

Base of the deposit about 6 feet above high water. Boulders on the present beach. Rock platforms are visible at about high-water mark.

c. In Porthleden Cove the following section was taken:—

Head, brown loam with small angular pieces of quartz, containing small fragments of slate, and, occasionally, granite, 12 feet thick; upon yellowish-brown and brown loam with a few angular fragments; upon well-worn and subangular boulders with a few large pebbles, a few feet above high water.

d. Mr. Godwin-Austen (Q. J. G. S. vol. vii. p. 121) notices the occurrence of granite pebbles, under yellowish clay, with large and small angular stones, and from 5 to 20 feet in thickness, at Creek Tor, in the parish of St. Just, Penrith.

e. On the north of Cape Cornwall, Mr. Carne (T. R. G. S. Corn. vol. iii. p. 229) noticed a bed of slate boulders, 2 feet thick, and a chain in length, on greenstone at 10 feet above high water. The boulders were imbedded in clay and sand with small slate particles.

14. Pendeen Cove (*op. cit.*). Mr. Carne observed 3 feet of small pebbles in sand, made up of comminuted marine shells and pulverized granite, in one place capped by a bed of sand, overlain by 60 feet of Head. The base of the deposit is at about the level of spring-tide high water. The sand is in process of consolidation by iron oxide; it appears to have been blown from the beach into the interstices of the gravel.

(To be continued in our next Number.)

NOTICES OF MEMOIRS.

I.—GEOLOGICAL NOTES ON WESTERN AFRICA. By Dr. O. LENZ.¹

[Communicated by Count MARSCHALL, F.C.G.S.]

1. *The Gabbro of Monrovia.*—Gabbro appears near Monrovia in the form of irregularly fissured, isolated massives, rising above hills covered with the richest tropical vegetation. In its fresh condition it is dark green, distinctly granular, without any traces of schistose or porphyritic texture. Microscopical investigation proves a light-grey plagioclase to be its chief component, together with light-yellow tabular crystals of diallage, and interspersed particles of titanate of iron. The presence of serpentine also is probable, although not ascertained by positive observation.

2. *Polished Rocks in the Beds of Rivers.*—Several of the West-African Rivers, opening into the Atlantic, force the lower portion of their course through a low and long chain of crystalline schists and quartzites, striking N.-S. Violent rapids, cataracts, and cascades, especially in the Congo and Ogowe, are serious obstacles to navigation. The rocks in the bed and on both banks, as far as they come in contact with the waters, are covered with a thin dark-brown varnish-like crust of extremely thin lamellæ of oxyd of iron, whose uppermost surface, continually exposed to the action of water,

¹ [Proceed. Imper. Geol. Instit. Vienna, January, February, and March, 1878.] See also *GEOL. MAG.* Dec. II., Vol. IV. p. 27, and Vol. V. p. 312.

assumes a metallic brightness. The crust is most conspicuous on the gneisses and on the mica-schists with garnets in the Apinshi region. It is absent as well on the portions above the contact of water as on the rocks along the banks where the water flows quietly.

Similar facts have been ascertained on the Rapids of the Nile, on the Cataracts of the Congo (by Captain Tuckey), and on the syenite rocks along the Orinoco (by Alex. von Humboldt). Dr. Darwin observed a black crust, similar in appearance to graphite, on the banks of several Brazilian rivers which open into the Atlantic. Berzelius found this crust to be composed of oxyds of iron and manganese.

The older crystalline rocks of North-west Africa are everywhere overlain by a (probably Diluvial) deposit of intensely yellow, loamy, and highly ferruginous sands, including large blocks of brown hydroxyd of iron. These blocks are aggregated concretions of the size of beans or peas, similar to the pisiform iron-ore of Europe. When such blocks are decomposed, the concretions, bearing distinct marks of having been rolled, are spread over an extensive surface. The rivers carry with them enormous quantities of fine white quartz sand, with flakes of mica, which every year during low water are deposited in enormous sand-banks, rising several mètres above the sea-level. The waters, whirling violently against the rocks, keep in suspension the quartz grains and the concretions of iron-oxyd, and the last material, comminuted by the friction of the hard sand, is deposited on the surface of the rocks in the form of a thin crust.

3. *Geology of the Gold Coast, Guinea.*—The gold here appears in the shape of dust or granules, seldom of the size of a pea. The natives wash it out of the clays and sands in a most primitive way; and they frequently adulterate it, by boring holes into the granules, filling up the cavities with copper or brass, and carefully closing them again. The primary locality of the gold is still unknown.

