist as well as the physicist. The volume itself is a model of systematic arrangement, clearness and beauty of typography, and is singularly free from typographical errors. It would add much to the credit of the general government if this volume could be used as a model for the style of its future scientific and military publications.

ART. XIX.—*Contributions to Mineralogy;* by F. A. GENTH.

1. *Gold, pseudomorph after Aikinite.*

IN a former communication (this Journ., [2], vol. xxviii, 246–255) I have called attention to the occurrence of gold in pseudomorphs and other forms and associations, which admit of no doubt that it must have been in solution, previous to its deposition in veins or beds. I have lately received a new and very interesting fact confirming this opinion in a specimen which shows gold pseudomorphous after aikinite. The exact locality from which my specimen comes is doubtful, but it is stated to be from Georgia. It is a small piece about 1½ inches square and about ⅜ of an inch thick, and consists of greyish white crystalline quartz with minute druses of crystallized quartz, one side of it covered with an earthy manganiferous hydrated ferric oxyd. The quartz has the appearance of that from many of the gold veins of our Southern States. In one place it shows particles of unaltered aikinite, the greater portion of this mineral however is converted into the well known pseudomorph (as proved by the blowpipe), a cupreous carbonate of bismuth in slender needles of different degrees of purity, of a waxy lustre and a pistachio or oil-green, when earthy, of a greenish white color. The centre of these crystals is in many of them taken up by bright yellow gold of a high degree of fineness, some of them distinctly showing the rhombic form of the original mineral.

It is easy to conceive how this pseudomorph has been formed, when we take into consideration that in the oxydation of the aikinite sulphur, lead and copper were oxydized first, and the bismuth may have been eliminated, occupying the centres of the crystals; but afterwards, when coming in contact with a solution of gold, precipitated it, the bismuth being carried off by the electro-negative element, previously in combination with the gold.

Specimens from Beresofsk, containing both aikinite and gold in quartz, which I have examined, did not show anything similar; where both minerals are found intermixed, the gold occurs in irregularly shaped particles, evidently formed *simultaneously* with the aikinite and *not after* its decomposition.

2. *Antimonial Arsenic and Arsenolite.*

An interesting variety of *antimonial arsenic* in reniform finely crystalline, somewhat radiated masses of a color between tin-white and iron-black on a fresh fracture, but greyish black from tarnishing, occurs at the Comstock 'lead' of the Ophir Mine, Washoe county, California. Being associated with arsenolite, calcite and quartz, the material for examination was first treated with a mixture of dilute chlorhydric and tartaric acids. The solution thus obtained, contained *no* antimony, but lime, magnesia, ferrous oxyd and arsenious acid, corresponding with:

Carbonate of lime,	86·78 p. c.	89·43
" " magnesia,	2·05	
" " iron,	0·60	
Arsenious acid,	10·80	10·80
	100·23	

The residue dissolved in a mixture of chlorhydric acid and chlorate of potassa, left behind some quartz, which was filtered off and the arsenic separated from the antimony by Levol's method; the following results were obtained:

Quartz,	11·02 p. c.
Arsenic,	80·81
Antimony,	8·17

Of the isomorphous metals $\frac{1}{18}$ is antimony. After deducting the quartz the composition is:

	Found.			Calculated.
Arsenic,	90·82	$\frac{17}{18}$	Arsenic,	90·81
Antimony,	9·18	$\frac{1}{18}$	Antimony,	9·19

It resembles in its composition the antimonial arsenic from the Palmbaum Mine near Marienberg, Saxony, analyzed by Schultz, containing 92·03 per cent of arsenic and 7·97 per cent of antimony. (Rammelsberg's Mineralchemie, p. 984.)

3. *Arsenids of Copper.*

*a. Whitneyite.**—After the publication of the results of my examination of the peculiar arsenid of copper from Lake Superior, introducing *whitneyite* as a new species (this Journal, [2], xxvii, 400), I learned of the existence of several specimens of arsenids of copper from Lake Superior, and that some qualitative examinations had been made of one of them by Dr. John Torrey even as early as 1853, which, however, have never been published. I have been very anxious to get some of this material for examination. Prof. Jas. C. Booth, who was fortunate enough to secure one of these early specimens, has with the greatest liberality presented me with a sufficient quantity from it for investigation. The locality is stated to be on the north shore of Lake Superior.

It had a brownish tarnish and in some places showed rainbow and pavonine colors. On examination it proved to consist of two minerals, *whitneyite* and *algodonite*, and although it was almost impossible to get them separated in a state of absolute purity, the analyses will show that this has been done sufficiently to prove the correctness of the determinations of the species.

* It is surprising that even after Prof. George J. Brush (9th suppl. to Dana's Mineralogy, this Journal [2], xxxi, 370,) has noticed the oversight of D. Forbes (Phil. Mag. [4] xx, 423) giving the new name "Darwinite," to a species established nearly two years previously, this name is still continued by F. Field.—(Philos. Mag., [4], xx, 423).

This whitneyite is compact, with an exceedingly fine-grained structure, (far more so than that from the Pewabic location, which is rather coarse grained,) and a reddish, greyish white color and no lustre on surfaces of fresh fracture. Scratching developes strong metallic lustre and a reddish white color, but it soon tarnishes. Probably owing to some porosity the sp. gr. was found to vary from 8·246 to 8·471 (at 21° C.), the hardness is a little below that of fluor. It is slightly malleable. Fracture subconchoidal. The analysis of the purest pieces gave:

	I.	II.	III.	Theory.
Arsenic,	10·92*	12·284	12·277	11·64
Copper,	87·64	87·477	87·371	88·36
Silver,	0·19	0·040	0·032	
	98·75	99·801	99·680	

b. Algodonite.—α. The dense whitneyite changes gradually into a mineral of larger crystalline grains, a more greyish white color and metallic lustre. When polished it is almost silver-white. The purest of it forms the lining of little cavities as minute crystals, too indistinct, however, to determine their form; they have the composition of algodonite; a slight admixture of whitneyite generally gives the arsenic a little too low. I found:

	I.	II.	III.	Theory.
Arsenic, - -	15·30	15·56†	16·72	16·50
Copper, - -	84·22	84·10	82·35	83·50
Silver, - -	0·32	0·34	0.30	——
	99·84	100·00	99·37	

β. For comparison with the arsenids of copper from Lake Superior, Prof. G. J. Brush kindly communicated a few fragments from a Chilean specimen, received last April by Prof. Dana from Prof. Domeyko—labelled: "Arseniure de cuivre pur, du Cerro de las Seguas, Depart. de Rancagua."

The purest pieces consisted of a very fine grained steel grey dull mineral, when magnified it showed silver-white somewhat larger specks disseminated through the mass. Admits of a fine polish, when polished it has the color of an alloy of copper and silver, containing about 60 p. c. of the latter metal. Tarnishes easily, scratches fluor with difficulty. The sp. gr. of an apparently pure piece at 25° C. was =7·603; fracture subconchoidal; brittle. Associated with cuprite, malachite, barytes, etc. The analyses gave:

	I.	II.	III.
Arsenic, - - -	17·46	16·94	16·44
Copper, - - -	81·82	82·33	83·11
Silver, - - -	*trace*	*trace*	*trace*
	99·28	99·27	99·55

* An accident in drying the precipitate of $2MgO, NH_4O, AsO_5+HO$ compelled me to determine the arsenic as $2MgO, AsO_5$, which gives it always too low.

† From the loss.

c. Domeykite.—*α.* The first observation of the occurrence of domeykite on Lake Superior was made by T. Sterry Hunt (this Jour. [2], xix, 417), who detected this mineral by its tin-white color, and the results of his analyses in the peculiar mixture of copper-nickel and domeykite from the Michipicoton Island. J. D. Whitney (this Jour. [2], xxviii, 15), remarks that it appeared homogeneous in composition, of the general appearance of copper-nickel, forming nodules with a structure in concentric layers. I have in my collection two little pieces of it, the first received about two years ago from Prof. Whitney, and another a short time ago from Prof. Brush. The latter, when received, had a fresh fracture and showed distinctly the mechanical mixture of the copper-nickel with a tin-white mineral, which however, quickly tarnished. The other was quite homogeneous, when obtained, but of a paler color than copper-nickel. Now, after having been exposed to the atmosphere for two years it can be distinctly seen to be a mechanical mixture, the domeykite having tarnished and become brown, while the copper-nickel still retains its bright color and metallic lustre. The concentric structure has become quite visible; the nearly pure (now brown) domeykite occupying the centre, covered by a layer of nearly pure copper-nickel, followed again by domeykite, which is surrounded by copper-nickel. The layers are about $\frac{1}{16}$th to $\frac{1}{12}$th of a line in thickness.

β. In the Portage Lake Mining Gazette, vol. ii, No. 9, of September, 1860, an article appeared headed "*A new mineral,*" in which it was stated that a large mass of vein rock with a great amount of arsenical copper had been discovered on the surface of the Sheldon location near the course of the Isle Royale vein, the matrix consisting principally of quartz with some prehnite and a little epidote. It is described as fine steel-grey, very brittle like copper pyrites, of about the same hardness, and consisting of copper and arsenic, without any sulphur. From this description I suspected the *new mineral* to be domeykite, and at my request John F. Blandy, Esq., very kindly furnished me with a portion of the material for examination. I am also indebted to Prof. Brush for a very fine piece, which he lately brought from the same locality.

Massive. Hardness a little below that of fluor; sp. gr. at 16° C. =7·750; color on a fresh fracture between tin-white and steel-grey, quickly tarnishing, first changing into yellowish and pinchbeck, afterwards into beautiful pavonine and rainbow colors, at last turning brown. Lustre metallic when fresh, dull after oxydation. Fracture uneven, somewhat subconchoidal.

One of my specimens shows a thin coating of an arseniate of copper, probably olivenite.

Quartz being so much intermixed with the mineral, it is difficult to obtain material for analysis quite free from it. The quantity in analysis I, was 0·55 p. c., in II, 6·71 p. c., which were subtracted, leaving for the pure mineral:

	I.	II.	Theory.
Arsenic,	29·25	29·48	28·32
Copper,	70·68	70·01	71·68
	99·93	99·59	

It is certainly a very remarkable fact that the Lake Superior copper region as well as Chile furnish the *three* arsenids of copper, neither of which has, as far as I know, been observed at any other locality, excepting the impure variety of domeykite (condurrite), which occurs at one or two mines in Cornwall.

4. *Copperglance pseudomorphous after galena* (Harrisite, Shepard.)

When I pronounced *harrisite* to be a pseudomorph of copper-glance after galena, (this Journ., [2], xxiii, 415,) I little thought that soon after, by the discovery of Dr. John Torrey (who communicated to me specimens from the Canton mine, Georgia, still containing a nucleus of unaltered galena, noticed by Prof. Brush in the 9th supplement to Dana's Mineralogy), my suggestion would be proved to be a positive fact.

I received about one year ago from a *new* locality several specimens of this interesting pseudomorph from the discoverer, Alexander Trippel, Esq., Superintendent of the copper works in Polk county, Tennessee. They occur at the East Tennessee mine, Polk county, in a feldspathic rock, associated with chalcopyrite, pyrites, blende, garnet and lime-epidote (see No. 9 below); their color varies between dark lead grey and blueish black; frequently they contain a nucleus of almost unaltered galena, while others are almost pure copper-glance, or intermediate states of alteration. A portion of the copper present is in the form of covelline, as already indicated by the blueish color of several pieces and confirmed by the analyses. The following results were obtained:

	I. Nucleus of galena.	II.	III.	IV.	V.	VI.
Lead,	84·33	12·55	11·38	2·85	1·07	0·41
Silver,	0·72	0·50	0·73	1·10	0·20	0·16
Copper,	0·94	66·27*	67·45	74·90*	76·40	70·44
Iron,	0·20	0·51	0·40	0·40	0·65	4·11
Sulphur,	14·27	20·17	20·04	20·75	20·60	24·07
Selenium,	*trace*	*trace*	*trace*	*trace*	*trace*	*trace*
Quartz,	....	....	....	....	0·11	....
	100·46	100·00	100·00	100·00	99·03	99·19

The rational composition of the above analyses would be:

* From the loss.

Galena,	97·41	14·50	13·14	3·29	1·24	0·47
Silverglance,	0·83	0·57	0·84	1·26	0·23	0·18
Covelline,	1·41	5·02	4·11	4·70	2·26	9·03
Copperglance,	....	78·82	81·05	89·89	93·80	80·70
Pyrites,	0·43	1·09	0·86	0·86	1·39	8·81

It may be interesting to give for comparison the results of an analysis of a specimen made by Mr. Trippel, although the amount of sulphur is evidently too low. He found:

Lead,	23·31	or	Galena,	26·93
Silver,	0·21	"	Silverglance,	0·24
Copper,	56·10	"	Copperglance,	70·26
Iron,	1·50	"	Pyrites,	3·20
Sulphur,	18·66			
	99·78			100·63

This composition corresponds, nearly, with the formula $4Cu_2S+PbS$, which requires 58·08 copper, 23·59 lead and 18·33 sulphur. The composition of F. Field's *alisonite* is $3Cu_2S+PbS$ and that of the *cuproplumbite* $Cu_2S+2PbS$. I have no specimens of either of these minerals for comparison. May they not also prove to be pseudomorphs of copper-glance after galena in a yet unfinished condition?

5. *Millerite.*

A beautiful variety of *millerite* occurred lately in considerable quantities at the Gap Mine, Lancaster county, Pa., forming coatings of a radiated structure of $\frac{1}{16}$ to $\frac{1}{4}$ of an inch in thickness or concentrically radiated semi-globular masses or tufts. It is frequently tarnished, and many pieces show a commencing alteration into copperglance. Such specimens are dull, of a black color at the upper part of the tufts or little crystals, while the lower still presents the brass-yellow color and metallic lustre of the millerite. Analyses made in my laboratory, gave for:

I. *The purest millerite.*

Sulphur,	35·14			
Copper,	0·87	or	Cu_2S	1·09
Nickel,	63·08	"	NiS	97·29
Cobalt,	0·58	"	CoS	0·89
Iron,	0·40	"	FeS	0·63
Insoluble,	0·28			
	100·35			99·90

II. *The partly altered millerite.*

Sulphur,	33·60			
Copper,	4·63	or	Cu_2S	5·80
Nickel & Cobalt,	59·96	"	(NiCo)S	92·48
Iron,	1·32	"	FeS	2·07
Insoluble,	0·54			
	100·05			100·25

6. *Proustite* (?)

The very rich silver ore tetrahedrite (?) described by me (this Jour., [2], xvi, 83) has been found by some late explorations at McMakin mine, Cabarras county, N. C., apparently in considerable quantities. I had an opportunity to examine a great number of specimens and have observed on a few of them, besides native silver, microscopic crystals of a bright cochineal red color, which appear to be *proustite.* Although the quantity is too small for any further examination, I considered this occurrence interesting enough to have it recorded. Associated species are, besides those already mentioned, galena, blende, pyrites, talc, quartz, diallogite, calcite, barytes, etc.

7. *Automolite.*

The beautiful automolite from the Canton Mine was first noticed by Prof. C. U. Shepard (Report on the Canton Mine, Savannah, 1856, and 2d edit., New Haven, 1856.) The crystals are of a very deep leek-green color and vitreous lustre, and present the octahedral and dodecahedral planes, the latter very deeply striated, parallel with the macrodiagonal. An examination made in my laboratory gave:

			Oxygen.	
Silicic acid, (quartz)	2·37 p. c.			
Cupric oxyd,	1·23 "			
Alumina,	53·37 "	contains	24·95	26·95 = 3
Ferric oxyd,	6·68 "	"	2·00	
Ferrous oxyd,	3·01 "	"	0·67	8·97 = 1
Zinc oxyd,	30·27 "	"	6·97	
Manganous oxyd,	0·20 "	"	0·04	
Magnesia,	3·22 "	"	1·29	
	100·35			

The small percentage of silicic acid in the above analysis results from a mechanical admixture of quartz; the cupric oxyd probably does not belong to the mineral and therefore has not been considered so; taking the iron as magnetic oxyd, which is most rational on account of the deep leek-green color, we get exactly the spinel formula $RO : R_2O_3 = 1 : 3$.

8. *Pyrope.*

A deep blood-red, and sometimes brownish-red variety of pyrope was several years ago brought from near Santa Fé, New Mexico. It forms small, somewhat angular grains, of from $\frac{1}{8}$ to $\frac{1}{4}$ of an inch in size, the edges rounded as if worn off. Sp. gr. at 12° C. =3·738. An analysis made in my laboratory gave:

			Oxygen.	
Ignition, - - -	0·45			
Silicic acid, - - -	42·11	contains	20·86	
Alumina, - - -	19·35	"	9·04	9·85
Chromic oxyd, - - -	2·62	"	0·81	
Ferrous oxyd, - -	14·87	"	2·30	9·47
Manganous oxyd, - -	0·36	"	0·08	
Lime, - - - - -	5·23	"	1·49	
Magnesia, - - - -	14·01	"	5·60	
	99·00			

Considering in this analysis the chrome as chromic oxyd, and the iron as ferrous oxyd, we get for this pyrope the garnet formula: $3\dot{R}_2\ddot{S}i+\ddot{\ddot{A}}l_2\ddot{S}i_3$ the oxygen ratio being nearly $= 1 : 1 : 2$.

9. *Lime-Epidote.*

The minerals presented to me by Alex. Trippel, Esq., contained an interesting variety of epidote from the Polk County Mine, East Tennessee. It occurs in large but indistinct crystals, which are lengthened parallel to *ii*, which plane is best developed and can be distinctly observed on every crystal; some of the crystals show also the planes $1i$ and $\frac{1}{2}i$, but the two latter generally are obliterated, and generally can be recognized only by a deep striation. The cleavage is very distinct parallel with *ii*. The color is grey, with a blueish greenish or greenish brown tint. Their sp. gr. at 12° C. = 3·344. Frequently, especially the larger crystals, intermixed with chalcopyrite and pyrites, and quartz. I found them to contain:

Ignition,	....	0·71
Silicic acid,	39·73	40·04
Alumina,	....	30·63
Ferric oxyd,	....	2·28
Manganous oxyd,	....	0·19
Lime,	....	25·11
Magnesia,	....	*trace*
Cupric oxyd,	....	0·24
		99·20

Another variety in aggregations of coarse grained, confusedly crystalline, sometimes columnar masses of a greyish white color, has evidently undergone a partial decomposition; it is associated with blende, harrisite, garnet, etc. Mr. Trippel has communicated two analyses, I. by fluohydric acid, II. by fusion with carbonate of soda. He obtained:

	I.	II.
Silicic acid,	....	43·20
Alumina,	29·08	29·60
Ferric oxyd,	2·73	2·88
Magnesia,	0·60	0·56
Lime,	23·93	22·72
Ignition,	0·26	0·26
Potash,	*traces*	
		99·22

10. *Leopardite, a true porphyry.*

This peculiar feldspathic rock, which occurs in the neighborhood of Charlotte, Mecklenburgh county, N. C., and first noticed by Prof. C. U. Shepard as the leopard stone of Charlotte, and by C. L. Hunter, (this Journal, [2], xv, 377,) has also been observed at other localities; for instance, near the Steele Mine, Montgomery county, N. C. According to Prof. Shepard, it is a compact feldspar and quartz, the spots being produced by iron and manganese. I have made an examination of it, which proves it to consist of a feldspathic matrix and disseminated through it minute crystals of a feldspar, apparently orthoclase, showing rectangular cross-sections, and six-sided double pyramids of quartz, thus having the petrographic character of a true porphyry, a conclusion which was confirmed by analysis.

The matrix, which was carefully selected for examination, had a crypto-crystalline structure, only visible with the aid of a lens, and a very faint silky lustre. Color, yellowish white. Some portions scratched orthoclase, others did not, notwithstanding the material appeared to be quite homogeneous. The purest that could be selected contained as follows:

Silicic acid,	75·92
Alumina,	14·47
Ferric oxyd,	0·88
Magnesia,	0·09
Lime,	0·02
Soda,	4·98
Potash,	4·01
Ignition,	0·64
	100·01

It will be observed that the composition of Bunsen's normal constitution of trachyte, to which the porphyries belong, closely resembles the above, containing:

$\ddot{Si}$	$\dddot{\overline{Al}}, \dddot{\overline{Fe}}$	$\dot{Ca}$	$\dot{Mg}$	$\dot{K}\dot{Na}$
76·67	14·23	1·44	0·28	7·38

11. *Staurotide ?*

I have examined the mineral, that Prof. C. U. Shepard, in his Report on the Canton Mine, first noticed as Staurotide or supposed Partschine, and of which Prof. W. J. Taylor found a new locality near Webster, Jackson Co., N. C. (Proc. Ac. Nat. Sc. of Phil. Aug. 1858) and of which he remarks that an examination made by Dr. Genth and himself renders it very doubtful as to its being staurotide. I have since made several analyses of quite pure material, using the utmost care to obtain *perfectly correct* results.

It occurs in minute crystals, rarely of ¼ of an inch in length, of a yellowish brown or cinnamon brown color, apparently right rhombic prisms, similar to those of staurotide with the planes *I* and *ĭĭ*. I have not observed any others. Sp. gr. at 27° C. = 3·792.

Associated with the copper and lead ores of the Canton Mine, and very characteristic for this locality. I obtained:

	I.	II.	III.	IV. Mean result.		Oxygen.	
Ignition,	1·91	1·25	1·25	1·47			
Silicic acid,	28·72	28·87	28·88	28·82	contains	14·96	} 15·29 = 5·60
Titanic acid,	0·88	0·94	0·70	0·84	"	0·33	
Alumina,	49·02	49·42	49·20	49·21	"	23·00	} 25·85 = 9·47
Ferric oxyd,	9·34	9·64	9·55	9·51	"	2·85	
Zinc oxyd,	6·49	} 7·41	7·66	7·13	"	1·41	} 2·73 = 1
Manganous oxyd,	not det.		0·15	0·15	"	0·03	
Magnesia,	3·19	3·29	3·17	3·22	"	1·29	
$\dot{Cu}$ $\dot{Ag}$,	*traces*	*traces*	*traces*				
	99·55	100·82	100·56	100·35			

Considering the bases RO to be combined with alumina in the proportion in which they form spinel, we would have 28·60 per cent of this aluminate. This would leave 14·81 oxygen of the alumina, which with 2·85 of the ferric oxyd are in the ratio of 5 : 1, as in most of the staurotides. The oxygen ratio of the remaining bases R_2O_3 to SiO_2 (TiO_2) is = 6·47 : 5·60 = 1·14 : 1. The formula for the above mineral would nearly resemble: $2\dot{R}\,\ddot{Al}+\ddot{Al}_4\ddot{Si}_5$.

It may be interesting to state that calculating in Jacobson's analyses of the Polewskoi staurotide the magnesia as being combined with alumina, we would obtain from 8·67 to 8·82 per cent of aluminate, and the oxygen ratio of the remaining bases R_2O_3 and SiO_2 would be as 1·18 : 1 and 1·15 : 1 or nearly the same as in the Canton mineral.

Jacobson's other analyses, calculated in the same manner, give different results, and after deducting the magnesia as aluminate, we get for the bases R_2O_3 and SiO_2 in the Brittany mineral the ratio 1·23 : 1, in that from Airolo near St. Gothardt, 1·48 and 1·42 : 1, and in that from St. Gothardt from 1·88 to 1·62 : 1.

The difficulties in the analysis of staurotide, especially with regard to the quantity of silicic acid and the separation of the bases RO from those R_2O_3, and the doubts existing as to the state of oxydation of the iron and manganese, render it very desirable to have this mineral re-investigated. Not before a *series* of the most careful analyses of the different varieties of pure staurotide have been made, can the true constitution of this species be established.

12. *Chrysolite and minerals resulting from its alteration.*

Chrysolite, or especially the variety which is known as olivine, has for a long period of time been observed as occurring *only* in basalt or lava or rocks of a similar origin. Since the important discovery of the well known pseudomorphs of serpentine after chrysolite, at Snårum, in Norway, sometimes having still a nucleus of the latter, it has been found at several localities in talc slate, at Sissersk and other places, and in Siberia, (glinkite) and a titaniferous variety at Pfunders in Tirol.

I have lately received several specimens from a new locality, from Webster, Jackson county, N. C., and an examination of them appears to give evidence that chrysolite is probably the mineral from which talc slate and many of the serpentines have been formed.

I have two varieties from there, (I) a pale, greyish green one, of granular structure (the largest grains not over two lines long, but generally very minute) and very friable, and (II) another less friable, of a somewhat darker yellowish olive green color. Sp. gr. of I. at 12° C. =3·280, of II. =3·252.

In talc slate probably belonging to the lower Silurian formation, associated with small octahedra of chromic iron, and a peculiar mineral, resembling pyrosclerite and serpentine. The analyses gave:

	I.	II. a.	II. b.
Ignition,	0·82	0·50	0·76
Chromic iron and quartz,	0·58	1·27	1·83
Silicic acid,	41·89	40·87	40·74
Ferrous oxyd,	7·39	7·39	7·26
Nickel oxyd,	0·35	0·50	0·39
Magnesia,	49·13	not det.	49·18
Lime,	0·06	not det.	0·02
Alumina, oxyds of cobalt, and manganese,	*traces*	*traces*	
	100·21		100·18

Even the purest specimens show here and there a few specks of talc and a chloritic mineral, both of which evidently result from the alteration of chrysolite; where the talc increases in quantity it forms first slender crystalline masses, like spears passing in all directions through the olivine; where it predominates the remnants of the olivine can frequently be observed in little patches or nodules or between the greenish white laminæ of the talc, generally having lost the vitreous lustre, and where it is in immediate contact with the talc, more or less tinged yellowish or brownish from a minute quantity of hydrated ferric oxyd, resulting from the oxydation of the ferrous oxyd of the chrysolite. An analysis of the talc gave:

Water,	0·34
Silicic acid,	64·44
Alumina,	0·48
Ferrous oxyd,	1·39
Nickel oxyd,	0·23
Magnesia,	33·19
	100·07

Not only talc, however, results from the alteration of the chrysolite, but also a mineral, which in its physical properties, as far as they could be ascertained, resembles pyrosclerite. It appears to be rhombohedral; the crystals although indistinct present triangular basal and also rhombohedral planes. The cleavage is basal and highly perfect. H. = 2·5. Color, dark blueish to brownish green; translucent. B.B. it exfoliates slightly and becomes silver-white. Infusible. The material for analysis was too small to have it of a uniform color. The results were as follows:

	I.	II.	Mean.		Oxygen.	
Ignition,	3·29	not det.	3·29	contains	2·92	= 0·15
Silicic acid,	31·15	31·75	31·45	"	16·33	= 0·9
Alumina,	13·70	12·45	13·08	"	6·11 }	7·39 = 0·4
Chromic oxyd,	4·16	not det.	4·16	"	1·28 }	
Ferrous oxyd,	4·83	4·94	4·88	"	1·08 }	
Nickel oxyd,	0·16	not det.	0·16	"	0·03 }	
Magnesia,	not det.	43·10	43·10	"	17·23 }	18·40 = 1
Lime,	0·17	not det.	0·17	"	0·05 }	
Potash,	not det.	0·06	0·06	"	0·01 }	
			100·35			

Although the results of the two analyses agree pretty well, and are believed to be correct, I hesitate to express an opinion on this mineral. The composition corresponds nearly with the formula: $3\dot{R}_3\dddot{A}l+3\dot{R}\dddot{S}i+\dot{H}$. It is to be hoped that soon larger quantities of this interesting mineral may be obtainable for a more complete investigation.

It is worthy of remark that the oxygen ratio of SiO_2 and RO is nearly as in the original chrysolite, and the bases R_2O_3 : HO nearly as 3 : 1, as in diaspore.

Another product resulting from the decomposition of this chrysolite is serpentine of a dark greenish grey color, resembling the duller varieties of the so-called *williamsite* of Wood's mine, Lancaster county, Pa. I have no specimens showing the *gradual* change from the chrysolite; it still shows however to some extent the granular structure of the same and here and there little lustrous specks, where formerly the larger grains of it existed. Examined with a good lens some of the grains have a vitreous lustre and appear to be unaltered chrysolite. Small grains of chromic iron are also intermixed with it. An analysis gave:

			Oxygen.	
Ignition,	9·55	contains	8·49	= 1·5
Chromic iron,	0·57			
Alumina,	0·31			
Nickel oxyd,	0·27	"	0·06 }	
Ferrous oxyd,	7·17	"	1·59 }	17·09 = 3
Manganous oxyd,	*trace.*			
Magnesia,	38·62	"	15·44 }	
Lime,	0·02			
Silicic acid,	43·87	"	22·78	= 4
	100·88			

The formula is: $2(\dot{R}_3\dddot{S}i_2)+3\dot{H}$ or $\frac{1}{4}$ water less than usual.

In the change of chrysolite into talc or serpentine a portion of the magnesia is eliminated, which separates either as brucite, hydromagnesite, magnesite or dolomite, minerals which occur more or less at the principal serpentine localities. I have not received either from North Carolina and know nothing of their occurrence. The serpentine regions of Maryland, Pennsylvania, New Jersey, New York, Connecticut, Vermont and the other New England States, as well as Canada, do not appear to have furnished any unaltered chrysolite. I frequently have had an opportunity to examine the so-called "sand chrome ores" from Maryland and Pennsylvania from almost every locality, but in not a single instance have I observed the least indication of chrysolite. The only sample in which I found very fine grains or conglomerations of minute grains of this mineral of a yellowish olive green color, in appearance almost exactly like that from North Carolina, came from Loudon county, Virginia, in the neighborhood of the city of Washington.

By the numerous very careful analyses of T. S. Hunt,* of American serpentines, a very important fact, the existence of two varieties, has been established; the first containing both nickel and chrome, and the other being entirely free from either of these metals. From my own observation it seems that the latter result from the alteration of pyroxenic and amphibolic minerals. It is a question of great interest whether the nickeliferous and chromiferous talcs and serpentines may not all have the same origin and result from the decomposition of chrysolite? I do not know a single fact which speaks against this suggestion.

If we assume the nickeliferous or chromiferous talc slates and serpentines to owe their existence to chrysolite, this mineral must in the earlier days of our planet have been very plentiful, and this fact in connection with some ideas of Gustav Bischof on the origin of olivine (Lehrbuch der chem. und phys. Geologie, II, 1, 676–685. Bonn, 1851,) renders the occurrence of specimens, showing the *direct change* of it into talc, etc. of great scientific interest. After having shown that the olivine in the basalts and lavas cannot have been eliminated from the constituents of the molten rocks, but must have pre-existed in its present condition, before it was intermixed with them, he remarks: "*The question whether the olivine which is brought up by the lava comes from unknown rocks*, or whether it is an exclusively volcanic product, we must leave undetermined."

This is certainly a very important question. The occurrence in strata belonging probably to the lower Silurian, does not admit of its volcanic origin, and the facts established by the above observations leave no doubt in my mind that the *chrysolite* or *olivine-rock*, which formerly must have existed in large strata or masses, has furnished the material for the globular masses and grains of this mineral, found in the basalts and lavas, which is made the more probable since almost all the chrysolites analyzed since Stromeyer, have been shown to contain nickel, and, according to Walchner, chrome not less generally disseminated through

* In T. S. Hunt's paper on Ophiolites, this Journal, [2], xxvi, 239, line 30, read chrysotile for chrysolite.

them, the latter certainly as chromic iron, which I have observed with a good magnifier in exceedingly fine particles or even in minute octahedra of the characteristic greasy sub-metallic lustre in olivines from numerous localities. B.B. they give distinctly the chrome reactions.

13. *Serpentine.*

In connection with the preceding paragraph, I will mention a few observations of serpentines, resulting from the alteration of other minerals, which lately have come to my notice.

In my collection I have specimens of fibrous serpentine from Texas, Lancaster county, Pa., of a greenish white color. The fibres are about 1½ inches long and separate very easily. It has no lustre, and evidently results from the alteration of asbestos; a chemical examination proves it to be pure serpentine.

The so-called "baltimorite" is certainly nothing else but a pseudomorph of serpentine after asbestos.

A specimen of chrysotile with silky lustre and a greenish, brownish and greyish white color, the fibres from three to four inches long from Providence Township, Delaware county, Pa., also originates from asbestos, which, of exactly the same structure, is still found in the neighborhood.

Another piece of chrysotile from Marble Township, Del. county, Pa., was formerly bronzite. It consists of small roundish masses of ¼ to ½ of an inch in diameter, imbedded in massive dark blackish green serpentine, the fibres corresponding with the former cleavage separation of the bronzite. Its color is greyish-brownish-greenish white, and the lustre silky.

In the same township is found chrysotile resulting from the alteration of actinolite; it is of a greenish white color and somewhat silky lustre, shows still the divergent structure of the original mineral. It is imbedded in massive, somewhat granular, greyish green serpentine, in some places of a darker color from the admixture of exceedingly fine grains of magnetite, evidently another product of the decomposition, which has taken place.

The well known foliated variety, the "*marmolite*," results according to the observations of Prof. Geo. J. Brush and myself, from the alteration of brucite into serpentine.

With regard to fibrous serpentine or chrysotile, I was for a long time in doubt, whether it might not be an original mineral, I mean one crystallized *as such*—but all the above observations and the mode of its occurrence appear to show conclusively that, like all the other serpentines, it is the result of the alteration of other minerals.

14. *Kerolite.*

A milk-white inclining to blueish-white kerolite, with waxy lustre, from Harford county, Md., which I have examined in my laboratory contains:

	I.	II.	III.
	By sulphuric acid.	By carbonate of soda.	
Water,	not det.	20·91	not det.
Silicic acid,	51·20	51·09	51·02
Ferrous oxyd,	0·22	0·23	0·26
Magnesia,	26·81	28·28	27·91
		100·51	

15. *Monazite.*

One crystal of this rare mineral has been found in the gold washings of Todd's branch, Mecklenburgh county, N. C., associated with diamond, garnet and zircon, the latter similar in form to those of McDowell Co., N. C. (Dana's Mineralogy, 4th edit., page 195, fig. 386.)

It is ¼ of an inch long, a little over ⅛ wide and somewhat less than ⅛ thick, of a yellowish brown color and shows distinctly the following planes: 1, 1*i*, *ii*, *I*, −1 and *iì*. The crystal being slightly waterworn has the edges somewhat rounded, by which some others may have been obliterated. The sp. gr. at 12° C. =5·203.

16. *Rammelsberg's Mineralchemie.*

It is with great regret that I feel it my duty to investigators to call their attention to several omissions and misapprehensions in Rammelsberg's great work, "Mineralchemie," which I consider of too much importance to be allowed to pass unnoticed. Not intending to write a criticism of the work itself, I will limit my remarks to those investigations only, which have been made in my laboratory either by myself or under my immediate supervision.

On page 5, under *Tellurwismuth* he gives the analyses of "*C. Selen-Tellerwismuth*," made by Coleman Fisher (this Journal, [2], vii, 282) and states that the great variety of the Virginia mineral is somewhat surprising. If Prof. Rammelsberg had read my paper (this Journal, [2], xix, 15) he might have found that I *distinctly* state, that the material for my analyses was *a portion* of the *same*, which Fisher examined, and his analyses being erroneous, that a selen-tellurwismuth with such a high percentage of selenium *does not exist.*

On page 21, he gives Shepard's old analysis of chathamite (cloanthite), which was made before any exact mode of separation of cobalt and nickel was known, and in a note he adds my recent analyses.

On page 50, he states that according to Pratt the harrisite is the dimorphous form of the subsulphid of copper, whilst the credit for this suggestion is certainly due to Prof. Shepard. The above analyses, under No. 4, I hope will satisfy Prof. R. as well as others of the correctness of my views that harrisite as well as cantonite are pseudomorphs after galena.

On page 177, he gives the analyses by myself (8) and Whitney (11) of the variety of pitchblende, which LeConte had distinguished as coracite, and at No. 11 with a mark of interrogation he says: "whether identical with No. 8," although in my paper (this Journal, [2], xxiii, 421) I speak of it as the *same* mineral.

On page 425, my species "barnhardtite" figures amongst the minerals of which the composition is but incompletely known, notwithstanding the numerous analyses of this mineral from several localities, all agreeing very well with the formula given, and the fact that my results have been corroborated by an analysis of O. Dieffenbach (Liebig and Kopp's *Jahresbericht*, 1854, 810). No doubt can exist as to this species. This opportunity offering I may add a new locality, the Cambridge mine, Guilford Co., N. C., and state that an analysis of it gave results corresponding with those previously obtained.

On page 228, he gives my analysis of the herrerite or cupreous smithsonite, saying that the mineral in which Herrera alleged to have found tellurium, carbonic acid and nickel-oxyd, had been *correctly* determined by Del Rio; this is true as far as the principal constituents are concerned, but Del Rio called it a "*nickeliferous*," whilst it is a *cupriferous* smithsonite; on page 429, we find herrerite again under the *doubtful* species—and to make it still more doubtful, Rammelsberg says with a mark of interrogation, that I consider it a cupriferous smithsonite. It may well be questioned whether Rammelsberg or any other chemist has the right to speak authoritatively on a subject, upon which he has had no opportunity to inform himself autoptically or by chemical investigation. My analyses are of course open to re-examination by any chemist, provided he uses the same material upon which I operated and equal care, and criticisms based on *such* re-examinations are perfectly justifiable. But wherever that has not been done, I earnestly protest against an author casting a shadow of doubt over my investigations, when I know that all pains have been taken to furnish reliable information. Where a doubt exists, I make frequent use of an interrogation mark: a compiler, if he intends to make his work a reliable one, has no more right to omit this query, where an author has considered it necessary, than to add one without stating obvious reasons for so doing.

On page 632, he says that we have no crystallized feldspar of a higher amount of acid than orthoclase, and "baulite" is mentioned on page 638 as containing minute crystals of feldspar, apparently on my authority. I am not aware that I ever made such a statement. It is certainly a grave misapprehension of my investigation (Ann. der Chem. und Pharm., lxvi, 270). This is the more surprising from the fact that Prof. J. D. Dana has at my request examined a specimen with the microscope, but could not detect any admixture of quartz, and that it consisted of quite small glassy crystals or grains, which appeared to be purely the *baulite* (1st Suppl. to Dana's Mineralogy, this Journal, [2], xix, 356). Baulite *is a crystallized feldspar* with the oxygen ratio of $\dot{R}:\dddot{\bar{R}}:\ddot{Si}=1:3:24$.

On page 1019 he remarks that the zamtite, a hydrocarbonate of nickel from Spain is probably *identical* with nickel-gymnite (*a silicate*); it is more likely identical with emerald-nickel.

Amongst the omissions I notice the analyses of the meteoric iron from New Mexico, the nickel meteorite from Octibbeha, Miss., platinum from Oregon, orthoclase from N. C., etc. etc.

Philadelphia, Nov. 30th, 1861.

ART. XX.—*On some questions concerning the Coal Formations of North America. Families, Genera and Species of Coal Plants of the United States;* by LEO LESQUEREUX. (Continued from vol. xxxii, p. 205.)

Pecopterideæ.

IF we continue to follow Brongniart's principle for the classification of the fossil ferns, attempting to fix the divisions *from the nervation, in relation with the general form of the fronds and of the pinnules*, the tribe of the *Pecopterideæ* and its generic sections appear fixed by reliable and sufficient characters.

The *Pecopterideæ* have a bi- or tri-pinnatifid frond with unequal, open pinnæ and equal, oblong or linear-obtuse pinnules, generally united together near the base and thus attached to the rachis by the whole enlarged, sometimes decurrent, very rarely narrowed base. The medial nerve is strong, straight, generally ascending to the top of the leaflets, and the veinlets are either straight and perpendicular to the medial nerve, simple or forking once or twice, or somewhat oblique, arched and dichotomous. The fructification is apparently punctiform; sometimes marginal and continuous as in the genus *Pteris*.

This definition is, with slight modification, that of Prof. Brongniart. Though the last remark about the fructifications has been generally repeated by European authors, I do not know of any species of *Pecopterideæ* that has been seen with evident marginal fructifications. The likeness of form and nervation of some of our fossil species of the coal-measures with species of *Pteris* living at our time is undeniable; but it is the only reason we have to suppose that their fructification may be sometimes marginal. If species of this tribe were found with evident marginal fructifications, they should be at once separated and put into a peculiar division.

The *Pecopterideæ* that by their general form and nervation most resemble the genus *Pteris* constitute a separate group. Generally larger than the other species of the tribe, their fronds are broad at the base, lanceolate pointed in the upper part, nearly triangular in outline. The lower pinnæ are bi-pinnately or pinnately divided with long-linear obtuse, rarely somewhat acute leaflets, while the upper pinnæ become pinnatif and then simple with shorter and broader pinnules. Thus the fronds in the lower part are bi- or tri-pinnately divided while the upper part is only bi-pinnately or even pinnately parted. The strong medial nerve of the leaflets ascends to the point and the nervules generally perpendicular to the medial nerve, or nearly so, are strongly marked and simple or forked once.

The name of *Alethopteris* given to this division by Sternberg and Göppert has been admitted by Brongniart; and the section itself considered by this author as forming a well characterized genus, provided it be restricted to species agreeing with the above definition and not extended beyond its limits, as has been done by Unger. The known American species belonging to this genus are: *Alethopteris lonchitidis* Sternb., *A. aquilina* Göpp., *A. Serlii* Brgt., the largest of our species with pinnæ sometimes longer than one foot and pinnules two inches long; *A. marginata* Brgt., very rare indeed and perhaps not even belonging to our coal-measures, the specimen referred to this species being obscure and incomplete. These four species are common to both continents. As exclusively American species we have: *Alethopteris Pennsylvanica* Lsqx., *Alethopteris species nova*, (ined:) formerly referred to *A. urophilla* Brgt., (Penn. Geol. Rep., p. 864) but differing by twice forked veins and by a broader, shorter and pointed terminal pinnule. *Alethopteris Owenii* Lsqx., (Ark. Geol. Rep., vol. ii, p. 309, pl. 2, fig. 1), *A. Coxiana* Lsqx., (Ky. Geol. Rep., vol. iv, ined:) and *A. distans* Lsqx., if this species founded on two small and imperfect specimens proves to be a good one. Our *A. Coxiana* Lsqx., somewhat resembles *A. sinuata* Brgt. Its secondary veins are more oblique than those of any other species of the genus. It is thus intermediate between this and the following division.

The genus *Callipteris*,* proposed by Brongniart for another group of fossil ferns, is related to the *Neuropterideæ* by the nervation, and to the *Pecopterideæ* by the leaflets attached to the rachis by their whole base and generally united together. Prof. Göppert formerly referred the species of this group to a peculiar section of *Neuropteris*, and I admitted the same views in the

* This name Callipteris is given also by Mr. John Smith to a genus of living ferns (Hook. Mem. on the Geol. of Great Brit. p. 410).

Pennsylvania report. But this last genus is far more natural if preserved with this characrer: (*leaflets attached to the rachis by the middle of their base or by the base of the medial nerve only*); and the group of species forming the genus *Callipteris* find also a more natural place as the first of the *Pecopterideæ*, serving for a link of union between this and the *Neuropterideæ*.

In comparing the species referable to the genus *Callipteris* Brgt., it is evident that they present two somewhat different types of nervation and thus should be separated in two sections. The one characterized by a thick straight medial nerve, ascending above the middle of the leaflets and by thin, close, arched, dichotomous forking veinlets, is more closely related to *Neuropteris;* the other with a thinner, somewhat flexuous medial nerve, dichotomously forking in ascending and veinlets oblique, a little arched, distant and forking only once or twice, is related to *Odontopteris.* Of European species: *Pecopteris gigantea* Brgt., *P. punctulata* Brgt., *Neuropteris conferta* Göpp., and *N. obliqua* Göpp., (four species extremely alike and perhaps identical). *Pecopteris sinuata* Brgt.,* *Neuropteris* (*Pecopteris* Brgt.) *ovata* Germ., are referable to the first section of this genus with a single American species: *Callipteris Sullivantii* Lsqx.† In the second section represented in the coal-measuaes of Europe by *Neuropteris conjugata* Göpp., I would place our *Neuropteris Moorii* Lsqx., *N. adiantites* Lsqx., and *Alethopteris rugosa* Lsqx. This last species was formerly described and figured from very incomplete specimens first as *Ale-*

* No good good specimens of these species have been thus far found in our coal measures. The specimen from Pennsylvania, referred to the last species, is indistinct.

† It is on the stems and leaves of this species that the small body, *Gyromices Ammonis* Göpp., alluded to in a former paper (No. 95, page 105 of this Journal), is especially found in the coal-measures of Illinois. Since the publication of my former paper where this species is considered as a small freshwater shell, I have received from Prof. J. W. Dawson of Montreal a kind note on this subject, with specimens showing that the Nova Scotian species is the same as ours. He says: "This species *Spirorbis carbonarius* formerly *Microconchus carbonarius* abounds in the Carboniferous rocks of Nova Scotia, occurring in the lower coal-measures under the Carboniferous limestones and thence up to the upper Coal-measures. It is usually found attached to the leaves and stems of land plants or to shells of the Univalve and Modiola-like Mollusks of the Coal-measures (*Naiachites* Daw.). A similar species is found in the Devonian at Gaspé and St. Johns, New Brunswick, attached to land plants. I first observed this shell in 1844 and noticed it as a *Spirorbis* (Journ. of the Geol. Soc. of London, vol. i, 1845). Mr. Binney referred the British shell to *Spirorbis* in 1852. In 1853 I noticed the resemblance of the Nova Scotian to the British species (Journ. of the Geol. Soc., vol. x) and in my Supplement to Acadian Geology, have stated my belief in their identity, (Acad. Geol., p. 147, Supl. p. 43)." As I formerly stated, it is certain that *Gyromices Ammonis* of the German authors is the same species as ours, and from Prof. Dawson's specimens it is evident also, that his *Spirorbis carbonarius* of Nova Scotia is identical with it. The remarks of the distinguished Professor establish beyond a doubt that the species is a shell. Judging from the figure in Acadian Geology, p. 147, that shows the mouth of the spirorbis as being cut in an undulating line, and especially from Lyell's figure (Manual of Geol., p. 525), I supposed that the Nova Scotian and the English species were different from ours whose mouth is exactly oval, with a thick obtuse margin. If Lyell's figure is exact, I think still that it cannot represent the same species as ours.

thopteris obscura, in the Penn. Geol. Rep., (p. 865, pl. 1, fig. 13 and 14) representing the upper part of a pinna, and later as *Alethopteris rugosa* in the Catalogue of fossil plants of the coal-measures of America (p. 11, tab. 1, fig. 2 and 3) showing only the lower part of a separate pinna. But better and more complete specimens of this fine species have since been obtained presenting its different parts. Like the other species of *Callipteris*, it is by the general outline of its frond and the form of its divisions a true *Alethopteris*, while its nervation is that of a *Neuropteris*. It has a tripinnately divided frond, with open, flexuous, ovate-lanceolate primary pinnæ and linear secondary pinnæ. The pinnules, united together up to the third of their length, are ovate-oblong, entire, somewhat obtuse, with a deltoid, obtusely pointed terminal pinnule. The lower and inferior pinnules are sometimes of an abnormal form or a little broader and more obtuse and as the upper pinnæ are decurrent on the rachis, they often become attached to the main stem. The medial nerve is thin, flexuous, forking in ascending (dichotomous) and the veinlets somewhat distant are oblique, arched and forked once or twice. Our *Alethopteris Sullivanti* Lsqx., has not yet been found with pinnæ attached to the rachis and it is still uncertain if these are decurrent as in the other species. In *Neuropteris Moorii* Lsqx., and *Neuropteris adiantites* Lsqx., this character is well marked and the main rachis is winged by decurrent leaflets.

I consider as a third well established division of the *Pecopterideæ* of the coal, the genus *Pecopteris* Brgt., as it is fixed in the following definition slightly modified from Brongniart, in his *Tableau des Genres*, page 24. Frond bi-tripinnatifid; pinnæ long, pinnatifid, with pinnules attached to the rachis by their whole base, generally united together at the base, oblong, obtuse, entire, equal, not decurrent. Medial nerve thick or well marked; veins oblique or perpendicular, simple, once, twice, rarely thrice, forked.

The modification of Brongniart's definition concerns only the characters taken from the form of the pinnules: oblong, entire, obtuse, and equal; permitting the grouping of the species of our coal-measures in a more simple and natural way. The only species that apparently differs from these characters is *Pecopteris arguta* Sternb., whose leaflets are sometimes sharply serrate. As will be seen below, this fossil fern has its pinnules sometimes entire, and thus the serrature of part of the leaflets may be considered as abnormal.

Prof. Brongniart in his *Tableau des Genres* has farther subdivided the genus *Pecopteris* into three subgenera, according to the direction and the number of the divisions of the veins. As these characters are not always permanent in the same species, these subdivisions can be preserved for convenience sake only. They are :—

§ 1. *Aplophlebis. Pecopteridis* species with straight medial nerve and secondary veins simple, oblique or perpendicular to it. As belonging to our coal-measures, we have in this section: *Pecopteris arguta* Brgt., *P. unita* Brgt., *P. acuta* Brgt., *P. æqualis* Brgt., *P. concinna* Lsqx., *P. arborescens* Brgt., *P. cyathea* Brgt., *P. affinis* Brgt., *P. pusilla* Lsqx., *P. dubia* Lsqx., and *Asplenites rubra* Lsqx. These last five species may be varieties of *P. arborescens*, or at least are considered as such by some authors. To this section, I would still add : *Pecopteris longifolia* Brgt. and its identical species *Diplaxites emarginatus* Göpp.

§ 2. *Dicrophlebis :* containing species with twice or thrice forked veins. Our American species agreeing with it are : *Pecopteris oreopteridis* Brgt., *P. pennæformis* Brgt., *P. plumosa* Brgt., (identical with *P. dentata* Brgt.), *P. villosa* Brgt., and *P. decurrens* Lsqx.

To the third subgenus *Cladophlebis* Brgt., with pinnules sometimes free at the base, nervules more oblique on the medial nerve, more divided, generally arched and dichotomous, we could refer as species from our coal-measures : *Pecopteris Cistii* Brgt., *P. polymorpha* Brgt., *P. distans* Lsqx., *P. Sheafferi* Lsqx., and perhaps *P. velutina* Lsqx., whose nervation is entirely obsolete and unknown.

A number of species of *Pecopterideæ*, especially belonging to our coal-measures, should, I think, from their peculiar appearance, be grouped together in a separate genus. They are all thick-leaved ferns, and their pinnules though mostly entire have a tendency to become irregularly lobed, when they increase in size, especially the lower and inferior one of each pinnæ. The pinnules are unequal in size and varied in form. They have a strong medial nerve, dichotomous or forking in ascending, generally straight and the secondary nerves or veins diverging in an acute angle and once or twice forked, according to the size of the pinnules. In this group, I would place *Pecopteris nervosa* Brgt., *P. muricata* Brgt., *P. Pluckneti* Brgt., *P. Loschii* Brgt., commonly found both in the European and the American coal-measures, with the following species belonging exclusively to ours: *Pecopteris Sillimani* Brgt., *P. callosa* Lsqx., (Ill. Geol. Rept. ined. pl. 3, fig. 1,) nearly related to *P. Loschii*, *Sphenopteris Lesquereuxii* Newb., scarcely distinguishable from *P. Sillimani*, and likely a variety of the same, *Sphenopteris Newberrii* Lsqx., and *Pecopteris dimorpha* Lsqx. This last species is related to *Pecopteris bifurcata* Sternb., referred by Prof. Geinitz to *P. Pluckneti*. The nervation and the form of some of the leaflets is the same, but it differs by peculiar and apparently persistent characters. The leaflets generally free at the base are sometimes distant and have a different form on each side of the pinnæ. The upper ones are shorter, broader, broadly obtuse at the top, variously and irregularly lobed, enlarged and somewhat decurrent at the base; those of the lower side of the pinnæ are longer, lanceolate, mostly entire, slightly pointed and also a little decurrent on the rachis. In the upper pinnæ only the shorter, generally triangular, pinnules are apparently united at the base, at least continuous; but they preserve the same difference of form on both sides of the pinnæ, broadly triangular on the upper, longer lanceolate triangular on the lower side. This remarkable species, which comes from the coal-measures of Rhode Island, varies as much in its ramification as in the form of its different parts. On one specimen, showing the part of a frond, the pinnæ are alternate, distant, very oblique on the main rachis; on another, the alternate pinnæ, more than six inches long, are perpendicular to the rachis, and placed very close to each other. It is probable that this last part is that of a large, primary pinna, and that the first one shows the upper part of the frond. In that case the frond is tripinnate or even quadripinnately divided, the lobes or divisions of the pinnules being sometimes deep and regular on both sides.

The only one of our species that might appear out of place in this newly proposed group is *Sphenopteris Newberrii* Lsqx., especially from the peculiarity of its ramification. The leaflets also, though sometimes irregularly lobed, are less so than in the other species and the enlarged main rachis appear narrowly winged by the inferior decurrent pinnules like that of some *Sphenopteris*. Except this last character, which cannot be considered as generic, the essential features of this fern refer it to this group. Its nervation is nearly exactly like that of *Pecopteris nervosa* Brgt., though less deeply marked, and its pinnules unite near the base. The ramification also of *Pecopteris nervosa* and *Pecopteris Loschii*, is, if not dichotomous, at least forked at the upper part of the fronds, into two diverging branches as in the *Gleichenites* of Göppert. In *Sphenopteris Newberrii*, these branches are united in a more open angle at the top of an apparently naked pedicel in the form of an upturned crescent.

If, as I think, this peculiar group of fossil ferns of our coal ought to be separated as a genus, the name of *Aspidites* Göpp. would be appropriately preserved for it. It was formerly established by the author, in his Systema, p. 348, and afterwards abandoned, because, characterized as it was, especially by its fructification either known or supposed, it contained species that had not sufficient affinity to be grouped together. Nevertheless the definition characterizing the second section of this old genus would without hardly any modification agree with the species of the new one. Frond bi-tripinnate. Pinnules generally enlarged at the base, united, decurrent or separated and sessile; medial nerve somewhat flexuous, thinning upwards and becoming bifid at the upper end; secondary nerves emerging from it in an acute angle, dichotomous; branches simple or forking, more or less arched. *Pecopteris Pluckneti* Brgt., was already placed in this section by Prof. Göppert, and some of the species appear nearly related to species of *Aspidium* of our time.

There are still some other species that have been placed by Brongniart in a separate section of the *Pecopterideæ,* named by him *Sphenopteroides.* These species are true *Sphenopteris,* and have been generally considered thus by European authors. Mr. Brongniart himself says, in his *Tableau des Genres,* that they would find perhaps a more natural and better place with the genus *Sphenopteris* than with the *Pecopterideæ.* We have only two American species referable to this section, and they are of course mentioned with the genus *Sphenopteris.*

It would be out of place to examine critically now the other genera proposed for the classification of the *Pecopterideæ.* A few only, on which our American specimens furnish some interesting data, can be mentioned here.

Göppert has separated his genus *Diplaxites,* especially from the pinnules united nearly in their whole length, and the medial nerve pinnately branching, with simple veinlets a little curved inwards and ascending to the margin of the leaflets. Mr. Bunbury, in his examination of some fossil ferns of Frostburg, Md., (Quart. Journ. of the Geol. Soc. of London, vol. 2, p. 82,) has made some very interesting remarks on this genus, referring to it as likely to be new, one of our American species. From numerous specimens collected in various parts of our coal measures it is evident, first, that our species and *Diplaxites emarginatus* Göpp., are identical, and secondly, that *Diplaxites emarginatus* Göpp., and *Pecopteris longifolia* Brgt., are also the same species. It is true that hitherto we have found this fossil fern only in pinnæ separated from the common rachis. But they are sometimes in great numbers on the same slate and both the broad-leaved and narrow-leaved forms, to which both names have been applied, are found mixed, together with those of an intermediate size, serving as transition. In some of the leaflets the inferior veins do not ascend to the top of the pinnules but diverging against the borders meet those of the contiguous pinnule half way, or below the point of union of the leaflets. In that case the species has exactly the nervation and the form of some pinnæ of the very variable *Pecopteris unita* Brgt. It is thus a true *Pecopteris,* perhaps identical with the last species.

The genus *Asplenites* Göpp., was separated from *Pecopteris* on account of the lengthened or linear fruit-dots. I formerly admitted it for one of our fossil ferns: *Asplenites rubra* Lsqx. But from the examination of a great number of specimens, it is evident that the narrow linear marks on the upper surface are mere irregular impressions from the fruit-dots, placed under the leaflets, varied indeed by contraction of the epidermis, and do not show the real form of the dots. Both the linear and the round impressions are seen on the same specimens. Our species in this case is undistinguishable from *Pecopteris arborescens*. The *Asplenites nodosus* of Göppert has been also recalled to it by Geinitz.

In the genus *Polypodites* Göpp., still preserved by Unger, we find *Polypodites elegans* Göpp., when another species which appears to be identical with it, *Pecopteris arguta* Sternb., is left by the same author with the genus *Pecopteris*. The only difference that separates both species is that in the first, the leaflets are entire, and in the second evidently and sharply serrate. On some specimens of ours, both the forms are found on the same frond, viz., sharply serrate leaflets becoming entire either by the pressure of the teeth against the margin of the leaflets or by insensibly passing to an undulate and then to a perfectly smooth margin. The great and splendid specimens figured by Germar, of *Polypodites elegans*, are extremely like specimens of our *Pecopteris unita* Brgt.

It is still doubtful if the genus *Crematopteris* Schp., with a frond simply pinnate and leaflets vertically placed, ovate, oblong, very entire, without any trace of nerves, should be referred to the *Pecopterideæ* as it has been generally done. It is still more uncertain if our species *Crematopteris Pennsylvanica* Lsqx., belongs to this genus or is referable to it. The only specimen ever found of this fossil plant is figured Tab. 3, fig. 5, of the Penn. Report. It may be part of an undeveloped frond or even part of a root. This species like *Scolopendrites grossi-dentata* Lsqx., (same Rep., p. 868, tab. 8, fig. 7,) ought to be left as plants of undetermined affinity, till better specimens shall have been found.

Sphenopterideæ Brgt.

The fossil plants referable to this tribe are, even for the same species, extremely variable in their characters. This causes a great difficulty in their classification. Prof. Brongniart has remarked indeed that a division of the *Sphenopterideæ* would be possible, in combining characters drawn from the form of the pinnules and from the nervation; but he has not proposed any one himself. Prof. Göppert has divided the *Sphenopterideæ* in three genera only: *Sphenopteris*, *Hymenophillites*, and *Trichomanites*. With the exception of this last genus to which none of our species can be referred, this classification is admitted for our *Sphenopterideæ*.

The genus *Sphenopteris* Brgt. is still subdivided by Göppert in three sections, named here in an order contrary to that of the author.

1st. *Dicksonioides:* frond bi-tripinnate, pinnules suboblique, sessile, often united together at the base, entire or lobed or pinnately divided. Nerves pinnate, flexuous, distant, the inferior ones forking or dichotomous, the superior ones simple. This section makes a link of union between the *Pecopterideæ* and the *Sphenopterideæ*, containing, as before said, some species referred by Brongniart to the genus *Pecopteris*. Of this section we have in our coal-measures: *Sphenopteris paupercula* Lsqx., (Geol. Rep. of Ill. ined. pl. 5, fig. 4 and 4*a*,) related to *Pecopteris Shoenleiniana* Brgt. *Sphenopteris* spec. nov. (ined.), distinguishable from *Pecopteris Murrayani* Brgt. only by the *slightly pointed and once-toothed* lobes of the pinnules that in the European species are roundish and entire. *Sphenopteris abbreviata* Lsqx., *S. plicata* Lsqx., a species established from a too small and incomplete specimen with nerves entirely obliterated and perhaps referable to *Pecopteris Pluckneti* Brgt.; *Sphenopteris intermedia* Lsqx., *Sp. Davalliana* Göpp, *Sp. Dubuissonis* Brgt., *Sp. Gravenhorstii* Brgt., and *Sp. flagellaris* Lsqx. I would even join to this division *Alethopteris serrula* Lsqx., a beautiful species that has some relation of form and nervation with this last one and that has no natural affinity with *Alethopteris*.

2d. *Cheilanthoides* Göpp. Frond bi-tripinnate with sometimes entire, mostly pinnately lobed pinnules. Nerves pinnate and secondary nerves mostly geminate in each lobe and forked near the top. Our American species of this section are: *Sphenopteris latifolia* Brgt., *Sp. acuta* Brgt., *Sp. obtusiloba* Brgt., *Sp. irregularis* Sternb., *Sp. polyphylla* Ll. and Hutt., *Sp. glandulosa* Lsqx., and *Sp. squamosa* Lsqx.*

3d. *Davalloides* Göpp. Frond bi-tripinnate, pinnules or lobes of the pinnules wedge-form; nerves oblique, ascending, single or double in each lobe. As referable to this section, we have: *Sphenopteris tridactylites* Brgt., *Sp. spinosa* Göpp., *Sp. distans* Sternb., *Sp. dilatata* Lsqx., *Sp. decipiens* Lsqx., and *Sp. rigida* Brgt.

If the American species do not throw any new light on the genus *Sphenopteris*, scantily represented in our coal-measures, it is I think different with those referable to the genus *Hymenophyllites* Göpp.

This genus is nearly related to existing species of *Hymenophyllum* and *Trichomanes*. According to Göppert, it has for characters: a frond bi-tripinnate, either irregularly cut-lobed or pinnatifid, with the divisions decurrent on a filiform rachis. Nerves pinnate or dichotomous, simple in each lobe or excurrent. I have formerly (page 69, vol. xxx, of this Journal) alluded to some species of disputed affinity, that were at first separated in a peculiar genus, *Pachyphyllum* Lsqx., (Penn. Geol. Rep. p. 863,) and afterward referred to a separate section of the genus *Hymenophyllites* Göpp., (Cat. of Fossil Plants,) for the following reasons:

1st. Living species referable to the genus *Hymenophyllum* have two different typical forms to which both the proposed sections

* The nervation of this species is unknown. The general form of its divisions is that of *Pecopteris Sillimani*.

of *Hymenophyllites* are evidently related. The species belonging to the first have a lanceolate, bi-tripinnate frond with forked pinnules. All its divisions are dichotomous, linear and decurrent upon a narrow, half round or flattened rachis. The nerves divide according to the divisions of the frond and the nervules simple in each lobe are excurrent. Of species referable to this section we have from our coal-measures: *Hymenophyllites Hildrethi* Lsqx., *H. flexicaulis* Lsqx., (Geol. Rep. of Ark., p. 309, pl. 1, fig. 1 and 1*a*,) *Hymenophyllites pinnatifidus* Lsqx., (Geol. Rept. of Ill. ined., pl. 2, fig. 2 and 2*a*,) *Hymenophyllites furcatus* Göpp., and *H. artemisiæfolius* Brgt. The other typical form of the genus *Hymenophyllum* to which another section of our fossil *Hymenophyllites* is related has for characters: a simple, cartilaginous frond, nearly round or oval-lanceolate in outline, irregularly pinnately cut-lobed in short obtuse divisions. The medial nerve at its base is the continuation of a short, naked pedicel, emerging from a creeping rhizome. The nerves are dichotomous, forking and thinning in ascending and the nervules simple and decurrent in each division. Indeed, although the general appearance of the species belonging to both these sections is far different, it results only from a greater or lesser expansion of the limb of the frond. In the first case, there is only a narrow strip of it extending on each side of the nerves and following them in their divisions, in the second, the *derma* is broader and sometimes fill the space between the nerves except near their extremities. It appears evident that all our species related to the second section of *Hymenophyllites* have the same characters as described above. All have a strong generally inflated basilar nerve, dichotomous or forking in ascending, with simple nerves, decurrent to the top of more or less irregular divisions; all also appear to have had a cartilaginous frond. Some authors assert that species like *Hymenophyllites giganteus* Lsqx., (*Schizopteris lactuca* Göpp.) cannot belong to the ferns. But our American specimens have apparently either a pinnate frond with large pinnæ attached on a common rachis, or a compound of simple fronds attached to one side of a creeping rhizome, and thus are fern-like. Our other American species are still more related to the ferns than the former.

With *Hymenophyllites giganteus* Lsqx., we have from our coal-measures: *Hymenophyllites laceratus* Lsqx., *H. hirsutus* Lsqx., *H. affinis* Lsqx., *H. fimbriatus* Lsqx., *H. adnascens* Ll. and H., and a new species from Rhode Island, related to the *Hymenophyllites giganteus*, but with broad obtuse lobes.

Another reason for abandoning the genus *Pachyphyllum* is, that some of the species now under examination have already been referred by European authors to five different genera, *Schizopteris*, *Aphlebia*, *Filicites*, *Fucoides*, and *Algacites*. The two first only have been preserved for *Hymenophyllites giganteus*, but their characters are entirely at a variance with those of this and of the other species of this group. Brongniart characterizes his genus *Schizopteris* thus: Frond irregularly forking, sub-dichotomous or pinnately lobed; lobes fastigiate, elongated, enlarged-cuneiform at the top, truncate, without rachis and primary nerves; nervules very thin, parallel, equal, forking, &c. The genus *Aphlebia* Sternb., is from its character still less adapted for our plants, its characters being: frond lobate or flabellate, pinnatifid or pinnate, lobes or laciniæ plane, nerves and veins none; rhizome filiform, ascending. Moreover, both these genera characterized as they are, have no affinity with any other of the fossil plants and thus their place is uncertain.

(*To be continued.*)

ART. XXI.—*Abstract of a Meteorological Journal, kept at Marietta, Ohio:* lat. 39° 25′ N., and long. 4° 28′ W. from Washington City, for the year 1861; by S. P. HILDRETH, M.D.—[Thirty-fifth annual Report.]

MONTHS.	THERMOMETER. Mean.	Maximum.	Minimum.	Fair days.	Cloudy days.	RAIN. Inches. Thous'ths.	WINDS.	BAROMETER. Maximum.	Minimum.	Range.
January, . .	32°·33	51	10°	12	19	2·704	W., N. & S.	29·75	28·84	·75
February, . .	38·20	69	2	12	16	2·316	S., S.W. & E.	29·75	28·85	·90
March, . .	43·00	75	15	12	19	2·278	S., S.W. & N.	29·78	28·95	·83
April, . .	52·70	82	30	14	14	6·372	N., N.W., S. & E.	29·60	28·95	·65
May, . . .	56·39	86	28	15	16	5·619	N., N.E. & S.	29·65	28·65	1·00
June, . . .	70·25	92	44	16	14	3·961	S., S.W. & N.	29·68	29·15	·43
July, . . .	68·17	90	48	16	15	5·146	S., S.W. & N.	29·60	29·20	·40
August, . .	71·00	94	50	18	13	3·031	S., S.W. & E.	29·60	29·10	·50
September, .	66·00	89	36	18	12	4·312	S., S. E., & N.	29·84	28·88	·92
October, . .	44·20	79	28	15	16	4·433	S., S.W. & E.	29·80	28·95	·85
November, . .	41·33	71	25	14	16	4·631	N., N.W. & W.	29·64	28·85	·79
December, .	37·00	69	12	21	10	1·618	S., S.W. & N.	30·00	29·10	·90
Mean for the year,	51·71			185	180	46·441				

The mean temperature for the year is 51°·71, being not far from the average of a series of years.

The amount of rain and melted snow is 46·441 inches and considerably above the mean for this locality.

Winter months.—The mean temperature for the winter is 33°·55. It was a very mild winter—the mercury being at no time at zero, though very near that point. The Ohio river was not closed, so as to prevent navigation, but contained at times considerable floating ice, lasting only a few days. There was but little snow.

Spring months.—The mean temperature of spring was 50°·69, which is nearly two degrees below the average, this season varying in different years from fifty to fifty-seven degrees.

Summer months.—The mean for summer was 69°·80, which is rather below the usual temperature for this season of the year, the mercury at no time rising above 92°.

Autumn months.—The temperature for autumn is 50°·51, which is two or three degrees below the average. In the year 1854, the mean of this season was 56°·50, a notable variation. The first snow fell on the 24th of the month of November, about half an inch, but melted away in a few days.

Remarks on the year 1861.—The year has not been marked by any great extremes of temperature—the coldest day being two degrees above zero, and the hottest, ninety-two degrees. There has been no suffering of the crops of grain and grass from drouth, but an abundant supply of rain has fallen, and at times when most needed. In the northerly and eastern portions of Ohio, an unusual quantity of rain has fallen, causing disastrous floods in the streams at unusual seasons of the year. In Columbiana county, on the 12th of August, there fell in six hours, seven inches of rain.* The water courses, unable to hold this quantity, overflowed their banks, sweeping the bottom lands of their crops, and many bridges from the Big Beaver creek and its branches. The latter part of September excessive rains fell on the head-waters and branches of the Alleghany, Monongahela and Kanawha rivers, causing destructive floods in all these streams, especially that of the Big Kanawha. The rain commenced on the 26th of September, in the afternoon, and by Sunday morning at one o'clock, the river at Charleston had risen fifty-eight feet. It began to rise on Friday evening, and in twelve hours rose forty-five feet, nearly four feet an hour; a proof of the excessive rains in the mountains at the head of the stream. The ravages on this river were greater than on any other, destroying the salt works and all the crops within its reach.

The borders of the Alleghany river not only suffered in the destruction of crops, but also in the loss of great quantities of pine boards and lumber of all kinds. The Ohio river, at Marietta, on the 29th and 30th of September, was covered with drift, embracing saw logs, boards, bridges and fences, with the dead bodies of many domestic animals. The banks were nearly full, but did not overflow the town. Crops of corn on the low bottoms of the Ohio and Scioto rivers were destroyed, to the amount of several hundred thousand bushels. The Muskingum river was not unusually high; and the crops suffered less than on many other streams. The Little Kanawha was higher than ever

* See this Jour., xxxii, 296.

known, and the region of "Rock Oil," suffered the loss of more than a thousand casks, besides the destruction of reservoirs, buildings, and engines. The effects of the September flood will long be remembered.

On the morning of the second day of May, a disastrous frost visited all the southern and middle portions of Ohio, ruining the apple and peach crop of 1·861. The trees were in bloom on the 22d of April, and the fruit well set. A similar calamity visited Washington county, the third day of May, in 1803. The apples then were as large as ounce balls. In Indiana and Illinois, the apple crop was uninjured. The wheat was not hurt by frosts, but in places suffered from the ravages of an insect, eating the grain while yet in the milk. Indian corn, potatoes, oats and hay, produced largely. Grapes and the smaller fruits partly compensated the loss of apples, and were in great abundance. The forests were full of nuts and acorns, so that this may be called a fruitful year.

Floral calendar, ripening of fruit, &c.—March 4th, Robins appear; 19th, Blossoms of Magnolia conspicua nearly open, but injured by frosts; 27th, Martin birds seen; 28th, Daffodil in bloom; 29th, Hepatica triloba and yellow primrose.—April 1st, early Hyacinth; 4th, Peach in bloom on the hills; 7th, Peach in bloom in the bottoms; 8th, Forsythia viridis; 9th, Sanguinaria canadensis; 10th, Hyacinth; 12th, Primroses; 13th, Pear trees, Spiræa prunifolia, Scotch gooseberry; 15th, Scarlet Pyrus Japonica; 17th, Siberian crab; 18th, pink colored Japonica; 19th, Garden currant; 20th, white Narcissus; 21st, Red-bud tree, vernal Snow drop; 23d, yellow root; 25th, Apple tree in full bloom.—May 1st, Cornus Florida; 2d, Harebell; 6th, Haw tree, Pæonia montanus, garden pea in bloom; 10th, Tulips; 14th, Horse chestnut, Snowball; 18th, Wigelia rosea; 19th, yellow Harrison rose, Magnolia tripetala; 21st, yellow and white Moccasin flower; 25th, Lawton blackberry; 26th, Variegated Iris; 27th, Rose acacia; 28th, Seedling Peonies; 29th, white and purple China Peonies; 30th, common Locust tree.—June 4th, Syringa fragrans; 6th, blue Iris, Strawberry ripe; 9th, Syringa Philadelphica; 18th, Magnolia glauca; 23d, Prairie rose; 24th, red Raspberry ripe; 25th, Catalpa in bloom; 30th, Catawissa Raspberry ripe.—July 5th, Sweet Bough apple ripe; 17th American broom in bloom; 19th, Blackberry ripe.—August 5th, Catharine pear ripe; 12th, Watermelons; 13th, Peaches ripe; 23d, Burgundy pear ripe.—Sept. 4th, St. Michael's pear; 15th, Seckle pear ripe.

Marietta, Ohio, January 2d, 1862.

ART. XXII.—*On the Study of the Electric Spark by the aid of Photography;* by Prof. OGDEN N. ROOD, of Troy, N. Y.

PHOTOGRAPHIC images of the electric spark between the carbon electrodes of the voltaic pile were obtained on silver plates in November, 1840, by Prof. B. Silliman, Jr. and Dr. W. H. Goode, (see this Journal [1], xliii, 185). These observers remarked the greater actinic activity of the negative spark as compared with the light from the positive electrode, which I believe is the earliest recorded observation on this point. These authors also noticed a double concentric structure in the impression from the electric spark similar to that described in this paper.

Photographs of the stratification and luminous discharges in Geisler's tubes were obtained in the spring of 1860, by Prof. W. B. Rogers of Boston, operating with one of Ritchie's coils. These results were communicated to the British Association at their Oxford meeting in June, 1860, (Report, &c., Abstracts, p. 30.)

Similar photographs were obtained by Gunther and Dove, and presented by the latter to the Prussian Academy, on the 27th of May, 1861. A photographic camera was employed, and an exposure of from $3\frac{1}{8}$ to 6 minutes.* In the same number of Poggendorff's Journal, W. Feddersen, in a highly interesting article on the electric discharge from the Leyden jar, states, that by means of a concave mirror silvered according to Liebig's process, he obtained fine photographs of the electric spark, even when the mirror was in rapid rotation. Photographs of the spectra from the spark of Ruhmkorff's coil have also been obtained by Prof. W. A. Miller, (this Journal, vol. xxxii, No. 96, p. 408).

In all these cases the electric light was photographed from a position at right angles to its motion, a side view being obtained: my object in the present article, is to describe a very simple and easy method of obtaining remarkably fine photographs of the electric spark, from a point of view parallel to the direction of its motion, the pictures being as it were transverse sections of the spark and of the electric brush in all its variety. The very short duration of the electrical discharge, renders its study by ordinary means difficult and uncertain: while photography, by revealing a mass of new details otherwise invisible, and furnishing a permanent record, which can be studied at leisure, offers advantages that cannot be too highly estimated.

Method employed.—M. E. Becquerel showed several years ago, that paper coated with the bromid of silver is sensitive to the light of the electric spark; the discharge of a battery of four

* Pogg. Annalen, vol. cxiii, No. vii.

Leyden jars in its immediate neighborhood causing a slight darkening. When a single spark was allowed to strike the paper no effect was produced.*

In experiments on instantaneous photography, with the wet collodion process, I was often encountered by the well known fact, that while those portions of the sensitive surface which had been acted on by a very bright light darkened strongly under the developing solution, adjacent parts, where the action of the light had been somewhat feebler, remained quite transparent and free from a deposit of silver. This rendered it probable to me, that if the electric spark were made to strike directly on the sensitive surface, only those portions would be affected which were in immediate contact with the luminous atmosphere. Actual experiment confirmed this idea to a most surprising degree: when a single spark was allowed to fall on the sensitive surface, under the action of the developing solution a fine, intense, and sharply defined image, full of delicate details, was produced. The sharpness and perfection of these images was such that they bore examination by the microscope under a power of 40 diameters, while there was not the least difficulty in enlarging them by means of photography as high as 20 diameters. The enlarged negatives then furnished good prints on paper. Sometimes the small original images were accompanied by an irregular partial halo caused by the diffused light of the spark, but this for the most part was so faint as in no way to interfere with the distinctness of their outline.

The question naturally arises whether these delicate and beautiful images are produced by the action of the *light* on the sensitive plate, or are owing to a decomposition of the silver salt by electrical agency, in other words whether these pictures are photographs or electrographs. That they are due to the action of light the following experiments will render probable.

(1.) Sparks were allowed to fall on sensitive plates and their form was observed by the aid of a lens of one inch focal length; on developing the latent images they corresponded in shape with those observed.

(2.) A glass plate was coated with plain collodion, free from iodid or bromid, and allowed to remain five minutes in the bath of nitrate of silver: it was then removed, and single sparks were allowed to fall on different portions of the wet collodion surface: under the action of the developer the well known spark images appeared.

A simple clean glass plate without any coating at all was placed in the nitrate bath for a few seconds; on its removal and while still quite wet, sparks were discharged on different portions of

* Pogg. Annl., vol. liv, p. 54.

its surface; when the sulphate of iron developing solution was poured over it as usual, clear, sharp images of the spark were obtained!

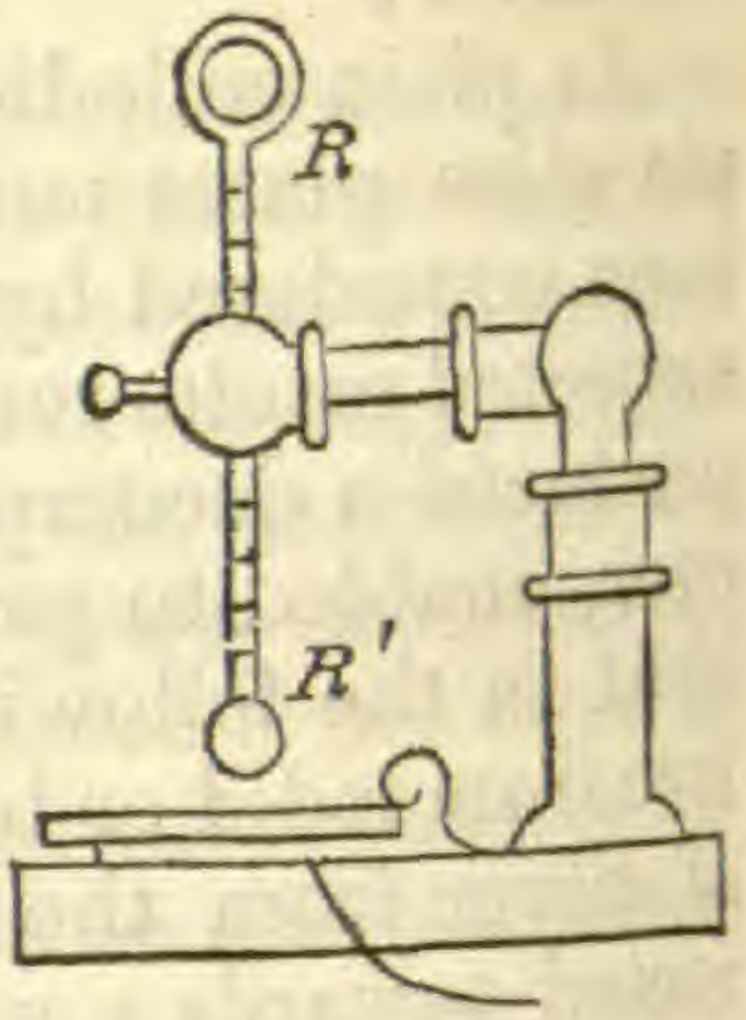
As plain collodion free from iodid and bromid as well as simple glass plates moistened merely by the nitrate bath have not been considered by photographers as sensitive to light, these unexpected results rendered it probable that the electrical discharge produced a decomposition of the nitrate of silver. I was, however, enabled to prove that these surfaces really are sensitive to *light*, in the following manner: A plate coated with collodion, free from iodid or bromid, but saturated with a solution of nitrate of silver from the bath, was placed in a camera which was directed towards a window with a bright sky beyond. The lens used was the "portrait combination," its focal length being six inches, with an aperture of 1½ inches: the exposure lasted ten minutes, the full aperture being used. Under the sulphate of iron solution, a distinct image of the window, of no great intensity, was obtained. Next, sunlight was concentrated by a "bull's-eye" condenser on a little stand, which to avoid too great heat was arranged so that its surface was about half way between the lens and its focus, the bright spot on the stand covering an oval space ¾ of an inch in diameter and 2 inches long. A plate merely moistened by immersion in the nitrate bath, was placed on the stand for ten seconds, and then developed by the sulphate of iron solution, which brought out an intense image of the oval spot.

(3.) The image of the positive spark falling on a plate merely wet with nitrate of silver has a peculiar and definite form: if this form is really traced by *light*, we should expect that the light would be able to act on another sensitive plate placed directly under and in contact with the first. This was found to be the case: a glass plate coated with sensitive collodion, on its removal from the nitrate bath, was covered with a piece of the very thin glass used for microscopic purposes, the latter having previously been moistened by a solution of nitrate of silver; sparks were then discharged on the covering plate of thin glass. When the latter was removed and the collodion surface developed as usual, images of the spark were obtained. The definition was much impaired, and the intensity lessened. When the thin glass was blackened so as not to transmit light, and the experiment repeated, no images were produced, not even by allowing a large number of sparks to strike the same spot.

Apparatus for the production of the photographs.—For the generation of the electricity a small cylinder machine was used: the diameter of the cylinder was seven inches, its length ten inches; the prime conductor exposed a surface of 200 square inches.

The apparatus for throwing the spark on the sensitive plate is seen in the diagram: a brass rod R R′, terminated by a freshly polished brass ball six-tenths of an inch in diameter, is supported over the centre of the sensitive plate and insulated in the manner seen in the wood cut (fig. 1): the rod is graduated and held in position by a binding screw. The sensitive plate is supported on a silver disc, which is in metallic connexion with the rubber of the machine; a weak spring of platinum foil rests on the collodion film and connects it with the silver disc; R is connected with the prime conductor.

1.



The manipulation was as follows: a glass plate three inches square was carefully cleaned, coated with collodion, and sensitized in a bath of nitrate of silver of 40 grains to the ounce of water: the plate on being taken from the bath was held in an upright position, so that it could *drain* for one or two minutes; it was then placed on the stand, and the machine very slowly turned, until an apparently single discharge had been effected, when the plate was removed about three-tenths of an inch and the operation repeated until twenty sparks had fallen upon it. The plate was then developed and fixed as usual; after each experiment the brass ball was wiped to remove dust, &c.

The pictures produced in this way are apt to be too intense, whereby the interior details are often obscured. Some care must therefore be taken in the selection of a collodion; that which is suitable for "ambrotypes" is to be preferred: the following formula answered well in my hands.

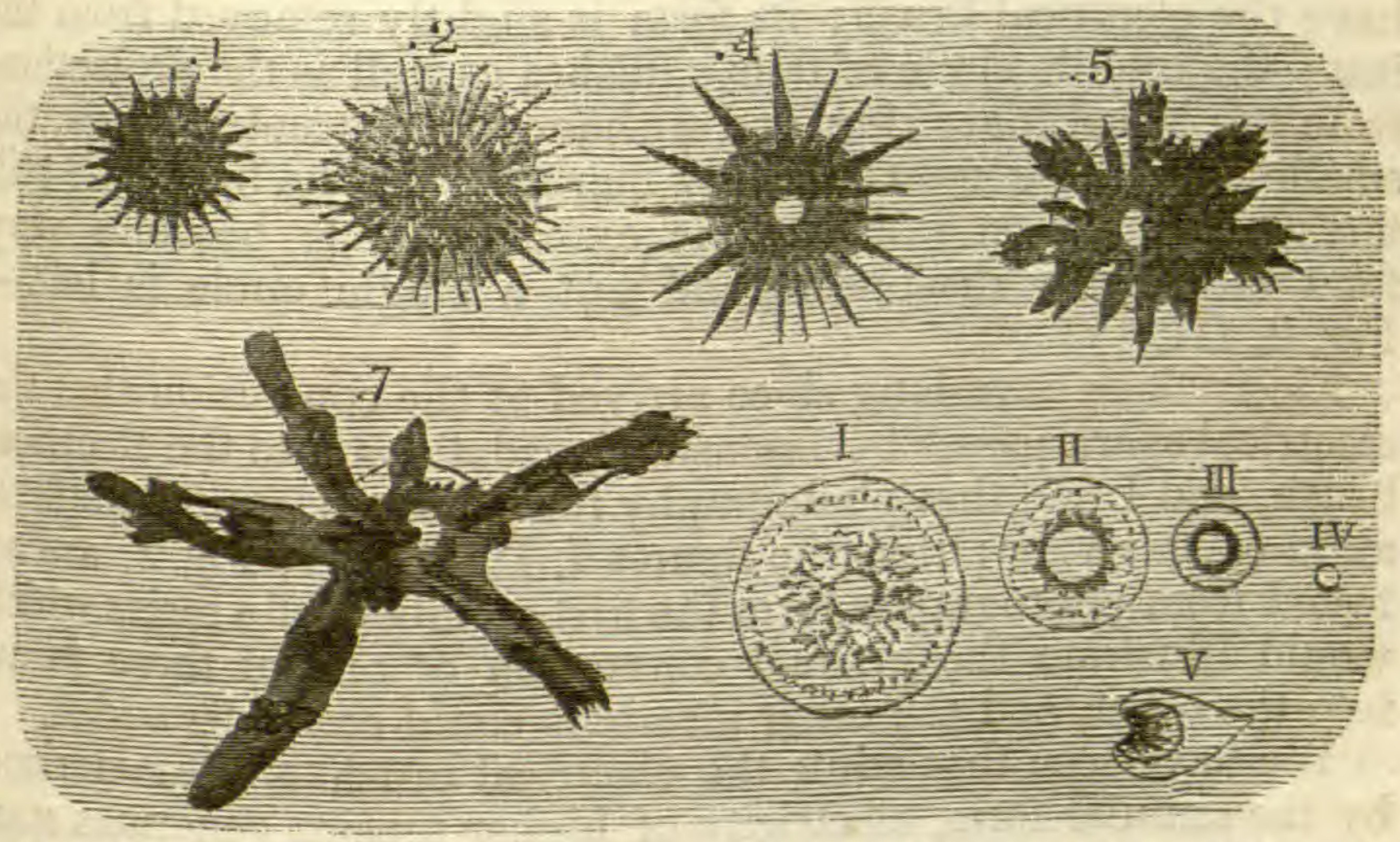
Plain collodion, - - - - -	8 oz.
Iodid of potassium, - - - -	40 grains.
Bromid of ammonium, - - - -	20 do.

This collodion should be used while still new, as it then is sensitive and not too intense in its action.

Form of the positive spark when drawn from the prime conductor by a short thick metallic rod.

The positive electrical spark under these circumstances consists of a combination of two figures, viz.: a star and one or more rings. The relation which they hold to each other is modified by the distance the spark travels in the air, that is by the tension of the electricity: the two figures are usually arranged with a considerable degree of symmetry. The very marked difference in these two components, and the fact that the annular form is, as I shall show, characteristic of the electrical brush, seems to indicate that each simple spark consists of two or more successive discharges of different intensity. The wood cuts showing the forms of the spark were executed from photographs enlarged 9 diameters; in them the bright portions of the spark are of course represented by dark shading, &c.

2.



Distance of the brass ball from the sensitive plate $\frac{1}{10}$ inch. The most general form is that seen in diagram 2, at .1: the starlike figure is very distinct, one of the rings is included within its area and faintly indicated by a deeper shade: the other ring is sometimes seen circumscribing it.

$\frac{2}{10}$ .2. The rays are larger and the external ring is plainly visible.

$\frac{3}{10}$ and $\frac{4}{10}$. .4 The rays increase in size and the ring is well developed.

$\frac{5}{10}$. Like the above except that the rays begin to grow irregular.

$\frac{6}{10}$. Rays quite irregular, both rings distinctly visible.

$\frac{7}{10}$, $\frac{8}{10}$, $\frac{9}{10}$, 1, $1\frac{1}{10}$, $1\frac{2}{10}$. The star loses its regularity and the rings are no longer symmetrically disposed.

$1\frac{3}{10}$. No spark passes over, it is replaced by the electrical brush, or rather by discharges intermediate between the brush and the true spark, fig. 2, I.

These produce a strong impression on the plate and yield intense sharp figures consisting of three parts: an external sharply defined circle, within a series of dots arranged in a circle, and finally innermost of all a broad ring which may pass by delicate gradations into a star. This would indicate that the partial spark consists, under these circumstances of at least three successive discharges of electricity of different tension. The circles on the plate seem to have exactly the same diameter they possess in the air: this is strongly suggested by the following experiment: if the plate is held obliquely the partial sparks generally pass near its surfaces for some little distance before actually coming

3.

in contact with it, and their path is marked by comet-like tails (see fig. 3). The diameter of these tails is the same with that of the circles. This is also true of the brush.

Electrical brush.—When owing to distance or the use of a pointed wire these partial sparks become reduced in intensity we have the electrical brush: its form is slightly removed from the last; the middle circle of dots vanishes as well as the projections from the broad inner ring, and we have two concentric rings, the smaller one being most strongly marked. If the brush be still farther reduced in intensity the external circle becomes very faint and finally disappears, and but a single circle is left.—Fig. 2, III, IV.

Electricians have long since arrived at the conclusion that the electrical spark passes by insensible gradations into the electrical brush, and I find that photography furnishes a beautiful confirmation of this view: thus the figures I, II, III, IV, Fig. 2, are selected from photographs form the first members of a series which would illustrate the gradual conversion of one of these forms into the other, and the other members could easily be added.

We have seen that while the electrical brush is characterized by the annular form, electricity of higher tension generates star-like figures, the rays being larger in proportion to the tension up to a certain point; now the constant occurrence of a combination of these two forms, in the photographs of *bright sparks*, points out, I think, clearly, that these sparks consist also of more than one discharge; moreover, the ring where it cuts the rays of the star can often be traced under them, as though superposition had taken place. Again, when the bright spark travels some distance the ring is generally not symmetrically placed, as though the discharge producing it had followed a slightly different path. Indications are constantly observed, which lead to the idea that even the star itself, is produced by the overlaping of two stars, having rays of different size and different intensity.

