SCIENCE.

FRIDAY, AUGUST 31, 1883.

SONNET.

THE years through which aught that hath life, O Sun!
Hath watched or felt thy rising, what are they
To those vast aeons, when, from night to day,
From dawn to dark, thy circuit thou didst run,
With none to greet thee or regret thee; none
To bless thy glowing harbinger of cloud,
Rose-tinted; none to sigh, when, like a shroud,
The banner of Night proclaimed her victory won?

Yet through that reign of seeming death, so long
To our imperfect ken, the marvellous force
Which means to ends adjusts in Nature's plan
Was bringing to the birth that eye of man
Which now, O Sun, surveys thy farthest course, —
A speck amid the countless starry throng.

JOHN READE.

NOTES ON THE GEOLOGY OF THE TROAD.

A brief summary of the results derived from the observations made in connection with the Assos expedition.

THE terranes of the Troadic peninsula comprise a variety of stratified and massive or eruptive rocks. The former, excepting the most recent deposits, which are not considered in this connection, may be divided into three groups, according to their mineralogical conditions and geological age.

The most ancient group is highly crystallized, and, in all probability, belongs to the mica-schist zone of the 'grundgebirge' or archean formation.

The youngest group, embracing the miocene and pliocene tertiary deposits, is, in part at least, well characterized by its fossils. The middle group is not defined, excepting by the widely separated limits of the other two groups. It embraces rocks which may be paleozoic or pre-paleozoic, as well as others which are probably of cretaceous and eocene age.

The crystalline schists have their greatest development in Mount Ida, of which they form almost the entire mass. They are of many varieties, all conformably interstratified, as if all belonged to the same great terrane.

True gneisses are not abundant, and occur chiefly upon the north side of Mount Ida, under such conditions that they appear to overlie the schistose rocks. In Hagi ouldòuren-dagh the mica is in large part replaced by hornblende, so that the gneiss has a somewhat dioritic aspect.

In the schistose rocks, chiefly amphibolites, hornblende is one of the most widely distributed and abundant minerals. It generally appears as actinolite, and not infrequently constitutes almost the whole of the rock in which it occurs. With amphibole, at times, are associated, besides plagioclase, more or less quartz, epidote, magnetite, titanite, and rutile. True mica-schists are of less common occurrence interstratified with the amphibolites.

Near the centre of Mount Ida, the oldest rocks crop out; and among them are talc-schists, which, by the gradual addition of olivine, pass into small lens-shaped masses composed almost exclusively of the latter mineral. According to the nomenclature of Brogger, this rock should be called olivine-schist. By alteration it gives rise to serpentine with the characteristic reticulated structure which ever marks the serpentine derived from olivine. Occasionally the fibrous serpentine forms veins of considerable size in the adjacent rocks.

The olivine-schist, where purest, has no schistose structure. The passage from talc-schist, in which no olivine occurs, to that composed almost completely of olivine, takes place sometimes within a short distance. The chief mass of the rock, however, is a middle stage between the two extremes, having a distinct schistose structure, and composed for the most part of olivine and talc, besides considerable quantities of pyroxene, as well as other minerals not yet determined. At various intervals throughout the zone of schistose rocks, occur rather coarsely crystalline white limestones.

The structure of Mount Ida is a comparatively simple anticlinal, with so short an axis extending east and west that the upper portion of the mountain is approximately a dome.

The highly crystalline stratified rocks are perhaps the chief topographical determinants of that region. Their position and distribution indicate, that, in the early stages of its development, the peninsula of the Troad was represented by several islands, which furnished much of the detritus for subsequent formations.

The rocks of the middle zone are for the most part semi-crystalline limestones, a very ferruginous quartzite, together with greenish,

somewhat schistose rocks, and others which are macroscopically like argillites, but contain too large a proportion of quartz. The limestone is generally compact, gray or reddish colored, very like the cretaceous (according to Professor Neumayr) in the acropolis at Athens, and has often large quantities of silica so irregularly accumulated as to produce a very rough weathered surface like the cretaceous limestone west of Smyrna. This limestone is found chiefly about the base of Mount Ida, at Edremit, Qojùkia-dagh, and Chalỳ-dagh, as well as between Qayalar and Ahmadja, and several kilometres south-west of Ilisfagy. At Qojùkia-dagh it is peculiar in containing many small needle-shaped quartz crystals. The ferruginous quartzite was observed only upon the acute summit of Dikili-dagh.

