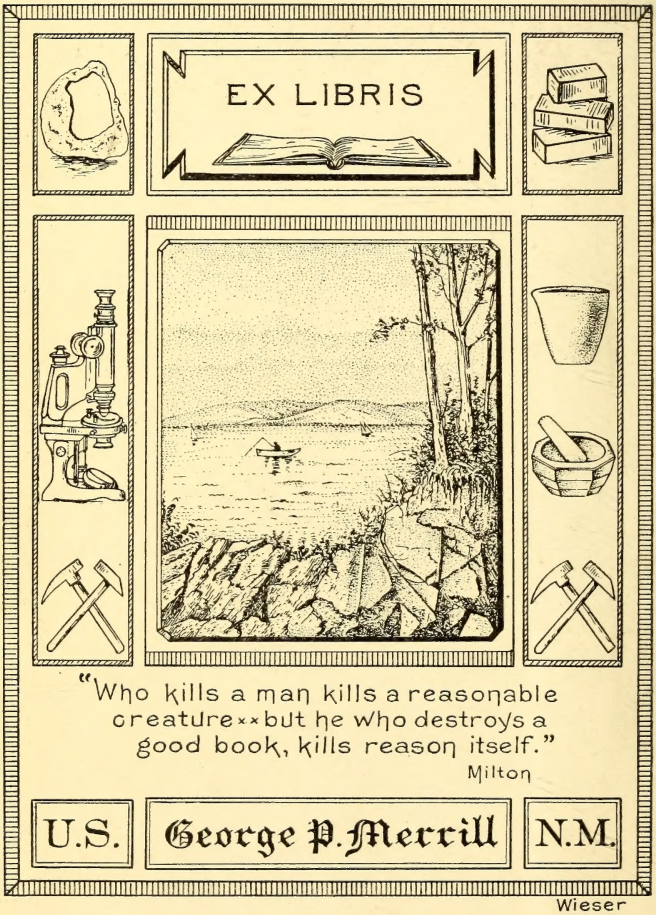

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TRANSACTIONS

OF THE

GEOLOGICAL SOCIETY OF PENNSYLVANIA.

VOL. I.—PART I.

ON THE GEOLOGICAL POSITION OF CERTAIN BEDS WHICH CONTAIN NUMEROUS FOSSIL MARINE PLANTS OF THE FAMILY FUCOIDES; NEAR LEWISTOWN, MIFFLIN COUNTY, PENNSYLVANIA.

By Richard C. Taylor, Fellow of the Geol. Soc. of London; Associate Fellow of Inst. Civ. Eng. London; Member of the Geol. Soc. of Pennsylvania; of the Acad. Nat. Sci. of Philadelphia; and of the Albany Institute, New York.

In a recent number of the London Magazine of Natural History, I communicated a drawing of *Fucoides Alleghaniensis*, so named by Dr Harlan of Philadelphia; together with a slight sketch of some of the rocks comprised within the grauwacke group of central Pennsylvania, and a more detailed notice of the strata in which numerous fossil plants of this family prevail.

I propose to state the substance of that article, as relates to the Fuci, and to annex some observations which have been made subsequent to that communication.

Fossil plants of this family are very common in the silicious and argillaceous deposits of the transition series, in this country. In the grauwacke group of Sweden, Mr De la Beche enumerates two species; and one

other undetermined species occurs in Ireland. In England I am not aware that any have been described in the same series of rocks. On the authority of M. Ad. Brongniart, Dr Harlan refers to two species in the transition limestones of Canada. Within the space of a few months, I have observed *Fucoides Alleghaniensis*, with other species, in the brown sandstone of Tussey Mountain, near Alexandria in Huntingdon county. Further south I noticed them in a similar rock in Bedford county. In the white sandstone of the seven Mountains, in Centre county, F. *Alleghaniensis*, and several others prevail at the height of seventeen or eighteen hundred feet above the sea. At Muncy Ridge, near Muncy, in Lycoming county, I obtained splendid specimens of F. *Alleghaniensis*, on white sandstone; and in the same vicinity other species in grauwacke slate. At the latter place and near Lewistown they occur at 450 feet above tide water. In the lower part of the old red sandstone, on the eastern slope of the Alleghany Ridge, I have observed fossil fuci of simple form, associated with Productæ, at points more than a hundred miles apart.

Detached fragments containing specimens of F. *Alleghaniensis*—amongst others, that from whence Dr Harlan's figure and description are derived—have not unfrequently been observed among the talus of the ridge, called Shade Mountain, on the north side of the Juniata river; and in the deep valley of "the Long Narrows," below Lewistown.

Towards the close of the last year the strata in which these fossil plants occur in situ, came under my observation, and I proceed to describe the circumstances attending their position.

Fig. 1.
14th Size.

Fig. 2
14th Size.

Sarnet & Brandshaw Lith. Boston.

After passing Lewistown, the Juniata flows easterly five or six miles, between two ridges of siliceous rock, each upwards of 700 feet high, through the narrows. So narrow indeed is this ravine for the most part, that it only suffices for the channel of the river. The western turnpike road, and the Pennsylvania canal are chiefly formed out of the base of the Shade Mountain, which rises on the north side. In making the excavations for these works, the arrangement of the lower strata, is consequently exposed. This developement is the more interesting, since it comprises the beds which contain fossil fuci in singular abundance.

October 2d, and 25th. Commencing the examination from the west, I traced these beds uninterruptedly among the debris, for a couple of miles, to a position where they could be examined more satisfactorily.

They consisted of compact, fine grained argillaceous sandstone, interstratified with greenish seams of shale and some with their laminæ of dark carbonaceous slate, both containing mica. Further westward, the fucus beds were again laid bare, to the height of near fifty feet. Here I counted seven courses of them, comprised within a thickness of only four feet.

Among the lower beds are some of white sub-crystalline quartz rock, and others of micaceous and schistose sandstone, whose upper surfaces were traversed by fuci of another species, distinguished by long curving stalks; whilst on other slabs a third species, crossing in straight lines, formed a reticulated surface, resembling network.

At three miles below Lewistown, are exposed numerous seams of fine greenish brown sandstone, separated as before, by thin courses of micaceous clay and shale, containing some magnesia. So numerous are the beds of fucoides here, that eight or ten were counted within the space of six feet; some of which did not exceed an inch in thickness. Lower down the narrows succeeds a group of argillaceous and ferruginous beds; whose upper surfaces were covered with obscure forms, and irregular branching protuberances, probably derived from some other species of fossil algæ.

November 11*th and* 12*th.* The exploration of the fucus beds was resumed, and from it results the discovery of a series far more extensive than had been contemplated. On the margin of the canal, at the western end of Shade Mountain are exhibited numerous seams, varying from an inch to a foot in thickness, of argillaceous sandstone, the superior faces of which were observed to be thickly covered with obscure fuci or algæ. These seams are separated by partings of soft argillaceous rock, and greenish or yellow clay, from half an inch to an inch thick, almost entirely composed of accumulated plants of the same description. An opening or quarry made in this series exhibits an astonishing succession of vegetable surfaces or growths. At least one hundred courses are distinguishable within a perpendicular section of only twenty feet, all of them crowded with fossil plants of the obscure kind, and occasionally crossed by the larger fucoides.

At another point as many as twenty layers of fucoides

Fig. 3.
Size.

Fig. 4.
Size.

Surface of the Flagstones with which the Town of Lewistown is paved.

were counted in the thickness of only three feet. There seems to be more than a hundred and fifty feet thickness of this part of the series. It is difficult to estimate the entire thickness, since it cannot be known how low it descends under the level of the Juniata. Allowing for the average inclination of the whole group from the river to the ridge, it cannot be taken at less than 200 feet. At the west end of Shade mountain I found these beds extending uninterruptedly to an elevation of from 300 to 350 feet. Those containing the obscure algæ reached 250 feet, and at 300 feet abundance of surface slabs exhibited the *Fucoides Alleghaniensis* in situ. Above this height the ridge is abrupt and is covered with loose sandstone blocks.

The deposit which has been thus briefly traced out, although it forms an insignificant fraction of the immense succession which is comprised within the grauwache group, presents matter for the consideration of the speculative geologist. It has been seen that here occur almost innumerable beds of fucoides, of several species.

Hence may be inferred the existence at various epochs, of so many surfaces on which vegetation flourished, at the bottom of an ancient ocean. We ascertained that there were frequent repetitions of these submarine plants, and many renewals of the argillaceous matter in which they took root. We further learn, from the often repeated successions of this marine vegetation, and from the absence of the coarse aggregates, grits and conglomerates, that this member of the

grauwache group was formed under a quiescent state of the antediluvian waters. The F. *Alleghaniensis* has with propriety been classed with the most interesting fossil productions of this continent. A single slab in your cabinet, ornamented in relief with groups of this remarkable fossil, whose figured surface reminds us of the Gothic tracery of ancient sculpture, is of itself an object of admiration. Imagine beds of these, miles in extent, deposited or rather accumulating growth after growth, and layer over layer, and you will have one more subject for contemplation, in addition to the innumerable others, which result from our inquiries into the "Remains of a former world."

Since the preceding passages were written, I have again explored the position of the fucus beds in the Shade mountain, and am enabled to subjoin a few additional notes.

It may be premised that in estimating the position and areas of the various deposits in this vicinity, no small perplexity arises from their curvatures or contortions. Erroneous impressions relative to their prevailing inclination and direction, must not unfrequently result from the inspection of detached sections. It is only by a continued series of observations, under propitious circumstances at various points, and at different seasons of the year,—for even the season of snow is favorable to the exhibition of some of the broader geological features in mountainous districts—that the intricacies of such deposits can be unravelled. This remark is strictly applicable to the entire valley of the Juniata, on

Fig. 6.
½ Nat. Size.

Fucoides Brongniartii.

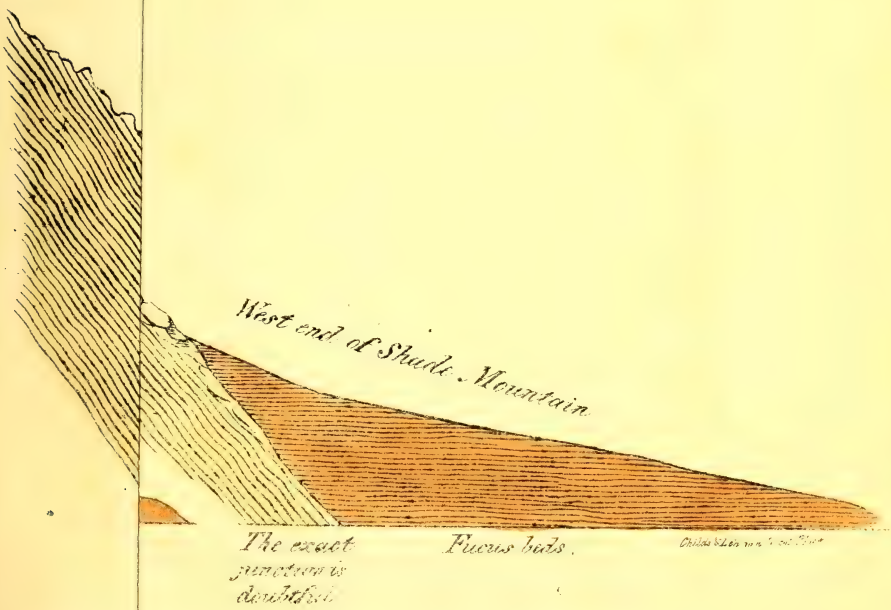
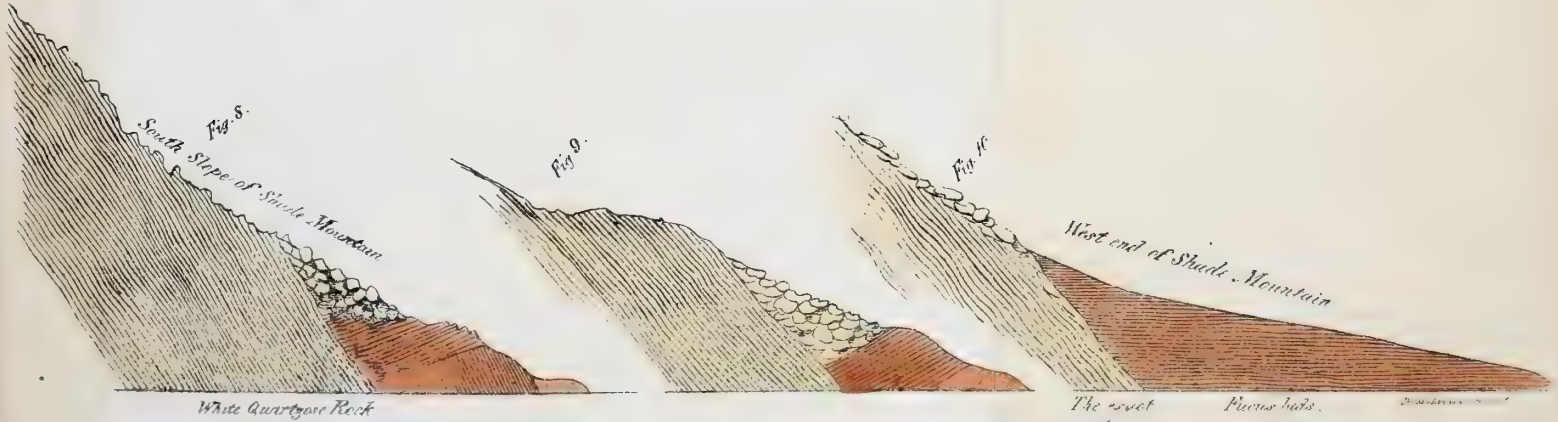


Fig. 5.
1/4th Scale

Fig. 6.
1/2 Nat. Size.

Fucoides Brongniartii.



Transverse Sections of the Fucoid beds
in the Shade Mountain

either side of which, throughout its course, a continued series of contorted stratified masses, rolling and heaving like the weaves of a stormy ocean, embarras the progress of geological investigation.

It has been long ago noticed, that the deposition of the grauwache and transition strata, appears to have been subjected to much interruption; that the order of their succession is extremely variable; and that while in some situations, certain deposits were accumulated in great thickness, they were at other points wholly absent.

The Lewistown argillo-siliceous beds, which are distinguished by such a remarkable succession of fossil marine plants, furnish an example in accordance with these views.* Occupying the bottom of a deep trough, between two lofty ridges which are formed of a different material and incline at opposite angles, these beds broken and distorted by violent action and apparently unconformable to the subjacent rocks, bear evidence of a more recent origin.† Towards the eastern termination of this trough, they are seen rising up at a high angle and then folded back against the mountain; appear to abut upon the siliceous rocks of the ridge; dipping about twenty degrees to the north west.‡ In the centre of the narrows they dip at an angle of thirty degrees in the same direction *towards* the ridge,§ and at the upper or western entrance the inclination changes to a very gentle slope *from* the mountain.‖

* Pl. iv. Fig. 6. † Pl. iv. Fig. 7. ‡ Pl. iii. Fig. 8.
§ Pl. iii. Fig. 9. ‖ Pl. iii. Fig. 10.

They do not exhibit themselves in situ in the narrows at a higher elevation than about fifty feet above the Juniata, and occupy merely a strip of the breadth of one-sixth of a mile. At the western termination of the Shade mountain we find this deposit not only expanded over an area a mile in breadth at least, but attaining an elevation of three hundred and fifty feet; the whole mass descending, as we have before stated, at a small angle towards the west.

The Juniata cuts across the Fucus beds at this point, traversing from the north to the south side of Shade mountain; and here this ridge having passed in a straight line for more than forty miles from the Susquehanna and having maintained a uniform elevation throughout, loses its bold character and terminates in a gentle slope to the river. Through the comparatively soft strata which contain the vegetable remains, the Juniata has in the lapse of ages, effected a passage, first transversely, and then longitudinally down the gorge, and during this process a large portion of such strata have evidently been removed. These details are illustrated by the map and section, Pl. iv. fig. 6, and Pl. iii. fig. 7, by which it will be perceived that the stratification of the two ridges incline toward each other, at an angle of about fifty degrees, and if prolonged would meet beneath the centre of the trough; and as the fucus beds seem to rest upon both, as a filling up, it is obvious why we incline to the opinion before given that this deposition was effected at a period subsequent to the upheaving of the ridges.

Rough Sketch of the position of the Transition Beds near Juniata ... M.xxx ... D ...

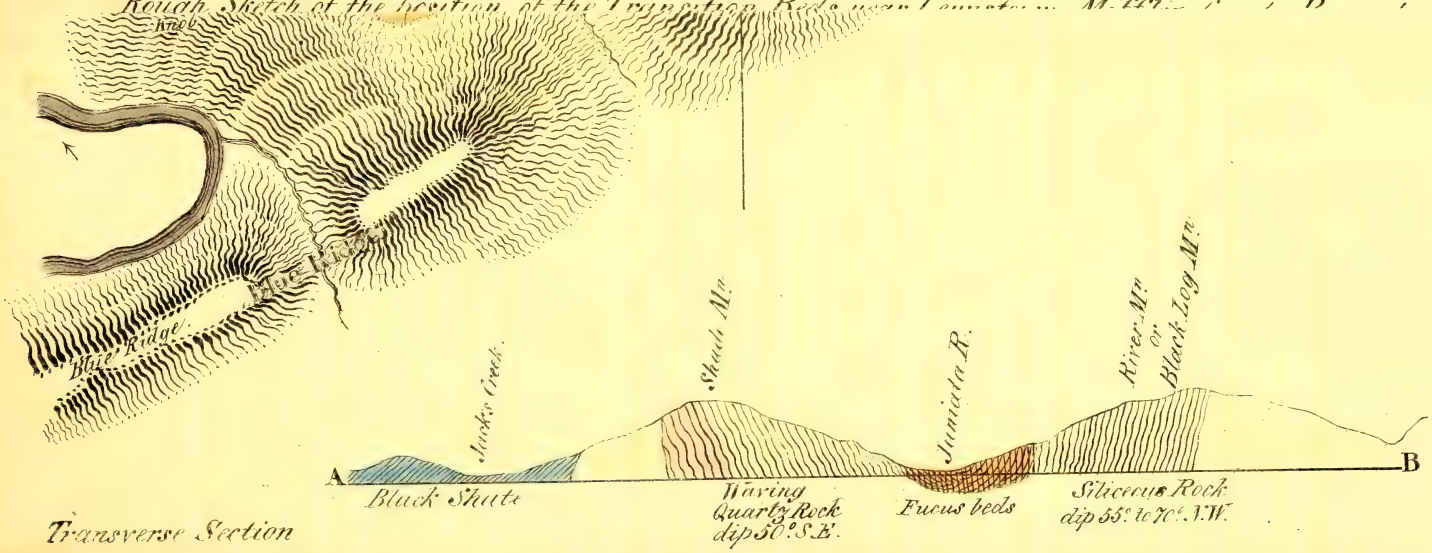


Fig. 7.

Transverse Section

Scale 1½ Inch to a Mile.

Childs & Lehman Lith. Philadelphia.

Rough Sketch of the position of the Transition Beds near Lewistown Mifflin County Pennsylvania containing various species of Fossil Fucoides.

by R. C. Taylor.

Fig. 6.

Scale 1 Inch to a Mile.

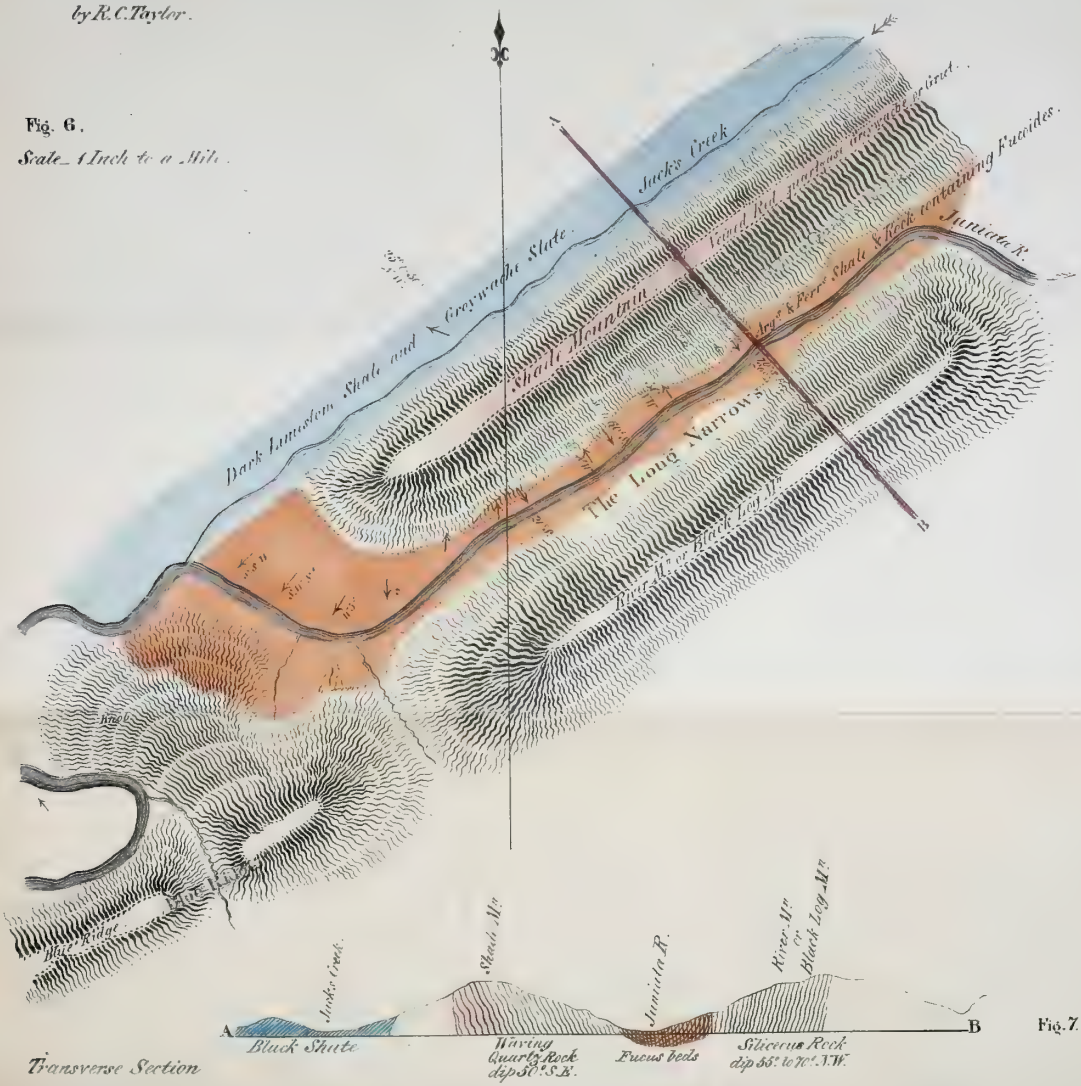


Fig. 7.

Transverse Section

Scale 1½ Inch to a Mile.

Shade mountain, on its southern side, consists of a compact rock, composed of crystalline grains of quartz, and rising to the height of near 750 feet in waving beds and coarse lamina, whose average inclination is about 50° S.E. their direction being N.E. nearly. The surface of this stone is covered with minute quartz crystals, and its masses are every where intercepted by that peculiar striated glance cleavage, so commonly observed in the anthracite coal slates, and even in the coal itself. On breaking this rock, it appears spotted with a brown mineral substance, occupying small cells. This mineral oxidates on exposure, and being soon removed, the empty cavities confer a honeycomb appearance on weather-worn masses. Rocks of this structnre are by no means uncommon in the grauwache group. The neighboring parallel ridge of Jack's mountain is of this description on its south side; and I have even observed fragments on the west side of the Alleghany ridge.

Red sandstone, (quartose, greywache or grit,) with interlacing white quartz veins, occurs on the north slope of both the Shade mountain and Jack's mountain, and a similar arrangement prevails in the main ridge of the next group, called the Seven mountains. Coarse, imperfectly defined traces of Fucoides are occasionally seen on the surface of the red sandstones, in all these localities.

The deposits, which by way of local distinction I have designated as the Fucus beds, comprise strata of different mineralogical character; consisting of modifications and admixtures of argillaceous, slaty and silice-

ous rock, coarsely laminated, and separated by thin partings of shale. Some of the slates are of fine texture, and contain chlorite, magnesia, mica and ferruginous matter. Animal remains have not been detected in them.

The marine vegetable fossils are all referrible to the family fucoides. *Fucoides Alleghaniensis* has been originally described by Dr. Harlan from this locality, and is the most remarkable fossil here. In one variety the rugæ of the branches or digits are more strongly serrated than those figured by Dr. Harlan.

F. *Brongniartii*, also described by the same naturalist, occurs here, but more sparingly. Vid. pl. iii, fig. 6.

Figures 1, 2, pl. i. and iii, pl. ii. and v, pl. ii. are sketches one-fourth the natural scale, of another species of fucoides, distinguished by its long, flexible and flattened stalks, with few branches. The breadth of these stalks is commonly half an inch, but sometimes greater. The specimens are sketched from slabs which occur in the Long Narrows. It would have better served the purpose of scientific illustration, could more perfect specimens, exhibiting the superior terminations of these plants, have been procured.

Figure 4, pl. ii. is a sketch from a large slab of that species which has been referred to as obscure or indeterminate, and which covers in relief the upper surfaces of the pavement slabs used in the streets of Lewistown. It occurs in greater profusion than the other species. Hundreds of beds, some of them not an inch

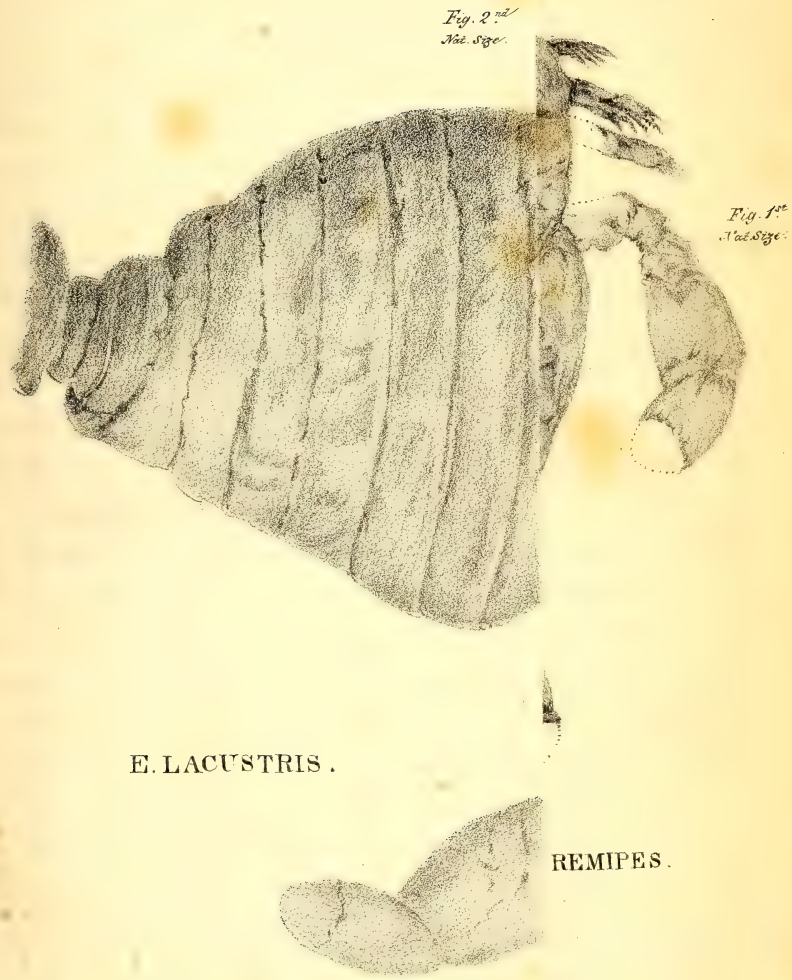


Fig. 2nd
Nat. Size.
Fig. 1st
Nat. Size.
E. LACUSTRIS.
REMIPES.

Fig. 2.nd
Nat. Size

E. LACUSTRIS.

Fig. 1st
Nat. Size

EURYPTERUS REMIPES.

in thickness, and seldom excceding five or six inches, occupy an aggregate thickness of probably 200 feet, at the western termination of Shade mountain; and the quarries on the margin of the canal, within a mile of Lewistown, furnish an inexhaustible supply of these excellent paving materials. The vegetable forms are less distinguishable when fresh from the quarry, than in the weathered slabs and pavements, where the argillaceous shale, which always interposes between the seams of indurated stone, is decomposed and scaled off.

In the foregoing notes have been brought together the observations which a temporary residence near the spot has enabled the writer to make, respecting this singular depository of fossil plants; to which investigation he is happy to acknowledge himself stimulated by the instructive paper of Dr. Harlan on the *Fucoides Alleghaniensis*, in the Journal of the Academy of Natural Sciences of Philadelphia, vol. vi. p. 289.

AN ESSAY ON THE GOLD REGION OF THE UNITED STATES.

By James Dickson, F. G. S. of London, C. M. G. S. of Penn., and of various Societies of Europe. Read June, 1834.

The gold region of the United States of N. America, so far as it has yet been developed by mining operations, is considered to extend from the Rappahannock river in the state of Virginia, to the Coosa river in the state of Alabama.

The indications of the existence of gold ores have been met with as far south as the Gulf of Mexico, and in a northern direction in Vermont. There is but little doubt, that at no distant period, it will be ascertained that gold is abundant in Canada, and in regions still nearer the Arctic circle.

The importance which has of late attached itself to the gold region of the United States, and the progressive development of its resources, has long wanted a notice in scientific journals. If, however, an unpretending statement of facts, and the accumulated results of three years research in this interesting mineral section, will tend to induce a correct appreciation of the value and extent of its resources, the object of this paper will have been amply achieved.

It is worthy of remark, that amid numerous obstacles in the way of the American gold miner,—obstacles pro-

ceeding as well from ignorance of the character and indications of gold ores and mines, and their mode of treatment and operation, as from the consequent discouragement in the first stages of a business which is admitted in older mining countries to require a large share of perseverance, judgment, economy and science to conduct to a profitable issue,—that notwithstanding all this, fresh attempts and developments of daily notoriety are in progress along the vast region bordering on the Blue Ridge mountains, from Virginia to Alabama.