The wet collodion film offers of course a certain amount of resistance to the passage of electricity over its surface, and thus furnishes us with the different indications above decribed.

Finally, as the researches of Riess, Kirchhoff, Helmholtz and Feddersen, have shown that the electrical discharge is oscillatory and wave-like, I am the more inclined to regard these photographic figures as produced by a series of consecutive discharges of different intensity.

Before passing on to the next point of interest, I will allude to a curious modification which the positive partial spark undergoes if the machine be turned rapidly, so that a large number of them fall quickly on the same spot: see V, fig. 2. Many of the partial sparks are arranged radially around the point under the brass ball, the pointed portion being turned outward.

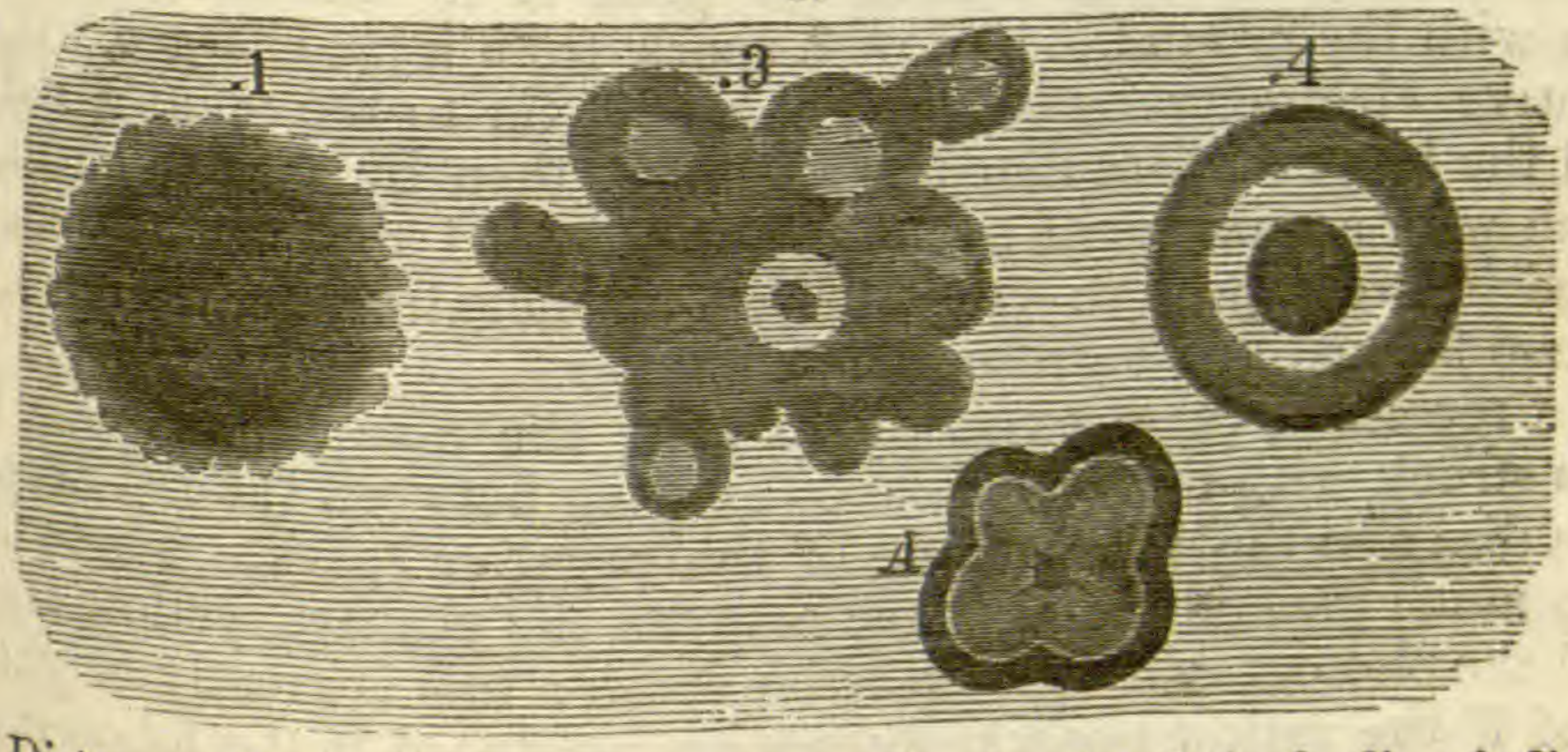
Form of the negative spark when drawn from the prime conductor by a short metallic rod.

The production of Lichtenberg's figures has been considered as indicative of a real difference between positive and negative electricity. Riess, who has examined this subject with great care, found that in addition to the marked difference in the two forms, the diameter of the positive figure is to that of the negative as 2·77 is to 1. The same physicist has lately made an elaborate examination of Priestly's rings, which are formed when a large number of sparks strike on polished plates of metal, and arrived at the conclusion that the set of rings generated by negative electricity is quite different from that produced by positive.* It consequently becomes very interesting to ascertain whether such difference also prevails between the photographs of the two sparks.

The apparatus was arranged as before and sparks of negative electricity fell on the sensitive surface.

The form of the negative spark was found to be quite different from that of the positive: it was destitute of rays, circular in shape and often made up of a number of minute circles placed without symmetry. For short distances it was much larger than the positive spark and never nearly so well defined.

4.



Distance of $\frac{1}{10}$ of inch. Round discs showing by their shading indications of internal structure. Fig. 4 .1.

$\frac{2}{10}$. Similar to above.

$\frac{3}{10}$. Discs broken up into a number of small circles. See .3.

$\frac{4}{10}$. See diagram .4.

$\frac{5}{10}$. The same as above; sometimes the form at A is produced.

$\frac{6}{10}$. No spark passes over: the partial discharges produce no figures, but merely a general blackening of the plate under the developer.

* Pogg. Annalen, vol. cxiv, No. 10, p. 193.

If the sensitive plate be placed on the prime conductor charged with positive electricity, and sparks be drawn from the surface of the plate, the negative figure is produced; if the plate rest on a conductor charged with negative electricity and sparks be drawn from it the positive form is obtained; and finally, if the plate be coated on both sides with collodion and insulated with a brass ball before and behind it, one of them being also insulated, while the other is in communication with the ground—if now a spark of either kind of electricity be allowed to pass from the insulated ball to the plate and from the plate to the second ball, we obtain as would be expected, on the opposite sides of the plate, the negative and positive images by development.

It is well known that when the knob of a jar, charged with positive electricity, is touched to a thin plate of pitch, a yellow star-like figure is produced by sprinkling the plate with a mixture of powdered sulphur and red lead; while if negative electricity is used a rounded red figure is formed. These figures bear the name of their discoverer, Lichtenberg. The method employed by Riess is much better calculated to give accurate results than the common one just mentioned: a small square plate of copper is coated thinly with black pitch on one side: the point of an insulated metallic rod touches the centre of the pitch surface, while the other side of the plate is in metallic connection with the ground. If now a spark from a jar charged with positive electricity be allowed to pass over to the pointed rod, and the latter still insulated be removed, then by sprinkling the pitch with a mixture of sulphur and red lead the star is generated in great purity: very perfect red negative figures are of course formed in a corresponding manner.

In repeating these experiments after the manner of Riess, I was struck with the resemblance existing between the red negative disc and the photographs of the negative spark. There is also much general resemblance between the positive yellow star and the photographs of the positive spark: this is greatly heightened if the yellow positive figures are produced in the following ways: the pitch plate is held at such a distance from the ball of the prime conductor that no spark can pass over, the machine is turned and the brush is allowed to strike it for an instant: on powdering the plate a multitude of small yellow stars very much like the photographs appear. They are often surrounded by small red circles, such portions having become negative by induction.

The results obtained with Leyden jars, and in a partial vacuum, as well as by the use of metallic plates, I propose to detail on a future occasion.

Troy, Jan. 6th, 1862.

ART. XXIII.—*On the Production of the Methyl Bases, and on the Preparation of Nitrate of Methyl;* by M. CAREY LEA, Philadelphia.

(1.) *On the Production of the Methyl Bases.*

HAVING found in the nitrate of ethyl so convenient a source for the production of the ethyl bases, I was naturally led to endeavor to employ it for the preparation of the corresponding substances in the methyl series, and the result proved eminently satisfactory.

When nitrate of methyl was placed in a sealed tube and immersed in water at 120° F. for an hour or two, a crystallization already took place. In a subsequent experiment it was found that complete decomposition was effected in about three hours at a temperature of 180° to 190° F. But with methylic nitrate we may dispense with sealed tubes altogether, in which respect the methylic bases are more easily obtained than the ethylic.

Bottles provided with well ground stoppers are filled one-third full with a mixture of nitrate of methyl and of the strongest liquid ammonia, in the proportion of 14 parts by volume of nitrate of methyl to 15 of liquid ammonia. The liquid ammonia which I used was a thoroughly saturated solution of the gas. In from five to seven days decomposition is complete and the nitrate of methyl has disappeared. This time may be somewhat reduced by frequent agitation, and by placing the bottles on the second day at a temperature of 90° F., and on the third at 100°. In this way three days complete the process. It is not even necessary to secure the stoppers, if the operation is performed at ordinary temperatures.

The solution then contains ammonia, methylamine, and at least one more substituted ammonia. The separation of the methyl bases is a matter of extraordinary difficulty. I am now engaged in studying it and hope to publish my results at a future time.

(2.) *On the Production of Nitrate of Methyl.*

For the production of nitrate of methyl but one process appears to have been proposed, and that is to be found in all our text-books, English, German and French. Two parts of powdered nitre are to be distilled in a capacious flask with a recently prepared mixture of 5 parts wood spirit and 10 oil of vitriol. Judging from the reactions of ethylic alcohol, it did not appear to me probable that such a proceeding could succeed. It was tried, however, and with the following results.

The substances were placed in a flask capable of containing twenty times their united volume, which was connected with a

Liebig's condenser by a wide delivery tube. For a few minutes no action was perceptible, but it soon set in, with rapidly increasing violence. Torrents of gaseous products with deep red fumes of oxyds of nitrogen, were evolved, and presently the apparatus blew up with a loud explosion, and had not due precautions been taken with a view to a possible unpleasant conclusion, personal inconvenience might have resulted, for the 3-litre flask was shattered into very small pieces, which were thrown to a considerable distance. The quantities operated upon were small, 50 grammes of methylic alcohol and proportionate quantities of the other substances. No heat was applied.

It is scarcely probable that the gases were evolved in such quantities as to have caused the explosion. It seems more likely that the heat generated by the reaction was sufficient to raise the temperature of the interior of the flask to 150° C., at or below which point, according to Dumas, the vapor of methylic nitrate explodes.

I have had no difficulty, however, in preparing this ether by a different process. By dissolving a considerable quantity of urea or nitrate of urea in methylic alcohol, it supports the action of nitric acid with the utmost facility. The following are the proportions which I have employed.

Into a retort of the capacity of a litre, 200 c. c. of purified wood spirit are placed and about 40 grammes of nitrate of urea are added and heat applied. When solution has nearly taken place, 150 c. c. of nitric acid free from the lower oxyds of nitrogen,* sp. gr. 1·31, are added, and the mixture is distilled to one-third. 170 c. c. of wood spirit and 130 of nitric acid are then added and distilled to the same point. Finally 150 c. c. wood spirit and 110 nitric acid with 10 grammes of nitrate of urea are added, and distilled to the same point as before. It is useless to carry the distillation further than the point here specified, not that it is accompanied by any inconvenience, but because nitrate of methyl ceases to be evolved. The temperature rises very high at the close of the distillation.

The operation may be carried on rapidly. We are recommended in the text-books to carry off the vapors very carefully in preparing nitrate of methyl, on account of the production of cyanhydric acid as a by-product. In chemical laboratories there is doubtless generally rather too little precaution taken than too much against noxious vapors, but in the present case, I have carefully examined the distillate, both in the old process, which failed, and in that which I here propose, and I could find no

* Freedom from the lower oxyds is an essential condition of success. That nitric acid is colorless is not in itself a sufficient indication of purity in this respect. An acid which causes the least darkening to a solution of ferrous sulphate is wholly unfit for use in the preparation of either methylic or ethylic nitrate.

trace of cyanhydric acid either by the iron or the silver tests, or by conversion into sulphocyanid. Both the ether itself and the watery part of the distillate were tested. As however it is impossible without special analysis to know what impurities may be present in so variable a substance as commercial wood spirit, it is difficult to foresee what substances may be generated in its decomposition, but I think I am justified in concluding that cyanhydric acid is not generated by the action of nitric acid upon methylic alcohol; at least not in the presence of urea.

Treated as above described, 420 grammes of wood spirit yielded a distillate from which by agitation with solution of salt, there separated the very large quantity of 300 grammes crude nitrate of methyl. This may be subsequently agitated with a little weak solution of carbonated alkali.

The wood spirit before use should be distilled with one-third of its bulk of very strong (almost saturated) solution of caustic soda, to decompose any acetate of methyl which may be present. This operation must be performed over the water bath.

Philadelphia, Nov., 1861.

ART. XXIV.—*Colored Derivatives of Naphthaline;* by M. CAREY LEA, Philadelphia.

IN the course of a variety of experiments on the effects of reducing agents upon dinitronaphthaline undertaken some time since, I made some observations which appeared to me to be of interest. But not having access to the publications of several chemists engaged in the same direction, I could not ascertain how far they were new.

I now find by the able résumé of M. Emile Kopp in the *Rep. de Chemie Appliquée*, that my results have been in a considerable degree anticipated. One reaction, however, I do not see mentioned, and as it is rather curious, I give it here.

If a solution of protochlorid of tin in strong solution of caustic soda be brought to the boiling point, and an extremely minute quantity of dinitronaphthaline be added, and the whole be boiled a few moments, a clear solution is obtained, having a blackish blue color with a tinge of green. If this be poured into a large quantity of water, the dingy blue changes to a magnificent purple, of great depth and richness. If pieces of woolen or silk be dipped for an instant into the blue liquid, they come out bluish black—if they are then washed with plenty of water they exhibit a similar change, and assume a full, rich purple shade. This color is brightened by soap and hot water, and resists dilute acids. In diffuse light it stands tolerably, but prolonged exposure to sunlight causes it to fade.*

The production of this color does not take place unless the proportion of dinitronaphthaline is extremely small in comparison with the quantity of reducing solution, one part to one or two hundred; if more is employed, the liquid assumes either a green, an olive, or a brown color, according to the quantity of the naphthaline compound. If the proportion has been too large, the liquid, when poured into water, instead of a rich purple, gives a dull purple, a lilac, a lilac brown, a green or an olive shade, according to the degree of excess in the dinitronaphthaline. A somewhat similar change in the dyeing effect is produced. It requires care and repeated experiment to obtain the exact proportions necessary for the production of the brilliant color.

I also obtained the solid purple coloring matter described by the French chemists as resulting from the action of stannous chlorid on dinitronaphthaline. The difference appears to be that the substance which I here describe seems to be only capable of existing in a caustic alkaline solution, for if the blue liquid be neutralized by even a weak acid its color is destroyed. Also that when enough dinitronaphthaline is employed to produce the *solid* coloring matter, the liquid portion, although even then of a green color, does not exhibit the characteristic change on dilution, but colors water of a dingy green. I do not mean to affirm that these products will necessarily prove to be positively and essentially distinct, but according to my experience, the production of the solid coloring matter is never accompanied by that of the liquid which exhibits this peculiar change of color, and which has not been, I believe, before described.

The blue solution left to itself decomposes in a few hours, becoming brown and muddy. The coloring power which it exhibits when fresh, is very remarkable. The solution obtained with a few milligrammes of dinitronaphthaline, suffices to impart a rich purple color to several litres of water.

Philadelphia, Dec. 21, 1861.

* The specimens of silk dyed with the purple here described by Mr. Lea, which he has kindly sent us, possess a delicate shade of lilac-purple.—Eds.

ART. XXV.—*Physiographical Sketch of that portion of the Rocky Mountain range, at the head waters of South Clear Creek, and east of Middle Park: with an enumeration of the plants collected in this district, in the summer months of* 1861; by C. C. PARRY, M.D.

WITH the exception of a few isolated peaks and elevated ridges in connection with the Appalachian mountain range, in no instance reaching an elevation of 7000 feet above the sea level, the truly alpine vegetation of the North American continent is confined to the remote region of the Rocky mountains. Here alone, within temperate latitudes, do we meet with mountain ranges where the summer sun is reflected from snowy wastes, and in which occur peaks attaining an elevation of over 12,000 feet.

Our previous knowledge of the general external features and peculiar vegetation of this alpine district, has been derived from the researches of various explorers, who have traveled hastily over this heretofore inhospitable region, noting the most prominent features of scenery along the ordinary routes of travel, determining the latitude and longitude of various fixed points, mapping out the direction of water-courses, sketching in the more prominent mountain ranges, and rarely, (as in the case of James, Douglas, Drummond, Nuttall, and Fremont,) making collections of its plants. From all these different sources of information, extending through the present century, we have derived a considerable though still imperfect knowledge of the peculiar natural features of our American Switzerland.

Within the past few years, however, the discovery of gold deposits in this portion of the mountain range has attracted thither an adventurous and enterprising population, settling with wonderful celerity its picturesque valleys and introducing into its wild recesses many of the arts and comforts of civilized life. These various social movements have afforded facilities for the prosecution of researches in natural history which were not enjoyed by the early pioneer explorers of this region.

In order to improve this opportunity, the writer was induced to make a journey to this region during the past season, (1861,) with the especial object of studying its alpine vegetation and making collections of its native plants. With this view a station was selected near the foot of the dividing ridge, at the head waters of South Clear Creek. From this point an extensive scope of alpine exposure was brought within the range of an ordinary day's journey. Here, among the pine-wooded slopes on both sides of the Snowy Range, coursing along its alpine brooks, clambering over its precipitous rocks, floundering through snow-drifts, and mounting to its irregular crests and high alpine peaks, was spent most of the summer months of 1861. The scientific results of the observations here made, are presented in the following brief sketch and the accompanying list of plants.

The first impression made upon the traveller in approaching the mountain barrier from the broad undulating slope of the Great Plains, is the irregularity of outline and apparent want of system in the grouping and arrangement of the different ridges which compose the general mass of the mountain range. Some of the higher peaks rear their snowy summits at considerable distances from the dividing crest, and are met with at irregular points along the eastern slope. Numerous cross ridges interrupt the general parallelism of the principal ranges, and the actual "divide" is mostly obscured from view by elevated projecting spurs. The streams with their impetuous currents foaming along their rocky channels descend in a zigzag course, making their passage through intervening ridges by deep precipitous chasms. On reaching the more elevated mountain district, the valleys become more open, and frequently spread out into oval-shaped basins, to which the name of *bars* has been applied by the miners. Towards the head waters of the various streams, these basin-shaped portions of the principal valleys, beset with scattering groves of pine, encircled by steep ridges, generally clothed with heavy growths of spruce or exhibiting occasionally smooth grassy slopes, are known as *parks*. These are the miniature representatives of those larger open stretches of country which occur at the head waters of the Platte and Grand rivers, forming North, South, and Middle Parks.

In approaching the dividing ridge, by following up any of the principal streams by which the mountain range is penetrated, the open parks give place to narrow valleys, generally heavily timbered with pine and spruce. The water-courses force their way through narrow rocky *cañons*, or, obstructed by beaver dams, spread out into marshes occupied by a tangled growth of willow and alder bushes.

The smaller tributaries which collect the waters that trickle from alpine snows ebb and flow with the diurnal changes of temperature, increasing in volume as the sun ascends to relax the icy bonds of a protracted winter, and again contracting as the clear night once more asserts the reign of perpetual frost. These alpine brooks constitute one of the most attractive features of Rocky mountain scenery, and along their borders grow some of the finest plants of this region. Their course is that of a continuous *torrent*, presenting in their rapid descent a perpetual sheet of foam, rivalling in whiteness the snows in which they have their sources. Their waters of crystal purity and delicious coolness glisten in the deep shade of overhanging pines, and moisten with their spray such choice plants as *Mertensia Sibirica*, *Cardamine cordifolia*, *Saxifraga æstivalis*, and a most elegant and conspicuous *Primula* (311) near *P. nivalis*.

In mounting up the steep ridges which border their course, to reach their alpine sources, the view of the surrounding country is entirely shut in by the heavy growth of pines, including on the higher ridges and abrupt slopes, *Pinus contorta* with its slender tapering trunk and stiff scanty foliage; while on more level spots, or occupying depressed basins forming sub-alpine marshes, *Abies alba* and *Abies balsamea* shoot up their tapering spires. The usual undergrowth in these pine woods is composed of *Vaccinium Myrtillus*, *Shepherdia argentea*, *Berberis Aquifolium*, *Pachystima Myrsinites*, &c.

In moist springy places and along the borders of marshes we find *Gaultheria Myrsinites*, *Pedicularis surrecta*, *Senecio triangularis*, *Mitella pentandra*, *Habenaria dilatata*, *Pyrola rotundifolia*, var. *uliginosa*, &c. As a rarity, in scattered localities, we here meet with the charming *Calypso borealis*.

On approaching the limits of arborescent growth, indicated at first by a stunted appearance of the common varieties of pine, as well as the more frequent occurrence of the alpine species, *Pinus flexilis*, we at length come somewhat abruptly upon open stretches, characterized by their peculiar vegetation and general aspect as truly alpine. Some few trees straggle for a variable distance up the abrupt rocky slopes, but in these situations they plainly exhibit the severity of the exposure by deformed and blasted trunks, often nearly prostrate, and showing by a uniform bending of their upper branches the direction of prevailing fierce winds, and the weight of wintry snows. These arctic forms are confined almost exclusively to a single species of pine, heretofore undescribed, (*Pinus aristata*, Engelm.) belonging to the same group as *Pinus flexilis*, James.

Beyond this there is a succession of alpine exposures, characterized by extensive patches of snow scattered irregularly over the mountain slopes, generally indicating the accumulation of drifts; being most abundant and persistent in recesses near the higher elevations. At other points a rough *talus* of rocks is spread over the surface, the separate blocks being of every conceivable shape, and loosely aggregated, forming numerous fissures. In these burrowing recesses the Siberian squirrel finds a congenial abode, and salutes the traveller with his reiterated bark, often the only animate sound to break the solitude of these alpine deserts. Through these loose masses quarried out by nature's hand, we often hear beneath our feet the gurgling of invisible streams, connecting by these subterranean channels elevated snow-banks with lower alpine brooks. Among these rock crevices we meet with many of the rare and attractive plants of this district, including *Aquilegia brevistyla*, *Viola biflora*, a variety of *Ribes lacustre*, *Senecio Fremontii*, *Oxyria reniformis*, *Polygonum Bistorta*, &c.

Other portions of these mountain slopes are covered with a sward of alpine grasses, mingled with *Carices* and mountain clovers, all characterized by their peculiar tough, matted, and penetrating roots. In connection with these, almost every square yard presents a botanical feast of the most attractive and varied features. Neat little tufted plants of the most cerulean blue, including *Polemonium pulcherrimum*, *Mertensia alpina*, *Myostis nana*, Torr., (*Eritrichium aretioides?*) spot the surface. In scattered localities the bright yellow disk of *Actinella grandiflora* is conspicuous, while the varieties of alpine *Phlox*, *Primula angustifolia*, *Trifolium Parryii*, &c., supply almost every tint to complete a floral rainbow. Here also by a close inspection we discover such tiny plants as *Thalictrum alpinum*, *Gentiana prostrata*, and others almost hidden in the confused mass of matted foliage. In moist depressed places, and along the spongy margins of alpine lakes, we meet constantly with an alpine *Salix*, *Caltha leptosepala*, and a white *Trollius* near *Americanus*.

Toward the summit of the dividing ridge we find plants whose names plainly indicate the frigid climate to which they belong. Here grows the elegant flowered *Claytonia* which I have called *megarhiza*, sending its deep tap-roots into the crevices of rocks whose projecting angles shelter its succulent foliage from the rude blasts that sweep over these bald exposures. Affecting similar situations we meet with an alpine *Synthyris*, (255,) with its glossy foliage and neat spike of pale blue flowers.

On the summit of the crest, which here presents a flattened irregular surface, composed of weather-worn rocks imbedded in the coarse *debris* of its disintegrating granitic masses, we find *Trifolium nanum*, *Stenotus pygmæus*, *Papaver nudicaule*, *Saxifraga serpyllifolia*, *Gentiana frigida*, and others, all indicative of a rigorous climate, whose brief summer is thus elegantly adorned by these arctic forms of vegetation. Among the rarities of this district we may notice the newly discovered [or re-discovered] *Chionophila*, (256,) *Pedicularis Sudetica*, and several others well known in the Old World, but now for the first time added to the North American flora.

Such is a general and very imperfect sketch of the prominent features of the vegetation belonging to this elevated district, taking for a sample the alpine ridge at the head waters of *Mad Creek*, to which from my frequent visits I involuntarily applied the name of *Mount Flora*.

In my solitary wanderings over these rugged rocks and through these alpine meadows, resting at noon-day in some sunny nook, overlooking wastes of snow and crystal lakes girdled with midsummer ice, I naturally associated some of the more prominent mountain peaks with distant and valued friends. To two twin peaks always conspicuous whenever a sufficient elevation was attained, I applied the names of *Torrey* and *Gray;* to an associated peak, a little less elevated but in other respects quite as remarkable in its peculiar situation and alpine features, I applied the name of *Mount Engelmann.* Thus following the example of the early and intrepid botanical explorer, Douglas, I have endeavored to commemorate the joint scientific services of our *triad* of North American botanists by giving their honored names to three snow-capped peaks in the Rocky mountains. With such innocent scientific pleasantry I felt at liberty to amuse the solitary hours of my mountain excursions, often wearied, but always enjoying with the keenest zest the magnificent scenery and rich botanical treasures that lay scattered along my varied path.

No description indeed can do justice to the grand features of scenery brought to view from the elevated points and commanding crests of this broad mountain range. While to the east the comparatively level plain stretches out like a boundless sea, in every other direction rise elevated peaks and snow-girt ridges, hemming in deeply sheltered valleys. An obscure parallelism of the principal ridges is here for the first time noticeable, more evidently marked however by the occurrence of culminating points forming broken lines extending northwest and southeast than by any continuity of the principal ridges. The *watershed* itself is a very irregular line, difficult to trace with the eye even from the most elevated points. This is owing to a very marked peculiarity of the range which exhibits the higher culminating points disposed quite constantly on the eastern slope of the divide, with which they are generally connected by depressed spurs. It is from these offsetting peaks that the most comprehensive views are obtained, and the general topography of the range can be best studied.

It may be noticed also that the most feasible *passes*, over the Snowy Range, are met with where the dividing ridge is inclined to an east and west course. In such situations the streams flowing thence north and south, respectively have their sources in the most depressed portions of the range, usually only a short distance apart.

In such a position, near the head waters of South Clear Creek is found the depression known as *Berthoud's Pass*, discovered by an Engineer of that name, while engaged in making a reconnoisance, for the location of a direct road from Denver to Salt Lake. In this pass the elevation at the highest point does not reach above the limits of arborescent growth, the dividing waters on either side heading but a few feet apart, in a pine grove.

Farther observation will be required, to show how far the accumulated snows of winter may offer obstructions to a through route, accessible at all seasons. The practical difficulties interposed by the steep ascent of the main abrupt slope can no doubt be readily overcome, by the construction of embankments and zigzags. When the principal height is once gained, farther progress is easy in either direction, by the usual appliances of road construction, for which the proper materials of stone and lumber are abundant, and of excellent quality.

The westward view takes in that irregular scope of country, including Middle Park, with its broad open spaces, encircled by broken ranges of mountains.

These mountains send down into the plain below, numerous spurs, heavily timbered with a magnificent growth of spruce, (*Abies alba*). Between these ridges, deeply sheltered valleys collect the tributary streams, forming the head waters of Grand River. The projecting mountain peaks on this side do not attain the height of those met with on the eastern slope, but the general surface is more elevated; the lowest depressions, occurring in the basin of *Middle Park*, being considerably higher than corresponding points on the great plains to the eastward. Hence the streams are less rapid, and the vegetation indicates a colder and more humid climate.

Here during the rainy season, in the months of July, and August, the different surface exposures give rise to variable atmospheric currents, which, meeting at various points, occasion a rapid development of clouds and aqueous precipitation, such as characterizes the sudden showers in this peculiar district. Here in fact may be studied to the best advantage, (though not always under agreeable circumstances), the formation of clouds, in their endless variety of shape, density, and progressive development. These at times may be seen gradually accumulating about the summits of snow covered peaks, thence spreading over the horizon and extending to the zenith, causing a regular steady rain; while at other times a sudden gust calls attention to a rapidly forming angry cloud, which sweeps over the surface in a well defined path, scattering rain, hail, or snow in its wake.

The regular afternoon showers which occur on the eastern slope are readily explained by referring them to the junction of heated air, charged with moisture, ascending from the great plains, with the descending currents of cold air from the snowy range, by which the moisture of the former is precipitated. As soon as the equilibrium is established, the rain passes off, and a sky more or less clear succeeds, followed almost invariably by clear nights and bright mornings. This series of phenomena, often succeeding with remarkable regularity from one day to another, continues during the months of July and August, constituting a rainy season.

The principal object of my journey being the collection of plants, I may here very properly conclude this sketch of the general features of scenery, and climate.

The accompanying list of plants prepared from my collections, and notes, by Prof. Gray and Dr. Engelmann, will serve to give a more precise view of the botany of this region, particularly of the alpine district, to which my attention was specially directed.

Travelling over a path so ably investigated by early explorers, I have still been rewarded for my labors by the discovery of several interesting novelties, as well as by adding quite a number of alpine plants, well known in the Old World, to our North American Flora.

Should circumstances prove favorable, it is the intention of the writer to continue these observations during the coming season, over a wider section of country lying to the west and south of the investigations of the past season.

Enumeration of the Plants; by A. GRAY, *aided by notes of Drs.* ENGELMANN *and* TORREY, *and upon the habitats, &c., by Dr.* PARRY.

[The numbers are those under which the specimens have been distributed. Their order is followed, excepting a few transpositions to bring allied species together, when it could conveniently be done.]

1. *Erigeron grandiflorum*, Hook. Fl. Bor.-Am., t. 123; var. *elatius.* "In moist shady places, near the upper limit of the arborescent growth. Rays tinged with pink or purple." The specimens (a span to a foot in height) are considerably taller than Drummond's plant, from the summit of the Rocky Mountains much farther north, and the cauline leaves more clasping. Its affinities are with our American species of the section *Stenactis* on the one hand, and with the following species on the other, notably with the form named *E. alpinum* var. *eriocalyx* by Ledebour from the Altai.

8. *Erigeron uniflorum*, L., the true, with black-woolly involucre, like Bourgeau's specimens from the snowy region of the Rocky Mountains farther north. "Near the base of the bare alpine ridges."

3. Varieties of the last (one with blue, the other with nearly white rays), far less pubescent.

4. *Erigeron macranthum*, Nutt.

5, 6, 11, 33. *Erigeron compositum*, Pursh; different forms; the last smoothish and the same as *E. pedatum*, Nutt. No. 5 is a var. *discoideum*, wholly destitute of rays. Drummond long ago gathered specimens with very short rays. No. 33, is a single specimen of the same discoid variety.

7. *Erigeron acre*, L., var. Just the *E. Drœbachensis* of the Flora Danica, which we have from Labrador.

9. *Erigeron Bellidiastrum*, Nutt. A plant of the plains.

10. *Arnica angustifolia*, Vahl., var. *discoidea! latifolia.* There is a discoid species in California; but none of the common species have before been met with in this condition.

2. *Arnica cordifolia*, Hook.

12. *Boltonia latisquama* (sp. nov.): foliis lineari-lanceolatis et magnitudine capitulorum inter *B. glastifoliam* et *diffusam* media; squamis involucri spathulatis vel obovatis nervo crasso excurrente mucronatis vel cuspidatis; pappo pluri-squamellato et 1–2-aristato. "Near the mouth of the Kansas river, Sept.; growing in large clumps, 3 to 5 feet high, in rich soil." Well marked by the broad and rounded, abruptly tipped scales of the involucre.

13. *Aster* (*Orthomeris*) *glaucus*, Torr. & Gray, (*Eucephalus glaucus*, Nutt.) Abundant and very fine specimens of a rare and interesting plant, by aid of which the species should be characterized anew.*

14. *Machæranthera* (*Dieteria*) *canescens*, Gray, Pl. Wright.

15. *Solidago Missouriensis*, Nutt., a dwarf, subalpine variety.

17. Another dwarf variety of the above species.

16. *Solidago humilis*, *β*, Torr. & Gray; to be restored to *S. Virgaurea.*

18. The var. *alpina* of the above (i. e. *S. Virgaurea*, *alpina*, Bigelow), resembling the plant from the summit of the White Mountains, New Hampshire, but only an inch or two high.

19. *Senecio aureus*, var. *Balsamitæ*, with leaves more pinnatifid.

20. *Senecio canus*, Hook., with few and large heads.

22. The same species with more numerous and smaller heads.

21. *Senecio lugens*, Richards., but the scales of the involucre not at all sphacelate at the tip.

23. *Senecio exaltatus*, Nutt., var. *minor.* A form of *S. lugens.*

24. *Senecio integerrimus*, Nutt. A rare species.

25. *Senecio triangularis*, Hook., in beautiful specimens.

26. *Senecio eremophilus*, Richards.

27. *Senecio Fremontii*, Torr. & Gray. Taller and well developed specimens of this alpine species, mostly a foot high.

28. A low, apparently more alpine variety of the preceding, with monocephalous stems, and leaves all tapering at the base.

29. *Palafoxia Hookeriana*, Torr. & Gray.

30. *Aplopappus spinulosus*, DC.

31. *Coreopsis involucrata*, Nutt. This, with the two preceding, and a specimen of *Pectis angustifolia*, Torr., were gathered on the plains.

32. *Arnica angustifolia*, Vahl; the tall, leafy-stemmed form common in that region, and approaching *A. Chamissonis.* Bourgeau collected the same on the Saskatchawan.

33, 35. *Townsendia sericea*, Hook.

34. *Cirsium edule*, Nutt.? "A common subalpine species, 3 to 6 feet high; flowers yellowish."

Cirsium foliosum, DC., or a plant generally agreeing with Hooker's character, was sparingly collected in the bare alpine region.

36. *Euphrosyne xanthifolia*, Gray, Pl. Wright. *Cyclachæna xanthifolia*, Fresen.

* *Aster Engelmanni*, Gray, coll. H. Engelmann, in Exped. Lieut. Bryan, I believe still unpublished, is another fine species of this section. The same was collected by Dr. Lyall of the British Oregon Boundary Commission, in the Cascade Mountains.

37. *Antennaria dioica*, R. Br. 39. Var. *rosea* of the same.
38. *Antennaria Carpathica*, DC.
40. *Iva axillaris*, Pursh.
41. *Artemisia borealis*, Pall.
42. *Artemisia Richardsoniana*, Bess. A form with looser pubescence and acute lobes to the leaves.
43. *Artemisia frigida*, Willd.
44. *Artemisia filifolia*, Torr. From the region where Dr. James first collected it.
45. *Artemisia Canadensis*, Michx.; a canescent form.
46. *Actinella acaulis*, Nutt. Probably *Actinea integrifolia*, Torr.
47, 60. *Aplopappus* (*Stenotus*) *pygmæus*. *Stenotus pygmæus*, Torr. & Gray, Fl. 2, p. 237. "Found only on the highest crests of the snowy range, and on the dividing ridge, growing in scattered patches." A most interesting rediscovery of a plant before known only from a single specimen, gathered by Dr. James during his hurried visit to the alpine region, in Long's Expedition.
48. *Grindelia squarrosa*, Dunal.
49. *Limosyris viscidiflora*, var. γ. *L. ciliata*, Torr. &c.
50. *Helianthus* (*pumilus*, Nutt.?): caule 1–3-pedali hispido oligocephalo; foliis oppositis ovato-lanceolatis subintegerrimis cinereo-hispidis (novellis resinoso-atomiferis) juxta basin triplinerviis breviter petiolatis, summis lanceolatis subsessilibus sæpe alternis; involucri disco paullo brevioris squamis oblongis exappendiculatis obtusiusculis vel breviter acutatis extus albo-villosis; fl. disci luteis; acheniis glabris versus apicem parce hispido-ciliatis; pappi paleis subulatis corolla paullo brevoribus cum paleolis interpositis extus marginibusque appresse hispidis. "On a rocky hill bordering the upper Clear Creek." Dr. Hayden also collected it on the Laramie Mountains. His specimens, being too far advanced, I had confounded with *H. rigidus;* but the plant is nearer *H. lætiflorus.* If it is not Nuttall's obscure *H. pumilus* it must be a new species. The latter is said to have the heads "apparently sessile," from which it may be inferred that they were not well developed in Nuttall's specimen. In ours they are on slender peduncles.
57. *Helianthus orgyalis*, DC. This seldom occurs in collections.
51. *Aplopappus* (*Pyrrocoma*) *Parryi* (sp. nov.): caule pedali superne subviscoso-puberulo apice corymboso-polycephalo, pedunculis brevissimis; foliis submembranaceis fere glabris angusto-oblongis obtusis integerrimis, inferioribus subspathulatis in petiolum attenuatis, summis basi latiore subamplexicaulibus; involucri campanulati squamis lato-lanceolatis tenuiter coriaceis apice subfoliaceo laxo; ligulis plurimis parvis; acheniis glaberrimis; pappo albo haud rigido. "Hillsides and pine woods, upper Clear Creek." A well-marked species, with somewhat the aspect of a *Sericocarpus*, especially of *S. Oregonensis;* heads half an inch long; the rays 15–20, yellow, narrowly linear, but little longer than the disk-flowers. Pappus white in the flowering specimens (unknown in the mature state) nearly equalling the disk-corollas. "These specimens grew in the shade; in open ground the leaves are not so thin."
52. *Senecio cernuus* (sp. nov.): mox glaber; caule gracili sesquipedali apice paniculato-polycephalo; foliis lanceolatis basi in petiolum

marginatum subciliatum longe attenuatis parce argutissime dentatis vel subintegerrimis; capitulis parvulis (vix semi-pollicaribus) in pedicello 1–2-bracteolato nutantibus discoideis; involucro bracteolis parcis laxis subcalyculato; ovariis glaberrimis. "Dry hillsides, and in the crevices of rocks, upper part of Clear Creek, sometimes growing in close bunches." A species entirely new to me, well marked by its small nodding or cernuous heads, and its leaves (either broadly or narrowly lanceolate) tapering into wing-margined petioles of an inch or two in length. No ray flowers; those of the disk yellow.

53. *Arnica mollis*, Hook.? a dwarf form.

54. *Arnica angustifolia*, Vahl; the alpine form, as of the Rocky Mountains farther north, and of the N. W. coast.

55. *Chænactis achilleæfolia*, Hook. & Arn.

56. *Senecio amplectens*, (sp. nov.): lana parca mox decidua glabratus; caule (sesquipedali e radice perenni) apice nudo 1–2-cephalo; foliis membranaceis repando-subdentatis oblongis plerumque obtusissimis, radicalibus in petiolum alatum decurrentibus, caulinis præsertim superioribus e basi lata (integerrima vel utrinque 1–2-dentata nunc subhastata) semi-amplexicaulibus; pedunculo gracili; involucro calyculato pilis brevibus atropurpureis parcis munitis; ligulis elongatis linearibus aureis apice sæpius 2–3-fidis; acheniis glaberrimis. "In the mountains high up, at the foot of the snowy range." This is quite distinct from any North American species known to me. Compared with *S. frigidus*, it is far less woolly, even when young, and not at all hairy, except some purple hairiness of the involucre; the latter is calyculate with linear scales of about one-third the length of the proper involucral scales; and the thin and green leaves are from 3 to 5 inches long, the cauline ones half clasping or more by a broad base, not at all inclined to be spatulate. Head nearly as large as in *S. frigidus*, the rays longer, an inch or more in length. Pappus equalling the disk-flowers.

58. *Villanova chrysanthemoides*, Gray, Pl. Wright; a more pubescent form.

59. *Chrysopsis villosa*, Nutt., var. approaching *hispida*, *mollis*, &c., all probably forms of *C. villosa.*

61. *Actinella grandiflora*, Torr. & Gray in Bost. Jour. Nat. Hist. Soc., 5. "Scattered over the alpine ridges, growing singly or branched from a deep tap root, 6 to 9 inches high." A most splendid dwarf alpine plant, which, having caused seeds to germinate, I hope to introduce into the gardens. The heads, with their numerous rays fully expanded, are nearly 3 inches in diameter, and bright yellow. It was before known only by the single specimen gathered by Fremont, in Dr. Torrey's herbarium.

62. *Gaillairdia aristata*, Pursh.

63. *Senecio aureus*, L., var. *alpinus:* caule scapiformi 1–2-cephalo tri-pollicari bracteato; foliis radicalibus coriaceis rotundatis seu obovato-oblongis fere aveniis integerrimis vel apice subtridentatis. This doubtless was collected near the snow line. I believe it is an alpine and extremely reduced form of *S. aureus*, var. *borealis*, and that *S. subnudus*, DC., may also be reduced to *S. aureus.*

64, 66. *Macrorhynchus troximoides*, Torr. & Gray; broad-leaved and narrow leaved.

65. *Troximon glaucum*, Nutt., var. foliis laciniatis.

67. *Troximon parviflorum*, Nutt. Probably a depauperate form of the last.

68. *Lygodesmia juncea*, Don.

69. *Crepis runcinata*, Torr. & Gray.

71. *Hieracium Fendleri*, Schultz Bip. in Bonpl. 1861, p. 174. *Crepis ambigua*, Gray, Pl. Fendl.

72. *Hieracium triste*, Willd.

73. *Mulgedium pulchellum*, Nutt.

74. *Atragene alpina*, L.: the same as Fendler's, i. e. var. *Ochotensis.*

75. *Thalictrum alpinum*, L. Very rare as an American plant, found before only on the eastern borders of this continent, Anticosti, &c.

76. *Thalictrum sparsiflorum*, Turcz.; vide Gray, Pl. Wright, adn. p. 8: forma ovariis breviter stipitatis unacum pagina inferiori foliorum resinoso-atomiferis. Maximovicz, commenting in the Flora Amurensis upon my identification of *T. clavatum*, Hook. (non DC.) with *T. sparsiflorum*, indicates a difference between the American and the Siberian plant in the length of the filaments and of the stipe. The latter is variable; the former is subsexual; both short and long filaments occur in Richardson's specimens. I am able to compare the fruit of a Hudson's Bay specimen with that of one of Tilings, of the Fl. Ajanensis, and to pronounce them precisely alike. In the latter the leaves are resinous-atomiferous underneath, as they are in Dr. Parry's specimens, in which similar atoms thickly beset the carpels. The oval sepals appear to be white. *T. Fendleri*, Engelm., from the mountain region farther south is really much allied to this; but that has diœcious instead of hermaphrodite flowers, linear and conspicuously pointed instead of barely oblong anthers, the achenia oblique (instead of dimidiate) and sharp-edged, the ribs straighter and stronger.

77. *Ranunculus affinis*, R. Br.

78. *Ranunculus Cymbalaria*, Pursh.

79. *Ranunculus glaberrimus*, Hook.; var. foliis omnibus integerrimis, radice magis fibrosa. Mr. Spalding's specimens from the interior of Oregon connect this with Hooker's species.

80. *Ranunculus Eschscholtzii*, Hook. (an Schlecht.?) But perhaps an alpine form of No. 77. Some specimens under this number, with finely-cut leaves tend to confirm this suggestion.

81. *Ranunculus amœnus*, Ledeb.? I have before seen no American Ranunculus like this. It accords well with an authentic specimen of *R. amœnus*, but not so well with Ledebour's figure. This species has been joined by Ledebour himself to *R. affinis*, to which I should never think of referring our plant, with its large and very broad, overlapping petals. The fruit was not collected. It grows "in the high alpine region, in scattered patches near snow-banks: fl. June."

82. *Clematis Douglasii*, Hook.

83. *Trollius laxus*, Salisb., var. *albiflorus*. *T. Americanus*, Hook. Fl. Bor.-Am. "In moist or marshy places below snow-banks, associated with No. 91, June 21. Stem 6 to 12 inches high. Flowers white: these often frozen to a crisp recover perfectly in bright sunshine." The

pure white and broader sepals, lower stature, and alpine station, distinguish this from the ordinary form of the Northern United States. Regel in Fl. Ajan., reduces all the proposed species of this group to three, with many varieties, some of them too closely connecting *T. patulus* with the American species.

84. *Delphinium elatum*, L., a species which doubtless includes *D. intermedium*, *palmatifidum*, *flexuosum*, *villosum*, and *cuneatum*, DC. Also, I suppose, in part *D. exaltatum*, Hook. Fl. Bor.-Am., being more like that species than the next is; but it is not the plant of our Alleghany region. Like most of the present collection, the specimens are particularly good and neatly prepared. "It grows in large patches, on the moist borders of alpine brooks, near the limit of arborescent growth. Stem 3 to 5 feet high, the flowers vivid blue-purple."

85. *Delphinium scopulorum*, Gray, Pl. Wright. This is the same as one of Bourgeau's collection from the Saskatchawan, distributed as *D. exaltatum*. The spurs on the *lower* petals appear to be constant.

86. *Aconitum nasutum*, Fisch. (*A. Columbianum*, Nutt.) "Two very distinct varieties, one, 1½ to 3 feet high with greenish white flowers, growing in shady places along the borders of streams; the other with deep blue flowers, in more open places, not so tall, and inclined to twine about adjacent bushes."

87. *Anemone multifida*, DC., with both red and white flowers.

88. *Pulsatilla Nuttalliana*, Gray.

89. *Aquilegia cærulea*, Torr. Most beautiful specimens, from the district where Dr. James discovered this striking species. Limb of the petals apparently white, contrasting with the purple-blue sepals: spurs 2 inches long.

90. *Aquilegia vulgaris*, L., var. *A. brevistyla*, Hook. In the high alpine region.

91. *Caltha leptosepala*, DC. Borders of alpine brooks, with No. 84, &c.

92. *Thlaspi cochleariforme*, DC.? Hook., *T. Fendleri*, Gray, Pl. Wright. Although the silicle is less winged than in Delessert's figure, it is likely that the plant of the Rocky Mountains is not distinct from the Siberian; but I have not yet seen the evidence to justify its combination, as Dr. Hooker proposes, with *T. montanum* and *T. præcox* as well as with *T. alpestre*.

93. *Draba Johannis*, Host. (*D. nivalis*, DC.) Probably to be included among the forms reduced to *D. hirta* in the Fl. Ajanensis and elsewhere. In the high alpine region.

94. *Turritis patula*, Graham.

95. *Erysimum pumilum*, Nutt.; but the stigma is two-lobed or emarginate. "In the alpine region, low; flowers light sulphur-yellow." This may really be identical with Gaudin's *E. pumilum*, of the Swiss Alps, and it has equally a slender style and erect siliques. But it appears to pass into our *E. asperum* just as *E. pumilum* does into *E. Cheiranthus*. Not a single species of this group of *Erysimum* is well defined.

96. *Draba streptocarpa* (sp. nov.): radice § Holargis more bienni vel subperenni rosulam amplam caulesque floridos foliatos (spithamæos) proferente; foliis integerrimis setis simplicibus et bifurcatis villoso-hispidis, radicalibus spathulato-lanceolatis acutiusculis in petiolum marginatum longe attenuatis, caulinis sessilibus; racemis sæpe paniculatis; pet-

alis aureis calyce duplo longioribus; siliculis linearibus (vel imperfectis oblongo seu ovato-lanceolatis) hispidulo-ciliatis cæterum glabris, maturis eximie spiraliter tortis; stylo longo.—Forma vero *alpina* bipollicaris, siliculis (immaturis) brevioribus. "On rocky cliffs bordering the upper Clear Creek, extending into the high alpine region, where the dwarf form was found in flower in July, while the larger form lower down was mostly with ripe fruit." A most interesting species, allied to *D. aurea*, and with similar bright yellow, mostly retuse or emarginate petals. The leaves appear as if veinless, except the strong midrib, are all entire, and are beset, and especially ciliate, with long and rigid, shaggy, spreading, simple or simply forked hairs, far more bristly than in *D. aurea*, and with no fine stellular pubescence intermixed. Leaves of the radical clusters ¾ to 1½ inches long; the cauline ones half an inch or so in length, oblong or oblong-lanceolate, the upper ones on their upper face, like the upper part of the stem, sometimes becoming glabrous. Racemes many-flowered. Style a little shorter than the ovary; stigma emarginate-capitate. Fructiferous pedicels 3 lines long, more or less spreading. Silicles when well developed from half to two thirds of an inch long, either minutely or strongly hispid-ciliate, and twisted like an auger, the turns 3 or 4; but many of them, especially the later ones, are shorter and with only one or two twists: the style 1½ to nearly 2 lines long.

103. *Draba aurea*, Vahl, Hook. A form with smaller and narrower leaves than in Hooker's figure, and with simple elongated racemes. It accords very well with the plant cultivated several years ago under this name in Kew Gardens, and has a similar (at most biennial) root. *Draba* No. 6, of Bourgeau in Paliser's Expedition, is apparently the same; while Burke gathered in the Rocky Mountains specimens agreeing with Hooker's figure. All have a short and fine pubescence, and minutely hoary, plane or slightly twisted silicles, the style from a line to a line and a half in length. But, as in other Cruciferous plants, no great reliance can be placed on the length of the style. In New Mexican specimens, var. *stylosa* (*D. aurea*, Pl. Fendl., No. 43, p. 10, and in coll. Bigelow, Pacific R. R. Rep. iv, p. 66,—both ramose forms), the style is quite as long as in *D. streptocarpa*. I have seen no Greenland specimens.

Draba alpina, L.; a form apparently of this species, with one or two leaves on the scape, and a rather conspicuous style, was gathered on the summit of the snowy range.

97. *Draba nemorosa*, L.

98. *Arabis hirsuta*, Scop.

99. *Cardamine cordifolia*, Gray, Pl. Fendl.

100. *Sisymbrium canescens*, Nutt.

101. *Physaria didymocarpa*, Gray (*Vesicaria didymocarpa*, Hook.): var.? racemis fructiferis elongatis; siliculis minoribus corrugatis minus inflatis. "Dry gravelly bluffs of upper Clear Creek, growing in bunches a foot in diameter: the vegetation more luxuriant than *P. didymocarpa* of the plains, of which it is probably only a mountain variety." If so, it is a remarkable one. There is an unpublished species, *P. Newberryi*, allied to *P. Geyeri*, collected by Dr. Newberry in the interior of New Mexico.

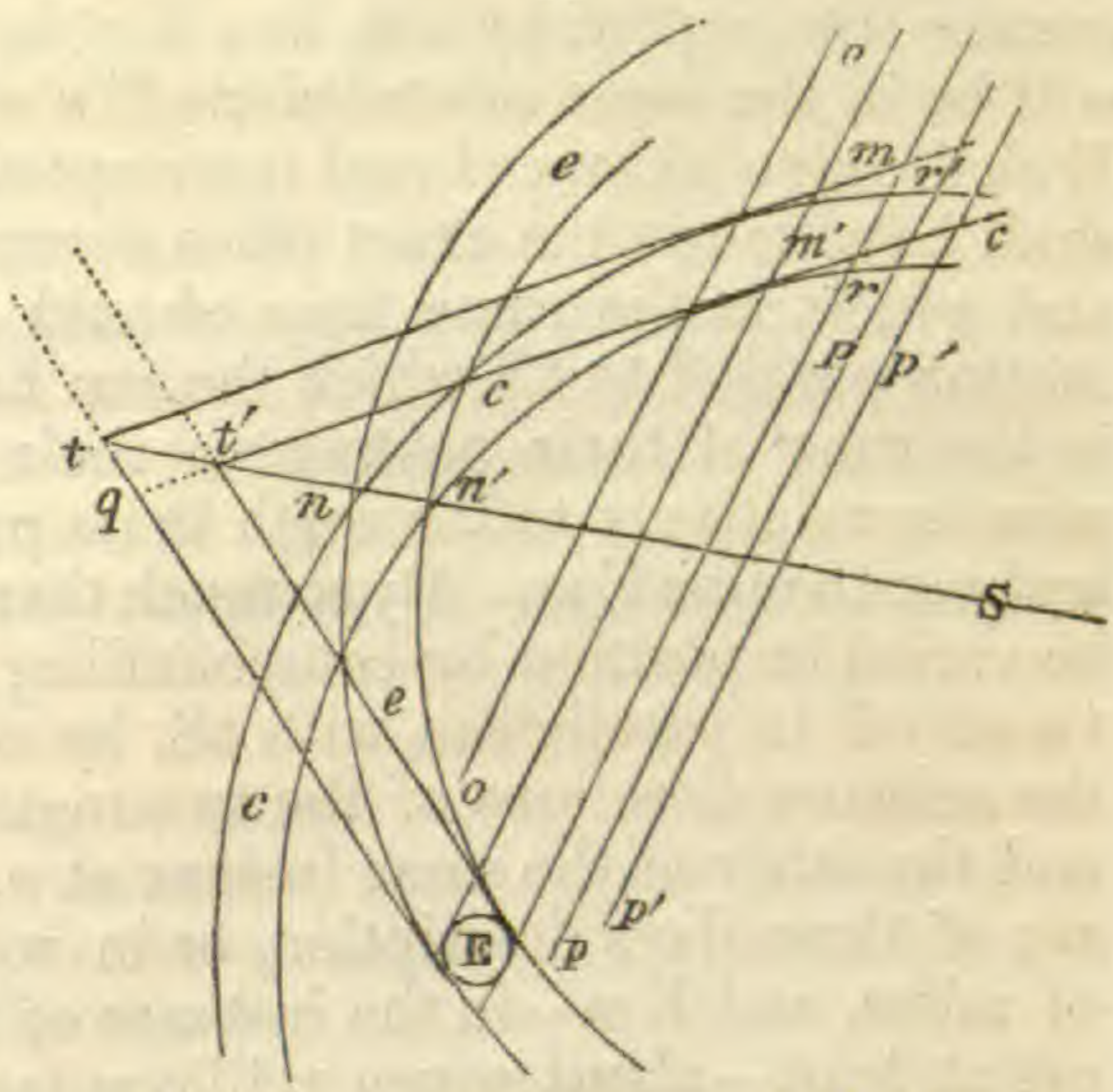
102. *Erysimum asperum*, DC., the form with orange-colored flowers, *E. Arkansanum*, Nutt., collected on the plains.

ART. XXVI.—*Investigations respecting the Phenomena of Meteoric Rings, as affected by the Earth;* by ALEXANDER C. TWINING.

THE object of the proposed investigations is a practical one. It is, principally, to lead the way towards determining certain questions relating to the phenomena of periodic meteors—especially the meteors of August 9th–11th; only, however, by the simplest methods consistent with an essential accuracy, and in the hope that these phenomena may thereby be made to an increased extent the objects of intelligent observation at the times of their annual appearance. Of the questions referred to one relates to the effect of position on the Earth's surface upon the apparent "radiant" as observed from that position,—and another relates to the changes of radiant in latitude and longitude, from day to day, during the earth's passage through the body of the ring. If the changes mapped from my own observations upon the chart published in the last November No. of this Journal are admitted and shall be confirmed by farther observation as a fact constantly occurring, it will become an interesting enquiry, to what cause those changes can be or cannot be referred,—whether to perturbations occasioned by the Earth directly, or whether they are to be explained by an existing and permanent constitution of the ring deducible by analysis, as a cosmical effect, from the planetary influences. This latter enquiry however, although I thus state it in full, covers it will be seen, a vastly greater area than all which lies within the present purpose and discussion. A meteoric ring is, of course, the subject of influence from all the planets, through their entire revolutions. But these unintermitting influences of the general system are clearly distinguishable from the special and immediate effects and results of the Earth's conjunction with and penetration of the ring. Only the latter will be treated of in the following theory,—which is intended, however, to embrace them in one simple and elementary view and discussion.

Let S be the sun, E the earth, E *e e* the orbital space or track of the earth in its annual revolution, and *c c c* the corresponding breadth of a meteoric ring intersected by it. Although our results are independent of any particular hypothesis respecting the primary constitution of the ring, yet, for convenience, the meteoric orbits are supposed primarily all parallel, one to another, in the parts at and near the nodes on the ecliptic *ccc*; a supposition which includes, as a consequence, the mutual intersections of those orbits in or near a line passing through S and normal to the mean line of nodes S*nt*. Let E*t*, E*t'* be tangent to the exterior and interior bounding circles of E *e e*, and let *m, r,* be meteors which if undisturbed by the earth, would find their nodes at n, n', and would there meet the earth's circle E at the tangent points. Let $m t$, $r t'$ be tangents at m and r to the orbits of those meteors: then E t and E t' will be intersected in t and t' by either those tangents or by others which approximate to them with extreme closeness; for, because of the small length of the arcs E n, E n' and $m n$, $r n'$, compared with the radius vector E S or m S and r S, the sun's action upon the meteors and upon the earth may be considered the same, both in amount and direction, as will more fully appear in a subsequent paragraph, and by discussing separately the inequalities introduced by that supposition. Also, on account of the near proportionality of those tangents to their arcs, as well as their near approach to the same in magnitude, if E t represents the earth's velocity in that tangent, $m t$ will equally represent the velocity of m in the latter tangent. Both the earth and the meteor would therefore meet in t if undisturbed; and, inasmuch as the two are affected alike by the sun's attraction they will, in fact, meet in n, fulfilling accordingly the condition which alone is required to constitute $m t$ $m' t'$ true tangents. In other words if the earth and a meteor considered as mere points in their respective orbits will in fact meet, then, under the supposition that the solar influences upon both have been the same in amount and direction, the same points would have met by their motion uniformly continued—that is to say the respective tangents meet. The same concurrence may be shown in respect of E t' and $r t'$; so that the planes E $m t$ and E $r t'$ may be taken as parallel and as continuing parallel to their first positions, although moving with the points E, m, t, or E, r, t', as those are moved by the sun's attraction. Under such a representation of the two velocities, E m represents also, both in amount and direction, the velocity of m relatively to E,—also r is moving with the same relative velocity in the parallel E r. It is also desirable to notice that if m' is a meteor intercepted by the relative line E m, and if $m' q$, parallel to $m t$, intersects E t in q the meteor m' and the line $m' q$ bear the same relations to the orbits of E and m' and to the plane E $t m$ which E and m and the tangent E t will bear to the same when E shall have advanced a distance equal to

1.



qt. Therefore the node q' will be in the same orbital circle E*ne* with the node *n*; and the same is true of every meteor intercepted by the line E*m* in any part of it. In like manner if *r* is a meteor intercepted by the line E*r'* in the plane E*t'r* its node will be in the same orbital circle E*n'e* with *n'*. Moreover, when E shall have advanced and intercepted *m* in *n*, a meteor which shall have taken the exact place occupied by *m* as first supposed and which, at the same time, should be affected with the same motion parallel to *t*S which the sun has imparted to E and to *m* in the time of their passing to their common node, would be moving relatively to the earth in its present and acquired motion truly in the line E*m*. By so much therefore as the line E*m* would be varied in position by compounding with it twice the subtense *tn* set off in parallelism with *t*S, by only the same do we vary the relative directions of the two meteors one of which is at *m* and the other at the same instant at *n*. If now E*n* is taken an arc of three days description, or in round numbers five millions of miles, and E*m*—in the instance of the August periodic meteors at least—about seven millions (and in the instance of the November periodic meteors unquestionably still greater,) we have the double subtense *tn* but little more than one quarter of a million; which, applied to E*m*, is but $\frac{1}{28}$th part and gives but 2° of variation from the parallels. But *m* is now at an extreme of distance, being four millions of miles when nearest. At this distance the earth's disturbing force being but one millionth part of gravity at the surface we arrive at the conclusion that the initial relative velocities of all meteors originally parallel and equal in their absolute motions may be safely treated as parallel within the limits of this class of disturbances on every side of the earth and under the conditions supposed in this article. (A)

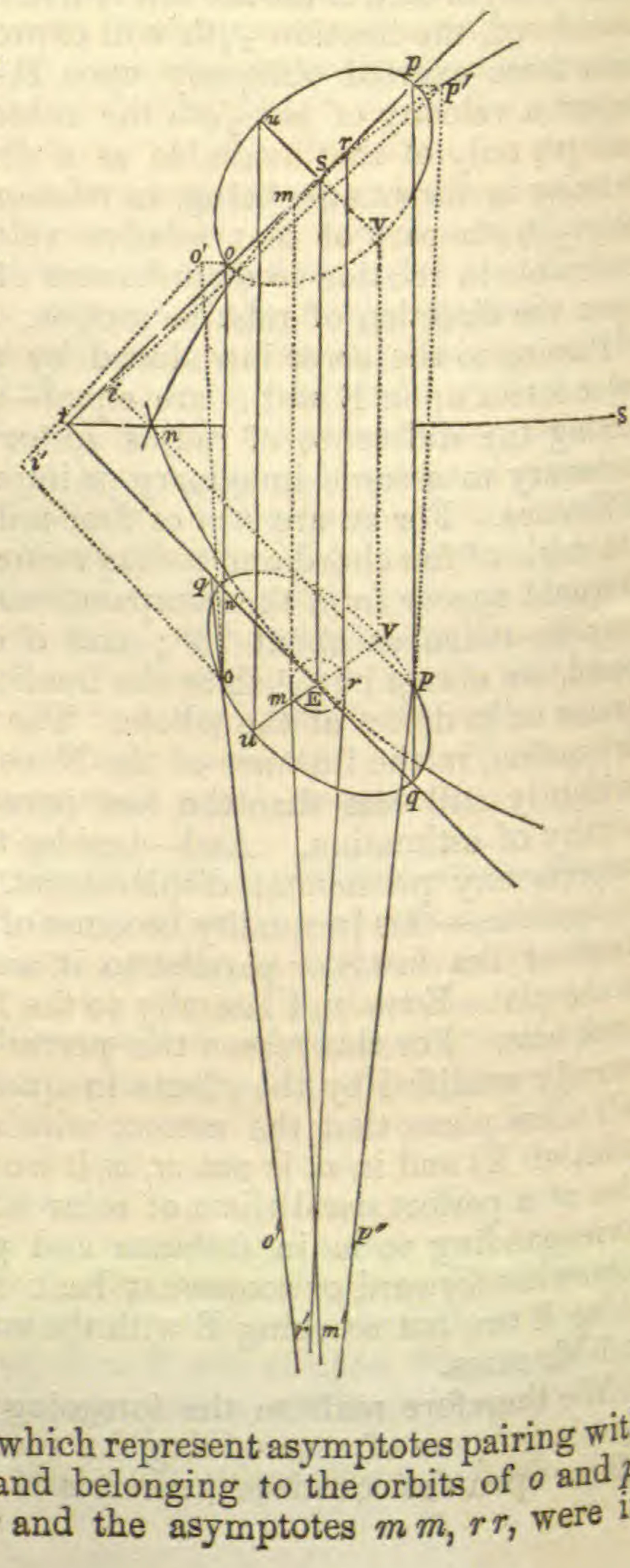
Moreover the errors involved in the supposition above alluded to are but trifling, as will readily appear by a brief consideration of them separately. Referring anew to figure 1, if the sun's action were, as above supposed, accurately the same in amount and direction upon both the meteor *m* and the earth, those bodies would remain accurately in the tangents E*t*, *mt* respectively and in the moving plane. In fact however the action is a little oblique. This circumstance, it will appear, does not in the least vary the fact that the bodies will meet in the line *t*S at one and the same instant, although not necessarily in one and the same point of meeting as before. For, considering the distances ES and *m*S equal, and of consequence the solar attractions equal—and perpendiculars dropped from E and *m* upon the line *t*S we have the velocities of the bodies, when resolved in a direction normal to *t*S, proportional to those perpendiculars; because they will meet in *t*S and their uniform velocity is unaffected by forces parallel to t S. But the same perpendiculars, throughout their changes of magnitude, represent the forces of obliquity respectively, and therefore the velocities, however accelerated, continue in a uniform ratio to one another and to the distances remaining to be described. Therefore both meet the line t S at the same instant; and since they have been subject only to equal and parallel forces in the direction t S, they will not be disturbed as to relative motion except by a fraction of the normal force above considered, and that fraction ordinarily a small one. For, in fact, if the arc En is five millions of miles as above considered, the fraction $\frac{1}{40}$th will express nearly the amount of solar force exerted obliquely upon E,—competent therefore to impart a velocity of but $\frac{1}{20}$th the subtense t S in the same time and $\frac{1}{5}$th only of that available as a disturbance of the relative velocity in direction—being, in relation to the August meteors, only $\frac{1}{5000}$th part of that relative velocity. This evidently is insensible in relation to disturbances of the earth which depend upon the direction of relative motion.

Passing to the error introduced by the supposition that the solar forces upon E and m are equal—and which arises by neglecting the difference of radius vector m S from E S—it is not necessary to assume imaginary or improbable amounts for that difference. For an arc nm of four millions and a half of miles the angle of the chord and radius vector for the August meteors, it would appear from the computations of Prof. H. A. Newton, may be taken at about 76°; and if even only 70° were supposed, we obtain but $\frac{1}{64}$th as the fraction of solar force acting in excess or in defect of the whole. The corresponding difference or fraction, in the instance of the November periodic meteors is evidently still less than the last named, and, in fact, scarcely worthy of estimation. And—besides that it is compensated, as respects any permanent displacement, during the recession of the meteors—this inequality becomes of the less significance, that its effect lies in t S or parallel to it, and therefore is presented in the plane Etm and laterally to the line of force in which the earth acts. For this reason the perturbations of the earth are scarcely modified by the effects in question,—but only this result takes place, that the meteor which meets E at the tangent point of Et and in n, is not m, as it would be conformably to the idea of a perfect parallelism of solar influence, but it is a meteor corresponding to m in distance and place, except that it lies somewhat forward or somewhat back of the moving or relative plane Etm, but reaching E with the same effects of perturbation in both cases.

We therefore reaffirm the foregoing conclusion, that, for the simple purpose of ascertaining the species and amount of those effects upon the constituent meteors of a ring which are due immediately to the earth's conjunction with the ring, we may investigate the orbital effects upon all meteors within a cylinder extending to the utmost appreciable extent of immediate or extraordinary terrestrial influence considering the relative motions equal and parallel to an axis—as it may be termed—of the cylinder passing through the earth's centre. (B)

Let then the cylinder of influence, so to call it, be represented in figure 2 by its bounding curves and surfaces upon the ecliptic, as *o u q p v*–and upon a plane of the meteoric ring, as *o v p′p u*, and the contained lines *o o*, *u u*, *p p*, *v v*, which also represent the parallel relative lines of approach of the meteors *o*, *u*, *p* and *v* to the earth, or the asymptotes of their orbits. The axis is E *s*. The plane E *m t* is the same as designated by the same letters in figure 1, and *o o s p q* E is a section by that plane, and *u u s v* E is a section perpendicular to it. The lines *m m*, *r r* represent the asymptotes of two orbits touching a circle or section of any definite extent from the earth's centre E, in the plane E *m t*.

2.



Now the meteors *m* and *r* will be made to describe around the earth similar orbits whose asymptotes, pairing with *m m* and *r r* respectively, will be *m m′ r r′* somewhere crossing (if sufficiently disturbed) beyond the earth, or else made to incline towards one another—as *o o′* and *p p″* which represent asymptotes pairing with *o o* and *p p* respectively, and belonging to the orbits of *o* and *p*. Now if the section *m* E *r* and the asymptotes *m m*, *r r*, were in the plane $u\,r$, normal to the first, or in any plane of intermediate position, their orbits would be unchanged except as to the plane of their description; and the same is true in a like comparison of all orbits of meteors at one and the same distance from and around the axis E s, whatever the plane passing through E s in which their orbits are described. If the earth is considered a sphere, and if m E r represents the extreme circle or elevation at which, under given conditions of observation, the phenomena of meteoric flights are visible, it is an obvious conclusion that *all perturbations occasioned by the earth, and consequently all the changes in radiant positions observed, from the earth, obey a regimen in relation to the axis* E*s alike and equally on every side; and, relatively to that axis, take effect directly away from it, and in the plane common to it and to the meteor's orbit.* It should also be observed, in passing, that the same proposition holds true even in respect to the aberrations occasioned or that may be supposed to be occasioned by the atmosphere itself, so far as those are normal and not the effect of irregular forms of meteors or accumulations of air. For the axis E s, whether occupied or not by any meteoric flight E s, does always obtain—and always in exact symmetry with the atmosphere on every side in any normal condition of the latter.

We now pause briefly to consider whether the above perturbations and consequent diversities of radiant positions in the celestial sphere are considerable enough, in the instance of the August meteors, to be detected by comparative observations.

In m E r taken as a true circle one hundred miles above or outside of the earth's surface, and therefore 8112 miles in diameter, let m and r be meteors, and the orbit of one, as m, be represented by its asymptotes $m\,m$, $m\,m'$, the initial and terminal points of which are at an equal distance from E, and that distance at an extreme—say seven millions of miles. Let v be the velocity of the meteors supposed uniform at that distance,—that is, 26·6 miles per second, as determined from the observations of Mr. Marsh, Mr. Herrick, and myself, by Prof. H. A. Newton,—and let p be the perpendicular distance from E to $m\,m$. Then $\frac{pv}{2}$ is the area described by the meteor's radius vector in a unit or second of time. Also the area described in the same unit by a body revolving, at the distance p, in a circle may be called $a\sqrt{p}$, the value of a being 154·52. Then the latus rectum of the orbit (hyperbolic in form) will be expressed by the formula $L=\frac{p^2v^2}{2a^2}$. Let z be the distance of the apsis from E, and the velocity at the apsis will be $(v^2+f\frac{1}{z})^{\frac{1}{2}}$, in which f has the value

191,003, and z becomes known by the equation $z^2+\frac{f}{v^2}z=p^2$ or $z=3923$. And if x and y are the transverse and the conjugate axes respectively they are measured by the formulas $x=\frac{4z^2}{L-4z}$, $y=2(\frac{Lz^2}{L-4z})^{\frac{1}{2}}$:—therefore x is 270, and y 8112. Consequently the angle of the asymptotes is 3° 49′, which is also the angular deviation of m and r compared together in their lines of motion taken at their apsides.

It appears therefore *that the variations of radiant position, for the meteors of August 9th–11th cannot exceed* 3° 49′, *and may, in the comparison of extremes, approach to that amount.* It is obvious that the axis itself changes place continually in a circle of latitude in consequence of the terrestrial rotation,—so that to the view of a single observer the hour of day is productive of a change of the radiant's position, although observation may not ordinarily be close enough to detect it.

If we enquire into the general effect upon the mass of meteors at great distances from the earth, we have simply to observe that in the formula $x=\frac{4z^2}{L-4z}$, inasmuch as L varies as the squares of the areas simultaneously described, and therefore as p^2 or y^2, and is also equal to $\frac{y^2}{x}$, the latter varies as y^2,—that is to say x is constant. But y is equal to p. Consequently the small angular deflection of asymptotes will vary in the inverse ratio of p. If half the above distance, or 4056 miles, is taken unity, and D is any other distance in any axial plane, the average effect upon all meteors in that plane and to that extent will be, in minutes, $229'\frac{\log. D}{D-1}$; so that for half a million of miles extending on either side of the earth the average deflection would be 9′. But for the entire circle the same would be approximately $229'\frac{2}{D}$, or for the entire cylinder of one million of miles diameter, the average permanent deflection would be $3\frac{3}{4}'$, which is the average estimated in all directions taken in the aggregate. But if estimated in a single direction only the same average would sink to only $2\frac{1}{2}'$. These quantities are meant to give some idea of the effect upon large masses or assemblages of meteors; which, however, after all, form only small fractions of the entire ring.

It will be observed that those orbits which are nearest to the earth will cross one another; and that others still will cross at distances varying all the way from one-fourth of the distance of the moon to many millions of miles. And, since the deflection of tangents or asymptotes diminishes almost exactly as the perpendicular p increases, the places of crossing will lie more and more distant behind the earth in the ratio of the square of that perpendicular. But the numbers crossing, if the meteors are distributed equably in the ring, increase in the same ratio, or as the square of p,—consequently the numbers vary as the distances through which the crossing takes place. By this it appears that the earth, at each conjunction with the ring, leaves behind itself, to a certain extent, a kind of *wake*, or line of *equable condensation*—as it may be called—which would shortly disappear, and only reappear when the same meteors shall again have just passed their nodes; but which, for aught that appears to the contrary, may by successive conjunctions occurring in different parts, during say 5000 years, come to occupy a permanent position forward of the nodes, and to possess a uniform constitution. (C)

The foregoing discussion of *relative* motions and effects gives a key to the absolute and resulting perturbations, so far as the latter are primary and immediate, and exhibits the principles upon which formulæ may be constructed which shall measure the effects upon inclination, velocity, motion of nodes, and magnitude and form of orbits. For if in the plane E tm the orbits of two meteors o and p are represented by their asymptotes oo'' and pp'' equally distant from E, and if $p''p$ is produced back in pp', and $o''o$ in oo' and if oi' and pi are the lines of common section of Etm with planes parallel to the ecliptic, then from similarity of the triangles E tm, $oi'o$ and pip it appears that if oi', oi' represent the real motion of the earth and of the meteors respectively oo will represent their relative motion; and in like manner pi, pi and pp, may represent the same in pip. Now the terminal relative motion in o'' and p'' is the same in amount as the initial motion in o and p, and is represented by oo' equal to oo and pp' equal to pp. And, inasmuch as the asymptotes of the meteors o and p intersect in their relative position the lines $i'o$, ip respectively, the lines of real motion must intersect in i' and i. Join $i'o'$ and ip' and they will represent the real motions possessed by the meteors o and p after they have receded into the ring and are no longer subject to a sensible disturbance. Also ooo' and ppp'' are, with due reductions in a plane truly normal to the ring, the changes of inclination. Let the arc of ooo' and of its equal ppp' be called A. Now, as the sides of the similar triangles and the angles are known from observed data, if we represent the angle Est by B we obtain $p'ip$, and $o'i'o =$ $A \cos. B \frac{pp}{ip'}$ and $A \cos. B \frac{oo}{i'o'}$ respectively,—and if the initial velocity is called unity, the resulting velocities will be $1 \pm \frac{Es}{st} \tan.$ $A \sin. B$ very nearly—the positive sign applying to pp and the negative to $o\,o$. For the August ring we may take $t\,s = 1$, and $E\,s = 1{\cdot}6$ and $B = 45°$, and A is found in (C) 229′, consequently the change of inclination in opposite directions for o and p will be over 4°, and the changes of velocity $1 \pm {\cdot}0755$. These numeral determinations, it will be understood, apply simply to orbits whose asymptotes pass 4056 miles from the centre; for the more distant orbits they would apply in the inverse ratio of the corresponding distance.

The foregoing effects take place in $E\,s\,t$. Attending next to those in the normal plane $u\,v$, in which plane we will now suppose $m\,m$ and $r\,r$ to lie, and at the same distance or circle $m\,E\,r$ as before, we may assume that the deviations of relative motion take place in lines perpendicular to $E\,s\,t$ at the points m and r. This class of deviations therefore leaves velocity unaffected, and takes effect nearly in the plane of the meteors' solar orbits. It simply changes the line of apsides and angle of the tangent with the radius vector; and, diverging outward from s, it affects the perihelion distance in opposite senses—enlarging the same for $m\,m$ and the orbits upon the same side of $E\,s$ with it and diminishing those on the same side with $r\,r$. The expression for this angular effect in the meteoric plane is simply $\pm A \frac{E\,s}{s\,t}$ or, at an extreme for the same conditions as above, $\pm 6°\,6'$; and for other distances inversely as the distance. (D)

Two separate effects therefore in the separate planes contribute to modify the meteoric orbits and at the same time to shift the radiant positions. For, referring anew to figure 2, we find in $E\,s\,t$ that a meteor, as $m\,m$, on the side *preceding*, undergoes both a depression of tangents towards the ecliptic and a contraction of orbit; while in $u\,v$ the meteors of the side *following*—as $v\,v$—are contracted as to perihelia, and advanced in longitude as to their tangents. On the opposite parts or sides effects precisely opposite are realized. In planes having an intermediate position between $E\,s\,t$ and $u\,v$ the two classes of effects in different degrees accumulate upon one another or abate one another according to the quadrant's situation and their position in the quadrant.

Referring now to the effects in the plane $u\,v$ and observing the angles of radius vector with the tangents to become 84°, in the case of $m\,m$, and 72° in the case of $r\,r$, and with the velocity 16·8 miles per second, while that of the earth is 18·89, we obtain for the perihelion distances 0·63 and 0·52. By this it appears that the perihelion is shifted, at the extremes of distance, more than ten millions of miles. It will be recollected that those meteors which have the less perihelion distance are also those whose radiant at the earth would have the greater longitude. The line of apsides also experiences a change between the extremes of 21° and 39° south of the ecliptic.

Turning now to the effects in the plane E *s t*, we find the elements in part for the meteors above designated as *m m* on the side *preceding*, and *r r* on the side *following;* viz.

Transverse axes,	1·51	and	1·84
Perihelion distances,	0·47	and	0·72

This perturbation therefore expands the ring to an extreme breadth at the ascending nodes of about twenty-four millions of miles, and—admitting the sufficient exactness of our data—throws it closely up to the orbit of Venus. It will be remembered that the meteors which have the extreme perihelion distance have also the higher latitude and elevation for the radiant at the earth. (E)

Our discussion includes also the motions of nodes. Referring to figure 1 it will be observed that while the meteors *m* and *m′* or *r* and *r′* are in the same line of flight *m* E, yet their nodes upon the ecliptic are separate, one from the other, and are distant by the line *q t*. But *m′* reaches *q* in the same time with E and *m* reaches *t* likewise simultaneously with E. Therefore the nodes of *m′* and *m* are separated by the distance moved by the earth in the interval between the arrival of *m′* at its apis and the arrival of *m* at the same. Transferring our attention to figure 2 and supposing the initial places of *m* and *r* in their orbits to be equidistant from their apses with the corresponding terminal places *m′ r′*, after the meteors have receded into the ring away from the earth's immediate influence, it is obvious that the meteors in their orbits have reached *m′* and *r′* earlier than they would by their uniform motion through *m m*, *r r*, and (at the centre of their hyperbolas experiencing an instantaneous inflection) by the same motion continued to *m′* and *r′*. By whatever space the earth would have advanced in that interval, by just that space will the nodes have retrograded on the planes parallel to the ecliptic passing through their orbital centers above referred to.* It is noticeable that this retrogradation takes effect alike and equally on every side of the earth and to an amount depending only upon the distance from E. The position of the orbital centres, above and below the ecliptic, and in the quadrants *v* E *q′*, *u* E *q′*, &c. modify this effect when referred to the ecliptic. Thus if *o* E *p* is a line normal to the relative lines *p p*, *o o*, &c. *p* will at the orbital centre, lie above the ecliptic, and *o* beneath it. Therefore in the plane E *s t* the nodes are thrown forward by the small distances *n q*, *n′ q′* which are nearly equal. Moreover this distance is the same, very nearly, for *r r* as for *p p*, and for *m m* as for *o o*, because the small angles *n p q*, *n′ o q′* have a magnitude inversely as the distance of their angular points from E,—see (C)—and consequently inversely as the distances of the same

* The small reduction to the ecliptic may be neglected.

from the ecliptic. But in the plane $u\,v$, such is the direction of the deflections or effects in the line $u\,\mathrm{E}\,v$ that, even if the radial distances were not in or near the ecliptic, neither a retrocession nor an advance can be consequent upon them.

Resuming the expressions and quantities from (C); viz. x and y the transverse and conjugate diameters and v the miles traversed in a second, putting also b for the assumed *initial* distance upon the asymptote from the centre, so that $2\,\frac{b}{v}$ shall measure the time from the initial to the terminal places by the uniform and undisturbed initial motion, the nodal motion which applies individually to all the meteors of the *cylinder* will be expressed by $x\left(l.\frac{2b}{y}+l.\left[1+\left(1+\frac{y^2}{4b^2}\right)^{\frac{1}{2}}\right]-1\div\left(1+\frac{y^2}{4b^2}\right)^{\frac{1}{2}}\right)\frac{e}{v}$; in which x is constant, e is the earth's velocity, and $l.$ is the symbol for the Napierien logarithm; and which, when differentiated with reference to the spaces, gives

$$x\left(l.\frac{2b}{y}+4\frac{b^2}{y^2}\left[1-\left(1+\frac{y^2}{b^2}\right)^{\frac{1}{2}}\right]+l.\left[1+\left(1+\frac{y^2}{4b^2}\right)^{\frac{1}{2}}\right]\right)\frac{e}{v},$$

for the average of nodal effect upon the entire cylinder to the distance of $\frac{y}{2}$ on every side. The same is equivalent to a retrogradation of m, m, r, r (which are next the earth) to the distance of 1370 miles; while the advance $n\,q$ in the plane $\mathrm{E}\,s\,r$ is only 254 miles on the ecliptic *preceding* and 223 on the side *following*. Yet the advance is nearly constant, while the recession diminishes with the distance, and down to a very moderate average for the entire mass. If a factor is required for reducing the above uniform mean amount (239) to the average effect upon the whole cylinder whose radius of section is y, it may be obtained nearly by integrating the differential expression $\frac{a}{c^2}\,\overline{(1+c^2\,.\,\overline{1-\cos.^2 \mathrm{D}})}^{\frac{1}{2}}d\cos.\mathrm{D}$; in which a is a constant derived from the inclination of the relative line and the amount of tangential perturbation, reduced to the plane of the ring, c is the natural tangent of that inclination, and D is the arc of the meteors' relative position in the normal cylindric section taken from the line of section of the latter with the ecliptic, so that this effect upon the nodal position, averaged for such a cylinder, will be comprehended with sufficient closeness in the expression $\frac{1}{2}\frac{a}{c^2}(1+c^2)^{\frac{1}{2}}$; also, $\frac{a}{c^2}(1+c^2)^{\frac{1}{2}}\sin.^2\mathrm{D}$ gives the same for any individual meteor. The factor therefore is the fraction $\frac{1}{2}$, neglecting a small term with a double sign which eliminates itself from the average by appearing in opposite senses on opposite sides of the ecliptic. For the August meteors we thus perceive this average effect to be 120 miles advance, while the maximum in the relative plane is about 530 miles, and the corresponding retrogradation as above stated.

From these computations, as they now appear, the conclusion most pertinent to our object is that the nodes of the ring, so far as affected at all, are up to a certain limit retrogradient, and afterward advance, but only to an exceedingly minute angular amount in either case.

It farther deserves mention that there is due to the same acceleration on which the first of the above formulæ depends a motion in the radius vector itself,—the expression for which might readily be formed from the elements or quantities above employed, because it is one to which, within the limits of the problem, that retrograde nodal motion bears the same ratio that the tangential distance described by the earth in the time bears to the difference of the distances described parallel to the line of nodes St in the same time. (F)

The only question remaining of which it is proposed to treat, respects the cumulative effect, from year to year, which may be supposed to take place from disturbance by the earth,—confining attention, as was particularized at the outset, to the immediate actions, and *declining* for the present the larger question, but professing to attempt investigation relatively alone to *tendencies* which will take effect if no superimposed influences of planets or of the ring itself shall merge or counteract them.

If thus left free and undisturbed, the meteors would return to their nodes with the orbital conditions last impressed upon them by the earth. If then the meteoric orbits and the earth's were commensurable, the same conditions would be imparted at certain definite intervals to different groups or *cylinders*, as they have been termed above,—after which the concurrence with or penetration of the ring would be repeated in presence of the same bodies as at first, and the effects would be duplicated in a second *cycle* through the ring—then in a third, and so on. But the earth's disturbance would of itself prevent entire uniformity of orbital elements among the meteors. Even were it otherwise it could only be by the most improbable fortuity that the successive cycles, at least after several repetitions through the ring, could fail to present themselves successively a little in advance of or a little behind the individual penetrations of cycles which had preceded. In this manner, for a time, there would be an accumulation of effects through many cycles, continued until the individual penetrations instead of standing in the relation of being left more and more behind by the succeeding cycles should come more nearly into the condition of a successive approach by the same from an opposite direction. Under the necessarily resulting changes of presentation on one side of the earth and on the other, the effects which had accumulated for a time upon certain meteors would afterwards experience a gradual and successive compensation. In the absence therefore of superinduced disturbances it would appear that the ultimate constitution of the ring must be one in which accumulation and compensation will be going on equably and simultaneously, imposing a limit and maximum to the former. Nevertheless, up to such a limit, the accumulations do prevail. For in figure 1, let *p p* after having experienced, during a recession of cycles, an accumulation of effects on the side *following*, present itself, as it gradually must, farther and farther, within the spaces *preceding*, until it shall have come to the position *o o* where the supposed effects shall have received their compensation,—or vice versa, from *o o* to *p p*, if the cycles advance. The meteor is now in what may be considered its normal or neutral condition in respect to this class of effects; but between the two normal states at *p p* and *o o*, the accumulation with all its results will have subsisted in different degrees. In like manner an accumulation of opposite effects and results may then commence its progress and find a subsequent limit and compensation. It would be futile to pursue this view beyond a mere rudimental form so long as we cannot be certain that perturbations by other planets, and even by the ring itself, if it has mass enough, may not throw the meteors into quite other compensating positions than by the progress and succession traced above. Still, however promiscuous those positions, ordinary laws ensure constant although irregular *surges* of accumulated effects in various kinds, and opposite senses. The arbitrary supposition made in the outset, of orbits crossing in lines of mutual nodes or intersections normal to the ecliptic, however convenient in the first instance, is obviously not a necessary condition to the reception and accumulation of either class of effects which have entered into this discussion. It imposes no restriction upon our deductions. The one supposed line of mutual intersections would become progressively disposed into innumerable lines throughout the quadrants, in the manner explained above. If by original constitution the ring is supposed to embody within certain limits every variety and degree of orbital elements it is only what our preceding discussion has shown that the earth must itself produce. (G)

Our enquiry therefore—although by the very terms of its enunciation a partial one compared with the grand problem of the necessary ultimate constitution of the August meteoric ring—becomes the occasion of certain conclusions more or less definite, which it only remains to enumerate:—

1st. The position of the nodes cannot be shifted by the earth's action more than a degree or two in half a million of years. Without attempting nice determinations, in the absence of data entirely explicit, it is sufficient to observe that the few expressions above formed in (F) show such a balance of opposite effects as must leave the meteors which pass at three to five millions of miles on every side of the earth neutral in respect to advance or retrogradation,—so that a cylinder of many millions of miles diameter and length of axis, although retrograding in the parts within a certain limit as just mentioned and advancing in the parts beyond it, would as a mass remain not appreciably disturbed in either respect.

2d. An effect of another kind would however become appreciable in a separation into more or less advanced assemblages of orbits with constituent meteors retaining in various degrees a common amount or direction of disturbance. Thus a belt of orbits in planes parallel and contiguous to Est will retrograde less than such as group themselves in planes parallel and near to the normal plane uv (see figure 2.) The latter will be occupied by meteors departing most from the mean longitude of the tangents and consequent radiant positions, while the former will exhibit the greatest variations of tangents, and of corresponding radiant positions, in their inclination to the ecliptic. Our results therefore do embrace a change of positions from day to day in determinate directions, *of the kind* shown upon the writer's fragmentary chart at p. 445 of the last November No. of this Journal,—not because of any direct action at or during the particular penetration in progress at the time, but because both the elevations and longitudes of that radiant are considerably and more or less *cumulatively* affected, and also the meteors similarly affected are congregated *in classes* into the more expanded or the less expanded orbits. The farther explanation, however, if not merging itself in a question of the particular primal constitution of the ring, properly belongs to the subject (not embraced in the preceding investigations) of the different nodal positions assumed in the lapse of ages by these two classes of orbits under the general planetary influences.

3d. There is an appreciable change of radiant positions relative to locality upon the earth's surface and to the hour of day, whose maximum is about 3¾° between the extremes, and to which the extremes approach.

4th. The terrestrial disturbance is sufficient to affect the meteors' perihelion distances by many millions of miles and to expand the ring to a corresponding breadth at the ascending nodes; also to collect together in orbits of similar elements those meteors which are similarly affected in respect of radiant positions.

It ought not to be overlooked, in passing, that multitudes of the meteors appear to be thrown within the influence of the planet Venus by even a single conjunction of the earth with the ring. Under the effect of accumulation therefore, it is almost an unavoidable conclusion from the computations in (E) that the confines of the same ring which is intersected by the earth cross also the orbit of Venus, if not bodily, at least in the instance of multitudes of stragglers thrown tens of millions of miles away from their normal perihelion distances.

5th. The terrestrial disturbances do not appear sufficient to draw off meteors into permanently erratic orbits; so that, unless in exceptional instances, meteors are probably not lost to the ring other than those which the atmosphere absorbs or arrests. But if meteors can be arrested partially, and without being dissipated, in an excessively *tenuious* upper medium it becomes a plausible conjecture that the ordinary and unconformable meteoric wanderers may be such as have missed a return to the ring under the effect of atmospheric retardation.

If it be allowable to diversify topics which belong to the sphere of a rigid rationality by speculative fancies, or to attempt any addition to the interest which invests the bare existence of such a member of the cosmical system as a *meteoric ring*, I may add to the foregoing two other conjectural considerations or suggestions. It may be held as an interesting possibility—if no more—and as one which doubtless enhances the desirableness of fixing the exact elements of meteoric rings, that comets—whose vastly extended atmospheres or heads around the nucleus, although greatly attenuated, may be competent to arrest meteors completely—may be found, in rare instances, to have been disturbed by *impact* with a meteoric ring whose mere attractive influence it would not be possible to detect. Again, a far more interesting idea would be realized if analysis can but evince a necessary ultimate constitution existing in meteoric rings, and impressed upon them by the other members of the solar system in concurrence with their own mass; and of which the visible phenomena, as evidenced and defined by a comparison of numerous, long continued and varied observations, must have required not less than a certain definite cumulation of myriads of centuries for their production. Thus it is our fancy, and in a measure our hope, that the astronomer and analyst may discover in meteoric rings a kind of celestial monument whose hieroglyphics, deciphered and interpreted, shall date back the age of our solar system to at least a minimum period of duration in its present features and configuration.