The greenish, somewhat schistose rocks, with sandstones of the same color, near Ahmadja, as west of Smyrna, overlie the limestone. The cretaceous age of the limestone at the locality last named appears to be quite definitely determined by Strickland, Tchihatcheff, and Spratt; but the age of that near Ahmadja is yet uncertain. Only one fossil has been found in it. Concerning this, Professor Neumayr writes, "It is a Rhynconella which is so widely distributed that it cannot be used as a certain means of determining the age of the strata in which it occurs; but the limestone is probably cretaceous."

That these rocks are younger than those of the mica-schist zone is indicated, not only by the fact that they contain fossils, and are less crystalline than that group, but also by the fact that they are made up of sediments derived from the crystalline schists. On the other hand, that they are, at least in part, old rocks, is shown by the contact zone produced in them by the quartz diorite.

In 1881 Mr. Frank Calvert, American consul at Dardanelles, discovered undoubtedly eocene fossils (determined by Professor Neumayr) at several places in the Troadic peninsula outside of the region visited by the geologist of the expedition. The same rocks, in all probability, occur also in the southern Troad; but, until further investigations are made, their appearance must be left doubtful.

It seems probable, therefore, that in the intermediate zone there are a number of terranes of different age. It should be stated in this connection, that the rocks of the southern Troad, placed by Tchihatcheff provisionally in the lower tertiary, are, according to Professor Neumayr, of more recent origin.

The third or youngest group of stratified deposits, embracing those which are certainly not older than the miocene, may be divided into two portions. Geographically they are entirely distinct, and their stratigraphical relations are yet uncertain.

The rocks of the sarmatic stage (tufa) of the miocene, so well exposed at Eren-kiêui, are now known to border the western coast from the Trojan plain to beyond the mouth of the Touzla, near the promontory of Baba-bournou.

At the site of ancient Hamaxitos, several kilometres south-west of Kinlahly, the 'mactra-kalk,' with its characteristic fossils, forms the acropolis. This limestone is undoubtedly of marine origin; and although it has a wide distribution north-eastward, toward the Caspian and the Vienna basin, yet it has not been recognized farther south-west than the coast of the Troad.

Beneath the limestone, as at Eren-kiêui, is a great thickness of sand and clay beds which are underlaid by a conglomerate, and probably at the bottom of the series a stratum of red clay. The conglomerate is composed chiefly of fragments of andesite and liparite. Fossils have not been found in these beds near Hemaxitos; but at Eren-kiêui, according to Calvert and Neumayr, organic remains are not infrequent, and of a mixed character, indicating that the strata belong, at least in great part, to the sarmatic stage. The marine beds which overlie the mactra limestone are largely developed south of the mouth of the Touzla, and contain great numbers of fossils, among which are many Ostrea and gastropods.

The second portion of the tertiary deposits occupies a large part of the interior of the Troad about the great plain of the Menderè, between Ezine and Bairamitch, as well as along the southern coast, west of Papazlỳ. It has furnished but few fossils, and they are of such a character that its age cannot be determined with certainty. However, according to Professor Neumayr, who has kindly undertaken the determination of the fossils collected by the expedition, it must be upper miocene, miopliocene, or lower pliocene. That it is in great part a fresh, or at most a slightly brackish water deposit, cannot be doubted. As has already been shown in a preliminary report, where these deposits are described at some length, the basis of the series is a conglomerate in which fragments of the basalts, andesites, and liparites, have not been found. It is overlaid by a series of shales, upon which, between Demirdji-kiêui and Narly, rests a puzzling rock, regarded by Tchihatcheff as limestone. It is usually pale-yellowish colored, soft, light, and

porous, and generally shows no trace of effervescence in hydrochloric acid. In general appearance it closely resembles an impure siliceous limestone from which the greater portion of the carbonate of lime has been leached away. Having a thickness of about a hundred and thirty metres, it becomes the chief topographical determinant of that region, and gives rise to profound gorges and bold escarpments. Throughout the greater portion of the mass, it is uniformly fine-grained, but under the microscope has the structure of a tufa.