Some few individuals, favoured as much by chance as otherwise, have met the success they sought for. Many mining enterprises have been abandoned in despair, at a period when a little longer perseverance would have found its own reward: while others again have wisely broken up mining establishments which never, in any country, would have excited the hopes of an experienced miner.

To the failure of some mining enterprises—to the reckless and heavy expenditures of others,—but more than all, to the visionary statements and anticipations of all, must be attributed the coldness and distrust with which, for some time, this important mineral section of the U. S. has been regarded.

When we look around and regard the position of the celebrated mining districts of S. America, the exact position of the mineral treasures—the expense of mining "materiel," and many of the circumstances bearing prominently on the subject, and then cast a glance com-

paratively at the "gold region" of the United States of North America, there is but one impression left on the mind—a conviction—a settled conviction of the superiority of the latter.

In the one we perceive unsettled government and laws—but slight security of life and property, the precious metals embosomed in wild and desolate regions—all the "materiel" for mining purposes scarce and costly—barriers, natural barriers, in the impassable mountains, to the facilities of transportation; in numerous instances a want of miners, who, in the intestine commotions and political revolutions, are made conscripts and marched to the scene of battle, seldom to return, while doubt and gloom and hopelessness of amelioration alike prevent and stifle all enterprize.

In the United States, it is unnecessary here to place in juxtaposition the advantages of its mineral regions, thick forests, navigable rivers, inland seas and bays, cheap engines for draining alike the mines and facilitating the extraction of the precious metals—a population well organized and numerous; and more than all, the stability of its government and institutions. With a mild and genial climate is blended great agricultural prosperity,—the necessaries of life within the reach of all.

The conclusion inevitably is, if the ores and mines are equal or at least productive, then does the gold region of the United States stand alone in its superiority. Thus far has been premised in general; in the course

of this treatise, a plain statement of facts will be offered, and inferences are left to the philosopher and the capitalist.

It has been the fortune of the writer of this essay to have had it in his power to visit many of the mining countries of celebrity, and to have become familiar in practice of late years with the various mining operations for the precious metals in different nations, from the mines of the Russian empire to those of the ci-devant Spanish colonies.

The impression induced by his researches in the United States has been that there are richer ores of gold and richer diluvial gold deposits than are to be met with at Gorgo Soco, in the Brazils, or the Uralian chain of mountains.

In Russia, splendid and interesting as are the gold specimens found in the deposit mines of the county Demidoff, yet in Georgia, North Carolina, and principally Virginia, in the United States, the writer has met with numerous instances where the weight of specimens of solid gold and the character has been much superior. The mines of the Brazils, the Gorgo Soco itself, cannot be compared with a vein at present known to the writer as existing in the United States. Specimens from Jonora and California he has seen in Mexico, as also from El Oro and Angangeo, and from the north in Zacatecas and Chihuahua. They were indeed interesting and beautiful, but are not to be compared with those of the gold regions of the United States. Even the far famed mass of gold in the cabinet at St. Petersburg does not

weigh as much by several ounces as that which was found in North Carolina. In that portion of the gold region of the United States situated within the chartered limits of Georgia, the richest mineral belt, if it may be so termed, is met with in talcose slate and granite formations, alternating with hornblende, slate, gneiss and chloride slate, taking a direction nearly N. N. E. and S. S. W. between the Chestatee and Chatahoochee rivers, in Habersham county, near the Cherokee nation, crossing subsequently the Chestatee and entering the Cherokee county, it passes the Etowah river and pursues an unvarying course till we meet it again on the banks of the Coosa river in the creek nation, in the state of Alabama.

There are other mineral "belts" of gold veins and mines running a parallel course, at stated intervals and distances from each other,—generally from eight to ten miles,—and are to be met with low down towards Augusta, on the Savannah river. These latter cross the Chatahoochee below Columbus. They are terminated in their nearer approach to the seaboard of the Atlantic by the disappearance of the primitive formation, which occurs a short distance above Augusta. This same position of the rocks occurs a little above Fredericksburg in Virginia, where the primitive formation also terminates towards the coast. The same geological features are presented as in the neighbourhood of Augusta, Georgia.

Following the course of the upper mineral belt of Georgia, which is at a distance of from twenty-five to

thirty miles from the Blue Ridge chain of mountains, we met it in comparatively the same aspect, in South Carolina and North Carolina; where, however, the gold region enters Virginia, a sensible difference occurs in relation to its position with the Blue Ridge. The upper mineral belts cross the Blue Ridge and pass on through the valley between that chain and the Alleghanies. It is only the lower mineral belts that are met with in Virginia on this side of the Blue Ridge.

The largest amount of gold has been obtained from a class of mines generally known by the name of "branch mines" or stream mines; situated in the beds of rivers and rivulets or ravines. The capital required to work such mines being small, and the profits almost immediate and daily, a few machines called "rockers" for washing the gravel strata in which the gold is found, and some negroes with the necessary digging tools, are the preparations for opening and profitably working a mine of this nature. Many hundred negroes are yearly employed in the different states for this purpose, and in general very profitably. It is considered that a mine of ordinary importance will yield from one to 5 dwts. to the hand per day. It is not uncommon to obtain 10 dwts. to the hand, and instances have occurred when as high as 120 dwts. to the hand per day have been obtained. Several individuals in N. Carolina and Georgia have been eminently successful in this particular kind of gold mining, and have realized large fortunes.

The gold is found in a bed of gravel—the debris of some vein or veins either crossing a watered ravine or

taking the same course as the defile itself—this bed of gravel rests on the slate of the country, (talcose slate generally,) which is from nine inches to three feet in thickness of strata, and placed from three to six feet from the surface of the ground; it is however, met with occasionally much deeper under the ground, and several strata of gravel have also been found to exist, of which the lowest only contains gold.

It is unnecessary here to describe the process of washing the gold from the gravel in which it is contained, as the machines in operation are generally known, and drawings of them already published. It differs from the process used in the Ural mountains and in the Brazils, and is superior in all respects, whether for the amount washed per day of the gravel, or the fineness of the gold saved, to any machine in operation in any other country in the world. The "Burke rocker," as it is commonly called, was the combined improvement of various miners in N. Carolina; it is estimated to wash from 700 to 1000 bushels or a cwt. of gravel per day, and costs about twenty-five dollars, when completely furnished and ready for use.

Many theories have been started, and many opinions entertained relative to the origin of these gold deposits of the U. States. During the researches and private operations on an extensive scale, in this class of mines, the writer of this essay has become satisfied, as regards the manner in which these gold deposits have originated and been made.

In working the trenches or pits of a branch mine, nu-

merous veins partially decomposed are to be seen in the soft bed of the talcose slate, where the superincumbent strata have been removed. These veins cross the branch at various angles, depending on the relative course of the ravine through which the branch or stream wends its way.

The gravel strata are entirely composed of the broken fragments of the quartz veins, which are to be met with outcropping on the banks of the ravine. The ore itself, sometimes undecomposed, is met with in the bed, and all the characters of the mineral found in the vein are also to be met with in the branch gravel. The gold also is similar—for gold in some mines is entirely distinct in character from that of others. There was not a mine in Georgia, the gold of which could not be distinguished from any other of the same district, so distinctly marked were the characters of each.

Branches have been worked, where but one gold vein crossed them, and that at right angles with the stream. Gold would have been found in considerable quantities a few yards below the place where the river crossed—the vein itself being found in the bed of slate in the branch. No gold would be found up the stream, above the vein, and but little down, any great distance from the vein.

The richest branch mines are to be found where the veins enter the branch and continue a straight course for some length down the branch. This is apt to be an extensive gold deposit.

Branch mines have led to the discovery of many va-

luable vein mines, for when they worked until the gold seemed to fail, they would come back and open into the sides or banks of the ravine, guided by the gold, and at last discover valuable bodies of gold ore. Many instances of this kind are notorious in North Carolina and Virginia.

It has been calculated that not less than six millions of dollars in gold have been extracted from the branch gold mines of the United States, since the commencement of mining operations; the larger portion of the gold finding its way, not to the mint, but abroad, and being worked up for jewellery in the different parts of the country.

Three deposit mines in Georgia have alone furnished half a million of dollars; and if we look at the great number of labourers employed, the vast extent of the gold region, hundreds of miles in length, and the increasing attention given to this subject, we need not be surprized if the gold deposits of the United States yield far larger returns than those of Brazil, Colombia or the Urals, united.

One singular geological fact, as also connected with the history of the gold region and the aborigines, may be cursorily noticed here: It is, that arrow heads and other implements peculiar to the Indians of the American continent, are met with in the superincumbent strata of these gold mine branches. They have been found at various depths above the gravel, but never below it. The greatest depth at which they have been met with is twelve feet below the surface, in second strata of gra-

vel. The mine situated in Georgia had three distinct strata of gravel; one at six feet, then five feet of blue clay, with vegetable remains contained in it; then a stratum of gravel two feet thick in which were found the Indian arrow and spearhead of a siliceous mineral; then about six feet of the blue clay, as above; and finally, the gravel in which was found the gold; as much as 1000 dwts. of gold having been obtained at this depth from a trench forty feet in length by ten in breadth.*

In the Creek nation, as also on the borders of the Cherokee nation, remains are to be met with which clearly indicate that gold mines were known to exist in those regions, and that they had been partially worked long prior to the present epoch. The traditions of the

*Whilst this essay was yet in press, we observed the following notice of a submerged Indian village, in one of our daily Gazettes, which, from its connexion with the subject before us, is deemed worthy of an insertion here:

A letter to the editor of the Southern Banner states, that a subterranean Indian village has lately been discovered in Nacoochee valley, Georgia, by gold miners, in excavating a canal for the purpose of washing gold. The depth to which it is covered, varies from seven to nine feet; some of the houses are embedded in a stratum of rich auriferous gravel. They are 34 in number, built of logs from six to ten inches in diameter, and from ten to twelve feet in length. The walls are from three to six feet in height, forming a continuous line or street of 300 feet. The logs are hewed and notched as at the present day. The land beneath which they were found was covered, on its first settlements by the whites, with a heavy growth of timber.

The houses are situated from 50 to 100 yards from the principal channel of the creek; and as no further excavations have been made, it is more than probable that new and more interesting developments will be made, when the land is worked for gold.

During my mining operations last year, I found at one time, about one half of a crucible of the capacity of near a gallon. It was ten feet below the surface,

Indians, or at least their oldest men, are unable to give an account of it. It may probably have been the attempt of the exploring party of Spaniards which penetrated from Pensacola into the interior, and which expedition terminated fatally, according to documents met with in the public archives of Pensacola.

Numerous as are the vein mines opened and partially developed in the states of North Carolina and Virginia, few have been the subject of any systematic mining operations. Some, however, where a regular plan of mining has been introduced, are at present successful, and yielding returns commensurate with the capital employed. And others are about to be placed in a situation, by means of adequate machinery, to test the value of their mineral load. Occasional failures have taken

and immediately beneath a large oak tree which measured five feet in diameter and must have been four or five hundred years old. The deposit was alluvial, or what may be termed table land. The stratum of quartz gravel in which the vessel was imbedded is about two feet in thickness, resting upon decomposed chlorite slate.

It is not difficult to account for the deposit of those substances in alluvial soil, for the hills are generally very high and precipitous, and from the immense quantity of rain which falls, the streams are swollen to a great height, sweeping every thing with them and frequently forming a deposit of several feet in thickness in a season; but some of the alluvial land is from 10 to 15 feet above the present level of the streams. These deposits exhibit appearances of as great attrition as those recently formed.

There was a vessel or rather a double mortar found in Duke's creek, about five inches in diameter, and the excavations on each side were nearly an inch in depth, basin like, and perfectly polished. It was made of quartz, which had been semi-transparent, but had become stained with the iron which abounds in quantity in all this country. In the bottom of each basin was a small depression half an inch in depth and of about the same diameter. Some suppose it was used for grinding paint &c., or in some of their plays or games.

place; in some mines such a failure has originated in the poverty of the ores, which were actually of insufficient value to justify even an experiment involving but slight expense. There have been others again abandoned from the want of capital to carry out and execute plans which had at the commencement been based on large expenditures and immediate prospects of return.

The gold loads of the United States cannot yet be considered as properly and fully explored. The greatest depth yet examined does not much exceed 150 feet; shafts of 100 feet in depth are, perhaps, more general; but in ordinary attempts at mining in the gold region, from twenty to thirty feet from the surface has generally either satisfied curiosity or the rude attempts at development. At such a depth as this little information is to be gleaned of the position or character of mineral load in these sections of country.

The character of the formation—the certain evidences every where met with of change and interruption in the position of the veins, would at the first glance satisfy any experienced miner that such attempts, such partial developments, were idle and fruitless; but nevertheless veins are daily opened to this slight depth, and however promising the surface indications, however rich the display of actual gold in the debris on the top of the ground; if the vein is altered in appearance; if it is accidentally heaved to a side; if it becomes less in width, or more shattered than at the commencement of the shaft, it is ten to one but it is abandoned altogether. This fact is of common notoriety, and many

promising veins are now regarded as valueless which under proper auspices would prove very lucrative. This is to be remarked in almost every gold load in these regions, until a depth of 70 to 100 feet has been attained. The walls of the vein and the vein itself show appearances of much disorganization, as to position and constituent parts. In the state of Virginia, where the granite and the talcose slate form respective walls of the vein of quartz containing gold, masses of a decomposed granite are to be found sometimes in the slate of the opposite wall, and vice versa, seams of red clay also traverse the respective walls. In fact, the whole of the formation is in a crude and confused state. The vein itself consists of disjointed masses of ore, with seams of clay intermingled; its dip and inclination varying from one point of the compass, and from one angle to another, every four or five feet in depth or horizontally. One fact is apparent, the whole formation has been once softened by the influence of superincumbent water, from a depth varying from 50 to 100 feet; that it has been almost in a state of suspension in water, as the muddy sediment of a pond; that while it continued in this state, it had been frequently violently agitated and waved to and fro, like a field of grass in a high wind; that these various changes in the position of the walls of the vein and the load itself, thus originated, is self evident.

When the gold loads consist of auriferous vein ore, or a quartz vein containing a large proportion of sulphuret of iron and native gold, changes have taken

place above the depth of 100 feet, which could alone have originated in the action of water for a lengthened period on the sulphuret. The pyritical cubes have been converted into brown, red and purple hydrates of iron; sometimes a cube is found only half decomposed. In the centre of the solid quartz itself, cavities are met with resembling a honey-comb, entirely empty, but which bear the impress of the shape of the pyritical cube, and coating richly the interior of each minute cavity is found a quantity of gold. There is one point clearly shown: it is, that all the gold which is obtained by amalgamaters from these pyritical ores of gold is that portion which has been disintegrated, and left isolated in its native state by the decomposition of the sulphuret. The residue of metallic sulphuret, if collected and concentrated, would yield and does by experiments frequently repeated by the writer of this essay, afford a large portion of the precious metal by fire assay.

Pyritical ores of gold constitute the mass of the loads of Columbia, the Brazils and the United States; if then a process was employed which would in the first place obtain by amalgamation nearly all the disintegrated gold, and the balance of metallic matter was concentrated, many rich mines, which at present are considered to consist of very untractable ores, would yield vast profits.

During an extensive series of practical operations in the gold regions of the United States, many experiments and processes have been attempted and put in operation on a large scale, by the writer. He deems that a

summary of his views and experience on that subject might prove serviceable to the mining world, if not in the processes themselves, at least in the probability of their affording hints to men abler than himself.

We would briefly consider the various processes at present in use, and point out the difficulties or advantages of each.

The wet stamps and Tyrolese cold amalgamating mills have been tried very generally in the United States. In many instances, without, however, much knowledge of their treatment and arrangement. Three wet stamps, weighing each from 300 to 400 lbs., wood and iron, stamp upon an iron bed plate, and a box or cistern is fitted to it, within which the stamps work; the ore is introduced behind by a self-feeding hopper, is stamped under water, and has to rise from a depth of from fifteen to seventeen inches before it passes over into the conducting trough, which, on an inclined plane, leads it to the first of the sets of the Tyrolese mills. When it thus passes from the stamp trough, the ore is in a very minute state indeed. In the first Tyrolese mill, from 300 to 400 lbs. of quicksilver is placed, and a proportionate amount in the succeeding two. The ore passes from one to the other and the greater portion of the gold is obtained in the first. This process is extensively used in N. Carolina and Virginia, and is greatly approved of by the miners there.

The great desideratum is to stamp the ore fine enough and to attenuate it when entering the bowls or Tyrolese mills with abundance of water. No gold is to be found

in the residuum coming out of the last bowl, by simple washing in the pan; but it is to be found by the fire assay. This undoubtedly arises from the sulphuret which passes over with ground matter, and which sulphuret contains gold.

The disadvantage of this process consists in the rapidity with which the wet stamps are worn away and destroyed, the best seldom lasting longer, so as to be useful, than three weeks; each wet stamp is considered to stamp up 10 bushels or cwts. per day of 24 hours. It is not maintained as yet that they fail by this process in obtaining all the gold visible to the naked eye.

The process of dry stamping and amalgamating by the arrastre, as at El Oro and Guanaxuato, in Mexico, has also been in use.

The arrastre, in Mexico, is considered to amalgamate from 13 to 15 cwts. in the 24 hours. It is well established that all the gold visible to the naked eye, by the most minute pounding in a mortar, and afterwards washing by hand, is to be obtained thus, but at a serious loss in quicksilver; a loss partly caused by the continual attrition of the quicksilver, and its consequent oxidation.

The Chilian mill has also been in vogue, but has given way to the wet stamp and arrastre processes; smelting has not yet been systematically attempted. Thus have been briefly described the processes in use in the United States.

Whether the wet stamps or the arrastre will be universally in use, is a question which experience and time will show.

The wet stamps and Tyrolese mills if used, and found to obtain all the disintegrated gold would answer well, in connexion with a process of concentrattion, to obtain the sulphuret of iron. This auriferous sulphuret residuum might with great ease, by being thus concentrated, be smelted in a gold region such as the United States, where the forests are boundless and close, covering the very surface of the ground, where the mines are most commonly met with. There are alkaline fluxes which could be used that cost less than one dollar per cwt.: lime too is abundant, were that deemed necessary, and excellent fire clay for brick is to be found every where.

Taking a glance at the various circumstances which combine to render the gold region of the U. States a favorable site for mining establishments, much might be said of the cheapness of slave labor; (slaves alone are employed in the coal mines of Virginia.) The abundance of timber and fuel, the advantages of inland steam navigation, the healthy and excellent climate and more than all the security of life and property which, unlike the sad picture exhibited in the ci-devant of the Spanish colonies, give assurance to the capitalist that he will be permitted in peace and tranquillity, to reap the reward of his labors and skill.

SOME EXPERIMENTS ON A SULPHATED FERRUGINOUS EARTH FROM KENT COUNTY IN THE STATE OF DELAWARE, WITH A VIEW TO ASCERTAIN ITS COMMERCIAL VALUE.

By Jacob Green, M. D. Prof. Chem. in Jef. Med. College, Pa.

Last winter I presented to the society some specimens of an interesting earth from the state of Delaware, and read at the same time some extracts of a letter from Mr. W. Winser Morris, describing its locality in Kent county. Since that period I have, with the assistance of my friend Dr. S. Calhoun, subjected it to some experiments, an account of which may not be uninteresting to the society.

In three specimens of earth presented, all appeared to be composed essentially of the same ingredients, but our examination was confined principally to the sample contained in the middle division of the box, as it seemed to be the most highly charged with active materials.

In its external characters, this earth has but very little solidity, and presents rather a spongy, pulverulent texture; its color is blackish brown, inclining to gray; on exposure to heat it loses its original tint, and becomes light gray; its taste is very sharp and highly astringent.

On exposure to a strong heat in an open vessel, but little volatile matter was given off, and no combustion ensued; thus proving that but little carbon, or vegetable matter, was present; the resulting mass was of a dirty gray color.

On washing a known quantity of the solid earth with

cold water, until the water came off tasteless, and then evaporating the lixivium to dryness, the earth was found to contain 16.25 of soluble salts. The weight lost by the earth during lixiviation, was to a grain equal to the weight of the salts obtained. In another portion of the earth, we found the salts equal to 18.7 per cent. From which it is probable that in the natural bed of the earth, the soluble salts are very unequally diffused.

A considerable quantity of the earth was now washed; the lixivium filtered, and a strong solution of the salts made, which was subjected to the following experiments:

1. The ferrocynate of potassa added to a portion of the solution of the salts gave a deep blue precipitate. The supernatant liquid was decanted, and the precipitate dried, and formed with alumina into a cake of Prussian blue.

2. The tincture of galls dropped into the solution produced a dark bluish black color. These two experiments undoubtedly indicate the presence of the *peroxide of iron.*

3. On adding to the solution of the salts, the carbonate of potassa, carbonic acid escaped, and a grayish green deposit was formed. This was separated by a filter; its color was reddish externally, but greenish beneath the surface; when dry it presented a dark brown tint. The greenish gray color was no doubt produced by the presence of protoxide of iron. The above appearances also indicate the peroxide and protoxide of iron united to an acid.

4. On treating a clear solution of the salts with the

muriate of barytes, a dense, copious white precipitate occurred. From this it was concluded that the salts obtained from the earth, contained the sulphuric acid, united to the peroxide of iron, forming, probably, the sesquisulphate of the sesquioxide, the formula of which is in modern chemistry—$\frac{1}{2}(\dddot{F}e+3\dddot{S})$

5. On throwing a coil of iron wire into the solution of the salts, the red or peroxide of iron was precipitated from it in abundance; the sulphuric acid united to the wire, and hydrogen gas escaped. The color of the solution passed at the same time from its clear original brown tint to a bright green. On evaporating this solution, light green crystals appeared, which were found to be copperas, or the sulphate of the protoxide of iron, represented by $\dot{F}e+\dddot{S}$. A dark brownish earthy substance which would not crystallize remained in the liquid.

6. Supposing that alumine formed an ingredient in the salts washed out from the earth, we added an alcoholic solution of pure potash to the dried red precipitate produced in the last experiment, (5th.) This solution was then filtered and treated with sulphuric acid. No precipitate took place, not a particle of *alum*, or sulphate of potassa and alumina $(\ddot{A}l+3\dddot{S})+(\dot{P}o+\dddot{S})24$ aq. could be discovered. On evaporation, a yellow ferruginous mass was obtained, intermixed with some transparent crystalline needles, which had the bitter saline taste of the sulphate of potassa; the sweetish astringent taste of alum was altogether wanting.

From these experiments we conclude that there is no

alumina in the salts, derived from the earth, and that they are formed by the union of sulphuric acid with an oxide of iron. The working of the salts for commercial purposes, we think can never be done to advantage. The oxides of iron form with the sulphuric acid, a considerable number of salts, but the object of our analysis was not to determine the precise species to which the salt under consideration belongs; we incline to the opinion, however, that it is a sulphate of protoxide and peroxide of iron.

It is stated in most chemical works, that when the sulphate of potash is mixed with the persulphate of iron $\frac{1}{2}$ ($\ddot{F}e+\dot{3}\ddot{S}$) crystals will be formed by spontaneous evaporation, similar to common alum, the sulphate of alumina being replaced by the persulphate of iron with which it is isomorphous. We then obtained its composition by substituting $\ddot{F}e$ for $\ddot{A}l$, in the formula. Now when we added the sulphate of potassa to the solution of the salts washed from the earth, no precipitate occurred until it was reduced very low by evaporation; then it consisted of a yellow ferruginous salt, tasting like copperas ($\dot{F}e+\ddot{S}$)+6 aq.; the sweetish astringent taste of alum was entirely wanting. This experiment seems to indicate that our salt is not sesquisulphate.

DESCRIPTION OF A NEW TRILOBITE FROM NOVA SCOTIA.

By Jacob Green, M. D. Prof. Chem. in Jef. Med. Col. Philada.

ASAPHUS? CRYPTURUS. Green.

Cauda acuta; articulis terminalibus obscuris; parte marginali vix membranacea; corpore convexo.

A tolerably perfect fragment of the abdomen and tail of this highly interesting fossil, comprised all of the animal which has yet been found. Eleven articulations of the middle lobe, and ten of the lateral lobes are quite distinct. All the costal arches or ribs are smooth and rounded, being without pustulatious striæ or grooves. Four of the upper arches of the dorsal, or middle lobe, are longer than those on the sides of the body, a peculiarity which is sufficiently decisive to mark the species. Indeed this organization furnishes a striking exception to the generic characters of the Asaphus, as given by Professor Brongniart, who states "that the middle lobe of the abdomen is rarely more than one-fifth the width of the body." But what is more remarkable, and still further distinguishes this animal remain from all other Asaphs, is the epidermal covering which concealed the terminal articulations of the tail. In our specimen there is no appearance of what has been called the membraneous development beyond the lobes of the animal, another circumstance which seems to separate it from the genus Asaphus. The body is quite convex, and

both in breadth and length our fragment measures nearly three inches.

I am indebted to the kindness of Dr. Charles T. Jackson, of Boston, Mass. for this interesting species; it occurs in magnetic iron ore, and was found by Dr. Jackson and Mr. F. Alger, during their geological tour through Nova Scotia. Their highly important memoir describing the mineralogy and geology of that part of North America, has been justly proposed as a model, both in its generalizations and its details, to future explorers of those districts of our country which yet remain unexamined and undescribed. According to this memoir, Nova Scotia is based upon granite, although that rock is almost every where covered by more recent formations. A transition slate, with marine organic remains; and containing beds of limestone and rich deposits of iron ore, is very abundant. The iron ore is often beautifully impressed with organized bodies, of which our A. *crypturus* is a fine example. Sometimes one portion of a fossil is found moulded in the slate, and the other portion in the iron ore, thus indicating their contemporaneous formation. Sandstone is next in extent after the slate, and it is said corresponds geologically, with the new red sandstone or red marl of England. Dr. Jackson, in his letter which accompanied our fossil, remarks, "I send you a Trilobite from the mines of magnetic iron in Nova Scotia, which exist in the clay slate of Clements on the Moose river at Anapolis Basin; also a Terebratula found in the same locality. I beg you to show these specimens to the

ASAPHUS CRYPTURUS, (GREEN.)

Geological Society of Pennsylvania, and let me know the result of your decisions. The most extraordinary thing connected with these fossils is, that they were found in a magnetic iron ore, the protoxide mixed with the peroxide and clay slate. The walls of the bed are of the same, or nearly the same date with the bed of the ore, for they are filled with terebratulæ."

In a communication recently made to the Geological Society of London, by J. Prestroich, Jr. Esq. "on some of the faults which affect the coal field of Coalbrookdale," the author concludes his memoir with some observations on the fossils he procured, principally from the ironstone of the coal measures; among the most remarkable, were the remains of some *trilobites*, hitherto undescribed. They were procured from a bed of ironstone in the centre of the coal measures. No description of these animals being, to my knowledge, yet given, it is impossible to say what affinities they may have to our *Asaphus crypturus*. Mr. Prestrioch, who notices a *coleopterous insect*, and another apparently belonging to the genus ARANEA, which were obtained from the ironstone nodules. The occurrence of these different races of animals in the same formation, is certainly a very curious and highly important fact.

ON THE STRUCTURE OF THE TEETH IN THE "EDENTATA," FOSSIL AND RECENT. By Richard Harlan, M. D.

Read April 28th, 1834.

Profiting by recent opportunities that have offered themselves, for the examination of the intimate nature of the structure of the teeth in several genera of the order Edentata, both fossil and recent, I have observed some peculiarities not hitherto noticed, and have been enabled to correct a few previous errors existing in relation to this subject.

The close relation of the results of these inquiries to comparative anatomy and fossil geology, may, in the opinion of this society, render them worthy of publication.

To the "*Ossemens Fossiles*," of Baron Cuvier, and the "*Dents des Mammiferes*," of M. Fred. Cuvier, we must refer for the most recent information on the subject in question.

The following is a translated extract from the work of the former. Vol. v. part i. p. 84.

"In both species of sloth, there are four molar teeth above and three below on each side; all are conical during youth, but become cylindrical when the summit is worn off by detrition. The truncature of the summit produces a hollow in the osseous substance; the borders, which are of enamel, remain projecting, but unequally, sometimes more on one side, sometimes on

the other; sometimes equally before and behind, leaving two lateral points, all depending on the manner in which the teeth meet and rub against each other. The teeth of the sloths are of the most simple structure imaginable. A cylinder of bone enveloped by enamel, and hollow at both ends, at the external end by detrition, at the internal, by default of ossification, and for the purpose of lodging the remains of the gelatinous pulp, which served them for a nidus—voila toute leur description."

"These animals do not possess, like the other herbivora, plates of enamel, which penetrate the tooth in various directions, and which render the crowns more fit for grinding vegetables; consequently *their mastication ought to be very imperfect.*"

"It is still further necessary to remark that the plates which compose their osseous substance, are but imperfectly united to each other. In sawing a tooth longitudinally, these plates are observable, piled one on top of the other, like pieces of money in a tube, and this tubular case consists of enamel."

The observations which I have made on the structure of the teeth in the sloths, lead to different results, both as regards fact and inference. In the first place, the two species of the Linnæan genus BRADYPUS, (B. *tridactylus*, and B. *didactylus*, or the three-toed and two-toed sloths,) differ considerably in their dental structure, and in the form of the head. In reference to the latter point, Illiger and F. Cuvier have arranged these tardigrade animals under two distinct genera, the

former author applying the term CHÆLOPUS to the B. *didactylus;* and the latter author taking the B. *tridactylus* as the type of his genus ACHEUS.