ART. XXVII.—*Geographical Notices.* No. XVI.

THE notices of the progress of Physical Geography which were commenced in this Journal in 1858, having been for a few months interrupted, it appears necessary in resuming them to refer briefly to certain expeditions of which our readers through other channels may have been already informed, but the effort will be made to report the latest information which has reached us from trustworthy sources.

Those who are interested in the maintenance of these Notices are respectfully requested to communicate to the undersigned or to the Editors of this Journal, such information of an original and reliable character as may come to their knowledge. Written communications and printed documents bearing in any way upon the progress of geographical science, (especially such as are not accessible through the ordinary channels of the book trade) are especially requested. As there is an evident propriety in making an American Journal the repository of everything which pertains to the exploration of this continent, all such information whether published by congressional or legislative bodies, by societies or by private enterprise will be particularly welcome. DANIEL C. GILMAN.

Yale College Library, New Haven, February, 1862.

AFRICA.

SPEKE'S JOURNEY TO LAKE NYANZA.—Those who have kept informed in respect to the progress of African discovery will remember that on the celebrated journey (often referred to in this Journal) in which Major Burton visited and explored one of the great lakes of eastern central Africa, known as the "Tanganika," his associate, Capt. Speke, discovered at a considerable distance northeast and at a much higher altitude, a second immense lake called by the natives the Nyanza, to which the loyal Englishman prefixed the name of his sovereign, calling it the Victoria Nyanza. It is this second lake which was supposed to be the source of the Nile. In regard to it, however, nothing definite was known, as the explorer only saw the southern extremity and had only very meagre and indefinite information respecting its extent toward the north. The possibility and indeed the plausibility of the proposed solution of the vexed problem of the Nile induced the British Government to coöperate with the Royal Geographical Society, in sending Capt. Speke to Zanzibar, once more, thence to retrace his steps to the Nyanza, and traverse the lake if possible to its northern shores, where of course it could be determined whether a great river flowed from it. He set out upon this second journey April 21st, 1860, having as an associate Capt. Grant. They left Zanzibar for the interior Sept. 25, 1860. Letters have been received from them, dated Khoko in Western Ugogo, Dec. 12, 1860.

PETHERICK'S EXPEDITION TO GONDOKORO.—To coöperate with Capt. Speke, Mr. John Petherick, (author of "Egypt, the Soudan and Central Africa; being Sketches from sixteen years travel," London, 1861, 8vo,) for many years British Consul at Khartum, has been commissioned by the Government and Society already mentioned, to go up the Nile to Gondokoro, fourteen hundred miles above Khartum and nineteen hundred above Alexandria, where he will be able to establish a depot of provisions and apparatus for Capt. Speke, and if need be, engage with him in exploring any part of that region. Gondokoro, described as being in north latitude 4° 30′ and east longitude 31° 50′, is the seat of an ivory mart during the months of December and January, when traders from Khartum visit it and obtain their ivory in exchange for grain and beads. Here also Knoblecher established a Roman Catholic mission which was abandoned in 1859.

The appeal of the Royal Geographical Society for funds to the extent of £2000, in aid of this expedition gives the following additional statements:

"Immediately above Gondokoro, a succession of rapids prevent farther navigation; below Gondokoro the passage is perfectly open to boats, sailing at the times when the periodical winds are favorable. During ten months of the year Gondokoro is deserted; the scanty and barbarous population of the village is dispersed over its barren neighborhood, and an expedition such as that under Captain Speke and Grant must necessarily be—exhausted of means of barter, and wholly ignorant of the negro languages of Northern Africa—will be sure to tempt hostility, and to incur serious danger of absolute want of supplies. If Captain Speke be unable to reach Gondokoro in December or January, his position will be exceedingly precarious, while farther advance to the north would be impossible.

"The first of Mr. Petherick's proposed objects, is to form a sufficient depôt of grain at Gondokoro, under the charge of his own men, to insure to Captain Speke means of subsistance and security from violence whenever he should reach that place; the second is, to explore the district colored *orange*, in the accompanying sketch map. The third is, to effect a meeting with Captain Speke, and to assist him through the hostile tribes between the Lake and the Nile. Many of these negro tribes are known to Mr. Petherick, and it is precisely in the locality where the party under Captain Speke would be most helpless, that that of Mr. Petherick would, comparatively speaking, be most at home; and even if the union of the two parties did not actually take place, the aid which Mr. Petherick's presence in the country might, with reason, be expected to afford to Captain Speke, can hardly be overrated.

"These circumstances being taken into account, together with the fact of Mr. Petherick's services being now available, who, beyond any other Englishman, is peculiarly fitted for carrying out the expedition he proposes, the President and Council of the Royal Geographical Society consider that they would fall short of their duty if they left any legitimate means unemployed for securing those services to the advancement of Geography and the honor of this country. Her Majesty's Government having declined to send out this additional expedition, the President and Council make their appeal to the liberality of individual Fellows of the Society and to that of the Public.

"The sum required to be raised is £2000. Should this be quickly obtained, Mr. Petherick will undertake to reach Gondokoro in November, 1861. He will then explore until March, 1862, when the setting in of the rainy season prevents farther movements. Starting afresh in August, 1862, he proposes to continue his travels till February, 1863, and after that to return to Gondokoro, reaching his depôt in 1863 or early in 1864."

Although only £1000, or half of the sum called for, was raised, Mr. Petherick set out in April, 1861. Letters have been received from him dated Korosko, Aug. 9, 1861.

The following instrumental instructions for his guidance were issued by the Honorary Secretary of the Society, F. Galton, Esq.:

"The observations that it is absolutely requisite you should make, are—

1. You are earnestly recommended to use every opportunity of practising with your sextants *upon stars* while on the lower Nile, and able to check your results with known latitudes; also to practise observing eclipses and occultations under the same circumstances.

"2. As a general rule, observations should be made at marked points, such as the confluence of rivers, prominent hills, and native towns, rather than at mere encampment.

"3. Reliable latitudes of different places on the White Nile between Khartum and Gondokoro, and on your further line of travel. The latitude of Gondokoro is especially desired, and the meridian altitudes of at least six stars; three north and three south should there be observed.

"4. Longitudes by the exceedingly simple methods of the eclipses of Jupiter's satellites, or of occultations of stars, to be made at Gondokoro and at the furthest point of your travel, or at places adjacent to these. The local time should there be determined by more than one set of observations, to guard against error, and the method of altitudes on both sides of the meridian should always be used. Any longitude south of the parallel of the Bahr el Ghazal would be very valuable.

"5. The elevation above the sea of the following places by observation of the temperature of boiling water:—Cairo; Thebes; Assoun; Junction of Atbara; Khartum; the capital of the Shilluk country; the river at a point opposite the Bahr el Ghazel; Gondokoro, and different stations on your further route.

"6. The three boiling-point thermometers to be occasionally compared, and to be carefully preserved, with the view of determining any changes in their index errors. They are also to be compared with those of Captain Speke, in the event of the hoped-for meeting taking place between you and that gentleman.

"7. Simultaneous observations of the rise and fall of the Nile, at Gondokoro and Khartum, should be instituted, and also at as many other places as trustworthy observers may be found to make them.

"8. It is of great geographical importance that the breadth, depth, and velocity of the Upper White Nile and its tributaries be ascertained, in order that their sections may be protracted, and the quantity of water that passes down them be determined. A few notes on practical methods of doing this will be prepared and given to you by Mr. George.

"9. The compass bearing of marked hills should be frequently taken, and the position whence they are observed defined and laid down as unmistakably as possible by cross bearing. Your course and estimated distances should be noted continuously day by day, and the variation of the compass frequently determined.

"10. Time observations with your chronometer should be taken whenever latitude observations are made. These will serve to connect distant points whose longitude has been reliably determined by the rare occurrence of satellite eclipses and occultations.

"11. If any architectural monuments are met with, it would be important to take sketches or photographs of them, however rude; to make a general plan by measurement (for which a measuring-tape should be taken); and to note any peculiarities of construction or style, such as the use of the arch, the angles of the walls, doorways, and windows. If there be any inscriptions or hieroglyphs, they should be copied, or impressions taken of them, if possible, with coarse paper damped in water and pressed with a brush, upon the inscription. Any small objects of art or antiquity found amongst the natives should, if possible, be collected.

"12. Every observation is to be copied from your rough notes into the Register-book which is supplied to you. Your entries, up to the last opportunity of communicating this winter with Khartum, to be forwarded from Gondokoro to the Secretary of the Royal Geographical Society.

LATEST INTELLIGENCE FROM DR. LIVINGSTONE.—From the Proceedings of the Royal Geographical Society, London, it appears that Bishop Mackenzie, of the United University Central African Mission, arrived off the mouth of the Zambesi in February, 1861, where he found Dr. Livingstone and his associates about to start on an exploration of the Rufuma river, in hopes of discovering by its waters a more convenient access to the Nyassa and Shire districts. The Bishop and one of his companions joined the expedition.

A letter from Dr. Livingstone to the late Professor Ritter, dated from the Rufuma, March 2, was presented to the Berlin Geographical Society at its August meeting.

Subsequent intelligence shows that the attempt of this bold traveller to ascend the Rufuma in his new steamer, the *Pioneer*, was not successful. After grounding several times he had been obliged to desist, and return to the Zambesi. The failure was attributed to the fact that the boat drew five feet of water, and did not arrive from England till the rainy season was far advanced.

LEJEAN'S EXPEDITION TO GONDOKORO.—Mr. G. Lejean, who is said to have been aided in his outfit by the Emperor of the French, set out early in 1860 from Chartum, and went south, hoping to find the source of the White Nile in the Lake Nyanza of Speke,—the same end in part which Mr. Petherick proposed to himself. Lejean reached Gondokoro, and was then prevented by illness from pushing his explorations farther. But the Journal of the Geographical Society of Paris gives us reason to expect good results from his investigations in Eastern Soudan and high Nubia.

ROSCHER AND VON DER DECKEN.—Karl v. d. Decken, a friend of the late Dr. Roscher, (murdered in his attempt to reach Lake Nyassa from the East African coast,) endeavored to prosecute the discoveries of Roscher, but was robbed and driven back. A recent letter to Sir Roderick Murchison says that v. d. Decken will now try to reach the peaks of Kilimandjaro.

THE POLAR REGIONS.

THE POLAR EXPEDITION OF DR. HAYES.—The return of Dr. I. I. Hayes who set sail from Boston, July 10, 1860, for the purpose of adding to our knowledge of the Arctic Regions and especially of ascertaining whether there is an Open Polar Sea, has already been mentioned in this Journal, (xxxii, 452). Immediately after his arrival in Boston he addressed a letter to Henry Grinell, Esq., President of the American Geographical Society in New York, and on the 13th of November he made a public statement before the same society, under whose auspices in part he went forth, in respect to the results which his expedition accomplished. A few days later he addressed the Academy of Natural Sciences in Philadelphia upon the same subject. Full reports of these communications have been made in the newspapers of the day, but so far as we are aware Dr. Hayes has not yet printed any complete authentic account of his voyage. Indeed it is too soon to expect him to do so.*

In a letter addressed to Prof. B. Silliman, Jr., he speaks as follows in reference to one of these addresses: "You will understand that I do not undertake in it a discussion of results, for my materials are yet unreduced. I shall merely describe what I saw and what was done in behalf of the science of the Arctic regions. My materials are I believe of much value. Since the death of Mr. Sonntag I have labored almost alone and of course I have not done all that might have been accomplished by a *corps* of workers. The duties of my command occupied much of my time and I embraced every opportunity to collect photographic views. Of these I have nearly two hundred, many of them quite

* A phonographic report of the Philadelphia address (from the Phil. North American) will be found in Littell's Living Age, January 4, 1862.

good. My scientific friends will I trust therefore be lenient towards any imperfections or deficiencies in my results. The photographic views especially of the glaciers will not be without a certain scientific value.

The expedition has been for the most part fortunate and satisfactory."

Awaiting from Dr. Hayes a more elaborate statement of the voyage, we place upon record here for convenience of reference a few of the principal data.

The United States, Dr. I. I. Hayes, commander, set sail from Boston, July 10, 1860, and returned to that port, October 23, 1861. The first stopping place was Proven, in lat. 72°, then Upernavik, and then Tessuisak, in lat. 73° 40′ from which he set sail (going northward through Melville Bay) Aug. 22, 1860. After various repulses by the ice, the vessel entered Smith's Straits, Sept. 2. The ice was so extraordinarily thick that it prevented any access to the western coast of the straits, and Dr. Hayes contrary to his plan was driven into winter quarters on the east coast about ten miles north of Cape Alexander and about twenty miles south in latitude and ninety miles south by coast line of Dr. Kane's winter quarters in 1854–5. He named his harbor Port Foulke after a distinguished member of the Philadelphia Academy. The loss of Dr. Hayes's dog team, the death of his chief scientific reliance, Mr. Sonntag, the peculiar condition of the ice and other difficulties seriously interfered with the proposed sledge journey to the North,—but persevering, amidst great obstacles, Dr. Hayes succeeded in going as far north as 81° 35′ latitude which he attained on the 18th of May. He returned to his winter quarters in June. The remainder of the summer he spent in scientific researches and in making ready for his return voyage. He saw no reason to suppose that by spending a second winter in that high latitude he could with his reduced force accomplish enough to warrant the increased expenditure. The results of his voyage are thus briefly stated.

"1. A detailed survey of the west coast of North Baffin Bay, Smith Strait, Kennedy Channel, and the extension of the survey to the north of any previous explorations. This survey embraces about 1,300 miles of coast line.

"2. The discovery of a new channel opening westward from Smith Strait, parallel with Jones' and Lancaster Sounds.

"3. A detailed survey of the coasts of Whale Sound, and the coasts to the north and south of it. This survey embraces about six hundred miles of coast line.

"4. Surveys of glaciers by which their rate of movement is estimated.

"5. Complete sets of pendulum experiments.

"6. Sets of magnetic experiments at Port Foulke, Cape Isabella, in Whale Sound, at Upernavik and Godhavn.

"7. Topographic and hydrographic surveys, including tidal observations.

"8. Large collections of specimens of natural history, and geological and mineralogical collections.

"9. A continuous set of meteorological observations.

"10. An extensive collection of photographic views.

"11. The accomplishment of a more northern latitude than ever before attained upon land.

"12. Fresh confirmation of theories respecting the open Polar Sea."

TORRELL'S POLAR EXPEDITION.—The Swedish Polar Expedition under Torrell which was fitted out with extraordinary completeness has failed in its chief objects. The ships lay for more than a month in the Treurenberg Bay, on the north coast of Spitzenberg, shut in by pack ice, and were afterwards much hindered by bad weather and other difficulties, while the sled expedition to the North Pole was wholly given up on account of the floating ice.—*Petermann's Journal.*

THE NORTH ATLANTIC TELEGRAPH EXPLORATIONS.—Since the possibility of a transatlantic telegraph was so successfully demonstrated by Mr. Field and his associates in their great experiment of 1858, various plans have been suggested for accomplishing the same results in a manner more likely to be of lasting service. The scheme upon which most attention has been bestowed proposes to run a line from the North of Scotland to the Færoe Islands a distance of about two hundred and twenty-five miles; thence to Iceland about three hundred miles, thence to South Greenland about six hundred miles and thence to the coast of Labrador also about six hundred miles. The greatest of these intervals in which the telegraph wire would necessarily be submerged is less than a third of the distance between the points on the coasts of Ireland and Newfoundland which were successfully united in the experiment above referred to.

In one of the meetings of the Royal Geographical Society last year, this new project was discussed, and a great deal of fresh matter pertaining to the physical geography of the regions specified, was brought forward. Five papers were read. The first by Capt. McClintock, R. N., gave an account of his soundings on the *Bulldog* in the summer of 1860. The second by Sir C. T. Bright gave a report of the soundings of the *Fox* under command of Capt. Young. The third paper was a report of an exploration of the Færoes and Iceland by Dr. John Rae. The fourth paper was by J. W. Tayler, Esq., on the Fiords of South Greenland, and the fifth was by Col. T. P. Shaffner on Electric Circuits. These papers are printed in the Proceedings of the Royal Geographical Society, Vol. v, No. ii.

From the paper of Sir Leopold M'Clintock we make the following extracts in relation to the soundings which were made under his direction.

"Leaving the Færöe Isles on the 6th of July, we sounded across towards Ingolfsholde upon the southeast shore of Iceland, a distance of 280 miles, and found the depth to be generally less than 300 fathoms, the greatest depth being 680 fathoms. The specimens of the bottom consisted chiefly of fine sand, or mud and broken shells, and, in two instances, of minute volcanic debris; the temperature of the sea at 100 fathoms below the surface scarcely varied from 46°. The depth of water upon this section of the telegraph route is so moderate that it would be an easy matter to lay down a cable between Færöe and Iceland. Since my return I find that Beru Fiord, upon the east coast of Iceland, has been examined with a view to its selection as the landing-place for a cable; it is about 80 miles to the northeast of Ingolfsholde, and has the advantage of being somewhat nearer to Færöe."

* * * * "Five days of very calm weather enabled us to complete the line of soundings between Faxe bay [on the southwest coast of Iceland] and the southeast coast of Greenland. The depths generally were very regular, the greatest being 1572 fathoms, and situated in mid-channel; but when within 40 miles of Greenland the depth decreased from 806 fathoms to 228 fathoms, in the short distance of 3¼ geographical miles.

"The nature of the bottom was chiefly oaze, that is, fine mud partly consisting of minute organic remains; but near to Iceland volcanic mud and sand were more frequently brought up. The temperature of the sea at 100 fathoms below the surface gradually diminished from 46° near Iceland, to 39° off the Greenland coast. Circumstances which it is unnecessary to allude to here prevented me from commencing before 18th August the line of soundings between the southwest coast of Greenland and Hamilton Inlet on the Labrador coast, a distance of 550 miles.

"The Greenland shore was still blockaded by such a vast accumulation of drift-ice that we could not approach within 45 miles of it, at which distance the depth was ascertained to be 1175 fathoms. This line of soundings to Hamilton Inlet shows that the greatest depth—which is in mid-channel—is 2032 fathoms; and that the decrease is very gradual until within about 80 miles of Labrador, where there is a change from about 900 fathoms to 150 fathoms in 7 or 8 miles.

"The ocean-bed consisted of oaze, but with fewer microscopic organisms than previously met with, whilst the average temperature of the sea at 100 fathoms below the surface was 40°.

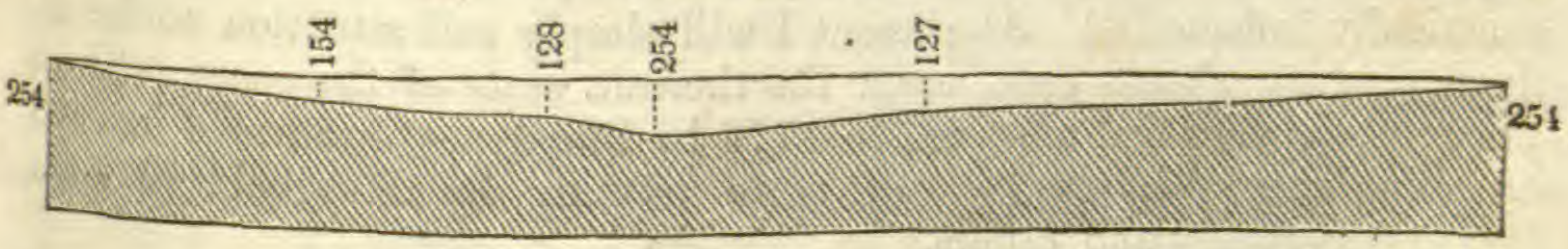
"Seven days were all I could devote to the examination of Hamilton Inlet. Its length was found to be 120 miles, whilst its width varies from about 15 miles at its mouth to scarcely half a mile at "the Narrows," which are about half-way up to its head, and above which it expands into an inland sea of about 20 miles in width. All this great inlet was rapidly explored, its main channel from "the Narrows" to seaward was sounded, and the whole laid down by Mr. Reed, master and assistant-surveyor, with sufficient accuracy for ordinary purposes; but these soundings are not nearly sufficient to meet the requirements of a cable-route, nor even to decide whether a cable should be landed there.

"We found the depths to be very irregular, and seldom sufficient to secure a submerged cable from disturbance by icebergs. A perfect survey is absolutely necessary, and may show that the shallow water and reefs of rocks, which to our imperfect knowledge appeared intricate and unfavorable, may not only be avoided, but may afford a sure protection against the intrusion of icebergs within the mouth of the inlet. There are some small rocky islets off the mouth of this inlet, and of these Hern Islets lie nearly in the middle and contract the widest channel of entrance to about 5 miles; the greatest depth obtained in this channel was 49 fathoms. Had the depth of water amounted to 70 fathoms in as far as this position, I would not hesitate in pronouncing favorably of Hamilton Inlet as a terminus to the cable from Greenland."

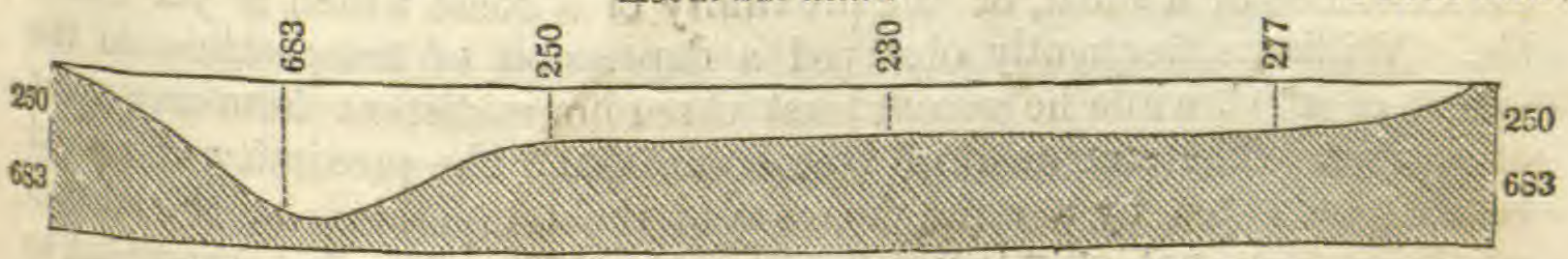
The following profiles, copied from the London Mechanics Magazine, give an outline of the soundings referred to in these remarks. An official report of this survey has not reached us. A map in the Journal of the Geographical Society gives some of the soundings, but not in such a form as to make it easy for us to transfer them to our pages.

PROFILES OF THE DEEP SEAS.

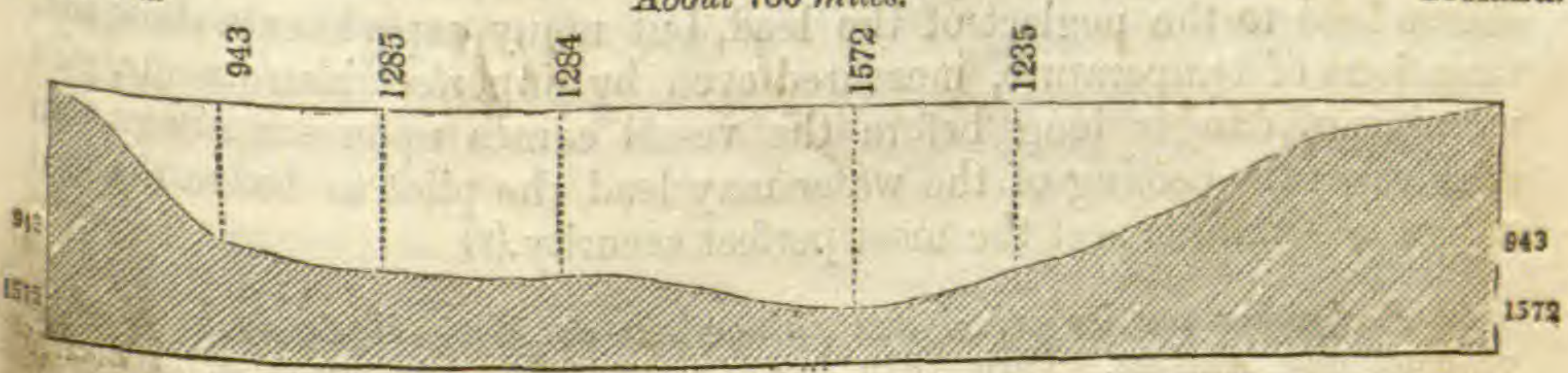
Færöe Isles. DIAGRAM 1. *About* 225 *miles.* Scotland.



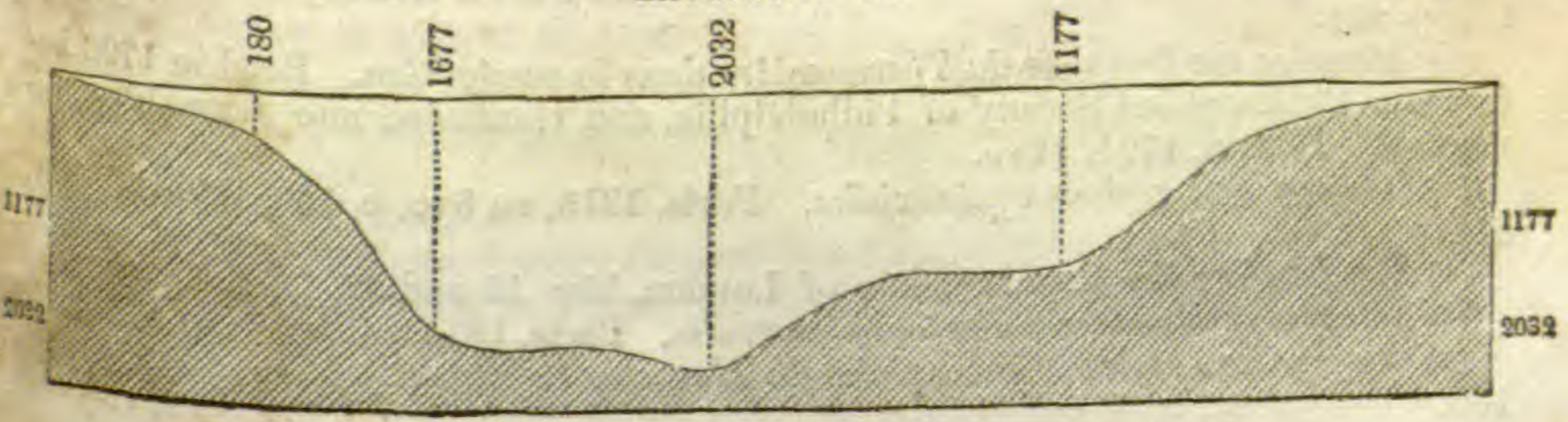
Iceland. DIAGRAM 2. *About* 240 *miles.* Færöe Isles.



Greenland. DIAGRAM 3. *About* 760 *miles.* Iceland.



Labrador. DIAGRAM 4. *About* 510 *miles.* Greenland.



SCIENTIFIC INTELLIGENCE.

I. PHYSICS AND CHEMISTRY.

PHYSICS.

1. *Temperature of the Atlantic Ocean compared with that of the air from Southampton to Havana*, (In a letter from M. ANDRES POEY to Prof. Silliman, dated Havana, December, 1861.)—In my passage from Southampton to Havana from the 3d to the 22d of November last I undertook, at the suggestion of Mr. Charles Saint Claire Deville, for the benefit of science, to observe, at different hours of the day, the temperatures of the waters of the ocean and of the air, also the prevailing winds, the barometric pressure, the atmospheric electricity and polarization, the saltness of the sea, etc. Observations of this kind in the open sea are of great interest both to pure science and to navigation. It was by the collation of thousands of observations, made principally by American navigators, that Maury has reduced to fourteen days the voyage from any point of the United States to South America. It is also by the same method that Mr. C. Saint Claire Deville has pointed out the poles of heat and cold which eddy in the sea of the Antilles, where the curves are concentrically inflected.(1) At present I will simply call attention to the influence which shoals exert upon the thermic state of the ocean. These phenomena were first observed in 1776 by Blagden,(2) confirmed in 1789 by Jonathan Williams,(3) and more recently by Humboldt,(4) John Davy,(5) Peron,(6) and others.

The depression of temperature near the land reveals to the navigator the existence of a shoal, or the proximity of a coast which is yet invisible. Williams frequently observed a depression of temperature to the extent of 4° C. while he was at least three hours distant from any point of danger. The statement of Humboldt that "the proximity of a sand bank is indicated by a rapid decrease of the temperature at the surface of the sea" is not only interesting to the philosopher but important to the safety of navigation. The use of the thermometer should not of course lead to the neglect of the lead, but many experiments show that variations of temperature, measured even by imperfect instruments, give warning of danger long before the vessel comes upon soundings. In such cases the cooling of the water may lead the pilot to heave the lead where he would expect the most perfect security.(7)

(1) *Recherches sur les principaux phénomènes de Météorologie de la physique générale aux Antilles.* Paris, 1849, in 4to, p. 189–229. *Annuaire de la Société Meteorologique de France*, 1853, t. 1, p. 160–165, avec une carte.

(2) Volney: *Tableau du climat et du sol des Etats-Unis d'Amérique.* Paris, 1803, t. 1, p. 231.

(3) *Memoire sur l'emploie du Thermomètre dans la navégation.* Read in 1790 before the Philosophical Society of Philadelphia, and translated into Spanish by Vimercati. Madrid, 1794. 8vo.

(4) *Voyage aux regions équinoxiales.* Paris, 1816, en 8vo, p. 100, 129–131, 145, 151.

(5) Read before the Royal Society of London, May 13 and 22, 1817.

(6) *Voyages de découvertes aux terres australes.* Paris, 1816. 4to, t. 11, p. 324–347.

(7) *Voyage aux régions équinoxiales du Nouveau Continent.* Paris, 1816, t. 1, p. 100.

Mean daily observations made from the 3d to 22d Nov., 1861, *between Southampton and Havana, on board the steamship Atrato.*

Day of the month.	Temperature of the ocean.	Temperature of the air.	Height of Barometer.	Prevailing winds.
Nov. 3	13°·75 C.	12° C.	30·08 inches	W.S.W.
4	14 ·50	14	30·09	W.S.W.
5	15 ·75	15	30·05	W.S.W.
6	17 ·75	16 ·50	29·02	W.N.W.
7	21 ·25	15 ·50	29·01	W.N.W.
8	18 ·50[8]	19 ·00	29·04	W.N.W.
9	22 ·25	20 ·75	29·08	S.E.
Rain. 10	22 ·50	21 ·00	29·06	W. by S.
11	22 ·75	21 ·25	29·04	W.S.W.
12	25 ·00	24 ·00	29·05	W.
13	25 ·25	24 ·25	30·07	S.W. by W.
14	26 ·75	25 ·00	30·08	W.S.W.
15	27 ·75	24 ·75[9]	30·02	S.
16	27 ·25	26 ·75	29·07	S.
17	27 ·00[10]	27 ·50	29·06	E.
18	27 ·25[11]	26 ·50	....	N.W.
19	27 ·00[12]	25 ·00	....	N.N.E.
20	27 ·50	26 ·75	....	N.N.W.
21	27 ·25[13]	26 ·00	....	N.N.W.
22	27 ·00[14]	26 ·50	....	E.S.E.
23	26 ·00[15]	27 ·00	....	E.S.E.

This table confirms the observations of Blagden and Williams. Thus the temperature of the water undergoes a remarkable depression on approaching shoals or land; as near the Azores, in the roads of St. Thomas, in the bay of Havana, and near the islands of Porto Rico, St. Domingo, and Cuba, also near Samana, Cape Grange, fort Moro, Matanzas and Havana.

2. *Dove's Photometer.**—The new photometric method proposed by Dove, has the advantage over those now in use, that it is equally applicable to the determination of the intensity of the light proceeding from a bright or faintly luminous body, whether it be white or colored, transparent or opaque; it is suitable also to determine the amount of light transmitted by optical instruments. The apparatus used is the compound microscope, which is usually brought into a horizontal position: a minute photograph representing black letters on a white (transparent) ground, or simply a cross on a similar ground, is placed on the stage and viewed under a power of from 20 to 60 diameters. The letters will of

(8) In sight of the Azores, distant 4 kilometres (= 2½ miles).
(9) Sky overcast. (10) In the roads of St. Thomas.
(11) In view of Samana.
(12) In view of Cape Grange (Mount Christi of St. Domingo).
(13) In view of fort Moro, Cuba. (14) In view of Matanzas.
(15) In the bay of Havana.

* Pogg. Annalen, vol. cxiv, No. 9, p. 145.

course appear by transmitted light, black on a white ground, and white on a black ground by reflected light, while the two illuminations can readily be balanced so that the letters are made to disappear. This is perhaps most elegantly effected by the use of two Nicol's prisms, one placed under the stage, the other directly behind the objective or eye-piece. By the revolution of either prism the transmitted light is weakened till the compensation is exactly effected, and the letters made invisible. The compensation may also be effected by reducing the size of the aperture under the stage, or by varying the distance of the luminous body which stands in the axis of the microscope. The light furnished by two candles is compared by placing them one at a time in the prolongation of the axis of the compound body, and varying their distance from the microscope till the compensation has been made for each separately. Their distances from the microscope is measured and furnish the data for calculating the relative amounts of light emitted, the zero of the scale being the microscopic photograph. The intensity of the light in various parts of the spectrum is measured by allowing different portions of it to fall on the under side of the photograph and effecting compensation. Nothing can be simpler than the application of this method to the determination of the equality, or inequality, in the amount of light transmitted by, or reflected from, differently colored substances. Dove recommends that photographs should be especially executed for this photometer, and I have found in fact that some are more delicate in their indications than others; the letters or figure ought to be very sharp at the edges, for if they are surrounded by an outline differing a little in density from the central portions, this in practice becomes a dividing band between the two shades and renders compensation difficult. It would also be well to remove the iodid of silver by cyanid of potassium, instead of the hydrosulphite of soda, as the letters then appear considerably brighter by reflected light. It is desirable that the sensibility of this new method, as compared with others now in use, should be tested by a carefully made series of numerical determinations.

O. N. R.

3. *On the specific heat of certain elements.*—REGNAULT has determined the specific heat of one or two elements not previously examined, and has revised that of others which were somewhat uncertain, in consequence of the impurity of the specimens which he employed in his earlier researches. The results are most conveniently exhibited in a tabular form.

	Spec. heat.	Atomic heat.	Equivalent. 0=100.
Magnesium,	0·2499	37·49	150
Lithium,	0·9408	75·61	80·37
Osmium,	0·03113	38·11	1244·2
Rhodium,	0·05803	37·84	652·1
Iridium,	0·03259	40·19	1233·2
Manganese,	0·1217	39·55	325·0
Nickel,	0·1108	38·78	350·0
Cobalt,	0·10620	37·17	350·0
Tungsten,	0·3342	38·43	1150·0

	Spec. heat.	Atomic heat.	Equivalent.
Silicon (cryst.),	0·1774	46·92	266·7
Silicon (fused),	0·1750	31·29	177·8
		15·64	88·9
Boron (amorphous),	0·4053		
	0·3483		
	0·3598		
Boron (graphitoid),	0·2352		
Boron (cryst.),	0·2622		
	0·2253	34·1	136
	0·2574		

From the above table it will be remarked that all the elements examined obey the law of Dulong except lithium and silicon. Regnault repeats in connection with lithium a suggestion long since thrown out by him, that the true equivalent of lithium is 40·18, and that consequently lithia should be written L_2O, just as for similar reasons potash and soda should be written K_2O and Na_2O. In the case of silicon the author remarks that no one of the three equivalents which have been proposed for this element corresponds to the law of Dulong, but that if we adopt for silica the formula Si_2O_5, which requires the equivalent 222·3, the atomic heat becomes 39·12, and comes within the ordinary limits of experimental error. Regnault does not adopt this view, but simply calls attention to the subject. It is possible, certainly, that silicon exhibits the same anomalies in its different forms as carbon. The specific heat of boron is doubtless somewhat too low, and the different experiments do not agree well with each other.—*Ann. de Chimie et de Physique*, lxiii, 1.

W. G.

CHEMISTRY.

4. *On the Cyanid of Sulphur.*—LINNEMANN has succeeded in preparing a cyanid of sulphur by the action of iodid of silver upon sulphocyanid of silver, iodid of silver and cyanid of sulphur being the only products of the reaction. The cyanid of sulphur, $\left.\begin{matrix}S\\S\end{matrix}\right\}Cy_2$ or S_2Cy_2, presents colorless rhombic tables, or long thin leaves which have an odor analogous to that of iodid of cyanogen, and evaporate slowly but completely in the air. Between 30° and 40° it sublimes and condenses in small thin leaves; at 60° it melts to a clear and colorless liquid, which on cooling solidifies to a white crystalline mass. When heated in a flame, it burns with the color of cyanogen. The cyanid is soluble in ether, alcohol and water, and crystallizes easily on cooling. Strong sulphuric acid dissolves it in the cold without decomposition, which however takes place on diluting the solution with water. Nitric and chlorhydric acids decompose it easily in the cold. Potassium attacks it strongly, cyanid and sulphocyanate of potassium being the products of the reaction. An alcoholic solution of potash produces with it, cyanate and sulphocyanate of potassium, the reaction being represented by the equation

$$\left.\begin{matrix}Cy\\Cy\end{matrix}\right\}S_2+\left.\begin{matrix}K\\K\end{matrix}\right\}O_2=\left.\begin{matrix}Cy\\K\end{matrix}\right\}O_2+\left.\begin{matrix}Cy\\K\end{matrix}\right\}S_2.$$

The action of sulphydric acid, sulphid of potassium and nascent hydrogen upon cyanid of sulphur is represented by the three following equations.

$$(1.)\quad Cy_2S_2+H_2Cy=H\ +CyH,\ S_2$$
$$(2.)\quad Cy_2S_2+H_2S_2=CyH+CyH,\ S_2+S_2$$
$$(3.)\quad Cy_2S_2+K_2S_2=CyH+CyK,\ S_2+S_2$$

A molecule of cyanid of sulphur unites directly with two molecules of ammonia to form an ammonium-sulphid which has the formula $\left.\begin{matrix}NH_3Cy\\NH_3Cy\end{matrix}\right\}S_2$.

This sulphid is a crystalline powder insoluble in ether, and easily prepared by passing dry ammonia into an etherial solution of the cyanid of sulphur. The author endeavored to obtain a bisulphid of cyanogen, by the action of an etherial solution of iodine upon sulphocyanid of silver. Iodid of silver is formed and a peculiar reddish brown very volatile liquid, which was not further investigated but which can scarcely be anything else than $\left.\begin{matrix}Cy\\I\end{matrix}\right\}S_2$. The cyanid of selenium so closely resembles the cyanid of sulphur in all its properties that the two bodies might easily be confounded; it is obtained by an exactly similar reaction.—*Ann. der Chemie und Pharmacie*, cxx, 36. W. G.

5. *On a combination of hydrogen and iron.*—WANKLYN and CARIUS have studied the action of zincethyl upon the chlorids and iodids of silver, copper, iron and nickel. The reactions represented by the equations

$$(1.)\quad (MeCl)_2+Zn_2(C_4H_5)_2=Zn_2Cl_2+Me_2+(C_4H_5)_2$$
$$(2.)\quad (MeCl)_2+Zn_2(C_4H_5)_2=Zn_2Cl_2+Me_2+C_4H_4+C_4H_6$$

take place with subiodid of copper or with chlorid of copper and chlorid of silver. The action of zincethyl upon iodid of iron and probably also on chlorid of nickel takes place according to the equation

$$(3.)\quad (MeCl)_2+Zn_2(C_4H_5)_2=Zn_2Cl_2+(MeH)_2+(C_4H_4)_2.$$

When zincethyl diluted with an equal volume of ether is brought in contact with iodid of iron, an evolution of gas immediately ensues, and when the action is over, a black powder remains, which is to be completely washed with pure ether. The powder gives off hydrogen by gentle heating, but at ordinary temperatures and with exclusion of water, may be preserved unchanged. When distilled water is brought in contact with the powder, pure hydrogen is given off, which does not occur with iron reduced by hydrogen. From this it appears that the powder is a combination of iron with hydrogen, which in contact with water gives protoxyd of iron and free hydrogen; the formation of protoxyd of iron is shown by the fact that the residue of the treatment with water, dissolves in dilute chlorhydric acid to protochlorid of iron almost without evolution of gas.

The composition of the hydruret of iron appears to be represented by the formula Fe_2H_2, though it is difficult to obtain the substance free from metallic iron. The authors suggest that the compound is well adapted to the replacement of chlorine or oxygen by hydrogen, and are engaged with further investigations of the subject.—*Ann. der Chem. und Pharm.*, cxx, 69. W. G.

6. *Lithia in Meteorites.*—BUNSEN has examined with the spectroscope two meteorites, that of Juvenas in France, which fell on the 15th of May, 1821, and that of Parnallee in South Hindostan, which fell on the 28th of February, 1857. He found in these however only the usual earthy elements, and in addition lithia, which has not hitherto been observed in meteorites.—*Ann. der Chem. und Pharm.*, cxx, 253. W. G.

7. *On the determination of Carbon in Iron.*—WEYL has given an ingenious and simple method of determining the quantity of carbon in cast-iron and steel without the previous difficult and laborious pulverization of the metal. The method consists in making the iron to be analyzed the positive electrode in dilute chlorhydric acid, when the iron dissolves, leaving the carbon, and without evolution of gas. To prevent the iron from becoming passive, which would produce an evolution of chlorine, it is only necessary to regulate the strength of the current by adjusting the distance of the electrodes from each other, so that only protochlorid of iron is formed; the formation of the sesquichlorid is indicated by the yellow color of the solution. A single Bunsen's element is sufficient, and the iron dissolves as protochlorid, leaving the carbon as a pseudomorph. The iron to be dissolved may be held in a forceps provided with platinum points, but so that the points of contact between the platinum and the iron cannot be moistened by the liquid. The separated carbon is to be collected upon an asbestos filter, dried in a current of air, and burned with oxyd of copper and oxygen in the usual manner. The weight of the iron dissolved is easily found by weighing the portion which remains between the platinum points and the surface of the acid, after the complete solution of the immersed portion. A number of analyses conducted according to this method gave results which closely corresponded and which were usually a little higher than those obtained by the ordinary methods. With respect to the time required, the author remarks that a piece of cast-iron weighing about eight grammes, is dissolved in twenty-four hours.—*Pogg. Ann.*, cxiv, 507. W. G.

8. *On the peroxyds of Potassium and Sodium.*—HARCOURT has studied the action of dry air and oxygen upon metallic potassium and sodium. The action of dry air upon potassium appears to consist of at least two stages. By carefully regulating the heat and the supply of air, nearly the whole of the potassium may be converted into a white oxyd. The exact amount of oxygen absorbed in this case is difficult to determine, as the oxydation rapidly proceeds farther, but the white oxyd appears to be a binoxyd. As the oxydation increases, the color becomes yellow, and by finally employing pure oxygen gas, a chrome yellow powder is obtained. The author represents the constitution of this body by the formula K_2O_8, though we are unable to see why the formula should not be KO_4. Water decomposes the powder with effervescence and formation of the binoxyd, the equation being

$$K_2O_8=K_2O_4+O_4.$$

The peroxyd of sodium as prepared by a similar process is of a pure white color; like the oxyds of zinc and tin, it becomes yellow when heated, and on cooling again loses this tint. Great heat is produced on mixing it with water, and a small quantity of gas is evolved; its constitution is represented by the formula Na_2O_4 or NaO_2. The binoxyd of sodium is soluble in water, and the solution on evaporation gives large tabular crystals of a hydrate, which has the formula Na_2O_4+16HO. Another hydrate produced by the efflorescence of the first, has the formula Na_2O_4+4HO.—*Quar. Journ. of Chem. Soc.*, Oct. 1861, p. 267. W. G.

9. *On the constitution of Croconic and Rhodizonic Acids.*—Will finds the formula of crystallized croconic acid to be $C_{10}H_2O_{10}+6HO$, according to which the acid is bibasic. The formulas of some of its principal salts are as follows:

2. $C_{10}Ba_2O_{10}+6HO$. $C_{10}Ca_2O_{10}+6HO$. $C_{10}Pb_2O_{10}+4HO$. $C_{10}Aq_2O_{10}$.

The yellow solution of croconate of potash is easily decolorized by oxydizing agents. Nitric acid and chlorine give rise to a new acid, which the author terms leuconic acid, the empirical formula of which is $C_{10}H_8O_{18}$, the rational formula being probably $\left.\begin{matrix}C_{10}H_5O_{12}\\H_3\end{matrix}\right\}O_6$, so that the acid is tribasic.

Rhodizonic acid has most probably the formula $C_{10}H_4O_{12}$, and is tribasic. Its principal salts have, according to Will, the formulas:

$C_{10}H_2K_2O_{12}+2HO$, $C_{10}H_2Ba_2O_{12}+2HO$, $C_{10}HPb_3O_{12}$, $C_{10}HAg_3O_6$.(?)

The rhodizonic acid obtained by Brodie, by the action of absolute alcohol on the compound of carbonic oxyd and potassium, has probably the formula $C_{20}O_{16}K_6$ or $C_{10}O_8K_3$, and by solution in water, taking up oxygen and giving off potash, is converted into croconate of potash. The acid of Will is clearly different, and dissolves in water without an alkaline reaction.—*Ann. der Chem. und Pharm.*, cxviii, 177, 187. W. G.

10. *On the presence of Rubidium and Cæsium in Triphyline*; by Eli W. Blake, Jr., of New Haven.*—Having obtained a quantity of the residues of the preparation of lithia from triphyline, which gave, when examined in the spectrum apparatus evidences of the presence of rubidium and cæsium, I have at the request of Prof. Bunsen made an analysis of it. After the removal of the iron and phosphoric acid, and the conversion of the sulphates of the alkalies into chlorids, it was found to contain:

Chlorid of lithium, - - - - -	40·98
" " potasssium, - - - - -	9·29
" " sodium, - - - - -	50·04
" " cæsium, - - - - -	0·11
" " rubidium, - - - - -	0·18
	100·60

The method of estimating the rubidium and cæsium depends upon the insolubility of their platino-chlorids as compared to that of the same salt of potassium, and the difference of solubility is not so great as to give very accurate analytical results. The above approximation however serves to show, that like some other minerals containing lithia, triphyline contains small quantities of these new and highly interesting alkaline bases.

* In a letter to G. J. Brush, dated Heidelberg, Jan. 12th, 1862.

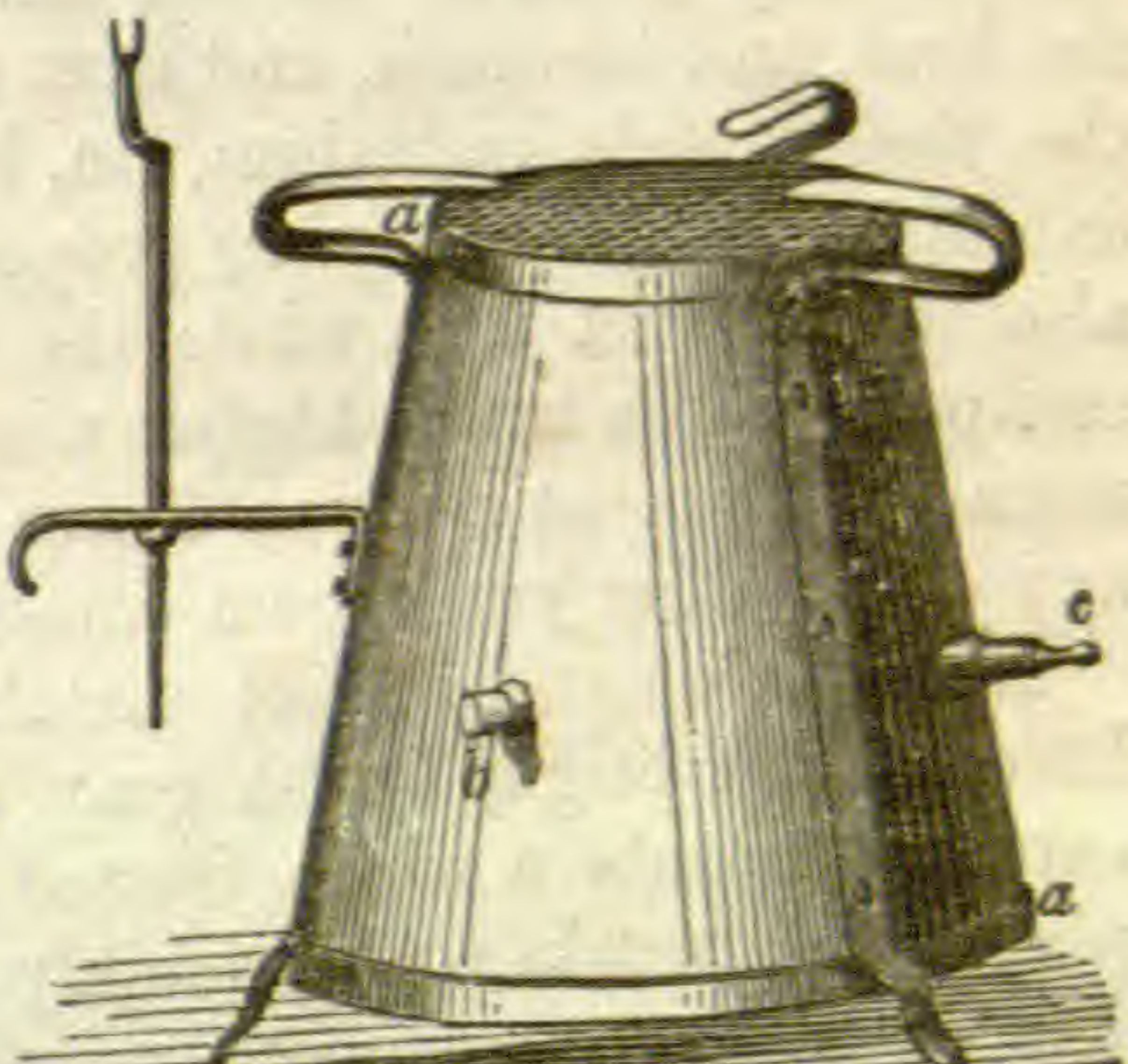
TECHNICAL CHEMISTRY.—

11. *On a Safety-lamp for laboratory use;* by C. M. WARREN.—The danger attending the distillation of highly inflammable liquids, in glass retorts, over an open flame,—and other manipulations of similar nature, —as commonly practiced in laboratories, has probably been felt by every one who has made such experiments. By the exercise of due precaution, the chances for accident under such circumstances, may doubtless be greatly reduced; yet the consequences which may result from a single mishap, are liable to be so serious (as the fate of the lamented Mansfield gives painful evidence, although I believe he was using a metallic retort at the time of the fatal occurrence), that it seemed to me desirable to devise means by which such experiments may be conducted with safety; especially as the chemist has so frequently to resort to protracted fractional distillation of complex mixtures of inflammable substances, as his only means by which to effect a separation.

I find that a lamp may be constructed on the principle of Davy's safety-lamp for miners, so as to afford the important desideratum of safety, and at the same time combine utility and convenience for general use, in cases where a broad open flame and a diffused heat are desirable. Simple modes of applying the principle will readily suggest themselves.

It is only requisite that the flame should be properly enclosed, and so placed and adjusted in relation to other parts of the lamp, that no part can become excessively heated, and yet so as to afford sufficient heat for any work of the kind that may be presented,—the openings below and above for the supply of air and escape of the products of combustion, being securely covered with fine wire gauze, of about 2500 meshes to the square inch. With certain slight alterations, the lamp figured under "Gaskochlampen" in J. F. Luhme & Co.'s, Berlin, catalogue of chemical apparatus—a medium size of which is represented in the annexed figure —makes a cheap and convenient lamp of this kind. As they may not be on sale in this country, a partial description, for the convenience of those who may desire to have them made, may not be amiss.

The sides are of a single piece of sheet iron, riveted together where the ends meet; the upper and lower edges are bent respectively upward and downward so as to stand in a good position to receive the movable brass rings, *a a*, which serve to hold firmly the wire gauze with which the top and the bottom of the lamp are covered.



As the wire gauze will occasionally require to be renewed, this simple mode of construction seems a very convenient one, as the movable rings may readily be taken off and replaced whenever new gauze is needed.

The tubulure, *b*,—which may be closed with a cork—serves for the introduction of a match for lighting. The nipple, *c*, communicates in the interior with a ring, 2½ inches in diameter, made of copper tube, and placed in the centre of the lamp, 3½ inches below the upper gauze, and provided with small perforations in the upper side, for escape of the gas. The height of the lamp, between the upper and lower sheets of gauze, is 5½ inches; its width across the top 4 inches, and across the bottom 6 inches.

The only alterations which I have made, consist in the addition of the tubulure, *b*, and the wire gauze across the bottom. It is obvious that they do not at all interfere with the use of the lamp as originally intended. It may still be ignited outside the gauze, so as to give a broad, open, blue flame. When used as a safety-lamp it is, of course, to be lighted inside, and furnishes a circuit of small luminous flames, but which afford sufficient heat for any purpose for which a safety-lamp is conceived to be desirable.

To show the confidence which one may repose in the safety of such a lamp, I may add that, I have repeatedly tested one by heating a fatty oil to ebullition—during which the gauze immediately under the retort would acquire a dull red heat—and then pouring boiling ether upon the different parts of the lamp, without, in a single instance, being able to ignite it outside the gauze. A portion of the ether would fall through and burn in the interior, while some would lie in the spheroidal state upon the gauze itself, until evaporated: showing that, if one were distilling such a substance, even with such an excessive heat in the lamp, the retort might break, and its contents fall through upon the lamp without any kind of danger. A similar safety-lamp could easily be constructed for using alcohol instead of gas.

Boston, February, 1862.

12. *Description of a new Fusible Alloy;* by B. Wood, M.D.—In this Journal for Sept., 1860, will be found a notice of the cadmium alloy discovered by me consisting of from one to two parts of cadmium, two parts of tin, four parts of lead, and from seven to eight parts of bismuth, and so exceedingly fusible as to melt below the temperature of 160° Fahr. A brief description of another alloy similar in character and scarcely less remarkable, is herewith submitted. It consists of,

Cadmium 1 part, lead six parts, bismuth 7 parts.

This alloy melts at about 180° Fahr., being nearly midway between the melting point of the old fusible metal consisting of the *three* metals, tin, lead, and bismuth, and that of the alloy first mentioned consisting of the *four* metals, cadmium, tin, lead, and bismuth. It is remarkable as exhibiting the liquidifying property of cadmium in certain combinations; also in the fact that while the mean melting point of the constituents composing it is much higher than that of those composing the old fusible metal, it melts at a much lower temperature,—being more fusible than any other *alloy* yet known consisting of but *three* metals.

It has a clear, brilliant metallic lustre that does not readily tarnish. Its color is a bright bluish gray, resembling platinum: when cast, its free surface presents a white, frosted appearance. It is very flexible in thin plates, and breaks with a hackly fracture; but when thicker bars are broken, the fracture is smooth, resembling that of tempered steel. It is malleable but not perfectly so. In hardness it is about the same as bismuth, and about the same as an alloy of two parts of lead and one part of tin, or "coarse solder" which it resembles more nearly in other respects.

It may be that more approved methods of measuring temperature will give the alloy a still lower melting point than above ascribed to it, as I see that the experiments made by Lipowitz* with my "fusible metal" indicate for it a much greater fusibility than my measurements.

Indianapolis, Ind., Dec. 21, 1861.

13. *Preparation of Hydrofluosilicic acid.*—H. DEVILLE prepares hydrofluosilicic acid by causing water to fall, drop by drop, upon a mixture of fragments of stone-ware and fluor-spar heated to redness in a tubulated earthen retort, or, somewhat less conveniently, by passing a current of steam through the mixture. By condensing the vapors formed, liquid hydrofluosilicic acid of about 17° B. is obtained, and this by concentration may be brought to 29° and 30° without depositing any silica, while the acid prepared in the ordinary way by dissolving fluorid of silicon in water can be brought to a strength of only about 4° and 5° before the solution becomes solid from the separation of gelatinous silica. At 7° B. a solution of hydrofluosilicic acid contains 66 grms. of the anhydrous acid ($2SiFl_3$, $3HFl$) per litre. At 29°, the maximum condensation, it contains 325 grms. per litre.

The acid of 29° is very energetic, expelling almost all the acids, excepting sulphuric acid, when heated with their compounds. Since it does not attack wood or other organic matters it may be kept in kegs. It has but little action upon vessels of stone-ware, but destroys glass somewhat rapidly with formation of fluosilicate of soda. In the opinion of the author this acid is destined to become of considerable industrial importance.—*Annales de Chim. et Phys.*, lxi, 333. F. H. S.

II. GEOLOGY.

1. *Note on the occurrence of Glauconite in the Lower Silurian Rocks;* by T. STERRY HUNT, M.A., F.R.S., of the Geological Survey of Canada.—In this Journal for Sept. 1858, xxvii, 238, I mentioned that glauconite appears to be the coloring matter of some Silurian sandstones; and in the Report of the Geological Survey for 1859, p. 195, I gave analyses of this material from the rocks of the Quebec group at Point Levis and the island of Orleans. In the latter place there are layers in the dolomitic conglomerate, which contain more than half their weight of soft rounded bright green grains closely resembling the green sand of the Cretaceous period. Analysis shows them to be a hydrous silicate of alumina and protoxyd of iron with about eight per cent of potash, differing from the glauconite of secondary rocks in containing a large proportion of alumina. I have since observed a similar mineral in limestones of the age of the Quebec Group from Texas, and in the Potsdam sandstone of the Uppper Mississippi where bright green layers described by Prof. Owen contain a large proportion of glauconite, whose composition approaches still closer to that of the secondary rocks. I am indebted for specimens of this to Prof. James Hall.

Murchison notices layers of green sand at the base of the Pleta limestone in Russia—and in Esthonia and Livonia, according to Schmidt, it characterizes strata which immediately overlie the alum slates.

The occurrence of these green grains in strata near the base of the Pa-

* Dingler's Polytechnisches Journal, clviii, 376, Lipowitz found that "Wood's fusible metal" when made of 8 parts of lead, 15 parts bismuth, 4 parts tin and 3 parts cadmium, fused at 60° C. (140° F.).—EDS.

læozoic series in regions so remote as Texas, the Upper Mississippi, the Lower St. Lawrence and the shores of the Baltic, is a fact worthy of further attention, and I shall send you my detailed analyses at an early day.

Montreal, Feb. 1st, 1862.

2. *On the Saurian Vertebræ from Nova Scotia.* In a letter from Mr. O. C. Marsh to Prof. B. Silliman, Jr.—[In publishing Prof. Agassiz's letter on page 138 of this volume, we supposed the vertebræ were newly found; this is a mistake, we saw these vertebræ in Mr. Marsh's hands six years ago when they were first discovered, and we assumed that the bones referred to by Prof. Agassiz were the results of last summer's explorations. The following note from Mr. Marsh sets the matter right.—s.]

"The Saurian vertebræ from the Joggins coal formation of Nova Scotia, alluded to in Prof. Agassiz's letter in your January number, were not discovered last summer as the notice stated, but in August, 1855, while I was examining that locality in company with Mr. W. E. Park of Andover, Mass. In the hope of obtaining further remains I have hitherto deferred publishing any account of these remarkable fossils. A recent re-examination of the locality, however, afforded nothing of a similar nature, and I see no reason for longer delay in announcing the discovery.

"The vertebræ were imbedded in a stratum of shale which forms part of group xxvi in the section made of this formation in 1852 by Sir Charles Lyell and Prof. J. W. Dawson. The coal measures at this place have a vertical thickness of about 14,570 feet, and the stratum which contained the remains is a little more than 10,000 feet above their lower limits. It is beneath nearly 5000 feet of coal strata containing about twenty separate veins of coal.

"The vertebræ are about two and a half inches in transverse diameter, flattened and deeply biconcave. They resemble in form the vertebræ of an Ichthyosaurus, and at the time of the discovery I referred them to that genus. A subsequent comparison showed some points of difference, but the Enaliosaurian characters appeared to be equally marked in each.

"As these remains are apparently distinct from any known genus, I would propose for the species the name *Eosaurus Acadianus.* A description of the vertebræ, with plates, will appear in the next number of the Journal of Science. Very truly yours, O. C. Marsh.

"Yale College, Feb. 10th, 1862."

3. *Canadian Pleistocene Fossils and Climate.*—Prof. Dawson, in a paper published in the Canadian Naturalist, gives a more complete list of the fossils of the drift in Maine, Canada, Labrador, &c., than has been before presented, and makes some interesting deductions from them in regard to the physical geography, climate, &c. of that part of the North American continent during that period.

From the facts now given, and others before reported, the conclusion is unavoidable that a far greater degree of cold prevailed during the pleistocene epoch than at present. The causes of this difference of climate Prof. Dawson finds in great recorded changes of level, and in the different distribution of land and water; during the cold period—as he infers—the relative proportion of dry land surface in the arctic regions to that in the temperate zone having been considerably greater than now. N.

4. *The Pre-Carboniferous Flora of New Brunswick, Maine and Eastern Canada;* by Prof. J. W. Dawson, LL.D. &c., (Canadian Naturalist, May 1861.)—In this and a former paper Prof. D. describes a large number of

Devonian fossil plants all new to science except one Calamite, (*C. transitiones*) found in Europe. These plants were collected at Gaspé, C. E., St. John's N. B., and Perry, Maine, and represent the following genera, *Prototaxites* 1 sp., *Dadoxylon* 1, *Sternbergia* 1, *Aploxylon* 1, *Sigillaria* 1, *Calamites* 1, *Arterophyllytes* 1, *Sphenophyllum* 1, *Lepidodendron* 1, *Lepidostrobus* 2, *Lycopodites* 1, *Psilophyton* 2, *Selaginites* 1, *Megaphyton ?* 1, *Cordaites* 2, *Sagenaria ?* 1, *Cyclopteris* 1, *Sphenopteris.*

Of these the *Cyclopteris* (*C. Jacksoni*) is the same submitted by Prof. Rogers to the geological section of the American Association at Newport, R. I. By him, as by Prof. Dawson, it was compared with *C. Hibernica* of Ireland. This and other species afford an interesting parallelism with the Devonian Flora of Europe.

In a note to Prof. D.'s paper, reference is made to the discovery by Mr. Hartt of a number of additional species at St. Johns, N. B. Of these, specimens have been sent to the Geological Cabinet of Yale College with some of the plants described by Prof. Dawson; they include several new ones and some genera not contained in Prof. D.'s catalogue. There are among them *Neuropteris*, *Sphenopteris*, *Nöggerathia*, *Cyclopteris*, *Cordaites* Unger, (properly *Pycnophyllum* Brong., as Unger's genus was published in 1850, Brongniart's in 1849,) *Lepidodendron*, *Annularia*, etc.—all closely allied to carboniferous species, but apparently distinct.

Goeppert in his recent memoir enumerates 57 species of Devonian plants of which he regards 50 as terrestrial—combining the plants formerly described from the Devonian rocks of Pennsylvania and New York, with those now referred to, the number of species of this date now known in America will be seen to be nearly or quite equal to that of Europe. As the subject of our Devonian flora has but just attracted the attention of fossil botanists, we may expect that future discoveries will prove it to be much more rich in species than has been supposed.

So far as the materials now in our possession suffice for a comparison between the Devonian plants of Europe and America, they would seem to indicate with equal *generic* identity a greater *specific* difference than has been noticed in the flora of the Carboniferous period. N.

5. *New species of Lower Silurian fossils;* by E. Billings, F.R.S., Palæontologist G. S. C. Montreal, 21st January, 1862. This is a continuation of a paper published Nov. 21st, 1861, and noticed on page 136 of the January number of this Journal. It is issued by the Geological Survey of Canada—under the able management of the distinguished geologist Sir W. E. Logan, F.R.S.—and contains well written descriptions, and excellent wood cuts of about fifty new species, and one new genus of Lower Silurian fossils. These fossils are from the Calciferous, Chazy, Black-river, and Trenton formations, and belong to the following genera, viz:—*Lituites* 2 species, *Nautilus* 1 sp., *Orthoceras* 2 sp., *Holopea* 4 sp., *Cyclonem* 2 sp., *Pleurotomaria* 2 sp., *Murchisonia* 4 sp., *Eunema* 2 sp., *Subulites* 1 sp., *Metaptoma* 6 sp., *Avicula* 1 sp., *Conocardium* 1 sp., *Modiolopsis* 5 sp., *Ctenodonta* 1 sp., *Cyrtodonta* 1 sp., *Lingula* 6 sp., *Discina* 2 sp., *Trematis* 3 sp., *Arthroclema* (new genus) 1 sp., *Stromatopora* 1 sp., *Serpulites*, species, and *Bathyurus* 1 species.

6. *Fourteenth Annual Report of Regents of the University of New York, on the condition of the State Cabinet of Natural History, and the Historical and Antiquarian Collection annexed thereto,* made to the As-

sembly, April, 1861. Albany, Aug. 1861.—This brochure consists of the usual report of the Chancellor, giving a statement of the condition of the State Cabinet of Natural History, and of the expenditures during the year for the purpose of increasing its extent and usefulness; together with the following appendices:—

"(A.) Catalogue of the additions made to the State Cabinet of Natural History, from January 1st, 1860, to January 1st, 1861."

"(B.) Guide to the Geology of New York, and to the State Geological Cabinet,—prepared by direction of the Regents; by Ledyard Lincklaen, Esq." This is an interesting and instructive popular treatise on the rocks and fossils of New York, with a brief review of the succeeding formations, not known in that State. It consists of about 65 pages of well written letter press, and is illustrated by 19 plates, containing some 220 good wood cuts of the characteristic fossils of the New York rocks;* together with sections showing the order of succession of the formations of that state, and of the more modern groups of strata occurring elsewhere.

"(C.) Contributions to Palæontology," by Prof. Hall, State Palæontologist, in which he describes with his usual clearness and precision, six new species, and one new genus of *Brachiopoda*—fifteen new species and two new genera of Univalves—and three new species of *Cephalopoda*. One of the univalves, *Euomphalus Conradi*, described on page 107, appears to be identical with a species figured and described by Mr. Billings under the name of *E. DeCuvi*, in the July number of the Canadian Naturalist. If so, Mr. Billings' name will have to take precedence, since the paper in which it was figured and described was issued in advance of Prof. Hall's. Even if the two papers were exactly contemporaneous, Mr. Billings' name would still be entitled to preference according to the usages of naturalists, since his description was accompanied by a good figure, while that of Prof. Hall was not.

Since the publication of the above, we have also received a continuation of Appendix (C.) of the Regent's Report, issued in two parts. The first 24 pages came out in August, and the remaining 60 in September. In this continuation Prof. Hall describes from the Hamilton and Chemung Groups, Schoharie Grit, &c., a number of new fossil shells, *Trilobites*, &c., which we have not space to notice in detail. On page 53 we observe he gives a "Supplementary note to pages 95 and 96 of the 13th Annual Report of the Regents on the State Cabinet," in which he materially modifies his views in regard to the Goniatite Limestone at Rockford, Indiana. In the 13th Report of the Regents, he describes a number of fossils from this rock, and referred it to the horizon of the Marcellus shale. In the supplementary note mentioned above, he carries it up to the Chemung Group. It will be remembered that in the September number of this Journal, Meek and Worthen published a paper on the age of this Goniatite Limestone showing that it could not be of the age of the Marcellus shale, but evidently holds a higher position.†

One of Prof. Hall's species, a *Spirorbis*, described on page 84—the last page of the continuation—was by an oversight left without a name.

* These are mostly the same cuts used in the N. Y. Geological reports, and the former Reports of the Regents of the University.

† Meek & Worthen's paper was in type in June, but was crowded out of the July number by a press of other matter, and laid over until the Sept. number.

7. *Mr. Marcou on the Taconic and Lower Silurian Rocks of Vermont and Canada.*—We have received a paper on this subject, read before the Boston Natural History Society on the 6th of November last, and published in their proceedings. In it, Mr. Marcou discusses the vexed question which has lately been so often before our readers, who are well aware that Mr. Emmons first gave the name of the Taconic system to the oldest Palæozoic rocks of North America. The late Prof. Eaton, who shares with Maclure the honor of having founded American geology, taught that the rocks between the Green mountains and the Hudson were older than those to the west of that river. He divided all stratified rocks into three classes, carboniferous, quartzose, and calcareous; by carboniferous, understanding schistose or argillaceous strata, and including in the carboniferous division of the first or primitive series, the gneiss and crystalline schists of the Green mountains; above which he placed the first quartzose and calcareous formations, the lower Taconic of Emmons. In the second or transition series, he placed the argillites and sandstones which are to the east of the Hudson, and are followed by his second calcareous formation, which seems to have included the Trenton group of limestones, and was succeeded by a third or lower secondary series. (Eaton's Geol. Text-book, 1832.) In opposition to the facts of physical structure, he supposed these formations to dip successively to the westward. The incorrectness of this latter view was perceived by his pupils, and Mr. Emmons, still maintaining the succession adopted by Eaton, included the 1st quartzose and calcareous, and the 2d carboniferous and quartzose in his Taconic system. This according to him underlies the Potsdam and Calciferous formations of New York, which are found horizontally resting upon the disturbed Taconic strata. These latter are supposed by him to have been disturbed previous to the deposition of the Potsdam, by a series of parallel faults, with upthrows on the east side, and to have a general eastern dip; so that the newer strata seem to pass beneath the older ones, thus giving to the whole the aspect of an inverted series. In defining this view, as Mr. Sterry Hunt has shown in the last number of this Journal; (p. 135,) Mr. Emmons has incorrectly spoken of them as inverted strata, while it is evident from his descriptions that he means to assert no more than *an apparently inverted succession.*

The Primordial fauna recognized in these rocks by Emmons and Billings, has attracted the attention of Mr. Barrande, who has lately given in the Bulletin of the Geological Society of France, an excellent and elaborate memoir; in which he discusses the various publications of Mr. Emmons, and those of other American geologists bearing upon the Taconic question. In this memoir, Mr. Barrande has apparently been led into error by the language of Mr. Emmons, and speaks of the overturn of the whole system. Dr. Hitchcock has also called attention to another misconception of Mr. Barrande, who says that Sir William Logan's published views about the Quebec group are "a formal recognition" by that geologist "of the Taconic system at the base of the Lower Silurian." (Bulletin, p. 320.) Now, as Dr. Hitchcock remarks, the rocks in question are by Sir William Logan regarded as the equivalent of the Potsdam and Calciferous formations, with which Mr. Barrande appears to confound them; while the whole Taconic system, according to Emmons, lies beneath these formations. (Hitchcock; Geology of Vermont, p. 386.)

But if the Taconic system has been misunderstood by Mr. Barrande, it has now been completely travestied by Mr. Marcou. Let us compare the system as defined by its author, with the view of it given by Mr. Marcou in his late communications to the French Academy, and in the paper now before us.

1st. Mr. Emmons asserts that the Potsdam and Calciferous repose unconformably on the upturned Taconic series. Mr. Marcou, on the contrary, while he follows the Canadian geologists in referring the sandstones and dolomites of St. Albans to the Potsdam, makes them at the same time members of the Taconic system.

2d. Mr. Emmons expressly states that the gneiss and crystalline schists of the Green mountains formed the eastern limit of the original Taconic basin; and that throughout the Appalachian range the ruins of these strata formed the lower Taconic rocks. Mr. Marcou, on the contrary, includes all the gneiss and mica schist of Vermont as a portion of the Taconic series.

3d. Mr. Emmons, as we have already seen, maintains that the rocks of his system owe their apparently inverted succession to a series of dislocations and upthrows; hence it results that the newer seem successively to pass beneath the older strata, the whole series having a general eastward dip, towards the Green mountains. Mr. Marcou, on the contrary, asserts that "crystalline and eruptive rocks occupy the centre of the Green mountain chain, and that the Metamorphic and other stratified rocks have been turned over on each side, to the east and the west, presenting the fan-shaped structure, and all the accidents which accompany a complete overturn of a whole system of strata." (*Comptes Rendus*, Nov. 4, 1861.) To those who are familiar with the geology of the Green mountains this statement is certainly startling. The eruptive rocks of the chain are confined to a few small trappean dykes, and the granites are evidently strata altered in place. See farther on this subject, the Geology of Vermont, p. 572. As for great overturns from the centre of the chain, it is simply a fiction of Mr. Marcou's invention, unsupported by a single fact. Can Hitchcock, Emmons and others, who have grown gray among these hills, have overlooked a condition of things, which is apparent to a tourist who spends a week in the region? We conceive Mr. Emmons to have erred in his explanation of the physical structure of the Vermont rocks; but it is at any rate conceivable, and to a certain extent countenanced by the fact that at least one such great fault as he supposes, does occur to the west of the Green mountains, bringing up older strata, so that they overlap younger ones. We may here however say for the benefit of Mr. Marcou, that his notion of the structure of mountain chains is a fiction of the last generation; and that although he compares his imagined structure of the Green mountains with that of the Alps, every one who is familiar with modern Alpine geology is now aware that the fan-shaped arrangement of the strata described by De Saussure, is an evidence of a synclinal and not of an anticlinal structure. Mr. Marcou should further be informed that the granites of the Alpine summits, instead of being, as was once supposed, eruptive rocks, are now known to be altered strata of newer Secondary and Tertiary age. A similar structure holds good in the British Islands, where as Sir Roderick Murchison has shown in his recent Geological map of Scotland, Ben Nevis and Ben Lawers are found to be composed of higher strata, lying in synclinals. This great law of mountain structure would alone lead us to suppose that the gneiss of the Green mountains, instead of being at the base, is really at the summit of the series. The strata between this gneiss and the Hudson River formation of the shore of Lake Champlain, we believe to be on the whole in their normal order; while the Georgia slates and the red sandrock which Mr. Emmons places at the summit of his Upper Taconic series, are (with the exception of the small Laurentian area in West Haven,) the most ancient strata in Vermont.

We cannot here stop to discuss Mr. Marcou's remark about "the unstratified and oldest crystalline rocks of the White mountains" which he places beneath the lower Taconic series. Mr. Lesley has shown that these granites are stratified, and with Mr. Hunt regards them as of Devonian Age. (This Journal, vol. xxxi, p. 403.) Mr. Marcou has come among us with notions of mountains upheaved by intrusive granites, and similar antiquated traditions, now, happily for science, well nigh forgotten.

But to return; we have already said that Prof. Emmons places in the Upper Taconic series, the Georgia slates containing *Paradoxides*, and the sandstones with *Conocephalites;* while beneath them, and in the lower Taconic, he ranges the Stockbridge limestones (Eolian limestones of Hitchcock,) with slates above and granular quartz rock below them; the whole series being by him regarded as destitute of fossils. Now if it should happen that these strata contain fossils, and these should be found to have a newer aspect than those of the Georgia slates, it would show that Mr. Emmons has misunderstood the whole structure of the region, and that the apparent succession of the strata is the true one. In the recently published report on the Geology of Vermont we find a list of the fossils up to this time found in these Stockbridge limestones, and identified by Prof. James Hall. The genera are as follows: *Euomphalus, Zaphrentis, Stromatopora, Chætetes, Stictopora* and crinoids (p. 419); while the underlying quartzites contain *Scolithus*, a *Lingula*, fragments of crinoids, an orthoceratite and a *Modiolopsis?* (p. 356). Surely these are not the organic forms which are to be expected in strata far below the horizon of *Paradoxides, Conocephalites* and *Atops*. On the contrary they evidently belong to a higher fauna, and sustain the view of our friend Mr. Sterry Hunt, that the Stockbridge or Eolian limestones belong to the Quebec group, or are of the age of the Calciferous and Chazy (this Journal vol. xxi, p. 402.) We are not yet prepared to go the length of Dr. Hitchcock, who conceives that they may be Upper Silurian or Devonian.

At page 374, in the Geology of Vermont, we have a view of the St. Albans section, in which the conformable superposition of the red sandrock series to the Hudson River group, is admirably shown; so that Mr. Hitchcock remarks "the natural inference from these relations is that the red sandrock is of the age of the Oneida or the Medina sandstone, and the Georgia slate, still newer, and therefore Middle Silurian. * * * If one wished to establish a palæontological system from the stratigraphical relations of the rocks containing the fossils under consideration, there is hardly a place to which we would refer with such confidence for the true order of the strata, as to these rocks in St. Albans." p. 375.

This accords with Sir William Logan's remark about similar sections near Quebec. He says "from the physical structure alone, no person would suspect the break that must exist in the neighborhood of Quebec, and without the evidence of fossils, every one would be authorized to deny it." (This Journal, vol. xxxi, p. 218.) To this testimony of Sir William Logan, so strikingly confirmed by Dr. Hitchcock, Mr. Marcou alludes, remarking that he can find no facts showing any conflict between palæontology and stratigraphy; an assertion which in the eyes of all who understand the question, will be most charitably regarded as evidencing only his own ignorance of the question. We have no doubt from the palæontological evidence, that a great dislocation and overlap exists both at St. Albans and at Quebec.

Not content with having annexed the Green mountain gneiss to his Taconic system, Mr. Marcou next proceeds to discuss the Laurentian and Huronian rocks of Canada in this wise. Sir William Logan, he tells us, having found some Taconic rocks on the southern edge of the Laurentide mountains, "proposed to introduce into the table of the American strata two new systems, which he called the Laurentian and Huronian systems. The Laurentian system is composed of the Lower Taconic, to which are added all the unstratified crystalline rocks forming the centre of the Laurentide mountains, such as granite, syenite, diorite and porphyry, mixing together strata and eruptive rocks; an attempt which was unexpected from a stratigraphical geologist. His Huronian system is formed from a mixture of the St. Albans group of the Upper Taconic with the Triassic rocks of Lake Superior, the trap native-copper-bearing rocks of Point Keweenaw, and the dioritic dyke containing the copper pyrites of the Bruce Mine on Lake Huron." p. 247. Comment upon such a display of ignorance and misrepresentation is almost unnecessary. As to the Laurentide mountains, of which Mr. Marcou knows absolutely nothing, we may state that one of their most remarkable features is the almost complete absence of unstratified rocks. The gneiss, hypersthene rock, quartzites and limestones, which make up their 40,000 feet, are all most clearly interstratified, and are lithologically entirely distinct from the gneiss of the Green mountains, a fact upon which Eaton insisted thirty years ago. (Geological Text-book, 2d edit., 1832.) For a map of the Laurentian limestones, showing their distribution, see the Geol. Survey of Canada, Report for 1859. This system has been identified and recognized by Sir Roderick Murchison as identical with the fundamental gneiss of western Scotland, which he now calls Laurentian; an additional reason, in Mr. Marcou's eyes, for denying the existence of the Laurentian system. As for the Huronian series, with its 10,000 feet of quartzites, conglomerates and diorites, so carefully studied and described by Mr. Murray, it neither includes Mr. Marcou's favorite Trias, (the Ste. Marie sandstones, which all the world now knows to be overlaid conformably by the Black River limestones,) nor the rocks of Keweenaw Point, the Upper Copper-bearing series of Sir William Logan; which he shows to be in the stratigraphical position of the Ste. Marie sandstones, and to rest horizontally on the upturned Huronian strata. As for the error that would make the stratified diorites of Lake Huron a dyke, comment is unnecessary. Mr. Marcou tells us that the labors of Messrs. Jewett, Billings, G. M. Hall, Perry, Farnsworth, Richardson, Bell and himself, have resulted in the collection of more than 1200 species of fossils from the Calciferous sandrock. Now the whole number of species yet described from this formation by Prof. James Hall, Vanuxem and Billings, including the Point Levis fossils, is not much more than 200. As for the additional 1000 species, Mr. Marcou's reiterated statement is either a mistake or a great exaggeration, though we do not doubt that farther researches must add to the fauna of these rocks. It will be noticed that in the lists of fossils given by Mr. Marcou, he does no more than make a display of the names cited from Mr. Billings's late published descriptions.

A word about Sir William Logan's sections, given in the *Canadian Naturalist* for June last, in a paper on the Quebec and Lake Superior rocks, which will appear in the next number of this Journal. Mr. Marcou chooses to confound the actual section from Montmorenci to Orleans Island, with an ideal one showing the supposed mode of deposition of the Palæozoic strata of eastern North America. To this section, and not to the actual one observed near Quebec, belongs the series cited by Marcou on page 247; which includes the strata from the lower black shales of the Potsdam to the top of the Birdseye and Black River limestone. In this section, Sir William makes no reference to Quebec; nor has he, as Mr. M. would imply, anywhere described the Potsdam shales or the Black River limestones as visible in that vicinity. In noticing the section from Montmorenci to Orleans Island, Mr. M. regrets that having no diving apparatus, he could not satisfy himself that the bottom of the intervening river is occupied by Utica and Hudson River rocks. The evidence of this given by Logan, is however very simple, being the occurrence of Utica fossils, alike at the foot of the Fall and on the adjacent shore of the island, to the north of the great fault. Here we must pause to congratulate Mr. Marcou upon one correct observation made by him at Montmorenci. In the Proceedings of the Boston Natural History, for December, 1860, Mr. M. gave us his views on the geology of that place. Logan had long before stated that the horizontal strata at the summit of the Fall are Trenton limestone, with its characteristic fossils, and that the same rock, inclined at a high angle, is found at the foot; where it has been let down by a fault, and is succeeded by the Utica slates and the Hudson River group. Mr. Marcou however, from his observations on a memorable day (the 28th September, 1849, he tells us,) was enabled to declare that Sir William Logan was altogether wrong. The limestone at the summit, Mr. Marcou referred, with some doubt, to the Niagara period, but he did not see the same rock described by Sir William at its foot, and says "it is difficult for me to believe that fifty feet of limestone could have escaped my notice." He moreover asserts, with all the emphasis of italics, that "the quartzite and mica schist *have upheaved the bituminous black slates, and the almost horizontal strata of limestone have been deposited after the dislocation.*" His visit to Montmorenci last autumn however taught him better, and he now tells us that the limestone "*at the top of the fall and at the foot of the precipice, immediately in contact with the quartzite, are of the Trenton limestone age.*" p. 249. The italics this time are our own. He moreover says that in 1849, he erroneously considered the black slates below as older than the Trenton limestone, and admits that they contain the characteristic Utica fossils; which, as Sir William Logan has shown, occur likewise on the north side of the island of Orleans. It is a man guilty of mistakes of this kind who ventures, with his notes of a few days' tour, to correct the results of years of patient labor. The nature of the crystalline rock at the fall seems to cause Mr. Marcou no little perplexity. In 1860 he called it "quartzite passing into mica schist, (gneiss of Messrs. Logan and Bigsby.)" In his paper now under review, he calls it Taconic, and describes it as "a quartzite, which Mr. Logan, for an unknown reason, persists in calling Laurentian gneiss." In his last communication to the French Academy however, (*Comptes Rendus*, Nov. 18, 1861), he himself speaks of "*the gneiss of the Fall of Montmorenci*" as a part of the crystalline rocks of the Laurentide mountains. We congratulate Mr. Marcou that he is, little by little, admitting the correctness of Sir William Logan's original description of Montmorenci.

But we must conclude this notice, which the opportunity afforded by it to discuss the interesting theme of the Taconic rocks, has led us to protract beyond the limits at first intended. The rocks of Vermont and Canada still require much study, before the details of their structure can be fully known, but we think that it is evident that in the red sandrock and the lower black shales we have the Primordial zone, of which the original Potsdam sandstone is a member. These we believe to be, with the exception of the small Laurentian area, the oldest rocks of Vermont, and we conceive that the whole series of Lower Taconic rocks, which Emmons and Marcou place beneath these, will prove to belong to the second fauna, if not in part to still newer rocks. So that Mr. Emmons' claim for the Taconic, as a system of strata older than the Potsdam age, is as yet unsupported by any evidence. T.

[NOTE.—In reference to certain charges of a personal nature brought by Mr. Marcou against the editors of this Journal and contained in this brochure—it is perhaps needless for us to say that they are wholly unfounded. The reference to Prof. Dana in the paper is also without foundation as he never saw the article referred to, owing to ill health, until months after it was printed.]

III. ASTRONOMY AND METEOROLOGY.

1. *On the Companion of Sirius;* by Prof. G. P. BOND, Director of the Observatory of Harvard College.—The companion of Sirius, discovered by Mr. Clark on the 31st of January, with his new achromatic object-glass of *eighteen and one-half* inches aperture, I have succeeded in observing with our refractor as follows:

Angle of position,	85° 15′	± 1°·1
Distance,	10″ 37	± 0″·2

The low altitude of Sirius in this latitude, even when on the meridian, makes it very difficult to catch sight of the companion, on account of atmospheric disturbances; when the images are tranquil, however, it is readily seen. It must be regarded as the best possible evidence of the superior quality of the great object-glass, that it has served to discover this minute star so close to the overpowering brilliancy of Sirius. A defect in the material or workmanship would be very sure to cause a dispersion of light which would be fatal to its visibility.

It remains to be seen whether this will prove to be the hitherto invisible body disturbing the motions of Sirius, the existence of which has long been surmised from the investigations of Bessel and Peters upon the irregularities of its proper motion in right ascension.

A discussion of the declinations of Sirius, establishing a complete confirmation of the results of Bessel and Peters, has been recently completed and published by Mr. Safford. The following passage is extracted from the last Annual Report of the President of Harvard College. Alluding to the operations at the Observatory, the Report gives, as the conclusion of this discussion, "an interesting confirmation of Bessel's hypothesis that the star revolves around an invisible companion in its near vicinity;—the period of revolution is about fifty years."

It will require one, or at the most, two years to prove the physical connection of the two stars as a binary system. For the present we know only that the *direction* of the companion from the primary accords perfectly with theory. Its faintness would lead us to attribute to it a much smaller mass than would suffice to account for the motions of Sirius, unless we suppose it to be an opaque body or only feebly self-luminous.

2. *On the Discovery of the Asteroid* (72); (communicated by Prof. G. P. Bond, Director of the Observatory of Harvard College.)—In reducing the positions of the asteroid Maja, made at the Observatory of Harvard College in April and May last, Mr. T. H. Safford had occasion to refer to the observations made by Dr. Peters at the Observatory of Hamilton College, published in Brünnow's Astronomical Notices, No. 27, p. 20. The first three of these, namely, those for May 9, 11 and 12, were found to agree with the nearly cotemporaneous ones made here, but the remainder presented an unaccountable discrepancy.

A comparison with Mr. Hall's ephemeris of Maja, published in the Astronomische Nachrichten, No. 1315, showed that the Cambridge series entire, and the first three of the Hamilton College positions, belonged to Maja; but the remaining eight, from May 29th to June 13th, differed widely from the ephemeris. That the latter was not at fault, was proved by its accordance with all the Cambridge positions.

The systematic character of the differences, suggested, as a possible explanation, that Dr. Peters had, in the interval between May 12th and 29th, left the track of Maja, and fallen upon a new planet. Mr. Safford proceeded to verify this conjecture by computing from Dr. Peters' published observations of May 29th, June 7th and 13th, the following elements, which have a decidedly asteroidal character:—

1861.	May 29·3851 Wash. m. t.
M	221° 24′ 45″·6
π	350 28 7 ·3
☊	208 37 18 ·8
i	5 20 2 ·6
φ	8 21 49 ·8
μ	1253″·997

The observations, as printed, furnished only approximate positions, for want of accurate places of the comparison stars. The latter have since been supplied from the Harvard Zones. The elements representing the corrected places are as follows:—

Elements of Asteroid (72); by T. H. SAFFORD.

1861.	May 29·375 M. T. Washington.
L	213° 3′ 24″·1 } M. eq. 1861·0
π	329 22 16 ·5 } M. eq. 1861·0
☊	208 1 28 ·0 } M. eq. 1861·0
i	5 23 16 ·2
φ	6 50 26 ·0
μ	1129″·372
log. a	0·331446

An ephemeris roughly computed from the above, shows the following agreement with observation.

	c.—o. $\Delta\alpha$	c.—o. $\Delta\delta$		c.—o. $\Delta\alpha$	c.—o. $\Delta\delta$
May 29,	+1″	0″	June 7,	+2″	0″
30,	−1	−2	8,	−1	−2
31,	−4	0	10,	+3	−3
June 1,	−4	0	13,	+1	0

which leaves no doubt that the object in question is a new asteroid accidentally fallen upon in searching for one discovered but a few weeks earlier. Its mean distance from the sun is the least of the known group.

3. *The recently discovered Asteroids.*—As a name has at length been assigned to the asteroid (59); the names of (61) and (65) have been changed; and new elements have been computed for most of them, we now give a complete list of the asteroids discovered since 1859, with the most recently determined elements.