It is washed everywhere also in the region of the Senegal and Gambia Rivers, as near Cape Palmas, out of a red clay, of probably comparatively recent origin, including layers of rolled ferruginous fragments. Near Accra, close to the sea-shore, there is a coarse-grained, intensely red, and somewhat argillaceous sandstone, with intercalated layers of large rolled fragments of quartz, and without any traces of organic remains. At first view it has a resemblance to some of the Triassic beds of Germany. Further inland are gneisses and granites; and in the Ashanti region and along the river Volta there are fine black amphibolic schists, abounding with garnets, locally of rather large size. Possibly, as in the Ural, these schists may be the primary locality of the gold.

4. *Itabirite (Iron mica-schist) of the Okande Region.*—The Okande region is situated some sixty geographical miles inland, amidst the rapids of the Ogowe. This river breaks its way westward through a chain of schistose rocks, with a main strike N.-S., and with a very steep dip from W. to E. The Itabirite rests on a very thick stratum of white and red quartz, the same which appears, at a lower horizon, intercalated among the mica-schists with garnets of the Apinshi region. In its upper horizons it passes gradually into quartz.

The Okande Itabirite is hard and heavy, its colour is reddish-purple; its texture granular-schistose; its components are quartz, specular oxyd of iron, and magnetic iron. The quartz is conspicuously prevalent, in the form of whitish-grey granules, in coherent parallel layers. The specular iron-ore appears in bright black lamellæ, scattered in the quartz, and frequently bearing a crust of red oxyd of iron. This oxyd appears, likewise, in coherent layers, parallel to those of quartz, and alternating with them. Thus a tranverse fracture offers an alternation of rather broad red and white stripes, interspersed with bright lamellæ of iron-ore. Magnetic iron-oxyd is scattered in minute particles throughout the whole, so that large specimens of this rock cause a marked irritation of the magnetic needle. Atmospheric agents give rise to a thin outward crust of hydroxyd of iron, and make the surface irregularly rough, the quartz offering a greater resistance to these agents than the portions impregnated with oxyd of iron.

The Itabirite of Okande differs from that of Brazil by not including such accessory minerals as gold, talc, chlorite, iron-pyrites, and actinote. Itabirite and analogous rocks, associated with Itacolunite, were first found in the Schist-formation of Brazil, subsequently in South Carolina, the South-east of France (Département du Var), Portugal (Tras os Montes), and Germany (Soonwald).

The Okande Itabirite is a normal and important constituent of the West-African Schist-formation. It assumes generally the shape of low and ragged cliffs in the river-courses. In the plain of Lope it disappears, almost entirely, beneath beds of Diluvial loam of comparatively recent origin.

5. *Geology of West Africa.*—The islands in Corisco Bay, somewhat north of the Equator, rise about ten mètres above the sea, and are composed of a light-coloured calcareous sandstone, in horizontal strata, overlain with vegetable soil, and extending eastward as far as the mainland at the mouths of the Rivers Muni and Munda. These strata contain many casts of very large, inflated, knotted, and carinated Ammonites, closely allied to *Ammonites inflatus*, a characteristic fossil of the Upper Gault. A well-preserved fragment of this species has been found farther south, in Fish Bay (Benguela). Small, badly preserved Bivalves are of rare occurrence: and carbonized stems of indeterminable plants are frequent. Numerous fissures in every direction are filled up with an uncommonly hard and solid ferruginous sandstone, occasionally also with oxide of iron.

Near Gaboon, white limestones, about two mètres thick, with many veins of calcite, and with local accumulations of Gasteropods, Bivalves, fragments of Crustacea, Echinida, etc., rest on Cretaceous Sandstones. The above-mentioned deposits bear an Eocene *facies*, and are strictly local.

The horizontal Tertiaries of the Loango Coast are overlain by an unstratified deep yellow loam, with nodules of white marl and hollow concretions of hydroxyd of iron, thus nearly resembling Loess. This loam, destitute of organic remains, extends along the

coast of Gaboon, on both banks of the Ogowe, even to the outposts of the West-African Schist-formation. Its surface is covered with innumerable granules of pisiform iron-ore, resulting from disaggregation of the concretions of hydroxydated iron. The whole deposit may be compared with what is generally called Diluvium, and may be coeval with the origin of the Ogowe Lakes, on the withdrawal of the waters into their existing beds. Still, a number of larger and smaller lakes exist on both sides of the Ogowe, connected with it by channels, a narrow wall of loam, at most ten to fifteen mètres in height, standing between lake and river. Many blocks of schistose rocks, probably transported by the waters once filling up the whole region from Gaboon to Ncomi (Kamma), are spread over the surface of these natural dykes. The analogy of this loam with the Laterite of East India is conspicuous. At present the Ogowe, in its whole course, down to a few miles above its mouth, carries and deposits only enormous quantities of purest quartz sand, without any trace of loam; while the adjacent loam dykes are completely devoid of arenaceous beds.