The teeth of the three-toed sloth, although constructed on general principles like those of other phytivorous quadrupeds, display remarkable peculiarities in the arrangement of their various parts; they are composed of *bone, enamel* and *cement,* or *pars petrosa;* but in place of being irregularly intermixed with each other, there exists, first, a central cylinder of bone which is surrounded by enamel, which itself is surrounded or enveloped by a regular layer of cement. The different densities of these constituent portions of the tooth, occasion its crown to present, by detrition, several irregular faces; the central pillar of bone being softest, wears away fastest and deepest, the central portion of the crown is consequently hollow, whilst the external surface of the tooth or the cement being softer than the enamel which it incloses, and harder than the bone proper, remains less worn than the bone, and more so than the enamel, and each portion projects proportionably, the circumference of the tooth presenting a bevelled edge.

This structure renders the masticatory apparatus of this species peculiarly appropriate for grinding vegetables; accordingly, in my dissection of an adult sloth (B. *tridactylus,*) which was killed soon after eating a hearty meal of green leaves, its customary food, I observed the stomach replete with vegetable matter, reduced to a fine pulpy consistence by mastication. *Vid.*

Anatomy of the Sloth, by R. Harlan, M. D. Am. Monthly Journal of Geology, vol. i. p. 499.

In the *two-toed sloth*, (B. *didactylus*, Lin. or *chælopus*, Illig.) the form and structure of the teeth differ from those of the former species, besides possessing true canines, differing in form and size from the molars; the latter are nearly destitute of the external layer of cement, which consists only of a slight brush of this substance, of a black color, probably stained by the vegetable juices on which the animal feeds; the crowns of the two middle molars display, by detrition, two irregular concave triangular faces, anteriorly and posteriorly. The central portion of the long pillar is of a softer structure, and differs in color from the rest of the bone.

In the genus Dasypus, or Armadillo, although the various subgenera and species, differ considerably in their dental formula from each other, I have observed nothing very remarkable in the structure of these organs, in the species which I have examined; they are generally subconical, apparently destitute of *cement*, surrounded by enamel, which, when worn off by friction, leaves the crown with a double concave semi-elliptical surface, with a central depression, there being, as in the B. *didactylus*, a central portion bone, of a softer texture; like the teeth of most of the animals composing the order Edentata, those of the Armadillo, are destitute of true roots or fangs, a structure which it is supposed enables them to continue through life, growing from the inferior extremity, as the crown is worn

by the friction, similar to the process observed in the incisors of the RODENTIA.

The structure of the teeth in the ORYCTEROPUS, or *Cape ant-eater*, is totally different from all the other animals of this order; they are destitute of fangs, and penetrated their whole length by an infinity of small parallel tubes, the superior orifices of which are visible on the crown when the enamel is worn off; and are still more visible at their bases.

The "MERMECOPHAGA," or *ant-eaters*, properly so called, are destitute of teeth of every description.

By referring to Cuvier's "Ossemens Fossiles," it would appear that the illustrious author had not enjoyed an opportunity of a detailed examination of the teeth of the *Megatherium*. It is merely stated, (at p. 179, vol. v.) "Another difference consists in the teeth of the Megatherium possessing two roots which I do not find in my specimens of sloths."

If I am correctly informed, the teeth of the Megatherium had not been seen at the "Jardin des Plantes" during the lifetime of the Baron; specimens were, however, subsequently obtained. The museum of the Royal College of Surgeons of London, has recently been put in possession of choice specimens of the remains of this interesting fossil animal, through the liberality and public spirit of Mr. Woodbine Parrish. It was among these remains that I first enjoyed the opportunity of inspecting the skull and teeth of the megatherium, through the kind politeness of Mr. Clift, the Curator. In struc-

ture, they resemble those of the B. *tridactylus*; they differ in form and in the possession of two radical fangs.

The teeth of the *Megalonyx* also consist of three distinct substances; their general structure bears a close analogy to those of the B. *tridactylus*; but complete series of the teeth of this species have not yet been obtained. The molars which have been discovered differ from each other in size and form; their crowns assume, by friction, a form analagous to those of the three-toed sloth.

CRITICAL NOTICES OF VARIOUS ORGANIC REMAINS HITHERTO DISCOVERED IN NORTH AMERICA. By RICHARD HARLAN, M. D. &c. Read May 21st, 1834.

THE author of the following observations has been led to the undertaking by the urgent requests of many of his scientific friends in Europe.

It will appear in the ensuing pages that many eminent American naturalists have occupied themselves in the successful prosecution of this most interesting department of human knowledge; and yet very recent inquiries has satisfied us, that but a small fraction of what has been published on this subject in this country is adequately known to foreign naturalists. With the exception of some few of our scientific journals, the limited circulation in foreign countries of our scientific publications, is a subject of just complaint among Europeans, who interest themselves in works of this nature. We have been honored with the personal acquaintance of hundreds of transatlantic savans, to whom we are well assured the following pages, imperfect as they necessarily are, will prove an acceptable offering; a motive in itself more than sufficient to impose upon us a more difficult task, and the end satisfactorily attained, is more than adequate compensation for the labor bestowed.

CLASS MAMMALIA.

ORDER PACHYDERMATA.

Genus Mastodon, Cuv.

M. *giganteum* or *maximus* of Cuv.

Recherches sur les Ossemens Fossiles, Vol. I. 3d edition; S. L. Mitchill's edition of Cuvier's Theory of the Earth; Harlan's *Fauna Americana;* Cooper's Notice of Big-bone Lick, Am. Monthly Journal of Geology; Peale's account of the Skeleton of the Mammoth, 4to.; Trans. Am. Philos. Soc.; Ann. of Lyc. Nat. Hist. N. York; Syn. Tetracaulodon, of Godman, Trans. Am. Philos. Soc. Vol. III. new series; Mammoth of the Anglo-Americans, "*Father of the Buffaloes*" of the Indians, *Animal d'Ohio* of the French.

Locality. Confined to North America, principally in the valley of the Ohio, Big-bone Lick, Kentucky, but occurring in every state of the Union. Specimens of the teeth and bones in most cabinets of Natural History. A skeleton nearly complete, both in the Philadelphia and Baltimore museums.

Place in the geological Series. Not yet ascertained with sufficient accuracy. According to De la Beche, "Geolog. Manual," occurring not later than his "Erratic Block Group," which also includes the elephant or mammoth and five other species of Mastodon, together with the genera Hippopotamus, Rhinoceros, Tapir, Cervus, Bos, Hyena, Ursus, Megalonyx, Megatherium &c.

Mr. De la Beche remarks, p. 169:—"The relative age of the deposit in which the American Mastodons are found, cannot be considered as satisfactorily ascertained. Some geologists are of opinion that these animals

have disappeared more recently than is commonly supposed; that is, previous to the commencement of the modern group."

In most instances, there is sufficient evidence that these animals died, and left their bones to become fossilized in the precise situations in which they are now found; and that they have not been brought from a distance or exposed to the action of running waters, which proves clearly that they have been destroyed subsequently to the action of those causes which formed the beds of gravel or diluvial detritus, in and upon which they are frequently found.

Not only are the teeth and bones of this animal unworn by the action of running waters, but the skeleton is not unfrequently discovered in a standing position, just as the animal has sunk into the marsh or mud, clay and sand. Such were those from Great Osage river. Cuv. An. Foss. vol. i. p. 222., and in the skeleton noticed by Dekay and others. Ann. N. Y. Lyceum.

In some instances it would appear that the stomach itself, with its vegetable contents, has been preserved. In a letter addressed to Cuvier, by the late Professor B. S. Barton, there is an account of the discovery of the remains of a Mastodon in Withe county, Virginia, five feet and a half beneath the soil, on a bank of limestone. "But what renders this discovery peculiarly curious," continues M. Cuvier, Anim. Foss. vol. i. p. 219, "is that they collected from amidst these bones, a mass of semimasticated small branches, grasses, leaves &c., among which it was thought a species of brier, still

common in Virginia, was recognizable; the whole of this being enveloped in a kind of sack, which was regarded as the stomach of the animal, so as to leave little doubt that it consisted of the identical substances which the animal had devoured."

M. Cuvier further remarks, p. 222, "Indications of the sojourn, or passage of the sea over the remains of these animals appear to be more rare than in the case of the elephant bones; I have never seen any remains of shells or zoophites on the bones of the great Mastodon which I have examined."

During the exploration made by Lieut. Col. S. H. Long, at Big-bone-lick, in 1824, great quantities of the remains of the elk and bison, both recent and fossil, were disinterred along with the bones of the Mastodon.

From the facts and observations above detailed, together with others of a similar nature, that might be produced, we are led to the conclusion that the great Mastodon, and other similarly situated animals, must have ceased to exist, at a period much more recent than is generally supposed. There are no evidences of its existence prior to the last general cataclysm. They may even have disappeared, together with the fossil elk, or moose, of Ireland, since the creation of man, though long previous to his earliest historical records.

Much has been written of late by inexperienced individuals, containing romantic descriptions of the remains of monstrous extinct quadrupeds, disinterred in various parts of our country, and which are calculated to produce much confusion when they attract the atten-

tion of the uninitiated. Thus, in excavating the canal around the falls of Ohio, the remains of portions of several individual skeletons of the Mastodon were exhumed from the river banks, several feet beneath the surface of the present soil. Several pairs of tusks were arranged in a circle, within which were the remains of a fire and Indian tools; various other bones of the same were scattered about this focus, which had no doubt at some distant day been so arranged by the native Indians. A writer in one of the Kentucky papers presumed that all the bones were the remains of a single individual, with its immense mouth filled with enormous teeth, and armed with several pairs of huge tusks, and the whole animal of course sufficiently large to swallow a forest at a meal.

Another account of a huge animal disinterred at Big-bone-lick, 60 feet long and 25 feet high! has gone the rounds, being first published in our western papers, republished in those of the Atlantic cities, and finally transferred to those of Europe.

Of a character somewhat analogous are the descriptions of similar organic remains published by individuals supposed to possess higher claims to science, in the Trans. of the Am. Philos. Soc. vols. iii. and iv. At page 478 of the volume first referred to, there is a description of the under jaw of a young Mastodon, with a figure. This relique was found in Orange county, New York, and is now in the New York museum.

The author of these remarks took an early opportu-

nity to forward plaster casts of this jaw, to the Geological Society of London, and to the Garden of Plants at Paris; and on his recent visit to the Jardin des Plantes, he was somewhat surprised to observe that he had already been in some measure anticipated by a foreign naturalist. This museum already containing the plaster cast of a portion of the lower jaw of a Mastodon, sent from Germany to Baron Cuvier, soon after the completion of the last edition of his American Fossiles. This specimen also contained the inferior tusk, about which so much has been subsequently written on this side of the Atlantic. The circumstance, however, elicited very little attention from the French professors. Yet it is on the existence of this inferior tusk in the jaw of the young individual from Orange county, above referred to, that the author has attempted to found a new genus of fossil quadrupeds, under the name of "TETRACAULODON."

Admitting that the genus had been established on a solid basis, the name is not a proper distinction, as it is equally applicable to the camel, hog, horse, deer, hippopotamus, fossil tapir &c. all of which possess "*four tusks*," or tusks in each jaw.

It further displays inattention at least, if not ignorance of established usages among naturalists, to found a genus on the existence or absence of tusks in the lower jaw, independently of any other specific differences in the organization of other portions of the body. It is well known that the *males* of some species of animals possess tusks in one or both jaws, whilst the females of the same species are destitute of these teeth; just as

some male animals possess *horns* whose females are destitute of them.

On the first appearance of this pretended "tetracaulodon," the inferior tusks were considered by the best authorities on this subject to characterize the young of the Mastodon; a subsequent examination, however, of numerous jaw bones of the Mastodon, in our various cabinets soon demonstrated these inferior tusks, to be mere sexual peculiarities; a goodly proportion of the jaws of the adult Mastodons being found to be thus characterized, but in no one single instance were specific differences observable in the jaw teeth, maxillary bones, or any other portions of the skeletons.

Volume iv. p. 317 of the Trans. Am. Philos. Soc. contains the lucubrations of a neophite in these matters, whose laborious observations as historian of the pretended "Tetracaulodon," would lead us to believe that he had clearly elucidated this subject, and had ended the dispute in question. The author occupies twenty-three pages of this quarto volume in letter press, besides ten plates, (with numerous figures.) With a critical acumen and depth of research peculiarly his own, he has "actually discovered," from the same materials previously examined in vain by naturalists of less penetrating zeal, three new "species of Mastodon," and two or three new species of "Tetracaulodon!!"

We repeat, that with others upon whose judgment reliance is to be placed, we have repeatedly examined all the specimens of fossil bones noticed in the memoir above referred to, and have searched in vain for any

specific differences, not to speak of *generic* distinction. The jaw bones, together with the various teeth connected with them, or separately existing; display no peculiarities or varieties of structure, but such as are found to exist in similar portions of the skeletons of any other species of animal recent or fossil, provided specimens are selected from individuals of different sexes, and different ages. No peculiarities or differences, in fine, worthy of notice, not fully described by Cuvier, in his Ossemens Fossiles, where he has given seventeen figures of the teeth and jaws of this species, and which are thus noticed in vol. i. p. 226, of his last edition:—

"The differences of teeth of the '*Grand Mastodonte*,' consist principally in the number of their points, and in their length and breadth.

"I recognize three kinds of them: those nearly square, with three pairs of points.

"Rectangular, with four pairs of points. Others still longer, rather contracted posteriorly, with five pairs of points, and an odd spur.

"The first are generally found among those most used; I have observed many about half used, and several others worn down even to the neck of the tooth.

"The latter, on the contrary, are very rarely used, and are almost always, their posterior parts at least, entire.

"This circumstance at once indicates their relative position. The teeth with six points are anterior, and are the first to appear; those with eight and with ten

points come after, and are situated behind. Direct observation has confirmed this induction."

Again, at page 227: "The disposition then of the jaw teeth in the adult animal is as follows—two with six points, and two with eight points above; and two with six points, and two with ten points below.

"But besides these eight molars which remain in the adult, there are others placed anteriorly to them in young individuals, which are shed successively.

"Thus the number of *effective jaw teeth*, which can be brought into action at one time, is eight in the young animal, and four only in the old.

"The *roots* of these teeth, like those of other animals, are not formed until after the *crown* is perfected. They are found complete only in such teeth as are already somewhat used."

After reading the above quotations from Cuvier's "Ossemens Fossiles," let any one attentively examine the *specific* characters of the "new genus and species" in the memoir above referred to, and judge for himself of their validity. But for such readers as may not have it in their power conveniently to refer to the memoir in the Transactions of the American Philosophical Society, we will now quote a paragraph in the author's own words, which affords a fair specimen of his notions of *specific* characters.

"The cabinet of *our* society [Am. Philos. Soc.] contains a portion of an inferior maxillary bone, which differs in its form from any of those hitherto described. This fragment consists of the chin, the right ramus,

with the posterior molares, and a portion of the left ramus. The anterior molar has three denticules, with two points each; and a ridge posteriorly. The ramus of this jaw is *straighter* and more *cylindrical;* the *height* from the base to the edge of the alveolæ is less; the groove for the tongue *broader* and *shallower,* and the *direction* of the teeth less diverging than in the maxilla figured in plate XXIV.; the crowns of the teeth are also less elevated in the former than in the latter." *Vid.* vol. iv. Trans. Am. Philos. Soc. p. 323.

"*Height, breadth, depth, direction*"! &c.

On comparing a number of human jaws together, scarcely two will be found to correspond exactly in these particulars.

The author of "Tetracaulodon" renown appears to pay no regard to the principles of classification, yet he ought to have been aware, that, whether "labouring for bread, or doing something for fame,"* writers on natural science are not permitted to swerve from established laws.

We shall now close our observations on the remains of the *Mastodon giganteum,* by one more quotation from an authority which our author appears to esteem as conclusive in such matters; we allude to Mr. William Cooper of New York, whom our author states "has been long engaged in the investigation of the history of the Mastodon; has visited Big-bone-lick, for the purpose of obtaining materials; and who, upwards of a

* *Vid.* "Tetracaulodon" Memoir. Trans. Am. Philos. Soc. vol. iv. p. 318.

year since, communicated to the Lyceum of Natural History of New York, some observations on the dentition of that animal."*

The conclusion to which Mr. Cooper arrived after the fullest and most complete investigation of the most extensive collections of the Mastodon bones, in this country, of the famous "Tetracaulodon" inclusive, will be found in the following paragraph, and needs no comment. "The '*Tetracaulodon*' of the late justly lamented Dr. Godman, appears to me, after a careful examination of his specimen, to be another young individual, also of the common Mastodon, but older than mine; I have stated my reasons for this opinion, in a paper on the dentary system of the Mastodon, which I read to the Lyceum of Natural History, in April 1830. It appears, however, from recent observations, that the lower tusks which I supposed all the species to have possessed in their youth, were in some instances permanent during the advanced age of the animal. But whether this was a sexual characteristic, or merely an individual case of anomaly, of which I have seen other curious examples, *I cannot recognize more than one species of Mastodon among the great quantity of their remains found in the United States, which have come under my observation, those just alluded to included.*" *Vid.* "Notices of Big-bone-lick, by Wm. Cooper," Monthly Am. Journ. of Geology and Natural Science, conducted by G. W. Featherstonhaugh, vol. i. p. 158.

* Ut supra, p. 336.

Finally, in the original memoir, descriptive of this supposed new genus, the author has himself expressed doubts of the validity of the characters on which it is proffered. He admits that the specimens he has described are the remains of a *young* individual, and that, "in every view, this animal so strongly resembles the Mastodon, but for the singular difference of organization presented by the lower jaw and its tusks, *we could not avoid concluding we had obtained a young animal of that species.*" As regards this jaw itself and *molar* teeth, they certainly do resemble those of the MASTODON *giganteum*, as closely as the same parts in any young animal resemble those of the adult individual.

Note.—MASTODON *angustidens*, Cuv. and M. *tapiroides*, Cuv. Indications of the existence of these species in North America, were given in the *Fauna Americana*, pp. 212, 213. Subsequent observations have not yet further confirmed this indication.

GENUS ELEPHAS.

E. *primogenius*, Blumenbach and Cuvier.

Ossemens Fossiles, 2d edition, t. i. p. 75, pl. 2; Harlan's *Fauna Americana*, and Journal of the Philadelphia Academy of Natural Science; Mitchell's edition of Cuvier's Theory of the Earth.

Locality.—In Europe these remains abound in the northern countries, also in France, Germany and Italy. They are scattered over a vast range of country in North and South America. The frozen bodies of these animals have been found enveloped in ice on the north

west coast of America, as well as in Siberia. (*Vid.* Kotzbue's Voyages.)

Place in the Geological series. The fossil bones of the Elephant, although they are found to exist contemporaneously with those of the Mastodon, Rhinoceros, Megalonyx, Ox, Deer &c. would appear to have belonged also to a geological period more ancient than the last named animals; according to Cuvier, "the isolated bones which are met with every where, are often observed to have marine animals attached to them, which establishes, in an incontestible manner, that since their dispersion they have been covered by the ocean under which they have been buried a considerable time."

These remains are most generally discovered in the diluvial deposits which fill vallies, or on the borders of rivers.

It is probable that the immense mass of the fossil bones of the Elephant scattered throughout the world, include the remains of several species; they are generally found in a state of decay, too imperfect for specific comparisons, the only perfect skeleton of this animal known, being that in the museum of St. Petersburg, Russia. From observations that we have made on the fossil elephant teeth, several years ago, and published in vol. iii. of the Journ. Acad. Nat. Sciences of Philad. there can be little doubt but that two distinct species at least once existed in North America.

Specimens of the teeth and fragments of the skeleton of this species abound in our cabinets both public and

private; more particularly in the cabinet of the Academy of Natural Sciences of Philadelphia, of the Philosophical Society &c. &c. The Geological Society of Pennsylvania, possesses an enormous fossil *Os femoris* of this animal, found near Moorestown, New Jersey.

I have observed several specimens of elephant teeth, with the enamel arranged like that of the African elephant, which appeared to be fossilized; two of these are in the museum at Liverpool, one in my own collection; their origin is uncertain, and all such are considered as apocryphal by Baron Cuvier.

Genus Tapirus.

T. *mastodontoides*, Harlan.

Fauna Americana, page 224.

Locality. Big-bone-lick, state of Kentucky.

This fossil molar tooth displays considerable analogy to that of the "small fossil Tapir" of Cuvier, differing only in the obliquity of the transverse eminences of the crown, and in the form of the disks of these, produced by detrition; but as subsequent and more extensive observation on the Tapirs, in the museum of the "Jardin des Plantes," at Paris, has convinced us that similar differences in the form and direction of the transverse eminences are displayed in the different teeth of the same individual, we admit that little reliance is to be placed on them, when regarded as *specific* characters.

The molar teeth of the Tapirs, Kangaroo and Mana-

tus, bear considerable analogy with those of the Mastodon; they are covered in a similar manner with enamel, and furnished alike with transverse mamillary eminences in the young animal, which by detrition present disks, more or less resembling each other in the teeth of these different animals; thus, a superficial observer might readily confound our fossil tooth with that of a young Mastodon, was not its size at least one half smaller than the smallest of the milk molars of the Mastodon that have come under the observation of naturalists. Mr. Cooper has casually remarked, (*vid.* Notices of Big-big-bone-lick, Am. Monthly Journ. of Geology, p. 163, in a note,) "Among these [the molars of the Mastodon,] I include one similar to the tooth, also from Big-bone-lick, described by Dr. Harlan, as having belonged to an extinct species of Tapir. That it is a young Mastodon's tooth, is evident, I think, from the milk teeth still remaining in the head on which the supposed genus Tetracaulodon is founded, as well as from the small jaw above described."

It is difficult to conceive in what manner "the milk teeth remaining in the head" of this or that animal, could prove any thing concerning the nature of the tooth in question. Mr. C. probably means to say that he compared the tooth of my fossil Tapir with those in the jaws of young Mastodons; I also have made similar comparisons, and have carried comparisons still further. Taking the disputed tooth in question to Paris, I compared it in presence of naturalists skilled for their observation, with the teeth of the various Tapirs, pre-

served in Cuvier's collection of comparative anatomy. The tooth in question proves to have belonged to the anterior socket in the upper jaw of a Tapir. The size of the tooth and the form and structure of its roots, distinguish it from those of the Mastodon.

Place in the Geological series.—Contemporaneous with the fossil remains of the Rhinoceros, Elephant, Mastodon and other Pachydermatous quadrupeds. Hitherto the fossil Tapirs have been found only in Europe, whilst the recent species inhabit only South America and Mexico, the peninsula of Malacca and the isle of Sumatra.

Genus Equus.

E. *caballus.* The Horse.

The fossil remains of this quadruped are sparingly found both in North America and in Europe. The late Dr. S. L. Mitchell, in his edition of Cuvier's Theory of the Earth, alludes to the fossil teeth and vertebræ of the horse, found near Neversink hills, state of New Jersey.

The cabinet of the Academy of Natural Sciences, Philadelphia, also contains specimens, from the valley of the Ohio or Mississippi, and we have to acknowledgo the receipt of others from Col. I. J. Abert, of Washington, which were found in excavating for the Chesapeake and Ohio canal, near Georgetown, D. C., not far from the Potomac river.

Genus Rhinoceros.

Rhinoceroides *Alleghaniensis.*

Vid. Am. Monthly Journal of Geology &c., where under this name is figured and described a petrifaction which displays cousiderable resemblance to the bony snout of the Rhinoceros. The original specimen was sent to London, and the geologist who there examined it considered it of too doubtful a character to be admitted as a fossil remnant.

For ourselves, we are disposed to wait for further discoveries of this nature, previous to admitting the present specimen as a part of our fossil fauna. The specimen is no less singular or interesting to geologists, as demonstrating the very close analogy of a mere *lusus naturæ* of the mineral kingdom, if it be nothing else, to a portion of the animal skeleton. One argument applied to this and other similar specimens, in order to prove that it could not be considered as an organic relic, viz.—the total absence of bony material, I conceive to be by no means conclusive; it being quite possible that the skeleton of an animal might be so circumstanced as to become completely mineralized, or changed from its original structure, just as we observe some vegetable structures to have changed. In ordinary instances, we are well aware the very reverse of this, as regards bones, is the fact; even the animal matter in fossil bones would appear to be, under some circumstances, as indestructible as the rock in which they are entombed, some of which are comparatively ancient, such as the saurian bones contained in the cuperose

schists of Europe, and which were found on analysis to contain animal matter.

ORDER EDENTATA.

Genus Megatherium, Cuv.

M. *Cuvieri*, of authors.

Cuv. Ossemens Fossiles, 3d ed. vol. v. part 1st, p. 174, pl. 16; *Megatherium*, S. L. Mitchell, Ann. of the Lyc. N. York, vol. i. p. 58, pl. 6, and Wm. Cooper, ut supra, vol. i. p. 114, pl. 7, and vol. ii, p. 267; Harlan's *Fauna Americana*, p. 200. Syn. *Animal du Paraguay; Animal incognita.*

Locality. In South America, Paraguay, Lima, and in the vicinity of the river Luxan, three leagues south west of Buenos Ayres, whence was obtained the skeleton nearly entire in the Madrid museum. In 1823, remains of this fossil animal were first discovered in North America. Specimens from Skidaway island, Georgia, in the cabinet of the New York Lyceum; a detailed account of which will be found in the volume of the Ann. of the Lyc. of N. York, above referred to, by the late Dr. Mitchell, and by Wm. Cooper, Esq.

Place in the Geological series.—The entire skeleton in the Madrid museum was obtained on the borders of the river Luxan, South America, in 1789. The bank in which it occurred is only elevated about ten yards. These remains occur most commonly in the great plains of South America, particularly in the vicinity of Buenos Ayres; in that flat country, washed by the Panama and its tributaries, the bones being found sunk in the

sand of the ancient alluvion, and sometimes, during very dry seasons, when the waters are low, they appear elevated above the surface; such was the position of those fine and valuable specimens of this fossil animal, recently brought to London and presented to the Royal College of Surgeons by Woodbine Parrish, Esq. The inhabitants of a remote district, we are informed, saw the pelvis of the animal appearing above the water, and throwing the lasso drew it on shore, carried it to the authorities of Buenos Ayres, from whom Mr. Parrish obtained it, and subsequently sent some hundred miles into the country, and with great exertions in dredging and turning off the water, succeeded in obtaining the greater portion of the skeleton, including the massive scaly cloak of the animal, with which it was covered somewhat in the manner of the Chlamyphorus and armadillo, together with with the caudal vertebræ, neither of which had ever been previously found. The os femoris is more than twice the thickness of that of the elephant. The bones of the feet are more than a yard long and twelve inches wide.

As regards the position of the remains of this animal discovered in North America, we are indebted for all the information we possess on the subject, to the observations of Mr. Wm. Cooper. *Vid.* Ann. of the Lyceum of New York, vol. i. p. 124.

"My inquiries have not, as yet, enabled me to give any very precise information respecting the locality of these bones, or the character of the formation in which they were found; their appearance, however, indicate

that they have been overflowed by the sea; and they appear to have had one side imbedded in the earth or mud, while the other was washed by the salt water. They are thinly incrusted in some places with *Flustræ* and other zoophites, and have recent shells of the genus BALANUS and OSTREA adhering to them. All are remarkably hard and heavy, and of a deep black color; they do not retain any of their animal matter."

It is further stated: "These bones are still to be procured in great quantity, by some labor and expense, at the same place. Bones of the same kind may be obtained at two other places: one called *White bluff*, also on the sea coast of Georgia, the other at some distance up the Savannah river."

We have only to remark, that the relative position of the bones above referred to, as regards the waters of the ocean, appears to be due to accident, or recent exposure; the fractured surfaces of the bones still retain their angles, and in other respects display sufficient evidence that they have not been exposed to the action of running water; they apparently occupy the situation in which they were originally deposited.

GENUS MEGALONYX, Jefferson.

M. *Jeffersonii*, Harlan, Fauna Americana, p. 201.
M. *Jeffersonii*, Desm. Mammalogie, p. 336.
MEGALONYX, Jefferson,

Trans. of the Am. Philos, Soc. vol. iv., old series, p. 246, and Wistar, same vol. p. 526, pl. 1 and 2; Cuvier, Ossemens Fossiles, vol. v. part 1, p. 160, pl. 15, 3d ed.

The characters of the genus, being founded on a single molar, the only one known when Cuvier wrote his notice of this animal, will require revision.

Locality. As yet only three localities for the remains of this interesting fossil are known—all in North America, viz:—Greenbriar county, state of Virginia, Big-bone-lick, and White cave, Kentucky.

Place in the Geological series. The first notice we have of the existence of this fossil genus is due to the late Mr. Thomas Jefferson, former President of the United States of North America, who made them the subject of a memoir published in the Transactions of the Am. Philos. Soc. of Philad. vol. iv. p. 246.

Mr. Jefferson compared these fossils with similar parts of the lion, to which he considered his animal congeneric. Plaster casts of these bones were sent to Baron Cuvier, who was thus enabled to estimate them at their true value, and to arrange them as pertaining to an animal of the tardigrade family, and as allied to the Megatherium.

The bones forwarded by Mr. Jefferson to the American Philosophical Society, consist of "a small fragment of the femur, or humerus, a complete radius, a cubitus complete, broken in two, three claws, and a half dozen other bones, belonging to the foot or hand." A tooth and some other small fragment were subsequently obtained by Palisot de Beauvois, from the same cave.

Similar caverns to that in which these bones were found, exist in great numbers throughout the western part of Virginia, Kentucky, Tennessee, and other

portions of the great valley of the Mississippi river, in the cavernous limestone, which here constitutes the surface rock for hundreds of miles. Some of these caverns, such as the mammoth cave of Kentucky, are several leagues in extent, and appear to have once been the channels of subterranean rivers, a circumstance which may possibly explain the comparative rare occurrence of organic remains within them.

Nitre, or saltpetre, is not unfrequently found adhering to the surfaces, and in the soil of clay, mud, or stalagmite formed at the bottom. The cave in Greenbriar county, Virginia, in which the Megalonyx bones of Jefferson were found, is thus situated, and was formerly extensively worked for saltpetre; the bones were buried two or three feet beneath the surface of the floor of the cave; they are completely fossilized, very dense and heavy, of a white color, and are still very well preserved.

MEGALONYX *laqueatus*. HARLAN.