Berlin mean time.	(57) Mnemosyne.	(58) Concordia.	(59) Elpis.	(60) Danaë.
	1860. Jan. 1·0	1860. Jan. 0·0	1862. Jan. 0·0	1862. Jan. 0·0
L	28° 35′ 25″·6	162° 28′ 26″·1	109° 37′ 23″·7	73° 6′ 25″·4
π	52 53 13 ·0	180 17 24 ·0	17 4 43 ·2	342 44 12 ·7
☊	200 5 25 ·1	161 11 39 ·8	170 21 58 ·8	334 16 57 ·9
i	15 8 1 ·6	5 1 6 ·7	8 37 53 ·4	18 16 32 ·9
e	0·1041157	0·0401686	0·1175831	0·1684354
μ	632″·4633	802″·2385	793″·2911	681″·4933
a	3·157287	2·694441	2·712789	3·003977
Berlin mean time.	**(61) Echo.**	**(62) Erato.**	**(63) Ausonia.**	**(64) Angelina.**
	1861. Jan. 0·8	1862. Jan. 0·0	1861. March 5·0	1861. April 0·0
L	38° 4′ 6″·5	96° 3′ 10″·7	177° 5′ 1″·5	170° 44′ 16″·7
π	98 28 25 ·3	34 4 53 ·4	269 4 44 ·3	126 28 10 ·5
☊	191 57 53 ·0	126 11 3 ·7	338 4 8 ·2	311 2 28 ·4
i	3 34 21 ·5	2 12 21 ·1	5 46 48 ·0	1 19 40 ·0
e	0·1847204	0·1710999	0·1256800	0·1248301
μ	958″·43568	640″·49134	956″·490	809″·508
a	2·391621	3·130850	2·396360	2·678286
Berlin mean time.	**(65) Cybele.**	**(66) Maja.**	**(67) Asia.**	**(68) Leto.**
	1861. Jan. 0·0	1861. May 16·0	1861. May 3·0	1862. Jan. 0·0
L	181° 9′ 11″·2	183° 16′ 42″·3	250° 35′ 33″·5	282° 33′ 47″·2
π	258 10 1 ·2	43 54 23 ·8	306 31 55 ·4	358 57 32 ·0
☊	158 25 36 ·1	8 11 59 ·8	202 31 32 ·5	44 37 54 ·7
i	3 24 24 ·7	3 4 8 ·8	5 57 5 ·9	8 10 16 ·5
e	0·1277782	0·1542290	0·1876756	0·1697848
μ	558″·1762	820″·71	945″·4575	789″·8
a	3·431547	2·653866	2·414960	2·722658
Berlin mean time.	**(69) Hesperia.**	**(70) Panopæa.**	**(71) Niobe.**	**(72) ——.**
	1861. April 30·0	1861. June 0·0	1861. Sept. 25·5	1861. May 29·6
L	158° 57′ 16″·3	253° 11′ 36″·7	322° 15′ 20″·8	213° 3′ 24″·1
π	118 19 45 ·1	299 3 0 ·2	221 59 19 ·0	329 22 16 ·5
☊	186 54 58 ·5	48 21 0 ·3	316 18 7 ·4	208 1 28 ·0
i	8 27 26 ·0	11 14 37 ·1	23 17 57 ·5	5 23 16 ·2
e	0·1740296	0·2235450	0·1733417	0·1191068
μ	662″·0986	813″·222	775″·41536	1129″·372
a	3·062358	2·670127	2·756226	2·145092

In the above tables

L represents the mean longitude of the planet at epoch.
π " " longitude of the perihelion.
☊ " " longitude of the ascending node.
i " " inclination of the orbit to the ecliptic.
e " " excentricity of the orbit.
μ " " mean daily motion.
a " " semi-major axis of the orbit.

Comparing these elements with those of the asteroids previously discovered, we find that the asteroid nearest the sun is (72), with a mean distance 2·14 and a period of 1148 days. The asteroid most remote from the sun is Cybele, with a mean distance 3·43, and a period of 2322 days. The orbit of (72) is therefore nearer to that of Mars than to that of Cybele.

The asteroid whose orbit has the least excentricity is Concordia, its excentricity being 0·04; that which has the greatest excentricity is Polyhymnia, its excentricity being 0·337, which is considerably greater than that of any other known planet.

The asteroid whose orbit is least inclined to the ecliptic is Massillia, whose inclination is 0° 41′; that whose orbit is most inclined to the ecliptic is Pallas, whose inclination in 34° 42′.

Of the 72 asteroids whose orbits have been computed, 18 have their ascending node in the first quadrant; 24 in the second quadrant; 17 in the third quadrant; and 13 in the fourth quadrant.

4. *Discovery of a Telescopic Comet.*—A telescopic comet was discovered at this Observatory by Mr. H. P. Tuttle, at 3 A. M., Dec. 29th. The following observations and elements have been obtained.

Observations of Comet 1861, III, *made at the Observatory of Harvard College, Cambridge, U. S.* [By a provisional reduction.]

M. T. Cambridge.	A. R.	Dec.
1861, Dec. 28, 18h 25m 34s	14h 12m 55s·3	−5° 12′ 39″
30, 18 20 16	14 15 29 ·9	−1 24 42
1862, Jan. 1, 18 37 18	14 18 29 ·9	+3 9 31

The following elements have been computed by T. H. Safford, Assistant at the Observatory:—

T. 1861.	Dec. 6·9867.	M. T. Washington.
log. q,	9·92400	
ω,*	331° 39′·10	
☊,	146 8 ·78	App. equinox Jan. 1, 1862.
i,	41 58 ·40	
	Motion retrograde.	

The middle observation is represented as follows:

	e.—o.
$\delta\lambda \cos. \beta$,	+0′·19
$\delta\beta$,	+0 ·03

The subjoined ephemeris may perhaps be useful for the reduction of observations.

18h Washington.	Comet's A. R.	Comet's Dec.	log. Δ
1862. Jan. 1,	214° 40′	+3° 8′	9·755
3,	215 39	8 36	9·714
5,	216 49	15 9	9·675
7,	218 19	22 59	9·638
9,	220 18	+32 3	9·609

About the 20th inst. it will approach the north pole.

* Distance of the perihelion from the ascending node in the direction of motion.

Elements of Comet III, 1861; by H. P. Tuttle.

Perihelion passage, Dec. 7·2024. M. T. Gr.

log. q	9·923922	
π	173° 27′ 42″·7	
☊	145 7 59 ·4	M. eq. 1862·0
i	41 51 54 ·2	

Motion retrograde.

From observations of Dec. 28th, Jan. 1st, 4th, and 7th.

4. *Encke's Comet.*—The physical phenomena which this comet has exhibited on several previous occasions, have been again repeated during its present apparition. At first it was quite destitute of any central condensation—more so in fact than is common with even the faintest telescopic comets. This is its usual aspect when far distant from the sun. It soon acquired greater consistency and even exhibited an almost sparkling nucleus. It was for some time visible to the naked eye, and showed a respectable tail 1° in length.

Its most interesting peculiarity was a very decided disposition of its nebulosity on the side towards the sun, constituting a faint tail, as it were, opposed to the normal direction. This was formed a long time before the true tail made its appearance. It is by no means a new feature, as it is mentioned in its preceding apparitions by Struve, Schwabe, Wichman and others. In 1848 and again in 1852 it was particularly evident. The fact of its repetition in so many instances gives a kind of individuality to this comet, distinguishing it from most bodies of its class, and is interesting from its associations with its otherwise very remarkable character. G. P. Bond.

Observatory of Harvard College, Jan. 3d, 1862.

5. *Shooting Stars of January* 2, 1862.—In Connecticut, a cold wind blew violently during most of the night of January 1–2, 1862, but the sky was clear. A lady in Hartford, in this State, who was up early on the morning of the 2d inst. saw at about $3^h 45^m$ A. M. in the southern sky a luminous cloud moving from west to east, which was followed by others somewhat less luminous. Shooting stars appeared moreover to be unusually frequent, and were noticed by this observer for an hour ending at $4^h 45^m$ A. M. They were very numerous and at times as many as three per minute were seen. They passed from north to south, appearing most thickly near the zenith. I have not succeeded in ascertaining that this phenomenon was observed by any one else.

It is not easy to interpret the luminous clouds above reported, or to infer what was the actual number of shooting stars visible in the sky at Hartford during this hour. The statement adds however new strength to the probability that the 2d of January is one of the meteoric periods. In his valuable *Catalogue des Principales Apparitions d'Etoiles Filantes*, published at Brussels in 1839, Mr. A. Quetelet cites two instances in which these meteors have been reported as uncommonly numerous on the morning of the 2d of January, viz. in 1835 and 1838 in Switzerland; and in his 2d edition (1841,) he adds two other cases, viz. in 1839 at Bossekop in Finland and in 1840 in Belgium. In 1825, January 2, about 5 A. M. a grand fireball was seen in Tuscany, Italy, and on the same night both before and after it appeared, falling stars were seen there in great numbers. (*Ferussac*, *Bull. de Sci. Math.*, *Mai*, 1825.) In a paper published by me in 1839, vol. xxxv, 1st series of the Amer. Journal of Science, this date was named as one of the possible meteoric epochs. Owing in part at least to the inclemency of the weather, this period has been generally neglected. It is to be hoped that hereafter it will receive the attention of observers, and that the average hourly number of meteors then visible, and the place of apparent radiation at this season may be determined.

E. C. HERRICK.

6. *Large Meteors.*—Several large meteoric fireballs, as below specified, have recently been seen in this part of the country, and any person who can give definite observations on any of them, is desired to communicate them to the editors of this Journal.

(1.) 1861, Dec. 9, 6 A.M.; near Brunswick, Maine, one, moving from W. to E., breaking into three parts. (2.) Dec. 17, 4¾ P.M. near Buffalo, N.Y., one with train, in S.E. (3.) Dec. 25, at sunset, from Connecticut, one seen in the S. over the Atlantic ocean, S. of Long Island, moving slowly from 10° high obliquely to horizon. (4.) Dec. 30, 7 P.M., Hartford, Ct., one in S.W. passing slowly from α Cygni to Delphinus, exploding with noise like a pistol. (5.) 1862, Jan. 3, 7^h 17^m A.M., New York City, one apparently as large as a third the moon's diameter, with short train, going from E. to W. (6.) Jan. 5, at sunset, one seen at Setauket, L. I., N. Y., from N.E., sparkling. H.

7. *Catalogue of Meteorites and Fireballs from A.D.* 2 *to A.D.* 1860; by R. P. GREG, Esq., F.G.S. Lond. 1860, pp. 74, 8vo. (From Report of Brit. Assoc. for Adv. of Science for 1860.)—This important catalogue is partly a sequel to the series of reports on Luminous Meteors published since 1847 in the annual volumes of the British Association, and partly as a continuation and enlargement of a Catalogue of meteorites published by Mr. Greg, in the Lond., &c. Phil. Mag. for Nov. and Dec. 1854.

It comprises, with introductory and concluding statements and notes,

(1.) A tabular catalogue with supplement, (57 pages,) of meteorites, detonating meteors and large noiseless meteors, (about 1900 cases in all,) combined in one chronological series, from A.D. 2 to 1860, stating the place, month, day and hour of the occurrence so far as known, and in some cases the size, weight, direction, velocity and other particulars, but usually without reference to the book or journal authorizing each statement; a general reference being however given to the sources from which the material of the catalogue is derived.

(2.) Ten analytical tables showing the yearly, monthly and hourly distribution and direction when known. These analyses evince much skillful labor, and present many interesting results.

There may be no theoretical objection to mingling in one catalogue meteorites and large meteors, but it is hard to discriminate between the large and the small. Of meteors as brilliant as Venus there are probably several hundreds visible in the earth's atmosphere every day, and no catalogue can be made which shall comprise even a hundred-thousandth part of the large meteors, fairly so called, which have been visible in our atmosphere during these 1858 years. These meteors are only larger shooting stars, and there seems to be no special reason for separating them from the smaller, except that they are less numerous. Every case of meteorite, fire-ball or shooting star, of whatever size, whose velocity, altitude, or direction is ascertained even roughly, is worthy of careful record. All other cases are of much less astronomical importance, except those in which meteors have appeared in showers or in unusually large numbers.

The work is one of great convenience and much value, notwithstanding some errors and omissions. These are however not more numerous than might have been expected in the first issue, and we have no doubt that the author with his well known zeal and thoroughness will render future editions yet more complete. H.

8. P. A. Kesselmeyer: *Ueber den Ursprung der Meteorsteine:* with three tables: (from the 3d vol. of "Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft," at Frankfort-on-the-Maine.) Frk à-M. 1860. 4to, pp. 144.—The first 45 pages of this work are occupied with a discussion of the subject of meteorites, especially with reference to their mineral characters, and their distribution throughout the globe and throughout the year. Some account is also given of the history of the science and of the hypotheses which have been proposed to explain their origin. His own conclusion is the untenable one that meteorites are probably connected with the active volcanoes of our earth.

Three charts accompany the three tables, viz. (1) one of Europe showing the localities, by numbers referring to the extended table, of the meteorites which have fallen in Europe, and showing also the position of the active volcanoes there found; (2) one indicating in like manner the meteoric falls and the active volcanoes of the eastern hemisphere; (3) a similar map of the western hemisphere, with a side map of the United States bearing like data. These interesting maps show that the law of the geographical distribution of meteorites is a simple one, viz. meteorites have been found most abundant where intelligent observers have been most abundant.

On pages 45, 46, 47 is a catalogue of 130 European meteorite-falls since 1700, arranged and summed according to the months of their occurrence, and on p. 48 is a like catalogue of 23 cases in Asia since 1700.

The remainder of the book (pages 49 to 144 inclus.) is occupied with tables enumerating all known meteorites and meteoric irons, with their time and place of fall, if known, some other details, and references to the work wherein described. One series is arranged geographically (p. 49–84,) and another series gives in chronological order a catalogue of meteorites certain and probable, from the earliest times to the present day, distinguishing (not always successfully,) by difference of type in the number prefixed, between the certain and the doubtful. In his zeal for thoroughness the author has introduced numerous cases from Chinese Annals which may be somewhat uncertain, and begins his list with the case of the "fire from heaven" which destroyed Sodom, Gomorrah, Admah, and Zeboim. The total number is

	Of known date.	Of unknown date.
More or less certain stone-falls,	287	17
" " " " iron-falls,	17	97
" " " doubtful stone-falls,	337	24
" " " " iron-falls,	6	10
	647	148

Then follows a list, (p. 134–143,) of bolides and probable meteorites and meteoric iron masses. The work is well arranged, and furnishes the most useful aërolitic catalogue hitherto published. A few errors observed in it will hereafter be mentioned. H.

9. *Abstract of Meteorological Observations made during the year* 1861, *with the averages of nine years, at Sacramento, Cal.*, lat. 38° 31′ 41″ N., lon. 121° 29′ 44″ W. Altitude at the top of the levee, in front of the city, 54 feet 5 inches. Height of lower surface of mercury, 52 feet 5 inches above low tide at San Francisco; by Thomas M. Logan, M.D.

1861.	January.	Feb'y.	March.	April.	May.	June.	July.	August.	Sept.	October.	Nov.	Dec.	Ann. Mean	Average.
Barometer.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
Maxima,	30445	30 386	30·289	30·283	30 199	30·107	29·930	30·008	30·084	30·150	30·383	30·297	30·203	30·233
Minima,	29·615	29·701	29·779	29·862	29·714	29·752	29·657	29·745	29 642	29·724	29·765	30·594	29·713	29·721
Mean,	30·130	30·103	30 063	30·027	29 942	29·916	29 812	29 890	29·877	29·975	30·029	30·042	29 984	30·001
Thermometer.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.
Maxima,	57·00	62·00	69·00	74 00	75 00	81·00	87·00	84·00	81·00	73·00	65 00	62·00	72·50	76 99
Minima,	36 00	45·00	45 00	50 00	55·00	57 00	64·00	61·00	59·00	47·00	40·00	40 00	49 99	46·70
Mean,	47·12	52·17	56·05	60 65	63·70	66·18	73·57	69·73	67·78	59·91	58 60	50·98	60·12	59 92
Thermometrograph.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.
Maxima,	58·00	62·00	70 00	76 00	77·00	82·00	92 00	90 00	84·00	78·00	68·00	63·00	75·00	77·50
Minima,	30·00	45·00	42·00	47·00	50 00	53·00	61 00	58·00	57 00	46·00	39·00	39·00	47·30	42 50
Range,	28 00	17 00	28·00	29·00	27·00	29·00	31·00	32 00	27·00	32·00	29·00	24·00	27·70	35·00
Force of Vapor.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
Maxima,	·376	·407	·446	·551	·519	·545	·639	·577	·595	·470	·439	·439	·500	·517
Minima,	·139	·204	·228	·288	·263	·337	·403	·370	·367	·212	·182	·175	·264	·217
Mean,	·257	·307	·340	·382	·397	·434	·501	·457	·464	·330	·312	·322	·367	·359
Relative humidity.	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Maxima,	93 00	95 00	96·00	88·00	83 00	77 00	75·00	77·00	80 00	79 00	88·00	93·00	85 00	87·07
Minima,	46·00	50 00	52 00	47·00	36·00	45·00	35·00	36 00	50·00	33·00	60·00	50·00	45·33	35 36
Mean,	78 37	77·93	75·30	72 08	67·47	67·40	60·94	63 35	68 68	64·27	74·67	85·00	71·28	70·19
Number of clear days,	9⅓	8⅓	13⅓	16⅓	21⅔	21⅓	27⅓	30⅓	27⅓	23⅓	5⅓	0	204	194⅔
Number of cloudy days,	21⅔	19⅔	17⅔	13⅔	9⅓	8⅔	3⅔	⅔	2⅔	7⅔	24⅔	31	161	170⅓
Number of rainy days,	7	9	6	5	3	4	0	0	0	1	12	18	65	61⅓
Quantity of clouds,	3·2	3·3	2·3	1·7	1·2	0 7	0·2	0·02	0·1	0·9	5·5	5·9	4·2	3·6
Quantity of rain and fog,	2·668	2 920	3·320	0·475	0 590	0·135	0·000	0 000	0·000	0·000	2·170	8·637	23·201	18·019

Column 1st No. of days, and column 2nd force of

Wind	January		Feb'y.		March.		April.		May.		June.		July.		August.		Sept.		October.		Nov.		Dec.		Ann. Mean		Average.	
N. wind	14⅔	1·6	8	1·5	11	1·7	8⅔	1·9	4⅓	1·9	2⅓	1·0	2	1·1	2	1·5	4	1·2	11	1·2	4⅔	1·1	10	1·4	82+	1·4	56	1·6
N.E. "	3	1·0	2⅔	1·0	1⅔	1·0	1	1·7	⅓	2·0	0	0·0	⅓	1·0	0	0·0	⅓	1·0	3	1·4	1⅓	1·2	3	1·3	16+	1·0	15	1·0
E. "	2⅓	1 0	2	1·7	1⅓	2·1	⅓	2·0	⅔	1·5	0	0 0	0	0·0	0	0·0	⅓	2·0	1	1·0	2⅓	1·2	1+	1·5	12	1·2	12⅔	1·0
S.E. "	5⅔	2 1	4⅓	2·0	2⅓	2·0	1⅔	2·3	1⅔	1·2	⅓	1·0	⅔	1·5	2	1·5	5	1·7	2⅓	1·2	7	2·1	5−	1·8	38+	1·7	67⅓	1·8
S. "	3	1·7	4	2·1	5⅔	2·3	6⅓	2·2	9⅔	2·4	12⅓	2 2	12	1·6	11⅓	1·7	6⅓	1·7	1⅔	1·7	7⅔	2·0	6	2 0	86	2·0	68⅔	2·1
S.W. "	0	0 0	⅔	2·0	2	1·9	2	1·8	3⅓	1·7	8	2 0	8	1·4	6⅔	1 5	4⅓	1·6	2⅓	1·7	1⅓	1·3	+	2·0	39−	1·6	56⅔	1·8
W. "	⅓	1 0	1⅓	1·3	2⅔	2·1	4	1·8	5⅔	1·9	5⅓	1·3	6	1·4	6⅓	1·8	5⅔	1·7	1⅓	1·8	1⅔	1·7	1+	2·4	42	1·6	21	1·3
N.W. "	2	2 1	5	2·3	4⅓	1·6	6	2·2	5⅓	2·2	1⅔	1·1	2	1·3	2⅔	1·5	4	1·2	8⅓	1·7	4	1·6	2−	1·5	47+	1·7	67⅔	1·7

IV. MISCELLANEOUS SCIENTIFIC INTELLIGENCE.

1. *Letter from Prof.* AUG. DE LA RIVE *respecting the paper of Mr. B. V. Marsh, on the Aurora, viewed as an electric discharge.* "Monsieur Silliman, Editor of the American Journal of Science and Arts:—*Sir:* No. 93 (May, 1861) of your Journal contains an article by Mr. B. V. MARSH, upon "*the Aurora viewed as an Electric Discharge between the magnetic poles of the Earth, &c.*" The author's ideas on the origin of the Aurora Borealis approach so closely to those which I put forth more than twelve years ago on this subject, that I fear my researches are unknown in America, although Mr. Marsh makes an indirect allusion to them in a note. Permit me then to recall to you in few words my claims to priority respecting the explanation of the phenomena of the Aurora Borealis.

I developed the theory of the Aurora Borealis for the first time in a letter to Arago in 1849 which was published in the *Annales de Chimie et de Physique.** On the same occasion I addressed a letter to Regnault inserted in *Comptes Rendus de l'Acad. des Sci. de Paris*,† in which to support my theory, I cite an experiment I had devised which showed the influence of a powerful magnet upon electrical discharges passing through a highly rarefied gaseous medium.

Later, in the third volume of my Treatise on Electricity,‡ published early in 1858, (by Longmans, London,) I have given a description and complete theory of the Aurora Borealis such as is now generally accepted.

The magnificent Aurora Borealis of 29th of Aug. 1859 went to confirm even in its minuter details the explanation which I have given of this phenomenon. This I have stated in a letter addressed to De Senarmont which appeared in *Comptes Rendus* (T. xlix, p. 424.) and which was followed by a second in the same volume, p. 662. I have also in the *Arch. des Sc. Phys. de la Bib. Univ. de Genève*, Sept. 1859, a detailed notice on the same subject, and finally I sum up in an article more general and extended, and published in the new series of the *Bibliothèque Universelle*, (Nov. 1859) my whole theory of the Aurora Borealis, supporting it by observations and experiments fitted to demonstrate its truth.

In these later publications I insist more particularly upon observations made during the occurrence of the Aurora, either in magnetic observatories or in telegraphic offices, as alike demonstrating the existence of currents of electricity directed from north to south in our hemisphere beneath and very near the surface of the earth. These currents in their discharge acting in the polar regions between the positive electricity of the atmosphere and the negative of the earth must, as I then said, (*C. R. de la Acad. des Sc.*, T. xlix, p. 665,) exist permanently but only with variable intensity according to the season of the year and the state of the atmosphere. When owing to favoring circumstances this intensity is considerable, the discharges are accompanied by the light, which in rendering them visible, constitutes the Aurora Borealis. I rest these considerations upon the frequent appearance of the Aurora Borealis, which is almost daily, in the polar region. As appears from the observations of Messrs. Lottin and Bravais, during their residence in Bossekop, and of

* Tome xxv, p. 310. "Sur les variations diurnes de L'Aiguille Aimantée et les Aurores Boréales." † Tome xxix, p. 412. ‡ Vol. III, p. 283.

those collected by Prof. Henry at the *Smithsonian Institution*, on the appearance of the Aurora in the Northern United States and in Canada.*

Quite lately a distinguished astronomer, Lamont of Munich, has demonstrated by direct observation the constant existence of electric currents flowing on the earth's surface from north to south in our hemisphere, so that what has been before a very probable conjecture is become an incontrovertible fact.† He has also established the existence of electric currents circulating from east to west over the surface of the earth. But these currents (the origin of which has no relation to that of the first named,) have nothing to do with the phenomena of the Aurora Borealis: their essential effect is to give to the magnetic needle its normal direction, although the others, (east and west currents) being much more variable in their intensity, only tend more or less to modify this direction.

In substance, I believe I was the first to demonstrate that the phenomena of the Aurora Borealis are the result of the combined action of terrestrial magnetism and the discharges which take place between the positive electricity of the atmosphere and the negative of the earth, and I consider it proved that even in the smallest detail of form, of appearance and the accompanying phenomena, the known laws of electricity suffice to give a perfectly satisfactory explanation.

Accept, sir, &c., Aug. de la Rive.

Geneva, Oct. 15th, 1861."

We take pleasure in placing Prof. De la Rive's letter before the reader of this Journal, especially as it gives us an opportunity of disclaiming any intention on our part of doing the slightest injustice to the world-wide reputation of the distinguished Genevan Professor. The splendid phenomena of the memorable Aurora of 1859 gave occasion to apply anew the well known views of Faraday,‡ Hansteen, De la Rive and others, on the electrical character of the Aurora to the more complete elucidation of this interesting phenomenon. It certainly is to Prof. De la Rive that we owe the beautiful experimental illustration which bears his name, by means of which the action of magnetism on the electric light is demonstrated, and the existence of a luminous ring concentric with the boreal magnetic pole cutting at right angles all the magnetic meridians that converge towards that pole, had been proved by the observations of Hansteen. No doubt it would have been well if definite reference had been made to these points in which Mr. Marsh's results coincided, although without his having been at the time aware of the fact, with those before announced. But in publishing his paper we did not think it necessary to give a résumé of well known opinions on the subject under discussion. It was sufficient to authorize its publication that Mr. M. had collected data from which he had determined approximately the height not only of the arch but also of some of the streamers in the display of August 28, 1859,§ and with

* Prof. De la Rive evidently refers here to observations earlier than those of 1859. It will be remembered that one of the eight articles on that display which have appeared in this Journal from the pen of Prof. Loomis, viz. the 6th (in vol. xxx, p. 339) was made up of observations collected by the Smithsonian Institution.

† *Arch. des Sci. Phys. Bibl. Univ.* Sept. 1861.

‡ So far as we know, Faraday made the first definite suggestion resting on experimental data, that the Aurora might be due to the discharge of electricity. Expl. Researches, p. 56, § 192. January, 1832.

§ See Journal of the Franklin Institute, Philad., Nov., 1859.

this advantage, having at his disposal the vast mass of new data collected in the pages of this Journal,* together with the results of the recent electrical investigations of Plücker and Gassiot, he had from their consideration been able to evolve an explanation of the phenomena of the Aurora different in important respects from any that had before been offered. But there was certainly no intention on the part of any one to deprive Prof. De la Rive of the distinction of having been the first to discuss in a philosophical and detailed manner the electrical relations of the Aurora Borealis, as well in his Treatise on Electricity as in separate memoirs.

BOOK NOTICES.—

2. *Report of the Secretary of War, communicating, in compliance with a resolution of the Senate, Lieut. Michler's Report of his survey for an inter-oceanic ship canal near the Isthmus of Darien.* pp. 457, 8vo, with 17 maps.—The first 147 pages are devoted to the Journal, and the geographical and climatological papers, by Lieut. Michler, and they seem to have been arranged in a clear and systematic manner. We call attention with pleasure to the important and valuable information they contain.

Chapter VII contains Mr. Arthur Schott's report on the physiography of the Isthmus of Choco, 21 pages.

Appendix A. Remarks on the geognostic structure of the country, with accompanying descriptive table of geological specimens; by Arthur Schott, 5 pages.

Appendix B. Botany—Algæ, by Prof. W. H. Harvey, with notes by Arthur Schott—4 pages.

Appendix C. Filices and Lycopodiacæ, by Daniel C. Eaton, with notes by Arthur Schott. Two new species, *Lindsœa* (*Dietyoxephium*) *Michleriana*, *Aspidium Draconopterum*, pages 11.

Appendix D. Botanical notes, pages 21.

Appendix E. Zoology—Mammalia, by Arthur Schott, pages 7.

Appendix F. Birds, by John Cassin, pages 35. 1 new genus, *Pittasoma* and 5 new species of birds are described :—*Monasa pallescens*, *Celeus mentalis*, *Orthogonis olivaceus*, *Pittasoma Michleri*, *Dendroiea Vieillatii.*

Appendix G. Reptiles and Amphibia; notes by Arthur Schott, pp. 2.

Appendix H. Fishes, by Theodore Gill, pages 3.

Appendix I. Invertebrata, pages 9.

The remainder of the report comprising 189 pages is devoted to the compilation of the results of the Geodetic Survey.

This report is certainly a valuable contribution to our knowledge of an interesting region, but the Natural History portion is sadly disfigured by numerous and gross typographical errors. Most of the scientific names are not familiar to proof-readers and in all cases the printers should submit the proof sheets to the respective authors, or some good naturalist, for correction. We regret that so few copies of this report have been published, as many persons to whom it would be useful must fail to obtain it. We hope to refer to it again more in detail at some future time.

3. *Annual Report of the Board of Regents of the Smithsonian Institution, for the year* 1860.—The "General Appendix" contains the following articles:—"Lectures on Roads and Bridges," by Prof. F. Rogers; on "Mollusca, or Shell-fish and their Allies," by Dr. P. P. Carpenter; a translation of "General views on Archæology," (illustrated,) by A. Morlot; and several other translations and extracts from European journals; also a note "On the disappearance of ice," by R. H. Gardiner; on "Differ-

* Vol. xxviii, 386; xxix, 92, 249, 386; xxx, 79, 339; xxxii, 71, 318.

ence of temperature in different parts of the city of St. Louis," by A. Fendler; on the "Best Hours for observations of Temperature," by Prof. C. Dewey; "On the Anemometer," (illustrated,) by Prof. Henry; "Suggestions for saving parts of the skeleton of Birds," (illustrated,) by Alfred Newton; "On the Wingless Grasshopper of Shasta and Fall River Valleys, California," (illustrated,) by Edward P. Vollum, M.D.; "Letter relative to the obtaining of specimens of Flamingoes and other birds from South Florida," by the late G. Wurdemann; "On the habits of the Pouched Rat (*Geomys pineti*) of Georgia," by W. Gesner, M.D.; and a "Catalogue of the Birds of Chester Co., Penn., with their times of arrival in Spring," by Vincent Barnard.

The longest of these articles is that on "Mollusca, or Shell-fish and their allies," (pp. 132,) which deserves more than a passing notice. Dr. Carpenter gives us, in a concise but very readable form, an account of the nature and habits of molluscous animals, and of their classification, down to the families;—being the substance of a course of lectures delivered by him at the Smithsonian Institution during his visit to this country in 1859–60. The subject is presented in a style quite new and interesting, which cannot fail to attract general readers. We observe the frequent occurrence of touches of quaint humor which are very refreshing amid scientific details, and remind us of those passages which contributed so much to render popular the writings of the lamented Edward Forbes. There are no technical descriptions and scarce any lists or tables to mar this style, but most of the genera are mentioned by name, and their differences pointed out. As an introduction to the science of Malacology the work cannot fail to prove exceedingly valuable.

The translation of Morlot's paper on Archæology will well repay the cost of perusal by those who have not read it in the original. The discoveries of the Danish archæologists in their "Kjoekkenmoedding" and other superficial deposits, and the discrimination of three pre-historic ages, that of Stone, Bronze, and Iron, form a well marked era in the science. We may now no longer depend upon semi-fabulous histories or obscure traditions for our knowledge of the early characteristics and distribution of man on the earth, but may study him in the remains of himself and his works, with the same certain results which attend geological investigations. Archæology in fact is but a branch of geology.* In connection with Morlot's paper several more recent works may be read with interest. Such are:

Habitations lacustres des temps Anciennes et Modernes, par F. Troyon, Lusanne, 1860.

On the Crania of the most ancient races of men; by Prof. D. Schaffhausen of Bonn. Translated, with remarks and original figures, by Geo. Busk. Nat. Hist. Review, April, 1861.

The Kjökkenmöddings: recent Geologico-Archæological Researches in Denmark; by John Lubbock, Esq., F.R.S. Nat. Hist. Review, Oct., 1861.

The discovery of implements of human workmanship in the gravel beds of Amiens, beneath a series of strata which must have required many centuries for formation, and associated with remains of extinct

* For a paper by Morlot on the same subject see this Journal, [2], xxix, 25.

mammals, distinguishes a period even earlier than the Stone Age of the Danish savans, and points to a much greater antiquity in the appearance of man upon the geological stage than has been hitherto supposed. The most ancient skulls (those found in the caverns) of which we have any knowledge, are of a very low type in the sharpness of their facial angle and in the prominence of the superciliary ridge, showing an approach to that of the higher Quadrumana. The great impulse now given to these investigations must tend to further discoveries, which cannot fail to enlighten us much in regard to the origin of the human races, now so obscure. We may ascertain whether any intermediate types have been created, and if so, what has been the range of their development,—matters about which we can now only speculate. To those who object to such speculations we may observe that, in a religious point of view, it matters little by what method the Creator made physical man, when we know that his creation as a spiritual and accountable being dates with the time when He "breathed into his nostrils the breath of life, and man *became* a living soul." W. S.

5. *On the Ornithology of Labrador;* by ELLIOTT COUES. pp. 215–257.—Mr. Coues visited the coast of Labrador in the summer of 1860, under the auspices of the Smithsonian Institution. He gives us a list of the birds observed by him there, with much interesting information concerning them. Very full accounts are given of the habits of water-birds, particularly of *Ulamania torda* (Razor-billed Auk), and *Mormon arcticus* (Puffin), which the author had abundant opportunity of observing. Of *Mormon arcticus* he says, "I observed not the slightest indication of any sympathy for those wounded or killed, on the part of the other birds, as stated by Audubon." The case is different however with an allied species (*M. corniculatus*) observed by the author of this notice in Behring's Straits. Upon one of these birds being shot, the others gathered around it as it floated upon the water, anxiously pecking at it and tearing at the wounds, so intently indeed that they were not driven away by repeated discharges of the fowling piece at a short distance. Whether this was sympathy or not we could not determine,—in appearance it was rather a furious attack. The paper is chiefly valuable for its important additions to our knowledge of the geographical distribution of North American birds. *Turdus aliciae* was found breeding in abundance;—it was formerly known only in the Mississippi and Missouri regions. *Saxicola œnanthe* is carefully compared with the European bird, and found to be identical. A new species (*Aegiothus fuscescens* Coues.) was discovered;—a rare occurrence in Eastern North America at this late day.—*Proceedings of the Philadelphia Acad. Nat. Sci.*, 1861. W. S.

6. *Post-pliocene Fossils of South Carolina;* by FRANCIS S. HOLMES, A.M., Professor of Geology and Palæontology in the College of Charleston, South Carolina, etc. 4to. Russell & Jones, Charleston, S. C., 1860. —This important work, the commencement of which has already been noticed in this Journal, ([2] xxix, 228) was completed more than a year ago. The part relating to the Vertebrate Fossils has been already reviewed, and received the commendation which it deserves. We now propose to discuss the Invertebrata only. The formation named in the title is more extensively developed in South Carolina than in any other state in the Union, and we may congratulate geologists upon the possession of a work illustra-

ting its fossils, by an author who has had such good opportunities for their study, and who could furnish such excellent plates. The figures, as a rule, are exceedingly well executed, and we therefore may excuse an occasional failure, (as in those of *Axinæa charlestonensis*, *Chama arcinella*, and *Liocardium Mortoni*, which are "blots,") in view of the general excellence of the work. It would have been better to have magnified the smaller bivalves. The work is equally valuable to students of recent conchology, as several existing species are here for the first time figured. The *descriptions* are, for the most part, extracted from the works of previous authors. The generic nomenclature of the shells is chiefly that of H. and A. Adams, excepting where those authors have not mentioned the particular species in their work. Thus such "genera" as *Peronæoderma* and *Angulus* are adopted, while *Strigilla flexuosa* and *Macoma cayennensis* are placed in *Tellina*. In fact we must protest against some of the nomenclature used by Prof. Holmes, although, as a very full synonymy is given, we can easily select more appropriate names. It is somewhat startling, for instance, to see our common sea-urchin, *Echinocidaris punctulatus*, figured and described as "*Anaperus carolinus* Trosch." Now the *Anaperus carolinus* is a "biche-le-mar,"—the *Holothuria briareus* of Le Sueur,—the soft body of which is not exactly adapted for preservation in post-pliocene sands. "*Schizaster atropos*" is *S. lachesis* Grd. "*Guia punctata*" should be *Persephona p.* We have the *Ostrea fundata* of Say (MSS.) now for the first time described and figured; it is a good species and must be credited to Prof. Holmes. "*Nucula acuta*" is a *Leda*. "*Leda limatula*" is a *Yoldia*. "*Cardium Mortoni*" is a *Liocardium*. "*Lucina Kiawahensis* n. sp." is not a *Lucina*; it looks more like *Diplodonta* or a Venerid. "*Dosinia concentrica*" is *D. discus* Reeve. "*Tapes grus* n. sp." is *Chione pygmæa*. "*Mya simplex* n. sp." is probably *Paramya subovata* Con., which is both Miocene and recent. "*Saxicava fragilis* n. sp." is probably a worn valve of *Solenomya velum*. "*Fusus minor* n. sp." appears to be a young shell, perhaps *Columbella avara* or *similis*. "*Fusus conus* n. sp." is a tip of *Columbella translirata* Rav. "*F. filiformis* n. sp." is the tip of a *Mangelia* common on the coast. "*Fusus bullata* (!) n. sp." is a young *Nassa*, probably *N. trivittata*. "*F. rudis* n. sp." is a tip of *Mangelia rubella* K. and S. A little *tipical* knowledge is quite necessary to an investigator of fossil shells. "*Volva acicularis*" is *V. intermedia* Sow. Prof. Holmes quotes Gould for *Natica pusilla*, but Gould's shell is quite different from Say's, and is the *Lunatia grœnlandica* of Beck. "*Adeorbis nautiliformis* n. sp." is *Cochliolepis parasitica* Stm., while the shell figured as *Cochliolepis* is a *Vitrinella*.

It is important to make these corrections, as they seriously affect the percentage of extinct species found in our Post-pliocene deposits. The following species described as new seem to be really so, as far as we can judge from the figures.

Montacuta Bowmani,
Mulinia Milesii,
Mesodesma concentrica,
*Abra angulata,
Volutomitra wandoensis,
Turbonilla cancellata,
quinquestriata,
Turbonilla lineata,
subulata,
caroliniana,
acicula,
subcoronata,
*Obeliscus crenulatus,
Architectonica gemma.

Those marked by an asterisk, as well as more than half the *Turbonillæ*, are also found living on the coast. Prof. Holmes gives much valuable information as to the distribution of our shells, both in a recent and fossil state. The climate of the Post-pliocene period could have differed very little from that now prevailing in South Carolina. W. S.

6. *Descriptions of new Cretaceous Fossils from Texas;* by B. F. SHUMARD, M.D. (From the Proc. Bost. Soc. Nat. Hist., September 4th, 1861, page 16).—The fossils described in this paper are chiefly from the counties of Lamar and Navarro. Those from Lamar county are from Dr. Shumard's Red river group (see his Section, Trans. Acad. Sci. St. Louis, vol. i, p. 583), and correspond to Cretaceous formation No. 1, or Dacotah group of Meek and Hayden's Nebraska Section (= Jurassic, and probably Triassic in part, of Marcou). The fossils mentioned were mostly collected from the bluffs bordering Red river, and those from Navarro county came from an interesting series of beds not hitherto recognized in Texas. Most of them were obtained from Septariæ, imbedded in blue and gray arenaceous clays. More than fifty species of fossils have been found in these strata, a large proportion of them new to science, and now for the first time described. Others correspond with species described by Mr. Conrad from the Ripley Group [No. 5 or Fox Hills Beds—Nebraska Section, probably] of Tippah county, Mississippi and Eupaula, Alabama. The following species were recognized common to the Tippah and Navarro beds: *Nautilus Dekayi*, *Baculites Tippaensis*, *B. Spillmani*, *Purpura cancellaria*, *Rapa supraplicata*, *Strombus densatus*, *Ficus subdensatus*, *Pleurotoma Ripleyana*, *Pholodomya Tippana*, *P. elegantula*, *Cardium Spillmani*, *Legumen elliptica*, *Silliquaria biplicata*, *Pecten simplicius*, *P. Burlingtonensis* and *Exogyra costata*." From the facts before us, we are inclined to think that the beds, from which the fossils, named above, were obtained, corresponded with No. 5 of the Nebraska Section. The following new species of fossils are described in this paper: *Scaphites verrucosus*, *Ptychoceras Texanus*, *Helicoceras Navarroensis*, *Turrilites splendidus*, *T. helicinus*, *Volutilithes Navarroensis*, *Ringicula pulchella*, *R. subpellucida*, *R. acutispira*, *Solidula Riddelli*, *Tornatella Texana*, *Cylichna striatella*, *C. secalina*, *C. minuscula*, *Scalaria Forsheyi*, *S.* (*scala*) *Lamarensis*, *S.* (*scala*) *bicarinifera*, *Ficus* (*Pyrifusus*) *granosus*, *Turritella Corsicana*, *T. Winchelli*, *Pleurotoma Texana*, *Pleurotomaria Austinensis*, *Anisomyon Haydeni*, *Scalpellum inæquiplicatum*, *Pholadomya Lincecumi*, *Panopæa subplicata*, *Ostrea Owenana*, *O. Lyoni*, *O. planovata*, *Crassatella lineata*, *C.? parvula*, *Cucullæa millestriata*, *Nucula bellastriata*, *Neæra alæformis*, *Avicula iridescens*, *Cyprina Laphami*, *Lucina parvilineata*. *Anatina sulcatina*.

The palæontological papers of Dr. Shumard always bear the stamp of careful and conscientious preparation, and their publication is hailed with pleasure. We are certain that scientific men, not only in this country, but in Europe, will ever regret that the survey of Texas, so ably inaugurated by Dr. Shumard could not have been completed under the same auspices.

7. *Lectures on the Science of Language, delivered at the Royal Institution of Great Britain, in April, May and June*, 1861. By MAX MÜLLER, M.A., Fellow of All Souls' College, Oxford: corresponding member of the Imperial Institute of France. London—Longman, Green, Longman

& Roberts, 1861.—The Lectures which this volume contains are an abstract of several courses delivered by Mr. Müller, from time to time, in Oxford. They are now presented to the public in the form in which they were prepared in MS. for delivery before the Royal Institution of Great Britain. They are an interesting contribution to the science of language, and it is with pleasure that we notice their publication.

In these lectures Mr. Müller has brought out of his treasure things new and things old. The advanced student of comparative philology will doubtless find in these pages much with which he is familiar, but he will not fail to appreciate the clearness with which the subjects are treated. To the general reader also this book will be attractive. There is no thick layer of the "dust of the schools" upon it. Indeed, there is a vivacity in the author's style which places the work within the class of the *readable*. Mr. Müller seems to combine the depths of German research with much of the happy talent of exposition eminently characteristic of French authors. This is no slight merit—especially in a writer upon the science of language. The science itself is of modern date. Indeed, as Mr. Müller observes, its very name is as yet unsettled. Those who have penetrated into the recesses of some newly discovered temple and have learnt where to seek for its long hidden treasure, are entitled to a double meed of praise, when they succeed in attracting attention to their discoveries by a felicitous description of them.

In his first lecture, Mr. Müller very happily states the claims of this modern science, which is so much indebted to Wilhelm von Humboldt, Bopp, Grimm, and others of this century.

"The problem" says Mr. M. "of the position of man on the threshold between the world of matter and spirit, has of late assumed a very marked prominence, among the problems of the physical and mental sciences. It has absorbed the thoughts of men who after a long life spent in collecting, observing and analyzing, have brought to its solution qualifications unrivalled in any previous age; and if we may judge from the greater warmth displayed in discussions ordinarily conducted with the calmness of judges, and not with the passion of pleaders, it might seem after all as if the great problem of our being, of the true nobility of our blood, of our descent from heaven on earth, though unconnected with anything that is commonly called practical, have still retained a charm of their own—a charm that will never lose its power on the mind and on the heart of man.

"Now however much the frontiers of the animal kingdom have been pushed forward, so that at one time the line of demarcation between animal and man seemed to depend on a mere fold in the brain, there is *one* barrier which no one has yet ventured to touch—the barrier of language. If therefore, the science of language gives us an insight into that which, by common consent, distinguishes man from all other living beings; if it establishes a frontier between man and the brute, which can never be removed, it would seem to possess at the present moment peculiar claims on the attention of all who, while watching with sincere admiration the progress of comparative physiology, yet consider it their duty to enter their manly protest against a revival of the shallow theories of Lord Monboddo."

Perhaps this passage does not appear inopportunely in view of some speculations that have been suggested by the recent work of Du Chaillu —descriptions of the Gorilla! Mr. Müller adds, as we believe correctly, that, "language, the living and speaking witness of history, was never cross-examined by the student of history, was never made to disclose its secrets until questioned and so to say brought back to itself by the genius of a Humboldt, Bopp, Grimm, Bunsen and others," and "if you consider that whatever view we take of the origin of language nothing new has ever been added to the substance of language, that all its changes have been changes of form, that no new root has ever been invented by later generations, as little as one single element has been added to the material world in which we live, and that in one sense, and in a very just sense, we may be said to handle the very words which issued from the mouth of the Son of God, when he gave names to all cattle and to the fowls of the air, and to every beast of the field, you will see that the science of language has claims on your attention, such as few sciences can rival or excel."

According to Mr. Müller every science has three marked stages; the empirical—the classificatory—and the theoretical. These three stages have suggested the principal division of Mr. Müller's book. The second of these he divides again into the genealogical and morphological classification of languages. Under these latter heads he considers the constituent elements of language, and passes in review, so far as practicable in lectures of this nature, the different classes of roots which he divides into the *predicative* and the *demonstrative*. Mr. Müller's remarks upon the root AR the source of the word Aryan, which he traces "in its wanderings from language to language" (page 239, and post) afford an illustration of his acumen. Our author examines also several of the roots in the three great families of languages—the Aryan, the Semitic and the Turanic languages, and he has added to his work genealogical tables of these three groups, dividing the latter into the northern and southern divisions of the Turanic. In these tables the living and the dead languages are specified.

Mr. Müller asserts the generally received view—that the whole framework of grammar had become settled before the separation of the Aryan family, and thus the broad outlines of grammar are the same in Sanskrit, Greek, Latin, and Gothic, and that it is purely to phonetic corruption, that must be attributed apparent differences. Hence the history of all the Aryan languages is a progress of decay. Mr. Müller's familiarity with the science of language at its present stage of development entitle his views upon the "common origin of language" to a brief notice.

Mr. M. very properly contends that the problem of the common origin of languages has no necessary connection with the problem of the common origin of the *races*. The two questions are independent of each other. Mr. Müller divides the problem of the origin of language into two parts, the *formal* and the *material*, and insists that the three distinct forms, the *radical*, the *terminational*, and the *inflectional*, can be reconciled with "the admission of the common origin of human speech." He admits however that the question is still an open one. In view of the light, as yet thrown upon it, he thinks the problem may be thus properly stated—"If you wish to assert that language had various beginnings you must prove it IMPOSSIBLE that language could have had a common origin." Without admitting the soundness of all the conclusions to which the historico-analytical school of some eminent German philologists have arrived, it is surely not going too far to say that no such *impossibility* has ever yet been established with respect to the Aryan and Semitic languages—and this is a great point in favor of the advocates of the common origin of language. We do not understand Mr. Müller however as going any farther on this question than the above statement of the problem which we have given in his own words. To leave the question in this position is, we think, to leave it at the point to which science has brought it. Any statement beyond this, in favor of the common origin of language, we believe, rather partakes of exaggeration. The further solution of the problem, belongs to the future of the still *young* "science of language."

Mr. Müller's review of Adam Smith's and Leibnitz's opposite views, as to the formation of thought and language, is written from an impartial and philosophical point of view. Indeed the whole work gives evidence of a true spirit of inquiry. Frequent reference is made by Mr. Müller to the writings of other investigators, and a well merited tribute paid to Mr. Marsh's first volume of lectures upon the English language. We fully agree with him in thinking "that if inductive reasoning is worth anything, we are justified in believing that what has been proved to be true on a large scale, and in cases where it was least expected, is true with regard to language," and "that the science of language leads up to that highest summit from whence we see into the very dawn of man's life; and where the words which we have heard so often from the days of our childhood, 'And the whole earth was of one language and of one speech,' assume a meaning more natural, more intelligible, more convincing than they ever had before."

8. *A Manual of Elementary Geometrical Drawing, involving Three Dimensions.* Designed for use in High Schools, Academies, Engineering Schools, &c., and for the Self-instruction of Inventors, Artisans, &c.; by S. EDWARD WARREN, C.E., Professor of Descriptive Geometry and Geometrical Drawing in the Rensselaer Polytechnic Institute. 12mo. John Wiley, New York.—We are glad to perceive that our teachers and artisans are beginning to recognize the importance of the study and practice of geometrical drawing, and we trust that it will at no distant day hold a prominent place in the courses of study of all our educational institutions. The present elementary work is a valuable contribution toward this desirable end. It is sufficiently comprehensive in its scope for the purposes for which it is designed; and is at the same time minute in its detailed explanations and directions. The subject is treated of under the several heads of—Elementary Projections—Details of Construction in Masonry, Wood and Metal—Rudimentary Exercises in Shades and Shadows—Isometrical Drawing—and Elementary Structural Drawing. While the general plan is scientific without being unnecessarily complex, the special topics are discussed in a simple and lucid manner. It may be mentioned, as an additional recommendation of the work, that valuable rudimentary instruction is incidentally conveyed in it, in the arts of construction.

9. *New Theorems, Tables, and Diagrams, for the Computation of Earth-work;* by JOHN WARNER, A.M., Mining and Mechanical Engineer; Author of Studies in Organic Morphology. 8vo. J. B. Lippincott & Co., Philadelphia.—The author of this elaborate work, in presenting to the public his new theorems, &c., has at the same time furnished students of engineering, and practical engineers, with a systematic treatise on the computation of earth-work. It is divided into two parts. In Part I, styled "A Practical Treatise," the processes of computation, for the various cases that may occur, are minutely detailed and exemplified. A general scheme of all the possible varieties of work, in excavation or embankment, is set forth, and illustrated by an admirable set of lithographic plates, "taken from models made expressly for the purpose."

Two general methods of computation are given; "by Transverse Ground-Slopes," and by "Centre and Side Heights." The computations are greatly facilitated by the use of a new set of tables constructed by the author. Scales are also furnished, to expedite calculations for approximate determinations. The rules and tables are derived from formulæ investigated by the author in Part II. The hyperbolic paraboloid is adopted as the form of ground-surface between two cross-sections of the ground to be excavated or embanked. The new formulæ, investigated upon this hypothesis, are shown to be equivalent to the Prismoidal formula, which Professor Gillespie has proved to hold good in this form of ground-surface.

Where the cross-section of the ground is level, the extended tables of McNeil and others, afford much the readiest means of determining the content of earth-work; provided the assumed width of road-bed and side-slopes are to be found in the tables. But in all cases of irregular cutting or filling, the methods and tables of the present work will materially facilitate the computations. Still it must be admitted that there is an air of complexity about the detail of the preparation of the elements to be used in the calculations, that may restrain many engineers from adopting these new methods. We are disposed to think that if an outline of the author's theory had been presented at the outset, his processes of calculation would be more readily apprehended and more easily retained and applied. A distinct theoretical conception frees one, in a considerable degree, from the necessity of burthening the memory with formal rules, and ensures greater certainty in computations.

PROC. BOSTON SOC. NAT. HIST. (continued from p. 160, vol. xxxii) 1861. Vol. viii. —SEPTEMBER.—162, New species of Microscopical Organisms, chiefly from the River Para; *Loring W. Bailey*, Cambridge, Mass.—169, Ores of Gold and Silver from Sierra Nevada, Pike's Peak and Sonora; *A. A. Hayes.*—171, Native Copper, pseudomorph of? *F. Alger.*—172, On the occurrence of Silver and Gold in the Rocky Mountains and California; *J. Marcou.*—173, Note concerning the Cocoanut Pearl; *John Bacon.*—178, Notice of some North American species of Pieris; *Samuel H. Scudder.*—185, A catalogue of the Koninck library; presented by *Prof. Agassiz.*—188, Descriptions of new Cretaceous Fossils from Texas; *B. F. Shumard.* —OCTOBER.—206, Siliceous Urinary Calculi; *John Bacon.*—NOVEMBER.—212, Catalogue of the Minerals containing Cerium; *Wm. Sharswood*—217, Presentation of Bones of Gorilla from West Equatorial Africa; *Dr. J. H. Otis.*—219, Notice of the genus Selandria; *Edward Norton.*—223, Descriptions of several of Harris's named Tenthredinidæ; *Edward Norton.*

THE

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[SECOND SERIES.]

ART. XXVIII.—*Some Remarks in regard to the Period of Elevation of those ranges of the Rocky Mountains, near the sources of the Missouri River and its Tributaries;* by Dr. F. V. HAYDEN.*

[Abstracted from Capt. WM. F. RAYNOLD's forthcoming Report and published by permission of the War Department.]

THE object of the present article, is to show, as nearly as can be done from known geological data, the period of the elevation of a portion of the Rocky Mountains. My observations have been more especially confined to the ranges from which the Missouri and Yellow Stone Rivers, with their numerous tributaries take their rise, though I feel confident that principles which will apply to mountains occupying so large an area will also be applicable to the whole Rocky Mountain district. It will be impossible, at this time, to mention in detail all the facts in support of my statements, and therefore I shall assume that the reader has examined the previous papers of my associate, Mr. Meek, and myself. During the coming year I hope to prepare a series of articles for this Journal which will have a more or less direct bearing on the physical geography of this region and the influ-

* For most important information I would direct attention to Second Series of this Journal, Articles xiii, xxxix, vol. iii, 1847, Art. xxxiv, vol. xii, 1849, and Arts. xxiv, xxv, vol. xxii, 1856, by Prof. J. D. Dana, in which, it seems to me, will be found the most profound, far-reaching generalizations in regard to the physical geography and geology of the West and other portions of our country, which have ever been given to the public. The origin and character of those subterranean forces which have produced such important results in the West are fully discussed in those papers.

ences which gave to it, its present configuration. Some erroneous statements, growing out of our limited knowledge of the structure of these mountain chains, may be made, but these when known, will be corrected. Geology is a progressive science and even our best efforts are but approximations to truth rather than the truth itself.

The evidence seems to me to be clear that the great subterranean forces that elevated the western portion of our continent were called into operation toward the close of the Cretaceous epoch, and that the gradual quiet rising continued, without a general bursting of the earth's crust until after the accumulation of the Tertiary lignite deposits or at least the greater part of them; also that after the fracture of the surface commenced and those great crust movements began to display themselves, the whole country continued rising, or at least, though there may have been periods of subsidence or repose, there was a general upward tendency which has continued even up to our present period. I hope hereafter to illustrate the correctness of these statements by all the facts that have been obtained in my past explorations as well as by those I may secure in the future.

Let us, in the first place, examine some of the barometrical profiles across the country from the Mississippi river to the Pacific coast, constructed under the direction of the War Department. Previously, however, to this examination we may make the statement that west of long. 98° the surface of the country may be separated into two divisions, mountain and plain, and that a combination of the two compose the Rocky Mountain district. After leaving the Mississippi the intervening country westward to the upheaved ridges is an apparently level or undulating plain, with no disturbance of the strata of the underlying formations until we come in close proximity to some of the mountain elevations. Reaching the base of the elevated ridges which form the mountain crests, we at once commence a rugged and abrupt ascent.

If we look at the profile constructed by Gov. Stevens, from St. Paul, Minnesota, lat. 44° 58′ and lon. 92° 58′ to the Pacific coast we shall find that the starting point is 828 feet above the ocean level. Near Fort Union, at the junction of the waters of the Yellow Stone and Missouri, 670 miles westward, the height above the ocean level has increased to 2010 feet, or 1182 feet higher than St. Paul. We thus see that the average ascent of the country between these two points is not quite two feet to the mile. From Fort Union to the Valley of Dearborn river, just under the base of the elevated ridges of the principal eastern range, we find the distance to be 448 miles and the height above the ocean 2081 feet greater than that at Fort Union, or the average rate of ascent increased to nearly five feet per mile. Over this vast extent of country, extends an almost limitless prairie, apparently level, with no forests or groves, with no timber except that which skirts the streams. There is in this great distance, a gradual increase in the inclination of the strata proportioned to the increase of the ascent, but no marked disturbance of the beds until we arrive in close proximity to the mountain elevations. There are a few local fractures of the earth's crust, caused by the elevation of the Bear's Paw, Little Rocky Mountain, &c., around which the sedimentary rocks are more or less disturbed, but all these lesser mountains are more or less remotely connected with the main chain. After passing the highest point of the principal range, along this line, which is near Cadotte's Pass, we commence our descent toward the Pacific very much as we ascended the eastern slope, but over a much more rugged route. We find a continued series of more or less parallel ridges of elevation until we approach the coast for a distance of from 400 to 600 miles. From Fort Walla Walla to the ocean however, the average descent is a little less than one foot to the mile.

Again, if we examine the profile constructed by Fremont, commencing at the mouth of the Kanzas river, we find that the initial point is 690 feet above the ocean. Proceeding westward, the average grade for the first three hundred miles is between four and five feet per mile. Thence to Fort Laramie the ascent, as stated by Fremont, is 8 feet to the mile, and from Fort Laramie to Hot Spring Gate although still passing over prairie country the average grade of ascent is given by the same explorer, as 45 feet per mile. Over this entire route, however, loaded wagons have been transported with ease. When we reach the foot of the mountains in this direction, the lofty elevated ridges seem to rise abruptly out of the prairie, averaging from one to six thousand feet in height above the surrounding country. From thence to the Pacific coast we pass over a continued series of elevations which taken in the aggregate seem to trend nearly northwest and southeast, but which when examined in detail, often present no definite direction or continuous line of fracture. This mountain region is composed of a series of these ridges forming a belt or zone, 400 to 800 miles in width from east to west, interspersed with beautiful valleys through which wind streams of clear water. So numerous are the profiles which have now been made across the continent by different explorers that it is hardly necessary to describe each one, since what we have already said indicates the object in view.

We have said that the western portion of our continent, especially if we look only at the easterly slope may very properly be divided into mountain and prairie. It is true that in Kansas and Iowa groves of timber of considerable size are seen, but they form rather the exception than the rule. Along the eastern slope there is a belt of country 300 to 600 miles in width, where, for the most part the only timber to be seen, is a thin fringe bordering the streams. Even in the eastern portion of the main range, the timber is not luxuriant, like that so common along the coast of Oregon and California. The pine trees are seldom more than three feet in diameter.

Again, we may divide the mountains or elevated ridges which form the different ranges into two kinds; viz., those with long extended lines of fracture, with a granitic nucleus and a comparatively regular outline, and those which appear to be composed of a series of cones or peaks more or less intimately connected, exceedingly irregular in their outline and of eruptive origin. Of the first class, the Black Hills, Big Horn, Laramie and Wind River mountains are good examples, while the Wahsatch, Green River, Jeton ranges and many others west of the dividing crest might be cited as illustrations of the second class. From all the information within our reach we have inferred that after passing the eastern slope the mountain ranges of eruptive origin are far the most numerous. We also know from personal observation that the main range of the Rocky mountains and the subordinate ridges on either side, near the head waters of the two principal branches, the Yellow Stone and Missouri, are of similar origin and present similar rugged features.

We may now return to the Cretaceous period. In a previous paper in this Journal,* we remarked that there were no indications in the geological formations of that portion of the West over which we have traversed of long continued deep water deposits, until we pass up into the Cretaceous epoch. The lower portion of No. 1, or the Dakota group, which ushered in the Cretaceous epoch in this portion of the West, is composed of coarse sand, pebbles, &c., with ripple marks, oblique laminæ, and with other indications of shallow water and change of currents. The same characters are seen throughout the formation wherever it is exhibited. We also know from the numerous impressions of leaves, and some beds of impure lignite, that dry land could not have been far distant. But as we pass up through Nos. 2, 3 and 4, whatever changes of land may have occurred in the meantime, we think there were periods at least when the sea was of considerable depth and suffered a quiet deposition to go on. We infer this from the fine and homogeneous character of the sediments. Throughout No. 4 we have a fine plastic clay which continues up into No. 5, when a gradual change takes place from the introduction of yellowish ferruginous matter, and a slow increase of sandy sediments. Toward the middle of No. 5, the sand begins to predominate until the upper part becomes a

* Vol. xxxi, March, 1861.

coarse, ferruginous sandstone, with all the indications of shallow water deposits. We know also, from fragments of wood and impressions of leaves which have been found quite widely distributed in the upper part of No. 5, that dry land could not have been far away. We also infer from the character of the Molluscan remains that the great Cretaceous sea which had so long spread its vast waters over this region was becoming shallow, and that a new epoch was approaching. As we arise in No. 4, and pass up into No. 5, there is an evident increase in the number of Gasteropoda indicating shoal waters. We have already remarked their peculiar Tertiary aspect, which seemed to point directly to that epoch, showing that it was not far distant. We may now ask the cause of this apparent approach to land, as foreshadowed by the lithological as well as the palæontological characters of the Upper Cretaceous formation No. 5. We think that the facts indicate that during the deposition of this formation the western portion of the continent was slowly rising above the ocean level, the waters on the one side receding toward the Pacific, and on the other toward the Atlantic, introducing the great Tertiary epoch which had already been foretold in the Cretaceous. At the commencement of the Tertiary period, throughout the central portions of the continent, lakes, estuaries, &c., more or less salt, at length becoming brackish, and finally fresh water, existed, and a new flora and fauna were introduced. The subterranean expansive power which was quietly lifting up the country still continued, although no bursting of the earth's crust had commenced. These brackish water deposits which appear to mark the dawn of the Tertiary period in the West, are distributed quite widely over the central portions of the Rocky mountain district and then by a general subsidence or a vast increase of fresh water, the true lignite deposits spread themselves over large areas and probably covered much of the country, now occupied by the mountain ranges and were doubtless more or less intimately connected with the Tertiary beds on the Pacific coast. What barriers separated them from the Tertiary formations along the Pacific—it is impossible from our present limited knowledge of the geology of the intermediate region, to determine.

We have remarked that the probable period of the bursting of the earth's crust which resulted in the formation of those abrupt mountain crests or ridges, occurred somewhere near the close of the accumulation of the true lignite deposits. We believe this for the following reasons. Whenever we observe the lignite beds in the vicinity of the mountain ranges we find them more or less inclined, in the same direction with the older fossiliferous rocks, though, as a general rule, dipping at a smaller angle, because more remote from the axis of the disturbing power.

Of course, as the land was slowly elevated toward the surface of the waters, the newer Tertiary beds would be subjected to the erosive action of water first, and thus continuing downward, as the mass was slowly rising, until the granitic nucleus was exposed. The Tertiary rocks, being composed for the most part of loose, yielding material, sands, clays and lignites, would be worn away from the surface for some distance from the axis of elevation. Although the lignite Tertiary beds are developed in full force all along the base of the larger ranges of mountains, it is not unlikely that some of these ridges formed barriers or lofty shores to these great Tertiary lakes. It would seem as if this country during the Tertiary period was not unlike the Undine region of the north, so called by the geographer Nicollet on account of the great number of fresh water lakes distributed over that district.

Near the Black Hills these beds are worn away from the immediate base of the mountains and it is doubtful from any proofs that we can now obtain whether the Tertiary lake extended over the country at that time occupied by the Black Hills. West of this range, the lignite Tertiary beds incline from the western slope 5 to 10 degrees. All along the Big Horn mountains, the same features, only more strongly marked, are seen. These beds often lie quite high upon the slopes of the mountains conforming to the Cretaceous rocks and sometimes inclining at a high angle. Between the western extremity of the Big Horn range and the Sweet Water mountains on the North Platte they are more disturbed than at any other locality. The lignite Tertiary strata are nearly vertical and the hard layers of sandstone or limestone extend in long projecting lines across the country, while the intermediate yielding beds of clay, sand, and lignite, are smoothed and leveled by atmospheric agencies and clothed with a thick turf of grass. All along the Laramie range, from the Red Buttes to Deer Creek, until the lignite beds are concealed by the White River group, the same features are seen, though the strata incline less, being more remote from the anticlinal crest. On both sides of the Wind River mountains the same phenomena occur, and other examples might be cited pointing to the same conclusions, but enough has been said to show that it is probable that the lignite Tertiary beds partook of the same movements that have elevated the older fossiliferous rocks. We therefore infer that the fracture of the earth's crust in this portion of the West, by which the nucleus of the mountains was revealed, occurred near the time of the accumulation of the lignite deposits or at the close of that epoch.

Again, although there is not a strict unconformability between the true lignite beds and the Wind River group, the latter incline in the same direction only at a much smaller angle. Near the source of Wind river, the Wind river group rests directly upon Cretaceous formation No. 2. At this point the Cretaceous rocks incline from 10° to 25° while the Wind river beds dip from 1° to 5°. As we ascend the valley of Wind river, towards its source, we pass, for a long distance, the steeply inclined Cretaceous and Jurassic rocks along the margins of the mountains on our left hand, while on our right, but a few hundred yards distant, the naked, almost vertical walls of the lower portion of the Wind river group are seen, the strata however seldom inclining more than one degree.

The same examples may be observed on the west side of the Wind River mountains, where the Wind River beds lie high upon the sides of the western slope in a very slightly inclined position and in some localities covering the very summit, showing clearly that even the dividing crest of the mountains was beneath the waters during the deposition of this group. Along the margins of both the Wind River and the Big Horn mountains these beds seem to have risen undisturbed or in a nearly horizontal condition. We have already expressed the opinion in a previous paper,* that the Wind River group was intermediate in age between the lignite Tertiary and the White River beds, and in point of time filled up a chronological chasm. We have inferred this from the fact that these beds seem to possess palæontological and lithological characters intermediate between the two. They contain casts of a species of *Vivipara* which is undistinguishable from *V. trochiformis* and fragments of a *Trionyx* apparently the same with that occurring in the lignite beds, also fragments of a *Testudo* which, so far as we can determine, is identical with the *T. Nebrascensis* of the White River beds. If we look also at the composition of the Wind River beds, we find that their light color, indurated arenaceous and argillaceous character, and their general appearance after erosion favors the correctness of the inference in regard to their intermediate position. From the facts before us in regard to this group, we conclude that even after the crust broke, the country continued slowly rising while the Wind River deposits were accumulating, and that the upper portions when not eroded away were elevated high upon the sides of the mountains in a nearly horizontal position.

Again, the White River beds hold a similar position with reference to the lignite formations as the Wind River group. They are seldom disturbed, and only in a few instances do they incline as much as 5°. They however occur high upon the mountain slopes along both sides of the Laramie range, showing that they partook of the gradual elevation of the country, after the crust was broken and the mountain district began to approach its present configuration. On the west side of the Black Hills,

* See this Journal, vol. xxxi, March, 1861.

where the White River beds probably began their origin, we find only the lower strata of this group, usually reposing directly upon Cretaceous rocks, though in a few localities upon lignite formations. But as we descend south and southwestward these lower beds disappear and more recent ones take their place, until they pass into the Pliocene sands of the Loup River group, and then in turn, still farther southward, are lost in the Loess or yellow marl deposits. We can only account for these phenomena on the supposition that this great Tertiary fresh water lake had its commencement in the White River valley, and as the Black Hills, and of course the whole Rocky Mountain district, arose slowly towards its present elevation, the waters gradually receded southward and southwestward, and then more recent beds continued to be accumulated, until this formation spread itself over the vast area which it now occupies. We thus think that, by means of these Cretaceous and Tertiary deposits of the West, we can yet trace step by step the progress of that grand development which has given the present geographical conformation to the West, and originated the fountains from which flow those mighty rivers which may well be called the commercial arteries of the American continent.

Another illustration of the gradual and long continued rise of the country may be found in the immense chasms or cañons which have been formed by the streams along the mountain sides. We can only account for them on the supposition that as the anticlinal crest was slowly emerging from the sea, the myriad sources of our great rivers were seeking their natural channels, and that these branches or tributaries began this erosive action long before the great thoroughfares, the valleys of the Mississippi and the Missouri, were marked out. The erosion would go on as the mountains continued slowly rising at an almost imperceptible rate, and in process of time the stupendous channels which everywhere meet us along the immediate sides of the mountains would be formed. If we examine the barometrical profiles, already referred to, we see at a glance that in traversing the country from the Mississippi to the foot of the mountains the ascent is very gradual, but increases as we approach the upheaved ridges. In an equal proportion will the rapidity and consequently the erosive power of the streams be increased so that we may readily account for those grand displays of the erosive action of water which occur so frequently along the mountain sides. Eastward from the mountains, beyond this immediate influence, the descent is so gradual that the Missouri flows quietly along over its yielding alluvial bed, transporting its sediments to the Gulf of Mexico.

That the progressive elevation of the country continued up to our present period or at least until near the time of the deposition of the most recent superficial deposits, we think we have evidence derived from the terraces, which are seen all along the streams. The elevation of these terraces increases as we approach the sources of the rivers, averaging from a few feet to 150 or 200 feet in height. This subject will be discussed more fully in a future article.

We conclude therefore that the barometrical profiles, constructed from explorations across our continent, and geological data, indicate a long continued quiet expansion of the earth's crust, commencing toward the close of the Cretaceous epoch and extending even to our present period; that near the close of the accumulation of the Tertiary lignite deposits the crust of the earth had reached its utmost tension, the long lines of fractures had commenced, and the anticlinal crests of the mountain ranges were marked out. In a previous paper in this Journal, we remarked that there is no unconformability in any of the fossiliferous sedimentary strata in the northwest, from the Potsdam sandstone to the summits of the true lignite Tertiary. We believe therefore that the elevated ridges which form the nuclei of the mountain ranges began to emerge above the surface of the surrounding country near the close of the Eocene period. We think also that the evidence is clear that there were periods of subsidence and repose, but the thought which we wish to illustrate is, that there was a slow, long continued, quiet, upward tendency which began near the close of the Cretaceous epoch and culminated in the present configuration of the western portion of our continent near the commencement of our present period.

Smithsonian Institution, Washington, D. C., Jan. 1st, 1862.

ART. XXIX.—*Contributions from the Sheffield Scientific School of Yale College**—II. *On the Chemical Constitution of the Wax of the Myrica cerifera;* by GIDEON E. MOORE, B.P.

THE fruit of the Myrica cerifera yields a wax which for many years has constituted, to a limited extent, an article of commerce in the United States under the names of Myrtle-wax, Candleberry wax and Bay-berry Tallow. It occurs abundantly as a white incrustation on the small globular nuts of the plant. To prepare it in a nearly pure state, the berries are enclosed in bags of coarse cloth and kept immersed in boiling water until the fused wax collects on the surface, it is then poured off into pans in which it solidifies on cooling—in this form and without further preparation it is brought into commerce. It is employed in its

* Communicated by Profs. Johnson and Brush.

pure state as a polish to diminish the friction between surfaces of wood moving in mutual contact, and in admixture with other fatty bodies as a substitute for bees-wax in the manufacture of candles. It is also used in polishing furniture and enjoys some popular repute as a remedial agent.

We are indebted for the first published account of this substance to Alexandre,* Surgeon, correspondent of M. de Mairan, who mentions a wax obtained in Louisiana from the fruit of a tree about the size of a cherry-tree and resembling myrtle in appearance, which he states to have been employed by the colonists in the manufacture of candles. Mr. Alexandre likewise states that the water in which the berries have been boiled, when evaporated to the consistence of an extract, is a certain cure for the most violent cases of dysentery.

At a later period accounts of the tree or shrub were given by Marshal, Lepage-Duprat, and by Toscan, Librarian at the Museum of Natural History at Paris. The latter in a memoir in his work entitled *L'Ami de la Nature* gave a circumstantial description of the mode of collecting the wax in early colonial times.†

The traveller, Kalm, speaking of myrtle wax says "in the country where it grows they make excellent soap of it which washes linen perfectly white."

The first attempt to investigate the chemical composition of this substance was made by the Danish chemist, Dr. John,‡ in the early part of the present century. By treating the wax from the *M. cerifera* with boiling alcohol, this observer separated it into two portions. To the soluble portion he gave the name of

* Histoire de l'Academie, Ann. 1722 and 1725—pp. 11 and 39.

† "Towards the end of autumn when the berries are ripe, a man leaves his house, together with his family, to go to some island or bank near the sea-shore where the wax trees grow in abundance. He carries with him vessels to boil the berries, and a hatchet to build a cottage where he may find shelter during his residence in this place, which is usually three or four weeks. While he cuts down trees his children gather the berries. A very fertile shrub will afford nearly seven pounds. When these are gathered the whole family employ themselves in procuring the wax. They throw a certain quantity of the berries into the kettle, and then pour a sufficient quantity of water on them so as to cover them to the depth of about half a foot. They then boil the whole, stirring the grains about and rubbing them against the sides of the vessel in order that the wax may more easily come off. In a short time it floats on the water like fat, and is collected with a spoon and strained through a course cloth to separate it from any impurities which might be mixed with it. When no more wax can be obtained they take the berries out with a skimmer and put others into the same water, but it must be entirely changed the second or third time, and in the meantime boiling water must be added as it evaporates in order to avoid retarding the operation. When a considerable quantity of wax has been obtained by this means, it is laid on a cloth to drain off the water with which it is still mixed. It is then melted a second time, and it is then formed into masses. Four pounds of berries yield about one of wax; that which is first obtained is generally yellow; but in later boilings it assumes a green color from the pellicle with which the kernel of the berry is covered."—*Translation in Nicholson's Journal*, vol. iv, p. 189.

‡ Chemische Untersuchungen, iii, 38.

cerin and to the insoluble that of *myricin*, from the specific and generic names of the plant. Subsequently discovering as he supposed two identical substances in bees-wax he conferred upon them the same names, which are even still in use.

In the year 1802 Mr. C. L. Cadet* gave an account of the myrtle berry and the mode of culture, with experiments on the solubility of the wax in various menstrua, and mentioned that it saponified readily with the alkalies.

A few months later, Dr. John Bostock† gave an accurate description of the physical properties of the wax, its comportment towards solvents and alkalies, and concluded by stating the affinity of myrtle wax to the fixed oils—at the same time giving it as his opinion that the vegetable waxes bear the same relation to the fixed oils of plants that the resins do to the essential oils, i. e., are derived from them by the process of oxydation.

Besides these early imperfect notices of the myrica wax, we have more recently, an elementary analysis by Lewy who found its composition as follows:‡

Carbon,	74·00
Hydrogen,	12·00
Oxygen,	14·00
	100·00

Chevreul also examined the myrica wax. According to him it is completely saponified by potash-lye and yields in the operation besides glycerine, stearic, margaric and oleic acids.§ As will appear in the sequel, this distinguished chemist must have operated on an adulterated specimen.

The wax employed in the following research was the commercial article as found in the drug stores of New Haven, and was collected in the vicinity of this place. To the kindness of Mr. E. W. Blake, Jr., I am indebted for a small specimen prepared by himself from berries gathered in Rhode Island, this enabled me to test the purity of the commercial wax. The latter though procured at different times from several sources, in no case appeared to have been adulterated, as shown by the uniform fusing point of the wax itself, and of the mixed fatty acids resulting from its saponification.

The wax, as existing in commerce, is of various shades of color, from greyish-yellow, nearly destitute of any other tint, to a rich deep green, due to chlorophyll; the odor is balsamic and slightly aromatic, much more powerful however in the dark than in the light colored varieties. These differences in appearance and odor are not connected with any material variation in the other physical properties, such as specific gravity and fusion point, which remain nearly constant throughout.

* Annales de Chimie, xliv, 140.

† Nicholson's Journal, iv, 130.

‡ Handwörterbuch der Chemie, v, 413.

§ *Loc. cit.*

The specific gravity of myrtle-wax ranges from 1·004 to 1·006 and the point of fusion from 47° to 49° C. Its hardness and brittleness are much greater than those of beeswax. According to Dr. Bostock one hundred parts by weight of boiling alcohol dissolve five parts of the wax, four-fifths being deposited on cooling and one-fifth remaining suspended in the fluid but gradually depositing after a few days, or it may be precipitated at once by the addition of water. Only four-fifths of the wax are dissolved by hot alcohol, the remainder being totally unacted on even by prolonged digestion with fresh quantities of the solvent. Boiling ether, according to the same author, dissolves more than one-quarter of its weight of the wax, of which, the greater part separates on cooling. At a moderate heat it is also taken up by oil of turpentine to the extent of six per cent.

With a solution of caustic potash, myrtle wax saponifies readily, giving a fragrant soap which is freely soluble in water and which by decomposition with sulphuric acid yields a mixture of fatty acids fusing at 61° C., and readily soluble in hot alcohol. From this solution it may be wholly precipitated by an alcoholic solution of acetate of lead. Upon washing and drying the precipitate, and digesting it for several days at a moderate temperature with twice its bulk of ether, a waxy substance was dissolved which did not blacken by sulphid of ammonium and left no residue upon ignition, thus proving the absence of oleic acid. The portion dissolved by ether consisted of unsaponified wax which being suspended in the solution of soap in a state of fine division escaped detection, was carried down mechanically in the precipitate produced by acids, thrown down a second time in the precipitate by acetate of lead and was afterwards dissolved out by the ether.

A portion of the wax was saponified with litharge and the lead soap repeatedly washed with water. Upon evaporation of the washings in vacuo, a viscid fluid was obtained possessing the sweet taste and other characteristic properties of glycerine, the quantity obtained was, however, quite small in proportion to the amount of wax employed.

About two pounds of the wax were then saponified with caustic potash and the soap decomposed by sulphuric acid, the precipitate was fused and agitated repeatedly in contact with renewed portions of distilled water and finally dried. It possessed a fusing point of 60° C. A portion of this substance was introduced with a considerable quantity of distilled water into a capacious retort and subjected to distillation; after about one-half of the water in the retort had passed over, the distillate was found to contain a few globules of fused fat floating on its surface—these were collected and their fusing point taken—it was found to be identical with that of the substance previous to distillation, thus proving conclusively the absence of the more volatile fatty acids.

One hundred grammes were taken, and after solution in alcohol, were subjected to fractional precipitation, the method originally proposed by Heintz* being employed under the following modification. The alcoholic solution of the fatty acids was made of such strength that the degree of saturation at which a precipitate separated on cooling to the ordinary temperature of the atmosphere, was almost, but not quite attained. The solution was measured and one-tenth part was poured into another vessel, this portion was then precipitated as accurately as possible by a saturated alcoholic solution of acetate of lead. The precipitate together with the fluid in which it was suspended was now poured back into the remaining portion of the solution, and the whole heated to ebullition and maintained at that temperature until the precipitated lead salt was redissolved and the fluid was brought to nine-tenths of its original bulk. The whole was then set aside to cool, by which the precipitate was a second time thrown down. This precipitate was collected on a filter and dried, as the *first fraction.* A portion of the filtrate equal to that first taken was now precipitated accurately with acetate of lead, the precipitate with the fluid in which it was suspended was poured back into the rest of the solution, the whole heated and evaporated until brought to eight-tenths of its original bulk, and after cooling, the precipitate collected and dried as the *second fraction.* This operation was repeated until *nine fractions* in all had been obtained, the fluid to be precipitated occupying successively, $\frac{9}{10}$, $\frac{8}{10}$, $\frac{7}{10}$, $\frac{6}{10}$, $\frac{5}{10}$, $\frac{4}{10}$, $\frac{3}{10}$, $\frac{2}{10}$, and $\frac{1}{10}$, of its original bulk. The last portion of fluid containing the *tenth fraction* gave no precipitate with acetate of lead, and upon examination was found to contain the ethylic ethers of the fatty acids with but very little free acids.

Of the fractional precipitates thus obtained, the 1st, 2d, 3d, 7th, and 9th were further examined. They were decomposed by repeated boiling with moderately dilute hydrochloric acid and the fatty acids thus separated were thoroughly washed by hot water. The fusing points of these products were as follows, respectively:

1st fraction, 60·5° C., 2d, 61·°, 3d, 61·°, 7th, 55·°, 9th, 50.° The 10th fraction which gave no precipitate with acetate of lead remained fluid at 20·° C.

The fact that by long boiling the mixed fatty acids with water, a distillate was obtained which had the same fusing point as the original mixture, together with the narrow range of fusing points among the fractions first examined, made it appear unnecessary to study the others.

* Jour. für Prakt. Chem., lxvi, 1.

The products obtained from each of the above mentioned lead precipitates were severally subjected to repeated crystallization from alcohol until the fusing point of the crystals stood unaltered by further treatment. From each fraction an acid was thus procured which fused at 62° C., and agreed in all respects with *palmitic acid.* The first three fractions consisted almost entirely of this substance and it was present in considerable quantity even in the ninth fraction.

The filtrates from the crystallization of the 7th and 9th fractions were then mixed and subjected to recrystallization. A crop of crystals thus obtained likewise fused at 62° C. The new filtrates were then mingled and crystallized again with the same results.

The concentrated mother liquors from which nearly all the palmitic acid had thus been separated, were now evaporated nearly to dryness, and the mass saponified to destroy the ethers formed by prolonged contact with alcohol. The soap was decomposed by acids, the precipitate dissolved in alcohol, the fluid evaporated until a slight crop of crystals formed on cooling; the fluid poured off from these was again evaporated until a deposit ensued on cooling, and this process was repeated until the crystals thus formed exhibited a constant fusing point, viz. 43° C. It thus appears that *lauric acid* is an ingredient of this wax. The 10th fraction which was fluid at ordinary temperatures was found by similar treatment to consist almost entirely of *lauric ether* formed by prolonged contact with alcohol.

About one pound of the crude fatty acids was repeatedly agitated with small quantities of boiling alcohol until the fusing point of the portion undissolved, remained constant at 62° C. The several alcoholic solutions thus obtained were then mixed and evaporated to the point at which crystals formed on cooling, the whole allowed to cool to the ordinary atmospheric temperature, the crystals thus formed removed, and the process repeated several times, by which means a still further portion of the least soluble substance was removed. The fluid filtered from the crystals was now treated with caustic potash and after addition of water the whole was heated until no more alcohol could be expelled. The precipitate obtained by treating this solution with sulphuric acid, was dissolved in alcohol and subjected to a fractional crystallization to remove palmitic acid, by which means a sufficient quantity of the substance fusing at 43° C. was obtained for an elementary analysis.

The two substances thus obtained and which from their fusing points and other characteristic properties were pronounced to be respectively palmitic and lauric acids, were further purified by solution in alcohol, decolorization by animal charcoal, resaponification, decomposition of the soaps by acids, and careful washing with distilled water, by which means they were obtained in a state of nearly absolute purity.

The above operations were very much complicated by the fact of the strong tendency of lauric acid to form an ether when left for any length of time in contact with alcohol. In this respect it far surpasses palmitic acid. A mixture of these two acids in which there was a great preponderance of the latter, was digested for several days in alcohol at the ordinary temperature of the atmosphere. Upon adding a weak solution of potash to remove uncombined acid, and finally washing with water—an oily fluid was obtained which became solid by a very slight decrease in temperature, and which upon examination turned out to consist of nearly pure laurate of oxyd of ethyl. This ether could only be decomposed by prolonged digestion at a moderate heat with a very concentrated solution of fixed caustic alkali.

The palmitic and lauric acids obtained in the preceding operations were subjected to combustion with oxyd of copper and oxygen gas, with the following results:

0·1967 grms. palmitic acid gave 0·54 grms. carbonic acid and 0·228 grms. water.

	Theory.		Experiment.
C_{32}, - - -	192	75·00	74·96
H_{32}, - -	32	12·50	12·87
O_4 - - -	32	12·50	....

0·1857 grms. lauric acid gave 0·4917 grms. carbonic acid and 0·202 grms. water.

	Theory.		Experiment.
C_{24}, - - -	144	72·00	72·21
H_{24}, - -	24	12·00	12·06
O_4 - - -	32	16·00	....

A portion of the crude wax was repeatedly treated with fresh quantities of boiling alcohol until no further solution ensued, the residue was several times crystallized from hot ether, and finally after decolorization with animal charcoal, maintained in a state of fusion for some time to remove volatile impurities derived from the ether. It possessed the fusing point, hardness, and other properties of pure *palmitin*. Since according to Bostock, boiling alcohol dissolves only four-fifths of the wax, the amount of palmitin present may be approximately stated at one-fifth of the whole.

The results of the foregoing experiments indicate that the wax of the Myrica cerifera consists of about *one-fifth* part of *palmitin*, the remaining *four-fifths* being free *palmitic acid* with a small quantity of *lauric acid*, the latter either free or in the state of *laurin*.

With regard to the uses of this substance, its composition and abundance suggest it to the chemist as the most convenient and accessible source of pure palmitin and palmitic acid, and it will probably be the means of increasing in no small degree our knowledge of these bodies and their derivatives. As a substitute for bees-wax in the manufacture of candles, the Myrica wax appears to be worthy of more attention than it has yet received. In illuminating power it seems to be scarcely, if at all, inferior to the best bees-wax. It can be furnished at less than one-fourth of the cost of the latter material, and owing to its superior hardness it can be cast instead of having to be subjected to the tedious and expensive process of moulding by hand. By care in preparation, it can be obtained more free from color than crude bees-wax, and moreover, it is said to be rendered perfectly white by the ordinary modes of wax bleaching. It might probably be used also with advantage to harden paraffine candles.

Taking into consideration the abundance of the plant itself, its hardy habits of life—in fact it thrives best upon soils which from their poverty and proximity to the sea are unfitted for all other purposes of cultivation—the slight degree of attention required to insure abundant crops, and finally the ease of extraction of the wax itself, there appears to be no reason why the preparation of myrtle wax should not constitute an important branch of manufacturing industry.*

The foregoing investigation was undertaken at the suggestion of Prof. Johnson, for whose guidance and assistance I here take pleasure in expressing my grateful acknowledgments.

Sheffield Laboratory, New Haven, Feb. 3d, 1862.

ART. XXX.—*Considerations relating to the Quebec Group, and the Upper Copper-bearing Rocks of Lake Superior;* by Sir W. E. LOGAN, F.R.S., Director of the Geological Survey of Canada.†

(Read before the Montreal Natural History Society, May, 1861.)

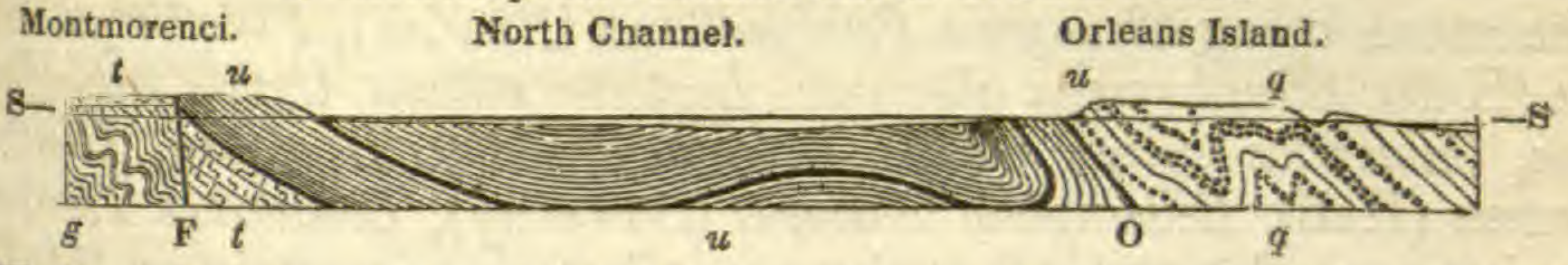
IN a communication addressed by me to Mr. Barrande on the fauna of the Quebec group of rocks, (this Jour., xxxi, 216,) after showing that the organic remains discovered last year at Point Lévis, placed the group about the horizon of the Calciferous formation, I stated that the apparent conformable superposition of the group on the Hudson River formation was probably due to an overturn anticlinal fold or overlap.

* In course of the preceding investigation a property of the *palmitate of silver* was noticed which I believe has not yet been placed on record. I allude to its becoming powerfully electric by friction. A small quantity of this salt, purified from extraneous fatty matters by digestion in ether, was gently rubbed in an agate mortar, when a sufficient amount of electricity was generated to cause the powder to fly out in every direction and cluster around the pestle and the hand holding it.—G. E. M.

† From the Canadian Naturalist and Geologist.

The character of this overlap is exhibited in the accompanying wood cut (fig. 1) of a vertical section of the neighborhood

1.—*Section from Montmorenci to Orleans Island.*



Horizontal and vertical scale, 1 inch to a mile. *g*, Laurentian gneiss; *t*, Trenton limestone; *u*, Utica and Hudson River formations; *q*, Quebec group; F, Fault; O, Overlap; S, Level of the Sea.

of Quebec, extending from the Montmorenci side of the St. Lawrence across the north channel and the upper end of the Island of Orleans. The road from Beauport to Montmorenci runs over a floor of Trenton limestone, which has a very small dip towards the St. Lawrence; farther back from the river the rock has a gentle dip in an opposite direction, giving evidence of a very flat anticlinal form, which could scarcely be detected without the aid of the general distribution of the formations in the neighborhood. On the south side of the road there occurs a dislocation, which can be traced the whole way from Beauport church to Montmorenci falls, where the effect it produces is easily discernible. Here the channel of the Montmorenci is cut down through the black beds of the Trenton formation, to the Laurentian gneiss on which they rest, and the water at and below the bridge flows down and across the gneiss, and leaps at one bound to the foot of the precipice, which, immediately behind the water, is composed of this rock. At the summit, the Trenton beds are seen on each side; on the right bank they have a thickness of about fifty feet, and are marked by the occurrence of *Leptæna sericea* (Sowerby), *Strophomena alternata* (Conrad), *Orthis testudinaria* (Dalman), *Lingula crassa* (Hall), *Conularia Trentonensis* (Hall), *Calymene Blumenbachii* (Brongniart), and *Trinucleus concentricus* (Eaton). The dip of these beds is down the stream, at a very small angle; but at the foot of the precipice, and immediately in contact with the gneiss, about the same thickness of black limestone is tilted up to an angle of fifty-seven degrees. This is followed by about an equal amount of black bituminous shale with the same slope. In this attitude, these rocks climb up the face of the precipice, presenting their edges to the chasm on each side. They are succeeded by about eight feet of hard grey sandstone, weathering brown, in beds of from ten to eighteen inches, interstratified with black shale. On this repose grey arenaceo-argillaceous shales, composing the sides of the chasm out to the waters of the St. Lawrence; the distance being about a quarter of a mile, and the dip, which is towards the St. Lawrence, diminishing gradually to about thirty-five degrees.