The upper beds of the series, consisting of thin fresh-water limestones, sandstones, shales, and a large proportion of stratified tufas, with conglomerates, have not been seen east of Demirdji-kiöui. The fossils collected were found in this portion of the series; and it is evident that the ejection of the andesites began before the deposition of those beds was completed.

Numerous oscillations of the land, as indicated by the varying character of the strata, must have occurred during the miocene and pliocene; and, in all probability, these were connected with the extrusion of the eruptive rocks so abundant in that region.

The massive rocks of the Troad belong in part to those of pre-tertiary origin, but the greater portion were extruded since the beginning of the tertiary period. The older group includes biotite-hornblende-granite, quartz-porphyry, quartz-diorite, augite-porphyrite, melaphyre, and serpentine, while the younger group embraces liparites, andesites, augite-andesites, basalts, and nepheline-basalt.

The biotite-hornblende-granite occurs in a stock-like mass, forming the serrated ridge of Chigri-dagh. It is distinctly younger than the highly crystalline stratified rocks which it penetrates, and is especially interesting from the fact, that, where it is altered, the titanite is changed to anatase. The alteration of titanite and ilmenite to anatase is doubtless a common and widely distributed occurrence; but, as the crystals of anatase are so small, they have generally been overlooked.

The quartz-porphyries are chiefly microgranites, and are younger than the biotite-hornblende-granite through which they have been extruded. The dikes in which they occur are comparatively small, and do not exercise much influence upon the topographical features of the country.

The quartz-diorites form a number of comparatively small stöcke about the base of Mount Ida, and are evidently younger than the quartzose argillite of the middle zone of stratified rocks, which, in one case, has been metamorphosed into a cordierite and andalusite hornfels. It is to be especially noted that these eruptive rocks do not, as formerly supposed, enter into the structure of Mount Ida.

The augite-porphyrites (diabase-porphyrites) and melaphyres are, as far as yet known, limited to five outcrops, all lying in a line near the southern coast of the Troad, and, with the exception of that between Ahmadja and Qyalar, are not important. At the locality just named it is of especial interest from the fact that melaphyre was the first rock extruded in that isolated (completely surrounded by tertiary strata) volcanic centre, and was followed later by mica-andesite, hornblende-andesite, augite-andesite, basalt, and, late if not last, by a large outpouring of liparite.

The serpentine in the anterior part of the Troad about Qarà-dagh has been derived from olivine-enstatite rocks of a truly eruptive nature. The almost entire absence of the characteristic reticulated structure in some of the serpentine from the Kemar valley leaves, perhaps, some doubt as to the original rock from which it has been derived. As previously stated, the serpentine about the summit of Mount Ida has been derived from olivine-schist which undoubtedly belongs to the stratified rocks.

Although the ancient eruptive rocks are apparently not nearly so abundant as those of more recent origin, yet they represent very nearly the same range in chemical and mineralogical composition. The granite and quartz porphyries have their modern equivalents in the liparites; the quartz-diorites, in the mica and hornblende andesites; the augite-porphyrites, in the augite-andesites; the melaphyre, in the basalt. However, no equivalents were found for the nepheline-basalts and the ancient olivine-enstatite rocks. On the other hand, the syenites, and their modern representatives the trachytes, which were once supposed to be abundant in the Troad, are now known to be at most only very sparingly represented.

The liparites occur in various types, with many varieties, and are limited to the southern part of the Troad. They appear also south of Molivo on the island of Mitylene, and at Sal Mosac south-west of Aivalÿ. They are generally in the stony condition, but frequently glassy upon the boundaries, and contain many fragments of the andesites which they have penetrated and overflowed. They always occur in dikes, as at Qozlou-dagh and the great plateau, which give rise to the peculiar drainage of the Touzla River. That some of the liparites

were extruded before the deposition of the 'mactrakalk' is certain; but, from the fact that the exact age of the tertiary deposits in the southern part of the Troad has not been definitely determined, the time of the extrusion of the great mass of the liparites cannot be stated. However, it occurred most likely at the beginning or in the early part of the pliocene, when the land was raised above the sea, and the islands converted into a peninsula.