Journal of the Academy of Natural Sciences of Philadelphia, vol. vi. p. 269 Pl. 12, 13, 14. Also, in the American Monthly Journal of Geology and Natural Sciences, 1831 and 1832. "Description of the jaws, teeth, and clavicle of the MEGALONYX *laqueatis*." By R. HARLAN, M. D. vol. i. p. 74. Pl. 3.

Locality. "WHITE CAVE," Edmondson county, Kentucky, on the southern bank of Green river, fifty miles in a direct northern line from the Ohio river, and about half a mile from the mouth of "Mammoth Cave."

The specimens of this highly important organic re-

main are at present the property of John Price Wetherill, Esq., and have been by him liberally deposited in the Cabinet of the Academy of Natural Sciences of Philadelphia. They consist of the following portions of the skeleton, viz.: two claws of the fore feet; a radius; humerus; scapula; one rib, and several remnants of ribs, os calcis, tibia, portion of the femur; four dorsal and one lumbar vertebræ; a portion of a molar tooth; together with several epiphyses, the bones being portions of the skeleton of a young animal, all occasionally imperfect at their extremities.

Recent bones of the bison, the deer, the bear, and a metacarpal bone of the human finger, accompanied the specimens, and were stated to have occurred in the same cave with those of the Megalonyx; the latter, strictly speaking, are not fossilized; they retain a very considerable portion of their animal matter, are much more brittle and lighter than recent bones; most of the articulating surface are still covered, more or less, with cartillage, tinged of a yellow color. One of the unguial phalanges still retains the horney covering or nail, also tinged of a yellow ochreous color. These bones are stated to have been found on the surface of the floor of the cave, uncovered by earth or stalagmite. Not only the teeth, but other portions of the skeleton, were found, on comparison with similar parts of the Jefferson Megalonyx, to present differences estimated of sufficient importance to constitute distinctive specific characters.

In the same collection there are, a humerus, nearly perfect, nineteen inches long, and a metacarpal bone of an

adult animal of the same species, subsequently disinterred at Big-bone-lick; these are of a deep black color, of a dense and solid structure, like the soundest of the Mastodon bones.

Still more recently, a large collection of fossil bones obtained from Big-bone-lick, have been exhibited in the city of New York; among them were observed, the jaw, teeth, clavicle, and a tibia of the right leg of the MEGALONYX *laqueatus*, the same that are described and figured in the American Monthly Journal of Geology and Natural Science, of Philadelphia.

Place in the Geological series. Contemporaneous with the Big-bone-lick fossils, and probably also, with bones of the caverns of Germany, England, France &c.; but judging from the appearance of the Megalonyx bones from White Cave, Kentucky, they are still more recent than those of any extinct fossil species hitherto discovered, with the probable exception of the "Elk of Ireland." I have seen, in the museum of the Dublin Society of Natural History, the lower portion of the fore leg of a cervine animal, with the skin, hair, and hoof, simply dessicated, found in the peat bogs of Ireland, along with the bones of the fossil elk, of which animal it was supposed to form a part; it bears the closest analogy to the same part of the North American moose deer, (CERVUS *alces*, Linn.)

Most of the original specimens of the fossil bones of this extinct species are in the cabinet of Mr. J. P. Wetherill, deposited in the Hall of the Academy of

Natural Sciences, Philadelphia. Plaster casts have been taken, and the specimens thus multiplied, are contained in many European cabinets, among others, we have furnished the "Jardin des Plantes," Paris, and the Geological Society of London.

ORDER RUMINANTIA.

Genus Cervus.

C. *Americanus*, Harlan,

Fauna Americana, p. 245; Wistar, Trans. Am. Philos. Soc. vol. i. new series, p. 375, pl. 10, fig. 4. *Fossil Elk* of the United States of North America.

The present fossil species was first established on a mutilated skull in the cabinet of the American Philosophical Society, presented by the late President Jefferson; the species appears to be nearest related to the common elk of North America, (Cervus *Canadensis*, Briss.) although it displays several characters which distinguish it from all other species, living or fossil, hitherto introduced into the systems. Judging from the skull, the animal was larger than our common elk.

Locality. The bones of this fossil elk are not unfrequently found in the celebrated morass near the Ohio river, Big-bone-lick, in company with the bones of the Mastodon. Some fossil bones were observed by Dr. Bigsby in Canada, which from designs in his possession are judged to have belonged to the fossil Elk.

Place in the Geological series.—Such as indicated by the above mentioned locality.

Genus Bos.

B. *bombifrons*, Harlan,

Fauna Americana, p. 271; skull of a fossil Ox, Wistar, Trans. Am. Philos. Soc. vol. i. new series, p. 379, pl. xi. figs. 11 and 12.

This fossil species displays considerable analogies in such portions of the skeleton as are known, to the Bison (Bos *Americanus*,) or common Buffalo of the United States, but the form of the skull, and peculiar disposition of the horns in the fossil, distinguish it as a nondescript species.

Locality. Big-bone-lick and other similar morasses. The fossil teeth of this species are very common.

B. *latifrons*, Harlan,

Fauna Americana, p. 273; Cuv. Anim. Foss. 1st ed. vol. iv. pl. 3, fig. 3. *Broad-headed Fossil Ox.*

This specimen, a mutilated skull of large dimensions, is in the cabinet of the Am. Philos. Soc. Philad. It resembles in many respects the skull of the *Auroch*, (Bos *urus*, Cuv.) The horn is twenty-eight inches in circumference at its base.

Locality. State of Kentucky. According to Cuvier, similar fossil skulls have been found in Europe, on the borders of the Rhine, near to Cracovie in Bohemia &c.

B. *pallasii*, Dekay,

Ann. of the Lyc. of Nat. Hist. N. York, vol. ii. p. 280, pl. 6.

Among a large collection of fossils presented to the Lyc. of Nat. Hist. of N. York, by the late Dr. Mitchell, is a bovine skull, which Dr. Dekay has minutely described as above referred to, and compares it with the skull of the Bos *moschatus*, which it most nearly resembles.

Similar fossils have been occasionally found in Siberia, which it is supposed were probably carried there in ice from the American continent. *Vid.* Cuv. Anim. Foss. vol. iv. pl. 3, fig. 9 and 10; also, Ozeretskovsky, Memoirs of the Royal Academy of St. Petersburg, 1809–10.

Locality. "New Madrid, on the banks of the Mississippi river, ejected by the earthquake of 1812."

ORDER CARNASSIERS, Cuv.

Genus Trichecus, Lin. The Walrus.

T. *rosmarus*, Lin.,

Cuv. Recherches sur les Ossemens Fossiles, tom. v. Cooper, Ann. Lyc. Nat. Hist. of N. York, vol. ii. p. 271.

Only slight indications of the existence of a fossil Morse or Walrus have been hitherto observed in any country; a few molar teeth, and some fragments of bone found in France, have been referred to this species. In the work above alluded to, Mr. Cooper has given a lucid account of a mutilated fossil skull in the cabinet of the

Lyceum, which, without doubt, belonged to the Walrus; the skull is remarkably hard and heavy—the tusks having become almost agatized. On comparison with similar portions of the T. *rosmarus*, of Linn., it displayed strong specific affinity.

Locality. Accomac county, Virginia.

Place in the Geological series. Atlantic tertiary? along with the fossil bones of Cetacea.

Capt. Beechy brought home with him from the north west coast of America the fossil vertebræ of an unknown extinct mammalia; on comparing the fossil casts of these vertebræ with the amphibious tribe of Carnassiers in the museum of the Garden of Plants, the fossil appeared referrible to one of this family.

ORDER CETACEA.

Genus Manatus.

The fossil ribs and vertebræ of a large species of Manatus, are contained in the cabinet of the Academy of Natural Sciences of Philad. *Vid.* Journ. Acad. Nat. Sciences of Philad. vol. iv. p. 32, "Notice of Plesiosaurus &c. by R. Harlan, M. D.

Locality. Eastern coast of the United States, Atlantic Tertiary, Georgia, New Jersey, western shore of Maryland &c.

The cabinets of the Academy of Natural Sciences of Philadelphia and the Lyceum of Nat. Hist. of N. York contain ribs and vertebræ &c. of fossil whales, or

CETACEA *proper*.

Such remains are by no means of rare occurrence in the Atlantic tertiary.

In the estuary of the Mississippi river, numerous remains of recent Whales are daily discovered, the bones being observed projecting from the mud. The skull, jaws and teeth, of a very large spermaceti whale was thus obtained by the fishermen some few years since, and carried to New Orleans, where they were palmed on the public as the fossil remains of some enormous nondescript monster. Numerous theories and ingenious speculations arose on the subject, and were gazetted from one end of our country to the other. The bones were purchased at considerable expense, and exhibited through the United States. The late Dr. Godman produced a memoir on the occasion, and announced to the American Philosophical Society "the discovery of the remains of the largest '*saurian* fossil' ever heard of," and proposed to designate it by the name "MEGISTOSAURUS," which stands at the present day registered on the minutes of the society. The animal was represented as possessing a long horn several feet in length, projecting from the side of its head. The fame of this wonderful monster found its way even into the European newspapers—when lo! and behold! on the first examination of these remains by a naturalist, they were immediately perceived to form a portion of the skeleton of an immense recent spermaceti whale; the pretended horn being nothing more than one of the intermaxillary

bones sawed off, and fitted on the jugal bone of the right side.

Thus the remains at last met with an honorable burial, on the eve of departure for England, where they would no doubt have astonished the natives, both as to the gigantic fossil productions of the new world, and as specimens of the critical acumen of our scientific observers.

The articulating surface plates, or epiphyses of the vertebræ of whales, are not unfrequently found separate, both fossil and recent; they have occasionally given rise to false notions, and to the dissemination of error. The "New Fossil Genus" of Raffinesque, named "*Nephrosteon*," (*Vid.* Atlantic Journal,) and the bone on which the genus is constructed, and which this author considers as a portion of the head-plate of a fossil saurian, has no other foundation than one of these epiphyses from the remains of a recent spermaceti whale.

CLASS AVES.

The fossil remains of birds are of rare occurrence in any country, but particularly so in America; only one specimen clearly ascertained has fallen under our immediate inspection. This consisted in a femur, imperfect at its upper extremity, of an individual allied to the genus *Scolopax*, obtained by the late S. W. Conrad. The bone appears to be perfectly mineralized. Cab. of the Acad. Nat. Sciences, Philad.

Locality, from a "marl-pit" in New Jersey.

CLASS REPTILIA.

ORDER CHELONIA.

Fossil bones and breast-plates of turtles are not unfrequently discovered in the Jersey "marl-pits," but are too imperfect to admit of any satisfactory arrangement into genera or species; they occur principally in the Atlantic secondary. Specimens preserved in the Cab. of A. N. S. and Lyc. Nat. Hist. N. York.

ORDER SAURIA.

Genus Crocodilus. Cuv.,

C. *macrorhyncus*. Harlan,

Journ. of the Acad. of Nat. Sciences, Philada. Vol. iv. p. 15, pl. i.

Several fine specimens of the jaw, teeth, vertebræ &c. of an extinct fossil species of crocodile from the New Jersey marl-pits,* are contained in the Cab. of Ac. Nat. Sciences; the most perfect of these is described and figured as above referred to. It consists of the dental bone of the right side, in a good state of preservation, perfectly fossilized, or impregnated with iron, so abundant in the marl-pits of New Jersey; it contains the sockets of eleven teeth in a space of twelve inches.

The most striking peculiarity of this remnant is its great thickness in proportion to its length, compared with the same part in recent crocodiles, with which circumstance the structure and appearance of the teeth

* Marl-pits occur both in the secondary and tertiary of the Atlantic coast.

perfectly correspond, being exceedingly thick, short, and blunt. Length of one these teeth, two inches, diameter at base one inch; only one-half an inch projecting beyond the alveole.

We have seen a portion of the jaw of a very distinct species of fossil crocodile, in possession of Dr. J. E. Dekay, who is about to describe it in the Annals of the Lyceum of Natural History; this fossil is also from the Atlantic secondary in New Jersey; it displays considerable analogy with the CROCODILUS *gangeticus* of Cuvier.

GENUS PLESIOSAURUS, of Coneybeare.

The fossil vertebræ of a Plesiosaurien reptile, from the New Jersey "marl," is contained in the Cab. of Ac. Nat. Sciences, which we have described in the Journal of the Academy, vol. iv. p. 232, pl. xiv. Although the general character of this vertebra associates it with the plesiosaurus, yet the comparative great length of the axis of the bone will distinguish it from any species of that genus hitherto noticed.

GENUS BASILOSAURUS, HARLAN.

A name we have used to distinguish the remains of of an immense fossil saurian recently discovered on the banks of the Washita, or "Ouachita," river, state of Louisiana, and described in the Trans. Am. Philos. Soc. vol. iv. new series, p. 297 pl. xx. 1834.

The principal fossil which forms the subject of this

paper, consists of a vertebra of enormous dimensions, possessing characters which enable us to refer it to an extinct genus of the order "Enalio Sauri" of Conybeare. The animal of which the present remnant constituted a portion, existed in a period more recent than that of any of its congeners hitherto discovered.

On comparison of this vertebra with those of its congeners, it appears to be generically distinct from them all, but bears a closer approximation to the Plesiosaurien vertebræ than to any other. The length of the axis of the bone is twice its diameter, being fourteen inches long and seven inches broad. Its sides are slightly concave in the middle, and the weight of the vertebra is forty-four pounds: allowing the individual to possess as many vertebræ as the Plesiosaurus, that is to say sixty-six, independent of those of the tail, the weight of the whole fossil skeleton may be fairly estimated as exceeding two tons; even supposing each vertebra to weigh only thirty pounds instead of forty-four, and calculating the weight of the extremities, pelvis, and tail, to be collectively but a little heavier than the spine alone.

Judging from the position and descending obliquity of the transverse apophyses, and the small size of the canal for the spinal marrow, this vertebra must be referred to the posterior part of the column, and most probably to the lumber region: this opinion is strengthened by the coalition of the two foramina or fossæ, which characterize the *inferior* aspect of the vertebræ of the *posterior* part of the column in the spiral bones

of the *Plesiosaurus*, in which respect these portions of the two fossils closely resemble each other; they are also similar in the form of the *planes* of the articulating surfaces of the bodies of the vertebræ. But our fossil differs totally from the same portion of the Plesiosaurus in its *proportions*, the vertebræ of the latter being broader than long. All the superior apophyses of the Plesiosaurus are attached by suture to their bodies, but there are no marks of such a structure in our fossil.

Judging from relative proportions, the Megalosaurus did not attain to more than thirty or forty feet in length; the Iguanodon of Mr. Mantell did not exceed sixty feet; but the individual now indicated could not have been less than from eighty to a hundred feet. According to the statement of Judge Bry, to whom the society is indebted for the specimens, there were four hundred feet in extent, nearly in a curvilinear direction, marked by these fossils in the soil, which we must presume included the remains of several individuals. If future discoveries of remaining portions of this skeleton, should confirm the indications above pointed out, we may suppose the genus to which it belonged will take the name, not inappropriately, of *Basilosaurus*.

Locality. Banks of the Washita, Louisiana.

Place in the Geological series.—Atlantic tertiary. The piece of "sea-marl" which accompanied the specimen, is a conglomerate mass of small marine shells, principally of an extinct species of *Corbula*, similar to those observed in the same formation in Alabama. Most of these shells are comminuted; a few, however, re-

main perfect. On the upper surface of the mass, there remains a stratum of clay half an inch in thickness, inclosing pieces of chrystallized carbonate of lime.

Genus Ichthyosaurus, Conybeare.

I. *Missouriensis,* Harlan, ut supra, p. 405.

The fossil fragments which indicate the existence of the above named species, consist of the anterior portions of the upper and lower jaws. The form and structure of these fragments, as well as of the portions of teeth remaining in the sockets, bear a close analogy to those of the Ichthyosaurus, but the extreme length and breadth of the intermaxillary bone, which projects beyond the extremities of the superior maxillaries, will distinguish it from all other species of this genus hitherto described.

The portions of maxillary bones attached contain three teeth on each side, all equally broken off at the sockets; the intermaxillary bone contains four teeth, two on each side, also broken; thus displaying in all ten teeth, in a space of alveolar processes four inches long, the length of the fragment. The mode of growth and reproduction of the teeth is well displayed in the fractured portions which remain; the animal is allied to the Ichthyosaurus in these particulars. For further minutiæ we must refer to the volume above quoted.

Locality. In the vicinity of the Yellow-stone and Missouri rivers. Missouri territory.

Place in the Geological series.—Secondary limestone of the sub-cretaceous group.

We are indebted to Major N. A. Ware for the specimens, who obtained them at St. Louis, from a fur trader or trapper, who, "on his return home from the Rocky mountains observed in a rock the skeleton of an alligator animal, about seventy feet in length; he broke off the point of the jaw as it projected. He said that the head part appeared about three or four feet long."*

Genus Mosasaurus, Conybeare.

Maestricht *monitor*, Cuv.

Ossemens Fossiles, vol. v. part 2, ed. 3d. p. 310; Harlan, Journ. Acad. Nat. Sciences of Philad. vol. iv. pl. xiv.; Silliman's Journal, vol. xvii.; Dekay, Ann. of the Lyc. of New York, vol. iii. pl. xiii. p. 134.

Locality. From a "marl pit" near Woodbury, Monmouth county, New Jersey.

Specimens of the teeth, and probably of the femur, in the cabinet of the Academy of Natural Sciences, and the jaw teeth in the cabinet of the Lyc. Nat. Hist. N. York.

These remains are completely fossilized and impregnated with iron, dense and heavy, and of a deep dark color. The teeth of the second series, whilst they yet remain the sockets, are serrated on the edges.

* Baron Braunsberg Maximillian Prince de Wied, during his recent visit to Philadelphia, on his return from the Rocky mountains, informed me that he had obtained the fossil skeleton of a saurian animal, fifteen feet in length, from the "great bend" of the Missouri river, which on comparison of its characters with those of the animal above noticed, he thinks belongs to the same species.

Place in the Geological series.—Atlantic secondary, of New Jersey.

Genus Geosaurus. Cuv.

Lacerta *gigantea.* Soemerring.
G. *Mitchilli.* Dekay.

Ann. of the Lyc. Nat. Hist. of New York, vol. iii. p. 138, pl. iii. fig. 3, 4.

Dr. Dekay has established the existence of this genus in the United States, upon a fossil tooth, with a small portion of jaw attached.

"From various considerations we should be disposed to place this tooth among the most anterior of the lower jaw. Its elevated position on its osseous support, places it in the group composed of Mosasaurus and Geosaurus, while its compressed shape removes it from the former. The tooth now described agrees with those of the Geosaurus in shape, attachment, and mode of dentition."

Judging from the size of the tooth, the American species must have been of much larger dimensions than the European, or Monheim species. (G. *Soemerringi,* Dekay.)

Locality. Monmouth, New Jersey.

Place in the Geological series. New Jersey secondary.

Genus Saurocephalus, Harlan,

S. *lanciformis*, Harlan,

Journ. Acad. Nat. Sciences of Philad. vol. iii. p. 331, pl. xii. 1824.

This new fossil genus was originally established on the dental bone and teeth, discovered in 1804, by Lewis & Clark, in their "Expedition to Columbia river," by whom it was presented, on their return, to the American Philosophical Society, in whose cabinet it remained unknown and neglected, until about ten years since we published our description and figure in the work as above referred to.

Place in the Geological series.—Secondary limestone? Missouri, (subcretaceous group.)

This fossil genus has been further confirmed by the subsequent discovery by Mr. Lea of a distinct species of the same genus, in a "marl pit" of New Jersey, which was imperfectly described by Dr. Hays, as the

Saurocephalus *Leanus*,

Trans. of the Am. Philos. Soc. new series, vol. iii. p. 471, pl. 16, 1830.

Locality. In a "marl pit" near Moorestown, New Jersey.

Place in the Geological series.—Atlantic secondary, New Jersey.

Very soon after the memoir on the last named species was presented to the American Philosophical Society, we took occasion to read the following observations be-

fore that learned body, which are now offered for the first time for publication.

Note on a paper entitled "Description of a fragment of a head of a new fossil animal, discovered in a marl-pit, near Moorestown, New Jersey."

This fossil relic, in the possession of Mr. Lea, is interesting, not only on account of its geological locality, but also as it serves further to establish a new fossil genus, the *Saurocephalus*, described by the author of these remarks, in the Journal of the Academy of Natural Sciences, Philada. vol. iii. part 2d, p. 331, 1824. Both these relics evidently belonged to animals allied to the genus *Ichthyosaurus*, of Conybeare; but which approach, in their organization, more nearly to the fish than to the lizard. The specimen described by Dr. Hays, in the Transactions of the American Philosophical Society, possesses the following characters in common with the SAUROCEPHALUS *lanciformis:* the bodies of the teeth are in close contact throughout, the nerves and vessels of the teeth passing on the inner side of the alveolar processes. The inferior series of teeth entering the cavities of the superior directly in the centre, in the process of shedding; the inferior series are completed before they enter the superior, the dental serrature of the superior and inferior jaws closing like incisors. In both also, there exists a longitudinal groove along the mesial aspect of the jaw bone, directly below the alveolar margins, though this groove is not so evident in the S. *Leanus;* but it must be remarked that this species

was not more than one-half the size of the S. *lanciformis.*

In all these particulars of organization, both species differ from the Ichthyosaurus and Plesiosaurus, and from the Saurian order in general.

The S. *Leanus,* we find, on comparison, to be characterized as a distinct species from the S. *lanciformis,* by the greater acuteness of the teeth, by their greater *comparative* length, but particularly by their curvature; they are also slightly compressed at their inner face.

In both descriptions of these different specimens, it is stated that "the bodies of the teeth are placed close together;" which would seem to imply that there exists no "separate and distinct alveoli." But as the author of the paper on the S. *lanciformis* was not privileged to dissect the relic, he may have been mistaken in this point, a question which he is willing to cede as one of little importance in the present instance, as the statement was only made to convey an idea of the close approximation of the bodies of the teeth.

Dr. Hays would appear to entertain different opinions on this point, and although he states that distinct alveoli do exist in both specimens, yet has made a new genus for his animal under the name "SAURODON," which he subsequently altered to "SAUROCEPHALUS," and thus appropriated to himself the labors of another without acknowledgment, and dedicates the species to his friend Mr. Lea, in the first place in the feminine gender at page 476, "S. *Leaæ;*" but is notified of this amphibious

compliment, whilst the paper is still in press, in time to re-christen the bantling, which finally at page 477, figures as the S. *Leanus!* On the most critical examination the animals will be found to agree *generically* in every point of the least importance. The *reasoning* in the following paragraph of Dr. Hays' description, we are unable to comprehend. "The *most important generic character* which was supposed to distinguish this animal from the one we described, [viz.: the absence of distinct and *separate* alveoli,] having no existence, it appears proper, in the present state of our knowledge, to place the two species in the same genus; and as the *genus Saurocephalus is founded on erroneous characters,* and will not admit our species, it becomes necessary to construct a new genus, which we shall accordingly do, and shall retain for it the name '*Saurodon*'"!

Nothing can be more incorrect than the statements here made, or more preposterous than the deductions drawn from them. In the account of the SAUROCEPHALUS *lanciformis,* in the Journ. of Acad. of Nat. Sciences, p. 336, vol. iii., are the following paragraphs in direct opposition to the above gratuitous assertions:

"The row of teeth on the inferior, appear to have passed within those of the superior jaw; this supposition is further strengthened by the worn appearance of the sides of the teeth. This arrangement of teeth, which would require a peculiar configuration of the jaw, together with the peculiar distribution of the max-

illary nerve, appears to entitle this animal to rank as a new genus."

The distinct and separate alveoli, are not even alluded to in the characters of the genus *Saurocephalus*, which are thus designated in the account published several years ago,

"SAUROCEPHALUS *lanciformis*.

"*Generic characters*.—Bodies of the teeth approximated; those of the inferior and superior jaws closing like incisors. Inferior maxillary nerve passing along a groove on the mesial aspect of the dental bone." If it should be hereafter ascertained that the groove for the nerve does not exist in all the species which may be discovered, it will only be requisite to strike out the words "*a groove on*," to make the generic characters as originally established on a single fragment of jaw, apply correctly to all.

In the present state of our investigations the following are the *specific* characters which distinguish the *species* already ascertained:

S. *lanciformis*. Projecting portions of the teeth smooth and obtusely lanciform.

S. *Leanus*. Teeth rather acute, slender, slightly compressed and aduncate.

COPROLITES.

These curious organic fossils, so classically described by Dr. Buckland, and which occur so plentifully in the

Lias of England, are occasionally met with in the New Jersey secondary.

A specimen of the *Saurocopros* genus is described and figured by Dr. Dekay, Ann. of the Lyc. Nat. Hist. N. York, vol. iii. p. 140, pl. iii. fig. 6.

We have only further to observe concerning the fossil Sauria of the United States, that we possess a curious fossil tooth from South Carolina, presented by Dr. S. Blanding, whose root displays a mode of articulation peculiarly its own, and which may be hereafter found to indicate the type of a new fossil genus of animals. The same may be inferred from numerous fossil vertebræ from the New Jersey secondary formations in my possession, which differ in their structure from any others hitherto described. We have seen in possession of Dr. Dekay, the inferior jaw bone of a nondescript fossil animal found in New Jersey, which bears some analogy with a jaw bone figured in Mr. Mantell's "Geology of the South East of England," p. 153, under the name of "Jaw of a Reptile." My friend Dr. Pickering refers this fossil to the jaw of a fish of the genus SPHYRÆNA, Bl.

CLASS PISCES.

ICHTHYOLITES.

The fossil remains of fish are by no means of rare occurrence in many parts of the United States, but the observations of our men of science on this subject are not yet sufficiently numerous, or so completely digested, as to enable us to give a scientific classification of them.

The largest and most noted of the fossil fish of this country belong to the division,

CHONDROPTERYGIA,
Or Cartilaginous Fishes.

The bones of one species of shark, upwards of forty feet in length, allied to the Carcharias, have occasionally been found in several localities. In Cuvier's "Theory of the Earth, by S. L. Mitchell," p. 400, it is stated:—"The skeleton of a huge animal was found on the bank of the Meherrin river, near Murfreesborough, N. C. It was dug out of a hill, distant sixty miles from the ocean. Capt. Neville, and Dr. Fowler, who visited the spot, gathered the scattered vertebræ which the negroes had thrown out, and laid them in a row thirty-six feet in length. If to this the head and tail be added, the animal must have been fifty feet or more in length. The former of these gentlemen enriched my collection with two of the teeth and a joint of the neck bone: the teeth weigh sixteen ounces each; they are covered with an ash-colored enamel, except at the roots where they were fastened to the jaws; the sides of the triangles are six inches long, and the base is four inches and a half across. The single vertebra weighed twelve pounds and a half." These fossils are at present in the cabinet of the Lyceum of Nat. Hist. in New York. We have recognized them as the remains of a gigantic species of shark. The proteiform varieties presented by the teeth of the individual sharks, render it almost im-

possible to classify the species from these organs, viewed separately, those of the upper and lower jaw being in most instances entirely different in form. The cabinet of the Academy of Natural Sciences, however, contains specimens of sharks' teeth from New Jersey "marl pits," which resemble closely those of the SQUALUS *zygena*, S. *mustelus*, S. *squatina* and S. *carcharias*, two specimens of the last measuring five inches in length and four broad at base. Provided the same proportion exists between the fossil and recent *Carcharias*, the former must have been more than forty feet in length. Parkinson's Organic Remains, vol. iii., contains good figures of the teeth of most of the above named species; also, Mantell's Geology of the South East of England, p. 132. For further observations on the fossil remains of sharks, *vid.* "Journ. Acad. Nat. Science of Philad." vol. iv. p. 232, pl. xiv., in an essay published by the author, entitled "Notice of the Plesiosaurus, and *other fossil reliquiæ*, from the state of New Jersey, 1824."

Professor Hitchcock, in his "Report of the Geology &c. of Massachusetts," p. 193, pl. xi. and xii. has given figures of fossil teeth and vertebræ, found in what he terms the plastic clay formation at Gay-head, Martha's Vineyard; the former are evidently the remains of sharks, similar to those found in the green sand of New Jersey, the latter are either not well figured, or resemble but indifferently the vertebræ of sharks; but possibly the statement of the author, that "in general they (the bones) are much broken and often rolled," will explain their anomalous forms.

In addition to the genus Squalus, the isolated fragments of other cartilaginous fishes, as the Raia and Acipenser, are occasionally found in similar localities as the former.

Fishes *proper*.

The fossil bones of fishes hitherto discovered in the United States, belong principally to Cuvier's second division, or

Malacopterygia,

Including among others the carp and the gar. On the 24th of January 1825, the author of these remarks had the pleasure to be present at the reading of an essay by Dr. Dekay, before the New York Lyceum of Nat. History, on the "Fossil fish of the U. States;" this essay we believe has never yet been published, but we were impressed at the time by the following statement of Dr. Dekay: "All the fossil fish which I have examined in the United States, are modelled after the *Esox osseus*, or bony-scaled pike of the Mississippi" which last species then, he thinks may stand, "as the representative of a former creation,—the Logans of their race." This curious fact was subsequently confirmed by the observations of Baron Cuvier—vid. "Ossemens Fossiles."

ORDER ACANTHOPTERYGIA.

Genus Sphyræna.—Bl.

The fossil jaw from the N. Jersey secondary referred to above, as in possession of Dr. Dekay, who has not yet published a description of it.

Many years ago we received from Mr. A. Jessup, a fine collection of fossil fishes in the slate from Westfield, Connecticut.

Connected with the fossil fish of this locality, Prof. Hitchcock in his recent work, "Report on the Geology &c. of Massachusetts" has given a very interesting chapter—we quote his observations for the benefit of our foreign readers, who may not conveniently refer to the original. "The remains of fish have been found on bituminous shale, and on bituminous marlite, in Middletown, Con., at Sunderland, Mass., and also in West Springfield and Deerfield. Sunderland, however is the only spot where they can now be procured. The shale there forms the bank of the river several feet high: but the Ichthyolites are most abundant in the lower part of the bed, which corresponds nearly with low water mark. I have dug out hundreds of specimens at this spot, though perfect ones are very rarely to be obtained.