These tilted beds are fossiliferous, the species contained in the limestone being *Stenopora Petropolitana* (Pander), *Ptilodictya acuta* (Hall), *Strophomena alternata*, *Leptæna sericea*, *Orthis testudinaria*, *Camerella nucleus* (Hall), *Lingula* allied to *L. obtusa*, *Discina crassa* (Hall), *Bellerophon bilobatus* (Sowerby), *Conularia Trentonensis*, an undetermined *Orthoceras*, *Cyrtoceras constrictum* (Hall), *Calymene Blumenbachii*, *Cheirurus pleurexanthemus* (Green), *Trinucleus concentricus*, *Asaphus platycephalus* (Stokes). Those contained in the black shales are *Graptolithus bicornis* (Hall), and *G. pristis* (Hessinger). There is thus no doubt whatever that the limestones are of the Trenton and the shales of the Utica formation.

On the opposite side of the north channel, at the upper end of the Island of Orleans, there occur about 500 feet of black bituminous shales, interstratified with occasional beds of gray yellowish-weathering calcareous sandstone, and arenaceous limestone. They in some parts hold *Graptolithus bicornis* and *G. pristis*, and there is little doubt are subordinate to the Utica or Hudson River formation. They dip S.E. $< 50°$, and there rests upon them (the contact being visible) a series of magnesian shales and conglomerates, dipping in the same direction and at the same angle. These magnesian strata are of the same character as those at Point Lévis, and belong to the Quebec group. They thus overlap the black shales, which are probably overturned as represented in the diagram (fig. 1).

In his explorations of last year on Lakes Superior and Huron, Mr. Murray ascertained that the lowest well characterized fossiliferous rock in that neighborhood belongs to the Birdseye and Black River group, and that it rests conformably upon the sandstones of Sault Ste. Marie. These sandstones and their equivalents, consisting of red and yellowish-white beds, are traceable on the south side of Lake Superior, from Marquette to the River St. Marie, and compose Sugar Island, and probably the north part of Neebish Island. They extend to the north part of St. Joseph Island, and are met with on the Island of Camp-

2.

a, Birdseye and Black River limestone; *b*, Ste. Marie sandstone; *c*, Huronian conglomerates; H, Level of Lake Huron; S, Level of the Sea. Horizontal and vertical scale, 1 inch to 1 mile.

ment d'Ours. In one of the white beds near Marquette, Mr. Murray obtained a *Pleurotomaria* resembling *P. Laurentina* of the Calciferous formation, and observed the occurrence, in the same bed, of a species of *Scolithus*. The mass on Campment d'Ours is of the same color and friable character as the yellowish-white beds near Marquette, and is marked by the same *Scolithus*, and there is little doubt that the two exposures are of the same series. On Campment d'Ours the sandstone reposes on the Huronian series, and is eighty feet thick and very nearly horizontal, (fig. 2). It is succeeded in ascending order, by the following series of beds:—

Bluish-gray shales, interstratified with thin beds of yellowish compact limestone, presenting an escarpment over the sandstone. The fossils observed are *Stenopora fibrosa*, *Ptilodictya fenestrata*, *P. acuta*, *Strophomena alternata*, *Rhynchonella plicifera*, and a small undetermined *Lingula*, - - - - - - - - - - - - - - -	20
Measures concealed, - - - - - - - - - - - - - - - - - -	60
Ash-gray compact limestone, in beds of from three to five inches thick, interstratified with a five-inch bed of drab colored compact limestone. Among the fossils are *Stenopora fibrosa*, *Glyptocrinus ramulosus*, *Strophomena alternata*, *Pleurotomaria subconica*, *Subulites elongatus*, *Ambonychia amygdalina*, *Cyrtodonta Huronensis*, *Vanuxemia inconstans*, *Orthoceras tenuifilum*, *O. Murrayi*, *Leperditia Canadensis*, and *Asaphus platycephalus*, - - - - -	4
Ash-gray compact limestones, in beds of from four to six inches, underlaid by a dark brownish-gray arenaceous limestone bed of about ten inches, and divided by thin layers of gray calcareo-argillaceous shale. All of these strata are very fossiliferous, and contain *Glyptocrinus ramulosus*, *Ptilodictya multipora*, *Coscinium flabellatum*, *Strophomena alternata*, *S. filitexta*, *Rhynchonella recurvirostra*, *Orthis subequata*, *Vanuxemia inconstans*, *Cyrtodonta Huronensis*, *C. subcarinata*, *Pleurotomaria subconica*, *Trochonema umbilicata*, *Murchisonia perangulata*, *Orthoceras recticameratum*, *Cheirurus pleurexanthemus*, and *Leperditia Canadensis*, -	30
Ash-gray compact limestone, of the same character as the preceding, but still more fossiliferous. The beds contain *Tetradium fibratum*, *Stenopora fibrosa*, *Columnaria alveolata*, *Petraia profunda*, *Strophomena alternata*, *S. filitexta*, *Rhynchonella recurvirostra*, *Ambonychia amygdalina*, *Cyrtodonta Canadensis*, *C. Huronensis*, *C. mytiloidea*, *Vanuxemia inconstans*, *Ctenodonta nasuta*, *Pleurotomaria subconica*, *Eunema strigillata*, *Subulites elongatus*, *Orthoceras tenuifilum*, *O. Murrayi*, an undescribed *Cyrtoceras*, *Asaphus platycephalus*, and *Leperditia Canadensis*, - - - - - - - -	16
	130

The fossils of these limestones leave little doubt that they belong to the Birdseye and Black River group; and the underlying sandstones and other rocks, constituting the upper copper-bearing series of Lake Superior, may thus represent the Chazy, Calciferous, and Potsdam formations, and be equivalent to the Quebec group, with the black shales and limestones beneath it. This equivalency and the existence of an upthrow bringing the Quebec group to the surface in the regions to the southeast, as already described in my letter to Mr. Barrande (this Journal, xxxi, 216) suggest the following considerations.

From the occurrence of wind-mark and ripple-mark on closely succeeding layers of the Potsdam sandstone, where it rests immediately upon the Laurentian series, we know that this arenaceous portion of the formation must have been deposited immediately contiguous to the coast of the ancient Silurian sea, where part of it was in some places exposed at the ebb of the tide. No want of conformity is known to exist between the Potsdam and Calciferous formations, and the Quebec group being of Calciferous age and 7000 feet thick, it follows that during the Potsdam period, while the sandstones of the formation were being deposited on a level with the surface of the sea, there must have existed a depth of at least 7000 feet of water over the area in which were subsequently deposited the strata of the Quebec group.

With the exception of a small mass of the Potsdam sandstone at St. Ambroise, we have no evidence of a marginal outcrop of this formation between the St. Maurice River and the Mingan Islands. No marginal outcrops of the Calciferous and Chazy formations have been observed from the longitude of Lake St. Peter to the same group of islands; and between the vicinity of Kingston and the north shore of Lake Huron, all three of these formations appear to be wanting. From the Mingan Islands to the Mohawk River in New York, the marginal outcrops of the Potsdam, Calciferous and Chazy united do not in any part much exceed 1000 feet in thickness; while the thickness of the Quebec group alone, is about 7000 feet. This, constituting the great metalliferous formation of the continent, is traceable, under various designations, from Gaspé to Alabama, thence sweeping round on the west side of the Mississippi, through Kansas, to Lake Superior, where it appears without any diminution in its volume.

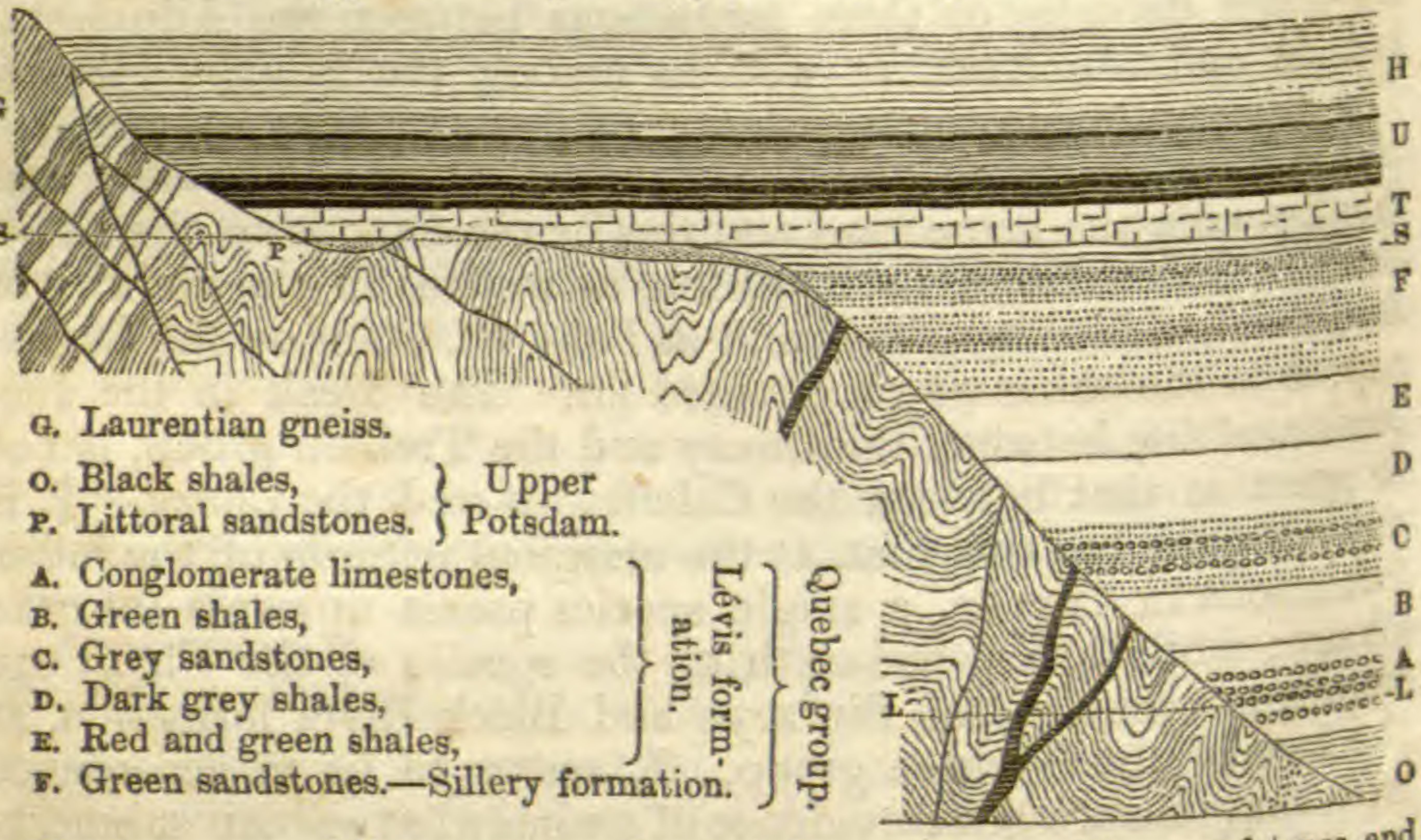
From these facts, it would appear probable that, during the Potsdam period, the older rocks, which formed the coast of the Lower Silurian sea, extended, under comparatively shallow water, southeastwardly from the St. Lawrence and the Ottawa, to the fault which brings the Quebec group between Gaspé and the Mohawk; and southwestwardly from a line between the Mohawk and Lake Superior, as far as Alabama. All around this shallow area, they descended quickly into deep water; thus constituting a subaqueous promontory from the Laurentian and Huronian rocks of the north, and forming, with these, what Mr. James D. Dana has termed the nucleus of the North American continent.

But although the great volume of the Quebec and Potsdam groups, shows that over the area occupied by them, there must have existed a deep sea during the Potsdam period; it is to be remarked, that many of the members, both of the lower and upper parts of the Quebec group, have by no means the characters of deep-sea deposits. It has already been stated, that the beds of passage between the littoral portions of the Potsdam and Calciferous formations, suggest the opinion, that, towards the termination of the Potsdam era, a gradual sinking of the surface had occurred. In order to obtain the conditions for the accumulation of the coarser sediments, which commence near the base of the Quebec group, it must be supposed, that, shortly after the beginning of the Calciferous period, a great continental elevation occurred; carrying the littoral deposits of the Potsdam, and the beds of passage just mentioned, high above the sea, and bringing the area at the base of the Quebec group comparatively near the surface. The successive coarse deposits of the group indicate a subsequent gradual subsidence, at unequal intervals, probably with subordinate oscillations, until the early shallow-water strata were again submerged; to be first partially covered over by deposits of the Chazy formation, and then, almost universally, by those of the Trenton and Hudson groups.

In this way may be explained the break which occurs in the succession of life between the Calciferous and Chazy, in the shallow-water deposits of these formations between the Allumettes Islands and Montreal, as well as among the Mingan Islands. The interruption in the succession of deposits between the base of the Trenton group and the Potsdam, at St. Ambroise; and that between the same base and the Laurentian, from the north shore of Lake Huron to Kingston, as well as in the vicinity of St. Paul and Murray Bays, and at Lake St. John on the Saguenay, is in the same way accounted for. The break in the succession of life between the Chazy and the Trenton group, is not so great as that between the Calciferous and the Chazy. It is not yet quite certain, that, at the marginal outcrop of the latter formations in Canada, a single species passes upwards into the Chazy; while about one-sixth of the species of the Chazy are known to occur in the Birdseye and Black River formation, at the base of the Trenton group. It seems to be in accordance with this, that we have evidence of a somewhat sudden submergence for the commencement of the Trenton period, and a somewhat rapid accumulation of its lower strata, the Birdseye and Black River limestones. Where these rest upon the Huronian and Laurentian series, the beds of contact are often composed of angular fragments of the underlying rock; and it frequently happens that the surface on which these beds rest, is rough, and broken into sharp projecting ledges and deep fissures, which were filled up and covered over by the deposits in question, before sufficient time had elapsed to permit the surface to be worn down. Instances in illustration of this occur on the Snake Islands, west of Lacloche, in Lake Huron, where the Birdseye and Black River formation rests on the quartzites of the Huronian series; and at Marmora, where it is supported by Laurentian rocks. Dr. Dawson has pointed out a striking instance of these phenomena at Hog Lake in Huntingdon; other examples occur at Sloat's Lake in Loughborough and its vicinity, as well as at Kingston Mills. The same conditions may be observed in the neighborhood of Murray Bay.

As an instance of the probably rapid slope of the bottom of the Lower Silurian sea from shallow to deep water, during the Potsdam period, in the neighborhood of Quebec, we see that the surface of the quartzose gneiss now supporting the Trenton formation at the Falls of Montmorenci, must have been 7000 feet above the gneiss under the island of Orleans; while the distance between the two positions does not much exceed a mile and a half. This would give a slope of nearly forty-five degrees; and perhaps it would not be extravagant to take this as representing the inclination along the whole line to Alabama. As the Potsdam and Quebec groups accumulated, the edges of their strata would abut against this slope; and ultimately both these, and the early shallow-water deposits on the higher terrace, would be

3. *Supposed arrangement of the strata before the break.*



T. Trenton group of limestones; U. Utica shales; H. Hudson River sandstones and shales; L. L. Sea level at the commencement of the Quebec period; S. S. Sea level at the close of the Potsdam, and also at the beginning of the Trenton period. Vertical scale of the section, one inch to a mile.

covered over by the Birdseye and Black River, the Trenton, the Utica, and Hudson River formations. This we have endeavored to represent in the accompanying ideal diagram; in which it will be perceived that the lowest of these formations is shown as resting (at P.) on one of those littoral deposits of Potsdam sandstone, like that at St. Ambroise, which are still met with along the marginal outcrop.

The strike of this rapid slope in the bottom of the ancient sea, coinciding with the break, had, as already indicated, a general northeastward bearing, from Lake Champlain to the vicinity of Cape Chatte. The present trend of the Laurentian gneiss, from the neighborhood of Quebec to Pointe des Monts, has a rude parallelism with it; but farther down the valley of the St. Lawrence, while the line of break turns gradually eastward, and ultimately south of east, in Gaspé, the trend of the gneiss becomes northward for about sixty miles, then eastward for three hundred miles, and finally northeastward for two hundred miles more, to the Atlantic extremity of the Straits of Belle Isle. This divergence of the two lines would lead us to anticipate an area of shallow water during the Lower Silurian period; so protected from disturbance that any strata occurring there, might be expected to present a comparatively horizontal attitude, like that of the Lower Silurian formations on the same side of the break to the west. We accordingly find, in the Mingan Islands, in Anticosti, and on the Straits of Belle Isle, the Lower Silurian deposits in such an attitude. In the latter locality, however, the volume of the undisturbed strata would appear to indicate that the bottom shelved more gradually before reaching the slope. The increase of the dip in approaching Bonne Bay in Newfoundland, suggests that we may expect to find the break somewhere in that neighborhood.

Without enquiring into the origin of the forces which may have produced the corrugations of the earth's crust, we may suppose that if a sufficient lateral pressure were applied to the strata thus accumulated and arranged, there would result a series of parallel folds running in a direction at right angles to that of the force, with prevailing overturn dips towards the line of resistance. The solid crystalline gneiss in the case before us, offering more resistance than the newer strata, there resulted a break coinciding with the inclined plane at the junction of these with the gneiss. The lower palæozoic strata, pushed up this slope, would then raise and fracture the formations above, and be ultimately made to overlap the portion of these resting on the edge of the higher terrace; after probably thrusting over to an inverted dip, the broken edge of the upper formations. The shallow-water strata of the higher terrace, relieved from pressure by the break, would remain comparatively undisturbed; and thus the limit of the more corrugated area would coincide with the slope between the deep and shallow waters of the Potsdam period. The resistance offered by the buttress of gneiss would not only limit the main disturbance; but it would probably also guide or modify, in some degree, the whole series of parallel corrugations, and thus act as one of the causes giving a direction to the great Appalachian chain of mountains.

ART. XXXI.—*On the action of substances of the Sulphur and Phosphorus Groups on solutions of the metals;* by THEODORE PARKMAN. (Abridged from his Inaugural Dissertation, Göttingen.)

THE subject of the following dissertation was suggested by an observation made in the laboratory of Prof. Wöhler, at Göttingen. In precipitating selenium, by sulphurous acid, from a solution which contained considerable copper, the selenium obtained was black, although the precipitation took place in the cold. On investigation, the selenium was found to contain copper. My honored instructor, Prof. Wöhler, suggested to me that, as this reaction was a new and somewhat singular one, to extend it to tellurium, sulphur, phosphorus, arsenic and antimony, might afford the matter for a not uninteresting investigation.

I. *Action of Sulphur on the solutions of Copper, Silver and Lead.*

As just mentioned, precipitated selenium, placed in a solution of sulphate of copper containing sulphurous acid, unites with copper. I find that sulphur, tellurium, phosphorus, arsenic and antimony all do the same. In most cases also, the same effect is produced, especially with the aid of heat, without the presence of sulphurous acid or other reducing agent. I have also extended the investigation, though less completely, to the salts of silver and lead. With the exception of the action of phosphorus on the copper and silver solutions, all these reactions appear to have been previously undescribed.

1. *Action of sulphur without the aid of reducing agents.*—Precipitated sulphur and flowers of sulphur were left a week in solutions of sulphate, acetate and chlorid of copper. At the end of that time, they were entirely unchanged. Precipitated sulphur, boiled five or six hours with the sulphate, was slightly blackened, from formation of sulphid. Precipitated sulphur and flowers of sulphur, boiled with the acetate, rapidly blackened and were finally, apparently, entirely converted into sulphid of copper. Sulphur,* left three days in solution of nitrate of silver, became dark grey. Boiled in solution of nitrate of silver, it became rapidly black and seemed to be entirely converted into sulphid of silver. Sulphur, boiled with acetate of lead, only by very long boiling became dark grey.

2. *Action of sulphur with the aid of reducing agents.*—Sulphur, left for some hours in solutions of sulphate, acetate and chlorid of copper, with which sulphurous acid was mixed, became gradually dark grey, from formation of sulphid. Left a week in similar solutions, it appeared to be almost entirely converted into dark blue or black sulphid of copper. By boiling the solutions, the reaction took place much more rapidly, the sulphur becoming black in a few minutes. Sulphur, green vitriol and

* In all the following experiments the sulphur used was precipitated by sulphuric acid from hyposulphite of soda.

sulphate of copper, boiled together, gave sulphid of copper rapidly. Sulphur, zinc and sulphate of copper, boiled together, gave, along with reduced copper, black sulphid.

Sulphur, boiled with acetate of lead and acetate of the protoxyd of iron, became rapidly black and was apparently completely converted into sulphid. The resulting sulphid contained no iron.

3. *Analysis of the products of the foregoing reactions.*—In preparing the above substances for analysis, my great care was to continue the action long enough to be sure that all the sulphur was converted into sulphid. In those prepared by simply boiling the sulphur with the solution of the metal, the boiling was continued from five to eight hours, in every case with an excess of the metallic salt. In preparing the sulphids by the aid of sulphurous acid, the sulphur was placed in the solution of the metal, the whole heated, though not to boiling, and then saturated with sulphurous acid gas. The solution was then boiled, allowed to cool, again saturated with sulphurous acid, and left to stand a couple of days in a closed flask. In every case, on opening the flask, there was still an excess of the metallic salt and of sulphurous acid. To prevent oxydation, the substances, during washing, were kept covered with water, as much as possible, and dried in vacuo. In none of them could any free sulphur be seen by the aid of the lens. Of each substance two preparations were made, in order to see if the composition of the substance remained constant.

For analysis, the substances were all dissolved by digestion with fuming nitric acid, which, in nearly every case, dissolved them completely, without separation of sulphur. The analyses of the copper compounds were made, in some cases, by precipitating the oxyd of copper, at the boiling point, by caustic potash, and the sulphuric acid from the filtrate, after acidulation, by chlorid of barium. In other cases, separate portions of substance were taken for the copper and sulphur determinations. The silver compounds were all analyzed by precipitating, first the silver by chlorhydric acid, and then the sulphuric acid, from the filtrate, by chlorid of barium.

Sulphid of copper prepared by boiling sulphur with acetate of copper.

1st preparation. 0·6946 grm. substance gave 0·2817 oxyd of copper and 2·6436 sulphate of baryta.

2d preparation. 0·3255 grm. substance gave 0·1479 oxyd of copper and 1·2938 sulphate of baryta.

	I.	II.
Cu,	32·37	36·28
S,	52·27	54·56
	84·64	90·84

Sulphid of copper obtained by the aid of sulphurous acid.

1st preparation. I. 1·9560 grms. substance gave 1·3145 oxyd of copper.
II. 1·7321 grms. substance gave 1·1615 oxyd of copper.
III. 0·6727 grm. substance gave 2·0356 sulphate of baryta.

2d preparation. I. 1·8346 grms. substance gave 1·4830 oxyd of copper.*
II. 2·2385 grms. substance gave 5·4626 sulphate of baryta.

			I. III.	II.
1st prep.	Cu,		53·76	53·54
	S,		41·54	
			95·30	

			Calculated.	I. II. Found.
2d prep.	Cu,	31·7	66·46	64·54
	S,	16·	33·54	33·51
		47·7	100·00	98·05

Sulphid of silver prepared by boiling sulphur with nitrate of silver.

1st preparation. I. 2·0266 grms. substance gave 1·6800 chlorid of silver and 4·9156 sulphate of baryta.
II. 1·3725 grms. substance gave 1·1359 chlorid of silver and 3·2839 sulphate of baryta.

2d preparation. 0·4670 grm. substance gave 0·3519 chlorid of silver and 1·4593 sulphate of baryta.

			I.	II.
1st prep.	Ag,		62·39	62·28
	S,		33·31	32·86
			95·70	95·14

			Calculated.	Found.
2d prep.	Ag,	108	57·45	56·70
	5S,	80	42·55	42·91
		188	100·00	99·61

The formula CuS, derived from one of the above analyses is probable enough. The formula AgS^5 is not a probable one, and the substance is perhaps a mixture of the ordinary sulphid of silver with unchanged sulphur. No sulphur, however, could be seen by the aid of a lens. The substance was apparently a perfectly homogeneous, dark-grey powder. Lumps of it, when crushed, had the same appearance.

* According to Rose (Analytische Chemie, ii, 187) in igniting oxyd of copper, the filter may be burned along with the precipitate, and any suboxyd formed may be reoxydized by means of the current of air, which may be directed into the crucible by means of the cover. This is probably true in most cases, but sometimes there may be considerable loss through reduction. In the above analysis, after weighing once, I ignited and weighed again. The substance had increased considerably; and only after ignition, in a current of air, of three or four hours in all, and a total increase in weight, from the first weighing to the last, of 0·0568 grm. (=3·1 per cent of the substance analyzed) was a constant weight obtained. On breaking up the lumps of oxyd of copper, some red suboxyd still remained, which had been protected from oxydation by the coat of protoxyd on the outside. This would account, in part at any rate, for the percentage of copper in the above analysis coming out too low. It is decidedly advisable to burn the filter separately. This was done in my other analyses, with one exception, in which, from its close correspondence with another analysis, little or no loss appeared to have been incurred.

It will be seen that, in the analyses of the above substances, two preparations excepted, there is a large loss, if the substances be supposed to consist only of sulphur and metal. That this loss is not owing merely to incorrect analyses is shown by the pretty close correspondence of the analyses of the first preparation of sulphid of silver and of two of the copper determinations. I at first supposed that the sulphids had partly oxydized to sulphates: but, on heating them, first with water and then with dilute sulphuric acid, either none at all or only a trace was dissolved. Any sulphate, or other salt of silver or copper with the sulphur acids, should have dissolved up in the dilute acid. Heated in a dry test-tube, none of the substances gave any water. These facts led me to suppose that perhaps the presence of an oxysulphid, either alone, or mixed with a sulphid, might not be impossible. On examining the analyses in which there was a loss, I find that the analysis of one of the sulphids of copper corresponds closely to the formula $CuOS^3$.*

		Calculated.	Found.
Cu,	31·7	36·15	36·28
O,	8·	9·12	
3S,	48·	54·73	54·56
	88·7	100·00	

This formula is an improbable one, and I regret that I had not the time to investigate the subject further.

The analyses of the other sulphids did not correspond to any formula. When carefully examined under a lens, the copper compounds appeared to contain two substances. At first they appeared to be simply composed of a deep blue or blue-black powder. On breaking some of the lumps, however, these latter were found in many cases to be composed of a hard, light colored substance, with a reddish tinge and somewhat metallic appearance. Its appearance was very much like that of protosulphid of iron, which has been fused and then broken. The substance, which corresponded to the formula $CuOS^3$, was almost perfectly homogeneous and was different in color from the other copper compounds. It was dark grey, nearly black, without the bluish tinge of the others. The sulphids of silver were dark grey, one nearly black, the other considerably lighter. Both appeared to be perfectly homogeneous.

With regard to the manner in which the sulphids are forming by boiling sulphur with the salts of silver and copper, it might be supposed that one portion of the sulphur would be oxydized at the expense of the oxyd of the metal, while another portion of sulphur would unite with the metal thus set free. Whether this is the case or not, appears to be somewhat doubtful. After boiling sulphur a long time with solutions of acetate of copper and nitrate of silver, until the sulphur was well blackened, the filtrates were tested for sulphuric acid. In the copper solution none

* The oxysulphids already described are ZnO, ZnS, CoO, CoS, and MnO, MnS, described by Arfvedson (Pogg., 1), AsO^3S^2 by Bouquet and Cloez (N. Ann. de Chim. et Phys., 13, 14; J. der Pharm., 7, 23), and red antimony-ore, SbO^3, $2SbS^3$. Of all these, the only one, the composition of which bears much resemblance to the formula ($CuOS^3$), is the arsenic compound; and from the wide dissimilarity between arsenic and copper, this analogy is of but little value as a proof of the probability of the above formula.

was found; in the silver only a trace. Another portion of each filtrate was then tested for other acids of sulphur, by boiling with nitric acid and then adding chlorid of barium. No sulphur separated, on adding the acid, and chlorid of barium gave merely a trace of sulphate of baryta in the silver solution; none in the copper solution. It is possible that the sulphur may be oxydized to sulphurous acid. No smell of this could be detected, during boiling; but as the action of the sulphur is not very rapid, the sulphurous acid may have been given off in too small quantity to have been detected. Against this hypothesis, however, are the following considerations. As has been shown, sulphurous acid and other reducing agents greatly assist the formation of the sulphids, and this can be owing only to their reducing power. Now, if the sulphur be oxydized to sulphurous acid, some of this latter would be oxydized to sulphuric acid, of which, in the copper solution at least, not a trace could be detected. If the sulphur is not oxydized and no reducing agent be present, it would seem that one of two suppositions must be adopted: either the sulphur sets the oxygen of the oxyd free, which, I take it, is highly improbable, or the oxygen still remains in combination with the metal and an oxysulphid is formed. The substances no doubt vary with the circumstances under which they are formed—length of time in boiling, concentration of solution, &c.,—since two of the analyses made agree with the formulas of sulphids, without oxygen. One of these was formed with the aid of sulphuric acid. In the other, it may be supposed that the sulphur perhaps in this case acted as a reducing agent.

II. *Action of Sulphurous Acid on the Solutions of Copper.*

As sulphurous acid was used in forming several of the compounds above described, I deemed it advisable to make some investigation into the action of sulphurous acid alone on the solutions of copper used.

Sulphurous acid in most cases produces no effect on the compounds of copper with the stronger acids. Under certain circumstances, however, a solution of sulphate of copper gives with sulphurous acid a small quantity of the well known red sulphite of protoxyd and suboxyd of copper (CuO, SO^2+Cu^2O, SO^2+HO, Rammelsberg), and in other cases small crystals of metallic copper.*

The action of sulphurous acid upon acetate of copper does not appear to have yet been observed. I found that sulphurous acid gas passed through a solution of acetate of copper, heated, though not to boiling, gave at first a yellowish precipitate. This dissolved up again as the operation was continued, and the solution deposited a large quantity of small, bright red crystals. The reactions of these corresponded to those of the red sulphite, mentioned above. This gives, therefore, a new method of preparing the above salt.

The yellowish precipitate, just mentioned, may also be obtained by adding sulphurous acid water, in small quantity, to a solution of acetate of copper, which contains little or no free acid. After washing and drying it was of a yellow color, with a slight greenish tinge. It appeared to be entirely insoluble in water. No crystals could be detected by the lens.

* Wöhler, Ann. der Chem. u. Pharm., lxxix, 126–127.

With sulphuric acid it gave off sulphurous acid in large quantity. By solution of caustic potash it was converted into a bright green, insoluble substance.* By boiling with caustic potash, it gave black oxyd of copper. A portion, dried in vacuo, over sulphuric acid, gave off considerable water, on heating in a closed tube. It was found to contain no alkali, and no acetic acid.

For analysis, the salt was boiled with chlorine water until it dissolved, the sulphuric acid precipitated by chlorid of barium, the excess of chlorid of barium by sulphuric acid, and the oxyd of copper, at the boiling point, by caustic potash.

1·2266 grms. substance gave 1·0341 sulphate of baryta and 0·6975 oxyd of copper.

		Calculated.	Found.
2CuO,	79·4	57·37	56·86
SO^2,	32·	23·12	23·15
3HO,	27·	19·51	
	138·4	100·00	

The salt is very soluble in sulphurous acid, to a green solution. The latter, by standing, deposits the red sulphite. Acetic acid has a precisely similar effect. In preparing the salt, therefore, the solution of acetate of copper must be neutral and the sulphurous acid added in small quantity. If too much acid be added, the precipitate will be redissolved, even before the solution smells of sulphurous acid.

The salt appears to be hitherto undescribed. The only mention I can find of anything similar is in a paper on the sulphites, by Böttinger.

Böttinger,† by mixing a solution of sulphate of copper with sulphite of ammonia containing but a small quantity of free sulphurous acid, obtained a dirty greenish-yellow precipitate, which, on the addition of a little sulphurous acid, was rapidly and easily converted into a beautiful green liquid. This yellow precipitate he did not investigate further. I prepared a quantity of it for comparison with the salt which I obtained. The color of the two substances varied considerably from each other. That obtained by means of sulphite of ammonia was brownish-yellow, with little or no greenish tinge. That prepared from acetate of copper was of a much brighter yellow, with a decided tinge of green. Böttinger's salt, however, gave precisely the same reactions as mine. With strong acids it gave off sulphurous acid in large quantity. With caustic potash it became bright green. By boiling with caustic potash it became black and gave no smell of ammonia. The two salts, therefore, are no doubt identical.

III. *Action of Red Selenium on the solutions of Copper, Silver and Lead.*

1. *Without the presence of reducing agents.*—Red selenium, left four days in solutions of sulphate and acetate of copper, still remained red, showing that it had not combined with copper. The same, boiled with

* The green color was owing, probably, to the presence of a little hydrated suboxyd of copper, the yellow color of which, with the blue of the hydrated oxyd, would give green.

† Ann. der Chem. u. Pharm., li, 410.

sulphate of copper, for a long time, did not take up any copper. Boiled with acetate of copper, however, it was found to have united with considerable copper.

For analysis of the product of this last reaction, red selenium was boiled several hours with acetate of copper, thoroughly washed, and dried in vacuo. The substance obtained was a black powder, mixed with hard lumps, which, when broken, had a somewhat metallic lustre. For analysis, it was dissolved in nitric acid, the oxyd of copper precipitated, at the boiling point, by caustic potash, washed, dried, and ignited with saltpetre and carbonate of potash.

0·5237 grm. substance gave 0·0507 oxyd of copper.

		Equivalents.
Cu, - - -	7·73	1
Se (by difference),	92·27	9·7
	100·00	

Hence it would seem that the selenium was only partly converted into selenid of copper, notwithstanding that the boiling was kept up five hours, or more.

Red selenium, left four days in solution of nitrate of silver, gave a black powder, along with a few white flakes of (probably) selenious acid. After dissolving out the latter by means of caustic soda, the black powder was found to contain selenium and silver, both in large quantity. No free selenium could be seen in it, by the aid of the lens. (See remarks on the action of tellurium on nitrate of silver.)

Red selenium, boiled a long time with acetate of lead, took up no lead.

2. *With the aid of reducing agents.*—As already mentioned, red selenium, with sulphate of copper and sulphurous acid, becomes black, through formation of selenid of copper.

For analysis, a portion was prepared in the same manner as the corresponding sulphid of copper. The product obtained was a black powder, nearly homogeneous, but containing a few glistening particles, which looked like metallic copper. The substance was dissolved in nitric acid and the oxyd of copper precipitated as usual by caustic potash. The separation of copper and selenium in this manner is not quite perfect, a little selenious acid being usually precipitated, along with the oxyd of copper. Accordingly, the copper in the following analysis comes out somewhat too high.

2·0735 grms. substance gave 0·8336 oxyd of copper.

		Calculated.	Found.
2Cu,	63·4	61·61	62·00
Se,	39·5	38·39	
	102·9	100·00	

This same compound may also be formed by heating copper with selenium, or by igniting the protoselenid in a close vessel. (Berzelius.) It is also found native.

Red selenium, boiled half an hour with acetate of lead and acetate of the protoxyd of iron, did not take up any lead.

IV. *Action of Precipitated Tellurium on the solutions of Copper, Silver and Lead.*

1. *Without the aid of reducing agents.*—Precipitated tellurium, left four days in solutions of sulphate and acetate of copper, did not unite with any copper. Boiled with sulphate of copper, four or five hours, it also remained unchanged. Boiled with acetate of copper, it took up considerable copper. Some of the product of this action, obtained by boiling the tellurium four or five hours with the acetate, consisted of a black powder, containing a few glistening particles, otherwise homogeneous. An analysis of it was made as follows. The substance was dissolved in aqua regia and the oxyd of copper precipitated by caustic potash, dried, and ignited with nitre and carbonate of potash. To free the oxyd entirely from tellurous acid, it was again boiled with caustic potash. After weighing, the oxyd of copper was tested for tellurium and was still found to contain a trace.

0·2671 grm. substance gave 0·0831 oxyd of copper.

		Calculated.	Found.
2Cu,	63·4	24·82	24·82
3Te,	192·	75·18	
	255·4	100·00	

This and the following are, I believe, the only analyses that have been made of a tellurid of copper. Gmelin (Handbook of Chem. Engl. Transl.) merely mentions that tellurid of copper is pale red, according to Berzelius.

The action of tellurium upon nitrate of silver has been observed by Fischer: viz., that it acts very freely upon the solution of nitrate of silver, and forms a black powder, which does not assume the metallic lustre under pressure. Fischer does not mention whether the black powder was tellurid of silver or metallic silver, but leaves it to be inferred that it was the latter, as the observation is given in connection with the reducing action of the metals upon the salts of silver. That tellurid of silver is formed is probable from the analogous action of sulphur upon nitrate of silver, as well as of selenium and tellurium on acetate of copper. The following experiment also makes this probable. Precipitated tellurium was left four days in solution of nitrate of silver. At the end of that time, the solution still contained a large excess of silver. The black powder appeared under the lens to be perfectly homogeneous and to contain no white flakes of tellurous acid. It was found to contain silver and tellurium, both in large quantity. Now, if metallic silver was precipitated by the tellurium, probably little or no tellurium would remain unoxydized, after being in contact so long with an excess of the silver solution, but would either pass entirely into solution (the hydrate of tellurous acid dissolves in water with tolerable facility—Berzelius), or, if there was not enough liquid present to dissolve the whole, be visible as white tellurous acid.

Precipitated tellurium, boiled a long time with acetate of lead, precipitated no lead.

2. *With the aid of reducing agents.*—Precipitated tellurium, heated with sulphate of copper and sulphurous acid, united with considerable copper. For analysis of the product of this reaction, a portion was pre-

pared in the same manner as the corresponding sulphid of copper. The substance obtained was a black powder. It was ignited with nitre and carbonate of soda, and the oxyd of copper separated from the melted mass by dissolving in water. This method is not to be recommended. The platinum crucible used was attacked somewhat (perhaps because there was not enough nitre), and platinum was thus mixed with the oxyd of copper. To separate them, the oxyd of copper was ignited a long time, to bring all the platinum into the metallic state, and then dissolved out with nitric acid and precipitated by caustic potash. A better mode of analysis is that given in the analysis last described.

0·9498 grm. substance gave 0·3818 oxyd of copper.

		Calculated.	Found.
Cu,	31·7	33·12	32·09
Te,	64·	66·88	
	95·7	100·00	

Precipitated tellurium, boiled half an hour with acetate of lead and acetate of the protoxyd of iron, did not combine with any lead.

V. *Action of Phosphorus on the solutions of Copper, Silver and Lead.*

1. *Without the presence of reducing agents.*—The action of phosphorus on solutions of copper has already been observed by Bœck, Vogel and Bœttcher, and I have but little new to add to their observations.

Phosphorus, placed in a boiling solution of sulphate of copper, gave at first metallic copper, but this gradually blackened and by continued boiling appeared to be entirely converted into phosphid. This has been also observed by Böttcher. For analysis, I prepared some of the above phosphid by boiling phosphorus five or six hours with sulphate of copper. The substance obtained was a black powder, the larger particles possessing considerable lustre. Under the lens it appeared to be perfectly homogeneous. Even when finely pulverized, not a trace of metallic copper could be seen. Heated on platinum foil, here and there a very slight flame was observed for two or three seconds. The quantity of free phosphorus, however, if there was any present, must have been extremely small.

For analysis, a portion was dissolved in hydrochloric acid, with the aid of chlorate of potash, the solution heated until it no longer smelled of chlorine, diluted, and the copper precipitated by sulphuretted hydrogen. The filtrate was saturated with ammonia, and the phosphoric acid precipitated by sulphate of magnesia (mixed with chlorid of ammonium in sufficient quantity to prevent its precipitation by ammonia). The sulphid of copper was dissolved in fuming nitric acid and the oxyd precipitated by caustic potash.

0·6695 grm. substance gave 0·7301 oxyd of copper and 0·2916 phosphate of ammonia-magnesia.

		Calculated.	Found.
7Cu,	221·9	87·74	87·06
P,	31·	12·26	12·16
	252·9	100·00	99·22

The phosphids of copper previously described are Cu^6P, Cu^3P, and Cu^2P.

Phosphorus in solution of nitrate of silver throws down metallic silver, as observed by Bœck. The silver has the usual color and metallic lustre, and is apparently crystalline. No phosphid could be seen.

Phosphorus, left three days with a solution of acetate of lead in a closed test-tube, gave merely a few white flakes, probably of phosphate of lead. On boiling, a black precipitate was rapidly formed in large quantity, along with white phosphate of lead. After dissolving out the latter with caustic potash, the black substance was dissolved up in nitric acid, and tested for phosphoric acid. None was found: so that the substance, it would seem, was metallic lead.

2. *In the presence of reducing agents.*—Solution of sulphate of copper was saturated with sulphurous acid, phosphorus added, the whole heated somewhat, and left three days in a closed flask. On opening the flask, the solution was colorless. The result was metallic copper, and black phosphid of copper, along with unchanged phosphorus. I did not attempt to analyze the phosphid, as it was so intimately mixed with finely divided metallic copper that it was impossible to obtain it pure.

VI. *Action of Arsenic on the solutions of Copper, Silver and Lead.*

1. *Without the aid of reducing agents.*—Pulverized metallic arsenic, boiled with sulphate of copper, took up considerable copper. For analysis of the product of this reaction, pure metallic arsenic, pretty finely pulverized, was boiled several hours with concentrated solution of sulphate of copper. The substance obtained was a perfectly homogeneous, dark-grey powder. It was dissolved up in hydrochloric acid, with the aid of chlorate of potash, and digested at a very gentle heat with excess of chlorate of potash, in order to make sure of converting all the arsenic into arsenic acid, until the solution was nearly free from chlorine. The solution was then made strongly alkaline with ammonia and the arsenic acid precipitated by a mixture of sulphate of magnesia and chlorid of ammonium. This was washed with water, containing considerable ammonia, brought upon a weighed filter and dried at 100° C. From the filtrate, after acidulation, the copper was precipitated by sulphuretted hydrogen, dissolved in fuming nitric acid and reprecipitated by caustic potash.

1·0225 grms. gave 0·7211 arseniate of ammonia magnesia ($2MgO$, NH^4O, AsO^5, $+HO$) and 0·9276 oxyd of copper.

		Calculated.	Found.
6Cu,	190·2	71·72	72·43
As,	75·	28·28	27·83
	265·2	100·00	100·26

The arsenids of copper previously described are Cu^4As and Cu^3As.

Arsenic in solution of nitrate of silver throws down metallic silver, as already observed by Fischer.

2. *With the aid of reducing agents.*—Pulverized metallic arsenic, heated with solution of sulphate of copper and sulphurous acid, forms

arsenid of copper. For analysis, a portion was prepared in the same manner as the corresponding sulphid of copper. The substance obtained was a dark-grey, perfectly homogeneous powder. Two arsenic determinations were made, in the same way as in the last analysis.

I. 1·1215 grms. substance gave 1·4189
$2MgO, NH^4O, AsO^5+12HO$ (dried in vacuo).

II. 0·3235 grm. substance gave 0·2650
$2MgO, NH^4O, AsO^5+Ho$ (dried at 100° C.).

		Calculated.	Found. I.	Found. II.
5Cu,	158·5	67·88		
As,	75·	32·12	32·78	32·33
	233·5	100·00		

Pulverized arsenic, boiled half an hour with acetate of lead, precipitated no lead. With acetate of the protoxyd of iron and acetate of lead, it also produced no effect.

VII. *Action of Antimony on the solutions of Copper, Silver and Lead.*

1. *Without reducing agents.*—Pulverized antimony, left three days in solutions of sulphate and acetate of copper, took up considerable copper, in both cases. A little white oxyd of antimony was also formed. By boiling, the action takes place more rapidly, and a large quantity of the oxyd is formed.

As already observed by Fischer, antimony precipitates metallic silver from the nitrate. Towards the end of the action, some antimonid of silver is also formed, according to Fischer.

Antimony, boiled a long time with acetate of lead, produced no effect.

2. *With reducing agents.*—Pulverized antimony, left three days in solution of sulphate of copper, mixed with sulphurous acid, combined with considerable copper. No white oxyd could be seen. In acetate of copper the same effect was produced.

Antimony, boiled with acetate of the protoxyd of iron and acetate of lead, did not throw down any lead.

ART. XXXII.—*An Account of two Meteoric Fireballs, observed in the United States, Aug. 2, and Aug. 6, 1860, with computation of their paths;* by H. A. NEWTON, of Yale College.

I. *Meteor of Aug.* 2, 1860.

THIS magnificent fireball appeared about five minutes after ten, P. M., Cincinnati mean time, and was seen over the whole region from Pittsburg to New Orleans, and from Charleston to St. Louis, an area of nine hundred miles in extent. Through the kindness of friends, and from newspaper notices, I have been able to collect much information respecting it, the most important of which is presented in the following summary. I wish to express my indebtedness to Mr. Robert Brown, Jr., of Cincinnati, for valuable assistance. Materials which he had collected for his own use he has generously placed at my disposal.

1. *The path of the meteor through the atmosphere.*

Mr. Samuel Schooler, M.A., Principal of the Edge Hill School, Guiney's, Va., (N. lat. 37° 58′, W. lon. 77° 52′), saw it move North, its path being inclined downward at an angle of 10° with the horizon. At my request, he measured with a theodolite the place of first appearance, viz: S. 59½° W., alt. 7° 12′. It passed behind obstructions S. 70° W.

Prof. Evans, of Marietta College, Ohio, says: "B. K. Shaw, Esq., of Marietta, (lat. 39° 29′, lon. 81° 26′), saw the meteor pass near certain definite landmarks, such as tops of trees, chimneys, &c. It first appeared to him about 11° West of South, at an altitude of 8° or 9°. It was just emerging from behind a clump of trees. He saw it pass through the topmost branches of a tree 28° West of South, at an altitude of 6° or 7°. It disappeared behind a church, S. 43° W., at about the elevation of the eaves, that is, about 4° above the horizon. I took these angles with a theodolite as Mr. Shaw pointed them out with a ruler."

Rev. J. McD. Mathews, D.D., of the Hillsboro Female College, (N. lat. 39° 15′, W. lon. 83° 30′), says that a young lady saw first a bright light, then a ball of fire, which passed the window 60 feet from her, in range with the upper part of it. Its course was descending. The middle of the window was 20° or 25° W. of S. from her, and the middle of the upper panes 7½ feet higher than her eye, giving an altitude of 7° 8′.

Mr. Robert Brown, Jr., of Cincinnati, (N. lat. 39° 6′, W. lon. 84° 27′) gives S. 5° W., alt. 12°, for one point of its path.

Peraz R. Polley, Esq., of Ironton, Ohio, (N. lat. 38° 35′, W. lon. 82° 30′), says its altitude when first seen was 15°, and that it disappeared due S.W., at an altitude of 7°.

Prof. T. A. Wylie, D.D., of Bloomington, Ind., (N. lat. 39° 12′, W. lon. 86° 26′), says that by referring to the top of a house which was nearly in a line with the meteor, he is able to determine that the altitude of no part of the track could have exceeded 8°. The brightest light first caught his eye near S. 22° E.

Madison, Ind., (N. lat. 38° 45′, W. lon. 85° 18′). Seen S. 15° E. at half the elevation of the moon (25°). Disappeared S. 5° E.

At St. Louis, (N. lat. 38° 37′, W. lon. 90° 15′), its altitude when first seen in the S. E. was said to be 3°, and about half that at disappearance in the East.

Mr. F. C. Herrick, of Bowling Green, Ky., (N. lat. 37° 0′, W. lon. 86° 24′), sent me a diagram which makes its path horizontal, and passing under the moon at less than half the altitude of that body.

At Pitts Cross Roads, Tenn., (N. lat. 35° 40′, W. lon. 85° 10′), it was said to come from the moon's place in the heavens. Mrs. J. W. Redfield saw it, when it was a little East of North, apparently proceeding Northerly.

Nashville, Tenn., (N. lat. 36° 10′, W. lon. 86° 49′). Apparently it passed under the moon which was then S. 53° E., 26° high.

Rome, Tenn., (N. lat. 36° 14′, W. lon. 86° 6′); it came from the S.E., and moved N.E.

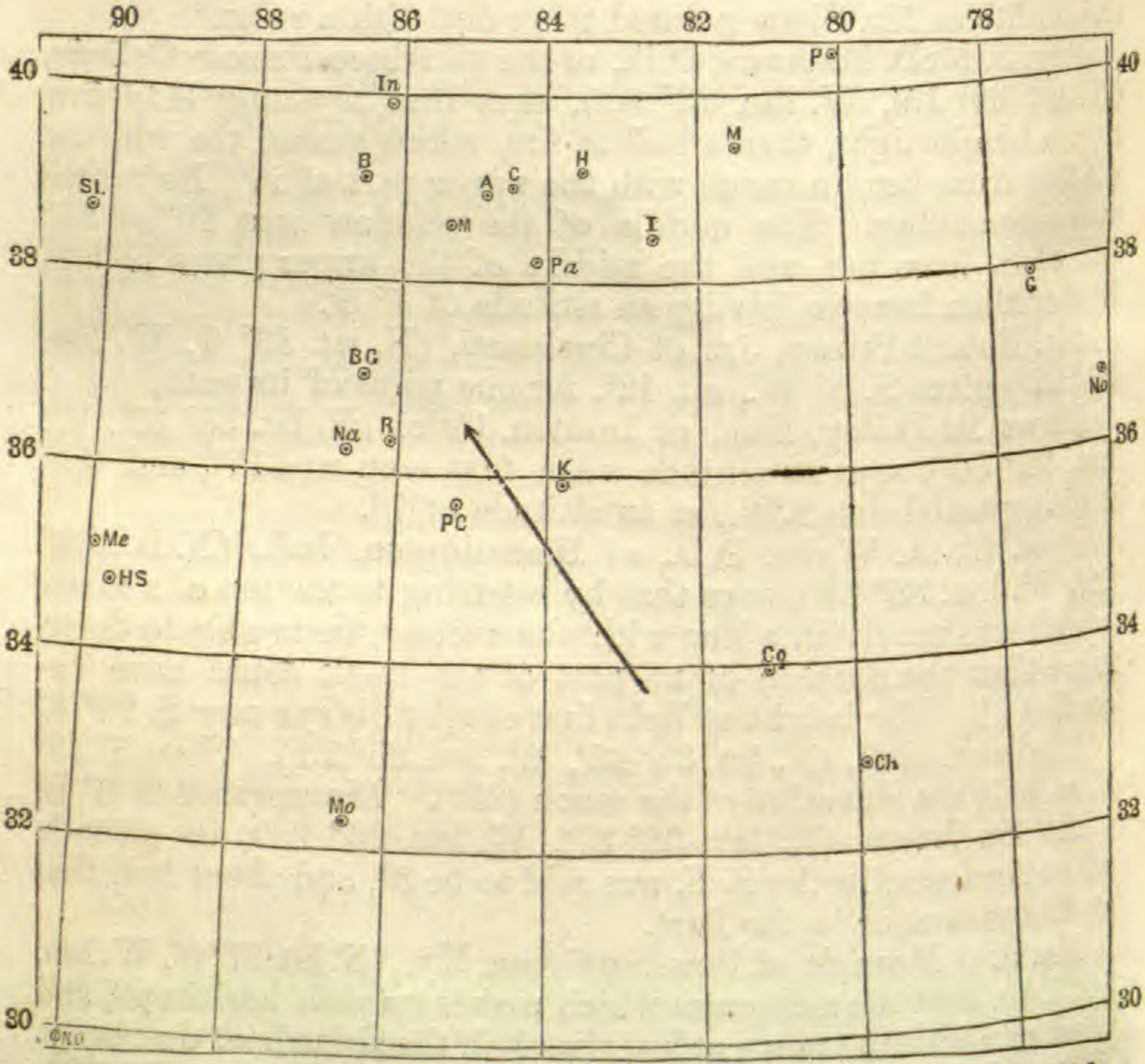
Montgomery, Ala., (N. lat. 32° 23′, W. lon. 86° 28′), started in the N.E. and went down almost due North.

Holly Springs, Miss., (N. lat. 34° 48′, W. lon. 89° 44′). Appeared in the Southeast, and exploded near the Northeast horizon. Greatest altitude 30°.

Charleston, S. C., (N. lat. 32° 46′, W. lon. 79° 56′), appeared nearly in the West at an altitude of about 40°. It did not disappear till very near the earth.

Many other indications of the path are given in the newspaper notices before me, but the estimates of altitudes are too great, or else the directions are manifestly in error.

1.



These observations indicate that the body first became visible over Northeastern Georgia about 82 miles above the earth's surface, near N. lat. 33° 50′, W. lon. 82° 40′, and that it exploded nearly over N. lat. 36° 40′, W. lon. 85° 5′, that is, over the southern boundary line of Kentucky, at an altitude of 28 miles. The length of the visible path was about 240 miles, and its direction N. 35° W. The position of the places of observation, and of the meteor's path, are indicated in the chart, (fig. 1) in which the places are marked by their initial letters.

The following table affords the means of comparing the above observations with the computed path. In the third and fourth columns are given the azimuths and altitudes at which points of the line given above would be seen at the several stations. The altitudes are corrected for refraction. When the azimuths are those of the beginning or end of the assigned path, it is indicated in the 2d column. The altitudes in the last column are derived from the observations.

Place.		Azimuth.	Comp. alt.	Obs. alt.
Marietta, ...	Beg.	S. 11° W.	9° 00′	8° or 9°
"		S. 28 W.	6 40	6 or 7
"	End.	S. 43 W.	4 30	4
Guiney's, ...	Beg.	S. 47 W.	8 15	
"		S. 59½ W.	5 45	7 12′
"		S. 70 W.	3 30	5 25
Ironton, ...	Beg.	S. 2 W.	12	15
"	End.	S. 48 W.	6 45	7
Cincinnati, ...		S. 5 W.	8 25	12
Bloomington, ...	Beg.	S. 31 E.	8	not over 8°
"	End.	S. 22 E.	7 15	"
Madison, ...	Beg.	S. 23 E.	10 10	12 30
"	End.	S. 5 E.	10 15	12 30
Hillsboro, ...		S. 22 W.	7 10	7 8
St. Louis, ...	Beg.	S. 54 E.	5 15	3
"	End.	S. 66 E.	3 10	1 30
Charleston, ...	Beg.	N. 66 W.	24	40
"	End.	N. 47 W.	1 30	above horiz'n.
Nashville, ...	Beg.	S. 57 E.	14 30	
"	End.	N. 70 E.	15	
Pitts C. Roads, ...	Beg.	S. 48 E.	22 15	
"		S. 52 E.	24 3	27
"	End.	N. 4 E.	21 15	
Bowling Green, ...	Beg.	S. 45 E.	13 15	
"		S. 52 E.	15	12 30
"	End	S. 72 E.	19 15	

2. *The duration of flight, and the velocity.*

Mr. Schooler, who is accustomed to the use of the transit instrument, gives six seconds. The estimate was made at the time. Mr. Shaw gives from five to seven seconds.

By others the following intervals were assigned. At Ironton, 2^s; Rome, 3^s; Charleston, 5^s or 6^s; Morrow, Ohio, 6^s or 7^s; Aurora, 10^s; Antioch Coll., 10^s; Pittsburg, 15^s; St. Louis, 15^s; Holly Springs, 15^s; Madison, 30^s; Cincinnati, Louisville and Nashville, several seconds; Chilicothe, nearly a minute.

These estimates lead me to consider 7 or 8 seconds as the most probable time of flight for the whole line. The corresponding velocity is 30 or 35 miles a second. The heliocentric velocity is on this supposition 24 or 28 miles. The latter velocity would indicate a hyperbolic orbit. The least possible heliocentric velocity for a body describing the given line is about 15 miles a second.

3. *Sounds heard after the explosion.*

Dr. Jas. W. Redfield, at Pitts Cross Roads, writes, that about five minutes after its passage they heard a tremendous explosion, and immediately another not quite so loud, in the direction in which the meteor had proceeded. They were re-echoed in the opposite direction with the prolonged roar of thunder. To the ear the explosion was like the booming of distant cannon.

Dr. Alex. McCall, of Rome, says that five or ten minutes after its passage there came a hundred sounds, like cannon fired in a deep hole, or like a great bass drum pelted by some giant keeping time.

Mr. W. C. Kain, of Knoxville, says that three minutes after the meteor had vanished, a long, reverberating sound was heard, of at least a minute's duration.

Paris, Ky. It was said to have been followed by a dull heavy sound like thunder.

As Paris is 125 miles from the place of explosion, the source of the sound may however be questioned. The above are the only reliable accounts which I have seen from those who heard the explosion.

4. *Magnitude of the body.*

It is most natural to measure the apparent size of a meteor by the moon's disc. From such a comparison and the distance of the observer the diameter of the body is at once computed. But this gives, I am convinced, a result very wide of the truth. The estimate of size is always vague. Irradiation too seems to prevent the diminution of apparent diameter naturally due to increased distance. This appears by comparing the estimates of the size of the meteor of Aug. 2d, made at different distances from its path, as below. The numbers indicate the distances to the nearest point of the meteor's path.

Knoxville,	(50);	head much larger than Mars.
Pitts C. Roads,	(50);	large as the moon, second ball not as large.
Bowling Green,	(80);	at first large as Venus, grew to the size of the moon.
Columbia,	(120);	two feet in diameter.
Aurora,	(170);	nearly as large as the moon.
Cincinnati,	(175);	large as a barrel.
Bloomington,	(190);	greater than the moon.
Ironton,	(200);	large as a barrel.
Hillsboro,	(200);	large as the moon or larger.
Portsmouth,	(200);	larger than the moon.
Antioch Coll.,	(230);	equal to the moon.
Indianapolis,	(230);	at first large as a man's hand, grew to the size of the moon.
Enon, Ohio,	(235);	first like a shooting star, grew to the size of a cocoanut.

Holly Springs,	(270);	at first not much larger than Mars, grew to exceed the rising moon. Others said large as the moon, large as a barrel, and two feet in diameter.
Marietta,	(280);	nearly twice as large as the moon.
Memphis,	(290);	large as the moon.
St. Louis,	(310);	from one-half to the full size of the moon.
Pittsburg,	(385);	large as the moon.
Guineys,	(400);	at first large as a star of the 1st mag., but grew in size and brilliancy until the whole western part of the heavens was brilliantly illuminated.
Norfolk,	(415);	each part as large as a butter keg.

This table indicates that an increase of distance does not produce any decrease in the assigned size. In fact there is rather an opposite tendency. It is useless then to compute the diameter of a meteor's nucleus (or of the flame even, if it is flame that we see,) by comparing its visible diameter with that of a heavenly body, as the moon. Thus we may get in the present instance four miles, or half a mile, according as we use the more distant, or the nearer observations. For anything I can see the smaller of these diameters may be a hundred, or even a thousand times greater than that of the nucleus.

In several of the accounts mention is made of a regular, or an irregular increase in the apparent size of the meteor, and that too when the meteor was not approaching the observer. Such an increase, if true, must be due to increased brilliancy, and hence to irradiation, or else to a larger body of flame. In either case the larger diameter evidently does not belong to the meteoric body.

5. *Colors of the body and of the train.*

Some persons classify meteors according to color. Those seen by a single careful observer may perhaps admit of such an arrangement. But this classification seems of little use when the meteors are seen by different and unpracticed observers. The nuclei of the meteor of Aug. 2d were said to be, white—pearl—rose color—pale red—red—bright red—crimson—saffron—yellowish—greenish—bluish—blue. The corona and train were bluish—bluish white—blue—green—yellow—rose color—reddish—pale red—red—bright red—crimson—scarlet—dazzling white.

6. *Brilliancy.*

In brilliancy this must be ranked in the first class of meteors. Its train was not many degrees in length. The path of the meteor of July 20th, 1860, was longer, and its motion more deliberate and stately. Yet this exhibition was, I am convinced, in most respects more magnificent than that of its noted predecessor.

It did not leave the atmosphere—for its path was downward, inclined more than 10° to the horizon of the place of explosion. It terminated abruptly, and that at a point low down in the atmosphere. It is impossible that it should have escaped again without a continuance of its visible path, and change of direction.

It must have been a solid body.—This is inferred; 1st, from the tremendous detonation that followed it; 2d, from its breaking up into several parts before disappearance; 3d, from visible explosions during the flight, during which multitudes of sparks were sent off; 4th, from its penetrating the atmosphere so far; 5th, from the similarity of the phenomena to those when aerolites are seen to come down.

Whether any parts of the body came to the ground except as fine dust it is impossible to say. Its tremendous velocity seems quite sufficient to entirely dissipate any substance.

I think it probable that only those meteors whose relative velocities are quite slow furnish aerolites. Those whose relative velocities are large are burnt up, or dissipated, before reaching the ground.

II. *Meteor of Aug.* 6, 1860.

On the evening of Aug. 6th, 1860, at about 7^h 38^m New York mean time, a very bright fireball was visible even in the strong twilight, from Pittsburg, Pa., to Roxbury, Mass. Its brilliancy was compared by several observers to that of Venus, and to that of Mars, which was then very bright in the southeast. To the nearer observers it was very much more brilliant than those planets. Near the middle of its course it appeared to distant observers to separate into two parts, while those who were nearer saw it continually giving off fragments. Had it appeared later in the evening it would perhaps have rivalled in brilliancy the displays of July 20th, and Aug. 2d. At Pittsburg and Buffalo the sun had gone down but 5^m before. No undoubted accounts of an audible explosion have been received.

Mr. Arthur N. Hollister saw the meteor from the roof of a house in New Haven (N. lat. 41° 18′, W. lon. 72° 55′). Two days afterwards I went with him to the place, and from his description of its path determined its places of appearance and disappearance to be, S. 80° W., alt. 6° to 7°, and N. 70° W., alt. 5°. To obtain the period of flight I requested him to suppose the meteor to pass again over the same arc of the heavens, with the same velocity as before, while the interval was noted by the watch. I cautioned him against making the motion too rapid. Three or four trials gave a result of 8 seconds. Another person who was with him gave 5 seconds for the interval, but 7 or 8 seconds was considered the more probable time of flight.

Mr. Homer G. Newton, the brother of the writer, saw the meteor from Sherburne, N. Y. (N. lat. 42° 41′, W. lon. 75° 33′), and observed carefully its path with a view to future measurements. On the evening of Aug. 11th I went with him to the place of observation, and he described the track of the meteor which I recorded by referring it to stars then visible. A few days later I measured with a quadrant and compass the altitudes and azimuths as pointed out by him. The first measurements gave for the points of appearance and disappearance S. 59° W., alt. 11½°, and N. 84½° W., alt. 9¼°; the second gave S. 54½° W., alt. 12° to 12½°, and N. 84° W., alt. 9° to 9½°.

The period of flight, determined as in the New Haven observation, was in several distinct trials given always as 6 seconds.

Washington McClintock, Esq., saw the meteor from Pittsburg, Pa. (N. lat. 40° 32′, W. lon. 80° 2′). It passed across an open space between trees two or three hundred feet distant. His son, then a member of the Senior Class in Yale College, was called, but not in time to see it. The apparent path was immediately located as accurately as possible with reference to the trees. Measurements made some months later gave S. 82½ E., alt. 10¾°, and N. 39° E., alt. 11⅓° for the places of its emergence and disappearance behind the trees.

Mr. William Wheeler saw the meteor from Crum Elbow Point (N. lat. 41° 45′, W. lon. 73° 56′), on the east bank of the Hudson river, five miles above Poughkeepsie. When first seen it was 6° to 10° above the horizon, S. 80° W., and it sailed slowly northwesterly, inclined gradually downward, and disappeared behind the high hills about N. 70° W. Time of flight, 8 to 10 seconds.

All these persons except Mr. McClintock are recent graduates of Yale College. I have felt that the four observations were worthy of more than ordinary confidence. United with a large number of newspaper and other accounts, they indicate that the following straight line is not far from the true path of the meteor both in direction and position: starting from a point 39 miles above the earth, nearly over the southern line of Pennsylvania (N. lat. 39° 35′, W. lon. 76° 45′), and passing N. 30° W. to a point 36 miles high, west or northwest of Buffalo. Its length is 225 to 250 miles, and its least height above the earth 35 miles.*

In the 3d column of the following table I give the altitudes at which this line would be seen at these four and at other places at the azimuths assigned. In the 4th column are corresponding observed altitudes, obtained from newspapers and other sources.

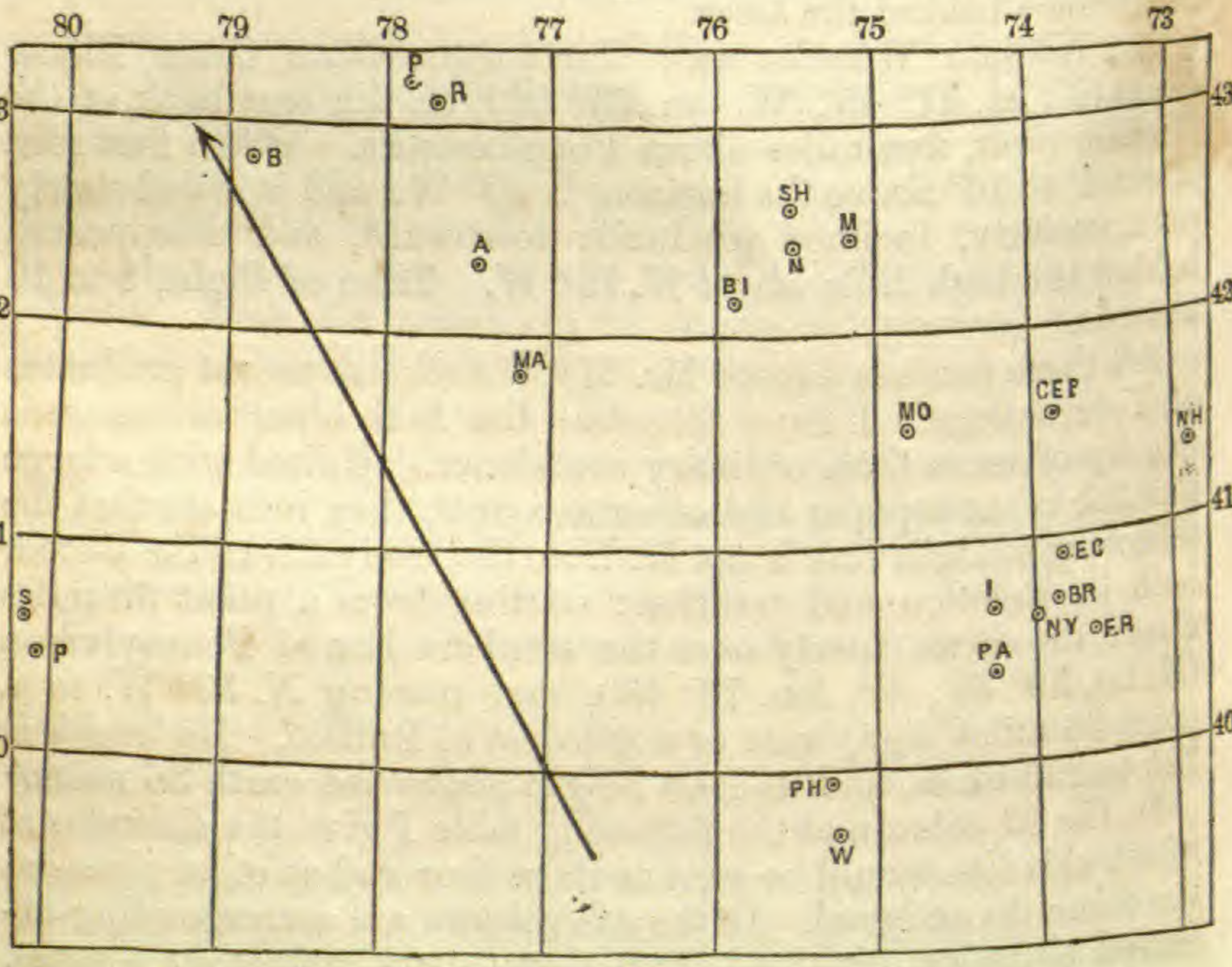
* Since this article was in type, Mr. R. T. Comstock of Westfield, N. Y. (N. lat. 42° 17′, W. lon. 79° 37′) writes to me that it passed 30° N. of the zenith of that place. As it disappeared at Buffalo towards the setting sun, the place of extinction is probably nearer N. lat. 43°, W. lon. 80°, than is represented in the chart. I have not however thought best to change the text. This change of path renders a hyperbolic orbit more probable.

When the azimuth has not been mentioned, I have assumed that that of the greatest altitude was meant.

Place.	Azimuth.	Comp. alt.	Obs. alt.	Place.	Azimuth.	Comp. alt.	Obs. alt.
	°	° ′	°		°	° ′	°
New Haven, ..	S. 80 W.	7 5	6	Philadelphia,	S. 85 W.	22 10	12¼
"	N. 70 W.	3 35	5	"	N. 52 W.	8 30	6½
Sherburne, ...	S. 57 W.	11 10	12	"	West.	21	25
"	N. 84 W.	9 40	9¼	"	N. 70 W.	15 30	20
Pittsburg, ...	S. 82 E.	14 25	10¾	"	N. 40 W.	5	9
"	N. 39 E.	14 15	11¼	Woodbury, .	West.	22 45	40
Crum Elbow Pt.,	S. 80 W.	8 30	6 to 10	Norwich, ..		12 15	10 or 15
"	N. 70 W.	5 15		Binghamton,	S. W.	17 15	20
Far Rockaway,	West.	8 30	15	"	N. 70 W.	10 30	12
Brooklyn, ...	S. 75 W	11 15	10	Avoca, ...		31	40
New York, ...		12 15	20	Mansfield, ..		35	40
East Chester, ..	West.	8 30	20	Rochester, ..		25 45	45
Irvington, ...		13 20	14½	Parma, ...		26 30	30
Perth Amboy, .	West.	11 30	30	Sewickley, ..		15	35

The positions of these places are indicated in the following chart (fig. 2) by their initial letters.

2.



The duration of flight and the velocity.

Mr. Wheeler gives eight or ten seconds for the passage of the meteor over 180 miles of its course. This gives a velocity of about 20m a second.

The Sherburne observation gives six seconds for 115 miles, or 19m a second.

Mr. Hollister gives 7 or 8 seconds for 215 miles, or 29^m a second.

Mr. Pratt of Binghamton saw the meteor for a course of about 190 miles. He rose from his seat and walked across the street during its flight to avoid losing sight of it behind buildings. Eight or ten weeks later he walked over the same space with what he considered the same speed, while I noted the interval, 15 seconds. Had this been done immediately after seeing the meteor it would have afforded by far the best determination of the time of flight. But a person under excitement must move more quickly than he would weeks afterward suppose. An interval of 15 seconds gives a velocity of nearly 13 miles.

Mr. Crowel who saw it from Sherburne gave 8 seconds as the interval of flight. Mr. Arthur G. Newton who saw it from Parma, N. Y., gave 6 seconds. The same method of obtaining the time was employed in both cases as in the New Haven observation. In the newspaper notices the following periods were assigned: at Roxbury, Mass., 10 or 15^s; Sharon, Ct., 15^s to 20^s; New York City, 5^s; Perth Amboy, 30^s to 45^s; Brooklyn 10^s to 15^s; Ironton, N. J., 10^s to 15^s; Morris, N. Y., 12^s; Riverdale, 30^s; Mansfield, 70^s; Avoca, 15^s; Evensburg, 8^s to 10^s; Danville, 40^s; Monticello, 30^s to 45^s; Rochester, 12^s.

I give all of the times assigned. But it is evident that the longer periods ought to be rejected. Disregarding those of 30 or more than 30 seconds, the average of the remainder is 11 seconds. Assuming that the observers saw the meteor describe on the average three fourths of its visible trajectory we have a velocity of 16 miles a second. But if we reject also the Sharon and Avoca observations, we have a velocity of 19 miles.

Unless there is a constant error in the method made use of at New Haven and Sherburne for ascertaining the interval of flight, eighteen miles a second must be considered a tolerable approximation to the true geocentric velocity. It is worthy of remark that the observers were in very favorable positions for estimating the time, the motion across the sky being quite uniform.

To obtain the heliocentric velocity it may be well to allow for the effect of the earth's attraction even though the amount of the correction is decidedly less than the probable errors of the observation, and are perhaps less than the effects of the resistance of the atmosphere. The increment of velocity due to the earth's attraction is $1^m{\cdot}4$ and the change of direction nearly 5°. These corrections applied to the direction and velocity above given would make the velocity $16^m{\cdot}6$ a second, towards R. A. 108° 30′, Dec. +43° 45′. The parts of the earth directly under the meteor were moving towards R. A. 42° 7′, Dec. +16° 15′. The heliocentric velocity of the meteor is then $30^m{\cdot}4$, towards R. A. 67° 45′, Dec. +33° 25′.

This of itself indicates a hyperbolic orbit.—Let us therefore inquire whether any changes are admissible that will make the orbit an ellipse. The path of the meteor cannot be carried much to the eastward so as to shorten its length, and thus diminish the velocity. Its azimuth may be changed, several degrees even, without great violence to the observations, but this will have little effect upon the heliocentric velocity.

The meteor cannot reasonably be supposed to have ascended during the larger part of its course. On the other hand, to change it so as to make it describe a descending line would increase the heliocentric velocity.

Any change then must be in the duration of the flight. If the body was moving about the sun in an elliptic orbit, and the line given above was its true path, the geocentric velocity could not be greater than about 14 miles a second, which would require 16 or 18 seconds for the whole flight. This would moreover make no allowance for the resistance of the atmosphere. Though an elliptic orbit is very possible I can hardly think it probable.

Yale College, March, 1862.

ART. XXXIII.—*On Orthite from Swampscot, Mass.;* by DAVID M. BALCH, B.S.

MORE than a year since, while examining the rocks at Swampscot Beach, near the Clifton House, I observed a mineral occurring in small amorphous masses in quartz and red feldspar, which immediately attracted my attention by its peculiar lustre and appearance; this on examination has proved to be orthite almost identical with that from the Norway granite.

The shore at Swampscot and for half a mile or so N.E. towards Marblehead, consists of ledges of rock, against which the sea breaks, ranging from sienite to porphyry, and extending 50 or 60 feet backward, and, at the most, from 15 to 20 feet in height, to the pasture land above; these rocks are very rugged, seamed with trap, veins of quartz and red feldspar; in the latter occur good specimens of fibrous epidote, and the mineral furnishing the subject for this paper.

The orthite is found almost always imbedded in quartz, but I have obtained a few pieces from the feldspar, which forms the bulk of the veins; it occurs in black amorphous masses, sometimes surrounded with a reddish coating of sesquioxyds of iron and cerium, when much exposed to the weather or the action of the sea; and in very small quantity, for I only obtained a few grammes in return for searching the rocks throughout their whole extent. I examined this mineral shortly after its discovery, sufficiently to determine its name and general composition, and more carefully again this winter, and give below an outline of the method of analysis, and its results.

The orthite of this locality appears always to occur massive, at least no specimens that I have found show any signs of crystal faces. Sp. gr. at 18° C. 3·69—3·71. Lustre, resinous and in some cases nearly vitreous. Color, jet black, and streak gray. Heated in thin splinters before the blowpipe, fuses slowly to a black blistered glass; dissolves readily in borax and gives a globule, red when hot, but yellow after cooling; with soda gives a slight manganese reaction; in its natural state is very easily decomposed by chlorhydric acid, but after ignition is not affected by it in the least.

A small portion being reduced to powder, dried at 110° C., and then ignited, lost 1·49 per cent of combined water.

The preliminary analysis was performed on ·445 grms.; from it I ascertained the composition of the mineral, but was unable to determine accurately the amount of those substances present in small quantity. My method of analysis was that given by Wöhler,* in which cerium, yttria, &c., are separated from iron and alumina by moist carbonate of baryta. The following results were obtained:

Silica,	32·62
Alumina, Ferric-oxyd,	29·47
Ceric-oxyd, &c.	24·74
Lime,	8·05

Magnesia and soda were also present.

The ceric oxyd, &c., weighing about a decigramme, was examined for yttria, and abundant traces of it found; also inconsiderable traces of manganese.

The succeeding analyses undertaken principally to ascertain the amount of yttria present, were conducted as follows: A quantity of the levigated mineral, dried at 110° C., was decomposed in a porcelain dish by chlorhydric acid, (sufficient nitric acid being added during the operation to peroxydize the iron) and the silicic acid separated as usual: the filtrate from the silica was then supersaturated with ammonia by which oxyds of iron, aluminum, cerium and yttrium were thrown down, the magnesia being held in solution by the chlorid of ammonium formed by the excess of chlorhydric acid present in the liquid; this precipitate, which I will designate by *a*, was completely washed by decantation and then on a filter, and the washings, evaporated to a small bulk, were mixed with the filtrate; from this the lime was thrown down by oxalate of ammonia, and weighed first as carbonate and then as sulphate; in the filtrate from the lime magnesia was precipitated by phosphate of soda, as I did not intend to determine the amount of soda or potassa which may have been present; manganese was also present in such small tracess that it was disregarded.

In order to separate the ceric-oxyd and yttria from sesquioxyd

* Practische Uebungen in der chemischen Analyse, Göttingen, 1853, s. 112.

of iron and alumina in precipitate *a*, I digested it, while still moist in aqueous oxalic acid; the separation was perfect, and the insoluble oxalates obtained were free from iron; after standing 24 hours, these were well washed, dried, ignited and weighed as ceric-oxyd and yttria. The sesquioxyd of iron and the alumina, contained as acid oxalates in the filtrate and washings of the above, were now separated, in the first case as usual, by potassa; in the second analysis by evaporating to dryness, igniting to destroy oxalic acid and expel ammoniacal salts, peroxydizing any reduced iron by nitric acid, and weighing the mixture of $Al_2O_3+Fe_2O_3$ as a control to the first analysis.

These analyses were performed exactly alike, with the exception given above, the first on ·782 grms., and the second on 1·032 grms. of substance.

To separate yttrium and cerium oxyds, I employed the following process given in Rose's Handbuch der analytischen Chemie, Braunschweig, 1851, Bd. 2, s. 72. The ceric-oxyd, &c., from both analyses, weighing nearly five decigrammes, was fused with bisulphate of potassa, the mass digested with a warm solution of sulphate of potassa sufficiently concentrated to deposit crystals on cooling, and the insoluble sulphate of potassa and cerium entirely washed out with this solution; yttria was thrown down from the decanted liquid and filtrate by excess of potassa, and weighed as such; it contained a little manganese.

The following results were obtained by these analyses:

	A	*B*
Silica,	33·31	32·94
Alumina,	14·73	Al_2O_3 } 33·60
Ferrous oxyd,	15·82	Fe_2O_3 }
Cerous oxyd,	21·94	20·71
Yttria,	1·32	1·32
Lime,	7·85	7·87
Magnesia,	1·25	1·47
Soda,	(undetermined)	
Water,	1·49	1·49
	97·71	99·40

In orthite and allanite about half the iron is usually in the state of sesquioxyd; in analysis *A*, all the iron is calculated as protoxyd which occasions the apparent loss; an attempt was made to determine the amount of protoxyd present, by the chlorid of gold and sodium process,* but it was unsuccessful, and could not be repeated for want of material.

These analyses and the physical properties of the mineral, prove it to be orthite, very closely resembling that from Hitteroe, Norway.†

It is interesting to remark that this is the first instance of the occurrence of yttria in New England, if we except the single specimen of yttrocerite, found sometime since in Worcester Co.,

* Rose's Handbuch, Bd. 11, s. 129. † Dana's Mineralogy, 1854, p. 210.

Mass., the locality of which is unknown. As our rocky New England ledges are more extensively examined or quarried, we have reason to hope that they may yield some of the other rare minerals of the Scandinavian granites.

Salem, Feb. 6th, 1862.

ART. XXXIV.—*A new Metal in the Native Platinum of Rogue River, Oregon;* by C. F. CHANDLER, Professor of Chemistry at Union College.

IN examining native platinum from the above locality, more than a year ago, I became convinced of the probable existence of a hitherto unobserved metal. I have deferred publishing my observations, hoping to obtain material for a more complete examination; in this I have thus far been disappointed.

The quantity of platinum examined amounted to only a few grammes. It was digested with hydrochloric acid to remove impurities, and the solution thus obtained was subjected to the ordinary routine of qualitative analysis.

A brown precipitate was produced by hydrosulphuric acid, which dissolved readily in hydrochloric acid on the addition of a crystal of chlorate of potassa. In this solution metallic zinc produced a precipitate which resembled metallic tin, obtained under similar circumstances. This precipitate dissolved readily in hydrochloric acid on the application of heat, but the solution thus obtained had no effect on a solution of protochlorid of mercury (HgCl), and on cooling deposited a small quantity of minute crystals. To guard against error these experiments were repeated two or three times on small portions of the original solution, always with the same result.

The chlorid of this metal differs therefore from the protochlorid of tin, in not reducing protochlorid of mercury to calomel, and in being but slightly soluble in the cold.

On mentioning my observations to a friend, I was referred to Dr. F. A. Genth's announcement of a new metal, made in 1852,* of which I was not previously aware.

The metal observed by Dr. Genth occurred among grains of platinum from California. It was malleable; it fused readily on charcoal before the blowpipe, becoming covered with a coating of black oxyd; it dissolved in borax to a colorless bead, which became opalescent on cooling; it was dissolved by hot hydrochloric acid and by nitric acid; and its solution gave a brown precipitate with hydrosulphuric acid. It seems quite probable therefore, that the metal which I have observed in the Rogue River platinum, is identical with that observed by Dr. Genth.

Schenectady, March 6, 1862.

* Proceedings of the Philad. Acad. Nat. Sci., Dec. 1852, and this Journal, [2], xv, 246.

ART. XXXV.—*Notice of the Rocks lying between the Carboniferous Limestone of the Lower Peninsula of Michigan and the limestones of the Hamilton Group: with descriptions of some Cephalopods supposed to be new to science;* by ALEXANDER WINCHELL, State Geologist of Michigan.

THROUGHOUT the counties of Hillsdale and Calhoun, and the southern half of Jackson county, in the Lower Peninsula of Michigan, occur frequent outcrops of a fine, friable ferruginous sandstone whose stratigraphical position in this part of the state, is not more than forty or fifty feet below the Carboniferous limestone. The whole thickness of the series is less than 300 feet. The upper portion of this succession of sandstone strata is more grayish than the lower, more firmly cemented, and more homogeneous; and it has thus far proved remarkably destitute of organic remains. The lower portion of the series, which is separated from the upper by fifteen feet or more of shale, is of a dingy-reddish or yellowish color, with a very conspicuous amount of ferruginous matter, often disposed in bands conformable with the lamination of the rock, or producing a rude concretionary structure, and not unfrequently solid nodules and bands of ironstone. At Battle Creek in Calhoun county, these strata, when not weathered, are of a bluish color, and firmly cemented by an abundance of calcareous matter. At Hillsdale and Jonesville in Hillsdale county, these sandstones are thicker-bedded, more fine and homogeneous, and incline more to an olive color. The lowest strata here are bluish, shaly and highly micaceous. The most instructive exposures of this part of the sandstone series occur at Hillsdale, Moscow and Jonesville in Hillsdale county, and at Marshall, Ceresco and Battle Creek in Calhoun county. At most of these localities, especially those in Calhoun county, the sandstone is well stocked with fossil remains belonging to the genera *Goniatites*, *Nautilus*, *Orthoceras*, *Bellerophon*, *Nucula*, *Solen*, *Myalina*, *Chonetes*, &c. These lower fossiliferous sandstones have been designated the "Marshall Group," and the upper, unfossiliferous beds the "Napoleon Group," though it will appear obvious there are no very conclusive reasons for separating the two groups.

From this part of the state, the outcrops of these two groups are believed to trend northeast and northwest in curved belts toward Pt. aux Barques and the mouth of Grand river. Toward the northwest, the next actual exposure known is in the township of Holland, Ottawa county, and west of there to the vicinity of Lake Michigan; though the intervening space affords numerous loose fragments of the formation. The Napoleon sandstone is seen again near Grandville in Kent county, and the Marshall sandstone near the center of Ottawa county. Toward the northeast, the next actual exposure occurs near the sources of the Cass river in Sanilac county, whence the sandstones are traceable to the shore of Lake Huron, which they occupy from the mouth of Pigeon river to Pt. aux Barques.

The fine-grained sandstones of the southern part of the state are overlaid by the saliferous and gypsiferous clays of the "Michigan Salt Group," attaining a thickness of 184 feet at Grand Rapids and Saginaw, but in Jackson county attenuated to less than 50 feet. They are underlaid in Branch, Calhoun, St. Joseph and Van Buren counties, by a considerable thickness of argillaceous strata sometimes plastic and abounding in Kidney iron ore, sometimes shaly, and sometimes blackened with bituminous matter. They contain very few fossils.

In the vicinity of Pt. aux Barques, the typical Marshall sandstone is separated by two feet of conglomerate from the bluish, fine-grained, homogeneous gritstone, from which have been manufactured the famous Huron grindstones. These are succeeded downwards by a great thickness of dark, fissile, somewhat bituminous shales, with intercalated flagstones, striking nearly southward in lines parallel with the lake shore in Huron and Sanilac counties, and occupying, as is believed, a large portion of the bed of the lake between Saginaw Bay and Port Huron. At a lower level occur the black bituminous shales of Kettle Pt. on the Canadian shore, and Sulphur island and Squaw Pt. at the head of Thunder Bay on the Michigan shore. At the latter localities, these are succeeded by the fossiliferous limestones of the Hamilton group. The black shales are seen again near the mouth of Grand Traverse Bay, covered by a few feet of green shale, and underlaid as before by the Hamilton limestones. No rocks of the age of the Hamilton Group have been recognized as yet, in the southern part of the state.

The following is a synoptical view of the strata embraced in the foregoing sketch; aggregate thickness over 800 feet.

Carboniferous limestone,		66	feet.
Michigan Salt Group,		184	"
Napoleon Group,		123	"
(*d*) Shaly micaceous sandstone,	15		"
(*c*) Napoleon sandstone,—highly saliferous in many localities,	78		"
(*b*) Shaly, micaceous sandstone,	15		"
(*a*) Clay and shale, more than	15		"
Marshall Group,		173	"
(*d*) Reddish, yellowish and greenish sandstones,	147		"
(*c*) Shaly, micaceous sandstone,	10		"
(*b*) Conglomerate,	2		"
(*a*) Fine, bluish gritstones,	14		"

Huron Group, ...		210 feet.
(c) Shales, limestones and flagstones, ...	180	"
(b) Green shale, ...	10	"
(a) Black bituminous shales, ...	20	"
Hamilton Group, ...		55 "

The reëxamination of the ferruginous sandstones and underlying shales, which have been made within the last two or three years, have tended to confirm the opinion long entertained that they are the equivalents of certain formations in other northwestern states whose true geological horizon has not yet been settled by the general consent of American geologists. The interest which attaches to any definite information bearing upon the controverted question of the exact age and equivalents of these rocks, would seem to justify the attempt to make known the facts in my possession. I accordingly submit the following notice of some characteristic fossils occurring in the rocks under consideration:

Descriptions of Cephalopods from the Marshall and Huron Groups of Michigan.

ORTHOCERAS INDIANENSE.

O. Indianensis Hall, 13th Rep. N. Y. Regents, p. 107.

Septate portion of shell more than 3·75 inches* in length; inclination of sides forming an apical angle which varies in different specimens from 6° to 11°; transverse section circular; septa at right angles with the central siphon; ratio of depth of chamber to its diameter, in different specimens 2·0, 2·67, 2·71 and 3·46; ratio of concavity of septum to its diameter 2·81; ratio of diameter of siphon to diameter of shell 5·67. No surface markings discernable on the cast.

Localities. The most abundant *Orthoceras* in the Marshall sandstone. I have specimens from Marshall, Calhoun county, Holland, Ottawa county, Moscow and various other points in Hillsdade county, and from Hard Wood Pt. (one mile S.W. of Pt. au Pain Sucre) on the shore of Saginaw Bay in Huron county.

The specimens from Michigan exhibit all the characters published, of *O. Indianensis* Hall, except the apertural constriction, with reference to which I have not been enabled to make any observations. The casts of this species cannot be distinguished from those of *O. cinctum* Sowerby, as defined by de Koninck ("Animaux Fossiles," p. 513, pl. xliii, fig. 6; xliv, 5; xlviii, 3). It is equally undistinguishable from *O. Goldfussanum* de Kon. (op. cit., 510; pl. xliii, 3, 4), except that the septa of this species are separated by only about one-eighth of their diameter.

* The measurements in the following descriptions are all given in inches. Where a measurement is followed by a number in parentheses, the latter is the *relative* dimension, the greatest measure given in the description being assumed as 100.

ORTHOCERAS ROBUSTUM, n. sp.

A septate fragment of this species has such a curvature that the individual must have been 3·4 in diameter. Amongst other fragments of the last chamber of the shell, one is so large as to imply a diameter of 4·6. The septa appear to be transverse, separated from each other ·31, where the diameter is 3·4, giving a ratio of 11. In another specimen this ratio is ·15 : ·98=6·54. No surface markings are indicated upon the casts. Siphon not seen.

Localities. Marshall, Moscow and Hanover in Jackson county.

This species has the size and general appearance of *O. giganteum* Sow. (de Kon., op. cit., 510, pl. xliv, 2; xlv, 3; xlvi, *a*, *b*; xlvii, 1), but differs, as far as observed, in having the septa separated by one-sixth to one-eleventh of their diameter, instead of one-third. It differs from *O. crassum* F. Röm. (Sandberger, "Versteinerungen," p. 164, Taf. xix, fig. 1) by a much greater approximation of septa; and this reason, as well as its very great size, has induced me to separate it from *O. Indianense.*

ORTHOCERAS VITTATUM. ?
Sandberger (Verstein., 165; Taf. xx, 9).