The andesites embrace typical mica-andesites and hornblende-andesites, as well as a great variety in which mica and hornblende occur in nearly equal proportion. These, with augite-andesite, occupy a great area between the Menderè and the southern coast; and, unlike the liparites, they seem to have reached the surface, at least in some cases, through volcanic vents. Not unfrequently they occur in dikes also, and have evidently overflowed a large area of late tertiary deposits.

Their extrusion along the western coast began before the deposition of the 'mactrakalk,' and along the southern coast during the formation of the fresh-water deposits of that region. Pyroxene is generally a prominent constituent of the andesites, and frequently both rhombic and monoclinic pyroxenes occur together. The former is generally the most abundant, and has in one case been proved to be hypersthene. It occurs not only in the mica-andesite at Assos and Smyrna, but also in the hornblende-andesite north-west of Qozlou-dagh, and the augite-andesite west of Sivriji-bournou. Among the great variety of andesites may be mentioned the oldest which flowed from the crater at Assos. It is a mica-andesite, in the groundmass of which is a large proportion of apparently primary mica and hematite.

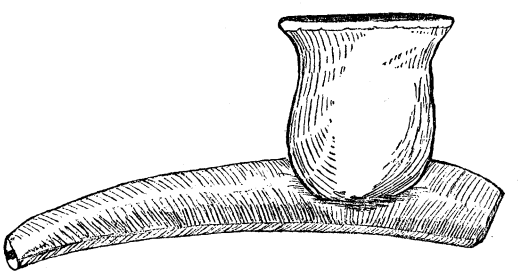
The basalts occur in dikes, and, although widely distributed, do not occupy large areas. Along the southern coast of the Troad it is of an andesitic type, and the olivine is occasionally altered to distinctly cleavable pleochroitic serpentine.

The same phenomenon is better developed in the typical nepheline-basalt which forms the prominent hill called Qaràlyly or Qapandjà-tepe, near the centre of the Troadic peninsula. The basalts and nepheline-basalt are evidently younger than the tertiary deposits with which they are associated; but the time of their extrusion with reference to that of the other eruptive rocks of the Troad cannot be definitely determined. J. S. Diller.

Greason, Cumberland County, Penn.,
June 4, 1883.

OCCURRENCE OF MOUND-BUILDERS' PIPES IN NEW JERSEY.

Until recently the one form of stone implement which is characteristic of the mounds of Ohio and westward, and that has not been duplicated in surface finds in New Jersey and elsewhere on our northern Atlantic sea-board, is the so-called mound-builders' pipes, such as were discovered in great numbers, and described in detail by Squier and Davis in the 'Ancient monuments of the Mississippi Valley,' and more recently by several authors. These pipes may be characterized as having a small bowl, usually in the shape of a bird, mammal, or human head, placed upon a short, flat, and slightly curved base, so perforated that it was used as the stem of the pipe. In other words, it was a complete smoking implement, and therefore unlike the ordinary pipes or pipe-bowls found in New Jersey and the New-England states, which, as a rule, required the addition of a stem of reed or hollow bone, to be used as the mouthpiece.



Within a few weeks, a pipe of the pattern I have described, assumed to be peculiar to the mound-builders, has been found in New Jersey. While the bowl is perfectly plain, except a slight scalloping of the rim, it will be seen at a glance, that the specimen is essentially of the same pattern as the 'animal pipes' found in Ohio, and recently also in Iowa.

Previous to 1882, I had been unable to find any pipes of this pattern, or traces of native copper implements of any kind; but since then copper spears, such as are found in Wisconsin, have been found in New Jersey, and now the pipe that I have described, and of which an illustration is given. Recently, also, specimens of flint arrow-heads have been collected, which in size, and delicacy of finish, are equal to the best examples from Oregon.

These specimens are now briefly referred to, as indicative of the fact, that in skill in working flint, and in the range of handiwork, whether in stone, bone, or clay, the difference