"On one layer of the rock, fifteen inches by three feet, seven distinct impressions are visible. Indeed I have not unfrequently met with one fish lying across

another, without the intervention of a layer of shale, and from these specimens, I can easily conceive how the mistake should have been made, that among the Monte Bolca ichthyolites, one fish was found in the act of swallowing the other.

"A thin layer of carbonaceous matter usually marks out the spot where the fish lay, except the head, whose outlines are rendered visible only by irregular ridges and furrows. In some cases, however, satin spar forms a thin layer over the carbonaceous matter, and being of a bright gray color, it gives to the specimens an aspect extremely like that of fish just taken out of the water.

"We sometimes find the specimens a good deal mutilated; so much so indeed, that the form of the fish is entirely lost, and the tail and fins are scattered about promiscuously; and this too in the vicinity of other specimens that are entire. Hence we cannot impute this mutilation, as is usually done, to a disturbing force acting on the rock at the time in which the fish was enveloped, or afterwards. But if we suppose that the fish, as they died, were gradually enveloped by mud, it is easy to conceive how some of them might have putrified and fallen to pieces, before they were buried deep enough to be preserved; or it might be, that most of the fish was devoured by some other animal: and in either of these ways, we might expect to find only scattered relics enveloped in the rock. The great resemblance of these ichthyolites to those found on the bituminous slate of Mansfield, in Germany, has

been already noticed. Probably all of them belong to the genus *Palæothrissum,* (Blainsville.) I am inclined to believe that I have found four species." *Vid.* p. 236, pl. xiv., fig. 44, 45, 46. 48.

As is generally the case, the fish appear to have lain on their sides when enveloped in the rock.

There are doubtless numerous localities of fossil fish in our widely extended country, which have not yet met the eye of a scientific naturalist. An intelligent friend has recently furnished us with a notice of a very interesting locality of this nature; he is the proprietor of a marble quarry situate in "Oval Limestone Valley," or "Nipnose Valley," on the west branch of the Susquehanna river, Pennsylvania. The marble is a greenish colored conglomerate, somewhat resembling verd antique, and admits of a high polish, being fine grained and hard, interspersed with softer spots of an argillaceous nature. Some parts of this marble are represented as being replete with the remains of fossil fish, about the size of a herring or carp; some specimens retaining the impressions of the scales; others only of the bones. The stone was too brittle to permit the obtaining of any of the specimens whole.

CLASS CRUSTACEA.

ORDER DECAPODA. Cuv.

Genus Cancer. Linn.

The Atlantic secondary formation, particularly of New Jersey, is the richest locality for these kind of fossils.

Dr. Van Rensselaer has described and figured several specimens of cancer from the above named locality, in the Ann. of the Lyc. Nat. Hist. of N. York, vol. i. p. 195, pl. xiv. The cabinet of the Lyceum, and of the Academy of Natural Sciences of Philadelphia, contain various specimens. In most cases they are said to bear considerable analogy with the genus Pagurus, of modern authors.

Locality. New Jersey, Chesapeake and Delaware canal &c.

Place in the Geological series. Cretaceous group. "Ferruginous conglomerate sand" of New Jersey, which Dr. V. refers to the tertiary, others to the secondary formations of the Atlantic.

In the cabinet of the Academy of Natural Sciences, Philadelphia, there is a fossil specimen of the genus Astacus, from the deep cut of the Chesapeake and Delaware canal; and also, a slab of carboniferous limestone filled with impressions of a crustaceous animal, about the size of a pea; the specimen is labelled "Cancer.

Linn." They resemble as much the trilobite as cancer, perhaps they will prove to be an intermediate genus.

Locality. Little Falls, New York.

ORDER BRANCHIOPODA.

Genus Eurypterus. Dekay.

E. *remipes.* J. E. Dekay,

Annals of the Lyceum of Nat. Hist. vol. i. p. 375. pl. 29.

Character of the genus. "Caput a thorace non distinctum: os ignotum: oculi duo, sessiles, distantes, lunati: abdomen elongatum, posticam versus extremitatem sensim gracilius, segmentis transversis subimbricatis divisum. Pedes octo; duo utrinque antici branchiferi, duo utrinque postici maximi, omnes lamellosi."

Description. "Head roundish, marked anteriorly by a deep indented line formed by the junction of the superior and inferior plates. *Eyes* distinctly lunated, much depressed, and marked by concentric striæ; *feet* four pair; the two anterior composed of four or more nearly equal articulations, of which the terminal one is the smallest and bluntly pointed, furnishedwith filaments, which from their size &c. are supposed to be branchiæ; the third pair are rather longer than the two preceding, and entirely destitute of filaments. The fourth or posterior pair are placed near the junction of the head with the abdomen, and are larger in proportion to the body than in any living genus of Crustacea. As nearly as can be determined from the faint and broken impres-

sions of the upper part of these rotatory feet, five articulations are visible, of which the second is furnished on its anterior edge with two slight spines, and the last terminates in an oval plate, as in the genus Portunus. The abdomen consists of eleven distinct articulations tapering gradually to the tail, a small part of which only remains. The abdomen presents no trace of a division into longitudinal lobes."

Dr. Dekay has indicated the genera *Apus*, *Binoculus* and *Lepidurus*, as most nearly allied to his new genus.

The highly interesting specimen which forms the subject of the above notice, is at present in the cabinet of the Lyceum of Nat. Hist. of N. York; it was originally described in the American Monthly Magazine, vol. iii. p. 291, by the late Dr. Mitchell, who considered it a fossil fish of the genus *Silurus*.

Locality. Westmoreland, Oneida county, New York.

Place in the Geological series.—There is some doubt as to the precise nature of the rock in which this fossil occurs; in the memoir above noticed it is stated:—"The rock containing the impression, is called by the country people bastard limestone, and has been described under many different names: it is said to be clay-slate, by Dr. Mitchell; graywacke slate, calciferous sand rock, transition sand rock &c., by others. It is of a bluish color, with a conchoidal fracture, homogenous appearance and earthy smell; it effervesces slightly with acids, contains a few sileceous particles, and gives fire with steel."

EURYPTERUS *lacustris*, Harlan.

By this name we intend to designate a well marked fossil species of this genus from the shore of Lake Erie, Penna. The specimen is preserved in the Museum at Buffalo, N. York, where we had an opportunity of inspecting it, and of making a drawing, in the autumn of 1829.

The following are the comparative dimensions of the two species.

E. *lucustris*			E. *remipes*	
Total Length,	5	inches	$3\frac{3}{4}$	inches
Length of the head	$1\frac{1}{4}$	"	1	"
Breadth	$2\frac{1}{4}$	"	$1\frac{1}{2}$	"
Breadth of the body	$2\frac{5}{8}$	"	$1\frac{5}{8}$	"
Distance between eyes	1	"	$0\frac{3}{8}$	"

but other differences exist beside those of size and proportions. The transverse bands or joints are proportionably wider in the *lacustris*, consequently there are fewer of them in a given space. These bands are nearly equal in the *remipes*, those of the former on the contrary are broadest above, and narrower near the tail—the first plate, nearest the head being double the size of the others. The tail in the *remipes* was wanting in the specimen—a faint outline of this member existed in our specimen, in which it appears to have been depressed and expanded, but contracted above where it unites with the body.

Some portions of the present species are more perfectly preserved than in the remipes, from which it appears that all the feet consist of five articulations, of

which the terminals of the three first feet are filamentous; by reference to fig 2. pl. v. it seems not improbable that these filaments exist on the under surface of some of the other articulations, an appearance of which is observed on one of the left extremities.

A comparative view will display other distinctive characters. *Vid.* pl. v. fig. i.; E. *remipes*, fig. ii.; E. *lacustris*.

Locality. Williamsville, seven miles below Buffalo.

Place in the Geological series. Grauwacke slate?

For the following list of the genera of North American Trilobites, and synopsis of the species, the author acknowledges himself indebted to the politeness of Dr. Green, who has presented to geologists the very best monograph on this subject, accompanied with beautiful plaster casts of each species.

Admitting the composition of the Grauwacke series of rocks to be the same as that proposed by De la Beche, all the crustaceous organic remains belong to this group. The following list includes all the species of Trilobites discovered in this country.

Genus Calymene, Brongniart.

C. *Blumenbachii*, Al. Brong.

Localities. Lebanon, Ohio; Trenton Falls, New York; near Reading, Pennsylvania, and many other places. No Trilobite is so extensively diffused over the United States, as the C. *Blumenbachii*. See Green's

Monograph, Eaton's Geology, p. 31, Monthly American Journal of Geology, p. 558.

C. *callicephala*, Green.

Locality. Near Cincinnati, Ohio. Green's Monog. p. 30, Monthly Am. Journ. Geol. vol. i. p. 558.

C. *selenecephala*, Green.

Locality. New York. Green's Monograph, p. 32; Monthly American Journal of Geology, p. 558.

C. *Platys*, Green.

Locality. Helderberg mountains, near Albany, New York. Green's Monog. p. 32; American Journal of Geology, p. 558.

C. *microps*, Green.

Locality. Near Ripley, Ohio. Green's Monog. p. 34; American Journal of Geology, p. 558.

C. *anchiops*, Green.
C. *macrophthalma*, Bron.

Locality. Ulster county, New York. Green's Monograph, pp. 35, 36, 37; Monthly American Journal of Geology, p. 558.

C. *Diops*, Green.

Locality. State of Ohio. Green's Monograph, pp. 37, 38, fig. 2; Monthly American Journal of Geology, p. 559, pl. xiv. fig. 2.

C. *macrophthalma*, Brongniart.

Locality. Berkley, Virginia. Green's Monograph, pp. 39, 40, 41; Monthly Journal of Geology, p. 559.

C. *Bufo*, Green.
C. *macrophthalma*, Brongniart.
C. *rana*, Green, variety of Bufo.

Localities. New Jersey, at Patterson; very extensively diffused in the slaty limestone throughout the United States. See Green's Monog. p. 41; Monthly American Journal of Geology, p. 559.

C. *odontocephala*, Green.

Locality. New York, Ulster county? Silliman's Journal, vol. xxv. p. 334.

Genus Asaphus, Brongniart.

A. *laticostatus*, Green.

Locality. Ulster county, state of New York. See Green's Monograph, p. 45; Monthly American Journal, p. 559.

A. *selenurus*, Eaton.

Localities. Glen's Falls and Buroft's Mountain, state of New York. See Geological Text Book, p. 31; Green's Monograph, p. 46.

A. *Limulurus*, Green.

Locality. Lockport, New York. Green's Monograph, p. 48; Monthly American Journal, p. 559.

A. *caudatus*, Briinnich.

Localities. Ripley, Ohio; Banks of Lake Superior. Green's Monograph, p. 50; Monthly American Journal, p. 59; Geological Text Book, p. 31.

A. *Hansmanni*, Brong.

Localities. Helderberg, New York; Shore of Lake Erie. Geological Text Book, p. 11; Green's Monograph, p. 52.

A. *pleuroptyx*, Green.

Localities. Helderberg and Genessee rivers, New York. Green's Monograph, p. 55; Monthly American Journal, p. 559.

A. *micrurus*, Green.

Locality. Trenton Falls; New York. Green's Monograph, p. 56; Monthly American Journal, 559, pl. xiv. fig. 3.

A. *Wetherilli*, Green.

Locality. Near Rochester, New York. Green's Monograph, p. 58; Monthly American Journal, p. 559.

A. *myrmecoides*, Green.

Locality. Genessee county, New York. Silliman's Journal, vol. xxiii. p. 397.

A. *astrogalotes*, Green.

Locality. Greenville canal, Upper Canada. Silliman's Journal, vol. xxv. p. 325.

A. *tetragonocephalus*, Green.

Locality. Newport? New York. Silliman's Journal, vol. xxv. p. 336.

A. *crypturus*, Green.

Locality. Nova Scotia. Transactions of the Geological Society of Pennsylvania, vol. i. p. 37, pl. vi.

GENUS PARADOXIDES. Brongniart.

P. *Boltoni*, Bigsby.

Locality. Lockport, New York. Journ. of Academy of Natural Sciences, vol. iv. p. 365, pl. 23; Green's Monog. p. 60; Monthly Amer. Journ. p. 360.

P. *Harlani*, Green.

Locality. Trenton Falls? New York. Silliman's Journal, vol. xxv. p. 336.

GENUS ISOTELUS, Dekay.

I. *gigas*, Dekay.

Localities. Trenton Falls; New York; near Cincinnati, Ohio &c. &c.; St. Joseph's, Canada. Annals of New York Lyceum, vol. i. p. 185; Green's Monog. p. 57; Month. Amer. Journ. p. 560.

I. *Planus*, Dekay.

Localities. Trenton Falls; New York; Newport, Kentucky. Annals of New York Lyceum, vol. i. p.

186; Green's Monog. p. 68; Monthly American Journal, p. 560.

I. *Cyclops*, Green.

Locality. New York? Green's Monog. p. 69, fig. 7.

I. *megalops*, Green.

Locality. Trenton Falls; New York. Green's Monog. p. 70.

I. *stegops*, Green.

Locality. Newport, Kentucky. Green's Monog. p. 71.

GENUS CRYPTOLITHUS, Green.

C. *tessellatus*, Green.

Localities. Glenn's Falls; Trenton Falls; New York. Green's Monog. p. 73, fig. iv; Month. American Journal, p. 560.

C. *Bigsbii*, Green.

NUTTAINIA *Concentrica*? Eaton.

Localities. Montreal; Trenton Falls; Champlain canal; New York. Green's Monog. p. 76.

GENUS DIPLEURA, Green.

D. *Dekayi*, Green.

Localities. Lockport, New York, and several other

places in the United States. Green's Monog. p. 79, figs. vii. and viii; Monthly American Journal, p. 560.

GENUS TRIMERUS, Green.

T. *delphinocephalus*, Green.

Locality. Niagara county, N. Y. Green's Monog. p. 82, fig. i; Monthly American Journal, p. 560.

GENUS CERAURUS, Green.

C. *pleurexanthemus*, Green.

Localities. Newport, New York. Green's Monog. p. 84, fig. x. Monthly American Journal, p. 560.

GENUS TRIARTHRUS, Green.

T. *Beckii*, Green.

Locality. Cahooes Falls, New York, and other places. Green's Monog. p. 37, fig. vi. Monthly American Journal, p. 560.

GENUS NUTTAINIA, Eaton.

N. *sparsa*, Eaton.

Locality. Near Albany, New York. Eaton's Geolog. Text Book, p. 33. Green's Monog. p. 80.

GENUS BRONGNIARTIA, Eaton.

B. *platycephala*, Eaton.

Locality. Lockport, New York. Eaton's Geolog. Text Book, p. 32. Green's Monog. p. 31.

Phytolithites.

In North America there is no lack of material in this department of our subject; but all the information we possess relative to the fossil plants of this country, is disseminated in the various works devoted to natural history. Our fossil vegetables are confined to no family in particular, but consist, as far as yet discovered, of the pine, oak, hickory, walnut, beech, palms, ferns, reeds, grasses, mosses, algæ, peat, and lignite in various stages of carbonization. Dicotyledonous lignite is of common occurrence in the deep cut of the Chesapeake and Delaware canal. Numerous popular accounts of submerged forests and petrified trees in scattered localities, will be found in the American Journal of Science and Arts, and occasional notices of similar phenomena in Hitchcock's Geology, and the Journal of the Acamy of Natural Sciences &c. &c.

The following remarkable account of a petrified forest, is extracted from a letter of G. H. Crossman, of the United States' Army, published in the Illinois Magazine, during the summer of 1830:

"The enclosed specimen was broken off from one of the many large stumps and limbs of trees, found near Yellow Stone river, Missouri territory, and brought away by some of the officers attached to the Yellow Stone expedition in 1815.

"The most remarkable facts, perhaps, with regard to these petrifactions, of what was once a forest of thick timber, are their location and abundance. For a dis-

tance of twenty or thirty miles over an open high prairie, upon the west bank of the Missouri river, and a few miles below its junction with the Yellow Stone, near latitude 48°, these remains are most abundant.

"The topography of this section of the country is hilly, and much broken into deep ravines and hollows. On the sides and summits of the hills, at an elevation of several hundred feet above the present level of the river and an estimated height of some thousand feet above the ocean, the surface of the earth is literally covered with stumps, roots and limbs of petrified trees, broken and thrown down by some powerful convulsion of nature, and scattered in all directions in innumerable fragments.

"Some of the trees appear to have been broken off, in falling, close to the root; while others stand at an elevation of some feet above the surface. Many of the stumps are of large size; I measured one, in company with Dr. Gale of the United States' army, and found it to be upwards of fifteen feet in circumference."

The vegetable impressions observed in our coal measures are equally numerous and interesting as in any of a similar nature in Europe, and all are of the same general character with those obtained from the carboniferous and grauwacke series in Europe.

Many of the fossil vegetables of our coal measures are peculiar to America: such are, NEUROPTERIS *Cistii*, N. *macrophylla*, of Wilkesbarre, Pennsylvania; N. *Grangeri*, of Zanesville, Ohio; SIGILLARIA *Cistii*, S. *rugosa*, S. *Sillimani*, S. *obliqua*, S. *dubia*, all from Wilkesbarre, Pennsylvania; LYCOPODITES *Sillimani*,

South Hadley, Mass.; LEPIDODENDRON *mamillare* and L. *Cistii*, Wilkesbarre; POACITES *lanceolata*, Zanesville, Ohio, and PECOPTERIS *punctulata*, Wilkesbarre.

Those common to both countries as enumerated by De la Beche, (Geological Manual,) are:—"Calamites, three species; Neuropteris, three species; Pecopteris, four species; Sigillaria, one species; Sphenophyllum, one species; Lepidodendron, three species; Stigmaria, two species; Andularia, two species; Asterophyllites, one species.

Several eminent American authors have communicated important information in this department of geology, in that highly valuable repository of American intelligence, the American Journal of Science. Among others, we refer with much satisfaction to the labors of Professors Silliman, Hitchcock and Eaton, and to Messrs. Grammer and Cist.

We refer our readers also, with great confidence, to the accompanying memoir of Mr. R. C. Taylor, in the present volume, for valuable information respecting the geological position of a class of fossils, (Fuci,) which have recently elicited much attention in this country. Mr. T. has indicated several additional new species.

Up to the period of the publication of the invaluable work of M. Ad. Brongniart, ("Histoire des Vegetaux Fossiles," 1828,) very little had been accomplished towards the elucidation of this interesting portion of the fossil flora.

The opinions offered by this enlightened author relative to the geological relations of the fossil Fuci, of Eu-

rope, receive confirmation by all the facts hitherto obtained of the like fossils observed in America:

"Fossil Fuci are found even in the most ancient formations of the globe, in the transition rocks of the north of Europe and of America."

"Such are the FUCOIDES *dentatus*, F. *serra*, F. *antiquus* and F. *Circinatus*."

"The Fuci become more abundant in the strata which separate the limestone from the chalk, and some remarkable species occur here."

"In England, these fossils are of frequent occurrence in the green sand formation which separates the Lias and Oolitic series (calcaire jurassique) from the chalk."

"It has been demonstrated that the Marine, like terrestrial vegetation, approaches nearer to that of our own climates, in proportion as they occur in the more recent formations. They present, on the contrary, characters equally resembling those of the vegetation of equatorial climates, in proportion as they occur in more ancient formations." Hist. des veg. foss. tom. 1. p. p. 41. 43. 45. 47.

The following list embraces all the determined species, hitherto discovered in North America.

NATURAL ORDER ALGÆ.

FAMILY FUCOIDES. Sternb.

F. *dentatus*, Ad. Brongniart.

Hist. des veg. foss. vol. i. p. lxxx. pl. vi. fig. 9. 12.

Locality. Point Levi near Quebec, Canada.

Place in the Geological series. Transition limestone.

F. *serra.* Ad. Brongniart, Hist. des. veg. foss. p. lxxxi. pl. vi. fig. 7. 8.

Locality. Point Levi near Quebec.

Place in the Geological series. Transition limestone.

F. *Brongniartii.* Harlan, Monthly journal of geology &c. 1831. First figured in the present volume, *vid.* pl. iii. fig. 6.

Locality. Welland canal, Canada; western part of the state of New York; mountain ranges of Western Pennsylvania and Virginia.

Place in the Geological series. Siliceous sandstone—Grauwache slate, and old red sandstone.

For further observations on this; and analogous fossils, *vid.* Mr. Taylor's memoir above referred to.

In Hitchcock's Geology, pp. 233, 234. pl. xiii. fig. 38, 39—there occurs a description of a fossil vegetable, which on very doubtful authority, Professor H. refers to a fossil fucus, analogous to that above described. In the opinion of this "*authority*," the fossil in question "*evidently* belongs to the fossil genus fucoides, of which Dr. Harlan has described a species from the sandstone of Genesee, under the name of F. *Brongniartii.* If the specimens were weathered, their

specific characters would be more obvious, and would probably prove identical with those from Genesee." *Vide* page 231, ut supra. We have no faith in opinions, on matters of science at least, delivered "ex-cathedra," and in this instance, the mere glance of the eye of an intelligent observer at the description of the fossils in question would convince him that they display no characters in common with each other—there is sufficient reason to doubt whether or not the specimens figured by Professor H. from Deersfield, really belonged to the natural order Algæ, much less to the genus or family fucoides—judging from the description, they would appear to possess much stronger analogy to the stems of dicotyledonous plants.

The following are some of the particulars in which this fossil differs from the fucoides, with which it has been confounded. *Viz.* Stem attains to more than twice the diameter, and twice the length in the former—its surface is moreover, uniform, without grooves or wrinkles. These stems are never branched in the Deerfield petrifaction, and the sandstone in which it occurs is rather fine, and quite soft, and easily disintegrates—the very opposite of all this characterizes the F. *Brongniartii*; but what distinguishes the former, or Deerfield fossil, from the fucoides above named, and from all the species of algæ that have come under our notice, is the peculiar vestige of organization observed in the stems figured by Professor H. who states, in his lucid and detailed description of his petrifaction, "by breaking the specimens transversely, a curious struc-

ture is revealed; it may be described, by saying that the cylinder is made up of convex layers of sandstone, piled upon one another." From the known fleshy organization of the aquatic cryptogamæ, it is difficult to conceive, how mere petrifaction, to say nothing of "weathering" could produce a structure similar to that noticed in the stems above alluded to.

Two years subsequently to the publication of the F. *Brongniartii*, Mr. Mantell described and figured a Fucus, by the same name, though of a very distinct species, (*Vide* "Geology of the south east of England," p. 95,) where this author states—"A fine species of Fucus has been noticed in chalk, which I have named in honor of the distinguished author of the Vegetaux Fossiles, *Fucoides Brongniartii*." We leave it to future systematic writers to correct these trivial collisions in classification. We learn from Professor Brongniart that it is his intention to favor the public with a complete synopsis of fossil vegetables, at the termination of his great work.

F. *Alleghaniensis*, Harlan.

Journal of the Academy of Natural Sciences of Philadelphia, vol. vi. p. 289. pl. xv.; R. C. Taylor, Louden's Magazine of Natural History, No. 37, for January, 1834, p. 27, fig. vi.

Locality. Eastern ridges of the Alleghany mountains.

Place in the Geological series. Compact sandstone, subjacent to the coal measurers.

(*To be continued.*)

OBSERVATIONS ON THE TREATISE OF MINERALOGY OF MR. C. U. SHEPARD, WITH THE TRANSLATION OF "THE CHARACTERISTIC OF THE CLASSES AND ORDERS OF BREITHAUPT." By ANDRES DEL RIO, Professor of Mineralogy in the School of Mines of Mexico; Pres. of the Geolog. Soc. of Penn. &c.

Read June 1834.

THE mere attempt to solve a difficult problem is, in itself, worthy of praise, although the method be complicated, because it can be subsequently simplified. "The problem of determining from books the names of the minerals, is frequently to be solved, and little benefit is to be enjoyed in the task from the scientific process by which the botanist and zoologist are guided to the names of objects in their respective departments."

Accordingly Mr. Shepard in his treatise of mineralogy, 1832, has imagined an analytical method, invented solely to conduct to the names of minerals, "independently of personal instruction, and the advantages of a completely arranged cabinet." He declares it, at the same time, as "inapplicable to the arrangement of a cabinet of specimens, and its preservation, after knowing the names, would be like preserving the staging of an edifice, after its construction was complete."

This is a solid objection indeed, since by the method of Moh's and Breithaupt it is not necessary to destroy the bridge, after having crossed the river.

The author divides the mineral kingdom into three classes. 1st, minerals possessed of regular forms. 2d, minerals yielding regular forms only by cleavage; and 3d. minerals destitute of regular forms, and not producing them by cleavage. The first is called the crystallized, the second, semicrystallized, and the third, the uncrystallized class,—thus, portions of the species Fluor, (and the author might have added nearly all the others,) are found in all of the classes, according as the individuals are crystallized, cleavable, or massive and amorphous. I cannot help thinking such a partition, is something like a division of quadrupeds, in order to find their names, into skulls with complete teeth, skulls with half teeth, and skulls without teeth, and of course a viverra or other carnivorous animal, might be placed in the three partitions, of an indivisible thing.

We must place ourselves in the situation of the student left to his own resources. I suppose him at first well informed in the terminology, and I know not how he should be, not being provided with select specimens; suppose, afterwards, he obtains a fine granular sulphuret of lead, he tries its hardness and its specific gravity, and he finds it, by referring to the third class, to be Galena: he gets also a cube, and finds by a second investigation, that it belongs to the first class; and when he gets also a large concretioned galena, which has three cleavages perpendicular to each other, he finds it to belong to the second class, p. 202, which the author has not quoted. Now, can he convince himself, al-

though they are *toto cœlo* different in their habit, that they are one and the same galena? I think it could be only on great mineralogical faith, such as no one can inspire him with, as he studies alone; it is more probable that he will think himself mistaken, and such mistakes often repeated, occasioned by the analytical method, will disgust the most herculean courage. Would not the same end be better obtained, and triplicate trouble spared the student, by adding only to the third class, or rather catalogue, that it is also found in cubes, and has triple perpendicular cleavage? But granting the partition into three classes, as it is, fluor is found most frequently in cubes, and yet the student shall not be able to find it in the first order of the first class, where it should be; it is to be found in the third order, the Octahedron, perhaps because Mohs has called it Octahedral fluor haloide, on account of the cleavage; but Mohs has not written for students, left to their own resources; and moreover, he assigns, in his Mineralogy, the fluor as an example of cubes. Indeed, I know only of two localities where it is found in Octahedrons; and so the author should have put at least the fluor at the end of the first order, with reference to the third. On the contrary, the leucite and analcime are included in the first order of the first class. The author himself observes, that the trapezohedron is the only existing form of the first. Why did he not add, that it is also the most common of the second? It is true that the order trapezohedron is wanting in his method, but I think it should have been added, to include in it, the

leucite, the analcime and the garnet, which are commonly trapezohedral. The author will perhaps answer that the trapezohedron belongs to the hexahedral system: the same will be asserted for the octahedron, tetrahedron and rhombal dodecahedron, which as primary forms are established as so many orders. For a student, the primary forms are no easy task, which even by the professors, are often differently expressed, and frequently they are even doubtful: what Mr. Shepard gives as a square prism is arranged by others as a square octahedron; and what he assigns as an oblique prism is announced by some as an oblique octahedron, and otherwise by others, which is not and cannot be the same to the student. I will go further, in saying, that the sulphuret of manganese, from Transylvania and Cornwall, is an hexahedron for Mohs, and that of Mexico is a rhombohedron for me. Nay, Professor Mitscherlich infers now from his observations, that every simple or composed body is able to take two different forms of crystals, which is the finishing blow even to the scientific classification of minerals by crystallization. Therefore, I propose to make as many orders as there are crystals found in nature, and so the quadrangular and hexagonal prisms, pointed and bevelled, should constitute orders, like the regular hexagonal prism; the student, per se, will never find in his lifetime, however long, that the quartz belongs to the order of the obtuse rhombohedron.

Returning again to the leucite, its edges and angles are sometimes so worn that it is impossible to distinguish

them; but it has got a confused dodecahedral cleavage, *not an hexahedral one*, as Breithaupt observes, who is the best authority, and so I think it should have been mentioned, in the third order of the second class.

I doubt if the harmotome is duly placed under the right rectangular prism, which is easily reduced to the oblique octahedron; because on the twin crystals, the faces of the pyramids concur exactly together, and they would not thus concur if they were oblique octohedrons; whatever it may be, the measurement of the angle of bevelment is not 177° 5, but 110° 26; the contrary statement I suppose to be an erratum.

After all, the most difficult part for the student is the second class: he must ascertain by the cleavage if a rhombic prism is right or oblique, since if he mistakes it he will never find the name of the specimen. The author observes, at page 70, "that if we arrive at the knowledge of the lateral faces of a prism, we possess, independently of the cleavage, means for determining the base, whether it be horizontal or oblique."

At first, I thought he alluded to the position of the axis of double refraction in transparent crystals, in which manner it has been determined that the euclase is an oblique rectangular prism, or a right rhomboidal one; but I found no allusion concerning polarization in his mineralogy; and he is very right not to entangle the poor student in this tortuous labyrinth, since it would be the shortest way to send him at once to Bedlam. Afterwards I found the means suggested at pages 77 and 78; but I know not if they are adequate for people

unacquainted with the first rudiments of geometry, for semicrystallized bodies of the second class, which must be of course broken or imperfect crystals: what Mr. Shepard takes for horizontal planes, another observer will take for vertical ones, and there are many examples. I was astonished to read at page 78, at the end "crystals belonging to the doubly oblique prism are among the most difficult to be understood, and the student, in examining them, will generally apply directly to the cleavage, the knowledge of which, though it be but in one direction, will often be sufficient to enable him to distinguish the primary planes;" but the cleavage in one direction, gives nothing but parallel planes, which afford no angles." I grant therefore the student to know two directions, P and M, inclined to each other 93°, but I cannot grant him to know the minutes of broken or imperfect crystals. How can he distinguish Valencianite from Mexico (my chovelia,) from the *Perikline*, perhaps better proskline, or the albite? the crystals of Valencianite are distinct but so imbedded, that my pupil Bustamante thought that P, and T, was inclined 124° 30′ instead of 122° 30′: he was only mistaken in two degrees; I assure Mr. Shepard that his student will make greater blunders than mine, although well acquainted with geometry.