Shell very gradually tapering; transverse section circular; ratio of the depth of the chambers to their diameter ·09 : ·22= 2·56; ratio of concavity of septa to their diameter ·07 : ·22=3·14. Siphon apparently slightly excentric. Surface (of cast) marked by delicate encircling bands, separated by rather sharp, fine grooves; four of these bands correspond to each chamber. There are also very feeble indications of striæ covering the bands.

Locality. In the Marshall sandstone at Battle Creek or Holland.

The single specimen in my possession differs from Sandberger's description only in the words "taeniis transversalibus *paullo obliquis.*" It differs from *O. bicingulatum* Sandberger (Verstein., 162, Taf. xvii, 3) in the transverse direction of the rings, and the perfectly circular section.

ORTHOCERAS ARCUATELLUM. ?
Sandb. (Verstein, 166; Taf. xix, 2).

Shell tapering to an angle of 12°; nearly smooth externally, with faint, encircling, unequal, irregularly sinuous striæ; section circular; septa transverse, with a convexity equal to one-sixth or one-seventh their diameter; siphon central. (?)

Locality. In the Marshall sandstone at Marshall.

The general characters of this shell present a good agreement with the species to which I have doubtfully referred it; but it is easy to point out differences. Our shell has a much less rapid taper, and the encircling striæ are much finer, more unequal, and not regularly reflexed on the anterior and posterior sides; moreover, no observations have yet been made on the depth of the chambers, while the position of the siphon admits of some doubt.

ORTHOCERAS OCCIDENTALE, n. sp.

Septate portion of shell more than 3¾ inches in length; greatest apical angle 8° to 12°; transverse section an ellipse whose minor axis is to the major as ·37 : ·48=1·3; septa nearly transverse with a concavity equal to about one-fifth the greater diameter; interseptal space about one-fourth the same diameter. Siphon situated on the minor axis about midway between the center and periphery, constricted where it passes through the septa, about ·06 in diameter in the chamber and ·04 in the constriction.

Localities. In the Marshall sandstone at Marshall and Moscow.

This species differs from *O. Muensterianum* de Kon. (An. Foss., pl. xlviii, 1, 5), by its nearly transverse instead of very oblique septa.

ORTHOCERAS BARQUIANUM, n. sp.

Septate portion of shell more than 4¼ inches long; greater apical angle (i. e., the one formed by the sides which are not compressed) about 10°; transverse section an ellipse whose minor axis is to the greater as ·35 : ·50=1·43; septa somewhat oblique, making an angle of 8° or 10° with a transverse plane, most elevated near one extremity of the longer diameter; amount of concavity and position of siphon unknown; distance between the septa about one-fifth the greater axis at the same place. No surface markings evident from an examination of casts.

Locality. Near the light house at Pt. aux Barques in a hard bluish sandstone embraced in the shales of the Huron Group. (See Huron Group, (*c*.) of the preceding table.)

This species may possibly prove identical with the preceding, but its apical angle is somewhat less, its septa more oblique, its section more excentric, and its geological position considerably lower.

ORTHOCERAS MARSHALLENSE, n. sp.

Septate portion of shell more than 5·75 inches long; greater apical angle 6°; transverse section an ellipse whose axes are to each other as ·36 : ·61=1·69; ratio of interseptum to greater axis ·25 : ·45=1·8; septa very concave, the concavity equaling ·17; siphon on the minor axis, a little excentric. The cast gives no evidence of surface markings.

Locality. In the Marshall sandstone at Marshall.

This species is readily distinguished from its allies and associates by the great distance of the septa from each other, and the very gradual taper of the shell.

ORTHOCERAS CLINOCAMERATUM, n. sp.

The only specimen of this quite distinct form is only 1½ inches in length, partly septate. It is a fragment of a shell about 3·3 inches long, having a major apical angle of 11°. The section is elliptical, with the minor axis to the major as ·24 : ·45=1·88. The first two septa are ·08 apart, and the ratio of this interval to the larger diameter at the same point is 6·25. The septa are deeply concave, oblique, and slightly sinuous, having one side ·12 in advance of the other. The greater diameter of the specimen is ·7 at one end and ·45 at the other.

Locality. In the Marshall sandstone at Hard Wood Pt. one mile S.W. of Pt. au Pain Sucre (called also Flat Rock Pt.) on the shore of Saginaw Bay.

ORTHOCERAS RETICULATUM.?

Phillips (Geology of Yorkshire, vol. ii, p. 238; pl. xxi, fig. 11).

The brief description given of this Carboniferous species does not disagree with the Michigan specimen in my possession. The figure agrees equally well. The fragment in question is 1¼ inches long, and shows only the exterior markings. Judging from the curvature of the specimen, it had a diameter of ·89 in the constriction between two rings, which are ·32 apart. The surface is marked by longitudinal and transverse striæ; the former are fine, raised, equidistant, 13 or 14 being embraced in the space of one-tenth of an inch; the latter consist of two sets —first, a set of irregular inequidistant, impressed striæ of which 3—6 occur in the space of one-tenth of an inch; secondly, a set of fine, regular, equidistant, filiform striæ, of which about 32 occur in the space of one-tenth of an inch. The latter give a finely moniliform appearance to the longitudinal striæ, but they are most distinctly seen after the exterior of the shell has been removed. Characters of the siphon and septa unknown.

Locality. In the Marshall sandstone at Marshall.

ORTHOCERAS sp.?

The only specimen seen of this species is a mere impression of the exterior, about an inch in length. It is made by a shell, apparently, with a circular section, and ornamented by a series of rounded rings, separated from each other by a concave depression about twice the width of the ring. The whole surface is further marked by distinct longitudinal striæ, about one one-hundredth of an inch wide. These seem to increase by interpolation of other striæ, which begin to make their appearance when the first ones are one and one-fourth hundredths of an inch wide, and look like a finer set of striæ alternating with the coarser. The diameter of the specimen, supposing the section circular, was about ·84 in the grooves between the rings, and the elevation of the rings is ·03. The distances of four successive rings, from center to center, are ·15, ·18, ·21 and ·21.

Locality. Marshall.

This impression agrees in form, dimensions and distance of rings with *O. dactyliophorum* de Kon. (An. Foss., pl. xvii, 2). But this species is described as having circular striæ without any longitudinal ones. It differs from *O. tenuilineatum* Sandberger (Verstein., Taf. xix, 7) by the greater approximation of the rings, and much more closely striated surface. This species, however, from the "Orthocerasschiefer" of Wissenbach, seems at least to be a close analogue. Our fossil is *perhaps* identical with *O. annulatum* of Hisinger, but I have no access to a description of that species.

NAUTILUS (TREMATODISCUS) PLANIDORSALIS, n. sp.
(non *N. planidorsatus* Portlock.)

Shell small, closely coiled, but the whorls not impressed; section angular, transverse diameter greater than the dorso-ventral. Dorsum perfectly flat and quite broad, marked by a strong longitudinal groove near each lateral boundary. From the dorsal area the surface bends abruptly down the dorso-lateral area, making with the dorsum a slightly rounded angle of 125°. The dorso-lateral area is half the width of the dorsum and is slightly concave. From the dorso-lateral area the surface bends regularly toward the umbilicus, but with an increasing radius of curvature. The umbilico-lateral area is marked by strongly raised, sharp, longitudinal striæ, which, under a lens, are seen to be decussated by fine, raised, transverse striæ, less rigidly direct than the former ones, more strongly marked where crossing the longitudinal striæ, and giving them a kind of moniliform appearance. Indications of longitudinal striæ exist over the whole surface, but the state of the specimen is unfavorable for their exhibition. The septa present a shallow, posterior sinuation in the middle of the dorsum, a similar anterior sinus on the dorso-lateral angle, and a slight posterior sinus on the lower portion of the dorso-lateral area.

Diameter of whorl ·76 (100); greatest transverse diameter of section ·43 (57); dorso-ventral diameter of section ·25 (33); greatest width of dorsum ·22 (29); greatest width of dorso-lateral area ·19 (25); distance of longitudinal striæ ·012 (1·6), giving 8 to one-tenth of an inch; distance of transverse striæ ·008 (1·0), giving 13 to one-tenth of an inch; greatest distance between the furrows on the dorsum ·18 (23); greatest distance between septa, measured on the dorsum ·14 (18).

Locality. Marshall.

The best specimen of this species in my possession is a fragment showing about half of one whorl from the septate portion of the shell. The species belongs to the group of angulated, widely umbilicated *Nautili* for which Messrs. Meek and Worthen have proposed the distinct subgeneric designation *Trematodiscus*

(Proc. Acad. Nat. Sci. Phil., June, 1861, p. 147; and this Jour., [2], xxxii, 174). *N. planidorsalis* bears an extremely close relationship to *N. digonus*, Meek and Worthen, from the Rockford "Goniatite bed" in Indiana (Proc. Acad. Nat. Sci. Phil., Oct., 1860, p. 470). It differs, however, by having a very *distinct* longitudinal groove along each lateral boundary of the dorsal area, and extending apparently the whole length of the shell, while *N. digonus* "is marked by two very obscure lateral depressions near the aperture." *N. digonus* also is "rounded regularly into the umbilicus," from the angle which bounds the dorsal area, while in *N. planidorsalis*, the "regularly rounded" area is separated from the dorsum by a dorso-lateral area which is concave.

NAUTILUS (TREMATODISCUS) TRIGONUS, n. sp.

Shell of moderate size, rapidly enlarging, marked longitudinally by three prominent, obtuse angulations—one dorsal and two dorso-lateral. The dorsal ridge is broadly convex, but the nature of the specimen does not permit me to ascertain whether or not the center is marked by a narrow groove. The dorso-lateral ridge is also regularly curved, and a small concave furrow separates it from the dorsal one. The slope from the dorsal to the dorso-lateral ridge makes an angle of about 65° with the dorso-ventral diameter. A broad, shallow lateral furrow succeeds the dorso-lateral ridge, and this is followed by a regular convexity descending into the umbilical cavity. The transverse diameter through this convexity is scarcely greater than that through the dorso-lateral ridges. The surface (of the cast) is smooth. The septa are rather deeply sinuous—a strong sinus turned backwards, occupying the dorsum, and a deep broad sinus, the side, these two being separated by an abrupt saddle whose apex rests upon the dorso-lateral keel.

Measurements, of a fragment forming less than half a volution, wholly septate. Dorso-ventral diameter ·45; transverse diameter about ·54; distance from dorsal to dorso-lateral ridge ·18; depth of dorsal sinus ·07; of lateral sinus ·14; interseptal distance on the dorsum ·17.

Locality. Marshall.

NAUTILUS (TREMATODISCUS) STRIATULUS, n. sp.

Shell small, rapidly enlarging, whorls not impressed, flattened on the dorsum on each side of the peripheral line, and thence rounded regularly into the umbilical expanse; transverse section somewhat elliptic, with the major axis corresponding to the transverse diameter of the shell. Septa slightly sinuous, one broad shallow sinus extending across the side and another across the dorsum. Surface finely and elegantly fluted longitudinally.

The largest fragment of this species is about half a volution, wholly septate, and about 1·18 (100) across; dorso-ventral diameter at larger end ·41 (34); at smaller end ·34 (29); transverse diameter at smaller end ·38 (32); interseptal space on the dorsum ·16 (14); distance of striæ ·025, giving 4 in one-tenth of an inch.

Locality. Marshall.

The above species agrees with Hall's brief description of *Gyroceras gracile* (13th Rep. N.Y. Reg., p. 105), except in the abrupt undulation of the septa upon the dorsum. Though the position of the siphon is not satisfactorily ascertained, there are some indications that it is excentric though not marginal. The striately fluted surface recalls some species of *Gyroceras* figured by de Koninck.

NAUTILUS (TREMATODISCUS) MEEKIANUS, n. sp.

Shell small, rapidly enlarging, whorls not impressed, flattened across the dorsum, and even slightly concave along the peripheral belt; sides obtusely angulated by the flattening of the dorsum, the slope from the lateral angle being a regular curve into the umbilicus. Transverse section, in consequence of the dorsal furrow, somewhat cordate. Surface below the lateral angle, distinctly striate; above it, very obscurely so. Septa forming a very shallow sinus just below the lateral angle, and another, considerably deeper, across the dorsum.

Diameter of whorl (wholly septate) 1·25 (100); dorso-ventral diameter ·40 (32); transverse diameter ·40 (32); interseptal space on the dorsum ·18 (14); depth of lateral sinus ·04 (3); of dorsal sinus ·07 (6); distance of striæ ·04, giving two and a half in one-tenth of an inch.

Locality. Marshall.

The present species is closely related to the foregoing, but differs by a more depressed dorsum and coarser striation.

NAUTILUS (TREMATODISCUS) DISCOIDALIS, n. sp.

Shell of moderate size, flattened dorsally and laterally; lateral surface but slightly convex, its width nearly equal to the height of the shell; umbilical slope regularly curved, making an angle of about 120° with the side. Dorsum making a right angle with the side, but the character of the peripheral belt has not been seen. Cast longitudinally striated or grooved, indistinctly so on the sides, while a raised line gives prominence to the dorso-lateral angle. Septa forming a broad moderately deep sinus, which extends across the entire lateral surface; another one exists upon the dorsum.

A completed volution, wholly septate, measures 1·6 (100); dorso-ventral diameter ·56 (35); transverse diameter unknown, but the umbilical slope on one side is ·22 (14); lateral surface ·38 (24); distance of striæ on the umbilical slope ·028 (2), which gives $3\frac{1}{2}$ to one-tenth of an inch; depth of lateral sinus ·08 (5).

Localities. Marshall and Battle Creek.

NAUTILUS SUBSULCATUS (?)

Phillips (Geol. Yorks., ii, 233, pl. xvii, 18, 25).

The general outline of the transverse section is hexagonal, with well rounded angles. The sides are nearly plane, and parallel with the dorso-ventral diameter, and in the ventro-lateral region slope abruptly into the umbilical cavity, making an angle with the side, of about 65°. The lateral surface joins the dorsal at an angle varying from 74° to nearly 90°. At a little less (apparently) than half the transverse diameter of the cast, the dorsum shows a small rectangular carina, similar to the one represented by de Koninck in pl. xlix, fig. 4*b*. The nature of the surface between this carina and the corresponding one on the opposite side of the peripheral line, has not been ascertained. The septa make a broad sinus coextensive with the lateral surface, and curve backwards again upon the dorsum. The angle of intersection with the sides shows that they are deeply concave. The inner whorl is somewhat impressed into the outer. External surface of cast is faintly marked by raised striæ crossing in lines parallel with the septa; and on the umbilical slope are seen traces of coarser longitudinal striæ.

Greatest dorso-ventral dimension ·8; width of lateral surface ·6; width of dorsal surface to carina ·27; width of ventral surface to impression of next inner whorl ·38; interseptal space on the dorso-lateral angle ·33; distance of transverse striæ ·02, giving 5 in one-tenth of an inch; distance of longitudinal striæ ·04, giving $2\frac{1}{2}$ in one-tenth of an inch. A fragment of a larger specimen (wholly septate) must have belonged to an individual more than 4 inches across the outer whorl. In this, the lateral surface is ·8, and the umbilical slope ·47.

Locality. Marshall.

The transverse section of these forms is much less sharply angular than is shown by the figures of European authors, and the striæ seem to be coarser.

NAUTILUS INGENTIOR, n. sp.

Shell very large; whorls not impressed; transverse section an ellipse whose larger diameter corresponds to the height of the shell, the sides in some specimens being somewhat flattened. Surface (of cast) smooth; septa bent abruptly forward at their junction with the shell so as to meet it at an acute angle, slightly sinuous,—a broad shallow sinus occupying the superior lateral portion of the surface; dorsum not seen.

One fragment in my possession $3\frac{1}{2}$ inches long, one-half septate, must have belonged to a specimen more than 7 inches across the outer whorl. The dorso-ventral diameter at the last septum is about 1½ inches; last interseptal space ·42 near the dorsum; depth of lateral sinus not more than ·10. Another specimen, wholly septate, supposed to belong to this species, though more rapidly curved, is 1·85 from the dorsal to the ventral side.

Locality. Marshall.

This species most nearly resembles the preceding, but differs in the absence of an angular section and the two sets of striæ. Among foreign species it recalls *N. ingens* Martin, but the section is less circular and the septa are more sinuous.

CYRTOCERAS TESSELATUM?
de Kon. (An. Foss., p. 529; pl. xlviii, 5).

A mere impression, undistinguishable from the above, seems to possess sufficient interest to deserve mention. It is one inch long and four-tenths broad, and could not have been made by any body which has heretofore come under my observation from the Marshall sandstone.

GONIATITES MARSHALLENSIS, n. sp.

Shell rather long, consisting of at least four whorls, the inner moderately impressed into the outer; transverse section varying from an ellipse of small excentricity to an oblong figure; surface smooth. Aperture and outer chamber not seen. Septa close, the lobes almost reaching the next posterior saddles. Dorsal lobe twice as long as its greatest width, clavate, with a long cuspidate acumination, at the extremity of which can sometimes be seen the outline of the minute siphon; first and second lateral lobes similar to the dorsal in form, but successively a little smaller and not acuminate; accessory lobe obtuse, half the size of the second lateral; ventral lobe profound. Dorsal and lateral saddles of form similar to the principal lobes, but regularly rounded at the extremity; first accessory saddle, half the size, the second, imperfectly developed.

Diameter of largest specimen seen 1·75 (100); major axis of transverse section ·59 (34); minor axis ·47 (27); length of dorsal lobe ·26 (15), of which the cusp is about ·07 (4); greatest breadth ·12 (7). Diameter of siphon ·015 (0·9).

Localities. The most abundant Goniatite in the feebly cemented, ferruginous sandstone at Marshall. Found also in a similar rock at Moscow, and numerous other localities in Hillsdale and Jackson counties. It occurs in the hard bluish calcareous sandstone at Battle Creek and in the hard purple sandstone at Hard Wood Pt., Saginaw Bay.

This Goniatite belongs to the group which embraces *G. Henslowi* Sow., *G. serpentinus*, *cyclolobus* and *mixolobus* of Phillips, but after careful study it seems sufficiently distinct from all. Its closest European analogue is *G. mixolobus* Phil., from the Mountain limestone of the Isle of Wight and the "Posidonomyenschiefer" of Wiesbaden. Its nearest American analogue seems to be *G. Lyoni* Meek and Worthen (Proc. Acad. Nat. Sci. Phil.; Oct., 1860), with which Prof. Hall's *G. Hyas* is identical (see 13th Rep. Regents N. Y., p. 102). The Michigan species, however, differs from the Rockford one in the addition of an accessory lobe and saddle, and in the dorsal lobe being broader and relatively longer. It is also somewhat more involute.

Goniatites Houghtoni, n. sp.

Shell moderately long, whorls but slightly impressed, almost evolute; transverse section elongate-oval, abruptly rounded at the dorsal and ventral extremities, and nearly flat on the sides. Surface of shell apparently smooth. Septa rather remote. Dorsal lobe infundibuliform, attenuately acute, length equal to breadth of its base; first lateral lobe clavate, acute, twice as long as broad, reaching as far back as outer lobe; second lateral lobe of the same form as the first but somewhat larger; accessory lobe present, but not distinctly seen. Saddles all regularly rounded at the extremity; the dorsal, broadest at the base, the other two clavate and reaching one-third their length further forward than the dorsal.

Greatest diameter 1·75 (100); major axis of transverse section ·42 (24); minor axis ·21 (12); length of dorsal lobe ·12 (7); distance from tip to tip of two contiguous dorsal lobes ·24 (14).

Locality. Marshall.

Resembles the preceding but differs materially in the form of the dorsal lobe and the transverse section. It differs from *G. Lyoni* Meek and Worthen, in the greater relative length of the second lateral lobe and the first accessory saddle, as also in the more appressed transverse section. Its closest affinities are with *G. Henslowi* Sow., but differs in the more acute lateral lobes, and relatively longer lateral and accessory saddles.

Goniatites Allei, n. sp.

Shell laterally compressed, the inner whorls impressed to the middle of the outer; umbilicus very small, not disclosing any of the inner volutions; aperture auriculate. Section (of an entire whorl) through the umbilicus, at right angles with the siphon, an elongated ellipse. Surface unknown, but the cast is marked along the dorsal region by minute, irregular, revolving striæ. Dorsal lobe wanting or too minute to be detected in sandstone casts. First lateral lobe acute, terminating at an angle of about 60°; second lateral lobe extending as far back as the first, its apex in the form of a low gothic arch, body of the lobe campanulate, equilateral. Dorsal saddle parabolic, not distinctly indented at the apex by a dorsal lobe; lateral saddle nearly twice as long as the dorsal, its apex rounded and slightly turned toward the umbilicus, its width equal to its height, size a little larger than the second lateral lobe; accessory saddle projecting nearly as far forward as the lateral, but twice as broad, and flatly rounded anteriorly. Ventral lobe small, but profound, and separated on each side by a narrow, rounded saddle from another small lobe upon the ventral surface of the whorl.

Greatest diameter of shell as far as seen ·72 (100); width of aperture between the auriculations ·21 (29); distance from tip to tip of two dorsal lobes nearest the aperture ·15 (21); distance between striæ on dorsal surface of cast ·004.

Localities. Marshall and Jonesville.

The side view of this species resembles that of *G. uniangularis* Conrad, but the details of the septa are materially different. It has affinities with *G. carinatus* Boyr., and *G. lamed*, var. *complanatus* Sandb., from the "Cypridinenschiefer" in Nassau, but differs from both in its closed umbilicus, the want of a dorsal lobe, and the presence of an accessory saddle, which, in our species, is as prominent as the lateral one.

Goniatites Oweni,
Hall (13th Rep. N. Y. Reg., p. 100).

A Goniatite common in the sandstone which is the prolongation of the beds at the grindstone quarries, on the shore of Lake Huron, in the vicinity of Pt. aux Barques, presents all the essential characters of *G. Oweni.* Comparing it however with figures and descriptions of this species, as well as with specimens from Rockford, Ind., our fossils are somewhat more compressed laterally, the septa are more approximated, and the lateral lobes lie along the middle of the lateral surface, instead of considerably nearest the dorsal region.

Prof. Hall's var. *parallela* (*parallelus?*) is also distinctly represented at the same localities, but it is to be remarked that in this variety the umbilicus is *more* open instead of *less* so.

Goniatites Shumardianus, n. sp.

Shell of moderate size, laterally compressed; dorsal surface narrowly rounded, dorso-lateral surfaces but slightly convex, making with each other an angle of about 27°, abruptly inflected into the moderately open umbilicus, which reveals a small portion of two or three preceding whorls; greatest width of transverse section (near the umbilicus) two-thirds the dorso-ventral dimension. Septa rather remote. Dorsal lobe not satisfactorily defined, but apparently simple, sharply acute, with a length about equal to the breadth at the base; first lateral lobe extending as far back as the dorsal, acute, but with a broad base; second lateral lobe wanting. Dorsal saddle parabolic; lateral saddle very broad, and extending one and one-fourth times as far forward as the dorsal, and having its umbilical branch much more abrupt than the lateral one.

Greatest diameter of shell seen 1·02 (100); greatest transverse diameter of section ·33 (32); dorso-ventral dimention ·49 (48); distance from tip to tip of two dorsal lobes nearest the aperture ·23 (23); greatest width of umbilicus ·23 (23).

Locality. From the gritstones in the vicinity of the quarries near Pt. aux Barques.

This species is closely related to *G. Allei*, but is laterally more compressed, with a sharper dorsum, and unlike that, has but one lateral lobe.

GONIATITES PROPINQUUS, n. sp.

Shell of moderate size, closely involute, with a closed, slightly indented umbilicus; slightly compressed, with a well rounded dorsum, and moderately convex sides making with each other an angle of about 10°. Septa rather remote. Dorsal lobe of medium size, infundibuliform, obtuse; lateral lobe extending half its length behind the dorsal, infundibuliform, slightly rounded at the apex, and with a base equal to the height; second lateral lobe wanting. Dorsal saddle parabolic; lateral saddle somewhat semicircular, but most convex anteriorly.

In the only specimen seen, the dorso-ventral dimension is ·65; the greatest diameter of transverse section (close to umbilicus) is ·43.

Locality. From the gritstones in the vicinity of Pt. aux Barques with *G. Shumardianus* and *G. Oweni.*

Closely related to *G. Shumardianus*, but has a more broadly rounded dorsum, with sides more nearly parallel and wants the open umbilicus. The lateral lobe is also much more produced posteriorly and both lobes are probably a little less acute.

A Goniatite having the general form and appearance of the three preceding species has been found at Marshall, in fragments which are marked by occasional sinuous transvere furrows, and while its single lateral lobe separates it from *G. Allei*, its more rounded dorsum differs from *G. Shumardianus.* Should it prove distinct it may appropriately be called *G. sulciferus.*

GONIATITES SINUOSUS ?

Hall (Geol. Rep. 4th Dist. N. Y., p. 245).

I have in my possession several specimens of an involutely coiled shell which cannot be distinguished by the aid of Prof. Hall's figure and brief description from *G. sinuosus.* At the same time some doubt exists in reference to the Goniatitic character of my specimens. The septa are very imperfectly shown, but by comparing different individuals, it appears that they form a broad (Nautiloid?) sinus, convex *anteriorly*, on the supero-lateral surface, and another of about the same size on the infero-lateral surface. A Goniatitic lobe may connect these two saddles, but it cannot yet be discerned. My specimens are sharply striated transversely in the umbilical cavity. In size and proportions they correspond exactly with the New York species, which occurs in the Portage Group.

GONIATITES PYGMÆUS, n. sp.

Shell very small, globose, closely involute, with a minute, perforated umbilicus. Whorls divided into quadrants by apertural constrictions. Dorsum regularly rounded, sides convex. Septa moderately angulated; dorsal lobe relatively broad, obtusely rounded, with indications of a slight indentation at the apex; lateral lobe shallow, acute, infundibuliform; dorsal and lateral saddles broad, shallow, circularly curved. Surface (of cast) perfectly smooth.

A sole specimen, which seems to embrace a portion of the last chamber is ·25 in diameter; height of section ·13; transverse diameter ·13.

Locality. Supposed to be Battle Creek.

This interesting little species externally resembles *G. planilobus* Sandb. (Verstein., Taf. x, 6, 7), but the septa are more angulated. It differs from *G. striolatus* Phillips (Geol. Yorks., ii, pl. xix, figs. 14–19), by a much smaller umbilicus, larger dorsal lobe and saddle, and much smaller inferior lateral lobe, and (in the cast) by the absence of striæ.

University of Michigan, Ann Arbor, Jan. 30, 1862.

ART. XXXVI.—*On Methylamine*; by M. CAREY LEA.

(1.) *Production and Separation of Methylamine.*

IN a previous paper I have pointed out that ammonias in which hydrogen is replaced by methyl are obtained by the action of nitrate of methyl upon ammonia at ordinary temperatures.* Nitrate of methyl, obtained by the distillation of methylic alcohol with nitric acid and urea, is placed in well stoppered bottles filled only about one quarter, together with a little more than its own bulk of thoroughly saturated aqueous ammonia, and is left till the nitrate of methyl disappears, or until only a few brown oily drops remain, a reaction which requires from three to six days, according to the temperature. The liquid is then distilled with caustic alkali and the gaseous products are conducted into water.

In this solution we should by analogy expect to find ammo-

* This Journal, March, 1862.

nia, methylamine, dimethylamine and trimethylamine, and it remains to separate these bases. This is a matter of extraordinary difficulty, much surpassing that of the separation of the ethyl bases. In the ethyl series the bases differ from each other and from ammonia by C_4H_4, whereas in the methyl series the successive terms acquire the addition of C_2H_2 only. Naturally therefore we must look for greater similarity in character and corresponding difficulty in separation. Accordingly, the methods which give such satisfactory results with the ethyl-ammonias, fail entirely with the methyl bases. Ammonia cannot be separated from them by a difference in the solubility of the sulphates in alcohol: when the mixed solution is neutralized with sulphuric acid and exhausted with alcohol, little or nothing is removed by it. Nor can the separation be effected by means of picric acid, although that substance may be used in one particular case mentioned below.

This problem I have as yet been able to resolve only in part. Two steps I have accomplished:—first, the complete removal of the ammonia from the mixed methyl bases, and second, the isolation of the methylamine in a state of purity. The separation of the more substituted bases still remains to be accomplished.

It is however, satisfactory to have a process for obtaining perfectly pure methylamine without resorting to the troublesome reaction of the cyanate of methyl, and that much has been effected. After the compound ether has been completely decomposed by the ammonia, the contents of the bottles are to be distilled with caustic alkali or lime. The solution of the mixed bases and of ammonia is to be exactly neutralized with oxalic acid and the water driven off as far as possible by being heated over the water-bath. The resulting mass is transferred to a flask, and boiled a few minutes with a large quantity of alcohol of density 42° B., and after cooling and standing some hours, it is filtered. The whole of the ammonia remains as oxalate upon the filter. The filtrate by spontaneous or gentle evaporation separates into two layers. The lower, which is much the least in quantity, becomes very soon crystalline, indeed this change takes place so rapidly that the fluid stage may easily pass unnoticed. More oxalate of methylamine remains in the mother liquid and separates on further evaporation.

After the fluid has crystallized, the resulting pearly white laminæ are purified by boiling with absolute alcohol, or with a mixture of equal parts of alcohol of 42° B. and ether, and this is repeated three or four times, allowing a thorough cooling to take place between each operation. The oxalate of methylamine finally crystallizes out quite pure, and methylamine may be obtained from it directly by distillation with caustic alkali. But the distillation is extremely unpleasant, exhibiting the phenomenon of percussive ebullition to such a degree as to endanger the whole apparatus, and to drive the liquid out of the Woulfe's bottle in strong jets through the safety tube. It is therefore advisable to treat the oxalate with nitrate of baryta or chlorid of barium, leaving them in contact for a day, to evaporate the filtrate and then distill. I give the preference to the nitrate of baryta, because the nitrates of the ammonias distill more quietly than any of the others of these salts.

The methylamine thus obtained was converted into chloroplatinate and analyzed.*

1·0105 grms. gave of Pt, - - -	·4216	
This corresponds to, per cent, - - -		41·72
Theory requires for $\left.\begin{matrix}C_2H_3\\H\\H\\H\end{matrix}\right\}NCl, PtCl_2$, -		41·62

The residue after the greater part of the oxalate of methylamine had crystallized out, was evaporated, exhausted with absolute alcohol, treated with nitrate of baryta, distilled with caustic soda and neutralized with picric acid. From this solution there crystallized out beautiful amber-colored bevelled prisms and hexagonal plates greatly resembling the picrate of ethylamine and apparently isomorphous with it. These were converted into chloroplatinate and analyzed with the following result.

·7265 grms. chloroplatinate gave of Pt, -	·3025	
This corresponds to, per cent, - - -		41·65
Chloroplatinate of methylamine contains, -		41·62

The substance was therefore picrate of methylamine.

The residue appeared to be a mixture. Analyses of different portions, from different crystallizations gave respectively 39·85, 40·14, and 40·23 per cent of platinum in the chloroplatinate, nor could any satisfactory means of separation be found.

Reactions of Methylamine.

Many of the reactions of methylamine have been already described by its discoverer, M. Wurtz. To these may be added the following.

Cerium, protochlorid,	A white precipitate insoluble in an excess of the precipitant.
" nitrate of protoperoxyd,	Dirty white, insoluble in excess of precipitant.

* It is scarcely necessary to observe that if platinum salts are recrystallized, the results of their analysis cannot be taken as a proof of the accuracy of the mode of separation used. In the analyses here published care was taken to use in all cases an excess of bichlorid of platinum, and to include the whole precipitate in the analysis.

Zirconium, sulphate of zirconia,	White, insoluble in excess.
Aluminium, alum,	A white precipitate which redissolves in an excess of the precipitant.
Antimony, terchlorid,	A red brown precipitate insoluble in excess of precipitant.
Glucinum, sulphate of glucina,	A white precipitate insoluble in excess of precipitant.
Molybdenum, protochlorid,	No precipitate.
" bichlorid,	Reddish precipitate insoluble in excess of precipitant.
Palladium, protochlorid,	Abundant flesh-colored precipitate, insoluble in excess of precipitant.
Ruthenium, sesquichlorid,	Brown precipitate, insoluble in excess of precipitant.
Platinum, protochlorid,	No precipitate.

In describing the reactions of diethylamine I pointed out* that the remarkable property of dissolving alumina, hitherto considered as characteristic of ethylamine, amongst the ammonias, was shared by diethylamine. It now appears that it is possessed also by methylamine, and it would not be surprising if it was found to extend to the other methyl and ethyl bases, and even to the bases containing other alcohol radicals, a point which I propose hereafter to examine.

The deportment of methylamine towards solutions of protochlorid of molybdenum is characteristic, and differs from that of ammonia, ethylamine and diethylamine.

Methylamino-chlorid of Palladium.

When aqueous methylamine is added in excess to solution of protochlorid of palladium, or to a solution of the following salt, at the first moment no precipitation takes place, but in a few moments a quantity of flesh-colored needles are formed. These were dried over sulphuric acid and ignited.

·2049 substance gave metallic palladium ·0969.

From which we find:—

		Calculated.	Found.
2C,	12	9·32	
5H,	5	3·88	
N,	14	10·88	
Pd,	53·3	41·38	42·45
Cl,	35·5	27·56	
HO,	9	6·98	
	128·8	100·00	

leading to the formula $C_2H_5\overset{\frown}{N}PdCl+HO$.

* This Journal, Jan., 1862.

The palladium is a little in excess because with the small quantity of material at command, it was impossible to wash out the not entirely insoluble precipitate thoroughly, without too great a loss.

Chloro-palladite of Methylamine.

When methylamine is added, not in excess, to an acid solution of protochlorid of palladium, or when the foregoing salt is treated with an excess of the same acid solution, a deep brown red liquid is obtained, which by concentration yields beautiful brown red laminæ, very soluble in water and in alcohol. The quantity at command was insufficient for analysis, but judging from analogy, their constitution must be

$$C_2H_6NCl, PdCl.$$

Picrate of Methylamine.

This is a very beautiful salt. It crystallizes in bright yellow laminæ grouped in fine arborescent clusters, or by somewhat slower crystallization, in amber-colored bevelled prisms and hexagonal plates. Heated on platinum foil it deepens in color, melts to a clear red liquid apparently without decomposition, and when the heat is further raised, burns with a vivid white light leaving a carbonaceous residue. It is moderately soluble in water and in alcohol.

Other combinations of methylamine will be described at a future time.

ART. XXXVII.—*On Prof. J. Hall's claim of Priority in the determination of the Age of the Red Sandrock Series of Vermont;* by E. BILLINGS.

IN an article published in the last January number of this Journal (this vol., p. 107) Prof. Hall states that in 1844 and 1845 he made several sections from the Hudson river and Champlain valleys eastward, and that he then recognized the Potsdam sandstone at several localities both in Vermont and Massachusetts. It is very true that he did; but his paper is so written, that any person unacquainted with the facts would, upon reading it without due caution, understand him to mean that the rock which he identified as the Potsdam was the Red Sandrock Series. The object of this communication is to supply several facts not mentioned by Prof. Hall, and which if read in connection with his paper will throw some additional light upon the subject. Apart from all personal considerations, I hold that this investigation is of such great importance that its history ought to be correctly worked out now while the facts are still fresh in the memory of all the parties concerned.

In order that what follows may be more clearly understood, it seems necessary to premise that the geologists of Vermont have always distinguished two great arenaceous formations in their country differing from each other in aspect and geographical position. One of these, the "Granular" Quartz Rock constitutes a narrow belt lying along the western base of the Green Mountains in the southern half of the state. In the recently published map of the Vermont Survey there are two outliers of this formation represented as occurring further north,—one in the county of Chittenden, completely surrounded by the formation now called the "Talcose" conglomerate, and another still further north lying alongside of the Georgia slate. This granular quartz rock is the formation recognized by Prof. Hall in his sections as the Potsdam sandstone, but it is not the formation always known under the designation of the Red Sandrock Series. This latter, and not the former, is the rock to which the papers of Mr. Hitchcock and myself relate. On the Vermont map and in Prof. Hall's sections, these two formations are indicated by different colors and distinguished by different names. Emmons considers the granular quartz rock to be an older deposit than the Potsdam. Prof. H. D. Rogers in 1840 examined it and came to the conclusion that it was the Potsdam itself.* The Red Sandrock Series forms an irregular belt along or near the shore of Lake Champlain, running the whole length of the lake and entering Canada near Phillipsburgh. The age of this rock has always been disputed, Dr. Emmons holding on one side that it was partly of the age of the Calciferous sandrock and partly Potsdam sandstone, while those who were opposed to his views on the Taconic System, held that it was a more recent formation. I believe it is now proved that Dr. Emmons' view is the correct one, and Prof. Hall's paper would lead us to suppose that he arrived at the same conclusion fifteen years ago. But the only documents that I can find which give us any clue to his original opinion are the sections to which he has made allusion, and the letter to Prof. Adams pointed out by Mr. Hitchcock. These do not prove that he agreed with Emmons, but rather that he was of a contrary opinion. The sections it appears were engraved but never published. I have however succeeded in procuring several of them and shall describe such portions as cross the Red Sandrock. By comparing Prof. Hall's paper it will be seen that he has omitted to make any allusion to these portions of the sections, the reason being, no doubt, that if he had done so, the reader would arrive

* See Proc. Am. Philosoph. Soc., vol. ii, p. 3, 1841, and also this Journal 1st ser. vol. xlvii, p. 151, where Prof. Rogers's views are given at length.

at a different conclusion from that intended to be induced by the learned Professor.

The first of these sections crosses Lake Champlain from Plattsburgh, traversing Hero Island and the towns of Milton and Fairfax. The only place where it crosses the Red Sandrock, is near St. Albans, and it must therefore pass through the Georgia slates very near the locality of the far-famed primordial trilobites. According to the new map of the Vermont Survey, above quoted, there is here a strip of Red Sandrock two miles wide, lying along the shore of the lake. This is followed by four or five miles of the Georgia slate and then about two miles of granular quartz rock. Prof. Hall's section represents the latter as the Potsdam sandstone, but the Red Sandrock and all the Georgia slates are called "*Trenton and Lower Limestones of the Mohawk Series.*" His section is colored,—the Potsdam, pink, and his so-called Trenton, blue. The remainder of this section does not cross any of the rocks under discussion and need not be noticed here.

This locality must always be looked upon with much interest, as the trilobites which have brought about so great a change in the opinions of some of our best physical geologists were here first discovered. Prof. Hall placed these trilobites and the slates in which they were found in the Hudson river group, but as soon as he saw that this view was incorrect, he denied that he had ever examined this part of the country at all, and at the same time gave the public to understand that he had been induced to refer this Primordial Fauna to the top of the Lower Silurian by Sir W. E. Logan. He says that "after the descriptions had been printed and *a few copies distributed*,"* he learned that Sir W. was at that time actually investigating the rocks of that part of Vermont. He then delayed the final publication till the meeting of the American Association (in Springfield) and there showed him the descriptions and obtained his authority for the addition of the note in which Sir W.'s opinion is stated.† He says, "left to palæontological evidence alone, there never could have been a question of the relations of these trilobites which would at once have been referred to the primordial types of Barrande." "Sir William Logan" he says, "yields to the palæontological evidence," and says "there must be a break." "He gives up the evidence of structural sequence which he had before investigated and considered conclusive; *and having heretofore relied upon the opinion* of the distinguished geologist of Can-

* May we be permitted to ask, to what formation are the Georgia slates referred in these "few copies" which were distributed before he obtained Sir W. E. Logan's opinion? Are they referred to the Hudson river group or to Dr. Emmons's Taconic System?

† Does he not here admit that the 12th Regents Report was altered by him in an important matter after the date of its publication.

ada *in regard to a region of country to which my own examinations had not extended*, I have nothing left but to go back to the position sustained by palæontological evidence."* As I understand this, it means that he never examined the country in the neighborhood of the Georgia locality of trilobites, and if he did not, then this section must have been compiled from the observations of of some one else. At all events the section proves very clearly that at the time he drew it up he did not know the age of the Red Sandrock Series.

The next section crosses the state of Vermont from Burlington eastward. On the Vermont map the Red Sandrock is here three miles wide along the lake shore. On the east side of it is a belt of Eolian limestone, also about three miles in width. The whole of this is laid down on Prof. Hall's section as "*Trenton and Lower Limestones of the Mohawk Series becoming metamorphic.*" He represents the rock as being all of this kind from the lake shore half way to the Green Mountains. A few beds of the Potsdam sandstone are then indicated as coming out from under the so-called Trenton limestone in the town of Willston. In the Vermont map there is a small outlier of granular quartz rock just about this locality, lying partly in Willston and partly in Hinesburgh, but it is totally separated from the Red Sandrock. The remainder of this section does not cross any of the rocks under discussion.

The above two sections are on plate 1. I have not been able to procure plate 2, and do not know what its contents are. I have plate 3, on which are engraved three sections. The first of these crosses from Whitehall in New York, to the Green Mountains. It shows an exposure of both the Potsdam and Calciferous formations at Whitehall. There never was any dispute as to the age of the rock at this locality. It has always been referred to the Potsdam and Calciferous, but never identified (except by Dr. Emmons) with the Red Sandrock. On this section all the slates between Whitehall and the Green Mountains are referred to the Hudson River Group. But according to the Vermont map they are the Georgia slates and are therefore the Taconic slates of Dr. Emmons, which lie below the base of the Lower Silurian, as that formation was originally limited. On this section therefore is engraved precisely the same mistake with respect to the age of the rocks, as that which was published in the 12th Regents' Report, with regard to the Georgia slates. The granular quartz rock lying at the base of the Green Mountains, is called "Potsdam," as it is in the other two sections. The other three sections do not cross any of the Red Sandrock.

* See Prof. Hall's letter to the Editors of this Journal, [2], xxxi, p. 220, March, 1861. In his last paper he seems to give the late Prof. Adams credit for having originated the mistake with regard to the Vermont rocks.

The only comment that need be made upon all of the above, is that at the time Prof. Hall prepared the sections to which he has appealed, *he did not know the age of the Red Sandrock*, but merely supposed it might consist of the Trenton, Black River and Chazy (the limestones of the Mohawk series) in a metamorphic condition. In no place where the Red Sandrock occurs is there a vestige of the Potsdam laid down in his sections. The fact that he recognized the Potsdam in other places avails him nothing in this discussion.

I have also lately procured the Geological Report containing the letter referred to by Mr. Hitchcock.* It is published as an appendix to the Report. The following is a copy of it:

"C."

"*Letter from Professor James Hall, on certain fossils in the Red Sandrock of Highgate.*"

"Albany, N. Y., September 17th, 1847.

My Dear Sir:—I have only now received your letter of the 10th instant, on my return from a geological excursion. I have examined the fossils and, as far as I can determine, they are all of the central portion of the buckler of a trilobite with a prominent narrow lobed glabella. The cheeks have been separated at the facial section, so that we have not the entire form of the head. The course of the facial section indicates that it terminated on the posterior margin of the buckler, and the glabella is narrower in front than behind — these two characters are inconsistent with Calymene, Phacops or Asaphus, the common genera, (as well as with several other genera) of our strata, but they belong to Conocephalus and Olenus. I am inclined to regard this fragment as part of a Conocephalus, of which I have not before detected a fragment in our rock. From its isolated character, therefore, I am able to infer little regarding its real geological position. The form known to me most like this one, is in the Clinton group of this state. I regret that more species could not have been found, or that some form in the preceding strata could not be obtained to compare with the others already known.

The meagre information of the two known species of Conocephalus is likewise an objection to any geological inference from the discovery of a species. All we know is that they are found in Graywacke, in Germany, or elsewhere, and the position of the Graywacke is too dubious and ubiquitous to be of any importance in such a case.

I regret exceedingly that I am able to give only this meagre and unsatisfactory information, and also that I have not had the satisfaction of seeing the localitty.

I shall see you in Boston next week, if I am able to go there, and will there reply more fully to the other part of your letter respecting New York fosssils.

I have prepared nothing for our meeting but am coming to see what others do. I am very sincerely yours, &c., JAMES HALL.

Prof. C. B. ADAMS."

* This Journal, [2], xxxii, p. 454.

"[Two specimens only have been obtained of a shell, which resembles Atripa Hemispherica, of the Clinton group of the New York system. Prof. Hall informs me that he is disposed to assign both the Clinton group and the Medina sandstone to one geological period.—C. B. A.]"*

This letter of Mr. Hall's proves the same thing that is established by his sections, i. e., that he was quite ignorant of the true age of the formation. The views of Prof. Adams on the age of the Red Sandrock must have been well known to all those engaged in the Taconic discussion, and most especially to Prof. Hall who has always been Dr. Emmons's leading opponent. The officers of three different geological surveys, namely, the survey of Vermost under Prof. Adams, the survey of Canada under Sir W. E. Logan, and the recent survey of Vermont under President Hitchcock, have at different times all placed the Red Sandrock in the horizon indicated in the above letter. They were all in constant communication with him, and in the Introduction to the 3d vol. of the Pal. N. Y., he claims priority over them all in the authorship of the very same views which he now seeks to charge upon them. In this last named work (p. 14) he says that the Hudson river group "may include all the beds from the Trenton limestone to the Shawangunk conglomerate." By this latter is meant the Red Sandrock. In the next sentence he says, "from the metamorphic slates of this group on the western slope of the Green Mountains in Vermont we have three or more species of trilobites which are of much interest, being representatives of a genus but little known in this country." These trilobites are no doubt the fossils of the Georgia slates which are called Trenton limestone in his sections. On page 15, he says:

"The opinions advanced by the writer (meaning himself) in 1844 and 1845, and published in the first volume of the Palæontology of New York, relative to the age of the rocks composing the metamorphic belt on the east side of the Hudson river, and including the principal part of the Green Mountain range, has been fully confirmed by Prof. Adams in the Geological Reports of Vermont. A re-examination of some portions of the same belt has added fresh evidence of the age of the formations, so far as included in Eastern New York, Western Massachusetts and Vermont."

He then gives Canada credit for contributing a good deal towards the confirmation of his views and closes at the foot of page 16 with "Geological structure therefore, and chemical and *palæontological* evidence all unite in proving the age of these deposits."

I shall only add that all the physical geologists engaged in this investigation with whom I have conversed on the subject,

* See "Third Annual Report on the Geology of Vermont." By C. B. Adams, State Geologist, &c., p. 31, 1847. Appendix C.

have assured me that Prof. Hall never gave them the least hint that the fossils proved a more ancient horizon than that indicated by the apparent attitude of the strata, but on the contrary always spoke of them as characteristic of the Hudson River group.* And so perfect was their confidence in the soundness of his opinion that it never occurred to them that he could be wrong, especially as every physical arrangement of the strata seemed positively to confirm his views. It was his duty to keep the fact always prominently before their minds that there was an antagonism between the physical and palæontological evidence. What the results would have been had he adopted this course is now apparent. As soon as the mist of erroneous palæontology was dispelled, the structure seen under a new light presented no difficulty of importance, and moreover many of the minor points which seemed to be very perplexing are now seen to be perfectly explicable.

Montreal, March 11th, 1862.

* The fossils alluded to here are those of the slates at Bald Mountain in New York published as Hudson River in the 1st vol. of the Pal. N. Y. in 1847, and also those of the Georgia slates in Vermont. Prof. H. never mentioned the *Conocephalites* to the Canadian Surveyors. The whole question has always rested on the correctness of the determination of the first of these, which are the original Taconic fossils on which Emmons depended. If Prof. Hall had been correct with regard to these, then all the Physical Geologists who sided with him would have been right as to the age of the Sandrock. The formation would be about the age of the Medina Sandstone. In fact he could not call the Red Sandrock Potsdam without contradicting in the most positive manner his own views as published in his first volume. Of course the Physical Geologists were well aware of Dr. Emmons opinions but nothing could shake their confidence in Prof. Hall. Even after the primordial aspects of the Georgia trilobites were pointed out, and for several months after the discovery of the Quebec fossils, they were very unwilling, as I know from my own experience, to believe that he could be wrong, especially as the physical structure seemed to confirm his views in the most remarkable manner. E. B.

ART. XXXVIII.—*Influence of Diffraction upon Microscopic Vision;* by Dr. M. C. WHITE.

[Read before the Connnecticut Academy of Arts and Sciences, Jan. 15th, 1862.]

IN a former communication to the Academy, and in an article on spontaneous generation, I assumed the limit of microscopic vision to be the same as the limit of resolvability of a series of lines,* or that objects could be seen no smaller than $\frac{1}{80000}$ of an inch. According to Hartung, "Das Mikroskop," &c., p. 784, it appears that with a microscope of 94° aperture made by Amici in 1848, an opake round object could be seen as small as $\frac{1}{4760}$ of a millimetre in diameter ($\frac{1}{119126}$ inch) and a thread-form object could be seen which was only $\frac{1}{41300}$ m.m. ($\frac{1}{1049022}$ inch) in diameter. These objects it appears were reduced images formed by reflection in bubbles of air or other fluid. The dimensions of these images were calculated, but not directly measured. It will be shown hereafter that the calculation of these dimensions are probably liable to considerable errors.

Mr. W. S. Sullivant of Columbus, O., has kindly supplied me with a single experiment of the same kind, made with the best American objectives. A microscope was adjusted with a $\frac{1}{12}$ inch object glass, and a $\frac{1}{30}$ inch objective to act as an achromatic condenser. A globule of mercury $\frac{1}{2000}$ of an inch in diameter, was placed about 3 inches from the $\frac{1}{30}$ condenser, in which position it was determined by previous experiment that an image, reduced 75 diameters, would be formed in the common focus of the condenser and the $\frac{1}{12}$ objective by which the reduced image was to be viewed. The reduced image of the globule of mercury was therefore calculated to be only $\frac{1}{50000}$ of an inch in diameter. This image was clearly seen in the compound microscope with the $\frac{1}{12}$ objective with a light (by no means the best) from a northern window and an overcast sky. It will be understood that the diameter of this reduced image of a spherical opake object, was not quite as small as the breadth of the alternate lines of light and darkness seen when the lines of Nobert's test of $\frac{1}{81213}$ in. were resolved by the same observer;† for either the lines themselves or the intervals between the lines must have been as narrow as $\frac{1}{162426}$ in. Now if single lines or dots can be seen much smaller than similar lines or dots that can be resolved when arranged in a series, what is the cause of this difference and what is the impediment that prevents the resolution of a series of lines like the bands Nos. 29 and 30 of Nobert's test?‡ These and many other

* This Journal, [2] xxxii, 9.

† This Journal, [2], xxxi, 14.

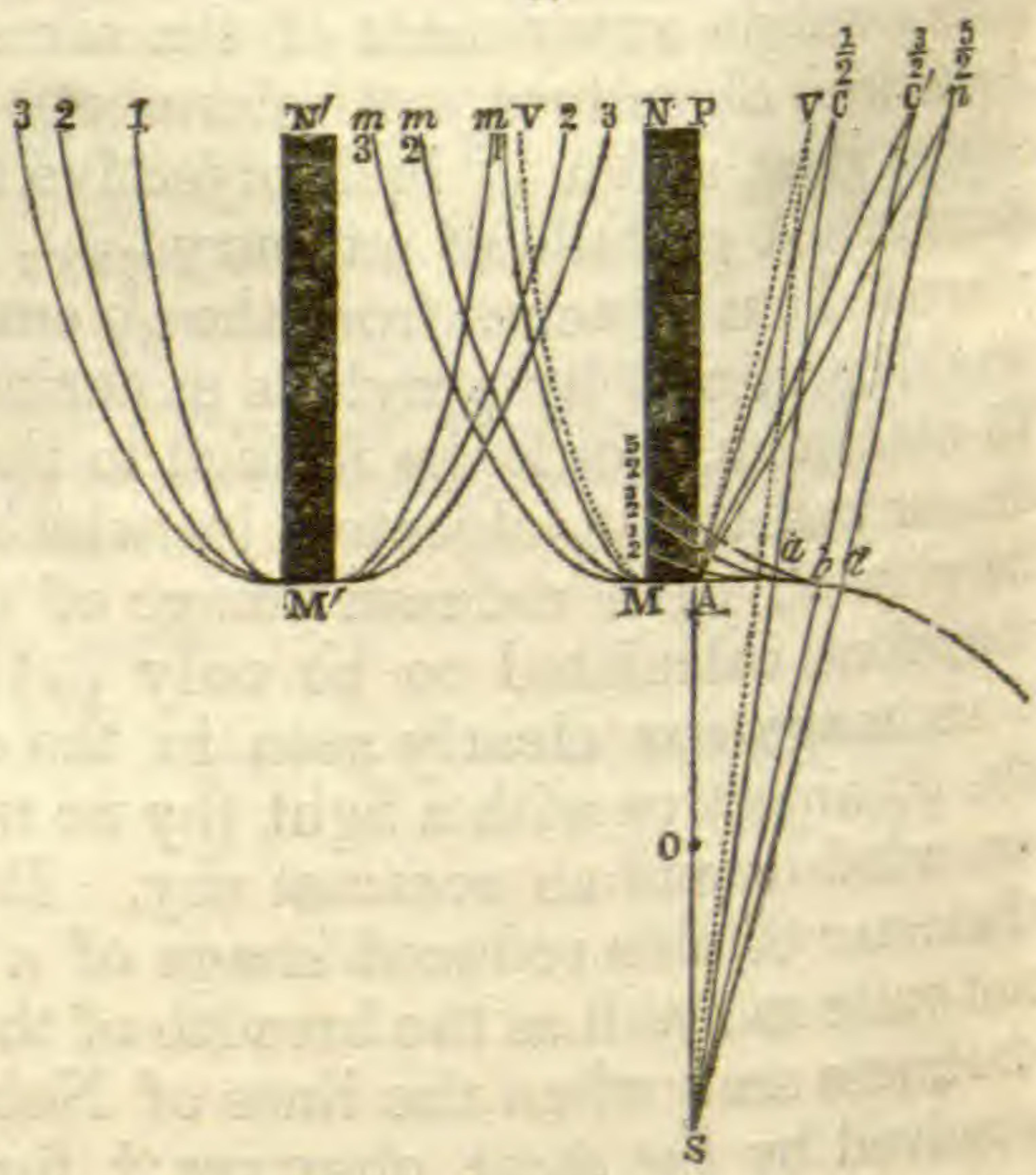
‡ This Journal, [2], xxxi, 14.

curious phenomena seen in the microscope, have induced me to investigate the influence of diffraction upon microscopic vision.

In order to show the influence of diffraction upon the appearance of objects seen in the microscope, the following mathematical analysis has been copied from Daguin's *Traité Élémentaire de Physique* with such modifications as its application to the microscope require.

In fig. 1, let M A N P and M′N′ be transverse sections of lines cut in a plate of glass of which the upper surface is in the plane N′, N P, *n*. These lines are to be viewed from above, and are illuminated by light from below emanating from S. According to the well known theory of diffraction, the light which strikes the opake object, A, radiates from that point in every direction, as from a new centre of illumination. If now any point, C, is taken at such a distance from P that the path S A C is greater than the distance S C by one-half the length of a vibration of light, the rays A C and S C will interfere and produce darkness at that point. The same thing will occur at C′ when S A C′ exceeds S C′ by three half vibrations, and so on for other points where the two paths differ by an odd number of half vibrations, the successive dark fringes being designated as of the 1st, 2d, 3d and *m*th orders respectively. If we consider the dark fringe *n* of the order *m*, and let λ represent the length of a vibration of light, it is evident we shall have $An-dn=(2m-1)\frac{\lambda}{2}$. Subtracting this equation from the equation $Sd=SA$ we have $Sd+dn-An=Sn-An=SA-(2m-1)\frac{\lambda}{2}$.

1.



The second member of this equation being constant whatever be the distance, AP, the trajectory of the fringe forms one branch of an hyperbola whose foci are at A and S. To obtain the equation of this hyperbola in a form convenient for discussion let $SA=2C$, $AP=x$, $Pn=y$, and then seek the values of 2A and 2B, the axes of the curve.

We first take $2A=Sn-An=2C-(2m-1)\frac{\lambda}{2}$, whence,

$A^2=C\left(C-(2m-1)\frac{\lambda}{2}\right)$ neglecting the term which contains λ^2.

The known relation $B^2=C^2-A^2$ gives,

$$B^2=C^2-C\left(C-(2m-1)\frac{\lambda}{2}\right)=C(2m-1)\frac{\lambda}{2}.$$

The equation of the hyperbola referred to its centre and to its axes is therefore,

$$C\left(C-(2m-1)\frac{\lambda}{2}\right)y^2-C(2m-1)\frac{\lambda}{2}x^2=-C^2\left(C-(2m-1)\frac{\lambda}{2}\right)(2m-1)\frac{\lambda}{2}$$

or $Cy^2-(2m-1)\frac{\lambda}{2}x^2=-C^2$; omitting the terms which contain λ^2 and neglecting $(2m-1)\frac{\lambda}{2}$ as too small to be considered when added to the quantity C. If we desire to refer the curve to the point A, as its origin we have only to replace x in the formula by $x+C$ when the equation becomes,

$$\left(C-(2m-1)\frac{\lambda}{2}\right)y^2=(2m-1)\frac{\lambda}{2}(x^2+2Cx) \quad \text{or,}$$

$$(1.) \qquad y=\sqrt{(2m-1)\frac{\lambda}{2}(x^2+2Cx)\div C}$$

considering as before $(2m-1)\frac{\lambda}{2}$ very small as compared with C.

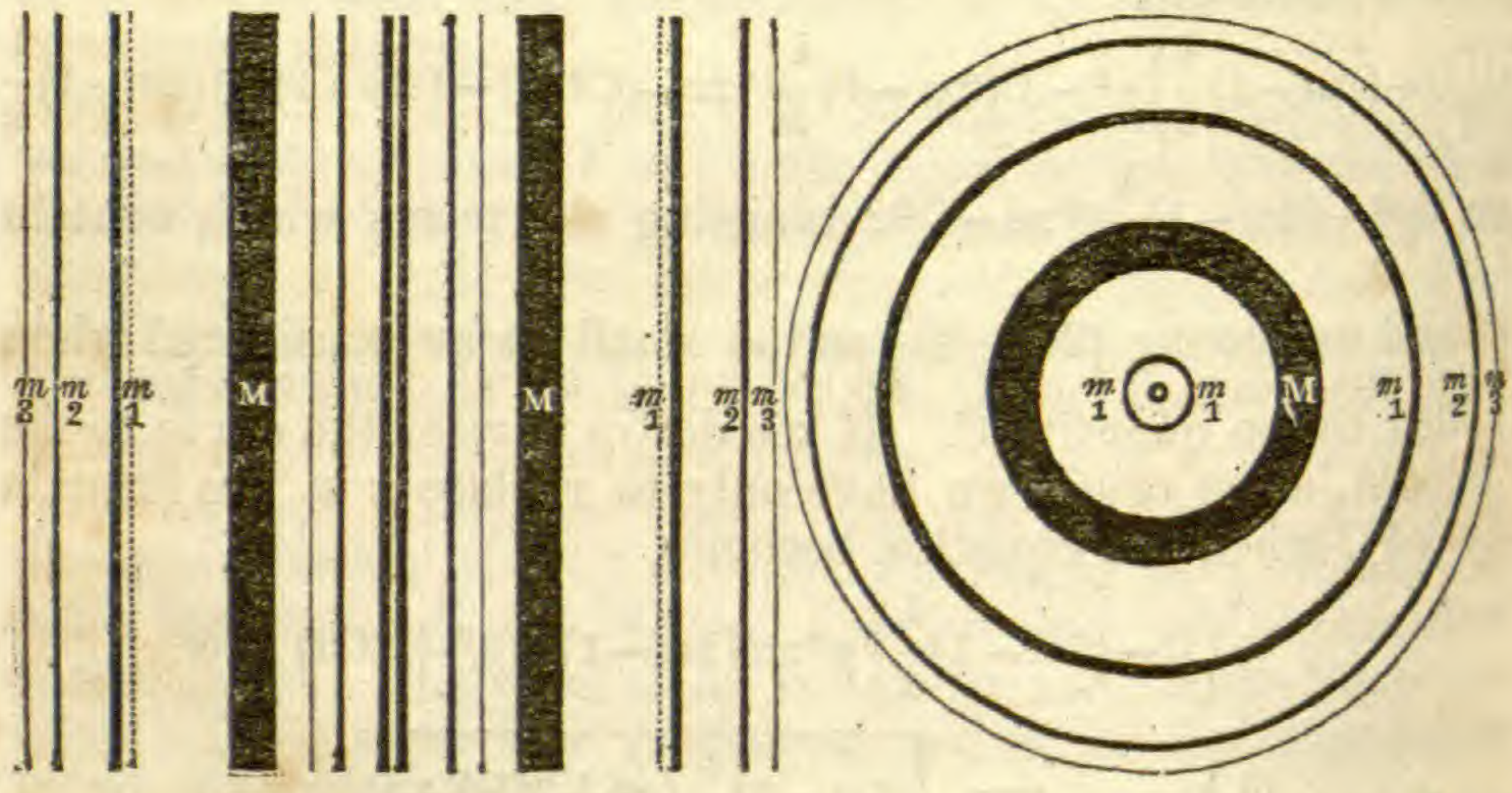
If we consider only the first fringe $m=1$ and the equation becomes,

$$(2.) \qquad y=\sqrt{\frac{\lambda}{2}(x^2+2Cx)\div C.}$$

Considering these equations it is evident that the value of y, or the distance of a dark band produced by diffraction from the real line which produces it, will be directly proportional to the value of the square root of λ. Now as the length of a wave of violet light is least and a wave of red is greatest, and the waves of other colors are of intermediate lengths, it is evident that the dark band produced by diffraction will consist of all the colors of the spectrum, the violet being nearest and the red most distant from the true shadow or image of the object. The dotted lines SV and AV, fig. 1, show the paths of the rays that produce a violet band, and MV shows the trajectory of the curve of violet light on the other side of the opake object. Mm_1, Mm_2, and Mm_3 show the trajectories of the first, second and third orders of fringes.

If M and M, fig. 2, represent lines ruled upon glass seen in the microscope from above, the other parts of the figure show the positions of the spurious lines or series of colored fringes of the first, second and third orders, produced by diffraction. These dark bands or fringes can easily be seen in the microscope bordering a line deeply ruled on glass with a diamond.

If M, fig. 3, represents a transverse section of a cylinder (as a section of woody fibre or other small tube) seen in the microscope, spurious rings m_1, m_2, m_3, will under favorable circumstances be seen outside the cylinder, and also internal spurious



rings as shown in the figure. I have frequently counted as many as five such spurious rings produced by diffraction surrounding a transverse section of human hair. Internal spurious rings may be seen in transverse sections of woody fibre.

Formula (1.) also shows, by substituting successively 1, 2, 3 and 4 in place of m, that the distances of the successive fringes from the opake body will be relatively as the square roots of the odd numbers 1, 3, 5, 7, and so on; showing that the distances between the remoter fringes are less than between the lower orders. Thus if the distance of the first fringe is reckoned as unity the distance of the third fringe will be but a little more than two. The higher orders of fringes, in addition to being indistinct, will be so close together that they will not be resolved. Thus these diffraction fringes bear a close resemblance to Newton's rings.

We see by the position of the spurious lines between M and M, fig. 2, that if the real lines are very near together the spurious lines may seriously interfere with the resolvability of such series of lines as are found on Nobert's test. From formula (2.) we see that the value of y, or the distance of the first dark band from the object, represented by PC, fig. 1, is an increasing function of x, or of the depth to which the lines we are considering are cut into the glass. In this analysis we shall suppose the focus of illumination is at a little distance below the object, and that the thickness, AP, of the object is very small.

Let us take $m=1$, $\lambda=\frac{1}{50000}$ inch, and suppose C to be very large in comparison with x, we may then neglect x^2 in equation (2.), which thus becomes, $y^2=m\lambda x$.

If $x=0$ then $y=0$, or if the object has no thickness there will be no fringe when the object is seen in focus. But if such an object having absolutely no thickness is a little out of focus it will be bordered by a fringe. If $x=\lambda$ then $y=\lambda$; i. e., if $x=\frac{1}{50000}$ inch, $y=\frac{1}{50000}$ inch. If $x=4\lambda$, $y=2\lambda$. If $x=9\lambda$, $y=3\lambda$. If $x=16\lambda$, $y=4\lambda$.

If $x=\frac{1}{2}\lambda$, $y=\cdot7\lambda$. If $x=\frac{1}{3}\lambda$, $y=\cdot6\lambda$. If $x=\frac{1}{4}\lambda$, $y=\frac{1}{2}\lambda$. If $x=\frac{1}{9}\lambda$, $y=\frac{1}{3}\lambda$. If $x=\frac{1}{16}\lambda$, $y=\frac{1}{4}\lambda$, &c. From this reasoning it appears that if the real depth of a line is $x=\frac{1}{16}\lambda=\frac{1}{800000}$ inch the breadth of the line including the first fringe on either side cannot be less than $\frac{1}{100000}$ of an inch. If the lines are ruled deeper the fringes will be broader, and it becomes an important question to know how we are to overcome this obstacle to the resolvability of series of lines at the smallest distances appreciable. If instead of employing light radiating from a point directly below the object, we illuminate it by means of parallel rays at a very oblique angle, as the direct light of the sun so oblique as to illuminate only one side of the lines, the fringes on the side not illuminated would be scarcely perceptible, and the microscope may be so focussed that the visible fringes shall overlie or apparently coincide with the real lines when the lines will be easily resolved. Here theory beautifully coincides with observation, for in just those conditions lines are resolved in the microscope, which defy resolution by other methods.

Another important phenomena of diffraction remains to be noticed. Let QRST, fig. 4, be an opake object, in addition to diffraction from the points S and T, which have been noticed above, the points Q and R also act as new centres of radiation throwing light into the shadow Q R $q r$. If the light proceeded only from one of the points Q or R, there would be no dark bands formed above the object, and the light would gradually fade away from the border towards the centre of the shadow. But by reason of the meeting of the rays diffracted from opposite sides into the shadow, a bright line will be seen in the centre of the shadow when the focus of the microscope is adjusted to a plane $q r$ a little above the object, and if the shadow is broad enough there may be dark lines on either side of the central bright line formed by concurrence of rays from the opposite sides. A perfect microscope should have its focus confined to a mathematical plane, i. e., the focus of the central and border rays should coincide, or the object glass should be free from spherical aberration, but this result is only approximately secured in ordinary achromatic objectives. The result is that the field of vision has a certain depth, so that if a very thin object is carefully focussed in the microscope, this spurious bright

4.

line above a real opake line is often visible. This peculiarity of microscopic vision frequently makes a fine opake line appear double.

If, to avoid seeing the spurious bright line above a real opake line, and also to diminish the breadth of the fringes formed by diffraction from the lower part of the line, we bring the lower part of the object into focus we encounter another difficulty in resolving a series of lines. The light transmitted does not form a sufficient angle and the space between the lines, if they have much thickness, appears dark, as is the case with natural vision when looking into a long tunnel.

I will now bring together some practical conclusions deduced from the above discussion and more or less comfirmed by experiment.

First. If a minute object, whether a speck or a line, having an appreciable depth, is examined in the microscope, the effect of diffraction is to increase its apparent breadth. A speck appears larger than it really is, a line or thread-form object appears wider than it should be and the edge of a diatom appears black and indistinct. These facts are recognized by Hartung, "Das Mikroskop," &c., § 247, but I am not aware that any writer has given an explanation of these facts.

Secondly. A single line under favorable circumstances appears bordered with fringes or spurious lines which in examining an unknown object may often lead to erroneous views of the real structure. This error is more liable to occur where dots or cell structures are examined. Cells having but a single wall may appear enclosed with double or triple walls, and opake molecules may appear as though enveloped by a cell wall. The practiced eye will doubtless learn to detect such fallacies.

When the first band of Nobert's test, the lines of which are at the distance of $\frac{1}{1110}$ of an inch, is viewed in such a position that the lines appear intensely black, these black lines are not the real grooves cut by the diamond but the spaces between the lines occupied by dark fringes produced by diffraction, while the bright spaces are the bright lines of double intensity over the real lines, as explained above by means of fig. 4. By bringing the objective nearer to the lines the black lines disappear and light spaces take their places, while the fine cuts of the diamond appear where the bright lines were previously seen. Beside this when the intensely black lines appear, the outer lines are narrower than the others and the number is greater by one than the real lines. If this series of lines is illuminated by sunlight or by artificial light of great intensity, the colors of the spectrum, especially the blue, yellow and red, can be clearly seen in the first diffraction band on each side of the diamond cut. In the 23d band on the Nobert's test, employed by the writer, with a moderate power irregular lines are seen, indicating that the depth of the lines is not uniform but more like the opake lines 1—6 seen in section at *mn*, fig. 5. Still further, when viewing the first band of Nobert's test, the focus can be so adjusted that each line appears like two dark lines.

5.

In this case there is no great danger of mistaking the number of the real lines, but with lines ruled much deeper for the purpose of experiment there is great difficulty in determining the number of real lines. Every observer has doubtless noticed when examining diatoms or other delicate objects with oblique light, a fainter image overlying the real object. I have often been puzzled to tell whether these two images did not belong to opposite sides of the diatom. May not this phenomena be due to diffraction?

The sources of error here indicated may possibly help to explain the discrepancy in the number of lines seen on particular species of Diatomaceæ as reported by different observers.

Thirdly. The theory of diffraction would indicate that a series of wires or threadform objects, such as are shown in section at MM, fig. 5, offer less impediment to resolution than objects of other forms, for the reason that a cylindrical surface diffracts the light less than a sharp edge or angle. According to Hartung ("Das Mikroskop," p. 722) Amici's microscope of 94° aperture resolved a network of wires whose diameter was $\frac{1}{6140}$ m. m. $=\cdot 000064 = 3\lambda$, with spaces between the wires of $\frac{1}{3750}$ m. m. $=\cdot 000102$, while a single thread-form object could be seen with the same instrument when its diameter was only $\frac{1}{41300}$ m.m. or only about one-seventh the diameter of the wire grating.

If we suppose the microscope to be so focussed as to allow the upper surface of the wire grating to be seen, and call the semi-diameter of the wire $1\frac{1}{2}\lambda$, the breadth of the first fringe on either side would be $y=1{\cdot}2\lambda$, the apparent increase of the breadth of the wire would be $2{\cdot}4\lambda = \cdot 000048$ inch. The entire apparent breadth of the wire would become ·000112 in., leaving an apparent clear space of ·000054 in., which would appear as a bright line having a breadth of $\frac{1}{185000}$ inch.

Fourthly. If we examine in the microscope a crystal, so small that the breadth of the diffraction fringe bears a considerable proportion to the breadth of the crystal, the effect of diffraction is to make the crystal appear as a round speck, and its crystalline form cannot be clearly distinguished. Here theory is abundantly confirmed by experiment. How difficult then must it ever be to distinguish minute organic germs from inorganic dust!

Lastly. Diffraction presents an important practical difficulty in the microscopic investigation of common objects. Transverse sections of hairs appear in the microscope surrounded with one or more fringes or rings. In some cases I have counted five distinct rings. In other cases a single ring with a dark border is seen giving the appearance of a thick cuticle covering the hair. This ring, generally supposed to be the cuticle, varies in thickness with the length of the sections examined. On transverse sections of human hair not more than one-fourth as long as they are broad this ring diminishes in breadth until it appears as a mere film or entirely disappears. Now although I believe there is no doubt that the outer cells of the hair differ in structure from those more internal, I seriously doubt whether this ring, called the cuticle, which surrounds transverse sections of hair is what it is usually supposed to be. Again transverse sections of woody fibre appear to show a laminated structure of the cell walls, one layer within another, which is generally supposed to prove that the cellulose is deposited within the wood cells in successive layers. I frequently find at least one internal ring, and, when the wood cells are slightly separated, one external ring that are without doubt due to diffraction. Some of the other so-called laminæ I have suspected to be due to the same cause. It is very difficult to tell how much of this appearance is due to organic structure and how much depends upon diffraction, but the phenomena of diffraction set forth in this paper would seem to require that this whole subject of cell structure and growth should be carefully reëxamined.

The binocular microscope has given me much assistance in detecting fallacies produced by diffraction, but the imperfections of this instrument as at present constructed prevent its useful application to the resolution of lines finer than $\frac{1}{15000}$ of an inch. The first five bands of Nobert's test, when seen in the binocular microscope, show that the coarser bands are cut much deeper into the glass than the finer lines. While this instrument shows the first and second bands like a series of plates set up edgewise, the lines in the bands above the fifth appear only as delicate scratches upon the surface of the glass. I hope that further improvements in the binocular microscope and the labors of other observers will give us more perfect knowledge of minute structures than we possess at present.

New Haven, Conn., April 3d, 1862.

ART. XXXIX.—*Discovery of Microscopic Organisms in the Siliceous Nodules of the Palæozoic Rocks of New York.*

AT Prof. Dana's suggestion, Dr. M. C. White, well known for his devotion to the microscope, has examined various specimens of the hornstone nodules found in the Devonian and Silurian rocks of this country, with a view to determine the presence of organisms analogous to those well known to exist in the flints of the Chalk. This research has been rewarded by the discovery of abundant organisms referable to the Desmidieæ, besides a few Diatomaceæ, numerous spicula of sponges, and also fragments of the dental apparatus of Gasteropods. Among the Desmids, there is a large variety of forms of Xanthidia supposed to be the Sporangia of Desmids, besides an occasional duplicated Desmid; also, lines of cells, some of which appear to be sparingly branched. The researches have been mostly confined to the hornstone of the Corniferous limestone; though extended also to the hornstone from the Black River limestone and that of the Sub-Carboniferous limestone of Illinois, both of which contain some organisms.

The hornstone nodules from the Black River limestone (as well as the Corniferous) have been since examined also by Mr. F. H. Bradley with similar results.

These observations will be regarded with much interest by geologists as well as by microscopists. They carry back to a very early epoch forms of life which have hitherto been looked upon as belonging only to a much more recent era in the life of our planet.

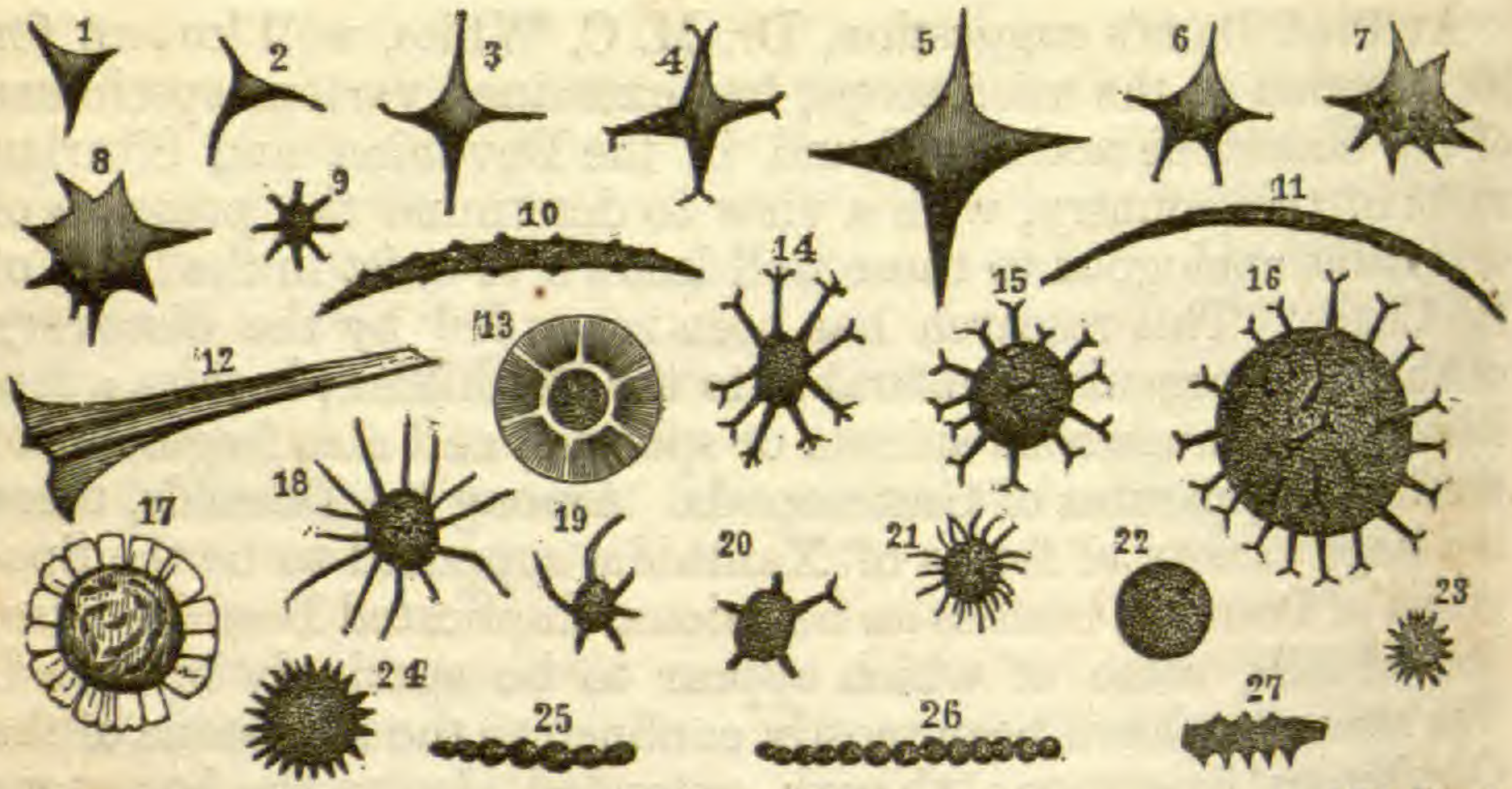
The analogy of these hornstone nodules to the flints of the Chalk is obvious; and the discoveries here announced may be regarded as establishing their similarity in origin. The organisms figured so closely resemble those of the flint that they might be taken for them; it is difficult in all cases to make out a difference of species.

The extreme abundance of the hornstone nodules in our palæozoic limestones will render it easy to multiply observations in this new field of research, which presents an interesting addition to the labors of the microscopist. It will be remembered by those who undertake such examinations that the use of turpentine renders the chips of chert almost as transparent as glass.

We add a note from Dr. White with figures of some of the more frequently recurring forms hitherto observed by him.—*Eds.*

TO THE EDITORS:

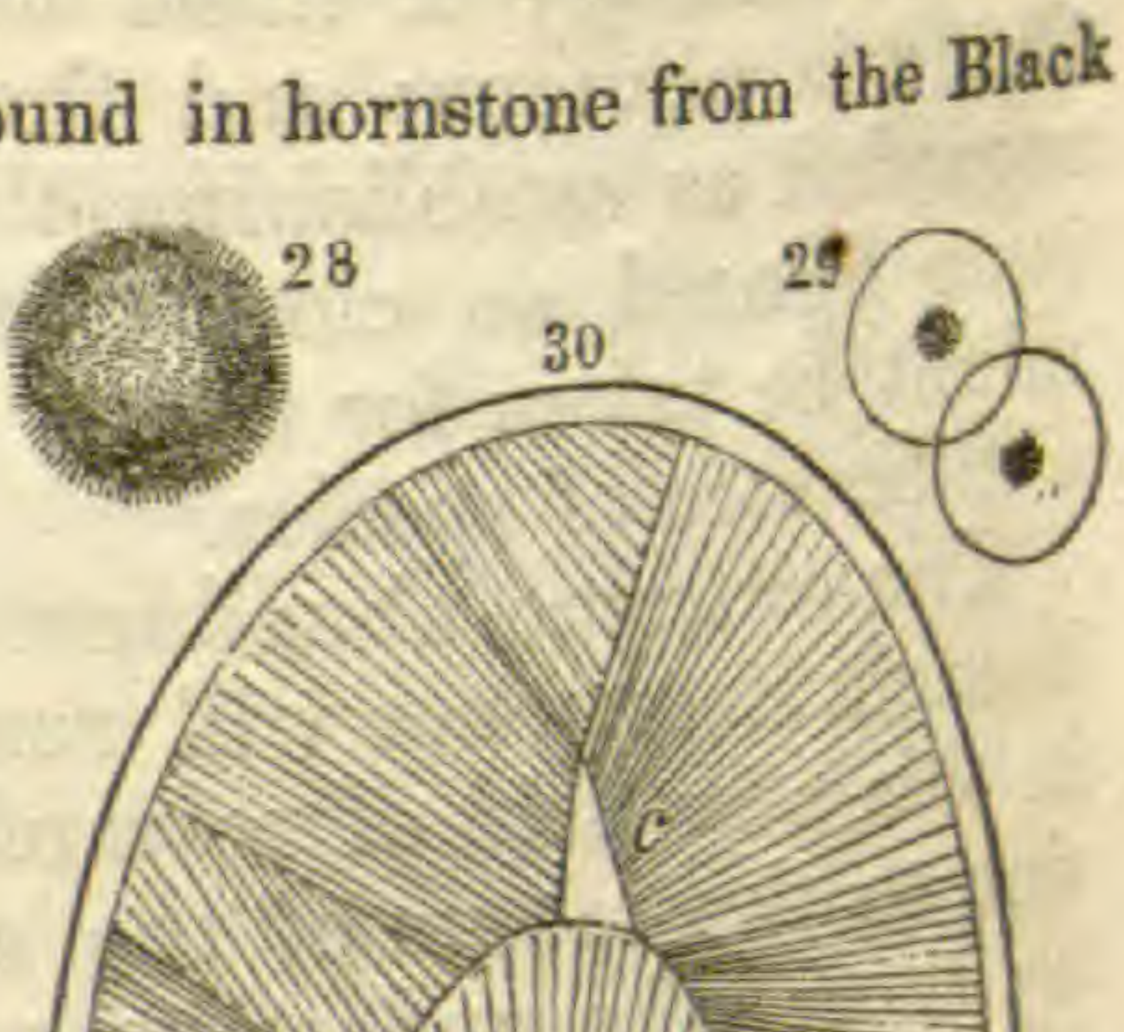
Having recently been engaged in examining the microscopic structure of hornstone from Palæozoic rocks, I send you the accompanying sketches of organic forms which I have discovered. They consist of spicules and gemmules of sponge and fragments of sponges, Desmidieæ, several species of Xanthidia, and disks which probably are to be considered as Diatoms. Hornstone from the Corniferous limestone of central and western New York contains the greatest variety of these organic forms. A few specimens have been found in hornstone of the Black River Limestone from Watertown, N. Y.



Figures 10, 11 and 12 were drawn with a magnifying power of 70 diameters. Fig. 9 with a power of 400 diameters, and all the other figures with a power of 225 diameters. Figures 1 to 9, and 14 to 22, are various species of Xanthidia found in hornstone from the Corniferous limestone (Lower Devonian) of central and western New York. Figures 10, 11 and 12 are spicules of sponge from the same localities. Fig. 13 is a Diatom, on which the radial lines were faintly seen. Figures 23 and 24 are gemmules of sponge found in the hornstone of central New York. Figures 25 and 26 represent Desmidieæ, which are very abundant in the hornstone from Corniferous limestone of central and western New York. Fig. 27 is supposed to be part of a tooth of a Gasteropod.

Some of the specimens also contain spherical and ellipsoidal bodies 6-1000th to 7-1000th of an inch in diameter, the true nature of which has not been determined.

Figs. 28, 29 and 30 represent structures found in hornstone from the Black River limestone from Watertown, N. Y., magnified 225 diameters: 28 is a Xanthidium covered with very minute spines. 29 represents two Diatoms: 30 is a section of an egg-shaped body, $\frac{1}{100}$ inch in diameter, enclosed in a distinct shell, the ellipsoidal character of which was clearly shown in specimens from the Corniferous limestone, the shell being filled with very nearly transparent quartz. The specimen shown in the figure, found in the hornstone from the Black River limestone, is filled with a crystalline substance of a silky appearance, very nearly transparent. Near the larger end is a disk, *d*, which is probably to be regarded as a Diatom: *c* is probably a crystal. The thickness of the ellipsoidal shell is about $\frac{1}{2000}$ of an inch.



These investigations were undertaken at the suggestion of Prof. Dana, who furnished the specimens of hornstone, the examination of which has enabled me to make these most interesting discoveries.

Yours, &c.
M. C. White.

New Haven, Conn., March 22, 1862.

ART. XL.—*Colorado River of the West.**

FOR a number of years prior to the commencement of the present war in which our country is so unhappily involved, an annual appropriation of from 50,000 to 100,000 dollars has been made by Congress, for explorations and surveys in unknown regions west of the Mississippi, to be expended under the direction of the Topographical Bureau. Expeditions were therefore sent out to various parts of the West, with specific instructions as to the unexplored district to be examined, and a party organized, composed of topographers, meteorological observers, geologists, artists, &c., and placed under the command of an officer of the U. S. Topographical Corps. With an appropriation of 25,000 dollars, Lieut. Ives was ordered in the spring of 1857, to examine the unexplored region bordering upon the great Colorado of the West and to ascertain the navigability of that river. How well Lieut. I. and his assistants performed the duty entrusted to them the volume before us bears ample testimony. We regard it as one of the most important and most finished reports yet published by the U. S. government in regard to the West, and so far as the labors of the authors are concerned, it is in the highest degree creditable to them. While thus examining the Report before us with real pleasure we cannot but feel the profoundest regret that so able and accomplished an officer as Lieut. Ives, a native of New York City, but reared in New England, should at this time be found fighting in the ranks of the enemies of our country, lost to science and the world, at war not more with the government which has educated and advanced him than with his own convictions of right and duty.

We quote that portion of the introduction which relates to the history of Colorado explorations and the organization of the expedition.

"The Colorado of the West is the largest stream, with one exception, that flows from our Territory into the Pacific Ocean. It has its sources in the southern portions of Nebraska and Oregon, and in its course to the Gulf of California drains two-thirds of the Territory of New Mexico, and large portions of Utah and California, an area of more than 300,000 square miles.

Very little has been known concerning this river. Two streams, Green and Grand rivers, which flow through Utah in a southerly direction, have been supposed to unite somewhere near the southern boundary of

* Report upon the Colorado River of the West; explored in 1857 and 1858 by Lieutenant JOSEPH C. IVES, Corps of Topographical Engineers, under the direction of the office of Explorations and Surveys; A. A. HUMPHREYS, Captain Topographical Engineers in charge. By order of Secretary of War. 364 pages 4to of text, with numerous engravings, 3 plates of fossils, 4 maps, two topographical and two geological.

that Territory and form the Colorado, but the point of junction has never been visited nor determined. For hundreds of miles below this point the stream has not been seen, till recently, by white men, excepting at one spot, and few Indians, for centuries past, have been near its banks. Notwithstanding this, some portions of the river were among the earliest parts of America to be explored. In less than fifty years after the landing of Columbus, Spanish missionaries and soldiers were travelling upon the Colorado, following its course for a long way from the mouth, and even attaining one of the most distant and inaccessible points of its upper waters. More information was gained concerning it at that time than was acquired during the three subsequent centuries.

In the year 1540 the viceroy of New Spain, interested in the accounts derived from a Franciscan monk of the latter's travels in the Territory now called New Mexico, sent an exploring expedition into that region under the command of Vasquez de Coronado. A detachment of twenty-five men, led by one Diaz, left Coronado's party and travelled westward. They discovered the Colorado and followed it to its mouth. Their description of the river and of the tribes they met upon it is not at all inapplicable to the condition of things at the present day, though the statements concerning the prodigious size of one community of Indians that they encountered are a little exaggerated. The Mojaves, to whom, doubtless, they refer, are perhaps as fine a race of men, physically, as can anywhere be found, but they do not quite come up, in stature and strength, to the descriptions of the Spaniards.

About the same time Captain Fernando Alarçon, by order of the viceroy, sailed up the Gulf of California and ascended the Colorado in boats for a long distance. The account of what he saw agrees with that of his cotemporary explorer.

Another of Coronado's captains, named Cardinas, with a party of twelve men, reached the pueblos of Moquis, and repaired from them, with Indian guides, to a portion of the Colorado, far distant from that seen by the others. The history states that after twenty days' march, over a desert, they arrived at a river, the banks of which were so high that they seemed to be three or four leagues in the air. The most active of the party attempted to descend, but came back in the evening, saying that they had met difficulties which prevented them from reaching the bottom; that they had accomplished one-third of the descent, and from that point the river looked very large. They averred that some rocks, which appeared from above to be the height of a man, wêre higher than the tower of the cathedral of Seville. This was the first description of the famous Big Cañon of the Colorado.

Several times, during the succeeding two centuries, the lower part of the river was visited by Catholic priests. In 1744 a Jesuit missionary, named Jacob Sedelmayer, went thither, following the course of the Gila, and travelled extensively in both New Mexico and Sonora, and about thirty years afterwards the Jesuits established missions among the Yuma Indians, who live at the junction of the Gila and Colorado. The priests were subsequently massacred by the fierce tribe among whom they had located themselves.

In 1776 another Catholic missionary, Father Escalante, travelled from

Santa Fé to Utah, and having explored the region south of the Great Salt Lake, pursued a southwesterly course, towards the sources of the Virgin, and then crossed to the Colorado, which he reached at a point that appears to have been almost identical with that attained, from the opposite direction, by Cardinas, more than two centuries before.

From this time the river was scarcely approached, excepting by an occasional trapper, or some overland party crossing the lower portion, *en route* to California. A considerable part of the emigration, induced by the gold discoveries in that region, passed through New Mexico, by way of the Gila, and the travellers were subjected to molestation from the Yumas. In 1850 a detachment of troops was sent to the mouth of the Gila to keep these Indians under control, and not long afterwards a military post, called Fort Yuma, was regularly established.

The difficulty of furnishing supplies to the garrison, across the desert, was such that, in the winter of 1850 and 1851, General Smith, commanding the Pacific division, sent a schooner from San Francisco to the head of the Gulf of California, and directed Lieutenant Derby, topographical engineers, to make a reconnaissance, with a view of establishing a route of supply to Fort Yuma, *via* the Gulf and the Colorado. The result of the reconnaissance was successful, and the route was at once put in operation. The freight, carried in sailing vessels to the mouth of the river, was transported to the fort—the distance to which, by the river, is one hundred and fifty miles—at first in lighters, and afterwards in steamboats.*

In 1851, Captain Sitgreaves, U. S. topographical engineers, with a party of fifty individuals, made an exploration from Zuni westward. He struck the Colorado at a point about 160 miles above Fort Yuma, and followed the east side of the river, keeping as near to the bank as possible, to the fort. He encountered the Mojaves, and found their appearance and customs generally to agree with the descriptions of the early explorers. The descent was accompanied with hardship and danger. Both the Mojaves and Yumas were hostile, and the difficulty of travelling near the river was extreme, owing to the chains of rugged and precipitous mountains that crossed the valley. The summer heats had parched and withered the face of the country; the stream was low, and what was seen of it did not create a favorable opinion regarding its navigability.

In the spring of 1854 Lieutenant Whipple, topographical engineers, in command of an expedition for the exploration and survey of a railroad route near the 35th parallel, reached the Colorado, at the mouth of Bill Williams's Fork, and ascended the river about fifty miles, leaving it at a point not far below where Captain Sitgreaves had first touched it. The expedition was composed of nearly a hundred persons, including the escort. The Mojaves were friendly, furnishing provisions to the party, whose supply was nearly exhausted, and sending guides to conduct them by the best route across the desert westward. The river was probably higher than when seen by Captain Sitgreaves, and it was the opinion of Lieutenant Whipple that it would be navigable for steamers of light draught. The course of the Colorado northward could be followed with the eye for only a short distance, on account of mountain spurs that crossed the valley

* A fuller account of the opening of this route is given in a subsequent chapter.

and intercepted the view. A high distant range, through which the river apparently broke, was supposed to be at the mouth of the 'Big Cañon,' which the Spaniards, in 1540, had visited at a place far above.

The marvellous story of Cardinas, that had formed for so long a time the only record concerning this rather mythical locality, was rather magnified than detracted from by the accounts of one or two trappers, who professed to have seen the cañon, and propagated among their prairie companions incredible accounts of the stupendous character of the formation. It therefore became a matter of interest to have this region explored, and to lay down the positions of the Colorado and its tributaries along the unknown belt of country north of the 35th parallel. The establishment of new military posts in New Mexico and Utah made it also desirable to ascertain how far the river was navigable, and whether it might not prove an avenue for the economical transportation of supplies to the newly occupied stations.

There was no appropriation that would enable the War Department to accomplish this service until the summer of 1857, when the present Secretary of War, having the disposition of a certain amount to be expended in field examinations, set apart a portion of it for the exploration of the Colorado, and directed me to organize an expedition for that object.

To ascertain how far the river was navigable for steamboats being the point of primary importance, it was necessary first to make provision for this portion of the work. The company employed in carrying freight from the head of the Gulf to Fort Yuma were unable to spare a boat for the use of the expedition, excepting for a compensation beyond the limits of the appropriation. A boat of suitable construction had, therefore, to be built on the Atlantic coast and transported to San Francisco, and thence to the mouth of the river. In order that the survey should be made at the worst and lowest stage of the water, I had been directed to commence operations at the mouth of the Colorado on the 1st of December. This left little time for preparation, considering that it was necessary to build a steamer and carry the parts to so great a distance.

In the latter part of June I ordered of Reaney, Neafie & Co., of Philadelphia, an iron steamer, fifty feet long, to be built in sections, and the parts to be so arranged that they could be transported by railroad, as the shortness of time required that it should be sent to California, *via* the Isthmus of Panama. About the middle of August the boat was finished, tried upon the Delaware, and found satisfactory, subject to a few alterations only. It was then taken apart, sent to New York, and shipped on board of the California steamer which sailed on the 20th of August for Aspinwall. Mr. A. J. Carroll, of Philadelphia, who had engaged to accompany the expedition as steamboat engineer, went out in charge of the boat.

The transportation of the steamer was, to the parties concerned, a source of more trouble than profit, but the kind offices of the agents of the Panama Railroad Company, and of the captains of the steamships on both the Atlantic and Pacific coasts, united to the careful supervision of Mr. Carroll, enabled the awkward mass of freight to reach San Francisco in safety by the first of October.

Dr. J. S. Newberry was appointed physician to the expedition, and also to take charge of the natural history department. This gentleman had previously made extensive geological surveys in California and Oregon while attached to the party of Lieutenant Williamson, topographical engineers, in charge of the Pacific railroad surveys in those regions.

Mr. F. W. Egloffstein, who had been attached to Frémont's expedition of 1853, and had subsequently been employed with the party that explored the Pacific railroad route near the 41st parallel, was appointed topographer. Messrs. P. H. Taylor and C. K. Booker were the astronomical and meteorological assistants. A gentleman belonging to the household of Baron Von Humboldt, Mr. Mollhausen, who had been a member of the exploring party of Prince Paul of Wirtemburg, and also of Lieutenant Whipple's expedition, received from the Secretary of War the appointment of artist and collector in natural history."

The Journal of Lieut. Ives is full of interesting descriptions of incidents of the trip, accounts of numerous tribes of Indians, scarcely known prior to his visit, as the Moquis, Mojaves, &c. An important hydrographic report of 14 pages is also appended. We have room only for the vivid description of that remarkable passage in nature, the Black Cañon, given on pages 85, 86, and 87.

"*Camp* 59, *head of Black Cañon, March* 10.—The skiff having been put in tolerable order, a bucket full of corn and beans, three pairs of blankets, a compass, and a sextant, and a chronometer were stowed away in it, and a little before sunrise the captain, mate, and myself commenced the exploration of the cañon. My companions each pulled a pair of sculls, and with considerable vigor; but as the current has a flow of three miles an hour we could not make rapid progress. We had proceeded a quarter of a mile, and had just rounded the first bend, when one of the sculls snapped, reducing by half our motive power. There was, fortunately, a current of air drawing in the right direction through the narrow gorge, and, with the odd scull and a blanket, an apology for a sail was rigged, which, at intervals, rendered great assistance.

In a few minutes, having passed what may be called the outworks of the range, we fairly entered its gigantic precincts, and commenced to thread the mazes of a cañon, far exceeding in vastness any that had been yet traversed. The walls were perpendicular, and more than double the height of those in the Mojave mountains, rising, in many places, sheer from the water, for over a thousand feet. The naked rocks presented, in lieu of the brilliant tints that had illuminated the sides of the lower passes, a uniform sombre hue, that added much to the solemn and impressive sublimity of the place. The river was narrow and devious, and each turn disclosed new combinations of colossal and fantastic forms, dimly seen in the dizzy heights overhead, or through the sunless depths of the vista beyond. With every mile the view became more picturesque and imposing, exhibiting the same romantic effects and varied transformations that were displayed in the Mojave cañon, but on an enlarged and grander scale.

Rapids were of frequent occurrence, and at every one we were obliged to get out of the skiff, and haul it over. Eight miles from the mouth of the cañon, a loud sullen roaring betokened that something unusual was ahead, and a rapid appeared which was undoubtedly the same that had been described by Ireteba. Masses of rock filled up the sides of the channel. In the centre, at the foot of the rapid, and rising four or five feet above the surface of the water, was a pyramidal rock, against which the billows dashed as they plunged down from above, and glanced upwards, like a water spout.

The torrent was swifter than at any place below, but a steamboat, entirely emptied of its cargo, which could be deposited upon the rocks alongside of the rapid, could, if provided with long and stout lines, be hauled up. During a higher stage of the river the difficulty of the place would be much diminished. With our nearly worn out ropes it would be very hazardous to attempt the ascent.

Several rapids followed at short distances, all of which would be troublesome to pass at the present depth of water. The constant getting out of the boat, and the labor of dragging it through these difficult places, made our progress for some miles exceedingly tedious and fatiguing. As sunset was approaching we came to a nook in the side of the cañon, four miles above the Roaring rapid, where a patch of gravel and a few pieces of drift wood, lodged upon the rocks, offered a tolerable camping place, and we hauled the skiff upon the shingle, and stopped for the night. There was no need of keeping a watch, with two grim lines of sentinels, a thousand feet high, guarding the camp. Even though we could have been seen from the verge of the cliff above, our position was totally inaccessible.

Darkness supervened with surprising suddenness. Pall after pall of shade fell, as it were in clouds, upon the deep recesses about us. The line of light, through the opening above, at last became blurred and indistinct, and, save the dull red glare of the camp-fire, all was enveloped in a murky gloom. Soon the narrow belt again brightened, as the rays of the moon reached the summits of the mountains. Gazing far upward upon the edges of the overhanging walls we witnessed the gradual illumination. A few isolated turrets and pinnacles first appeared in strong relief upon the blue band of the heavens. As the silvery light descended, and fell upon the opposite crest of the abyss, strange and uncouth shapes seemed to start out, all sparkling and blinking in the light, and to be peering over at us as we lay watching them from the bottom of the profound chasm. The contrast between the vivid glow above, and the black obscurity beneath, formed one of the most striking points in the singular picture. Of the subsequent appearance of things, when the moon rose higher, I do not think any of our weary party took particular notice.

This morning, as soon as the light permitted, we were again upon the way. The ascent of the river was attended with as much labor as it had been the day before; for though none of the rapids were of so violent a character, they were of constant occurrence. The wind still held to the south, and the blanket sail was again set to great advantage.

The cañon continued increasing in size and magnificence. No description can convey an idea of the varied and majestic grandeur of this peerless water-way. Wherever the river makes a turn the entire panorama changes, and one startling novelty after another appears and disappears with bewildering rapidity. Stately façades, august cathedrals, amphitheatres, rotundas, castellated walls, and rows of time-stained ruins, surmounted by every form of tower, minaret, dome, and spire, have been moulded from the cyclopean masses of rock that form the mighty defile. The solitude, the stillness, the subdued light, and the vastness of every surrounding object, produce an impression of awe that ultimately becomes almost painful. As hour after hour passed we began to look anxiously ahead for some sign of an outlet from the range, but the declining day brought only fresh piles of mountains, higher, apparently, than any before seen. We had made up our minds to pass another night in the cañon, and were searching for a spot large enough to serve as a resting-place, when we came into a narrow passage, between two mammoth peaks, that seemed to be nodding to each other across the stream, and unexpectedly found, at the upper end, the termination of the Black cañon.

Low hills of gravel intercepted the view, and prevented us from seeing far into the unknown region beyond. A mile above the cañon the river swept the base of a high hill, with salient angles, like the bastions of a fort. At the base was a little ravine, which offered a camping place that would be sheltered from observation, and we drew the skiff out of the water, determining not to proceed any further until to-morrow. Leaving the mate to take charge of the boat, the captain and myself ascended the hill, which is over a thousand feet high. A scene of barren and desolate confusion was spread before us. We seemed to have reached the focus or culminating point of the volcanic disturbances that have left their traces over the whole region south. In almost every direction were hills and mountains heaped together without any apparent system or order. A small open area intervened between camp and a range to the north, and we could trace the course of the river as it wound towards the east, forming the Great Bend. In the direction of the Mormon road to Utah, which is but twenty miles distant, the country looked less broken, and it was evident that there would be no difficulty in opening a wagon communication between the road and the river. We tried to discover the valley of the Virgin, but could see no indication of any stream coming in from the northwest. The view in that direction was partially obstructed by another summit of Fortification rock.

Not a trace of vegetation could be discovered, but the glaring monotony of the rocks was somewhat relieved by grotesque and fanciful varieties of coloring. The great towers that formed the northern gateway of the cañon were striped with crimson and yellow bands; the gravel bluffs bordering the river exhibited brilliant alternations of the same hues, and not far to the east, mingled with the gray summits, were two or three hills, altogether of a blood-red color, that imparted a purely ghastly air to the scene.

The approach of darkness stopped further observations, and we descended to camp, having first taken a good look in every direction, for the smoke of Indian camp-fires, but without discovering any. In making the sixteen miles from last night's bivouac, we have had to labor hard for thirteen hours, stemming the strong current, and crossing the numerous rapids, and being thoroughly exhausted, depend for security to-night more upon our concealed position than upon any vigilance that is likely to be exhibited."

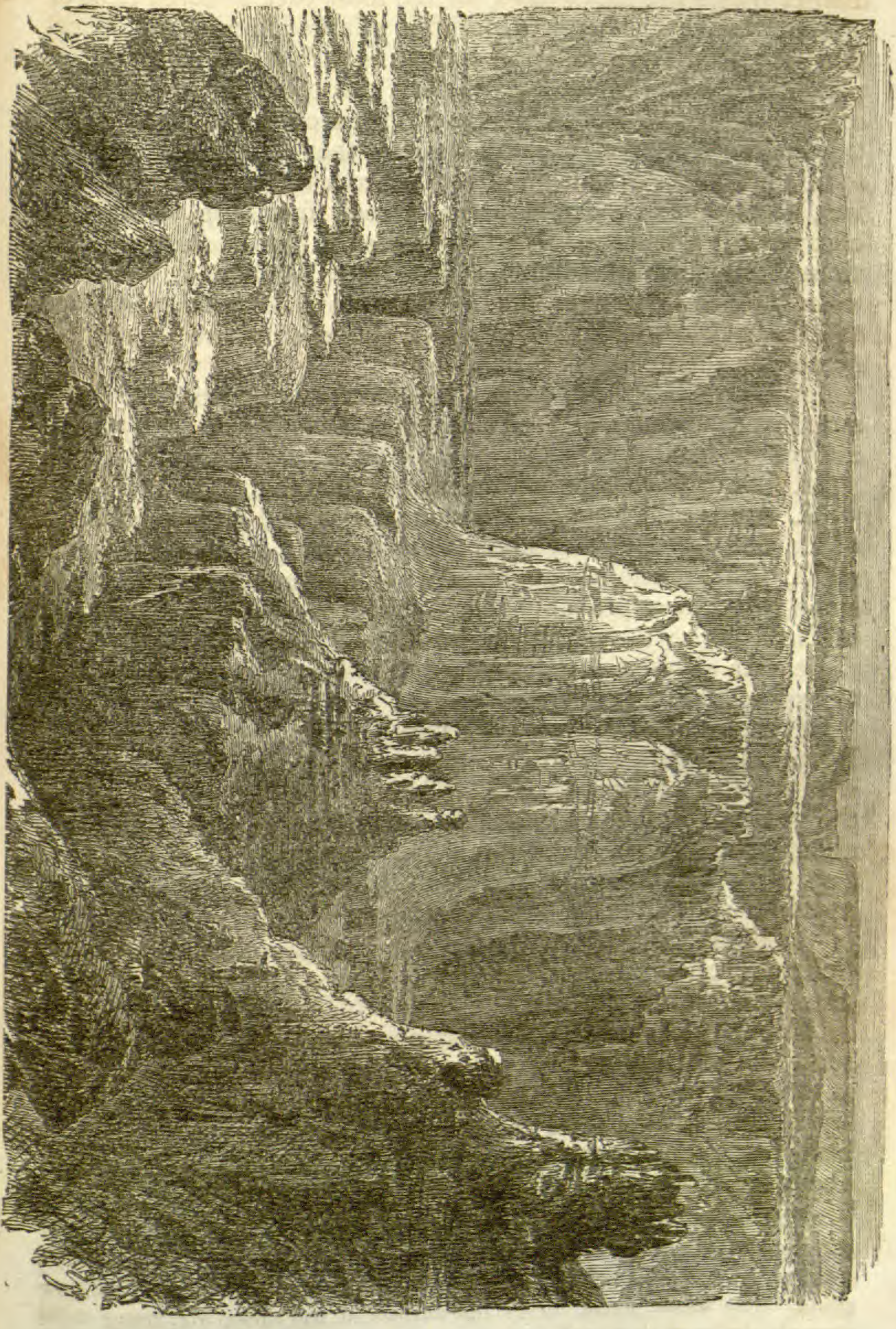
The greater portion of Lieut. Ives' report is in the form of a Journal, noting the current events of each day, in a style clear and attractive. His descriptions of the numerous cañons along the Colorado are exceedingly graphic and beautiful. On page 101 we have the following description of the side cañons of the Colorado, which are well depicted in the annexed engraving:

"A few of the Hualpais paid us a visit, but their intelligence is of so low an order that it is impossible to glean information from them, and their filthiness makes them ojectionable. Our new guides seemed to think we should have difficulty in ascending to the portion of the plateau which they traverse on the way to higher points upon the river. The route they ordinarily pursue follows the cañon of Diamond creek, but this they pronounced impracticable for mules, and said that we must retrace our course for several miles in order to strike a more circuitous, but easier trail, that ascended one of the branch cañons.

Following their advice and guidance, yesterday morning we toiled up the rough road by which we had come, for six miles, when they struck off into a side ravine that led towards the southeast. Half a mile from the mouth, the Hualpais told Ireteba that our camping plaçe was just ahead, and scrambling over the summit of a hill, in a minute were both out of sight. For a mile we kept on, every few moments coming to a fork, where the selection of the right road was left to chance. There was a network of cañons, and the probabilities were that nine out of ten would lead to an impassable precipice. The ascent became so rough that it was already almost impracticable for the mules, and at last the Mojaves stopped, declaring that they had lost their way, and had no idea how to find the camping place or the water, and that the Hualpais were a very bad set. This opinion no one was inclined just then to dispute. I however asked one of the Indians to go back and endeavor to find the deserters or some other member of their tribe. We waited impatiently for half an hour, and then the order was given to countermarch, for I intended to search for the route by which we had come; but before going far, the little Hualpais came back. He seemed amused that we should not have been able to find the water, and again took his place at the head of the column. He conducted us for two miles through a difficult and intricate maze of ravines, and then climbed a side hill, and in a most unexpected place pointed out a little spring. There was a sufficiency of water, and tolerable grass near by. The second Hualpais came back during the evening, and seemed also to be astonished that we should have had trouble in finding what to him was so familiar. They both professed a determination to accompany the train, and Ireteba told me that it was time for himself and companions to return."

In securing the services of Dr. Newberry as Geologist and Naturalist of the expedition, the Department was fortunate—his well known ability in these branches of science, as well as his previous experience in connection with other expeditions in the far west, peculiarly fitting him for the task. His report is ably drawn up and contains lucid descriptions of the geological and physical features of the country along the line of exploration.

Side Cañons of the Colorado.



The numerous great gorges and profound cañons cut by the erosive action of water, through thousands of feet of strata, in a district where the rocks have, for the most part, suffered little or no disturbance since their deposition, afforded him a fine opportunity to study its geological structure. Probably in no other part of the world can so great a thickness of strata be seen and examined inch by inch in one continued section as here. These tremendous chasms cleaving the beds, as they do almost vertically sometimes to the astonishing depth of from three to six thousand feet, reveal every bed and layer of rock from top to base, as clearly and distinctly as they can be seen in the artificial excavations along our rail-roads.

In the great Cañon of the Colorado, on a high mesa, west of the Little Colorado, Dr. N. saw at a single exposure in regular succession the following formations:

1st. Upper Carboniferous limestone surmounting beds of cross-stratified sandstones, and red calcareous sandstones with gypsum, altogether, 1200 feet.

2d. Lower Carboniferous limestone, 1000 feet.

3d. A great thickness of limestone shales, and grits, apparently of Devonian age, resting upon heavy deposits of limestone, mud rocks, and sandstones, apparently of Silurian age, with a sandstone at the base, probably representing the Potsdam sandstone of New York: the whole not less than 2,300 feet.

Beneath all these stratified rocks the gorge is excavated so as to expose 1000 feet of granite.

Of these rocks Dr. Newberry remarks that, "the Silurian and Devonian strata are entirely conformable among themselves, and with the Carboniferous rocks. They lie nearly horizontal upon the granite, forming a series of sandstones, limestones, and shales, about 2000 feet in thickness. The Carboniferous series consists of over 2000 feet of limestones and gypsum, apparently all massive, and often highly fossiliferous. The upper members of the latter series form the surface of the mesas of the Little Colorada, upon which the volcanic group of the San Francisco mountains rest as a base."

At other localities Dr. N. had opportunities to examine the succeeding formations above those just alluded to. One of these, at the crossing of the Little Colorado, where one side of the valley is formed by a third mesa wall, which with the slope at its base rises to an elevation of at least one thousand feet in height above the stream.

"This mesa," he says, "is composed of deep-red sandstones, shales, and conglomerates, resting conformably on the Upper Carboniferous limestone, over which is a series of variegated marls, with bands of magnesian limestone. The latter series forms the surface of the mesa for many miles towards the northeast, and has an aggregate thickness of perhaps 1,500 feet.

The variegated marls and the underlying red sandstones are all regarded as Triassic by Mr. Marcou; but the marls exhibit a remarkable lithological identity from top to bottom, and the upper portion contain plants of Jurassic affinities. Without more fossils from these formations it seems to me, at least doubtful whether we can draw the lines of classification as sharply as he has done; and it would even be a little surprising if there should ever be found good palæontological evidence for the identification of all the European subdivisions of the Permian, Triassic, Jurassic, and Chalk, of which he claims to have demonstrated the existence in this vicinity.

Upon the mesa of the variegated marls at the Moquis village rises still another, to the height of 800 or 900 feet, composed of coarse yellow sandstones, green shales, and beds of lignite—a group of strata which has been called Jurassic, but which contain impressions of dicotyledonous leaves, with *Ammonites*, *Gryphœa*, and *Inoceramus* of Cretaceous species. These fossils leave no room for doubt in reference to the age of the strata which contain them, but prove them to be Lower Cretaceous."

The enormous thickness of strata is at places surmounted by another series of great thickness. This series is thus alluded to by Dr. N.

"Going north from the Moquis villages, on the Lower Cretaceous mesa, our progress was arrested by a want of water; the surface being everywhere cut by deep cañons, by which it is drained to excess; every rain drop which falls finding its way immediately into the bottom of these ravines, where it is hurried off to the far deeper cañons of the Colorado and its larger tributaries. Before we turned back, however, we had approached nearly to the base of a wall rising abruptly from the mesa in which we stood to the height of more than 1,000 feet. This wall was as white as chalk, and reflected the sunlight like a bank of snow. It is evidently the edge of another and higher plateau, and apparently reaches to the Great Colorado, where it caps the 'high mesa,' forming part of the stupendous mural faces, presented toward the south and west, which were distinctly visible when we had receded from them to the distance of a hundred miles.

What is the character of this upper mesa I had no means of determining at this time, and even now there may be some question about it; but I have scarcely a doubt that it is composed of the Upper Cretaceous strata, the equivalents of the 'white chalk' of Europe."

In regard to the causes which have produced the remarkable topographical features of this interesting region, Dr. Newberry shows that it is not due, as would probably be supposed by one not accustomed to the study of such phenomena, to volcanic or eruptive agencies, but solely to the erosive action of running water. Thus he continues:

"The sketch which has been given of the table-lands of the upper Colorado, though brief, will perhaps suffice to convey an idea of the generalities of their structure and relations. But before returning to the details of the local geology of our route, I ought perhaps to refer briefly to two questions of general import, which would naturally suggest themselves to any geologist who should traverse the table-lands west of the Rocky mountains, or should receive an accurate description of them from others.

The first of these questions is: To what cause is due the peculiar topographical features of the surface of the table lands—where the different formations succeed each other in a series of steps, which generally present abrupt and wall-like edges—the more recent strata occupying the highest portion of the plateau? The other has reference to the place and extent of the dry land, of which the erosion furnished the sediments now composing the table-lands.

The first of these questions belongs appropriately to the subject of surface geology, and will be referred to again. I may say here, however, that, like the great cañons of the Colorado, the broad valleys bounded by high and perpendicular walls *belong to a vast system of erosion, and are wholly due to the action of water.* Probably nowhere in the world has the action of this agent produced results so surprising, both as regards their magnitude and their peculiar character. It is not at all strange that a cause, which has given to what was once an immense plain, underlaid by thousands of feet of sedimentary rocks, conformable throughout, a topographical character more complicated than that of any mountain chain; which has made much of it absolutely impassable to man, or any animal but the winged bird, should be regarded as something out of the common course of nature. Hence the first and most plausible explanation of the striking surface features of this region will be to refer them to that embodiment of resistless power—the sword that cuts so many geological knots—volcanic force. The Great Cañon of the Colorado would be considered a vast fissure or rent in the earth's crust, and the abrupt termination of the steps of the table-lands as marking lines of displacement. This theory though so plausible, and so entirely adequate to explain all the striking phenomena, lacks a single requisite to acceptance, and that is *truth.*

Aside from the slight local disturbance of the sedimentary rocks about the San Francisco mountain, from the spur of the Rocky mountains, near Fort Defiance, to those of the Cerbat and Aztec mountains on the west, the strata of the table-lands are as entirely unbroken as when first deposited. Having this question constantly in mind, and examining with all possible care the structure of the great cañons which we entered, I everywhere found evidence of the exclusive action of water in their formation. The opposite sides of the deepest chasm showed perfect correspondence of stratification, conforming to the general dip, and nowhere displacement; and this bottom rock, so often dry and bare, was perhaps deeply eroded, but continuous from side to side, a portion of the yet undivided series lying below."

In an attempt to restore the physical geography of this region during the Palæozoic age, Dr. Newberry remarks:

"The question of the origin of the sediments composing the stratified rocks of the table-lands of the Colorado can scarcely be intelligently discussed till we know more than we now do of the geology of a large area lying north of the Colorado, and of the broad and compound belt of mountains, which we have covered by a single name, (Rocky mountains,) but which, when carefully studied, will probably not be found to form a geological unity.

This much, however, we can fairly infer from observations already made on the geological structure of the far west, viz: That the outlines of the western part of the North American continent were approximately marked out from the earliest Palæozoic times; not simply by areas of shallower water in an almost boundless ocean, but by groups of islands and broad continental surfaces of dry land.

Since the erosion of rocks is always subaerial, or at least never takes place more than forty feet below the ocean surface, it follows that to form the stratified rocks of only that portion of the great central plateau which borders the Colorado, an island 300 miles in diameter, and at least 6,000 feet high, or, what is more probable, a continent of six times that area and 1,000 feet high, was worn down by the action of waves and rains, and in the form of sediments, sand, gravel, clay or lime, deposited on the sea bottom.

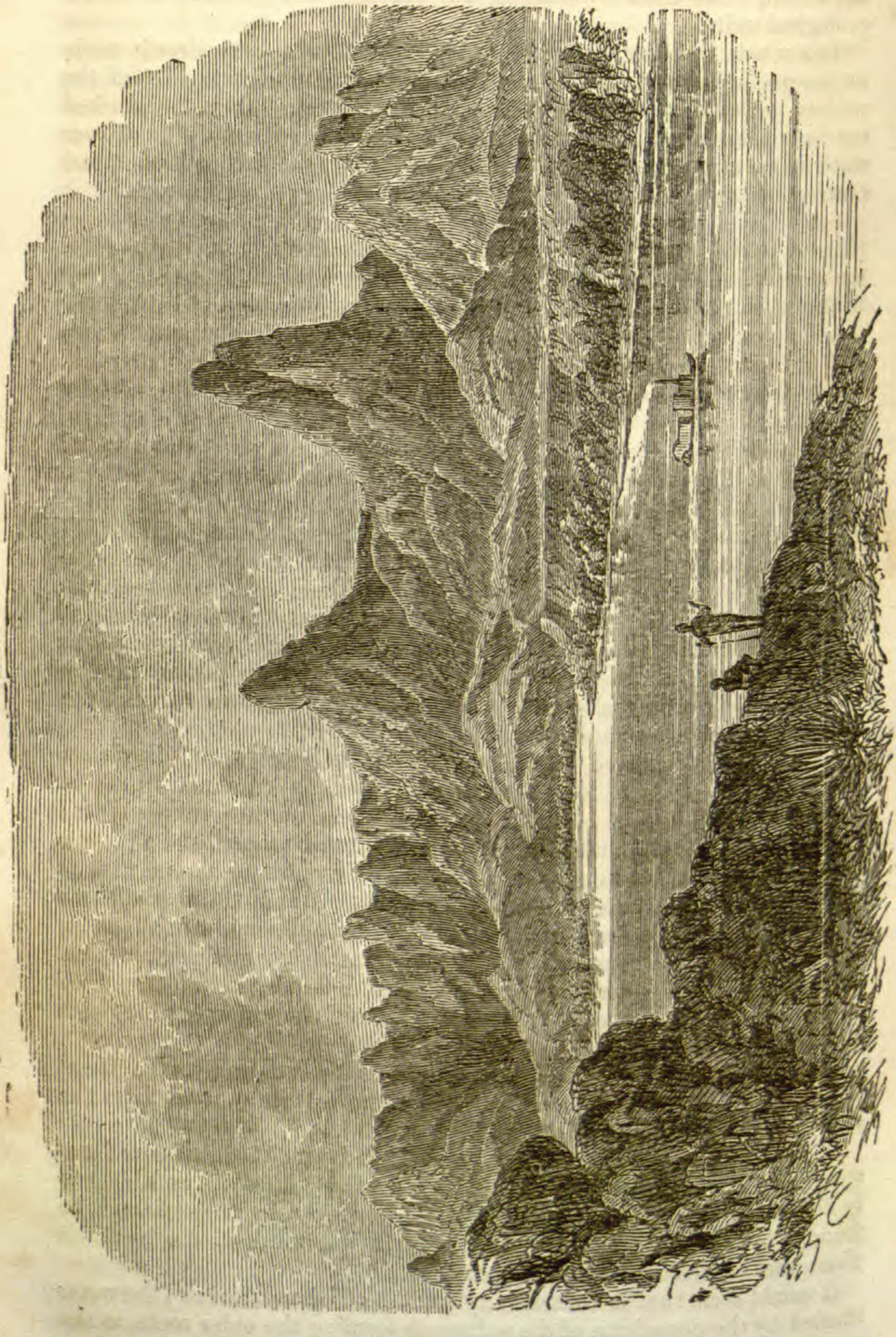
When we reflect that, with the exception of narrow wedges of erupted material in the mountains, an area having, on the 36th parallel, the breadth of the entire distance between the great bend of the Colorado and the Mississippi, (1,200 miles,) and a great, though yet unmeasured extension north and south is occupied by several thousand feet of Palæozoic and Secondary strata, we must conclude that these sediments have not been derived from the erosion of emerged surfaces east of the Mississippi, but here formed by the incessant action of the Pacific waves on shores that perhaps for hundreds of miles succumbed to their power and by broad and rapid rivers which flowed from the mountains and through the fertile valleys of a primeval Atlantis.

I have already alluded to the absence of the Silurian and Devonian rocks from the sections on the flanks of the Rocky mountain axes in New Mexico, while they occur in great thickness in the sections of the cañon of the Colorado, and that they were deposited around, and abutting in horizontal stratification against, the granitic spurs of the mountains bounding the table-lands on the west; and further, that the axes of these mountains are on the east side flanked by Carboniferous strata resting on the granite; the Silurian and Devonian rocks being absent. These facts show that the older Palæozoic strata were deposited in a trough or basin bounded on the east and west by granitic mountains which rose above the ocean's surface.

The Potsdam (?) sandstone which is largely developed in the Great Cañon is a coarse silicious rock that must have been derived from the erosion of land at no great distance.

It is true that the Silurian, Devonian, and Lower Carboniferous limestones are, where I examined them, nearly destitute of fossils, and seem to be deep-sea deposits, but shore lines would doubtless, by proper search, be found, where fossils are abundant, within a few miles of the localities where these strata are exposed on our route.

It would seem that in that vicinity (mouth of Diamond river) the water shoaled by the deposition of the sediments forming the older rocks, as the overlying Carboniferous strata abound in fossils, and one of the members



of that series, a sandstone, everywhere affords striking evidence of current action in its cross stratification.

In harmony with this fact is the occurrence of true coal measures with beds of coal, indicating emerged land at that epoch, north of the Colorado, at no great distance from this locality.

Hence the theory generally received that the formation of the continent began in a nucleus about Lake Superior, and that the places of the Rocky and California mountains were, until the Tertiary period, occupied by an open sea is proved untenable."

The engraving on the opposite page showing Chimney Peak range is thus described:

"Above the mica slate hills, red, white, green, pink, and blue tufas, porphyries, and trachytes, described as occurring below, reappear, giving the same fantastic appearance to the scenery. These rocks, with trap and scoria, extend from the river to Chimney Peak.

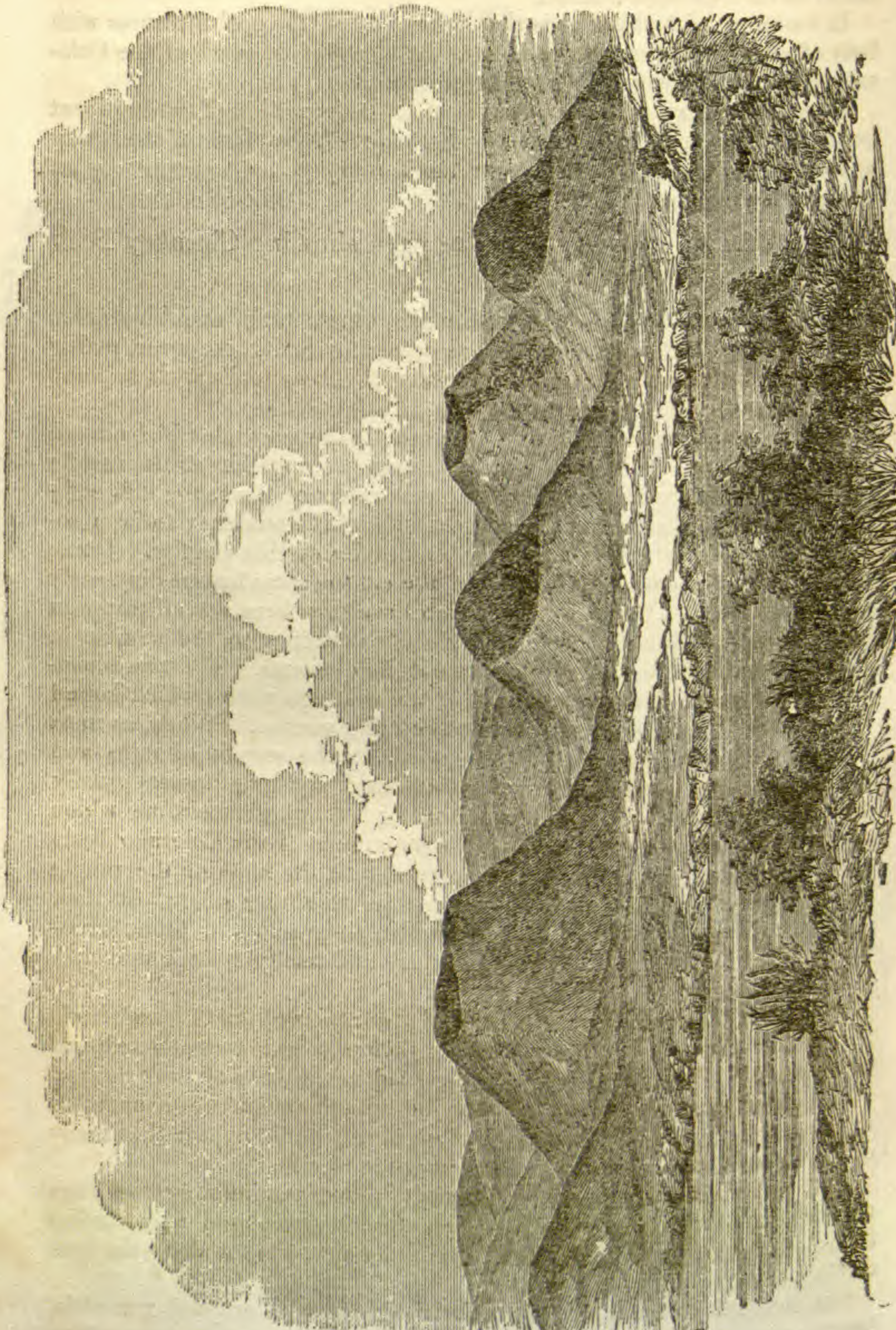
Chimney Peak is a remarkable picturesque double pinnacle which crowns a mountain chain, probably the northwestern prolongation of the middle range of the Purple Hills. Like the other peaks of the range it is composed of trap, and affords a striking example of the tendency to form columnar summits exhibited by all the mountains of this vicinity. Dome mountains on the east of the Colorado, present the same features in nearly an equal degree. The mountains which have this form are all trappeau in character, and doubtless owe their peculiar outlines to the manner in which this material yields to the action of the elements. The trap is usually more or less columnar in structure, the cleavage planes which bound the columns being perpendicular to the cooling surface. When, as most frequently occurs, these planes are vertical, by the erosion of rains and flowing streams, perpendicular walls are formed, and large masses usually exhibit mural faces. This will account for the peculiar outline which many of the trappean summits of the mountains of the Colorado basin present. Their great altitude, as compared with the mass of the ranges which they crown, is doubtless due to the resistance offered by their material to the atmospheric influences which have removed perhaps several hundred feet of the more yielding tufas and trachytes once surrounding them.

About the bases of some of the isolated mountains of the Colorado basin the material washed from the sides and summits has accumulated, and where these detrital slopes have been opened in the beds of the 'washes' I have described, I was able roughly to measure the amount of denudation the mountains had suffered. From these data it would appear that many of them have once been fully twice their present size.

At Precipice Bend and Barrier islands the river impinges against huge masses of red trachytes, west of which the highly colored rocks before described are very conspicuous, and extend for many miles along the base of Chimney Peak range.

"At intervals the sedimentary rock is covered with erupted materials, basaltic trap, scoria or ashes; and at several points are cones, once minor volcanic vents, and the sources from which these igneous rocks were de-

 Volcanic cones east of San Francisco Mountains.



rived. Near our camp 84 is the most interesting group of these craters met with on our route, (see p. 402). Several of them are still very perfect in form, and long sinuous lines of black lava run down their sides—graphic records of their latest eruptions."

But we have neither time nor space to speak farther of this interesting and valuable report. Nearly 15,000 copies of it have been published by the Government, and it will doubtless be accessible to all who may wish to examine it for themselves. The authors have acquitted themselves with honor, the typography is clear and excellent, with very few errors, but with the exception of the scenic views and the topographical maps, the engravings are many of them quite poor. The maps which accompany this Report do great credit to the artistic skill and originality of Mr. Egloffstein, who has adopted a system of ruled tints by which the light sides of the mountains are relieved and the comparative altitudes of different levels exhibited, producing a most beautiful and effective picture of the topography, resembling a relief model. The maps are duplicated for the geology, the tints of the various formations being lightly and skillfully washed over them. The fossils are done in a harsh mechanical style of ruling, with little or no delicacy of tinting, and fail to exhibit to the eye of the Palæontologist their proper specific characters. There are comparatively few engravers capable of executing such illustrations in a style to be of service in the identification of species and creditable to the artistic skill of the country, and such persons rarely visit the seat of government to scramble after contracts; the consequence is that this kind of work, in too many cases, falls into incompetent hands. Proofs of engravings of objects of natural history ought *always* to be submitted to the careful inspection of the author or to some competent naturalist who shall have the power to accept or reject them, which has been, hitherto, seldom or never done.

We think we see in the future the dawn of better things, when mere political influence shall not control the publication of those scientific works with the proper execution which the national honor is inseparably connected.

ART. XLI.—*Enumeration of the Plants of Dr. Parry's Collection in the Rocky Mountains in* 1861; by ASA GRAY. Continued from p. 243.

SINCE the first part of this Enumeration was published, Dr. J. D. Hooker's most interesting memoir, entitled "Outlines of the Distribution of Arctic Plants," has been received. This is of great importance in the study of any alpine or subalpine collection like the present, and has given occasion to a few remarks in the following pages. The memoir itself I expect to give some account of hereafter.

No. 79. Mr. Black, the obliging Curator of the Hookerian Herbarium, calling my attention to this number, enables me to correct an obvious error in my naming, in the first part of this enumeration. The plant is not *Ranunculus glaberrimus*, Hook., but an abbreviated subalpine state of *R. alismæfolius*, Geyer (the same as No. 306 of his collection), to which Bentham refers the *R. Flammula* of American authors. I am well satisfied to see that Dr. Hooker, in his important paper on the Distribution of Arctic Plants, reduces *R. Eschscholtzii* to *R. nivalis*, L. Some specimens of Parry's No. 80 probably belonged to *R. affinis.*

104. *Cleomella tenuifolia*, Torr., from the district in which Dr. James discovered this species, so long taken for the original *C. Mexicana.*

105. *Cleome integrifolia*, Torr. & Gray. The *C. serrulata* is probably a nonentity, or a mere variety of this.

106. *Viola biflora*, L. This arctic-alpine species of the Old World had been traced all the way round to N. Japan and Kamtschatka, but was not before known as American, unless perhaps recently to Dr. Hooker, who has recorded it in his Tabular View,—perhaps on Dr. Parry's specimens, which may have reached him in time; or perhaps Bourgeau may have met with the plant.

107. *Viola Muhlenbergii*, Torr.; with some pubescent specimens belonging to the next.

108. *Viola Muhlenbergii*, var. *pubescens*, passing into *V. adunca*, Smith (*V. longipes*, Nutt.); which, except in its longer (seldom crooked) spur, as closely answers to the *V. arenaria* and *pumila*, as the ordinary *V. Muhlenbergii* does to the *V. sylvatica*, of the Old World. *V. adunca* should therefore have been added to the synonyms adduced by Dr. Hooker, in bringing all of this group under *V. canina.* Parry's specimens answer well to Bourgeau's from Saskatchawan.

109. *Viola Nuttallii*, Pursh; from the plains.

110. *Viola palustris*, L. From the alpine region, apparently, and the true *palustris.* The plant of our White Mountains is rather *V. epipsila*, Ledeb. Dr. Hooker goes a step too far in referring our *V. blanda* (with its lanceolate sepals and white flowers) to *V. palustris.* Our difficulty is to keep *V. blanda* clear of *V. primulæfolia*, and that clear of *V. lanceolata.*

111. *Geranium Carolinianum*, L.

112. *Geranium Richardsonii*, Fisch. & Mey.: "var. stylis profundius divisis nudiusculis." Engelm.

113. *Geranium Fremontii*, Torr.: "var. *Parryi;* caulibus pedunculisque patenter glanduloso-villosis; foliis minus profunde incisis, laciniis ultimis dentibusve ovatis obtusiusculis." Engelm.—The deflorate pedicels are sometimes declined.

114. *Gaura coccinea*, Nutt.

115. *Œnothera lavandulæfolia*, Torr. & Gray.

116. *Œnothera albicaulis*, Nutt., with pinnatifid leaves.

117. The same with undivided leaves.

118. *Stenosiphon virgatus*, Spach.

119. *Epilobium tetragonum*, L. Just like Swedish specimens.

120. *Epilobium alpinum*, L. The same genuine form was gathered by Mr. H. Engelmann at Bridger's Pass.

121. *Epilobium alsinifolium*, Vill. The same as the larger form in the alpine region of the White Mountains of New Hampshire. Dr. Parry notes it as probably a form of the last, and so we have regarded it.

122. Nearly the same as No. 119, but nearly smooth.

123. *Epilobium latifolium*, L. Perhaps its most southern station.

125. *Epilobium paniculatum*, Nutt.

124. *Gayophytum ramosissimum*, Torr. & Gray.

126. *Mentzelia albicaulis*, Dougl.

127. *Mentzelia (Bartonia*, Nutt.) *nuda*, Torr. & Gray.

128. *Sedum Rhodiola*, L. The female plant. "Along the borders of alpine brooks."

129. *Sedum rhodanthum* (sp. nov.): floribus hermaphroditis plerisque tetrameris pedicello plus duplo longioribus; sepalis linearibus; petalis læte roseis lanceolatis sensim acuminatis stamina (oppositopetala eis infra medium adnata) paullo superantibus; ovariis rectis; stylis filiformibus: cæt. ut in *S. algido* videtur. "High alpine region in moist places, at greater elevation than the preceding: fl. July." Petals nearly half an inch long, of a clear and deep rose-color, while those of *S. algidum*, of the Altaic Alps are described and figured as yellow, or dull rose-color with age, and blunt. As the stamens are adnate to the petals nearly as high as in *S. algidum*, it cannot be the doubtful *S. euphorbioides* of the elder Schlechtendal, from Arctic Siberia, which Ledebour, who took it up, regards as a possible variety of *S. algidum.*

130. *Sedum stenopetalum*, Pursh. All our species should be elaborated anew.

131. *Silene Drummondii*, Hook. The species of this group are much confused in the Flora of North America.

134. *Silene Scouleri*, Hook.

137. *Silene Menziesii*, Hook.

132, 133. *Lychnis apetala*, L. (*L. brachypetala*, Hornem.) Uniflorous and pauciflorous forms.

135. See *Gentiana*, among the Monopetalæ.

136. *Stellaria longifolia*, Muhl.

138. *Cerastium vulgatum*, the var. *Behringianum*, and *C. arvense*, L. mixed.

139. *Sagina Linnæi*, Presl.

140. *Arenaria Fendleri*, Gray, Pl. Fendl.

141. *Arenaria arctica*, Stev., var. γ, Torr. & Gray.

142. *Claytonia arctica* (Adams), var. *megarhiza*: foliis caulinis lanceolato-spathulatis seu lineari-spathulatis basi attenuatis quasi petiolatis; racemo intra folia subsessili (an semper?). *C. megarhiza*, Parry in litt., a name very probably to be adopted. "High alpine stations, extending to the crest of the snowy range; flowers from June to August. Grows in crevices of rocks, its large tap root penetrating to a great depth. Flowers, profuse, white with greenish-purple veins."—The large perpendicular root (about an inch in diameter), with the radical leaves and flowers, are just as in large specimens of *C. Joanneana*, Rœm. & Schult. (*C. acutifolia*, Ledeb. Fl. Alt. and Ic. Pl. Ross., t. 372, non Pall., Willd.) of which, confirmed by Trautvetter in Fl. Taimyrensis, I conclude that *C. arctica*, Adams (published two years earlier) is only a more arctic form. But the leaves of the cauline pair in our plant are much longer and narrower, tapering into a petiole, a d they closely subtend the short raceme; wherefore this fine plant would most naturally, and perhaps more correctly, be taken as specifically distinct from the arctic-alpine Siberian one; in which view Dr. Parry's name is appropriate for it. I have seen no intermediate form. But after the experience we have had of the variability of the foliage of Claytonias, I prefer to risk the view here taken.

Aided by Dr. Parry's excellent specimens, I have now reviewed my MS. notes upon Pursh's *C. lanceolata* (which has been such a puzzle), and upon the related perennial species. It will be seen that Pursh's name, descriptive phrase, and figure do not accord; also that he adds, "*Pall. MSS.*," and states that he found in herb. Lamb. "a specimen collected by Pallas in the eastern part of Siberia, perfectly agreeing with the present species,"—doubtless the *C. Joanneana*, Roem. & Sch., of which I have seen Pallasian specimens. I have reason to think that Pursh's plate was made up from this Pallasian specimen and from the materials he had from Lewis, which last also perhaps comprised portions of two species. The radical leaves figured, which certainly are are not "lanceolate," are probably from the Siberian plant; the cauline of the plate are are not "ovate," and are narrower than I have observed them in any Siberian specimens,—in which, however, they are said to vary from ovate to elliptical: the naked corm, resembling that of *C. Virginica*, must belong to that *Claytonia* of the Rocky Mountains, &c., which is so nearly related to *C. Caroliniana*, but with sessile, oblong, linear-oblong, or even linear-lanceolate leaves, when dry 3-nerved from the base, i. e., the *C. lanceolata* of Hooker's Flora, and the *C. Caroliniana*, var. *sessilifolia*, Torr. in Pacif. R. R. Rep., 4, p. 70. Now, my notes, made in the year 1839, upon Pursh's materials in the Lambertian herbarium, state that the specimen there ticketed *C. lanceolata* by Pursh is the tuberiferous or corm-bearing plant, above-mentioned, and which may therefore, if permanently distinct from its eastern relatives, retain that name. With it is a specimen, ticketed by Pursh "*C. lancifolia*," having lanceolate-ovate cauline leaves. This may have furnished the model for the flowering stem of Pursh's figure, but it is not accompanied by any root or any radical leaves; while, as to the corm-bearing species, these bear only single or very few radical leaves, and mostly none at all when the corm produces its flowering stem. The *C. lanceolata* of Hooker's Flora, as to the specimens, so accurately characterized in his remarks, is the same cormiferous species as Pursh's. But his specific phrase and the closing remark are evidently more or less influenced by Pursh's figure. The present discovery of a great tap-rooted *Claytonia* in the Rocky Mountains renders it not unlikely that Lewis and Clarke may have gathered the two species,—this without the root, —and that Pursh may have confounded them. However that may be, the names of the species concerned should stand as follows:—

C. LANCEOLATA, Pursh, fide herb., &c., for the corm-rooted plant of the Rocky Mountains and California, with sessile narrow leaves. Yet this is quite likely to prove a variety of *C. Caroliniana* (which also inhabits the valleys of the Rocky Mountains, both in New Mexico and in the British possessions), and that again runs insensibly into *C. Virginica.* It would appear that *C. lanceolata* extends to Kotzebue's Sound (Hook. & Arn., Bot. Beech. Voy., p. 123), and to the opposite Asiatic coast (Cham. in Linnæa, 6, p. 563). But Hooker and Arnott's *C. Virginica* from the latter region is probably

C. TUBEROSA, Pall. in Willd. Rel., ex Schult. Syst. 5, p. 436. *C. Virginica*, Willd. Herb. If I may rely on my notes taken in the herbarium of Willdenow in the year 1839, this plant of Pallas, with leaves as narrow as those of our *C. Virginica*, has the cauline ones closely sessile, and a *fusiform caudex* (so that the *C. Virginica* of Fenzl in the Flora Rossica is factitious); and I suppose that *C. Eschscholtzii*, Cham. l. c., is the same plant. Also that *C. acutifolia*, Pall. in Willd. Rel. l. c., is a broader leaved form of it, verging towards

C. ARTICA, Adams. This species (to which I dubiously append Parry's No. 142) was founded upon the most reduced and arctic state of the species to which belong *C. Sibirica*, Pallas in herb. Willd., but not of Linnæus,* *C. Joanniana* of Schultes, *C. acutifolia* of Ledebour, and *C. arctica*, var. *maxima*, of Chamisso.

143. *Talinum pygnæum* (sp. nov.), Gray in coll. H. Engelmann, Exped. Bryan. I know not if this is yet published. Parry's specimens closely resemble those gathered by H. Engelmann at Bridger's Pass, in the year 1856, except that they are larger and finer. It is an acaulescent species, with a fusiform perennial root, the crown bearing a cluster of linear or spatulate-linear leaves, with one-flowered and mostly bibracteolate peduncles in their axils.

144. *Ceanothus Fendleri*, Gray, Pl. Fendl.

145. *Ceanothus velutinus*, Dougl., near the var. *lævigatus*, Torr. & Gray.

146. *Berberis Aquifolium*, Pursh, var. *repens.*

147. *Papaver alpinum*, L. (*P. nudicaule*). High alpine.

148. *Callirrhoë involucrata*, Gray, Pl. Fendl., &c.

149. *Ribes lacustre*, Poir. An alpine form: "the common alpine

* The statement respecting the *C. Sibirica* of the Linnæan herbarium, made in the Flora of North America, 1, p. 476, and for which I am responsible, is not borne out by my MS. notes, which, on the contrary show that *C. Sibirica*, L., is entirely *C. alsinoides*, Sims.

Gooseberry, fruit reddish, hispid: flowers brownish," fewer in the raceme than in the common plant. This is probably *R. setosum*, Dougl.; at least it is the plant cultivated under that name, many years ago, by Loddiges.

150. *Ribes cereum*, Dougl. "Fruit reddish or amber-colored, insipid."

151. *Ribes hirtellum*, Michx. "Fruit dark purple, very acid."

152. *Ribes prostratum*, L'Her.

153. *Rhus trilobata*, Nutt., a variety of *R. aromatica.*

154. *Archangelica Gmelini*, DC. Dr. Hooker, in his paper on arctic plants, has referred not only the *A. littoralis* or *Norvegica* of N. Europe, but also *A. Gmelini* and *A. atropurpurea* to *A. officinalis.* I have already in more than one place insisted that *A. Gmelini* (the *Physolophium* of Turczaninow, *Cœlopleurum* of Ledebour, &c.) is a good *Archangelica;* but for want of good fruit of *A. officinalis* and *A. littoralis* I am unable to judge whether the latter connects *A. Gmelini* with the former. But I have no question (theories of derivation apart) that our *A. Gmelini* and *A. atropurpurea* are abundantly distinct, as well in their fruit as in their whole appearance. "Growing in truly alpine situations."

155. *Berula angustifolia*, Koch; a strict form.

156. *Conioselinum Fischeri*, Wimm. Just like the plant of the Northwest coast, and the *C. Tartaricum* of North Europe. But also not different, as far as I can see, from *C. Canadense*, so that we may extend the synonymy and range as given by Dr. Hooker. It ranges south to the mountains of New Mexico east of the Rio Grande, and in the Alleghanies to North Carolina.

Leptotœnia dissecta, Nutt., was gathered, a single specimen, at the foot of the Rocky Mountains.

157. *Cymopterus terebinthinus*, Torr. & Gray, var. *C. fœniculaceus*, Nutt.

158. *Cymopterus alpinus* (sp. nov.): caudice cæspitoso; foliis pinnatisectis, pinnis 3–5 approximatis 3–7-partitis, segmentis lineari-lanceolatis acutiusculis vel mucronatis integerrimis seu inferioribus 2–3-fidis; scapo 2–4-pollicari umbellam subcapitatam gerente; involucellis subunilateralibus 5–7-partitis, segmentis linearibus seu lanceolatis viridibus flores aureos adæquantibus; calycis dentibus lanceolato-subulatis persistentibus; alis fructus æqualibus suberoso-incrassatis vix undulatis; valleculis 1–2-vittatis, commissura 4-vittata; carpophoro nullo. "On high alpine ridges, along with *Primula angustifolia*, one of the earliest plants to flower." Leaves rather shorter than the scapes, glabrous, not glaucous, the margins minutely ciliolate-scabrous; segments 1½ or 2 lines long, in the smaller specimens only three in number. Fruit (of which very little was gathered) only 2 or 3 lines long. This is most probably the Umbelliferous plant collected by Dr. James in this same district, without fruit, and described in Dr. Torrey's account of James's collection, p. 207, but not named.

160. *Cymopterus montanus*, Nutt.

159. *Thaspium montanum*, var. *tenuifolium*, Gray, Pl. Wright.

161. Probably *Thaspium montanum*, Gray, Pl. Fendl. In flower only.

162. *Pachystima Myrsinites*, Raf. (*Myginda myrtifolia*, Nutt.)

163. *Saxifraga punctata*, L. (*S. æstivalis*, Fisch.)

165. *Saxifraga flagellaris*, Willd.; with scanty runners.

164. *Saxifraga Hirculus*, L. A very condensed, cæspitose, high-alpine form, the flowering stems barely two inches high, perhaps the same as *S. propinqua*, Brown, from the arctic shores. *S. serpyllifolia* of Pursh seems very near this, with smaller flowers, &c.

166. *Saxifraga Hirculus*, L. A small form, only 2 or 3 inches high, but quite like the common Arctic American specimens.

167. *Saxifraga cernua*, L.

168. *Saxifraga bronchialis*, L.

169. *Saxifraga nivalis*, L. Dr. Hooker might properly have cited *S. Virginiensis* as the temperate form of this species, and *S. vernalis* as a connecting form. *S. Virginiensis* stands independently in Hooker's list, resting on *S. reflexa*, Hook., from the shores of the arctic sea. I have never seen *S. reflexa*; but, from the character (especially the upwardly dilated filaments) and the fine figures in the Flora Boreali-Americana, I suppose that it is rather a form of *S. Dahurica*, to which *S. flabellifolia*, R. Br., also belongs.

A solitary specimen, from alpine brooks, may be *S. heiracifolia*, but it is too young for determination.

170. *Saxifraga cæspitosa*, L., var.; a very condensed alpine form: *S. uniflora*, R. Br.

171. *Mitella* (*Mitellaria*) *pentandra*, Hook.

172. *Heuchera bracteata*, Seringe. An interesting rediscovery of one of plants before known only from a single specimen in Dr. James's collection. According to Dr. Torrey, it accords with the original plant, but is larger-leaved. "Common in crevices of rocks, from the base of the mountains to alpine situations."

173. *Heuchera parvifolia*, Nutt.; a small state. "Strictly alpine, always exhibiting its close spikes, which are never elongated as in No. 174.

174. *Heuchera parvifolia*, Nutt., the taller form, exactly Fendler's No. 264, and Wright's 1098. "Valley of Clear Creek, common." Dr. Parry remarks: "I did not suspect this to be a variety of the former: its loose habit and long inflorescence seem to distinguish it; and no intermediate forms were noticed."

175. *Jamesia Americana*, Torr. & Gray; from the original habitat. The genus was founded, in the Flora of North America, upon a specimen so imperfect that it was omitted in the original account of Dr. James's collection. It is now well known, having been collected by Fendler, &c.; and, as it proves, the discoverer (now recently deceased) is commemorated by a most distinct and interesting genus.

176. *Trifolium dasyphyllum*, Torr. & Gray. Less downy than Dr. James's plant is described, the flowers considerably smaller than those of *T. alpinum*.

177. *Trifolium nanum*, Torr. "On the crest of high alpine ridges, in dense patches." This and the preceding are interesting re-discoveries.

178. *Trifolium Parryi* (sp. nov.): Involucrarium: glabrum, surculosum, subcaulescens; scapo 3–4-pollicari basi foliato; stipulis ovatis scariosis; foliolis oblongis argute dentatis; involucro scarioso 5–7-par-

tito capitulo plurifloro multum breviore, segmentis ovatis obtusis; calycis corolla rubro-purpurea subtriplo breviore, dentibus lato-subulatis tubum campanulatum subæquantibus; legumine sessili 3–4-spermo. "On high, grassy, alpine slopes. Flowers bright-red and purple, conspicuous." A well-marked species, very different from any of our involucrate species except *T. fucatum*, which has similar, but larger, stipules and corollas. Leaflets 6 to 12 lines long. Flowers 20 or more in the head. about 9 lines long, the corolla persistent and somewhat ampliate after flowering.

179. *Oxytropis splendens*, Dougl.

180. *Astragalus oroboides*, Hornem. *Phaca oroboides*, DC. *P. elegans*, Hook. I possess a mere fragment, without fruit, of the original *Phaca elegans* of Hooker's Flora; but I have a fine specimen, so named, from Bourgeau's Saskatchawan collection; and "*Phaca* No. 5" of the same collection is just like my original specimen of *P. elegans*, and like *P. oroboides* from Labrador communicated by Dr. Steetz. The latter and European specimens have rather less slender calyx-teeth; but no other difference is manifest. The elliptical and sessile legume has the dorsal suture more or less intruse. "*Phaca* No. 2" of Bourgeau's collection in the Rocky Mountains is probably a variety of *A. alpinus*, but has a shorter stipe to the legume and longer, very slender calyx-teeth.

181. *Astragalus (Phaca*, Hook.) *nigrescens*, Gray. *Homalobus dispar, multiflorus*, and *nigrescens*, Nutt.

182. *Astragalus alpinus*, L. *Phaca astragalina*, DC.

183. *Oxytropis Lamberti*, Pursh., if the flowers are purple as they seemingly are. Also *O. sericea*, Nutt., I presume.

184. *Astragalus*, near *glareosus*, Dougl., but the raceme many-flowered. Fruit not seen.

185. *Astragalus* (*Phaca*, Hook.). *Pectinatus*, Gray.

186 and 189. *Oxytropis Lamberti*, Pursh.

187. *Lathyrus ornatus*, Nutt. On the lower Platte.

188. *Lathyrus linearis*, Nutt.

189. *Astragalus gracilis*, Nutt.

190. *Astragalus* (*Orophaca*) *sericoleucus*. *Phaca sericea*, Nutt. Sand hills of the Upper Platte, May: in flower.

191. *Oxytropis nana*, Nutt. (*O. arctica*, var.?). "High valleys, rooting in granitic sand, in shade of *Pinus Banksiana*: rare."

192. *Dalea alopecuroides*, Willd. Doubtless from the plains.

193. *Astragalus Parryi*, (sp. nov.): cæspitoso-multicaulis e radice crassa, humifus, laxe villosus; stipulis fere discretis liberis ovatis, superioribus ex ovato lanceolato-subulatis; foliolis 15–21 ovalibus supra glabrescentibus glabrisve; pedunculis folium subæquantibus; racemo brevi 6–10 floro; floribus (6–8 lin. longis) subpatentibus; calycis dentibus attenuato-subulatis tubo oblongo-campanulato æquilongis; corolla ochroleuca ("viridulo-lutea") carina apice purpurascenti; legumine pollicari hirsuto coriaceo subinflato ovato-lanceolato acuminato incurvo uniloculari, suturis utrisque leviter intrusis. *A. succumbens*, Torr. & Gray, in Pacif. R. Road Rep. 2, (coll. Pope) p. 163, non Dougl. "Common in dry gravelly banks along Clear Creek: prostrate, with decumbent branches, matting the ground." Capt. (now General) Pope collected it in flower on the Llano Estacado, and Mr. Gordon in the same condition in the

Raton Mountains. It is with great unwillingness that one adds another species to this great genus, while several in the books are still imperfectly known. I had before referred this to *A. succumbens*, but the forming fruit of Parry's specimens shows that it is very different, and more allied to *A. glareosus*, Dougl. (*A. argophyllus*, Nutt.) yet it can hardly have been confounded with that species.

194. *Hosackia Purshiana*, Benth. Valley of the Platte.

195. *Dalea laxiflora*, Pursh. From the plains.

196. *Sophora sericea*, Pursh. Probably from the plains.

197. *Thermopsis rhombifolia*, Nutt.

198. *Psoralea lanceolata*, Pursh.

200. *Lupinus*. The same as Fendler's No. 168, which was doubtfully referred to *L. laxiflorus*. It cannot be named correctly until the related species are revised.

201. *Prunus* (*Cerasus*) *Virginiana*, L.

202. *Sibbaldia procumbens*, L.

203. *Dryas octopetala*, L.

204. *Geum rivale*, L. A specimen of this in fruit (in herb. Durand) collected at Eureka by Mr. Howard, has the head of carpels sessile; but still it appears to be only *G. rivale*, not *G. geniculatum*.

205. *Geum* (*Sieversia*) *Rossii*, Seringe. Large forms, a span high.

206. *Spiræa discolor*, Pursh. (*S. ariæfolia*, var. *discolor*, Torr. & Gray.)

207. *Spiræa opulifolia*, L., a small-leaved form, near the var. *pauciflora*, Torr. & Gray.

208. *Rosa blanda*. Ait.

209. *Cercocarpus parvifolius*, Nutt. The plant so long ago collected by Dr. James, but mistaken for the Mexican *C. fothergilloides*.

210. *Rubus deliciosus*, Torr. "A profusely-flowering shrub, abundant from the base of the mountains to the upper valleys, associated with *Jamesia*. Flowers white, never purplish. Fruit small, coarse-grained and insipid, ripening few largish grains." With Dr. Parry, I cannot doubt that this is James's *R. deliciosus*, notwithstanding the discrepancies. Those relating to the berries are principally a matter of taste, under different circumstances. The color of the petals was probably mistaken by the describer. To this species accordingly belongs my *R. Neo-Mexicanus*, Pl. Wright.

211. *Rubus Nutkanus*, Moçino.

212. *Rubus Idæus*, L. "Alpine."

213. *Potentilla fissa*, Nutt. In the mountains.

214, 215. *Potentilla nivea*, L. Slender forms.

216, *Potentilla Pennsylvanica*, L., var. *strigosa*.

217. *Potentilla concinna*, Richards.? a large form. At least a solitary specimen of undoubted *P. concinna*, from a higher station, is ticketed by Dr. Parry as a dwarf form of No. 217.

218, 219, 220, are forms of *Potentilla diversifolia*, Lehm., including *P. glaucophylla* and *P. Drummondii*, Lehm., and probably some others. The whole group requires complete revision and much reduction.

221. *Adoxa Moschatellina*, L.

(*To be continued.*)

SCIENTIFIC INTELLIGENCE.

I. CHEMISTRY.

1. *On the employment of the diffusion of liquids in chemical analysis.* —GRAHAM has applied the principle of diffusion with great success to the separation of substances of different diffusive power and has in some cases obtained results of remarkable accuracy. The author terms the process of separation in question *Dialysis.* Those substances which are uncrystalline in structure and which possess an extremely low diffusive power Graham calls *colloid,* and their state or condition the *colloidal* form of matter. Gelatin may be considered the type of this class of bodies. The colloid condition is strongly contrasted with the crystalline, or as Graham terms it, the *crystalloid,* the difference being not merely in the low diffusive power of the former, but also in the fact that colloids exhibit an intermediate state between solubility and liquidity, in many cases at least, and may serve as a medium for liquid diffusion like water itself. Colloids are further characterized by their changeable nature: fluid colloids readily become gelatinous or *pectose,* or pass back again from the pectose to the fluid state. The soluble hydrates of silica, alumina and analogous metallic oxyds, starch, dextrin, gum, albumen, gelatin, casein, &c., are colloids. Graham considers the colloidal form to be the dynamic while the crystalloidal is the statical form of matter.

A very simple method of separating bodies by diffusion consists in placing the mixture in a cylindrical glass vessel, five or six inches in depth, and filling the vessel with water very carefully so as not to disturb the matter at the bottom. After a few days the upper layers of water may be drawn off by means of a pipette and contain the most diffusible substances in solution.

For practical purposes it is convenient to employ an apparatus consisting of a flat round vessel in the shape of a sieve, the rim of which consists of gutta percha, and the bottom of parchment paper: the diameter of the vessel may be from eight to twelve inches, and its depth three inches. To illustrate the use of this apparatus, a mixed solution of gum and sugar may be introduced into the vessel so as to cover the bottom about half an inch deep, and the vessel allowed to float upon a larger quantity of water. In the course of twenty-four hours, all the sugar will be found to have passed through the membrane, and so free from gum that the solution is scarcely rendered turbid by basic acetate of lead, and yields by evaporation crystallized sugar.

Graham explains this action by supposing that the sugar takes up the water which the colloidal membrane has absorbed, and in this manner obtains a medium for diffusion, while the gum, which is a colloid, cannot separate the water taken up by the membrane and consequently cannot pass through. The author applies the method of dialysis to the preparation of colloidal substances in a state of purity, and even in many cases to analytical separations, as for example, to the separation of arsenous acid and other poisons, from liquids which contain organic matters. Thus if a few milligrammes of arsenous acid be introduced into the dialytic apparatus with milk or other organic substances, after twenty-four hours the greater part of the arsenous acid will be found in the water beneath. This liquid, which the author calls the *diffusate*, is so free from organic substances that the arsenic may be precipitated directly by means of sulphuretted hydrogen.

If to a solution of albumen from eggs, acetic acid be added and the liquid be submitted to dialysis, the alkaline and earthy salts are rapidly diffused, and after three or four days, the albumen leaves no trace of ash. Albumen prepared in this way has a faintly acid reaction and still contains the sulphur which belongs to its constitution.

Half a liter of urine gave after a dialysis of twenty-four hours, the crystalloid substances contained in it, to the external water; this last on evaporation in a water-bath gave a white saline mass, from which alcohol extracted urea in such a state of purity as to crystallize on evaporation.—*Ann. der Chem. und Pharm.*, cxxi, 1, and *Phil. Trans.*, 1861.

In a note to the above paper Liebig calls attention to the fact that Graham's explanation of the diffusion of saline solutions through porous media, is identical with that which he had himself given in a paper on the causes of the motion of liquids in the animal body published in 1848, and which Graham appears not to have seen. Liebig further illustrates the importance of the method in examining the animal fluids, by a statement that flesh-broth, obtained by heating two parts of flesh with one of water in a water-bath, gave on dialysis an almost perfectly colorless diffusate, from which after concentration in a water-bath, very pure crystals of creatin were deposited, the other crystallizable substances in flesh being also present in the liquid. By a similar process, Liebig detected alloxan in a mucous discharge from the bowels. The importance of the method in the study of the chemical constitution of animal and vegetable secretions, can hardly be over estimated. W. G.

2. *On the determination of the density of vapors at low temperatures.*—Playfair and Wanklyn have given a method of determining the densities of vapors which depends upon the fact that permanent gases possess the property of converting vapors into true gases, or as the authors express it more accurately, the presence of a permanent gas acts upon a vapor in such a manner that its co-efficient of expansion for temperatures which lie near its point of evaporation, approximates to the co-efficient which obtains at the highest temperatures.

The authors remark that the mixture of a permanent gas may aid in distinguishing between the cases in which a vapor has an unusually high co-efficient of expansion and those in which an actual chemical change occurs. It is also possible by the employment of a permanent gas to determine the vapor densities of substances, which cannot be heated to the boiling point without decomposition.

In the case of those substances which may be heated above their boiling points, the authors employ Gay-Lussac's process for the determination of the vapor density. A slight modification of the process is however necessary. Before the glass bulb containing the weighed substance is introduced into the apparatus dry hydrogen gas is thrown up into the graduated tube and its volume measured with the usual precautions. In the subsequent calculation, the volume of the hydrogen reduced to the normal temperature and pressure, must be subtracted from the reduced volume of the mixture of gas and vapor.

When the substance cannot be heated to its boiling point, the authors employ a process which is similar in principle to that of Dumas, but different in execution. Two bulbs, holding together about 300 cubic centimeters, are connected and drawn out on either side into a narrow tube. On one of these narrow tubes, three or four small bulbs are blown; the other is bent upward and then horizontally. The apparatus is weighed in dry air, introduced into a bath and a current of dry hydrogen gas passed through. The bath is then to be filled with warm water and the hydrogen current interrupted for a moment, in order that a small quantity of substance may be introduced into the apparatus. The substance is partially volatilized in the current of hydrogen and passes in the form of vapor into the large bulbs. The temperature of the bath is kept uniform in different parts and very gradually increasing. When the temperature has nearly reached that at which the determination is to be made, the current of gas is to be nearly interrupted, so that the bulbs contain less vapor than is sufficient to saturate the gas at the temperature of closing. The water is now allowed to flow out of the bath till the bends of the side tubes are uncovered, the bulbs remaining covered. The hydrogen current is then interrupted and the bends of the outer tubes sealed with the blowpipe, the temperature and pressure being observed. The volume of the apparatus is found by filling it with water and weighing, after determining the volume of the hydrogen contained. This is done by breaking off one of the ends under water, which rises into the bulbs, absorbing the vapor and leaving the hydrogen. The bulbs must now, without any change of temperature, be taken from the water and weighed with the contained water. The difference between this weight and the weight of the bulbs when completely filled with water, gives the weight of the contained hydrogen and consequently its volume; the pressure is the height of the barometer minus the column of water which enters the bulbs; the temperature is that of the water.

The authors have applied their experiments to acetic acid and other substances. At low temperatures, the vapor density of acetic acid is nearly 4·00, no matter how much hydrogen may have been employed. At higher temperatures, the vapor density approaches the number 2·00, while it is unnecessary to heat as strongly as in the experiments of Cahours.—*Ann. der Chem. und Pharm.*, cxxi, 101.

3. *On the analysis of spectra colored by metallic salts.*—Debray finds that the colored spectra obtained in the experiments of Bunsen and Kirchhoff may be projected upon a screen and rendered visible to a large audience by employing the flame of the oxyhydrogen blowpipe as the source of heat, instead of the ordinary gas burner. The metallic salt may be introduced into the flame by means of a little piece of gas-retort carbon. By employing the so-called Drummond's light, the inversion of sodium line D may also be projected on a screen; it is only necessary that the light should pass through the flame of an alcohol lamp containing salts in solution.—*Comptes Rendus*, liv, 169. W. G.

4. *On the spectra of phosphorus and sulphur.*—Seguin has examined the spectra produced by volatilizing sulphur and phosphorus in a current

of hydrogen and then passing the sparks from a Ruhmkorff's coil through the mixture of gas and vapor. The spectrum of phosphorus as thus obtained contains a red ray, an orange ray almost as brilliant as the red, two green rays less marked at the extremity of the visible portion of the green; after a comparatively dark space a blue-green ray, and then blue or violet rays which are not well defined. The orange and the two green rays appear or disappear according as the recipient containing the phosphorus is heated or cooled: they are therefore characteristic of phosphorus. The red and blue-green rays appear to belong to hydrogen though the phosphorus may contribute to the red.

Phosphuretted hydrogen gives the red, orange and blue-green rays, the two green rays not being apparent. Terchlorid of phosphorus mixed with hydrogen gives the orange, red and blue-green rays, as well as blue and green rays which belong to chlorine, and violet rays which may belong to both elements. The spectrum of the vapor of sulphur has a remarkable brilliancy when the temperature is high. It presents a red ray; three strong green rays almost equidistant, the first and second appearing almost yellow from their lustre, the third less vivid and apparently composed of finer rays; a greenish-blue ray, two blue and two violet rays. The three green rays are most characteristic: they are found also in the spectra of sulphydric and sulphurous acids. The author employed in his experiments a simple prism without telescope.—*Comptes Rendus*, liii.

W. G.

5. *On a new method of detecting and preparing the organic alkaloids.*—ERDMANN and VON USLAR have given a new method of separating the organic alkaloids which depends upon the fact that the free bases are easily soluble in hot amylic alcohol, while their chlorhydrates are so insoluble that they may be separated from the amylic solution by simply shaking this with water containing chlorhydric acid in solution. In preparing the alkaloids the material is to be extracted with chlorhydric acid, the extract treated with ammonia to set free the bases, and evaporated. The alkaloid may then be dissolved with hot amylic alcohol, the solution is to be shaken with water containing chlorhydric acid, which gives a pure solution of the chlorhydrate, while fatty and coloring matters remain dissolved in the amylic alcohol, which may be separated mechanically from the watery layer.—*Ann. der Chem. und Pharm.*, cxv, p. 121.

W. G.

6. *Determination of carbonic acid in organic analysis.*—MULDER replaces in organic analysis the ordinary potash bulb apparatus by a tube filled with soda-lime. The apparatus which he employs consists of an ordinary combustion tube with a chlorid of calcium tube attached. To this last is attached a small U-shaped tube with small pieces of glass and from six to ten drops of concentrated sulphuric acid; after this comes a U-shaped tube, seven-eighths of which are filled with soda-lime, the other eighth with chlorid of calcium. Lastly, a tube filled with pieces of caustic potash is added; this is not weighed, but serves to prevent the influence of the air.

The chlorid of calcium tube and the U-shaped tube with the sulphuric acid are weighed together: the sulphuric acid tube enables the operator to watch the progress of the analysis. The soda-lime absorbs the carbonic acid completely; the chlorid of calcium serves to prevent the escape of water.

A U-shaped tube containing soda-lime and chlorid of calcium and weighing about forty grammes, will usually answer for two successive analyses; it is better, however, in the second analysis to add another and similar tube which should also be weighed before and after the analysis. When a current of oxygen is used to complete the combustion, it is necessary before weighing to fill the tubes with oxygen. If in the progress of the analysis, the sulphuric acid becomes brown, it may be inferred that volatile carburets of hydrogen have escaped combustion. The author asserts that this may be completely avoided by filling the combustion tube completely with oxyd of copper and by not making a canal for the escape of the gases as is usually done. Numerous analyses show that the method is capable of giving very satisfactory results.—*Zeitschrift für Analytische Chemie*, i, p. 2. W. G.

7. *On the determination of lithium as phosphate of lithia.*—FRESENIUS finds that lithia may be determined quantitatively in the form of phosphate according to the method proposed by Mayer. A weighed quantity of pure carbonate of lithia was dissolved in dilute sulphuric acid, the solution evaporated, the residue gently ignited, dissolved in a little water, and evaporated with phosphate of soda and enough caustic soda to give an alkaline reaction. The dry mass was gently heated with water, an equal volume of ammonia added, the whole digested at a gentle heat, filtered after standing twelve hours, and washed with a mixture composed of equal parts of water and ammonia. The filtrate and washings were again evaporated, and the residue treated as before, whereby a further portion of phosphate of lithia was obtained. This process must be repeated as long as weighable quantities of phosphate of lithia are observed. In this manner, very satisfactory results were obtained. It must however be remarked that the author employs in his calculations, the old equivalent of lithium 6·5 instead of 7, as determined by Mallet. The phosphate of lithia has the formula PO_5, 3LiO.—*Zeitschrift für Analytische Chemie*, i, p. 42. W. G.

II. GEOLOGY.

1. *Geology of Vermont.—Report on the Geology of Vermont; Descriptive, Theoretical, Economical and Scenographical;* by EDWARD HITCHCOCK, LL.D., ALBERT D. HAGER, A.M., EDWARD HITCHCOCK, Jr., M.D., and CHARLES H. HITCHCOCK, A.M. Two volumes 4to, pp. 988, with 38 plates, including a Geological map of the State, a map of the Surface Geology, several smaller maps, two plates of Fossils, several plates of scenery, and numerous wood engravings. Printed by Messrs. Goddard, Claremont, N. H., 1861.*—These two handsome, well printed and well illustrated volumes, are devoted to the elucidation of the geological structure and economical resources of a highly interesting and difficult region. They constitute a very important work for which all will feel thankful, not only to the excellent geologists whose labors are recorded therein,

* Copies of this Report may be procured by writing to A. D. Hager, Proctorsville, Vt.

but also to the people of the state of Vermont to whose well known patriotic spirit and love of advancement, science is now indebted for a valuable and most welcome contribution.

The greater part of Vermont has long been disputed ground between the advocates of several rival theories. Upon one of these,—the Taconic System, much light has lately been thrown, by discoveries made within this State as our readers are well aware; but there are other great problems such as the geological age of the Green Mountains and of several of the formations lying in the neighborhood of this chain which still remain. The officers of the Vermont Survey have wisely left these open, while at the same time they have given their own views and also published at length the opinions of other investigators who have arrived at opposite or somewhat different conclusions.

As the formations in this region are arranged in long rudely parallel belts running north and south, the work of the survey was carried on by measuring fourteen sections across the whole state in an easterly and westerly direction. The sections are engraved and colored to correspond with the colors of the map. In the text copious details are given descriptive of the lithological characters and attitude of the strata crossed by these lines. The geological column consists of 25 formations, embracing Azoic, Silurian, Devonian and Pleistocene-tertiary beds. We have space to notice only some of the more important observations.

A great belt of gneiss enters from the south and runs north through the whole length of the state, (about 160 miles) dividing it into two portions of which the eastern is somewhat larger than the western. This gneiss constitutes the principal mass of the Green Mountain range, and being both metamorphic and unfossiliferous, there are no means of determining its age except by its physical relations, whether above, or below, or on the same horizon with some one or more of the neighboring deposits whose chronology can be established. It would appear that the first step in this process is to ascertain the general structure of the range, whether it be upon the whole anticlinal or synclinal. If it be anticlinal then the gneiss must be, or most probably is, the most ancient rock in the state, with the exception perhaps of the Laurentian, of which latter there is a small exposure near Whitehall, at the south extremity of Lake Champlain. But if the gneiss constitute a synclinal, then it may represent some one or more of the Silurian or Devonian formations in a metamorphic condition. It is evident that this great problem can be solved only by good field-work. Mere library work will not do. The chapter relating to this formation is written by C. H. Hitchcock, and he is of the opinion that upon the whole the Green Mountains have an anticlinal structure. As the range runs the whole length of the state all the sections cross it. Six out of the fourteen sections exhibit the anticlinal structure perfectly and without any modification. In four others the strata all dip towards the east and may represent either inverted anticlinals or anticlinals which have passed into a fault and exhibit only the eastern limb. The remaining four consist of several folds each, but do not upon the whole indicate a synclinal form. These all relate to the main range of the Green Mountains, but a short distance east of this principal chain there is a smaller belt which does not run the whole length of the state. Six of the sections including one drawn across a portion of Massachusetts just south of the Vermont line, cross this smaller range of gneiss, and five out of the six are perfectly anticlinal; the sixth shows two folds, an anticlinal and a synclinal. As the localities where these sections may be examined are pointed out, and very full tables of the dip and strike of the strata at numerous localities are given, Mr. Hitchcock has undoubtedly advanced this great question to such a position as to throw the *onus probandi* on those who maintain the synclinal theory. All physical geologists will admit that good field-work can only be opposed by field-work, and therefore those who hold that there are no mountains on the face of the earth except such as have a synclinal structure, will hereafter in dealing with this particular chain, find it necessary to leave the easy chair and library and take some exercise in the open air and on the rough hill side.

Lying along the western base of the Green Mountains is a great formation of sandstone or quartz rock, the celebrated "granular quartz rock" which Dr. Emmons places at the base or low down in his Taconic series. In the opinion of the Vermont surveyors it rests upon the gneiss and is a more recent formation. It holds a few fossils and the determination of these is of great importance, because the evidence they afford will sooner or later not only decide conclusively the age of the rock in which they are found, but also most assuredly bear strongly upon the question of the age of the gneiss. In 1847 Prof. Hall published in the 1st vol. of the Palæontology of New York, one of the species as *Scolithus linearis* and identified the rock with the Potsdam sandstone. It had been previously, in 1841, referred to the same by Prof. H. D. Rogers, who also quoted this fossil in proof of his opinion. Some other fossils were afterwards found by Prof. Adams in this formation and referred to Prof. Hall. The following is his opinion as quoted in the Vermont Report, p. 356, from Foster and Whitney's Report upon the Land District of Lake Superior, 1851, p. 205. "I have recently received from Prof. Adams of Amherst, specimens of partially metamorphosed sandstone from Salisbury, Vermont, which he regards as the equivalent of the Potsdam sandstone. The specimens have all the characters of the purely quartzose variety of this rock, and contain fragments of crinoidal columns, and casts of an acephalous bivalve, similar to *Modiolopsis*. Such facts are highly interesting and promise important results for the future. Since however, no known fossils of the Potsdam sandstone occur with the rocks just mentioned, it requires a careful scrutiny to determine the age of the rock *in situ*."

Since that time a species of *Lingula* has also been discovered and was in 1860 placed in the hands of Mr. Hitchcock who referred it to Prof. Hall. The following is his opinion as quoted by Hitchcock, p. 500. "The Lingula though unsatisfactory, I regard as evidence of rocks of the age of the Clinton group of New York, or of Medina sandstone—a position reached by sandstones, a part of which we include in the Clinton and a part in the Medina sandstone."

It is to be regretted that these truly precious scraps of fossil evidence have not been carefully figured. A *Scolithus* very much like that of the Quartz Rock occurs in the Medina sandstone. No species of *Modiolop-*

sis has been found below the Chazy limestone in New York or Canada, although in the latter country one lamellibranchiate shell, a large *Conocardium* has been discovered in the Calciferous sandrock. The Vermont surveyors seem to have been to a great extent influenced by the fossil testimony as above interpreted in regarding the Quartz rock as of the age of the Medina sandstone.

The next formation of importance is the Eolian limestone, a vast deposit of crystalline rock 2000 feet in thickness, apparently overlying the Quartz rock. It is the Stockbridge limestone of the Taconic system and was first placed by H. D. Rogers in the horizon of the Lower Silurian limestone, including the Chazy, Black River and Trenton. It is found to contain several genera of fossils which have been referred to Prof. Hall for examination. With all deference we do not agree with him in his estimate of the weight of the evidence afforded by these remains. It appears that none of the species have been determined and that the conclusions were drawn from the range of the genera. *Euomphalus* both with round and angular whorls, the latter including *Helicotoma* (Salter) and *Ophileta* (Vanuxem) occurs abundantly in the Calciferous and Black River: and some of the species such as *H. planulata* and *Straparollus Circe* are very closely allied even specifically to Devonian and Carboniferous forms. No one can distinguish fragments of *Petraia* (*Streptelasma* Hall) from *Zaphrentis* without a knowledge of the age of the rock in which they are found. There is not the slightest generic difference between *Stromatopora* and *Stromatocerium* (Hall), the latter genus being abundant in the Lower Silurian limestones. *Stenopora* and *Ptilodictya* (*Chaetetes* and *Stictopora*) are also very prolific genera from the Chazy upwards. Very large round smooth crinoidal columns, such as those of *Cleiocrinus magnificus* occur in the Trenton. Wherever there are great deposits of Devonian or Carboniferous limestones, we are sure to find abundant remains of Brachiopoda of the genera *Producta*, *Chonetes*, *Spirifera*, &c., but no traces of these are reported as having been detected in the Eolian limestone. It would appear also that the fossils have been mostly found on the western side of the formation in Sudbury, Orwell, and Cornwall, in the neighborhood of the Red-sandrock which we now know to be about the age of the Potsdam. The evidence of the fossils therefore does not furnish any reasonable ground for placing this formation above the Lower Silurian. In the Report it is not positively placed in the Carboniferous system, the question being left open, but it is evident from the manner in which the fossils are quoted that that there is a very strong leaning in that direction. For this the surveyors are not responsible. The error is only a consequence of the old one, whose birth dates back to the publication of the 1st vol. of the Palæontology of New York.

The Eolian limestone appears to be developed upon a magnificent scale, and constitutes the principal portion of several ranges of mountains in the southern half of the State. Some of these, such as Mt. Eolus, exhibit a very perfect synclinal structure. They constitute however no part of the Green mountains, but independent ranges lying near and parallel thereto. The Quartz Rock forms a belt between the limestone and the gneiss. The gneiss appears to be the oldest rock; the quartz rock the next younger and the limestone the most recent of the three.

We have noticed particularly the above three formations because the correct determination of their age must be made a starting point for future investigations in the large azoic tract lying east of the Green Mountains. In this latter region there is a narrow belt of Devonian limestone about one mile in width and 20 or 30 in length. All the rest appears to consist of unfossiliferous rocks of undetermined age, although their geographical distribution and general relations to each other are well made out and clearly defined on the excellent map and sections of the survey.

The western part of the State lying along Lake Champlain consists of the Lower Silurian and Primordial rocks, the most interesting being the Red-sandrock and Georgia slates so frequently noticed in our pages. There are also two formations of slaty rocks, the Talcoid schist and Talcose conglomerate, west of the Green Mountains, which we have not space to notice.

The first volume of this report opens with a preliminary chapter of 52 pages treating of the general principles of geology, metamorphism and classification of rocks and fossils. The remainder to page 555 is divided into three parts; the first relating to the recent and Tertiary deposits, the phenomena of drift and surface geology. The second, by E. Hitchcock, Senior, is devoted to the Palæozoic, and the third, by C. H. Hitchcock, to the Azoic rocks. The second volume contains parts 4 to 10 inclusive. The 4th part treats of the unstratified rocks; the 5th notes on the geological sections; the 6th, by E. Hitchcock, Jr., localities of minerals; the 7th, Chemical Analyses, by C. H. Hitchcock; the 8th contains two local reports; one relating to the geology of northern Vermont, by the Rev. S. R. Hall, and another on the geology of Plymouth, by A. D. Hager. The 9th, by A. D. Hager is an excellent and very full report on the economical geology of the State. The 10th, also by Hager, gives an interesting account of the Physical Geography, illustrated by 19 lithographic plates of the scenery for which Vermont is famous. The map is remarkable for the clearness with which the different formations are defined, and the colors are numbered to correspond with the numbers of the geological column. It is to be hoped that some such method as this last will be adopted for all maps. For the want of it, some elaborate works of this kind, such as the splendid map of Pennsylvania, can be understood only by much disheartening labor. Upon the whole we look upon this Report as one of the best that has been published on this continent. E. B.

Montreal, 18th March, 1862.

2. *On the date of the recently published Report of the Superintendent of the Geological Survey of Wisconsin, exhibiting the Progress of the work Jan.* 1, 1861. Madison, Wis.: E. A. Calkins & Co., State Printers. pp. 52, 8vo. By E. Billings.—This Report contains descriptions of about 60 species of fossils from the Silurian rocks of Wisconsin, by Prof. Hall, Superintendent of the Survey. A copy of it was sent to Prof. Dana by Mr. Hall, I understand, Dec. 27, 1861, but it was not received at the office of the Geological Survey of Canada until March 12th. Dr. Dawson noticed the first sheet in the December number of the Canadian Naturalist, which was published on the 1st day of Feb.,

1862. On one of the two copies received here is written (in a hand writing which I do not recognize) the words "Published Nov. 1861." The sheet noticed by Dr. Dawson was sent him by Prof. Hall in November or December. It is quite clear therefore that this publication is antedated at least 11 or 12 months. In November, 1861, I published a description of the genus *Obolella*, and pointed out the characters of a species from the Potsdam sandstone of Wisconsin. My paper was published on the 21st of Nov., and a copy sent to Prof. Hall on the 22d. On page 24 of his Report Prof. Hall describes the same species under the name of *Lingula polita.* His description of the interior of the shell is, in substance, the same as mine, and he expresses the opinion that the species is neither an *Obolus* nor a *Lingula.* Any person in possession of the two papers would come to the conclusion that I had taken the hint for the institution of the genus *Obolella* from Prof. Hall, as his report is dated nearly eleven months before mine. I take this opportunity of stating that I never saw his report nor had the least idea of its existence until the month of February, 1862, more than two months after my paper was published, and fourteen months after the date which he has placed on his title page. It is extremely disagreeable for me to write this, but any one can see that I am forced to do it or leave myself open to the charge of plagiarism, which does not attach to me in this case certainly. It is fortunate for American science that this practice is confined within an extremely small circle, otherwise many of the costly works published by the enlightened policy of many of the state governments of the United States would lose much of their authority. Whenever any of those dates prove to be erroneous I shall not hesitate to state it, as I have a perfect right to do, in the most public manner. E. B.

Montreal, March 24th, 1862.