As the author pays as little attention as Beaudant to the diagonal cleavages, he misses a good character to distinguish Disthen, Sillimanite, and Jeffersonite, which have a distinct, short or brachy-diagonal cleav-

age, and those which have a long or macro-diagonal one, besides those which have both.

Blende, spathic iron, dolomite &c. wanted no synonymes, being too well known, but synonymes were necessary for the Willemite, or silicato-carbonated calamine, Poonahlite, or Mesotype, the Dysluit or Pleonaste, Peritomous lead-baryte, Peganite, &c. &c. the poor student has too much to embarrass him already, let him not be incumbered with the names in addition.

I am not partial to the disposition of flies, which attracts them only to rottenness: it is not the fault of the author, whose treatise is in general, very correctly written; it is the difficulty of the subject, which as I said in the beginning, it is very laudable to have endeavored to enlighten,—and I must confess, that I by no means, dislike the third catalogue, arranged according to the gradual increment of hardness, but with the addition of cleavage, and crystals. I partake with the author the great desire to simplify the study of mineralogy, but I prefer the means proposed by Moh's and Breithaupt, especially the last, published in 1832, and which translated by me from the German, I submit to the judgment of the society. Their classes and orders are not to be thrown away when the building is finished. It must be understood that the scale of hardness of Breithaupt is two degrees greater, than that of Moh's, and I think that the third and the seventh degrees are appropriately inserted.

The scale is as follows.

1. Foliated Talc.
2. Foliated Gypsum.
3. Foliated Mica.
4. Calcareous spar, distinctly foliated.
5. Fluor, distinctly foliated.
6. Apatite.
7. Sodalite, vitreous Actynolite, from Grainer, in Tyrol, and light greenish gray, fresh and large foliated Scapolite, from Arendahl, which is very common.
8. Adularia.
9. Rock, or mountain crystal.
10. Topas.
11. Corund, foliated.
12. Diamond.

"*Characteristic of the Classes and Orders of Minerals of Breithaupt.*"

It is not my intention to enhance the value of this work beyond its merits. I only offer it as something superior to the characteristic of Shepard.

FIRST CLASS—SALTS.

Common lustre.

H; from $\frac{1}{4}$ to $4\frac{1}{2}$.

G; 0, 9 to 4.

Soluble on the tongue, with salty, alkaline and sweet taste, or only aqueous cooling.

SECOND CLASS—STONES.

Common lustre.

H; from $\frac{1}{4}$ to 12.

G; 1, 8 to 8, 1.

Soluble on the tongue, without salty, alkaline and sweet taste.

When H. $\frac{1}{4}$ to 4, and G. from 1, 8 to 7, 4, they belong here under the following conditions:

If G. less than 2, 1, and they are opaline, and not easily electric by friction.

If G. from 2, 1, to 3, 4, and they are not black with black streak, nor yellow with yellow streak.

If G. from 3, 5 to 7, 4, and they have distinct cleavage, with blue, green and white streak; only when G from 5, 7 to 6, and they have reddish yellow streak.

When H. from 4 to $5\frac{3}{4}$, and they are not red with red or yellow streak, neither yellow, brown or black, with yellow, or black brown or black brown streak; moreover without distinct dodocahedral cleavage.

When H. from $5\frac{3}{4}$ to $8\frac{3}{4}$, and G. from 2 to 4, except such as have G. 3, 5 and more, give a black, deep brown or yellow streak, and those which by rhombic cleavage give a yellowish gray streak.

When H. from 7 to 8 and less, and they are tetragonal or pyramidal.

THIRD CLASS—MINERALS.

All those with metallic lustre, and which have G, from 3, 2 to 22, belong here without exception.

Those with common lustre; H. from $\frac{1}{2}$ to 9; and G. from 2, 2 to 8, 5, belong under the following conditions:

If H, from $\frac{1}{2}$ to $2\frac{1}{2}$: and G. from 2, 2 to 8, 5; yet,
When G. from 2, 2 to 3, 4, and color and streak black, or deep yellow.
G. from 3, 5 to 8, 5, and color and streak black, brownish red, or yellow.

If H. from $2\frac{1}{4}$ to 6; G. from 2, 3 to 8, 5, and color red, streak red or yellow, or color and streak black, brown or yellow: also, when being H. from $4\frac{1}{2}$ to $5\frac{1}{2}$, they are cleavable in dodocahedrons, with colored streak or not. If H. from 5 to 6, and also gray streaked.

If H. from 6 to 7; G. from 3, 5, to 8, 8, color black and brown streak dark gray, black, brown and yellow, or G. not less than 4.

If H. from 7 to 9; and G. from 3, 9 to 8, 5;

If G. from 3, 9 to 4, and they have prismatic cleavage, not tesseral.

FOURTH CLASS—COMBUSTIBLES.

H. from 0 to 4.

G. from 0, 7 to 2, 2.

When G. from 1, 9 to 2, 2: H. $2\frac{1}{2}$ and less, and streak, from metallic black to gray, or common lustre and yellow color, or easily electric by friction.

FIRST CLASS, FIRST ORDER—HYDROITE.

H. from $\frac{1}{2}$ to 2.

G. from 0, 92 to 0, 95: Cooling soluble on the tongue. Examples, ice, hail, snow, hoar frost. Ice in rhombohedrons, according to Sir David Brewster.

SECOND ORDER—CARBONATE.

Mono-axis.

H. from 1 to $2\frac{3}{4}$.

G. from 1, 4 to 2, 1.

Alkaline taste; examples—natron, trona.

THIRD ORDER—HALATE.

H. from $1\frac{1}{2}$ to $3\frac{1}{2}$.

G. from 1, 5 to 2, 2.

Urinous and sweet taste; examples—sal ammoniac, rock salt.

FOURTH ORDER—NITRATE.

Mono-axis.

H. from $1\frac{1}{2}$ to 2.

G. from 1, 2 to 2, 1.

Taste cooling saltish; examples—saltpetre and nitrate of soda.

FIFTH ORDER—SULPHATE.

H. from 2 to $4\frac{1}{2}$.

G. from 1, 4 to 3, 2.

Taste always salty astringent; in some metallic, (vitriolic,) in some acerb, and in some bitter. Examples, glauber salt, alum, all the vitriols, glauberite, polyhalite &c.

SIXTH ORDER—ALLIATE.

Diamond, to wax lustre.

H. from 3 to 4.

G. from 3, 6 to 3, 7.

Taste acerb, sweet, saltish. Ex. oxide of arsenic.

SEVENTH ORDER—BORATE.

H. from 1 to $2\frac{1}{2}$.

G. from 1, 4 to 1, 7.

Taste slightly alkaline or acid. Ex. borax, sassoline.

SECOND CLASS, FIRST ORDER—PHYLLITE.

Mono-axis. Perfect cleavage, which is only easy in one direction. Not opaline.

H. from $\frac{1}{4}$ to 4.

G. from 2, 1 to 4, 4.

H. less than 2 and G. 2, 8: with lateral cleavages. Ex. Pharmacolite.

H. from 2 to 3 and G. from 2, 7 to 3; and they are tetragonal, with cleavage through the basis, as in chalcolite, and uranite: or rhombohedral, with lateral cleavages, as in haidingerite.

H. more than 3 and G. 2, 6, and more. Ex. native magnesia, sulphate of lime, hopeite, cobalt bloom and vivianite, prismatic copper-mica, Jam., diatomous habronem, Malachite, Mohs &c.

SECOND ORDER—CHALCITE.

Color deep or dark green and blue, streak green and blue: no distinct cleavage, in one direction only. Not opaline.

Mono-axis.

H. from 3 to 7.

G. from 2, 7 to 4, 4. Ex. lenticular copper, Euchroite, Br.; blue copper ore; malachite, atacamite, olivenite, libesthenite, Br., phosphate of copper, dioptase &c.

THIRD ORDER—SPAR.

Not opaline.

H. from $2\frac{1}{2}$ to $6\frac{1}{4}$.

G. from 2, 48 to 8.

The thin laminæ inflexible.

Cleavable through the basis, unlike the phyllite, uncolored streak, and G. less than 2, 6 or more than 3; or tetragonal.

H. from $2\frac{1}{2}$ to $3\frac{1}{4}$: G. 5, 4 and more, and an uncolored, or green streak, Ex.; sulphato-tricarbonate of lead, corneous lead.

H. $4\frac{1}{2}$ and more, without pearly lustre; unlike phyllite, and without having rhombic prismatic, or brachy-diagonal cleavage of the first kind. Ex. Scorodite, Br. Green, brown and vanadic, from Mexico, rhomboidal leadspar, diprismatic leadspar, Jam.; baryto-calcite, arragonite, fluor, alum-stone, apatite, pyramidal tungsten, Jam. &c.

G. 2, 5 and less; not tesseral, Ex. pharmaco-siderite, cupreous sulphate of lead; cupreous sulphato-carbonate of lead; red and yellow leadspar: heavy spar and celestine, sulphate of lead, strontianite, witherite, rhombohedral calamine, rhombspar, rhomboidal red manganese; sparry iron, carbonate of lime, anhydrite, criolite, wawellite, herderite, datolite, wagnerite, ytterite, yttrocerite &c.

FOURTH ORDER—MICA.

Pearly lustre.

Mono-axis. Perfect cleavage through the basis, or a very flat half bevelment, (hemidoma, Br.:) thin laminæ easily obtained. Neither tesseral, tetragonal, or opaline.

H. from 1 to $6\frac{1}{2}$.

G. from 2, 5 to 3, 4.

H. less than 2: G. from 2, 6 to 2, 8, very unctuous to the touch.

H. from 2 to 3: G. from 2, 7 to 3.

H. $5\frac{3}{4}$ and more: hexagonal and cleavable through the basis.

G. from 2, 5 to 2, 6, without green streak.

G. more than 3: H. 3 and more.

Examples—Optic monoaxic, and optic biaxic mica, margarite, clintonite, pyrosmalite.

FIFTH ORDER—PORODINE.

Opaline, conchoidal fracture.

H. from 1 to $5\frac{1}{2}$.

G. from 1, 8 to 3, 1.

H. $4\frac{3}{4}$ and more: G. 2, 3 and more.

Examples—Alumo-calcite, and kerolite, halloysite, bole and sider-bole, allophane, common copper green, pimelite, chloropal, picrolite, magnesite, chlorophaite.

SIXTH ORDER—OPHITE.

Mono-axis. No distinct cleavage in one direction only.

H. from 1, 4 to $4\frac{3}{4}$.

G. from 2, 45 to 2, 9.

Unctuous to the touch; some odor after being breathed upon.

When H. is less than 3, it is between $1\frac{1}{4}$ and $1\frac{1}{2}$, and G. 2, 8.

G. 2, 4: never hollo-rhombic, or the rhombohedron entire.*

Examples—Pinite, serpentine, pyrallolite, picrosmine, osmalite, asbestus, steatite, agalmatolite.

SEVENTH ORDER—ZEOLITE.

Pearly, to vitreous lustre; not opaline.

H. from 4 to 8,

G. from 2 to 2, 46.

Tesseral, without dodecahedral cleavage, and G. 2, 2 and less. Example—Analcime.

G. from 2, 40 to 2, 46. Mono-axis, rhombic, rhomboidal, and laterally cleavable. Examples—Heulandite, stilbite,† brewsterite, laumonite, monophane, apophillite, Thomsonite, mesotype, zeagonite, Davine, Gmellinite, chabasite, and harmotome.

* Although the title of this mineralogy is German, the characteristic is nearly wholly Greek, for the sake of conspicuity.

† H. Rose proposes now to call this *desmine*, and the first named mineral *stilbite*, undoubtedly to assist the memory.

EIGHTH ORDER—GRAMMITE.

Not opaline.

H. from $4\frac{1}{2}$ to 9.

G. from 2, 2 to 3, 6.

Brown streak: G. from 3, 2 to 3, 4, distinctly laterally cleavable, and H. $6\frac{1}{2}$ and more.

Tesseral: G. 2, 5 and less.

H. from $4\frac{1}{2}$ to 6: rhombic, rhomboidal, distinctly laterally cleavable, and G. from 2, 8 to 2, 9, as in tabular spar, Jam., and again from 3, 2 to 3, 6, as in electric calamine, Jam.

H. from $7\frac{1}{2}$ to 8, and G. 3, 4 and more; distinct prismatic, or diagonal, but not half prismatic cleavage of the first kind, as in disthen and diaspor.

H. more than 8: distinctly cleavable, in one direction, or in two, which cut themselves obliquely, as in prehnite and pyroxene. More examples are, willemite, pectolite, amphibole, bahingtonite, bucklandite, sillimanite, epidote, gehlenite, eudialyte, azure stone, feldspar, edingtonite, scapolite and amblygonite.

NINTH ORDER—HARD STONES, OR PRECIOUS STONES OF MOHS.

H. from $5\frac{1}{2}$ to 12.

G. from 2 to 4, 7.

H. from $5\frac{1}{2}$ to 7: opaline, and G. 2, 3 and less; examples—opal, pith, pitchstone and pearlstone.

H. from 7 to 8: G. 2, 3 and less, and opaline, or G. from 3, 4 to 3, 9, and without distinct holoprismatic and diagonal cleavage.

H. from 8 to 9, without very distinct cleavage, through the basis, the *hemidoma*, or half bevelment, or the brachy-diagonal, or in two directions, which make an oblique angle.

When H. does not exceed $8\frac{3}{4}$: then G. is 4 and less. Examples—Quartz, obsidian, dichroite, tourmaline, axinite, anatase, sphen, brown menac, chrysolite, tautolite, garnet, staurolite, zircon, diamond, spinel, beryl, euclase, and topas.

THIRD CLASS—MINERALS. FIRST ORDER—ORES.

Metallic lustre, color from gray to black.

H. from 3 to 9.

G. from 4, 4 to 8, 5, and not ductile.

Perfect metallic lustre: H. 7 and more. Examples—Octahedral iron ore, Jam.

Light gray metallic color, H. 7½ and more. Examples—gray manganese, Br.

Semi-metalic black color: black streak, pyrolusite and psilomelan, or G. 4, 4 and more. Examples—manganite, brownite and chromate of iron, Jam.

Common lustre: H. from 1 to 9, G. from 2, 1 to 8, 1.

H. from 1 to 2½: black streak, and G. below 3, 4, as in black cobalt ochre.

H. from 2½ to 4¼: black, brown, red or yellow streak, and G. from 2, 3 to 4, 8, as in pitchy iron ore, (Phillips,) and yellow iron ore, Br.

H. from 4½ to 6: black, brown, red or yellow streak, and G. 3 or more, as in triplit, lepidocroquite, carphosideute, Br.

When G. from 5 to 6, the streak is gray, as in yellow antimony, and when tesseral it is even uncolored.

H. from 6 to 8: G. 3, 5 and more, as in pyrochlore, polymignite, uncleavable cerium ore, uncleavable uranium ore, black manganese ore.

When G. is less than 4, the streak is yellow, brown, black or gray, as in tephroite, lievrite, botryoidal zinc and stilpnosiderite.

When H. is from 8 to 9: G. is 4, 1 and more, as in gadolinite, ostranite, Br., tantalite. Further examples are found in rutile, cerin, brown iron ore, wolfran, red copper ore &c.

SECOND ORDER—PYRITES.

Metallic lustre. Color red, yellow,* white or light gray.

H. from 1 to $8\frac{3}{4}$. Brittle, not ductile.

G. from 3 to 7, 8, as in prismatic nickel pyrites, Jam. hexahedral and rhomboidal iron pyrites, Jam. and silver white cobalt.

When of a gray color, H. 5 and more, as in nickeliferous gray antimony, Jam.

H. from $3\frac{1}{2}$ to 5 : G. less than 5, 5, as in variegated copper or phillipsite, and soft iron pyrites, Br.

THIRD ORDER—METALS.

Perfect metallic lustre; color red, yellow, white or light gray.

Tesseral and hexagonal.

H. from 0 to $8\frac{1}{2}$: ductile or malleable.

G. from 5, 8 to 22.

Examples—octahedral copper, hexahedral gold, octahedral palladium, native platina and iridosmine, Br.

Tesseral : without cleavage, or G. 7, 4 and more, as native silver and native amalgam.

* What some authors call tombæ-brown, belongs yet to bronze yellow

H. from 2 to 5. The ductility can in some instances be only observed by the impression which the corner of the hammer makes on striking, as in native arsenic.

G. 10 and more, also without ductility, as mercury. We have further examples in octahedral bismuth, antimonial silver, hexahedral silver, octahedral iron, &c.

FOURTH ORDER—SULPHURETS.

Metallic lustre: color gray or black.

H. from 1 to 5.

G. from 4, 2 to 8, 5, as in gray antimony, Jam.; zinkenite, jamesonite, bournonite, prismatic copper glance, Jam.; polybasite, (H. Rose,) prismatic melane glance, Jam.

Streak, from brown to red, tesseral, without distinct cleavage, and G. from 4, 2 to 5, as in tetrahedral copper glance, Jam.

Ductile, very dark gray to black, and G. 7 and more, as in prismatic tellurium glance, and in hexahedral glance, Jam. We have further examples in molibdan silver, tetradymite, (Hdgr.,) hexahedral galena, peritomous antimony glance, (Mohs,) Eucairite, (Berzel.) and rhomboidal molibdena, Jam.

FIFTH ORDER—BLENDE.

Semi-metallic and common lustre, colored streak.

H. from 1 to $5\frac{1}{2}$.

G. from 3, 2 to 8, 1.

Semi-metallic lustre; green or red streak. Examples—miargyrite, or rather meiargyrite, because it contains less silver than the common red silver ore.

Common lustre; yellow, red or brown streak, or if uncolored, with dodecahedral cleavage.

H. from 1 to $3\frac{1}{2}$; color and streak red or yellow. Examples—red antimony and cinnabar.

H. from $3\frac{1}{2}$ to $4\frac{1}{2}$, red streak, and G. more than 5; as red silver ore, or dodecahedral cleavage, as dodecahedral Zinc blende, Jam.

H. from $4\frac{1}{2}$ to $5\frac{1}{4}$.

G. from 3, 8 to 4, 1.

Tesseral? semi-metallic lustre and green streak, as in manganese blende, or common lustre.

SIXTH ORDER—KERATE.

Diamond lustre. Without perfect cleavage in one direction only.

H. from $\frac{1}{2}$ to 2, from malleable to sectile.

G. from 5, 4 to 7, 7.

Examples—chloride of silver or mercury; iodide of silver, Vauq.

FOURTH CLASS, FIRST ORDER—SULPHUR.

From wax to diamond lustre.

Mono-axis. Without distinct cleavage in one direction only.

H. from $1\frac{3}{4}$ to $2\frac{1}{2}$.

G. from 1, 9 to 2.

SECOND ORDER—ROSIN.

Common lustre.

Mono-axis and opaline.

H. from 2 to $3\frac{1}{2}$.

G. from 1 to 1, 6; and again, from 2, 1 to 2, 2; streak neither black nor brown.

Examples—oxalite, honeystone and yellow mineral resin or amber.

THIRD ORDER—BITUMEN.

Wax lustre.

Mono-axis, as naphthaline; opaline, as elastic bitumen; or liquid, as naphtha.

H. from 0 to 2.

G. from 0, 7 to 1, 2.

Bituminous odor, as petroleum or uncolored streak.

FOURTH ORDER—COAL.

Metallic or wax lustre. Color black and brown.
Mono-axis or amorphous.

H. from $\frac{1}{2}$ to 4.

G. from 1, 2 to 2, 1. Examples—anthracite and bituminous mineral coal, Jam.

When G. from 1, 9 to 2, 1, no brown color. Examples—rhomboidal graphite.

APPENDIX FIRST—SLATES.

From common lustre, in a small degree, to dull.
Slaty.

H. from 1 to $7\frac{1}{2}$.

G. from 1, 8 to 3, 1.

The slates may follow after the order Mica.

APPENDIX SECOND—CLAY.

From glimmering to dull; no regular forms.
Earthy, uneven, splintery.

H. from 1 to 6.

G. from 1, 6 to 3, 4.

When splintery, H. from 1 to 2; G. 3, 2 and more.

They may follow after the Porodine.

ON THE CONVERSION OF SULPHURET OF SILVER INTO NATIVE SILVER, AFTER THE METHOD OF BECQUEREL. By Professor A. Del Rio.

Read June 1834.

Becquerel has obtained crystals of galena, similar to those formed in the veins in the humid way,* by taking a liquid and two substances capable of producing an electric current by their mutual reaction. He put into a tube, the calibre of which was five or six lines in diameter, some sulphuret of mercury, poured upon it a solution of chloride of magnesium, immersed in the liquid a slip of lead to the bottom, and sealed the tube hermetically. A month or six weeks after, he found on the walls of the tube above the sulphuret, a very thin layer of a metallic brilliant precipitate, formed of small crystals, which, observed through the lens, were regular tetrahedrons, like those of the artificial galena, and the mercury was reduced.

I changed the method of the experiment of Becquerel, so far as to use sulphuret of silver instead of cinnabar, and in a month after I observed some reaction, because some magnesia was precipitated, and the border of the slip of lead which touched the sulphuret of silver was tinged red only to the depth of less than one line, which prevented the use of the blow pipe. But as I wished to hasten the process of reducing the silver, I

* The aqueous formation might be already presumed, at least as far as is concerned, the galena, which occurs in secondary rocks, as Becquerel has very justly remarked.

substituted a copper spiral wire for the slip of lead, and in six weeks after, I observed a white layer upon the sulphuret of silver, which I thought to be chloride of silver; but it did not become black on exposure to the sun, nor dissolve in ammonia, as Professor Bache found on the application of this substance.

We next dissolved it in cold nitric acid, which disengaged nitrous gas, till the black sulphuret underneath made its appearance, and the solution yielded the reactions of sulphuric acid, magnesia and silver, proving that not only the white layer had been dissolved, but also the thin film of native silver formed below, which was observed before by the streaks I made in the white layer. It seems then that this was nothing more than the sulphuret of magnesium, the magnesium having taken the sulphur of the sulphuret of silver, and of course the silver had been reduced. The oxygen of the dissolved magnesia passed to the copper wire, which was reduced to a black powder of deutoxide. The solution of the small bottle was uncolored until it became green, when exposed to the air, by the green submuriate of copper which was formed. It did not contain any sulphuric acid.

This reduction of the sulphuret of silver, as well as the preceding, with a solution of nitrate of copper, and a copper spiral, which was read before the philosophical society on the 5th of November, 1830, and printed in their transactions, seems to me fully to demonstrate, that the Mexican amalgamation is an electro-chemical process.

ON THE LOCALITIES IN TENNESSEE IN WHICH BONES OF THE GIGANTIC MASTODON AND MEGALONYX JEFFERSONII ARE FOUND.

By G. Troost, M. D., Professor of Chemistry, Mineralogy and Geology, in the University of Nashville, Tennessee; Member of the Geological Society of Transylvania, and of Pennsylvania &c. &c.

Many conjectures have been formed respecting the first inhabitants of our country, and several hypotheses have been advanced to determine their origin—whether they belonged to more enlightened races of men &c. Although these investigations extend, comparatively speaking, over but a short space of time, we are, nevertheless, quite in the dark, and can only form some probable conjectures concerning them.

We can, however, speak with more certainty of beings which inhabited this country during a more remote period of time—beings which are not only anterior to historical record, but perhaps anterior to the existence of man. I allude to some large animals, the remains of which we find at present in several parts of the United States.

I learned, accidentally, that some large bones had been found near the farm of Mr. Thomas Holt, and went immediately to the place, but I was already too late to prevent the mutilation and destruction of these relics. I engaged some men to dig for the remaining portions, and found the under jaw-bone and several fragments of other bones. Mr. H. had the kindness to

offer me the whole collection, which is composed of fractured ribs, an atlas and two second vertebræ with numerous other vertebræ, a scapula, the heads of the humerus, ulna, femur and tibia, with fragments of the bones; the radius, several bones of the tarsus and carpus, with the metatarsal and metacarpal bones; most of the latter entire, as well as some phalanges. On the under jaw bone, the coronoid apophyses are wanting, but I found one of them amongst the fragments; it has one of its teeth complete, while of the other the crown is broken off, and the roots alone remain. I obtained only a small fragment of a tusk, the whole being crumbled to pieces. The parts of the skeleton which are in my possession, are pretty sound, and partly imbued with hydrated oxide of iron, which makes them very heavy. The circumstance of having found two second vertebræ, shows that the bones of at least two individuals were there. The atlas or first vertebra is more or less injured, but the two dental vertebræ are perfect; there is a great difference in the size of these vertebræ, the largest one measuring from the front to the back eleven inches and three-fifths, while the little one measures in the same direction not quite eight inches; the latter, nevertheless, is perfect, having its dental process and other projections perfectly preserved. Could this vertebra have belonged to a different species, or must it be considered as belonging to a young individual? The tooth which is yet in the lower jaw bone is about one-third narrower than those which I have in my collection, and must therefore have belonged to the M.

angustidens, or perhaps the narrowness of this tooth may be occasioned by the old age of the animal? because not only the external thick enamel of the transverse eminences of this maxillary tooth, has entirely disappeared, but the whole of the eminences are worn down, so that the crown is nearly flat, and shows only four large irregular three-lobed transverse sections, formed by the bases of the before mentioned eminences.

It is unnecessary to give a more detailed description of these bones; they are already sufficiently known; but I must mentioned one singular peculiarity—that is, an anchylosis of the dental vertebra with the third or next cervical vertebra; the cartilage between them is entirely ossified, even the marks of the junction have disappeared at several places; only in the front are two places of about two inches where they are not in close contact; the animal must have had also a crooked neck, because the right side of the cervical vertebra, while the superfices is perfect, is less in height than the left side, in the proportions of one inch and two-fifths to two inches and one-tenth; also the right lateral foramen of the atlas is completely filled and ossified, leaving no marks of its existence.

These bones were about half a mile from Liberty meeting house, north-east corner of Williamson county, about eleven miles south-east of Nashville. They were imbedded in a rich black mould, resting on a stiff ferruginous loam, which the bones partly penetrated. I found in the black part some pieces of ferruginous sandstone, or rather grains of sand agglutinated by hydrated

oxide of iron. I consider this deposit, which is no more than three or four feet deep, in fact at some places no more than a few inches, as the result of the disintegration of the prevailing rocks of the vicinity; it contains no materials which are not found in place in the same neighborhood, and it covers the strata of limestone which belong to the upper transition series or mountain limestone. The country is more or less rolling with small hills, and forms a kind of ridge which divides the water, part running westward towards Little Harpeth river, and part running east towards Mill creek—the bones were found in a small run or rivulet which carries off the water in the vicinity towards the latter creek, and is mostly dry; it runs between two elevations, and they lie not quite three feet under the surface; in fact, the head of the femur long since projected above ground, and was used in rainy seasons when the run contained water, for a step to cross it, there being a road there also for carts and wagons, which must have fractured many of the bones.

A few years ago, another skeleton, or part of one, was found not far from the place mentioned above, on the premises of Doctor Webb, near the Harpeth river, or rather between Nelson's creek and the above named river. Both these localities, that in the vicinity of Mr. Holt and Dr. Webb, must be considered as high and dry situations. Dr. Webb's habitation is near the little river Harpeth, and near the ridge which sends its water towards Duck river; as far as I know, no salt marshes or lakes are near. The bones lie about six feet under

ground, on the same limestone stratum as the first mentioned; they were discovered by digging, in constructing a tan vat, and were imbedded in a stiff sandy clay or loam, not ferruginous as the above mentioned, and the place of the latter is also somewhat lower. The bones were destroyed by the laborers, except a few fragments which are now in my possession, and for which I am indebted to the kindness of Dr. Webb. They are the extreme point of a tusk about eight inches long, the crown of a tooth, a small tooth and some fragments of bones; judging from this crown they belonged to a young adult animal; the enamel is not injured; the transverse eminences are perfect, only the enamel of the small tooth is partly worn off. The bones were much altered, not penetrated with hydrate of iron as the first mentioned, and some crumbled to dust as soon as they were exposed to the action of the atmosphere; the tusk is very much of a chalky nature.

I have in my cabinet another tooth, which was found near Dandridge, Jefferson county, East Tennessee; and I am told a bone was found in digging for brick clay, in the vicinity of Nashville.

To complete the list of the localities of those in my possession, I have one found near Natchez, on the Mississippi river, having part of the jaw bone attached to it; and one found in Indiana near the Wabash river.

Remains of the Elephant found in Tennessee.

Besides the remains of the Mastodon, we find also those of an extinct species of Elephant, (ELAPHAS *pri-*

magenius, Blumenbach.) I am indebted to the kindness of Mr. Littlefield, one of the members of our senate, for a molar tooth of this animal. I cannot say any thing of the situation in which it was deposited. It was discovered after a freshet on the banks of Green's Lick creek—a little creek running across the plantation of Mr. L., and falling into Duck river a few miles below Columbia, Maury county. This tooth is much altered: its enamel is brittle, and has lost much of its original constituents, it being soluble in nitric acid, under a constant and brisk effervescence.

In a small collection belonging to Mrs. Ephraim Foster, of Nashville, is a large tooth of a similar Elephant, which was found, according to Mrs. Foster, forty feet under ground, by digging for a well in the vicinity of Gallatin, Sumner county, Tenn.

Remains of the MEGALONYX *Jeffersonii, found in the state of Tennessee.*

The remains of a more uncommon animal have been found in the state of Tennessee. About twenty-four or twenty-five years ago, a number of large bones were discovered in a cave, ransacked at that time for materials for the preparation of saltpetre, situated near the western boundary of White county, and from this circumstance has since borne the name of Big-bone-cave. A friend of mine, Squire Moses Fisk, of Hilham, Tenn., obtained some of these bones from a person who lived in the neighborhood of the cave. He presented one of them,

a rib, to the late Mr. Clifford, of Lexington, Kentucky,* and a claw to the late Professor Barton, of Philadelphia. Squire F. kept the remainder for the noble purpose of presenting them, together with a large number of other specimens of natural history and articles found in the graves of the aborigines, to a seminary which he expected would have been erected in Overton county, but for the establishment of which that gentleman has as yet labored in vain; and as there does not seem even the least probability that such an institution will be formed, Squire F. had the kindness to present me with these valuable relics, together with some marine fossils.

These remains, which are in a well preserved state, having the color of fresh bones, effervescing more or less with acids, form now part of my cabinet, and consist of two ribs, one of which is thirty inches long, a little carious at the sternal extremity, two dorsal vertebræ, an os sacrum, an unguical phalanx, and judging from the latter bone, belong to the MEGALONYX *Jeffersonii*, first made known by the celebrated author of the Declaration of American Independence, and at present ranked, together with the MEGALONYX *laqueatus*, Harlan, with the MEGATHERIUM, an extinct animal, the remains of which were discovered in South America, and lately also, according to William Cooper, of New York, in the United States. (See Lyceum of New York, vol. i. p. 50.)

I found on a visit to the above mentioned cave, amongst the materials collected for the preparation of

* This rib has already been described and figured in the Journal of the Academy of Natural Sciences of Philadelphia, vol. vi. p. 269, by R. Harlan.

saltpetre, a bone which, judging from its color, state of preservation &c., must have been contemporaneously buried with the above mentioned remains. It is a tube of about seven inches, through which runs longitudinally a cavernous septum, and bears suture-like marks on its larger extremity of insertion into solid bone, and has externally impressions of tendons, along its upper and lower surface.

If this belonged to the Megalonyx, then he must be separated from the MEGATHERIUM and the MEGALONYX *laqueatus*, because there seems to be no doubt that it must have formed a kind of bony proboscis of an animal approaching perhaps to the genera Myrmecophaga and Manis; but it requires more knowledge of comparative anatomy than I possess, to decide this point; I have therefore sent it to my estimable friend, Dr. Richard Harlan, whose attainments in that science are generally known, and I hope that his skilful investigations may serve to complete our knowledge of these rare remains.*

I will next proceed to give the geognostical outline of the vicinity in which the fossiliferous cave is situated, and mention at the same time all that I have been able to learn respecting the history of the discovery of the fossil bones from the old settlers of that neighborhood.

(*To be continued.*)

* This anomalous fossil bone, together with a claw, two dorsal vertebræ, and the chief portion of the os ilium of the Megalonyx, from a cave in Tennessee, have just come to hand; we have only time to remark at present, that the bony tube, with cavernous septum above referred to, forms no part of a bony proboscis of any animal, and most probably is no portion of the Megalonyx skeleton; it has no remaining portion of articulating surface, and in the present stage of the investigation it is impossible to recognize it with certainty.

R. H.

REPORT OF THE COMMITTEE APPOINTED BY THE GEOLOGICAL SOCIETY OF PENNSYLVANIA, TO INVESTIGATE THE RAPPAHANNOCK GOLD MINES, IN VIRGINIA.

To the President and Members of the Geological Society of Pa.

GENTLEMEN—In compliance with your instructions to ourselves, the undersigned, informing us that you had done us the honor to nominate us a committee of your Society, for the purpose of investigating and examining an estate called Smith's gold mine, in the county of Stafford, in the state of Virginia; we beg to inform you that we proceeded to the mine on the 22d inst., and found it about ten miles to the south-west of the town of Fredericksburg and adjoining the Rappahannock river.

The whole country is undulating, consisting of hills of no very great elevation, intersected with ravines, and is composed generally of a bright red sand and gravel, which from its general external character and appearance, and its being covered with thriving pine trees, might at first sight be taken for a red sandstone formation, but on closer inspection it appears to be a decomposed talcose schist, highly colored by oxide of iron.

The metalliferous veins are rendered very conspicuous by their consisting of hard quartoze rocks, between walls, or bearers, as they are here called, of talcose slate in a more or less decomposed state, the laminæ of which are often vertical, and parallel to the direction of the veins. Indications of these metalliferous veins were seen from the road-sides in severalplaces for nearly two

miles before reaching the spot which was to be the immediate object of our examination.

The plot of land containing the gold veins is about 230 yards wide at its north-eastern extremity, and has an average length of upwards of 900 yards; its greatest length being in a direction from north-east to south-west. It is bounded on the north-west side and on the north-east end, by artificial boundaries or lines of demarcation, which separate it from an estate belonging to Mr. William Smith; on the south-east side by a shallow running brook, containing but little water, and which empties itself into the Rappahannock river at the south-west end of this estate, thus forming its south-western boundary. The entrance to this estate is at its north-east extremity, and is formed through a pine wood thicket, and the first object that attracted our attention was an excavation, (marked No. 1 in the subjoined plan,) being a mere ditch, or cut, of about a yard deep and the same width, and about 30 feet long, from which a quantity of red earth had been discharged, but no indications of a vein were visible. We however took up a portion of this loose red soil, and on simply washing it, found that about two handsful of it produced a considerable portion of minute granular gold, but it was not collected or weighed. On entering the estate, the road descends gently to about the spot No. 3, which marks the position of an excavation that has been commenced, and is carried sixteen feet below the surface, but has not been timbered or finished as a shaft; but the principal auriferous vein, to which our attention was chiefly directed, is distinctly seen in the bottom of it, and is

found running in a perfectly straight line from north-east towards south-west, very nearly in the centre of the plot of ground, as marked by the crimson line reaching from A to A in the plan. This hole or excavation is 101 yards from the north-eastern boundary or extremity of the estate, and no other opening or excavation has been made between it and such boundary, except only a kind of ditch, No. 2, similar to No. 1, which has turned up the same kind of red earth, though more mixed with broken quartz and pebbles; but in this last excavation the vein has not yet been found, owing no doubt to its very insignificant depth, and to its having been made on the brow of a hill, much higher than the position No. 3.

No. 4 is the first excavation that bears the appearance of a shaft, being seventeen feet deep, and is not very regularly timbered for proceeding downwards; its dimensions are thirteen by seven feet, and near the bottom of it the auriferous vein is finely developed, and is two feet nine inches wide. At the bottom of this shaft, there is a spring of water which appears to be free from any metallic impregnation, and is readily carried off by a short adit and deep open ditch into the South Brooks, but at a greater depth than seventeen feet, this water will prove troublesome unless stopped from running into the shaft, which may be readily done as the quantity is not large. Not being provided with any instrument for taking levels, we are unable to say with precision how much the bottom of this shaft is below the summit of the hill to the south-west of it, but it must be at least sixty feet, and as the adit and ditch for

carrying off the water may be lowered considerably, there is no doubt but that any part of the hill can be drained by adit to a depth of at least seventy-five feet.

Proceeding in a south-west direction from this point, the hill rises rapidly, and the Nos. 5, 6 and 7 indicate shallow ditches, or trial excavations, none of them exceeding three feet in depth, but in all of which the crown of the vein is manifest.

No. 8 is an excavation that was made before the course of the load or vein was properly understood, and having been found several yards to the north-west of the vein, another opening, No. 9, about three yards deep was afterwards made to the south-east of it, and in this the vein is palpably visible. Both these places are mere excavations, no shaft work having yet been done.

No. 10 is a shaft on the summit of the hill, or highest point of the ground; it is, as the other, timbered about half way down, having an opening of ten by seven feet, and is forty-one feet deep, with no other water in it than has fallen from rains. The vein has been regularly opened and is visible for about ten feet in height, and the metalliferous quartz in it is upwards of three feet wide. This shaft is 210 yards from the north-east boundary line of the estate.

No. 11 is a large round pit, about six feet deep, on both sides of which the vein is clearly developed.

No. 12 is a long but shallow cut made transverse to the vein, of small depth, but in which it is clearly seen without any material change of appearances. This is the last opening that has been made in a south-west di-

rection, and is distant 310 yards from the north-east boundary, or 209 yards from the first deep opening, No. 3, so that the vein has been laid open in different places for this entire distance, and is thus known to exist, and from the general form of the land, there is no reason to doubt but that the vein traverses the whole length of the estate, which is about 910 yards from A to A, as the walls of the load can be distinctly traced at A in common slate, though of a more solid and undecomposed quality, and partaking more of the appearance of ancient formation. These rocks contain small crystallized magnesian garnets, and the metalliferous character of the vein here is not quite so good or strongly marked as in the central and north-east end of the estate.

Nos. 13 and 14 are two log sheds erected for depositing the ores as they are brought up. They are thirteen feet square, and about seven feet high.

No. 15 is a long, shallow excavation made to the north-west of the load or vein above referred to, and by which the position of a small vein, BB, of from nine to twelve inches wide, was discovered. It is colored yellow in the plan, and is fifty-two yards north-west of the principal vein, AA. Its position towards the south-west could not be very distinctly traced on account of its passing through thickly wooded land; but specimens of the ore were taken from the excavation No. 15, and consisted of a blue quartz, much broken and separated, and the surfaces and interstices covered and filled with yellow oxide of iron. The washing obtained from these specimens was quite as rich, or richer, than those obtained from the principal vein.

The principal vein, AA, through so much of its entire length as has been laid open, appears of a most even and uniform character, and consists of blocks of quartz, occasionally quite white, but more frequently blue, or rendered yellow and green by oxide of iron, and generally much cracked, and filled in the interstices with oxide of iron, so as to make even this hard part of the vein so friable and easily detached one piece from another, that the whole of it may be removed by the pick and gad, without the use of gunpowder, which is a material saving of expense in all mining operations. The principal auriferous quartz vein is from two feet six inches to three feet six inches wide, and stands nearly vertical in a north-east and south-west longitudinal direction. It is cased on either side by a perpendicular wall of talcose slate, which by its thickness renders the load nearly three feet six inches thick. Beyond this, on either side, a vertical bed of the red earth before described, and varying from two to three and a half feet in width is found, and this is again walled in with vertical beds of talcose schist, in a very soft and decomposed state. This formation is particularly conspicuous in the openings Nos. 3, 10 and 11, and being curious to observe and ascertain whether the above red earth, thus walled in by the external schists, but external to the principal hard and central quartoze vein, contained gold, we had two portions of it taken up from the hole No. 11, one at three feet to the north-west, and the other at three feet to the south-east of the central vein, and on washing them they both yielded gold in a very percep-

tible quantity, although the quantities of earth used were very small.

The appearance of the vein in the openings 3 and 4 upon the plan, was such as is shown in fig. 2 of the annexed plans, which is a transverse section of the vein when looking towards the north-east, thus showing that the load at these points, between the two extreme walls of talcose slate, may be considered as nearly ten feet wide, although its hard central quartoze part is but three feet.

It may be observed here, that although these small shafts have only been sunk to the depth of seventeen feet below the surface of the soil, that this is the deepest part of the mine that has been explored, because the fissures and crowns of the veins appear to preserve a nearly horizontal direction, notwithstanding the hilly and unequal surface of the ground; and consequently although the shaft on the top of the hill is forty-one feet deep, yet as that hill cannot be estimated at a smaller elevation than about forty-five feet above the top of these shafts, which being respectively sixteen and seventeen feet deep, it will appear that the deep summit shaft, No. 10, must descend at least twenty feet deeper than it now is in order to reach the vein at the same level as in the above excavations, as will appear from an inspection of the rough eye section of the country in the longitudinal direction of the vein, as hereunto annexed in fig. 3 of the plans.

The appearance of the vein in transverse section as it is seen when looking towards the north-east in the

deep shaft, No. 10, at between thirty feet from the surface of the land and the bottom of the shaft, is such as is shown in fig. 4 of the accompanying plans.

On the whole, therefore, it is rendered certain by the above examination, that 209 yards, or 627 feet, of auriferous quartz vein, with a full average width of thirty inches, have been laid open to view, being equal to 1576 cube feet, at one foot in depth or thickness, and as the cube foot is equal to about two bushels of ore when broken out, we shall have 3,134 bushels of ore out of each foot in depth. But the vein has been exposed and laid open for more than ten feet average depth, making 31,340 bushels of ore that may reasonably be expected to be raised out of every ten feet in depth of the present exposed part of the vein, which is but very little more than one-fourth part of its entire length; so that if the remainder of the vein should prove equally productive with that which has been already exposed, (and which there is little or no reason to doubt,) four times this quantity, or 125,360 bushels of ore may be expected out of each ten feet in depth of this single vein; and how deep it may proceed into the earth it is impossible to say; but reasoning from analogy and experience in other mines, it may be fairly inferred that the vein will become wider, richer, and more valuable as it proceeds downwards for at least two or three hundred feet. But as the knowledge of these veins is yet in its infancy, it would be vain to offer any thing like a well grounded opinion upon this subject until it has been further investigated and proved.

Miners consider the bushel of ore as equivalent to about one hundred pounds weight, and in order to demonstrate the value of such veins it becomes necessary to perform experiments upon the produce or quantity of metal contained in given quantities of the ore. Accordingly we made such experiments, using in each case four pounds avoirdupois of the rough ore, as brought up from several places, which was pulverized in iron mortars to a tolerably fine powder, but not sifted for want of the necessary implements. The earthy water was then washed away by repeated agitations in clean water, until a small residuum was obtained, and this was then treated by friction with mercury to form an amalgamation with the gold, after which the washing was repeated until the amalgamation was obtained in a tolerably clean state, the superfluous quicksilver was then expressed by squeezing the mass through a double silk handkerchief, having no better means of working at hand, and the remaining mass of hard amalgams was then exposed upon a shovel to a sufficient heat to volatalize the quicksilver, when the gold remained behind, but we did not possess the means on the spot of examining the parity of this residuum, though its color and great weight very clearly showed it to be chiefly gold.

From the account of the above process it will be evident that it was far from a perfect one, for in the first place the powdered ore was not fine enough to admit of clean washing or perfect amalgamation, and we doubt much of the gold was lost in the rough and hasty manner of washing, as well as in the expressed quicksilver,

besides which much of the quicksilver was lost; still, however, under all these disadvantages, the quantity of three and a half grains of gold was obtained from an average of four pounds of ore, taken indiscriminately from all parts of the vein, and in another experiment, five grains of gold were obtained from four pounds of pure milky white quartz, which had no appearance or indication of containing any metal at all.

It may, therefore, be fairly inferred that if the experiments had been better and more accurately conducted, and made on a larger scale, that each pound weight of average ore would have yielded one grain of gold, or at the rate of five pennyweights to the hundred pounds weight of ore, which is much more than the probable, or indeed possible cost of working the mines, as we conceive that could in no case amount to so much as one dollar upon the hundred pounds weight.

In conclusion, we have to remark, that the water in the rivulet is by no means sufficient in quantity to make it available as a water power, or even to furnish sufficient water for washing and dressing the ore that may be raised; consequently it will be necessary to make use of animal or steam power for stamping and grinding the ores, and that the water for washing the same must be brought in artificial channels from the Rappahannock.

We are, gentlemen, with great respect,

Your obedient servants,

ANDRES DEL RIO,
JOHN MILLINGTON.

Philadelphia, Aug. 4, 1834.

To the President and Members of the Geological Society of Pa.

GENTLEMEN—Having obtained your permission to make a separate report upon the Rappahannock, or Smith's gold mine, by way of supplement to the joint report presented by Mr. Del Rio and myself on the 4th inst., I beg to say, that for the purpose of more fully investigating this mine, and confirming the observations we had previously made, I was induced to examine the land again, which has enabled me to fully confirm and corroborate all that we advanced in that previous report.

That report, however, refers only to the central, or principal vein, marked AA in the plan, and to another small vein, BB, colored yellow, to the northwest of the central vein, and believed to be parallel to it, but of which we stated the direction towards the south-west, could not be very distinctly determined on account of the land being thickly covered with wood.

From the form of the hills, the stony indications on the surface, and a careful examination of the course of the rivulet and ditch between No. 4 and C, I was induced to suspect other metallic veins to the south-east of the central ore, and after a careful search the vein DC was found, developing itself finely at the point C, though nearly hidden by the bushes. It is situated at the distance of ninety-two yards to the south east of the central vein, and though short, has a promising appearance, and its ores on trial appeared good, but they were

taken from the surface at C, as no openings have yet been made into it.

At the distance of fifty-five yards to the south-east of the central vein, and parallel to it, another small vein, EF, exists, and shows itself in the deep ditch F, as well as in the rivulet at E; and from the stones found upon the surface it appears the matrix of this vein is quite different from the others, and consists of an opaque white lamellar quartz, which breaks into rhomboidal masses, and in general appearance very much resembles feldspar. These veins, however, cannot but add to the value of the estate, as I believe they may both be worked to advantage.

In the joint report, it was stated that the metallic indications were not quite so good at the south-west end of the central vein AA as at its opposite extremity; but before I left the district I had an opportunity of conversing with several persons concerned in the United States' gold mine, and saw the map of the loads in that mine, and from such sources of information, found that the United States' mine was directly opposite to this mine across the Rappahannock river, in a more south-west direction; and I have reason to believe that the principal veins of that mine is nothing but an extension of Smith's central vein, and that the vein BB in the annexed plan, is not parallel to this central vein, but gets nearer to it at the south-west end, and crosses, or intersects it, at a small distance from the river shore, within the United States' mine estate. I saw specimens of the ore from their veins, and they are so similar in

character and appearance to those of Smith's mine as to leave little or no doubt of the identity of the loads.

It was also omitted to be stated in the former report, that about 3,000 bushels of gold ore was at that time raised and lying upon the ground, viz. 1,352 bushels of picked ore in the ore-house No. 13 of the map or plan, and about 756 bushels of like ore in the house No. 14, besides about 1,000 bushels of ordinary, but workable ores, in various heaps about the ground.

I have the honor to be, gentlemen,

Your very obedient servant,

JOHN MILLINGTON.

Philadelphia, Aug. 5, 1834.

SUPPLEMENT TO THE ABOVE REPORT. By Professor Del Rio.

To the President and Members of the Geological Society of Pa.

If by geology we are enabled to infer the resemblance, or even the identity of the sites of the different metals, it is by the minute observation of every locality that we obtain our data.

Mr. J. Dickson has recently published in the Transactions of the Geological Society of Pennsylvania, an essay on the gold region of Virginia, in which he states that "the Rappahannock mines perfectly resemble all the others in Virginia," and further, "that the largest amount of gold has been obtained from a class of mines generally known by the name of branch mines, or stream mines, situated in the beds of rivers and rivulets, or ra-

vines." And such is the situation of the vein which we have examined, which would cut a rivulet obliquely in its prolongation; its direction is from north-east to south-west; its matrix, quartz, with slate, more or less decomposed; its thickness from two and a half to three feet; and at sixty feet depth from the surface, the quantity of gold was eight grains to five pounds of ore, although this was not sufficiently stamped. This result was obtained by heating the quartz to a red heat, and throwing it into cold water, which is probably the surest means of obtaining the greatest portion of gold. The average, we are informed, is one grain to the pound. Accordingly we think the vein is well worth working to a greater depth, in both shafts, and stamping as fine as possible, since there is no danger of the quartz forming a thick slime, as when clay is present, in which the minute particles of gold might become entangled and not be precipitated. The same opinion is advanced by Mr. Dickson, who says, the great desideratum is to stamp the ore fine enough, and to attenuate it whilst entering the bowls or tyrolese mills with abundance of water.

I have this morning had an opportunity of seeing a pretty specimen from the same vein, with hepatic pyrites and antimonial galena, in needles, and probably light ochre and yellow oxide of antimony. It is to be observed that the antimony and gold are good geognostic friends, and this specimen is very rich.

But to the east of the vein, and at ninety yards distance, according to the measurements of Mr. Millington, there is another vein, called the fourth, parallel to

the others, which enters the branch, and from which Mr. Dickson says, "the richest branch mines are to be found when the vein enters the branch, and continues a straight course for some length down the branch; this is apt to be an extensive gold deposit." And further: "Branch mines have led to the discovery of very valuable vein mines, for when they work until the gold seems to fail, they would come back and open into the sides or banks of the ravine, guided by the gold, and at last discover valuable bodies of gold ore; many instances of this kind are notorious in Carolina and Virginia." Moreover, the position of the hill, traversed by the veins and environed by higher mountains, is what the German miners call *Schlucht*, where the richest formations are generally to be found; therefore we would propose to the company to open an adit in the ravine, in the direction of the fourth vein, by which means this vein would be explored to the depth of 150 to 200 feet. The labor might be abridged by sinking a shaft in the vein at the same time, at a distance of 200 feet, horizontally: but this would be attended with considerable expense. The tunnel, or adit, being twelve feet high, and six broad for the timber, and for allowing the water to run at the bottom, there will never be a deficiency of the circulation of air in such a short distance. When at a convenient place, communications could be opened with the other veins, &c.

Although I have signed the report of Mr. Millington, I do not agree with his calculation by the bushel of the ore, which is geometrically certain, but only probable

geognostically, since the vein may change in quantity and in quality every ten feet in depth, and even in the three-fourth parts of the undiscovered vein, in comparison with the fourth part hitherto discovered.

In such circumstances, I know no other means of solving the problem than to prove the identity of the new vein of Smith's gold mine, with some other known veins which are already profitably worked; therefore I only insisted, in my report, on the direction and the matrix of this vein, which is the same as in the others of Virginia; and the quotation of the Rappahannock mines by Mr. Dickson, as perfectly resembling the others; and the situation of the vein, which, like some others, according to the same author, would cut a rivulet obliquely in its prolongation; and lastly on the observation, that the fourth vein enters the branch and continues a straight course for some length down the branch, as Mr. Dickson has observed in many others.

Now, if any gentleman should ask the average amount of gold in this vein, we could only answer, that it will prove to be probably the same as in other similar veins, the precise and exact determination being, in my opinion quite impossible; this is a point only to be determined after working for some time, say six months, at least. From every other metal, by mixing exactly equal, or nearly equal parts of the best, of the medium, and of the worst ore, you may obtain an average mean; but this is not the case with gold, as it is so valuable in small quantities; some particles more, which may intervene by any chance, or some particles less, which may be

missing by some other chance, will give a fallacious result. The business of mining does not repose on certainty, but on probability, and all that we can do in such investigations is only to search for the greatest probability.

FIG. I.

Map or Ground Plan of an Estate called "The Rappahannock or Smith's Gold Mine," in Stafford County, Virginia.

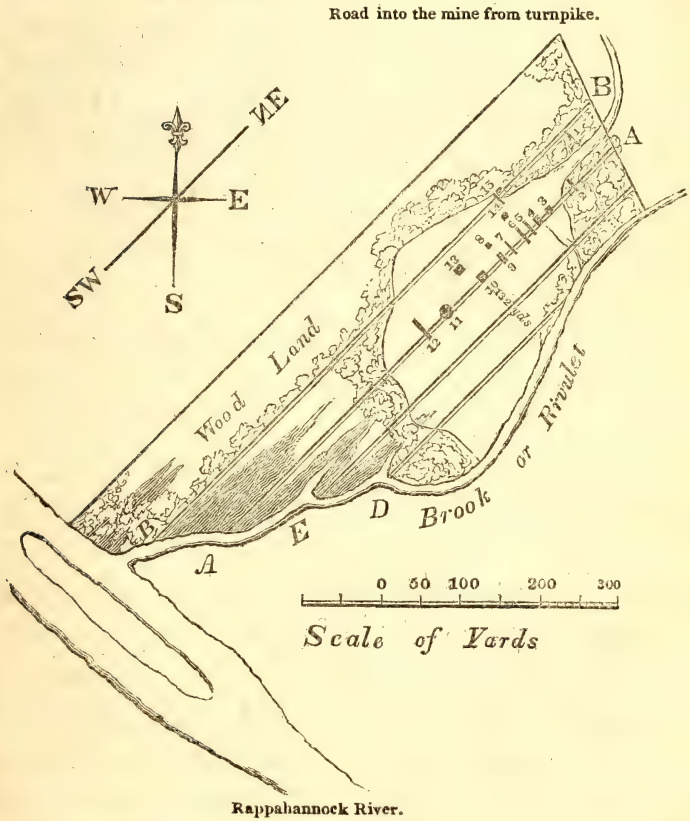


Fig. II.

Transverse section of the vein or load, when looking towards the north-east, in the shafts Nos. 3 and 4.

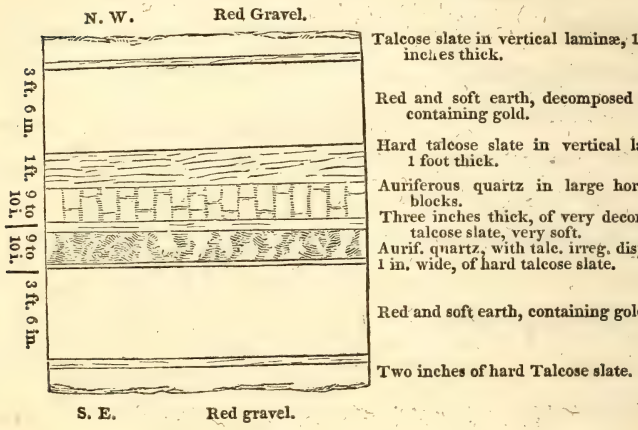


FIG. III.

Longitudinal Section of the country in the direction of the Central Vein, taken by eye estimation, without instruments.

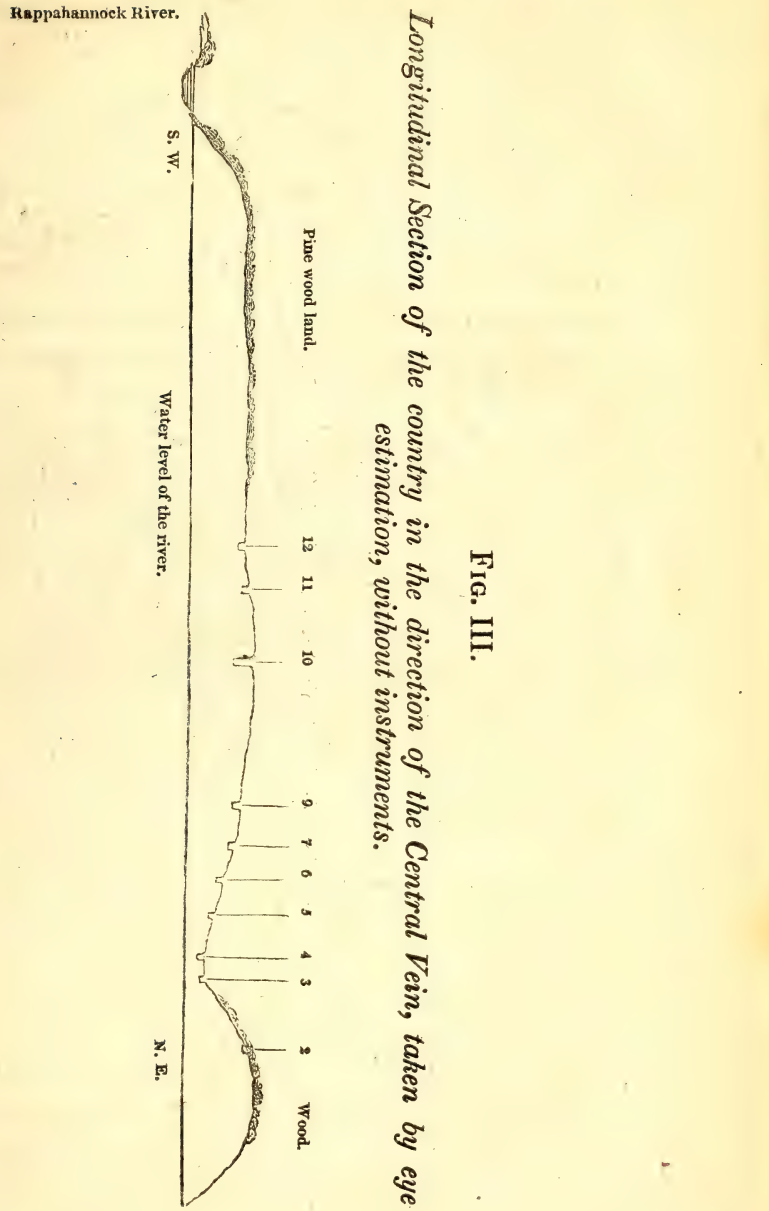
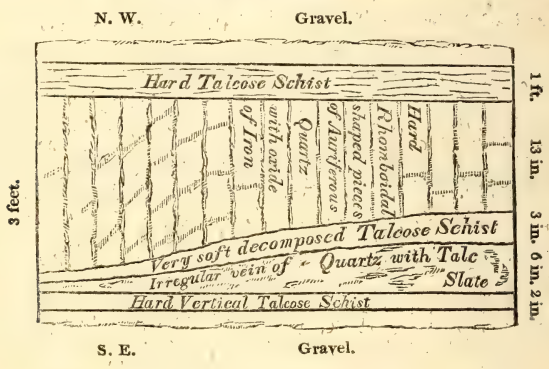


Fig. IV.

Transverse Section of the Vein or Load when looking towards the north-east in the deep shaft No. 10.



FLEMINGTON COPPER ORE.

About half a mile distant from the town of Flemington, Hunterdon county, New Jersey, there exists a large deposit of the sulphuret of copper. The loads here exist in an argillaceous schist, which is the predominant rock of this part of New Jersey, and appears to have been upheaved by the granite which makes its appearance farther south. At Lambertsville, on the Delaware, this rock is of a dark red brown, and contains rognons of epidote; these rocks dip to the north, at an angle of 18°. The rock, as it appears upon the surface of the earth, is always red, and as you descend becomes blue. Indications of copper are strong in several parts of Hunterdon county. At Flemington, about sixty tons of ore have been thrown out, notwithstanding the limited excavations. A comparatively pure specimen of this ore yielded—

Copper,	0.540
Iron,	0.134
Insoluble residuum,	0.082
Sulphur,	0.244
	1.000

THOS. G. CLEMSON.

August 11, 1834.

Miscellaneous Intelligence.