3. *Correction of the Article on the Red Sandrock in this vol., p.* 100; by E. Billings.—In my paper on the Red Sandrock of Vermont, (this vol. p. 100) I have inadvertently said that Barrande first determined the age of the Georgia slates. My attention has been since called to this passage by one of the parties interested, who says that it seems to exclude Dr. Emmons from the discovery. Such an idea never occurred to me while writing the article. I should have said that with the exception of Dr. Emmons, Barrande was the first. I was aware of Dr. Emmon's opinion four or five years ago. Col. E. Jewett of the Geological Museum of the State of New York, wrote me several letters in 1857 and 1858 on the subject, and sent me specimens of the trilobites for examination. He strongly urged upon me the importance of investigating the matter. As we had not at that time any such fossils in Canada, and as I wished to keep aloof from the Taconic question, I did nothing further than to express my coincidence with them in their previously entertained views that the fossils had a true primordial aspect. In the winter of 1860 I brought them under Barrande's notice as constituting with some others a primordial colony in the Hudson River group. I said nothing to him about the Taconic question, and I included in the supposed colony three species of *Triarthus.* Barrande immediately replied that he did not think it a colony. While his letter was on the way we discovered the

Quebec trilobites, and before my letter communicating this new evidence reached him he had written to Prof. Bronn the letter which has already appeared in these pages, (see xxxi, p. 212). The Quebec fossils removed all doubt from my mind at once. But it was not until I had procured the opinions of Barrande, De Verneuil, Angelin, (the two latter through Barrande) Salter, Shumard and Safford, that the great weight of the opposing American authority could be removed. No one can claim, or professes to claim priority over Dr. Emmons, whose reputation as the originator of the idea of a pre-silurian fauna in America is world-wide.

In the table of fossils, p. 104, the species, *P. congregatus* belongs to the Vermont column and not to the other. Also the word *Koturgina* should be *Kutorgina.*

4. *Observations upon the rocks of the Mississippi Valley which have been referred to the Chemung Group of New York, together with descriptions of New Species of fossils from the same horizon at Burlington, Iowa;* by C. A. White and R. P. Whitfield. [Proceed. Boston Soc. Nat. History, vol. viii, p. 289 to 304, inclusive.]

This paper, or at least that portion of it received at this date, (March 13th,) contains descriptions of twenty-seven new species of fossils, which are referred to the following genera, viz:—*Orthis*, *Streptorhynchus*, *Spirifer*, *Retzia*, *Rhynchonella*, *Pentamerus*, *Aviculopecten*, *Mytilus*, *Orthonota*, *Nucula*, *Leda*, *Macrodon*, *Conocardium*, *Cypricardia?*, *Cypricardella*, *Edmondia*, *Euomphalus*, *Platyceras*, *Pleurotomaria*, *Murchisonia*, *Porcellia* and *Bellerophon.*

These fossils were all collected at and near Burlington, Iowa, from a series of more or less arenaceous strata holding a position immediately beneath that member of the Carboniferous System in the west usually known as the Burlington limestone. In regard to the exact position in the Geological column, to which these lower beds belong, some difference of opinion exists. Doctors Owen and Norwood, and Mr. Pratten, included them in the Sub-Carboniferous series, as did Dr. Shumard and Prof. Yandell, Mr. DeVerneuil and others, equivalent strata at other localities in the west. Prof. Hall, however, maintains that these deposits represent the Chemung Group of New York, though as will be seen farther on, he not long since referred an equivalent stratum at Rockford, Indiana, to the Marcellus Shale, holding a position far beneath the Chemung, at the base of the Hamilton Group. Prof. Swallow and his assistants in the Geological Survey of Missouri, after identifying in the representative strata of that state, several of the same fossils known to occur in beds referred by Prof. Hall to the Chemung at other localities in the west, also placed them on a parallel with that rock.

More recently, Meek and Worthen, while investigating the fossils contained in the collections of the Geological Survey of Illinois, failing to find, after careful comparisons of extensive collections from these beds at numerous localities, a single species they could identify with any known Chemung form,—and finding them not only generally presenting close affinities to Carboniferous types both of this country and Europe, but in many cases in all respects undistinguishable from forms known to occur in well marked Carboniferous beds above, were naturally led to doubt the propriety of referring them to the Chemung epoch. These doubts were strengthened by a knowledge of the intimate relations existing between these beds and the Burlington Limestone, (acknowledged Carboniferous) wherever they occur at the same locality,—the two rocks being always conformable, and never separated by any intervening beds,—while the Chemung Group is known to be separated at places in New York, from the proper horizon of the Subcarboniferous, by a great thickness of Old Red Sandstone, containing the remains of a peculiar fauna of its own.

The views of Meek and Worthen on this subject were given more in detail in a paper published in the September number of this Journal, commencing on page 167.* By reference to this paper, it will be seen, however, that the principal objects its authors had in view, were to show :

1st, That the Rockford Goniatite bed, which Prof. Hall had in a paper published in the Thirteenth Annual report of the Regents of the University of New York, referred to the horizon of the Marcellus Shale of the New York Series, is much more recent than that rock, and in fact an equivalent of the beds at Burlington, Iowa, which he had placed on a parallel with the Chemung Group.

2d, That the Black Slate of the west, which the same author had also regarded as belonging to the horizon of the Marcellus Shale, (his impression at that time being that the Goniatite bed was an intercalated layer in the Black Slate) instead of holding a position at the *base* of the Hamilton Group, comes in *above* all the Hamilton Group beds in Illinois—and from this fact, as well as from the affinities of the very few fossils hitherto found in it, more probably represents the Genesee Slate of the New York Series, as suggested by Prof. Yandell and Dr. Shumard, as well as by Mr. DeVerneuil.

3d, That the beds at Burlington, Iowa, referred by Prof. Hall in the Iowa Report to the Chemung, and their equivalents at Rockford, Indiana, and in Missouri and Illinois, ought not to be regarded as strictly contemporaneous with the Chemung Group of New York, but belong to a more recent period ; though they did not say they regarded it as demonstrated that these beds belong to the Carboniferous System.†

Some time during the same month that the paper above alluded to was published in this Journal, Prof. Hall issued a continuation of his paper in the Report of the Regents, containing a supplementary note in which he states that in consequence of having discovered amongst his specimens from a rock in Ohio regarded by him as representing the Chemung Group of New York, a Goniatite identical with one of the Rockford species, he has been led to modify his opinion in regard to the age of the Rockford Goniatite bed, so as to carry it up to the horizon of the Chemung. He also states that this discovery leads him to think "there is room to doubt" in regard to the relative position of the Hamilton Group and the Black Slate of the west, and whether this slate, "may be

* Remarks on the age of the Goniatite Limestone at Rockford, Indiana, and its relations to the "Black Slate" of the Western States, and to some of the succeeding rocks above the latter ; by F. B. Meek and A. H. Worthen.

† They likewise admitted that there may be some representation of the Chemung Group below the horizon of the Chouteau Limestone of Prof. Swallow, and its equivalents at Burlington, Iowa, and Rockford, Indiana, but denied that this had yet been clearly established.

regarded as a continuation of the Marcellus Shale, or the Genesee Slate of New York."

As the authors of the paper under review, raise no objection to the position taken by Meek and Worthen in regard to the Black Slate of the West representing the Genesee Slate instead of the Marcellus Shale, as had been maintained; and admit that the Rockford Goniatite bed does not, as had been asserted, represent a certain bed in the Marcellus Shale of New York, but belongs to the same horizon as the beds that had been referred to the Chemung at Burlington, Iowa,—it may, we think, be taken for granted that there is now no difference of opinion on any of the points, excepting in regard to the Rockford bed and its equivalent strata in Missouri, and at Burlington, Iowa, being newer than the Chemung.

In regard to this latter question, the authors of the paper under review, still maintain that these strata represent the Chemung group. They do not claim, however, to have identified a single Chemung species amongst the fossils of these beds, but on the contrary not only admit that they are, so far as known, all distinct from the species found in the Chemung of New York, but that they present strongly marked carboniferous affinities. One of the same authors also, not long since, showed in a paper published in the Boston Proceedings, that at Burlington, a number of the characteristic fossils of these strata pass up into the well marked Carboniferous beds above.

The grounds then upon which the identity of these rocks with the Chemung in New York, is maintained, is, that the *Goniatite* mentioned by Prof. Hall, and a few other fossils, the names of which are not given, from a bed in northwestern Ohio, regarded as a continuation of the Chemung, are considered identical with species in the rocks referred to that horizon west of the Cincinnati axis. At the same time it is admitted that the group of fossils found in the rock referred to in Ohio, also presents a strange and unaccountable similarity to Carboniferous types. The explanation of this anomaly given, is, that "we find in tracing these rocks [the Chemung] westward from New York, a tendency of the fauna to assume a decided Carboniferous character." And it is admitted that, "in some parts of northwestern Ohio, this character is as decided as that of the fauna of the Burlington limestone, &c." Hence the startling conclusion is arrived at, and stated as a general principle, that "if it is our desire, as far as possible to recognize formations over wide areas, that are already well known and named, it appears evident that we must ultimately be confined to the use of generic values, and relative position;" thus completely ignoring the use of specific affinities in the identification of strata at distantly separated localities, even in the same zones of latitude.*

If these conclusions are sound,—that is, if in tracing the same formation westward, which is in eastern New York characterized by an

* We are aware Prof. Agassiz has shown that the fossils of synchronous deposits in different zones of latitude, sometimes present much more marked differences than geologists have generally supposed. Yet it will scarcely be maintained, we think, that the striking differences observed between the fossils of the Chemung group in southern New York, and those of some of the beds referred to that epoch in northwestern Ohio, and at Burlington, Iowa, can be due to differences of climatic, or other physical conditions, dependent upon latitude.

acknowledged Devonian fauna, and holds a position beneath fifteen hundred to two thousand feet of other Devonian strata, we find it as we go westward from New York, assuming a more and more Carboniferous character, so that in northwestern Ohio, its fossils become as decidedly Carboniferous as those of the Burlington limestone; and that again in tracing it farther westward to the shores of the Mississippi, we find it not only presenting similar Carboniferous affinities, but so intimately connected by the mingling of its fossils with those of well marked and undoubted Carboniferous beds above, that no very sharp line of separation can be drawn between them,—we may reasonably infer that if the same beds were exposed midway between the Mississippi and the Rocky Mountains we should find them containing the remains of an Upper Carboniferous fauna, and in seeking for them at the Rocky Mountains, we should not look for Devonian, but Permian or Triassic fossils.

Surely before geologists admit such conclusions as these, striking as they do at the very foundation of geological science, they have a right either to question the identity of the few fossils mentioned from northwestern Ohio, with species occurring in the rocks referred to the Chemung, west of the Cincinnati axis, or to doubt that the particular beds in which they occur in Ohio, are exactly synchronous with the Chemung of eastern New York. Otherwise we may cast Palæontology to the winds, so far as the identification of strata is concerned.

But it is asserted with much confidence, that such are the facts, at least in tracing the Chemung westward from eastern New York to Iowa. It will, however, be remembered that it was just as confidently asserted recently, and that too, as was supposed, upon palæontological grounds, that the Rockford Goniatite bed and the Black Slate of the west, belong to the horizon of the Marcellus Shale; and yet it is now admitted that the first must be carried up at least as high as the Chemung, and that the latter *may* represent the Genesee Slate instead of the Marcellus Shale. Again it is not very long since it was maintained with quite as much confidence that certain rocks in Vermont containing Primordial types of *Trilobites*, belonged to the horizon of the Hudson River Group; yet, thanks to the profound palæontological skill of Mr. Billings, of Canada, and Prof. Barrande, of Bohemia, it is now known that they really belong far down at the base of the Silurian Series.

5. GEINITZ: *Dyas, oder die Zechstein-Formation und das Rothliegende*, von Dr. HANNS BRUNO-GEINITZ, Leipzig, 1861—4°, pp. 130, 23 plates. —This excellent memoir on the group of rocks called Permian by Murchison, has reached us from the author. We propose in a following number to notice some of the conclusions, and especially to present a comparison of the characteristic European and American fossils.

At this moment we will only add a few remarks on the name Dyas. It was first proposed in 1859 by Marcou, and signifies that the formation consists of two parts,—the marine beds of the Zechstein (Magnesian limestone) and the upper portion of the Roth-liegende (Red layers, Gres bigarré). These are conformable and are overlaid by the Trias.

It will be remembered that in 1859 Sir R. I. Murchison published in this Journal (xxviii, 256), a notice of Marcou's Memoir entitled "Dyas et Trias," &c. The same author now reviews the arguments then used, and enforces it by new illustrations in a paper entitled, 'On the inapplicability of the New Term Dyas to the Permian group of rocks as proposed by Dr. Geinitz.' He aims to show that the term Dyas can be used only in open violation of all well established palæontological values—that it rests on certain lithological distinctions not essential or constant and is more objectionable than the kindred term 'Trias.'

He says "In borrowing the term 'Dyas' from Marcou, Dr. Geinitz shows, however, that that author had been entirely mistaken in grouping the deposits so named with the Trias or the Lower Secondary Rocks, and necessarily agrees with me in considering the group to be of Palæozoic age." After showing the reasons which in 1840–41 led him and his associates De Verneuil and Count Keyserling to propose the term "Permian" for the great group of sandstones, marls, pebble beds, copper ores, gypsums, &c., which have since been accepted under this designation, he adds:

"The chief reason assigned by Geinitz for the substitution of the word 'Dyas' is, that in parts of Germany the group is divided into two essential parts only—the Roth-liegende below, and the Zechstein above, the latter being separated abruptly from all overlying deposits.

"Now, not doubting that this arrangement suits certain localities, I affirm that it is entirely inapplicable to many other tracts. For, in other regions besides Russia, the series of sands, pebbles, marls, and gypseous, cupriferous, and calcareous deposits form but one great series. In short, the Permian deposits are for ever varying. Thus in one district they constitute a *Monas* only, in others a *Dyas*, in a third a *Trias*, and in a fourth a *Tetras*.* * * * *

"On my own part, I long ago expressed my dislike to the term Trias; for, in common with many practical geologists who had surveyed various countries where that group abounds, I knew that in numerous tracts the deposits of this age are frequently not divisible into three parts. In Central Germany, where the Muschelkalk forms the central band of the group, with its subjacent Bunter Sandstein and the overlying Keuper, the name was indeed well used by Alberti, who first proposed it; but when the same group is followed to the west, the lower of the three divisions, even in Germany, is seen to expand into two bands, which are laid down as separate deposits on geological maps of Ludwig and other authors. In these countries, therefore, the Trias of Alberti's tract has already become a Tetras. In Britain it parts entirely with its central or calcareous band, the Muschelkalk, and is no longer a Trias; but, consisting simply of Bunter Sandstein below, and Keuper above, it is therefore a Dyas; though here again the Geological Surveyors have divided the group into four and even into five parts, as the group is laid down upon the map—No. 62, 'Geographical Survey of Great Britain.'

"Respecting as I do the labors of the German geologists who have distinguished themselves in describing the order of the strata and the fossil contents of the group under consideration, I claim no other merit

* See 'Siluria,' 2d edit., 1859, and 'Russia in Europe and the Ural Mountains,' 1845.

on this point for my colleagues de Verneuil and von Keyserling, and myself, than that of having propounded twenty years ago the name of 'Permian' to embrace in one natural series those subformations for which no collective name had been adopted. Independently, therefore, of the reasons above given, which show the inapplicability of the word 'Dyas,' I trust that, in accordance with those rules of priority which guide naturalists, the word 'Permian' will be maintained in geological classification."

However the term Dyas, adopted by Dr. Geinitz as the title of his memoir, may be open to criticism, it is a pleasure to add that no recent memoir in geology does its author more credit or is more valuable in itself. We shall revert to it again with pleasure, as suggested above.

III. BOTANY AND ZOOLOGY.

1. *Botanical Necrology for* 1861.—The list includes the following names:—

Ferdinand Deppe, who in connexion with Schiede collected plants in Mexico, and to whom Chamisso and Schlechtendal dedicated the Rubiaceous genus *Deppea*.

A. E. Fürnrohr, the editor since the year 1843 of the "Flora oder Botanische Zeitung," of the well-known Botanical Society of Ratisbon.

Henckel von Donnersmarck, of Prussia, who must have reached a venerable age, as he published an Index to Willdenow's Species Plantarum in the year 1803, and other of his publications (which were small) are half a century old.

Rev. John S. Henslow, Professor of Botany in Cambridge University; born at Rochester in 1796; died at the rectory of Hitcham, Suffolk, May 16, 1861. Professor Henslow wrote the treatise on Botany forming the 75th volume of Lardner's Cabinet Cyclopædia; it was published in 1835, and did good service in its day. We are indebted to him, also, for an excellent Dictionary of Botanical Terms, recently published (without date) by Groombridge & Sons. Although the part which Prof. Henslow played in the direct advancement of the science was comparatively unimportant, his influence in botanical education, both at the University and in elementary schools, was very great, and his death left a void in England which is felt to be irreparable. Appreciative notices of his life and character were published in the Athenæum and in the Gardener's Chronicle.

Prince Salm-Dyck (*Joseph v. Salm-Rifferscheid-Dyck*) died at Nizza, his seat near the Rhine, in the 88th year of his age. His princely conservatories were devoted during a long series of years to the cultivation of succulent plants, which he assiduously collected from every part of the world, and illustrated in a series of monographs and catalogues, beginning with the genus *Aloë*, in 1817, and ending with the *Cacteæ in Horto Dyckensi*, in 1845. The good old prince—one of the mediatized at the dissolution of the German empire in 1806,—lacked little of being a century plant himself.

Prof. M. Tenore, the author of the *Flora Neapolitana*, and for 50 years director of the Naples Botanic Garden, the Nestor of Italian botanists, died on the 22d of July last, at the age of 81 years. His earliest botanical publication appeared in the second year of the present century.

Jules M. C. Marquis de Tristan, of Orleans, died on the 24th of January, 1861, having almost completed his 85th year. He was the author of several botanical papers of interest, as well as of some metaphysical works, and even so late as the year 1851 he read a botanical communication to the Scientific Congress at its meeting at Orleans. It was for him that Brown in 1812 named the Myrtaceous genus *Tristania*, —a name which (the etymology being unexplained by its author) Sir James E. Smith, in the Encyclopædia Britannica, ingeniously attempted to derive from the Greek.

Prof. G. W. F. Wenderoth, of Marburg, died on the 5th of June last, at the age of 87. He was a pupil of Mœnch and his successor at the Marburg Botanic Garden, &c., and the author of numerous botanical works.

While preparing the above notices the sad intelligence is received of the death of three very distinguished botanists of Holland, at the commencement of the current year, viz:

Dr. R. B. Van den Bosch, of Goes, the acute monographer of *Hymenophyllaceæ*, and editor, in part, of the Bryologia Javanica after the decease successively of its original authors, Dozy and Molkenboer. (He died on the 18th of January, at the age of 51.)

Prof. Wm. H. De Vriese, of the University of Leyden, a most active and estimable botanist, author of many important works and memoirs. He died on the 23d of January last, at the early age of 55 years, only ten months after his return from a laborious and successful mission, under the appointment of the Dutch Government, to the Dutch East Indian possessions, to investigate their botanical resources and culture.

Dr. Charles Louis Blume, an older and still more renowned botanist, the curator of the Herbarium of the Royal Museum at Leyden, as we learn from the same source (Gard. Chronicle of Feb. 8), died a few days later than Dr. DeVriese, viz., about the first of February. Dr. Blume's earliest publications, issued at Batavia, while he was in charge of the Colonial botanic gardens of Java, bear the dates of 1823 to 1826. His later works, several of them of a magnificent character, come down to a very recent date. (He died on the 3d of February, in the 66th year of his age.)

Dr. Edwin James died at Rock Spring, near Burlington, Illinois, on the 28th of October, 1861, at the age of 64 years. As the earliest botanical explorer of an alpine region, in which Dr. Parry has recently much interested the readers of this Journal, it is with peculiar propriety that the following biographical notice of this pioneer of Rocky Mountain botany is furnished by Dr. Parry. A. G.

2. *Dr. Edwin James*, who is best known among scientific men in this country as the Botanist and Historian of Long's Expedition to the Rocky Mountains, in 1820, was born in Weybridge, Addison county, Vermont, on the 27th day of August, 1797. His father, Deacon Daniel James, was a native of Rhode Island, and removed to Vermont, about the commencement of the revolutionary war. Edwin, the subject of this sketch, was the youngest of ten sons, three of whom became physicians. His early studies were conducted at home, in the manner usual

at that period; the summer months being devoted to the labors of the farm, and the winter spent at the district school. From a youth he was noted for activity, application, and industry. He pursued his academic and collegiate course at Middlebury, Vt., where he was graduated in 1816. Subsequently he engaged in the study of medicine, for three years, under an elder brother, Dr. Daniel James, in Albany, New York. While pursuing his medical studies, he was particularly interested in the Natural Sciences, then taught by Prof. Eaton, under the distinguished patronage of the late Stephen Van Rensselaer.

In the spring of 1820, Dr. James was attached to the Exploring Expedition of Col. Long, as botanist and geologist, taking the place of Dr. Baldwin, who accompanied this expedition on the previous season as far as Franklin, on the Missouri River, where he terminated his labors and his life.

Dr. James was recommended to this situation, by Hon. Smith Thompson, Sec'ty. of the Navy, Capt. Leconte, and by Dr. John Torrey, whose subsequent labors as the descriptive botanist of Dr. James' collections, has intimately associated his name with this pioneer Expedition. The connection of Dr. James with the expedition, lasted till its close, being engaged in active exploration, during the season of 1820, from May to November.

The efficient labors of Dr. James, in this arduous trip, may be readily inferred from the published scientific results. Interesting additions were made to our knowledge of the botany of the great plains, at that time but imperfectly known. The elevated peaks, forming the outliers of the Rocky Mountain range, rivaling in altitude the snowy summits of Mt. Blanc, revealed a flora of exceeding richness, and attracted the attention of botanists both in this country and in Europe. We can easily imagine the enthusiastic ardor with which the young naturalist, treading for the first time these alpine heights, gathered up its floral treasures, and scaled the snowy peak, which ought properly to bear his name. It is still unexplained why the recommendation of Col. Long, applying to this mountain the name of *James' Peak*, has not been adopted, by modern geographers. Amid the great number of elevated landmarks, of this region, some other peak fully as appropriate, might have been selected to bear the name of the enterprising *Pike.*

On returning from this expedition, the attention of Dr. James was occupied, for about two years, in compiling the results of the same, which were published, both in this country and in Europe, in 1823. The work elicited no little interest, and is now a valued fund of historical and scientific facts.

On the completion of this work, Dr. James was for six or seven years connected with the United States Army, as Surgeon, serving in that capacity at several of the extreme frontier posts. During this period, aside from his professional duties, he was occupied with the study of the native Indian dialects, and prepared a translation of the New Testament, in the Ojibwe language; subsequently published, in 1833. He was also the author of a life of John Tanner, a strange frontier character, who was stolen when a child from his home on the Ohio River by Indians, among whom he was brought up, developing in his future eventful history a strange mixture of the different traits pertaining to his early life, and savage education.

On the reorganization of the medical department of the U. S. Army, in 1830, Dr. James resigned his commission, and returned to Albany, N. Y., where for a short time he was associate editor of a temperance journal, conducted by E. C. Delavan, Esq.

After leaving this, he concluded to make his home in the far west, and in 1836 he settled in the vicinity of Burlington, Iowa, where he spent the remainder of his life, devoted mainly to agricultural pursuits.

It was at about this time that some peculiar traits, which distinguished Dr. James as a *strange* man, became more conspicuous. His mode of life, his opinions, and his views on moral and religious questions generally, were inclined to ultraism. Failing to find earnest sympathy, among those with whom he was thrown in contact, he gradually assumed the habits of a recluse. Indifferent always to public opinion, he marked out, and pursued his own course, without regard to the views of others. Strictly honorable in all his dealings with mankind, and naturally kind-hearted, he did not care to waste his sympathy where it would not be appreciated. With him to espouse a cause, was to carry it to the farthest possible extreme, often erroneous, and it is to be feared at times positively wrong. In full justice however to his many amiable traits, it must be admitted that his errors were on the side of goodness, and in all his waywardness, he never forfeited his self-respect, or the attachment of those who had known him in early life. In his personal appearance, Dr. James was tall, erect, with a benevolent expression of countenance, and a piercing black eye.

"On the 25th of October, 1861, he fell from a load of wood, the team descending a small pitch of ground, near his house, and both wheels passed over his chest. He at once said that he was a dead man. He lingered, much of the time in great pain, until the morning of October 28th, when he expired at the age of 64 years." C. C. P.

3. *DeCandolle's Prodromus:* Pars xv, Sect. posterior: fasc. I. Jan., 1862, pp. 188.—This includes the genus *Euphorbia*, elaborated by the indefatigable Boissier, issued in advance of the rest of the *Euphorbiaceæ*, which are undertaken by J. Müller, also of Geneva. Boissier, who is a keen observer, admits about 700 species of *Euphorbia*. That is, he describes 963 species chiefly from his own knowledge, and adds seven which are imperfectly known and not recognized by him, not to speak of 23 wholly obscure ones in the books. So that the Linnæan genus *Euphorbia* (which Boissier has the good judgment to retain entire) rivals *Carex*, *Solanum*, and *Senecio* in vastness. Dr. Engelmann, who has specially studied our species, and to whom Boissier acknowledges his particular obligations, should offer comments, if any be necessary, upon the present arrangement, as respects the North American species.
A. G.

4. *Illustrations of the Genus Carex;* by Francis Boott, M.D. Part III, tab. 311–411. London, W. Pamplin. 1862.—The first of these magnificent folios was issued in the year 1858; the second in 1860; the third is now, thanks to the extreme liberality of the author, in the hands of many of the principal botanists of this country. Our former

notices have explained the nature and extent of this great monograph. In this, as in the preceding volumes, Dr. Boott has favored the land of his birth and early years—and which would fain still claim him as her own,—by devoting half of his plates to the illustration of North American species. And with such generous profusion, such as only a love of Carices for their own sake could inspire,—lavishing four folio plates upon such a common and homely species as *C. vulpinoidea*, two upon the equally vulgar *C. stipata*, three upon *C. cephaloidea*, two upon *C. Muhlenbergii*, &c. The latter and their allies, however, as well as the group of *C. straminea*, are critical subjects, which the fullest elucidation will render none too clear. As Carices are still favorites with our botanists, we will enumerate the North American species which are illustrated in the present volume.

C. riparia, Curtis. To this European species, Dr. Boott restores our *C. lacustris*, and he figures North American specimens. It extends into South America, as far as to Chili and Montevideo.

C. alpina, Sw., including *C. Vahlii*, an arctic-alpine species.

C. atrata, L., including *C. nigra*, also arctic-alpine.

C. scoparia, Schk.; with its var. *minor*, from Arctic America and New Hampshire.

C. lagopodioides, Schk., distinct from the next.

C. cristata, Schweinitz, including *C. mirabilis*, Dewey,—filling three plates.

C. fœnea, Willd., also from New Granada,—filling three plates.

C. alata, Torr., figured from New York as well as Florida and Texan specimens.

C. adusta, Boott, including *C. argyrantha*, Tuckerman, and, as a northern variety, *C. pratensis*, Drejer,—illustrated by five plates! Carey's *C. adusta*, in Gray's Manual, Dr. Boott figures as a variety of *C. fœnea*.

C. straminea, Schk., with its varieties *tenera*, *aperta*, *festucacea*, *Crawei*, and *Meadii*,—six plates. The whole group, thus revised, will probably now be better understood than before.

C. stipata, Muhl., which comes also from Japan.

C. conjuncta, Boott, a new species, founded on the plant referred by Carey, in Gray's Manual, to *C. vulpina*, a plant of the Western States.

C. sparganioides, Muhl., with its variety *minor*.

C. cephaloidea, Dewey, at least in part, excluding the description in Wood's Botany.

C. cephalophora, Muhl., with *C. Leavenworthii*, Dewey, as a variety.

C. Muhlenbergii, Schk., and its variety *enervis*.

C. vulpinoidea, Michx., including *C. setacea* and *C. scabrior* of Dewey, "founded on immature specimens," *more suo*.

C. disticha, Huds., to which belongs *C. Sartwellii*, Dewey.

C. Gayana, Desv., a Chilian species, collected in New Mexico by Fendler (No. 881), and in the Rocky Mountains by Bourgeau.

It will be seen that this volume, illustrating some of our most troublesome species, will be particularly useful to North American botanists, who, with lively gratitude for what has been so generously done for them, indulge the earnest hope that the author's zeal and strength may enable him, *Deo favente*, to crown the whole with volume four. A. G.

5. *Thwaites, Enumeratio Plantarum Zeylaniæ, an Enumeration of Ceylon Plants, &c.*, Part III.—Although it has just reached us, this part bears the date of 1860. It comprises the *Monopetalæ*, excepting the *Rubiaceæ*, &c., which were in the second part. When finished we shall have a reliable and very convenient conspectus of the flora of Ceylon in a compact form. A. G.

6. *Annals of the Botanical Society of Canada:* Part III. From April, 1861, to February, 1862.—Contains the record of the general proceedings of this Society, as well as abstracts of some papers read, while others are printed *in extenso.* The contents are quite miscellaneous, many of the papers relating to culture or other practical subjects; and there are some local catalogues, &c. The society is evidently popular and flourishing, and is finding its way to its proper work. A. G.

7. *Bonapartea juncea* (Paxton's Bot. Dict.).—This rare and curious plant blossomed the last season at the Mount Hope Nurseries in this city. It belongs to the Pine Apple tribe, and was discovered in Peru, in 1800. It is one of the Bromeliaceæ, and was named, as above, in honor of Napoleon I. It has a large globose head just above the ground, covered with large scales closely compacted, from each of which arises a long, rush-like, four-sided and arching leaf more than a foot in length, presenting a very beautiful appearance. The intelligent proprietors of these nurseries, Messrs. Ellwanger & Barry, have reared this greenhouse plant for twenty-two years, but they do not know how old it was when purchased of Mr. Prince of Long Island, though then evidently not very young. Such had been its appearance for many years.

About the 10th of last September, from the summit of the globular head shot out a round tapering stem, near two inches in diameter, bearing small scales two to four inches apart and terminating in a small cuspidate point three inches long. The stem or scape grew rapidly, three or four inches a day, and once six inches, to the length of fifteen feet in less than sixty days. Three feet from the globular head there put forth a pair of flower-buds at each scale to the summit or through twelve feet, which soon began to blossom from the lowest in succession to the top. The flowers were yellowish or greenish-yellow, not striking, except for their great number. The pistil, six stamens, with versatile anthers, and the floral envelops of three inner and three outer parts, all stood on the ovary. The flowers did not come forth rapidly, so that the upper foot of them did not appear till February. On the lower part, the flowers rapidly decayed and fell off with the seed-vessel for six feet; but, on the plant being abundantly watered at the root, the flowers ceased to fall, and had the appearance of maturing some seeds. The plant was growing in an equably heated greenhouse. In the middle of March the plant was still maturing its seeds, though it is still doubtful whether any of them will be ripened, while it is certain that months must first intervene. There is no record of the flowering of this plant in the United States. An English nurseryman says he saw this species in flower in the garden of the Duke of Devonshire many years since. These few facts may be worthy of record in this Journal. C. D.

Rochester, March 25th, 1862.

8. *Acclimation encouraged in Australia.*—We have more than once had occasion to refer to the remarkable and well directed scientific activity which so honorably distinguishes the Australian colonies, and especially the colony of Victoria. To the Government Botanic Garden at Melbourne a Zoological Garden has been attached, and an Acclimatisation Society is coöperating in a practical direction. While Europe and America are making acquaintance with many a queer Australian beast or bird, or apparent combination of the two—like the *Ornithorhynchus*, our enterprising friends and neighbors at the antipodes are striving to stock their glades and streams with fish, flesh, and fowl from all lands, adapted to their fine climate, and subservient to use or ornament. Already, we believe, "the voice of the turtle is heard in their land," and the lark has become a denizen,—not to mention fowl of various kinds, of economical importance. As there is regular communication between New York and Boston and Melbourne, it may be well to publish here the following advertisement.

"*The Acclimatisation Society of Victoria, Australia,* are willing to make purchases of such useful or ornamental birds, animals, and fish landed in Melbourne, as may meet the requirements of the Society.

W. H. Archer, *Hon. Sec.*

"*The Argus Gold Prize Cup.*—The Argus gold prize cup, of the value of one hundred pounds, for the year 1861, will be given to any one (unconnected with *The Argus* or *Yeoman* newspapers) who, within the year ending 31st October, 1862, shall introduce into the colony the most valuable or interesting Animal, Bird, or Fish, in sufficient numbers to establish the breed. The decision to rest with the Council of the Acclimatisation Society, subject to the ratification of the Editor of *The Argus.* Application to be lodged with the Council of the Acclimatisation Society, before the 1st of December, 1862."

Zoology.—

9. *Uprising of the Seventeen-year Cicada, in New Haven County, Conn., in June,* 1860.—In June, 1843, swarms of the *Cicada septendecim,* Linn. (commonly called here the *Seventeen-year Locust,*) appeared in various places in New Haven County, Connecticut. Large numbers of this insect were then found in the bushes and trees on the eastern slope of West Rock, in the town of Hamden, about three miles N.N.W. from Yale College. On visiting this locality June 15, 1843, I found the insects active and noisy, and a record of my observations was made at the time. Seventeen years afterward, in the middle of June, 1860, I found this insect coming up in great numbers in and about the same spot, and one of the inhabitants of the vicinity assured me that the insect had not been seen there since 1843. The hoarse croaking noise made by an encampment of these insects can be heard a mile off, so that it is easy to detect them. In 1843 Judge Noyes Darling, who had spent most of his life near this place, told me that he could personally testify to an upcoming of this locust hereabouts in 1826, 1809 and 1792, and Rev. Jeremiah Day recently informed me that he had observed four of these periods here, viz: in 1809, 1826, 1843 and 1860.

It is remarkable that this insect, which exists but a few weeks in the perfect state above ground, should live nearly the whole of so long a life in the earth as larva and pupa, and that in spite of varying weather, exposure and local causes, it should observe its seventeen-year period with such precision. It is also remarkable that in the United States there should be so many different districts each having its 17-year period of differing dates. It would seem much more probable that in any one place varying circumstances would hasten or retard the development of the insect, so that some individuals might be found there every year. To a very limited extent this may perhaps be the fact.

The locust-district to which New Haven County belongs extends from the Connecticut river westward to the Hudson river, and into New Jersey. That part of our State which lies east of Connecticut river has a different period. On the 22d of June, 1835, while travelling through Tolland County, Conn., in a stage coach, I passed through woods swarming with this Cicada. A map of the United States colored so as to show these different locust-districts would be of great interest to entomologists.

This insect is supposed to be peculiar to North America, and was made known to European naturalists by Peter Kalm of Sweden (*Kongl. Vetensk. Acad. Handl.* 1756), who travelled in Pennsylvania, New York, Canada, &c., in 1748 and 1749, and mentions an uprising of the Cicada about Philadelphia, Penn., in May, 1749, (*Travels, trans. by Forster, Lond.* 1772, 8°, 1 : 316, 2 : 62).

Very good accounts of this insect may be found in Prof. Nathaniel Potter's *Notes on the Locusta Septentrionalis Americanæ decem septima:* (Balt. 1839, 8vo, pp. 27, with plate;) and in Dr. T. W. Harris's Treatise on *Insects injurious to Vegetation*, (8vo. Bost., 1842, 1852, 1862).

New Haven, Conn., April 15, 1862. E. C. HERRICK.

10. THADDEUS WM. HARRIS, M.D. *A Treatise on some of the Insects injurious to Vegetation. A new edition, enlarged and improved, with additions from the Author's manuscripts, and original notes, and illustrated by engravings drawn from nature under the supervision of Prof.* LOUIS AGASSIZ. *Edited by* CHARLES L. FLINT, *Secretary of the Massachusetts State Board of Agriculture.* Boston, 1862, 8vo, pp. xi and 640. With 8 engraved steel plates comprising 96 figures, besides 278 figures in wood. —The first edition of this excellent work of the late Dr. Harris of Cambridge, was published in 1841 (8vo. pp. 467) by the Legislature of the State of Massachusetts, as one of the Scientific Reports prepared at the public expense, a small issue of the same with slight changes being also printed for sale (Bost., 1842, 8vo, pp. 459). An enlarged edition of the same was published in 1852, (Bost., 1852, 8vo, pp. 521). These editions were without drawings of the insects described, and although the great merits of the work were from the first universally acknowledged, the want of illustrations lessened its usefulness. In 1859 the Legislature of Massachusetts directed Mr. Flint to prepare a new, enlarged and illustrated edition of Dr. Harris's work. Mr. Flint, availing himself of some of the best aid he could procure in this country, has executed his commission in a highly creditable manner; and the result is a beautiful and valuable volume of great practical usefulness to the horticulturist and the farmer. It is enriched by a large addition to the chapter on the butterflies from the author's own manuscripts, and by important notes contributed by Dr. John L. Leconte, Philip R. Uhler, Esq., Dr. John G.

Morris, Edward Norton, Esq., and Baron R. Osten Sacken. In this enterprise the State has expended over ten thousand dollars for 2500 copies for their own distribution. Besides this issue, the work appears in three other editions, one of 500 copies for the benefit of the family of Dr. Harris, in superb style on tinted paper with the steel plates colored, at $5 per copy, and two cheaper editions, at $3.50 and $2.50 each. It deserves to find an extensive sale.

A few of the insects described still lack illustrations, among which may be mentioned the *Angoumois grain moth* (p. 499)—the *Eurytoma Hordei* (553)—the *Cecidomyia culmicola* (582)—and the *wheat midge* (592), which at this time is one of our most destructive insects. In the cases of the *Aegeria exitiosa*, and the *Cecidomyia destructor*, a drawing of the female would have been more useful.

It would add much to the convenience of reference to give on the steel plates, under or near each figure, the Latin or English name of the insect represented, or at least the page of the book where the description may be found. H.

III. ASTRONOMY.

1. *Rediscovery of the Asteroid Calypso* (53).—The Asteroid Calypso (53) was discovered by Dr. Luther at Bilk, April 4, 1858. It appeared as a star of the eleventh magnitude, and continued to be observed at Berlin until the 17th of June. At the opposition in 1859 this asteroid was no where seen; and again at the opposition in 1860 it escaped detection, so that there was reason to apprehend that this body, like Daphne, was entirely lost. Dr. Luther therefore prepared an ephemeris from the most reliable elements, and after three weeks of laborious search, discovered on the 27th of January, 1862, a small planet, distant about one degree from the place computed for Calypso. Unfavorable weather prevented further observations until Feb. 6th, when he found it again, and proved that it was indeed Calypso. This planet has since been observed at several other observatories.

2. *Name for Asteroid* (59).—Asteroid (59) was discovered by Mr. Chacornac at the Observatory of Paris, on the 12th of September, 1860. According to established usage, it devolved upon Mr. Chacornac, or upon Mr. LeVerrier, the Director of the Observatory, to select a name for this planet. But LeVerrier declined giving this planet a name, on the ground that he wished to introduce a new nomenclature of the group of planets between Mars and Jupiter: and he suggested that without continuing to give each planet a particular name, it would be a sufficient distinction to mention the number in order of discovery, attaching thereto the name of the discoverer. Mr. J. R. Hind of London, to whom we owe the discovery of ten of these bodies, took decided ground against the proposed innovation, as leading inevitably to confusion and useless trouble; ultimately causing a return, by general consent, to our present nomenclature. The same ground was taken by Mr. Goldschmidt to whom we owe fourteen of these planets; and by Dr. Luther who has discovered eleven. The Astronomer Royal of England, Sir John Herschel, and Prof. Argelander, as well as astronomers very generally throughout Europe, also pronounced against the proposed innovation. After waiting for more than a year from the time of discovery, Dr. Weiss of the Vienna Obser-

vatory, who had taken particular charge of the observations of this planet, requested Prof. von Littrow, Director of the Vienna Observatory, to give the planet a name. Prof. von Littrow chose the name *Elpis*, in allusion to the political condition of Europe at the time of its discovery. This name was immediately accepted by the German astronomers. At length in January, 1862, Prof. LeVerrier announced that he no longer refused to allow Mr. Chacornac to select a name for this planet. Mr. Chacornac then requested Mr. Hind to assign a name, and Mr. Hind selected the name *Olympia*. This name has been accepted by the English astronomers, and will probably be universally adopted.

3. *Discovery of Asteroid* (73).—On the 8th of April, 1862, a planet of the 13th magnitude was discovered near the star Beta Virginis, by Mr. H. P. Tuttle of the Cambridge (Mass.) Observatory. It is the third which has been detected at this Observatory within the past year.

The name *Feronia* has been selected by Mr. Safford and Dr. Peters, for the asteroid (72).

4. *Letter from the eminent astronomer, J. R. Hind of London, announcing the disappearance of a nebula.*—"Towards the close of the past year, it was announced by Prof. d'Arrest, of Copenhagen, that a nebula in the constellation Taurus, which was discovered at this observatory on the 11th of October, 1852, had totally vanished from its place in the heavens. That one of these objects, which the giant telescopes of the present day had taught us to regard as assemblages of stars in myriads at immense distances from the earth, should suddenly fade away, so as to be quite imperceptible in powerful instruments, must, I think, have been deemed a very improbable occurrence, even by many who are well acquainted with the care and experience of the observer by whom the statement was made. Within the last few days, however, Mr. LeVerrier has obtained so strong a confirmation of its accuracy, that there is no longer room for supposing it to have originated in one of those errors of observation which every practical astronomer knows will creep into his work in spite of all his precautions.

The nebula in question was situated in right ascension 4^h 13^m 54·6sec., and north declination 19° 11′ 37″, for the beginning of 1862. It was therefore about a degree and a half from the star Epsilon in Taurus, in the group commonly known as "the Hyades." Its diameter was about one minute of an arc, with a condensation of light in the centre; or its appearance was that of a distant globular cluster, when viewed in telescopes of insufficient power to resolve it into stars. From 1852 to 1856 a star of the 10th magnitude almost touched the edge of the nebula at its north-following edge; it was first remarked on the night the nebula was detected, having escaped notice on many occasions when its position had been under examination with the same telescope and powers. Hence I was induced to hint at its probable variability in a note upon the nebula published in No. 839 of the *Astronomische Nachrichten*. The suspicion is fully confirmed; the star has diminished to the twelfth magnitude, either simultaneously with, or soon after, the apparent extinction of the nebula.

The history of this object and the results of his observations on the night of January 26, are appended by Mr. LeVerrier to his Meteorological Bulletin of the 29th. The sky being very clear at intervals, the

Paris equatorial, which has an object-glass 12 French inches in diameter, was directed to the place of the nebula, but, notwithstanding stars of an extremely faint class were visible in its immediate neighborhood, not the slightest trace of it could be perceived either by M. LeVerrier or M. Chacornac. The star which Professor d'Arrest and I have repeatedly noted, of the tenth magnitude, and almost touching the nebula, had dwindled down to the twelfth; so that telescopes which would have shown it well between 1852 and 1856, would not at present afford a glimpse of it. From the fact that M. Chacornac saw the nebula in forming a chart of the stars in that region in 1854, and did not remark it while reconstructing the same in 1858 with a much more powerful instrument, there is reason to infer that the disappearance took place during 1856, or the following year.

How the variability of the nebula and a star closely adjacent is to be explained, it is not easy to say in the actual state of our knowledge of the constitution of the sidereal universe. A dense but invisible body of immense extent interposing between the earth and them might produce effects which would accord with those observed; yet it appears more natural to conclude that there is some intimate connexion between the star and the nebula, upon which alternations of visibility and invisibility of the latter may depend. If it be allowable to suppose that a nebula can shine by light reflected from a star, then the waning of the latter might account for apparent extinction of the former; but in this case it is hardly possible to conceive that the nebula can have a stellar constitution.

It is at least curious that several variable stars have been detected in the region of the great nebula in Orion; that in 1860 a star suddenly shone out in the middle of the well-known nebula Messier 80 (about half-way between Antares and Beta in Scorpio) which vanished in a few days; and that, as first remarked by Sir John Herschel, all the temporary stars, without exception, having been situate in or near to the borders of the Milky Way—the star-cluster or ring to which our system of sun and planets belongs. In the latter class are included the memorable star of B. C. 134, which led Hipparchus to form his catalogue of stars, and those which blazed forth in 1572 and 1604, in the times of Tycho Brahe and Kepler.

In concluding, I will venture to express the hope that some of the many amateur astronomers in this country who have provided themselves with telescopes of first-rate excellence, will keep a strict watch upon the remarkable pair of variables which I have briefly described in this communication. Continuity of observation is often most important, and can only be secured—and that not always in the uncertainty of weather—by a strong force of observers in different localities.

I am, Sir, your most obedient servant,

J. R. Hind.

Mr. Bishop's Observatory, Regent's Park, Feb. 3.

P. S. Since writing the above, I have received a letter from Professor Secchi, the able and energetic director of the Observatory of the Collegio Romano at Rome, by which it appears that in one of the proverbially clear skies of that city, and with the large telescope at his command, he was unable on the 27th ult., to discern the least vestige of the nebula."

IV. MISCELLANEOUS SCIENTIFIC INTELLIGENCE.

From our Paris Correspondent.

1. *The Artesian Well at Passy.*—The complete success of the Artesian well at Passy has given lively satisfaction to all, and especially to those who appreciate the scientific interest which attaches to it. The question of water is of itself interesting enough to the Parisian people who have been reduced hitherto to the Seine as the principal source of potable water. The Prefect of the Seine had conceived a project for an aqueduct to be fed by the numerous springs in the neighborhood of Châlons sur Marne. It seems quite remarkable that this project was little to the public taste and that numerous voices were raised in favor of the river Seine! The Parisians are convinced that this river water is excellent; I will not affirm the contrary, but I am often struck with the complaints of strangers who generally charge upon this water the indispositions to which they are exposed during a visit in Paris. On the other hand I cannot maintain that in the long run an aqueduct is not the most economical provision for water for those who are prepared to meet the first cost. The example of Rome, which has been thus supplied even to the present day by the aqueducts of the Cæsars, proves this beyond dispute:—what would have been the expense during two thousand years of raising the water of the Tiber to a suitable height, if the Romans had been reduced to this method?

The city of Paris while awaiting the adoption of more thorough measures for attaining her water supply, has achieved an experiment which has given an excellent result, resolving several important questions and opening new ones. The first and most important question is to know if the water in a well of large dimensions will preserve an ascensional force sufficient to furnish a quantity of water proportioned to its increased diameter. Assuming that the water in the Passy well should rise with an abundance equal to that in the well of Grenelle, it ought to furnish near 40,000 cubic meters in 24 hours. (The cubic meter =220·17 gallons). Mr. Kind, the German engineer, the inventor of the method used in boring this well, and charged with the execution of the work, contracted to guarantee only 13,300 cubic meters, and on this estimate the plan was adopted. The boring commenced in September, 1854, and was finished on the 24th of September, 1861. The flow has remarkably exceeded the estimates—commencing slowly at first, on the 27th of last September it had reached 25,000 cubic meters and finally rested at 20,000 c. m. This yield, it is to be remembered, was found constant only at the well's mouth, and diminished very considerably when the tubes were added which carried it up to 25 meters above the ground. The well of Grenelle which yielded 2000 litres per minute at the surface, gave only 630 litres, less than one third, at the summit of a tube rising 33 metres above the level of the surface.

The second question is, what will be the influence of the new well upon the old, distant from it about 3000 metres (less than two miles). The latter soon commenced to show a diminished flow, and by the 1st of October the diminution had reached a fourth of the ordinary yield, falling from 630 to 460 litres per minute, a loss of about 40,000 gallons in

24 hours. The hope now is that there will be an increase again in the flow at Grenelle when the water of the Passy well by being raised considerably above the level of the earth shall again reëstablish the pressure. It appears impossible to foresee what may be the final result of this operation. Mr. Kind's method of boring perfectly met what was intended and the well had reached at the end of two years and three months 528 meters in depth, when a crush in the upper part seriously retarded the progress of the work. It required almost three years to repair this accident, and the total cost estimated by Mr. Kind at 350 thousand francs will reach near a million.

The water sheet is pierced 23 metres lower down than at the well of Grenelle—the latter being 547 metres absolute depth, and 511 m. below sea level; the well at Passy the orifice of which is $16^{m}\cdot5$ higher has an actual depth of 588 m. or 533 m. beneath sea level. The temperature of the water is the same in both wells $=28°$ C. or $82°\cdot4$ Fh.

It is easy to see that the third question—what advantage is it to make a new experiment of the same kind?—leaves an ample field for discussion. [We would say on this point that the experience of California has been decidedly adverse to the multiplication of Artesian wells, in the same hydrographical basin.—Eds.]

Dumas has given in the *Comptes Rendus* of the French Academy, (T. 53, p. 571) an interesting memoir in detail on this subject, from which most of the facts here presented are drawn.

2. *The Geological Society of France.*—This Society held its last annual reunion in Sept., 1861, at St.-Jean-de-Maurienne in Savoy, a province lately added to France. About sixty members were present at the meeting. The principal topic of discussion was the question which for thirty years has been controverted and sustained by Elie de Beaumont, viz: whether in the western Alps there exists an inversion, or a mixture, of the fauna and flora of the Lias with those of the Carboniferous formation. It is to be regretted that no one was present to sustain the thesis of the leading geologist of France, and still more that in so numerous a society there was no one to enter adequately into the detail of Alpine stratigraphy, a subject sufficiently difficult. The members were conducted over the ground of observation by Messrs Lory, Alf. Favre, the Abbé Chamoasset and Mr. Pillet.*

[The points of observation and argument are very nearly the same which have already been stated in detail in the review by Mr. Hunt of Prof. Favre's memoir on the structure of the Alps in vol. xxix, p. 118 of this Journal.—Eds.]

The number of the Bulletin of the Society containing the official notice of this meeting by the Secretaries is now in press.

3. *The Tunnel of Mt. Cenis.*—Your readers will find more interest probably in a notice of observations made during a recent visit to the famous Tunnel now in progress through Mt. Cenis, already more than once noticed in these pages.

This tunnel, the execution of which has been assumed by the Italian government, presents peculiar difficulties, especially because it is impossi-

* Prof. Favre has given a brief account of the observations made on this occasion in the Bib. Univ. de Geneve, Oct. 1861.

ble, owing to the enormous superincumbent mountain mass, to operate at more than two places. The mountain rises to the height of one thousand to fifteen hundred metres (3280 to 5000 feet, nearly) above the level of the gallery.

It was requisite from the first to find means to render the work as active as possible and employ machines for boring the blast holes. The little machine which moves the drills is ingeniously constructed but offers no difficulty to a mechanician. The percussion and rotation of the drill rod is accomplished by the power of compressed air which also injects a stream of water into the blast hole. In the trial made before the Geological Society of France which was conducted in one of the work shops of the company the drill entered a huge block of marble at the rate of 50 centimeters in 10 to 15 minutes, (about 1½ inches per minute). The feature of the process which interested us most was the production of the motive power. It is accomplished by an ingenious application of the hydraulic ram so much used in the United States, and set up here on a gigantic scale. The use of steam power presented great difficulties in a tunnel, each half of which when near its end will be over six kilometers long (=3¾ miles). They could not think of setting up boilers in the tunnel itself, since it was plain there would be serious difficulties in ventilation, and the attempt to conduct steam to so great a distance by pipes, would involve the loss of a great part of the power. By replacing steam with compressed air they enjoyed the double advantage of an economical application of the power at a distance from its source, and the use of the escaping air to renew the air of the tunnel. On the Italian side at Bardonèche, the air pumps are set up at about a kilometer from the opening of the tunnel, and they will act toward the last through nearly two leagues distance. The column of water which compresses the air in the chamber of the hydraulic ram is 25 metres high by 60 centimetres in diameter, the compression of air in the reservoir of the ram at the moment of fall is six atmospheres—at this instant a valve yielding at five atmospheres opens and a part of the compressed air escapes into immense boiler-like reservoirs. Five or six of these apparatus are needed for the regular progress of the work in the tunnel. The inventor of this remarkable apparatus, Mr. Tommelier, is director of the works. It is impossible to conceive any thing better adapted for a mountainous country where water is abundant. The apparatus appeared to us simple enough in its essential parts, which permitted the use of adequate solidity in the rest to resist the formidable shock with which it is shaken at short intervals. If the construction of these machines and the boring leaves little to desire it is by no means so sure that the perforation of the tunnel can be accelerated as much as would be presumed. They have perfected the rapidity of drilling, but the great labor of removing the rubbish is not accomplished more quickly than before. At the outset the engineers estimated six years, and to-day it seems probable that 12 years will be required to finish the tunnel if no unforeseen obstacles arise in the work.

4. *Spectroscope of Bunsen—Spectrology.*—The attention of the French scientific world is wholly fixed on *spectrology*, for thus do they designate the experiment with the spectroscope of Bunsen and Kirchhof. Mr. Grandeau, the pupil and fellow laborer of St. Clare Deville, has the merit

of having first initiated us into these beautiful researches, which he studied at Heidelberg whence he brought the first spectroscope seen in action in Paris. Since then it has become all the rage at Paris, and recently Mr. Jacmin has exhibited before a numerous auditory a large apparatus by Duboscq which projects the spectrum on a screen.

Mr. Grandeau has had the satisfaction of discovering the new metals, Cæsium and Rubidium, in the thermal waters of Bourbonne-les-Bains in larger quantities than in the waters examined by Bunsen. We might at first suppose that the discovery of new elements would be multiplied like those of the planets by a method at once so simple and certain. It does not appear at present however that this idea is likely to be realized. It is not sufficient, as seemed at first to be supposed, to expose a substance in the flame of the spectroscope to see defined there traces of all the elements it contains, while for those elements which like Cæsium and Rubidium exist in very minute quantity, it will always be found needful to separate first the larger part of the associated substances.

5. *The death of Biot*, is a great sorrow to all the friends of science. You have not wanted for biographical notices of this great savant. Permit me only to say what is on the lips of all:—that Biot is the most beautiful type known of what a scientist ought to be. He was wholly given up to science, and even to the last moment of his long life he was at its head. Three Academies of the *Institute* counted him among their members to prove that he belonged not alone to the physical sciences. But he was never any thing but the Professor and the Academician: he never subjected himself to the distractions of his illustrious cotemporary, Arago. Cuvier resembled him, with the advantage perhaps due to his vast erudition, and the clearness of his conceptions, but Cuvier did not see himself like Biot without a trace of the danger arising from the honors of high official station. Cuvier was made a baron, a peer of the realm, grand master of the University, and it is well known that he sometimes struggled against the power of jealousy.

6. *The two new Professors in the Garden of Plants.*—Messrs. Daubrée and d'Archiac opened their courses in the second week of March. Both the opening discourses resembled each other—first came an eulogy on their predecessors, followed by a profession of faith on their own part, and a programme of the courses they were commencing. These opening discourses, prepared with great care, drew together large audiences who rarely failed to find there matter for their legitimate applause.

Mr. Daubrée gave a masterly sketch of the history of geology, tracing its origin chiefly to the philosophers, Descartes and Leibnitz. He commenced his course, properly so-called, by the description of volcanic phenomena, and announced a complete exposition of Metamorphism, which will be taught now for the first time in the Garden of Plants. L. S.

Paris, April, 1862.

7. *Letter from Prof. Henry on the distribution of specimens in Natural History by the Smithsonian Institution.* (To the Editors of the American Journal of Science.)—GENTLEMEN:—In the letter of your Paris correspondent, published on page 149 of the January number of the Journal of Science for 1862, it is stated under the head of the Civic Museum of Milan, that the British Museum, and the Smithsonian Insti-

tution, were almost the only establishments that had not contributed materials towards the great work on serpents by Prof. Jan. As far as the Smithsonian Institution is concerned, this is an error, as its specimens have been freely at Prof. Jan's command. As full a series of North American serpents as could be supplied, amounting to about one hundred species was sent to him several years ago, and many additional species were transmitted last spring, leaving, according to Prof. Baird, but little to be desired as relates to North America. Indeed without the aid of the Smithsonian Institution, the species of serpents found in Texas, California, and other American localities, would have been inaccessible to Prof. Jan.

In this connection it may be stated that in the disposition of its undescribed materials, the Smithsonian Institution is governed solely by the desire to place them in the hands of naturalists best fitted to elaborate them without regard to individuals or country, and that it does not wait for an application, but itself makes the offer of the specimens. In addition to the free use by the best American naturalists, of such collections as they may need, its large series of Cephalopoda is now in the hands of Dr. Steenstrup of Copenhagen; its west coast shells is in the process of being described by Mr. P. P. Carpenter; its Polyzoa by Mr. Busk; its Hong Kong plants by Mr. Bentham, while types of the many new species described from its cabinet, amounting to more than ten thousand species and twenty thousand specimens, have been presented to most of the principal museums of the world.

I am, very respectfully your obed't servant,

JOSEPH HENRY, *Secretary S. I.*

Smithsonian Institution, Washington, Mar. 15, 1862.

8. *Ascent of Monte Rosa in Switzerland, September 4th*, 1861; by Rev. KINSLEY TWINING. (Extract from a private letter furnished by request to the Editors of this Journal.)— . . . . . But you are wondering, I presume, how we, who were lately on the other side of the mountains, have come into Italy. Our last was from Visp, where we were waiting for the cooler hours of the afternoon, and expecting then to go to St. Niklaus and thence to Zermatt. We carried out our plan successfully, and reached the inn on the Riffelberg Tuesday afternoon about 3 P. M. On the way we were joined by a young American from Boston who has travelled very largely. He had a desire equally strong with my own of climbing that terror of the Alps, Monte Rosa. Several ascents had been made this summer before we arrived. At Zermatt we saw three London young men who had made the attempt and gave it up only eight hundred or one thousand feet short of the summit, and we thought, after looking them over pretty carefully, that we were good for one thousand feet more than they. At the inn on the Riffelberg we met a young man who had achieved the ascent, and who told us so much about it that we determined to make the attempt the very next day if the weather should permit. We were fortunate in getting three of the very best Zermatt guides, and went to rest with our arrangements made and waiting to see what solution of the problem of the skies the morning would give.

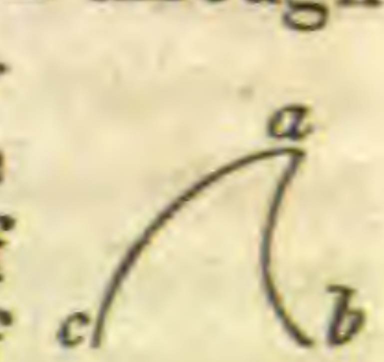
Without describing what took place in those hours of delay, I still wish to interrupt my narrative at this point with an episode about Monte

Rosa. The great Italian mountain, in the estimate of most persons, is Mont Blanc of course. But Lord Byron never saw Monte Rosa, and though it is only a few feet lower than its great rival of Chamouni it never had any hymns sung in its praise till a few years ago. Indeed it had never been ascended to the very summit until the year 1855. I have read in some of the books on Monte Rosa that when De Saussure, that intrepid explorer of the Alps, was at Zermatt, he was unable to persuade the guide to ascend the last two peaks of this mountain and was compelled to abandon the attempt. The way up was at last found (as I think has been true in the case of nearly all the more difficult Alpine summits) not by a guide, but by a company of English travellers. I say the way was found by them, but this is not quite correct; for many persons before them had stood at the bottom of the Zumstein Spitze, eight hundred feet below the summit, and seen a way up which they had not the courage to attempt; and after having myself passed up that tremendous pathway of ice, I am perfectly convinced that, were the way untrodden, and could not the traveller be assured by knowing that others had found it practicable, he would turn away content at having surveyed the steps which lead to the inaccessible summit. This at least was the fate of every one who went alone to that spot and attempted to get higher,—and the Höchste Spitze, as it is called, was never made until six or seven persons, Englishmen and their guides, went to work together, and (tied together with a rope so that if one fell the others could save him) pushed along slowly and bravely to the very top. There they saw a grander view than Mont Blanc affords; and, though none of the difficulties of the ascent have been removed, a number of persons have followed them, each succeeding year, to the same grand height.

Murray, in comparing this with Mont Blanc, says there is no difficulty in the latter, and, comparing it with the ascent of Rigi—a mountain as difficult as Mount Washington—calls the latter a pleasant promenade. It may be so in the comparison, (and I think it is,) but in fact I can say, after walking up it, that to go up Rigi, even, is quite a trying thing in a hot day. But, difficult as Monte Rosa is, all who have made the ascent have agreed that the world has no other point of view to equal it. I will not now describe the scene which there opens to the eye, but merely say—what more than one Englishman has said to me after having ascended both Mont Blanc and Monte Rosa—"there is nothing to be seen from Mont Blanc, and it is foolish to make the ascent when Rosa is practicable."

To return from this digression: we were to start at 3 A. M. if the morning promised good weather. But at three the skies were doubtful, and we did not get off till a quarter of five. An Englishman who had himself made the ascent walked with us to the Görner glacier to enjoy the sunrise over Monte Rosa and the Lys Kamm,—which was indeed indescribably beautiful. The soft tint of morning fell upon the spotless snow and lay there till it brightened into the splendor of day. Behind us, at the end of the valley which contains the Görner glacier, and closing the view in that direction, rose the colossal stony pyramid of Monte Cervino, so steep that no snow adheres to its sides. Its inaccessible summit, four thousand feet above the snow from which it seems to rise, and nearly fifteen thousand feet above the sea, caught also the first rays of morning and stood up in its many-colored magnificence, the only reminiscence among its snowy sisters of a world not covered with the glacier. One hour and ten minutes from the hotel brought us to the ice of the Görner glacier; forty minutes more took us across to the moraine on the other side, where the guides laid away a bottle of wine for the descent, and permitted us to take a drink of cold water. One hour more, up an icy hill about as steep as the lawn in front of the Hillhouse place, with deep crevasses opening on every side, brought us to our breakfast ground—a mass of broken rock, rising out of the glacier, and named "Auf der Platte." Here the guides brought out their stores of hard boiled eggs, bread, cheese, meat and wine. When these were eaten, or rather when as much was done in that direction as Kronig (the Grand Mogul of Monte Rosa) thought fit, the bags were shut, we were placed in line, and the rope (that signal that the time for hard work had come) was got out and all hands tied together in a line. King Kronig went first with his ice axe, to cut steps and hold on with the beak on the back of the axe; I next, three feet behind him; next Anton Rytz, a famous guide, with his face in a mask of checked cotton, who shouted "vorwärts" whenever Kronig cried "courage;" next came my friend Mr. ——, and last of all Franz Blatter, who sang "Ranz des vaches" all the way up, and who, if not strong enough to lift Monte Rosa itself, was abundantly able to carry any ordinary man to the top of it. Thus arranged we soon began to climb up the glacier, already quite steep (about 12°),—up, up, up, and ever up we went slowly and looking sharp where we stepped. First the surface was much like any ice that has been snowed upon and frozen again. Then we came into loose snow, three or four inches deep, which in its nature was a sort of compromise between hail and crystals. The path wound around from one ascent to another like a great serpent trailing between rounded hills of snow; what at one moment seemed like the crest of the ascent soon turned out the base of another, and where we discovered a level plain we were not permitted to go.

At first we walked a half hour together and then stopped for breath; but before long Kronig complained that we stopped every fifteen minutes; and after a while he declared that if we had our way it would be fifteen minutes walking and fifteen minutes on our backs on the snow—and then it would be all up for the Höchste Spitze. In the midst of these dismal forebodings I heard a heavy fall and the call of the guides behind, "attendez." I looked around. Blatter was rushing furiously down hill—for what, did not appear. But I soon saw that Mr. —— had fallen down exhausted and let his alpenstock go where he himself would have gone had not the strong arms of Tony Rytz been on him, and a good twist of the rope around him. His face was pale, his lips blue, and Kronig whispered to me in German, that it was impossible for him to reach the summit. However he rallied and went on very well. After three hours of such painful drudgery we reached the foot of the Signal Kuppe, where the guides took off their knapsacks—all hands had some new refreshment for the last great labor—the rope was doubled around us—and then Kronig set out ahead, cutting zig-zags in the fearful dome of ice we had to climb. In the earlier part of the morning I had looked around a good deal on the scenery; but as we went higher and the labor became greater, I could not afford to throw away strength enough to look around; and now in this spot my horizon was restricted to the three feet square which lay under my eyes. After a long time of zigzagging up and back, around a dome of ice so steep that it would be impossible to stand on it anywhere without having places cut for the feet, we surmounted the Signal Kuppe dome, and stood at the base of the peak of terror—the Zumstein—where, even now, fully one-half of the few who come to it turn back. Here we looked back upon the ice wall we had edged around, step by step, putting our toes in holes cut in the ice, and saw that though it was at an angle of nearly forty-five degrees it was nothing in comparison to the eight hundred feet which remained. There were still two peaks above us which rose like crests one behind the other and in the same line—sharp, like a hatchet, and accessible only over what may be called the *blade* of ice which formed the ridge. It is a fact that the path here was a scant foot in width,—on the right was an abrupt precipice three or four thousand feet in depth,—on the left an almost equally steep declivity. Up this comb of ice Kronig cut steps and shouted "courage" with stirring drum-like voice, while Blatter, every few minutes, sang "Ranz des vaches" for our amusement. The excitement of such an ascent and of the scene around and before was so great that I felt no fatigue, and marched up as easily as if it were over a stairway. After proceeding thus some twenty minutes, I learned by accident the meaning of something which had been unintelligible to me in descriptions I had heard of this part of the ascent. It happened that, in striking my alpenstock into the ice for a good hold, it seemed once to go through; and when I drew it up to see what was the matter, there was a little round hole punched through the ice under my feet, through which I could look down several thousand feet along the face of a greenish-blue icy precipice. If I did not comprehend at the moment the full meaning of this observation, I did an instant later, when I came upon a larger hole through which I could see at leisure how the mountain was constructed, and in particular what sort of support our path had. The case, as I understand it, is that this ice has filled in the hollow between one peak and the other, and while it is banked out in a steep declivity toward the north, on the south it is built up straight above the precipitous rocks, and even overhangs them, as is often the case in a drift of snow. Hence it happens that the only place possible for an ascent is the icy path overhanging the tremendous gulf I have described. We went up without any slip against a boisterous wind, and after a hard struggle with the rocks reached the bottom of the Höchste Spitze. A section through the middle of the Zumstein Spitze would give some such diagram as this: *ab* being the south face of the precipice, *ac* the rounded or banked up glacier on the north, and *a* the place of the path up the edge of the crest. On reaching the summit of the Zumstein we rested on the warm side of the rocks, then worked our way down a hard descent of fifty feet, and there found ourselves at the bottom of the Höchste Spitze. It is more steep than the Zumstein, but not as dangerous; for the path lies back two or three feet from the edge of the snow and ice. When this crest was surmounted we stood on the



Höchste Spitze, but not on its highest point. These mountains are a kind of slate which breaks up easily into large and small blocks; and where the summit is a thin blade of stone, like Monte Rosa, it is not one piece of rock, but more like a wall loosely put together and broken down. I fancy that once this whole peak was one narrow wall of rock, eight or ten rods long, running east and west, and highest toward the east. The action of frost and weather and other natural forces broke it up into blocks, and in the process of time cut a breach through the middle, leaving it as we found it, a double or forked peak with the shorter tine first, or toward the west.

To give some idea of the difficulty of crossing this little gap and actually getting upon the opposite and highest point, I will say that, although it is not thirty feet deep nor twenty feet broad, still the two German brothers Schlagintweit, who were certainly brave men and most intrepid explorers, and who had nerve enough to mount, first of all who have attempted it, on to the lower tine of the summit, gave up the other. It was not the muscular exertion which deterred them, nor the time likely to be occupied in crossing the gap; for I passed straight through it at a burst, and was on the topmost point in two or three minutes afterwards. But it must have been the dreadful unknown task of venturing out over that airy walk and on to that apparently unsupported summit, where no previous foot had been, and whose accessibility they could not prove beforehand and could scarcely believe when looking upon it. It was a far different thing for us to do. I knew that the path was firm and that we could all sit on the summit, though only one at a time could mount the sharp point which caps it. I knew that there was no great labor in the undertaking, and no danger if my head was steady and my courage good. All this made it a perfectly easy thing for me to do, and I so forgot both difficulty and danger and the descent, that the hour we spent on that stony point, 15,223 feet above the sea, was one of the most delightful in all my life. Around us on every side were great mountains sunk down beneath their snows, like abashed virgins drooping in reverence; north, east and west, a panorama of majestic mountains lay around us. The dark needle of the Finster Aarhorn rose out of the snows of the great glacier of the Aar,—Schreckhorn, Wetterhorn, Titlis, the Eiger, and the Sidelhorn stood around it like an ancient brotherhood of giants. The Bernese Alps drew out their line in equal beauty and majesty from the Angelhörner and the Wetterhorn till it seemed to run up into the skies from the Silberhorn and the Jungfrau. Nearly due west lay the immense mass of Mont Blanc, white and glistening,—the one summit over which the eye could not range. The space between was filled with whatever of lake or mountain, of valley, field or barren, moor there is in Switzerland—lonely snowy points rising one above the other—dark black-ribbed glaciers rolling into the valleys—here a dome of snow capping the mountain with a biscuit-like cover of the purest white—while, all around the broken edges, blue avalanches were ready to drop into the grey and hazy depths beneath them. Southward, the eye looked through a bright blue sky into Italy,—first over the Pennine Alps, resting for a moment with admiration upon that most grand and pleasing object, the Becca di Nona: then in swift flight it passed from the thousand peaks and vales of Piedmont to Lago

Como and Maggiore,—and thence ran straight out into the plains of Lombardy and Venetia. How can I ever describe what my eyes saw in this view. I stood there drinking it in with delight—I knew not how long. I bade myself remember this and remember that; but, now, what can I recall. Becca di Nona is a distinct form in my mind, but beside this all is a formless procession of beautiful images—a delightful memory of evanescent things whose shape I do not know that I ever saw, and with respect to which I am certainly unable to say at this moment of what they consist. I remember a light falling down upon Italy, blue, soft, and yet so distinct and clear that all I saw against the sky had an edge—but it was an edge of velvet. I remember how my eye, accustomed to the altitudes of the Alps, at first refused to rest upon the blue plains of Italy, but adjusted itself to them as clouds in the air, till at length after something like a struggle it took the right focus, and falling down to the level of the sea, made me conscious of my own great elevation.

It is impossible to describe the light which illuminated the Italian view. It was a substance—as it seemed—and a color; and yet it was soft and clear. It glowed without being hazy, and gave everything with great distinctness without letting the eye into the deformities of the country, or displaying the formless and less pleasing secrets of the landscape, as the midday sun of Switzerland does. The guides said that in perfect weather the spires of the cathedral at Milan are visible, and that the eye can reach nearly as far as Venice. There were clouds on our horizon, and some of the valleys were filled with their billowy masses. The wind tossed them about like balloons, and as they rose and fell and tumbled about on the unstable support of the air (as it seemed to be), and as at times they dissolved or broke apart, we had lovely views of the country below.

My companion reached the summit a few minutes after I did, but immediately fell asleep and could not be roused till a few minutes before we left the top. I really did not observe how he came up the Zumstein or the crest of the Höchste Spitze, but I well remember seeing him lying flat on the lower tine of the summit, whence the guides steadied and lifted him up till he was on the top; when he did precisely what Albert Smith did on Mont Blanc, i. e., went to sleep. I made a number of observations upon myself, and could not see that the great altitude changed my bodily condition in any way. I was not sick at the stomach at all—my breath was neither shorter nor deeper as I could perceive—my head was not at all infirm. Hearing was equally good, as I can testify after having been bothered with Blatter's incessant "Ranz des vaches." The air filled my lungs as it does elsewhere, and from observing myself I could detect none of those signs of a great altitude which other persons have felt on the summits of such high mountains. On Faulhorn, and at other times when I have been on high mountains, I have noticed the darkness of the sky, and was prepared to find the vault of a deep and almost blackish blue on Rosa. But in this I was disappointed; and I do not know to what I am to attribute its ordinary appearance unless to the slight haze which, as it were, detained the eye in an illuminated atmosphere, and prevented it from looking into the thin, clear and rayless space which so many observers have described as the dark vault seen from the summits of high mountains. I have an indistinct recollection of having felt cold, and am certain that the guides said they were, and that it would not do to remain longer in such a wind. What the temperature was I do not know, although there was a minimum thermometer there which had been placed by the Alpine Club. But I could not make out anything from it because the indicating fluid was perfectly colorless and seemed to have faded out, so that it was impossible to see where the column stood. At last we commenced the descent, at 1 o'clock P. M.; but first I went up the pinnacle once more and waved my adieus from it to the silent world of majesty and beauty which in an hour of time had given me so much pleasure. In the silence of those solitudes my voice was lost,—nothing that we could do seemed able to disturb it. The wind, which blew in tremendous gusts and then subsided, was the only sound which filled those spaces, except when the avalanche (of which there were many during our ascent) added its thunder to the roar of the tempest, or sliding down amid the silent snows grew into a sound which waved through the air and made the mountains tremble.

But this is not the descent. I confess I was more nervous about going down than I had been at any time in going up. One hour was consumed in the first eight hundred feet—then soon after we came to the dome up which our zigzags ran and which we had climbed so slowly in the morning with our faces to the wall and our toes in holes in the ice—edging our way along, a step at a time. Soon we saw, below, the knapsacks of the guides where they left them, with the bottle of champagne and other refreshments they had brought up and deposited there where the labor and danger of the ascent both begin and end,—to celebrate with them our victory, when we had come once more into safe places. Four hundred or five hundred feet above this spot the leading guide, John Kronig, sat down on the snow; and while I was wondering what was to happen, Mr. —— was got into place behind him, his feet put forward under the guide's arms,—then the second guide followed. I instinctively took my place, supposing it would be quite right, but rather hoping we were not going to slide down that tremendous declivity at the risk of our pantaloons. However, the sun, which was cold on the top, was warmer here, and the loose snow was soft to a depth of three or four inches, and the guides meant to improve it; so when all was ready Blatter sat down behind me, and off went the five like a kind of human sled. The guides' alpenstocks, managed by their strong and skillful arms, kept us in line, and, I suppose, lessened the speed somewhat. But they had, after all, so little power against the force of gravity that we shot down like an arrow and ploughed into the snow opposite our camp—all wanting to laugh and shout, but utterly without the breath required in such exercises.

When we were on our feet again the lunch came out and we had a merry time in consuming it. The guides danced and rolled about on the snow, and sang rattling French songs with a perfect *abandon*, as if delighted to have come down Monte Rosa once more alive. We were still a great way from the hotel—not less than eighteen miles. The guides said it could not be done in less than three hours, and we made up our minds to see if we could accomplish it in that time. The rope which had been taken off at lunch came out again, and we were all tied together once more in a line:—and now the problem was to slide down in one hour the glacier which had cost us five in the morning. We stood up straight, and steered with our alpenstocks; the strong arms of the guides served for rudders, stays and breaks; and down we went at a tremendous speed. Do not think, however, it was mere sport. My legs would now and then tremble under the exertion to keep them in place, my breath would give out, and after fifteen minutes of such rapid descent we would have to lie down and get ready to try it again. The steep places were passed sled-wise. The ladies had gone up to the top of Görner Grat about 1 o'clock, P. M., to watch our progress, and there, beside having one of the finest views in Switzerland to enjoy, had the full sight of our novel method of descent. Some gentlemen were with them who had made the ascent themselves and were able to show them where to point their glass in order to find the exceedingly small black specks they were looking for. At last these were discovered refreshing themselves at the bottom of the dangerous peaks, and then sliding down hill at an unheard of rate; and finally they disappeared among the rocks in the moraine of the glacier, when they were lost for the time, and not again seen till they appeared at the hotel, some two hours from the place.—I believe the distance up and down is rated at forty miles. We were absent from the hotel thirteen hours and a quarter; of which three hours and a half were consumed in the halt on the summit and those for breakfast and the other lunches up and down.

9. *Geological and Mineralogical Museum at Rochester, N. Y.*—Having lately enjoyed an opportunity of inspecting the collection of fossils, rocks and minerals formed by Prof. Henry A. Ward, of Rochester, a short notice of it will be acceptable as marking the steady progress making in the appreciation of scientific objects in the United States.. This collection has been amassed by the personal exertions and zeal of Prof. Ward during six years passed by him in all parts of Europe, in Asia, Africa and America, he having travelled over 100,000 miles in his visits to localities and collections. It has been formed from the first on a plan designed to illustrate the departments of geology and mineralogy to students. This plan contemplated the representation of every genus of fossil organism hitherto described, as well as a complete lithological and mineralogical collection. Happily for science, Prof. Ward's plans found a liberal patron in the noble liberality of the Hon. LEVI WARD, a wealthy citizen of Rochester, who advanced the funds required for the purpose to an extent of nearly twenty thousand dollars. These collections are temporarily arranged in a large hall (80 by 120 feet and 20 feet high) in Rochester, with several smaller rooms attached. The general effect is magnificent and imposing. On first entering the Hall, the eye is arrested by the gigantic head of the Deinotherium (cast) and other huge forms of fossil life, by the long ranges of polished marbles, Septaria, Ammonites, &c.; which although not yet systematically arranged in detail, are conspicuous objects in the *coup d'œil.* It is difficult from statistical statements to form any adequate impression of such a collection. A few figures will however assist in a comparison.

The Minerals are arranged according to Dana's last edition: 5,200 specimens are conspicuously placed on isolated blocks and nicely labelled.

The Rocks (numbering 3000 specimens) are classified according to mineral composition independent of structure or geological position—a strictly lithological collection. The individual pieces are large, well formed, and whenever needed to show structure or economical value, polished blocks of the same rocks stand beside their rough associates. A complete series of Cordier's species of rocks labelled by himself is merged in this lithological collection. In examining this collection one is constantly struck with the number of authentic specimens collected by Prof. Ward from the localities where specific rocks were first described, e. g., Syenites from Syena, Dolomite from Fassathal, Palagonite from Palagonia, &c.

In addition to the lithological collection is another of some 700 specimens arranged statigraphically and designed to precede the fossils in each geological formation. Of special collections we noticed a beautiful suite of 350 polished blocks of Italian marbles and ornamental stones selected and arranged by Prof. Meneghini of Pisa: a series of 180 Tuscan rocks; of 100 from Monte Bolca; 120 from the Paris Basin; 80 from Saxony; 60 from Lake Superior; and 200 from Central France. There is also a superior special collection from Mt. Vesuvius, selected from d'Archiac's cabinet. Thus the total of rock specimens reaches about 5000, each well mounted and labelled. The whole is arranged on the system of Cordier, with whom Prof. Ward was a diligent student.

It is difficult to form an estimate of the extent and value of a Palæontological collection by a statement of numerical quantities. It is probably safe to state that Prof. Ward's collection contains 8,000 distinct species of fossils from European localities represented by 25,000 specimens, besides the collection of fossils from American localities. Some of the genera we noticed as particularly rich in species. Thus there are about 540 species of *Ammonites*, 100 species of *Echinoderms*, 150 species of *Trilobites*. When completely arranged it is believed that this collection will require about 40,000 labels.

Unique specimens are represented by casts in which Prof. Ward's collection is peculiarly rich, embracing, if the *Trilobites* and *Foraminiferæ* are included, over 200 genera.

Thus the famous Mosasaurus Hoffmanni from the Garden of Plants, Cuvier's Maestricht specimen, never before allowed to be copied, is now available to American collections: Prof. Ward having the moulds for reproducing this and a large number of other celebrated and unique specimens, like the head of Deinotherium. We have received the following note from Prof. Hitchcock in reference to the cast of Deinotherium which has been recently added to the Museum at Amherst, as well as to Prof. Ward's collection.

From Prof. E. Hitchcock, Senior.

"A fine plaster cast of the head of a Deinotherium of the natural size, has just been added to the cabinet of Amherst College. As this is the first cast of this unique specimen ever prepared in this country, I have thought that you might like a brief notice of it. It was executed in Rochester, N. Y., under the direction of Prof. Henry A. Ward, of the University in that place, from a copy recently received by him from Germany, and is done very skillfully and perfectly. It makes a very strong impression on the beholder. One sees that this animal must have been the largest of all terrestrial quadrupeds yet discovered, if indeed it was such, and that the power of the curved tusks in his lower jaw, must have been enormous in grubbing up roots. The huge nasal fossæ are, also, apparently, a striking proof of the existence in the living animal of a huge proboscis, such as is usually figured. Pictet and others, as you know, place this animal among the Sirenoids.

Mr. Ward expects to receive and to copy, also, in a few weeks, a cast of the femur of the Deinotherium, five feet long, as well as some other bones; and a head reduced in size. The cost of the cast which we have received, with a platform and irons for mounting, is *one hundred and twenty dollars*, and it has been presented to the College by myself and Ephraim Brown, Esq., of Lowell.

I do not remember to have seen in your Journal any description of the splendid cabinet which Professor Ward has collected, now on exhibition in Rochester. By incredible industry, and visiting almost every important locality in Europe, and many in Asia and Africa, as well as in this country, and expending much money, he has brought together a geological cabinet unequalled as a whole in the United States; also a very large collectiou of simple minerals. It might well satisfy an octogenarian naturalist as his life work; but Prof. Ward, I understand, is not yet thirty. It will well repay the scientific man for turning aside a good distance to visit it.

Neither do I remember to have seen it any where stated in print, that Prof. Ward has had copied in plaster almost all the large and rare geological specimens in the cabinets of Europe, which are sold in such establishments as those of Krantz at Bonn. These are fully equal in execution to those from Bonn, and considerably cheaper, to say nothing of transportation.

I am very glad that Prof. Ward is able and willing to superintend this work, which will be of so great service to the literary institutions of our country. He will soon be able to furnish casts of 200 genera, great and small. I have obtained as many of them as my means would allow, and have seen most of them, and know that they are very satisfactory. I hope Prof. Ward will soon publish a catalogue, with prices, of such as his moulders can furnish."

We understand that an effort is on foot to secure this fine museum for the city of Rochester. It is an object well worthy of the ambition of any city to obtain such a noble and permanent institution, free at all times to the public. The power of such a collection is immense in raising the public taste to an enlightened standard, proving that there are other objects worth attention besides those which minister to sensuous pleasure. It is justly esteemed as an evidence of a refined and cultivated community when collections of art and museums of natural history are established and opened at the public expense. The citizens of Rochester, if they secure the permanent establishment of the Ward Museum in their city, may well pride themselves on the acquisition: they will hold the most extensive geological museum in the United States and secure the presence of students in geology and mineralogy, who will come up to Rochester to avail themselves of the educational advantages connected with this museum, and the lectures of Prof. Ward, who now holds the chair of natural science in the University of Rochester.

10. *Fossil larve in the Connecticut River Sandstone.*—One of the most interesting objects described and figured in the great work of Prof. Hitchcock on the footprints of the Connecticut River sandstone is the larve of a Neuropterous insect. In a recent letter, Dr. John L. Leconte has given the following opinion respecting the relations of the species:

"The animal figured on p. 8 of Ichnology of Massachusetts, appears to me to resemble most a larva of a Neuropterous insect belonging to the family *Ephemeridae.* The projections each side look to me like the branchiæ proceeding from the abdominal segments as seen in the larvæ of Ephemera."

Prof. Hitchcock has expressed his desire to the writer, in view of the above opinion, that the name of the species be changed to *Palephemera mediæva.* J. D. DANA.

11. *On the Geology and Natural History of the Upper Missouri;* being the substance of a report made to Lieut. G. K. WARREN, T.E., U.S.A., by Dr. F. V. HAYDEN, Surgeon and Geologist of the expedition to the Upper Missouri and Yellow Stone, under the command of Lieut. Warren. 228 pages, 4to, with a Geological Map. From the Transactions of the American Philosophical Society.—It being probable, from circumstances beyond control, that the publication of Lient. Warren's final report would be long delayed, permission was obtained to abstract such parts of the Geology and Natural History portions as were deemed desirable for publication in a connected form. These constitute a report of progress rather than a complete work on that portion of the West. The contents of the memoir are as follows:

Historical Introduction.
Part I.—Descriptive geology of the routes.
Chapter I.—Exploration of Platte River Valley from Bellevue to the mouth of Elkhorn river.
Chapter 2.—From Bellevue to the Big Sioux river.
" 3.—From Omaha City to Fort Laramie.
" 4.—Geology in the vicinity of Fort Laramie.
" 5.—Fort Laramie to the Black Hills.
" 6.—From Bear Peak to Fort Randall on the Missouri river.
Part II.—General geology of the country.
Chapter 7.—Granite, Stratified Azoic, and Eruptive rocks.
" 8.—Potsdam Sandstone, (Lower Silurian).
" 9.—Carboniferous and Permian periods.
" 10.—Jurassic System.
" 11.—Tertiary Basins of the Upper Missouri.
" 12.—Quaternary deposits.
" 13.—Resumé of the Geology of the Missouri river and its tributaries.
" 14.—Catalogue of Minerals and Geological specimens.
Part III.—Zoology and Botany.
Chapter 15.—Catalogue of Minerals with notes on their habits and distribution, 48 species.
Chapter 16.—Catalogue of Birds with notes on their geographical distribution, 256 species.
Chapter 17.—Catalogue of Reptiles, Fishes and recent shells. Reptiles, 33 species; Fishes, 25 species; Recent Mollusca, 65 species.
Chapter 18.—Catalogue of recent plants. Phænogamous plants, 726 species; Carices, 56 species.

Dr. Hayden is a devoted worker in several departments of investigation not usually united in one person. He is now engaged upon some ethnographical and philological researches related to the aboriginal tribes among whom he has resided. Some of the results of these studies we hope to present to our readers in an early number.

12. *Sixth Annual Report of the Secretary of the Maine Board of Agriculture;* embracing also the Reports on the Scientific Survey, 1861. Augusta: Stevens & Sayward, Printers to the State. 8vo, pp. 464.—The larger portion of this volume is devoted to the "Preliminary Report upon the Natural History and Geology of the State of Maine," under the direction of EZEKIEL HOLMES, of Winthrop, *Naturalist*, and CHARLES H. HITCHCOCK, of Amherst, Mass., *Geologist*, assisted by GEO. L. GOODALE,

of Saco, *Botanist* and *Chemist*, J. C. HOUGHTON, of Still River, Mass., *Mineralogist*, A. S. PACKARD, Jr., of Brunswick, *Entomologist*, and C. B. FULLER, of Portland, *Marine Zoologist*.

We must defer to a subsequent issue a notice of this Report, which embraces some points of general geology of great scientific interest: as for example, the proof that the lowest member of the Carboniferous system in New Brunswick overlies unconformably the equivalents of the Perry beds, establishing, in view of Mr. Hitchcock, the certainty that the Carboniferous system does not occur in Maine.

It is worthy of remark that, in these times of civil strife, Maine has the courage to inaugurate a new scientific survey, while some other States are suspending work on surveys only partly completed. This is the more to the honor of Maine, inasmuch as in case of a foreign war she would be the first to suffer the liability of invasion.

13. *Report on the Geological Survey of the State of Wisconsin*, Vol. I.; by JAMES HALL on General Geology and Palæontology, and J. D. WHITNEY on the Upper Mississippi Lead Region. Printed by authority of the Legislature of Wisconsin, January, 1862. Large 8vo, pp. 455.—This very valuable volume contains a chapter in 72 pages on the Physical Geography and General Geology of the State of Wisconsin, by Prof. Hall, followed by a Report on the Lead Region, filling 350 pages in five chapters by Prof. Whitney. This report is of the highest economic and general interest, presenting the whole subject of the lead region in its historical, physical, geological, mineralogical and mining relations in a methodical and exhaustive style, leaving nothing to desire. The report is concluded by some observations on the mammalian remains found in the lead crevices by Profs. Leidy and Wyman; and the last chapter contains a catalogue of fossils, with remarks and descriptions of some new ones by Prof. Hall. We shall revert to this report again in more detail. It is admirably well printed and illustrated. The beautiful maps, diagrams and sections by Prof. Whitney of the lead region deserve especial mention.

14. OBITUARY.—*Hiram A. Prout, M.D.* died at St. Louis, Mo., April 21, 1862. Dr. Prout was well known as a naturalist and a zealous member of the St. Louis Academy of Science. Our geological readers will recall his description, in March, 1847, (this Jour., iii, 248) of a fossil maxillary bone of Palæotherium from near White River in the Mauvaise Terres. This was our first definite knowledge of that vast mausoleum of Palæotherial remains, since become so famous. He was an eminent physician and most useful citizen.

K. C. v. Leonhard.—Died on the 23d of January, 1862, at Heidelberg, K. C. v. Leonhard, Prof. of Mineralogy in that city since 1818. He was born in Rumpenheim near Hanau, Sept. 12, 1779. Among his numerous writings the following deserve mention:

Handbuch einer allgemeinen topographischen Mineralogie. 3 Bde. Frankfort, 1809.—Characteristik der Felsarten. Heidelberg, 1823.—Handbuch der Oryktognosie. Heidelberg, 1826. 2 Aufl.—Die Basalt Gebilde. 2 Bde. Stuttgart, 1832.—Grundzüge der Oryktognosie. Heidelberg, 1833. 2 Aufl.—Agenda geognostica. Heidelberg, 1838. 2 Aufl.—Grundzüge der Geologie und Geognosie. Heidelberg, 1839. 3 Aufl.—Geologie oder Naturgeschichte der Erde. 5 Bde. Stuttgart, 1836–1844.—Lehrbuch der Geognosie und Geologie. Stuttgart, 1849. 2 Aufl.

Taschenbuch für die gesammte Mineralogie. Frankfort, 1807–1824.—Zeitschrift für Mineralogie. Frankfort, 1825–1829.—Jahrbuch für Mineralogie etc. von K. C. v. Leonhard und H. G. Bronn. Stuttgart, 1830–1862.

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