The legislature of the state of Tennessee, with a liberality and public spirit which does them infinite credit, some time since appointed Dr. G. Troost, a distinguished naturalist, *Geologist of the state.* At a late session he made a report in part, containing a geological survey of Davidson county, which has been read in the House of Representatives, and which will be published in a suitable form, with engraved maps and illustrations. When the whole work for the state shall have been completed in the same manner, a mass of information, scientific and practical, will be embodied, to which no other state can present a parallel. Dr. Troost proposes, in addition to the geological description of the strata which compose the soil of Tennessee and their organic fossils, to give an accurate mineralogical detail of the same, with an examination of all the "accidental" minerals which may occur.

The important communications received from Dr. Troost, by the Geological Society of Pennsylvania, some of which are published in the present volume, fully testify to his accuracy and skill in the investigations which now occupy his attention.

The same author is engaged in publishing a translation of the celebrated work of his friend Goldfuss, "On

Petrifactions." The proposed edition will be illustrated by the notes and additions of the American editor, who has been obligingly furnished with the original plates by Dr. Goldfuss. Every one wishing well to the progress of geology in this country, should, by his subscription, encourage this undertaking.

The lovers of science, and particularly of geological science, will learn with interest that Mr. G. W. Featherstonhaugh is at present engaged, under the authority of the United States government, in investigating the geology and mineralogy of the Arkansas territory. Mr. F. has a new and interesting field before him, with talents and persevering industry, which render him peculiarly qualified for this arduous and highly important duty. The most important results, both as regards the interests of science, and the permanent welfare of the country, may be fairly anticipated from his labors. We look with great interest for his report to Congress in February next.

The following is an extract of a letter recently received from Mr. F. on his way through Virginia, dated

"*Warm Springs, Bath county, Va.*

"As to the waters here, they deserve to have a volume written on them; they have elicited much of my attention during my short stay here. I have obtained two or three facts respecting them which you may rely on:—First, as to their gaseous contents—the greater part of their volume is *azotic gas;* next, carbonic acid

gas, and the least proportion is formed by sulphuretted hydrogen. Their solid contents are constituted by the neutral salts of lime, magnesia and soda, carbonates and sulphates.

"In a little pamphlet, by 'A Physician of Philadelphia," I find *iron* mentioned as present, "sufficient to strike a deep blue with the Prussiate of potash." I think this is a mistake, and find no evidence whatever of the existence of iron, either by reagents or by the taste; it is clearly a non-chalybeate. At the Hot Springs, five miles hence, they are decided chalybeates, with a temperature of 101° F. As to the proportions, you know it would not be becoming in me, at present, to give any statement of that kind; a man must be a very experienced analist to do that with a good face. Crystals of epsom salts are found formed in various places by the spray of the waters.

"The waters resemble those of Aix la Chapelle, with which I am familiar. Nothing can exceed the beauty of this water to bathe in; the large bath is so very pellucid, and has such a highly refracting power, that really it presents one of the most admirable and amusing spectacles possible, and produces the most delicious sensations; the bubbles of gas escaping and sporting over your body like little fishes. The larger and fatter the person, the greater the enjoyment.

"The temperature of this bath is about 97° or 98°. At the Hot Springs I found waters at 102°."

Our colleague, Mr. T. G. Clemson, has recently returned from Europe, after a long and faithful apprenticeship in the School of mines at Paris, and having availed himself extensively of the various sources of improvement only to be found in that great metropolis, has fixed his permanent residence in his native state. We look with confident expectations to the active cooperations of Mr. C. in the departments of mineralogy, chemistry and geology.

Mr. C. has accepted the appointment of the Geological Society of Pennsylvania, to visit and report on the gold region recently discovered in York county, Pennsylvania, and has proceeded on that duty. Mr. C. was also immediately on his return from Paris, honored with the appointment of director to the Flemington mining company. The mine is located in Hunterdon county, New Jersey.

The Legislature of Maryland, emulating the liberal policy and practical intelligence of the state Legislatures of Massachusetts and Tennessee, of North and South Carolina &c., have appointed Professor Ducatel and Mr. Anderson of Baltimore, with extensive instructions for a geological and topographical survey of the state of Maryland; these gentlemen are at the present moment actively and successfully occupied in this important duty.

"Report on the Geology, Mineralogy, Botany and Zoology, of Massachusetts, made and published by order of the government of that state. In four parts, viz: Economical, Topographical and Scientific Geology, and a Catalogue of the Animals and Plants. With a descriptive list of the specimens of rocks and minerals collected for the government. Royal 8vo. pp. 700. Illustrated by numerous wood cuts and an atlas of plates. By Edward Hitchcock, Professor of Chemistry and Natural History in Amherst College. 1833."

This work is a most elaborate, comprehensive and valuable production, and for the successful consummation of which the author merits the thanks of all those who are solicitous of the permanent welfare and scientific progress of our common country. It is to be hoped that some of our scientific contemporaries will furnish their readers with a condensed synopsis of its contents.

The Geological Society of Pennsylvania have it in contemplation to appoint a committee of their members to make a geological survey of Schuylkill county, Pennsylvania, for which purpose part of the necessary funds have already been subscribed. It is only requisite that the landholders in this county should be made acquainted with their true interests, in order to complete the subscription, and set the survey in operation.

The memorial addressed by this society, during the

session of 1832 and '33, to the Legislature of Pennsylvania, for the purpose of obtaining their aid towards the prosecution of a geological, topographical and mineralogical survey of this state, is still under the consideration of that body; nor do we permit ourselves to doubt the final success of a petition so reasonable.

One of our colleagues who has recently experimented on the gold ores of Virginia, cautions others engaged in similar experiments against using the mercury of commerce, or such as is sold in our apothecary shops, as it is not sufficiently pure to amalgamate with the gold, unless it be previously well washed with nitric acid.

Dr. Douglass Houghton who accompanied Mr. Schoolcraft and Lieut. Allen in their late expedition to the sources of the Mississippi, under the authority of the U. States' government, is now preparing a work on the geology of the country embraced by the objects of the expedition. From this work of Dr. H. we anticipate a satisfactory elucidation of the geology and mineralogy of the north western section of the United States, a region hitherto almost entirely unknown.

During the late session of the New Jersey state Legislature, a bill was reported for the geological survey of that state.

The geological and mineralogical surveys of Professor Olmstead and of Professor Vanuxem, the former of

North, the latter of South Carolina, under the authority of their respective state Legislatures, have for some time been before the public; their interesting and practically important results have been well received and duly appreciated.

The work of Messrs. Jackson and Alger, of Boston, on the geology and mineralogy of Nova Scotia, undertaken at the private expense of the authors, and accomplished with much labor, is a very creditable production.

We may refer also for interesting geological details connected with the formations west of the Mississippi, to the observations of the naturalists who accompanied Major Long's Expedition to the Rocky Mountains, and to essays of Messrs. James, Say and Nuttall, published in the Journal of the Academy of Natural Science of Philadelphia: to the meritorious pages of this volume, as well as to the Annals of the Lyceum of Natural History of New York, and to the American Monthly Journal of Geology &c., we refer for many rich contributions to American Geology.

Mr. P. A. Brown, of Philadelphia, has been for some time occupied, and will shortly publish, with a chart, "Geological Observations on the Schuylkill," from Philadelphia to the northern boundary of Montgomery county.

Mr. T. A. Conrad and Mr. I. Lea have recently contributed many new species of fossil testacea, which tend

to elucidate the history of the Atlantic Tertiary formations.

Since Mr. Taylor's Memoir on the Fossil Fucoides went to press, we are gratified in being able to announce the arrival of magnificent specimens of some of the species, from localities cited by Mr. T. These interesting geological specimens, due to the liberality of Dr. James Mease, of this city, embrace masses of sandstone rock, in some instances several feet in extent, the surfaces of which are replete with beautiful petrifactions of these curious vegetables. They principally consist of the F. *Brongniartii*, F. *Alleghaniensis*, and the Lewistown species.

Mr. T. has recently informed us, that during the course of the present summer, he has observed at least two nondescript species of Fucoides in the *old red sandstone* of Tioga county Pennsylvania. We hope to see these fossils figured and described in the succeeding part of this volume.

In thus attempting a brief sketch of all that is novel or interesting in a highly important department of knowledge as pursued in the United States, we have thought it unnecessary to enter more minutely into the detail of individual exertion; those who feel an interest in American geology will of course refer to the original sources of information.

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Charles Pickering, M. D.
Timothy A. Conrad.

ERRATA.

Page 7, line 12 from bottom, for "their" read *them.*
9, line 6 from bottom, for "ascertained" read *ascertain.*
11, line 3 from top, for "weaves" read *waves.*
19, line 14 from top, for "Gorgo" read *Gongo.*
line 7 from bottom, for "Ionora" read *Sonora.*
32, line 4 from bottom, for "ci-devant of the Spanish" read *ci-devant Spanish.*
39, lines 6 and 16 from bottom, for "Prestroich" read *Prestwich.*
42, line 1, for "Chœlopus" read "*Cholœpus.*
43, line 3 from top, ditto.
51, line 9 from top, for "American" read *Animaux.*
65, line 5 from bottom, for "M." read *Megatherium.*
112, last line from bottom, for "measurers" read *measures.*
149, 8th line from bottom, for "South Brooks" read *South Brook.*
151, 9th line from top, for "common slate" read *talcose* slate.
155, 10th line from top, for "earthy water" read earthy *matter.*
—— 15th line from top, for "amalgamation" read *amalgam.*
—— 12th line from bottom, for "amalgams" read *amalgam.*
—— 8th line from bottom, for "parity" read *purity.*
—— 3d line from bottom, for "and we doubt" read, and *no* doubt.
458, 7th line from bottom, for "principal veins" read, principal *vein.*

In Fig. I. the letters C. and F. are omitted at the upper end of the straight lines, commencing at D. and E.

APPENDIX.

Observations on the Geology of York County, Pennsylvania, by Thos. G. Clemson, read October 29, 1834.

To the President and Members of the Geological Society of Pennsylvania.

Gentlemen.—We, the undersigned, having had the honour to be nominated by this society for the purpose of examining certain formations in the district called York County, in the state of Pennsylvania, proceeded thence, and now beg leave to offer the following observations:

The honourable members of the society are well aware, that a thorough scientific examination of any district of country would require the united endeavours of several, or the long continued observations of one well educated upon a multiplicity of sciences, all more or less included in the now comprehensive term geology. The mineral constitution of any portion of the earthy surface can only be successfully developed after indefatigable, mature, and multiplied examination, of all points, and these results compared with new and distant appearances. The naturalist's attainments should be great, his physical attendants the hammer, the compass, and almost a laboratory. No stone should be left untried, no ravine, no excavation unexamined; the mineral constituents, the fossil contents should be well classed; and after the profound consideration of these, with many other characters, the observer may come to a just conclusion of the nature, geological position of one or more distinct particular formations.

His first aim should be to fix upon some distinct member of the geological series, whose position has been well determined: this must be his north star, and it is only by constant refer-

ence to, and comparison with this, his fixed guide, that the naturalist can discover his bearings. A like determination is one of great importance, and we may say of absolute necessity to the prosecution of any geological inquiry. Geological levels are to the geologist as the compass to the mariner, and we would here beg leave to call the attention of the society to the attainment of this first and all-important object of research.

The short time we spent in York county scarce enabled us to commence an examination of this district, we humbly claim the indulgence of the very learned gentlemen of the society for the meagre gleanings we now offer. We have thought that the collection of facts concerning rocks, minerals, their localities, &c. might be useful in filling up some masterly and comprehensive chain of observation. If we were all to throw down upon paper the various rocks over which we pass in our different perigrinations, but a short time would elapse before we could present to the world a mass of information orderly embodied in a geological map of the state of Pennsylvania or of the United States of America.

The county of York is bounded on the north and east by the river Susquehanna and the county of Cumberland, on the west by by Adams county, and on the south by the state of Maryland. Indications of mineral deposits were here remarked at a very early period in our history. Copper was foundby some of the followers of William Penn in the township of Hellam, which was included in that portion of land set apart by him as his mining tract.

Two distinct ranges of mountains divide the county. The South Mountain, which is a most important range, takes its rise a little back of Dillstown, and continues on through Maryland, crossing the Potomac below Harper's Ferry; the Conewago hills are parallel, and have the appearance of belonging to the same system. The Pigeon and Round Top hills do not much deviate from an easterly and westerly direction. It is from the summit of the last mentioned hills, that the observer descries the distant and minor highlands, and can obtain a correct idea of the physical geography of this interesting district.

The two ranges mentioned, with their spurs, cause the streams that bathe their feet to be more rapid than if the country was less hilly or more gently undulating. The numerous falls that occur are of immense advantage to the manufacturing interests of the country; mill sites abound, several forges and iron smelting furnaces have been erected, and are now in active operation. The highly undulating surface of the country, and the strata of impervious schistose rocks, give rise to numberless springs.

That portion of the soil which is termed limestone land may be known on first sight, even when the rocks are not apparent, by the admirable order in which every thing appertaining to these farms is sustained. These lands were first settled by Germans, and their descendants retain them with a kind of religious attachment. The soil being naturally well adapted to the growth of wheat, and the farmer bestowing upon it all the labour requisite, is thus enabled to reap prodigious crops. The German farmer is characterised by his close industrious habits; and besides the prolific qualities of the earth, his great secret in farming is the quantum of labour bestowed upon a given portion, and this he could not do if he was possessed of too much, for one should never be mastered by the land; on the contrary the farmer should always rule his estate.

The slate land stands next in point of reputation, though in fertility far behind the former. The quality of the soil varies with the chemical composition of these transition rocks, which form the basis of the soil; certain varieties are passably good, whilst others are wretchedly poor. Wonders have been effected within the last few years by the application of lime. It is as if some quickening fairy queen had waved her miraculous wand over these long abandoned sterile grounds. Thousands of acres had been laying open as barren; dwelling-houses, barns, fences. &c. had been left by their owners to the dilapidations of weather and time; and they thus from the want of but one single simple, scientific application were forced to quit their places of birth, the sites of frolic and youthful mirth, and seek an apparently less ungrateful soil in the far wilds of the lonely west.

By the application of lime these grounds have been regenerated, the population resuscitated, the smoke is seen gently curling from the cottage in the wood, the ploughboy's whistle, and the lowing herds that fill the land with health and prosperity, have risen as from the dead. This is a living example of what science might do, and speaks loud to those who are tardy in perceiving the advantages that would result from the scientific investigation of the manifold hidden resources of the state which now lie slumbering in their wealth.

Near Dillstown, in Monahan township, on the land of Col. Eichelberger, there exists a bed of marl, which might also be happily employed in ameliorating the composition of some unhealthy soils: it might be added alone, or mixed and used in compost.

The rocks that show themselves in York county are decidedly Transition. We observed no appearance of organic remains, in place: specimens of encrinites were shown us from the bed of the Susquehanna, but they were specimens that had been carried down by the river, and cannot be considered as characterizing any rocks that we saw in situ. At some former period this district was the scene of violent eruption and dislocation. The direction of the strata of these schistose rocks is from a few degrees northof north-east to as many south of south-west, lying vertical at different, though generally at highly inclined angles.

If we turn our backs upon the South Mountain, leaving Dillstown, which stands near its base in Monahan township, proceeding on through Warrington, Dover, West Manchester, on to York, we will cross in succession the following rocks, limestone, syenite, eurite, greywacke, greywacke slate, or argillaschist, breccia, coal, and limestone upon which the city of York stands.

LIMESTONE.

This rock is frequently termed, and in truth is most known, as the blue limestone, from a frequent characteristic blue colour. It however is sometimes yellow and white, and almost black; in this case I have found it to be coloured with carbonaceous

matter. The yellow variety owes its colour to the presence of a small portion of the oxide of iron; it is usnally compact, occasionally crystalline, and passes into marble. Veins of milky quartz are contained, and detached masses are seen scattered over the surface. This rock constitutes a portion of Monahan, Hellam, East Manchester, York, Paradise, Codorus, Heidleberg, and Maeheim townships, forming a band which runs through the county from south-west to north-east, dividing the same into two pretty equal portions. In some of the adjoining states seams of limestone in concordant stratification are quarried and burnt for hydraulic cement, with the composition of which you have already been made acquainted.* The limestone of York county is burnt into lime, which is used for building, it contains no magnesia, and is employed for the uses of agriculture. This rock alternates distinctly with the schistose rocks of the transition series, and frequently passes insensibly into shales, without any apparent line of demarcation betwixt the two rocks. When the limestone becomes schistose it is called slate limestone; in this case there is always an insensible mixture with a different rock, the stratification being either straight or contorted.

In this formation there exists a cavern of considerable importance, situate at a short distance a little to the north of York; a branch flows in on one side, and reappears on the other side of the hill. There is also an opening into it from the top of the hill: a stone thrown in at this spot may be heard rumbling for a considerable time. The aperture below is too small for ingress, and owing to the precipitate descent from above, the only possible mode of gaining entrance would be by means of a rope from the summit.

FELSPATHIC AND AMPHIBOLIC ROCKS.

As you leave the limestone of Monahan township, and ascend those elevations known as the Round Top hills, the rocks change and display an evident entritic character. The base of the rock, when sufficiently porphyritic as to distinguish the imbedded crystals, from the imbedding substance, appears to be of a petro-

* Vide T. G. Clemson's paper on Analysis of divers Mineral Substances, Journal of the Franklin Institute.

silicious nature, containing small dark brown or black crystals of amphibole. The base in this case predominates, and is compact, having a bright colour. It is often of easy decomposition, and is seen disintegrating at the surface of the earth; at other times, it is exceeding hard and tenacious, giving off sparks with steel, and resembling in appearance some of the Egyptian syenites, out of which sphinxes and other pieces of sculpture were formed, specimens of which may be seen in the public sculpture galleries throughout Europe, and in the gallery of the Louvre of Paris: again this rock changes, loosing its porphyritic structure, passing into a compact homogeneous, sonorous, and less tenacious blueish-gray, and even black mineral, thus passing into different traps, greenstones, and Lydian stones. These hills have every appearance of having once been a centre of dislocation and elevation, and may have been upheaved after the formation of the transition series. These porphyries and diorites being of Plutonic origin, represent pre-existing rocks thus modified.

GRAYWACKE SCHIST.

This rock soon makes its appearance as you descend the Round Top hills, and disappears under the bed of the Conewago creek. It has a dark blue color, and is distinctly, though not finely stratified, and follows the same direction as the phyllades of the transition series of this county, that is, from a few degrees to the north of north-east, to as many south of south-west. Its schistose structure is not evident in cabinet specimens, but it is distinctly stratified in mass. The graywacke slate of Hunterdon county, New Jersey, resembles this formation except in color; at both localities they are characterized by nodules of epidote. In York this mineral is more abundant; it is massive green, and not so mixed with foreign matter as to mask its discriminating characters. The quality of this soil for agricultural process is indifferent, inferior to the limestone land, or that of the red argillacious slate.

GREYWACKE.

Immediately after crossing the Conewago creek, the appear-

ance of the earth changes; instead of a blue, we have a dark red clayey soil, formed from the decomposition of the argillaceous schists which are seen alternating with, and always upon the confines of the sandstone, which predominates as you ascend the Conewago hills. It changes its aspect at almost every step; it is sometimes a hard ferruginous quartz rock, compact, white, red, gray, and of a variety of hues, even to a black; at other times it is a well-eharacterised sandstone, with small crystals of hyalin quartz. The grains of quartz vary in size, and it passes into a conglomerate; the base being argillaceous, red, with perceptible scales of mica, the imbedded pebbles are generally rolled quartz, varying from the size of a millet seed up. It is occasionally of a light color, free from iron. The imbedded pebbles are uniform in size; the whole rock is hard, and employed in the county for making millstones for the various uses to which the Burr millstones are employed. Compact ferruginous varieties of the rock are used for gudgeons or boxes supporting the axis of water and other wheels; they are found to answer this end admirably well, and have superseded those of iron or steel. In building furnaces for the smelting of iron ores, a proper hearth stone is considered a very great desideratum The crucible is often built of bad materials, causing the furnace to be put out of blast at very short intervals, to the very great loss of the proprietors. The campaign of certain furnaces in our country is called good if the hearth has resisted one year; we know of furnaces that have been in blast constantly for twenty years, and one of the principal causes of this astonishing success is undoubtedly owing to the very great attention that was paid to the choice of the hearth stones. We will not here discuss the merits of such materials, but let it suffice to say that the quartz rock of York county has the appearance of being well fitted for this purpose, and by a proper choice we think that superior hearth stones might be here procured, if not equal to those found and used in the Hartz mountains, much better than many we have seen used for these ends in the United States.

The greywacke quartz rock caps the summit of the generality of the highlands throughout the county, there are also hills

entirely composed of it. The Pigeon hills, for instance, which run from the Susquehanna to Adams county, masses or boulders are to be met with on the surface of the ground at some distance from those localities where it is found in situ. At the river Susquehanna, between Marietta and Columbia, the quartz rock forms itself into several noble bluffs. The scenery here for miles along the river may be considered as remarkably fine, and many think it equally romantic with any in our country.

COAL.

Between the Little Conewago creek and the city of York, in the townships of East and West Manchester, a thin layer of coal has been discovered in several localities by those who have sunk wells for water. It was not, however, of sufficient thickness to arrest attention. At other localities fruitless attempts have been made to find coal, and we are sorry to perceive not only in this county, but in various directions through our country very many enterprising and worthy, but too credulous citizens have been led to expend, and frequently considerable sums in searching for this valuable combustible in those places where we might say, with some certainty, coal never will be found.

Our citizens have been so frequently imposed upon by pretenders who call themselves miners, or mining engineers, because they may have dug at Mauch Chunk, or at Pottsville, or in the coal fields of Europe—and having acquired a vocabulary of terms, go about the country proclaiming that coal may be found on particular estates, and that the only reason why it has not been found is because they have not dug deep enough, or that the granite should be pierced, or, in fine, that there is coal where in the very nature of things coal could not exist. Their confidence induces the farmer thus to bury his hard earned money, and it is not until he has been duped by these spurious individuals, that he has discovered his mistake. Nor is this abuse alone confined to the searching after coal, the whole alphabet of metals may be found by a branch of hazlewood, when in the hands of the gifted pretender. We cannot cry out too loud against these charlatans, and unworthy, ignorant offenders. The facility with which these impostors de-

ceive, arises out of the difficulty in our country of acquiring scientific information of a certain kind. The arts of mining and metallurgy are of difficult acquisition every where; they require a great deal of profound theoretical knowledge, and very close practical observation; consequently they are by no means intuitive, and can only be purchased by long, laborious, and indefatigable exertions, not from books alone, but from the living school where the play of nature has been exposed to view, with the economy of art, where the furnace has taken the place of the crucible; nor is theory less useful, it is a glorious light which serves to conduct the operative through the dark labyrinths of practice.

BRECCIA.

On the confines of the blue limestone, which reappears a few miles to the west of York, there is found a breccia composed of a red argillacious cement, and masses of older rocks. The imbedded masses are of various sizes, and the majority of them are limestone, proving its age in relation to the limestone rock. This breccia has a very pretty effect when polished, and might be used for the same purposes as are the common marbles. It continues on, and is seen at the Susquehanna not far from Yorkhaven. You are all acquainted with that beautiful pudding stone, out of which the columns that ornament so richly one of the halls in the capitol at Washington have been made. This rock is precisely similar, and like that found on the banks of the Potomac is known in York county, and throughout the United States, as the Potomac marble.

TRAUMATES.

We will pass over in silence the limestone upon which York is located, it having been already described. In journeying in any direction, after leaving the city, from south-west to south-east, you will shortly come to the traumates of D'Aubuison, phyllades and transition slates of other geologists. These schists are characterized by a more perfect stratification than other rocks in the county; they are straight, undulating and inclined, and folllow a general direction with the other formations; that is to say, nearly north-east and south-west; the layers are di-

vided into a multiplicity of differently characterized strata, having all the variations of texture, composition and color, disintegrating at the surface into small, variously shaped pieces, and giving various colored powders. Clay or argile is evidently sometimes the most abundant constituent; chlorite predominates, and the aspect changes, as also the texture, and form a chlorite slate; the talc prevailing, a talcose slate well characterized appears, a greenish hue denotes the presence of either, and it is difficult to say whether the chlorite or the talc most abounds. At certain times, however, and in certain localities, the talcose slate is apparently free from chlorite, and is of a reddish hue, from the oxide of iron, and divides into laminæ, which have that particular satin lustre that accompanies magnesian rocks. There is a seam of red talcose slate that runs through the townships of Windsor, York, Shrewsbury and Codorus, into the state of Maryland; the width of this slate varies, and passes into chlorite slate, argillaceous slate, and a variety of slates, badly defined or characterized, and varying as either of the constituents prevail. These rocks as the rest, run nearly a north-east and south-west course. Ferruginous quartz is found upon the surface of the ground, and occurs in veins traversing the laminæ, and at other times seams of quartz run parallel with the strata, and between the leaves of the same, at places, the quartz is swollen out and gradually diminishes so as to almost disappear, assuming somewhat the form of a lentille. This the German miners term liegende stock, an example of which we have just endeavored to describe may be seen on the Baltimore road, in Shrewsbury township, on the side of a hill, near a public house known once and marked on the maps of the county, as Wilson's tavern. Veins of quartz are common to this formation; the quartz is more or less ferruginous and frequently cavernous; sometimes it contains hæmetitic oxide of iron, at others the peroxide, impregnating the whole and encrusting the caverns; appears to have come from the decomposition of pyrites. In some cases the iron pyrites have undergone no change, and are of the varieties yellow and white. Cubic crystals of this mineral are found imbedded, and may be found upon the surface of the soil; after a rain in small washes they may be collected with

ease and sometimes in abundance. The ferruginous, cavernous or drusy quartz that is found in veins, in the talcose, or contiguous rocks, is often so friable as to be crumbled by pressure with the hand, its structure becoming schistose, a mixture with surrounding rock is apparent. The roads are mended with this mineral, and, as we have observed, it is common upon the surface of the ground in all directions in the neighborhood of these talcose, chlorite, argillacious schist and limestone formations. These rocks, as also do the contained quartz, bear a very strong resemblance to those of the gold belt of Georgia, North and South Carolina, and Virginia; and so great indeed is the analogy between specimens of auriferous quartz from the several southern states and those of this county, as not to be distinguished but by reference to the label. My friends, Mr. Calvin Mason and Dr. Fisher, of whom I speak with a lively feeling of pleasure, remembering with gratitude their polite attentions to me whilst in York, these gentlemen, after frequent and close research, have discovered gold in quartz at different times and different localities within the limits of the formations we have just had the honor to describe.

No mines have yet been worked for gold in this county, and it was owing to the above named gentlemen having found some particles of this precious metal in quartz, that a loose notice gained its way into some of our public journals. A short distance above Columbia, on the Susquehanna, and in the county of Lancaster, a horizontal drift has been run into that hill known here by the name of Chicky's rock. This work is of trifling importance, not being in length above fifteen feet; it was then abandoned; some ore lay at the mouth of the work, and that which was pointed out to me as being good, was a heterogeneous mixture of chlorite, quartz, oxide of iron, feldspar &c. The gentleman who had superintended these workings informed me that the quartz here found contained sufficient gold to pay and yield. He was then engaged in researches for auriferous quartz, in the vicinity of Keysie's ferry, in Hellam township. The country hereabout is rugged and romantic, the rocks back of the ferry exhibit indications of copper, and the gentleman who caused to be assayed many specimens of quartz found in this vicinity, discovered the gold to be most

abundant in and about those places where the iron and copper met, or where different rocks came together, deranging the regularity of the quartz veins. I have also been informed that the iron ores of this county,—we speak of those near or in the limits of the gold range,—all contained gold. The presence of gold is by no means as rare an occurrence as many believe, for many sands used for making glass contain a small quantity of this metal; so little indeed is the proportion as only to be sensible by long accumulation from large quantities of sand, made evident in the manufacturing of glass. The crucibles used for containing the liquid salts, after having served for months this end, are cast off. On examination, small portions of gold have been found in the bottom of the vase. The discovery of the presence of this metal is of no importance; it is the proportion only that must be considered, and this must vary with the nature of rock, the surface of country, and a multiplicity of other considerations which grow out of the nature and mutability of things. Our object here was not to examine into the relative richness of any particular part or locality of this district, but to enable those to judge from a description of the whole, the nature of these formations when compared with those that characterize certain parts of those states in which gold has been found in sufficient abundance to interest capitalists, and which has now long since been an object of public attention. From the imperfect descriptions we have given, you will judge these formations to be similar. Gold has been found in quartz, visible to the eye, and when in too minute particles to be discovered by ocular inspection, it is nevertheless frequently possible to separate, with advantage, the gold by chemical means.

The specimens of minerals and rocks of this country we expected to receive ere this; had they arrived, we should now have offered to the society the results of chemichal examination; however, we place but little value upon the results of such examinations; assays of individual specimens are by no means just expressions of the whole, still we hope shortly to furnish these results to those who desire them.

Of the prevalent rocks that are found in the lower portion, or south-east part of the county, we can say but little, not hav-

ing had occasion to visit the same, but judging from specimens shown us. The hills near the Susquehanna appear to be composed principally of shining argillite or glimmer sheiffer. There is a fine quarry of slate in the township of Peachbottom; the quality of this useful mineral is very good, and is much used throughout this and the adjoining counties, for roofing slate.

We subjoin a partial list of mineral species found in this county; it cannot but be imperfect, but may answer for a commencement:

QUARTZ.—Hyalin, milky, ferruginous, drusy, auriferous, massive, Lydienne, prase.

Colophonite, garnets, wavelite, chlorite, epidote, pipe clay, haloysite, talc, amphibole, mica, feldspar;

Carbonate of lime, white, yellow, blue, &c.

Marl.

Oxides of iron—octohœdral crystals of, and micacious, magnetic, hœmetitic.

Sulphuret of iron.

Copper—native, red oxide, carbonate, sulphuret.

Gold—native.

Lead—sulphuret.

The ostensible object of the author's visit to the county of York, was to examine "the gold region and gold mines." How far this end has been attained, you are the better judge. Having tarried a much shorter time than our desires would have dictated, we were prevented from examining in detail the entire mineral riches of this interesting district; still, we have endeavored to pourtray the leading geological features of the county.