The foremost chains of an extensive range of crystalline schists, spreading from the inmost corner of the Gulf of Guinea, Southward to Angola, appear in the Okota region about forty miles inland. The range is composed of many parallel chains, dipping eastward with a steep angle. The lowermost horizon (Okota) has a group of thin-bedded, light-coloured, fine-grained schists, with some mica, locally talcose, and in one place containing a great lenticular intercalation of steatite. Subordinate beds of red and white quartz are not rare, both in the schists, and in the typical granatiferous mica-schists. A ferruginous schist, closely resembling the Itabirite of Brazil, exists along the frontier of the Okande region. Great beds of black siliceous schists extend from the River Okne to the Cataracts of Ndume, at the commencement of the inner plain. Granite, in fine varieties, appears only in large erratic blocks, brought probably from the interior when the Ogowe had a far larger bed.

The *massif* here described appears on the maps as Sierra Complida and Sierra do Crystall, and may be conveniently designated as the West-African Schist Mountains. Globular segregations, including fine crystals of yellow and reddish quartz, and covered on their surface with a peculiar network much resembling honeycomb, are found in both original and derivative situations, in the latter case having probably been transported out of the black siliceous schists mentioned above. The volcanic region of the Cameroon and Rumbi Mountains extends over more than 100 German miles; its highest summits, ascended by MM. Burton and Mann, exceed 13,000 feet. The existence of twenty-eight craters has been ascertained. All the lava-currents have gone southward; and, in this direction, the marginal ashes and slags of the craters are lower and are cut through. Emanations of smoke prove all this region to be still in the condition of a Solfatara. An eruption is said to have taken place between 1830 and 1840; details, however, are wanting. This region is south-westward of the volcanic islands of Fernando Po, Principe

Thomé, and Anobon; and a prolongation of the line connecting these islands reaches St. Helena.

The Clarence Peak on Fernando Po has a height of above 10,000 feet; smoke and fire are said to have been occasionally observed on it. The small island of Anobon seems to have been a single volcano, whose crater has become a lake. Dr. Pechsel-Lösche found on the coast of Loando (3° to 5° S. Latitude) a dark-brown very argillaceous rock of loose oolitic texture, containing Corals and many specimens of *Leda*, *Mactra*, *Tellina*, and *Cardium*. Near Landana, well-preserved remains of Fishes (among them the vertebral column and head of a large individual), teeth of Raïæ, palatal teeth, fin-spines, the tooth of a Crocodile, and a coprolite, were found, together with a large Nautilus, some small Gasteropods, and Bivalves. A light-coloured limestone along the coast south of Congo has abundant shells of *Ostrea*.

Very little is known of the Geology of Angola and Benguela. Granites, schists with abundant copper-ores, volcanic rocks, rock-salt, and asphalt are said to occur there. Limestones, in horizontal beds, possibly connected with those along the south coast, and prismatic basalt near Old Calabar, have been observed. The natives oppose any approach of foreigners to the rock-salt deposits.

II.—ON THE QUATERNARY DEPOSITS AT WESTEREGELN AND THIEDE, NEAR BRUNSWICK; IN ILLUSTRATION OF THE SUBAERIAL ORIGIN OF LOESS. By Dr. A. NEHRING.¹

[Communicated by Count MARSCHALL, F.C.G.S.]

I. *Westeregeln*.—The Quaternary Fauna of this locality is characterized as a "Steppe" fauna by the presence of remains of *Alaktaga Jaculus*, *Spermophilus Altaicus*, *Sp. guttatus*; *Arctomys Bobak*, *Lagomys pusillus*, several Eastern-European burrowing *Muridæ*, and Wild Horses, all of them having, apparently, lived in the locality where their remains are now met with. This is shown by the number of both young and adult individuals, and by their good state of preservation. Other species associated with the foregoing offer no objection to the "Steppe" character. *Cheiroptera*, Wolves, Badgers, Hares, Bustards, Ducks, Larks, Finches, Swallows, Frogs, and Toads are not of rare occurrence in the Steppes of East Europe and Asia. *Pelobates fuscus* is said to be frequent around Sarepta and other parts of the Steppes along the lower course of the Volga; and the Pike abounds in the waters of the Steppes. Similar animals have left their remains in the Quaternary deposits under notice. The local Fauna, like that now existing in the South Siberian Steppes, has mixed with it occasional visitors, such as came in summer from Central and South Germany, as Hyænas and Lions, or in winter from northern regions, as Reindeer, Arctic Foxes, and Lemmings. The presence of these last three indicates that the vicinity of what is now Westeregeln was not covered with forests. As to the extinct forms, such as *Elephas primigenius*, *Rhinoceros*

¹ Imper. Geolog. Institute of Vienna, Report of Meeting, July 31, 1878.

tichorhinus, and *Bos primigenius*, they (with habits similar to those of their living congeners) may have visited the Steppes in those seasons when vegetation had come to its full development there.

II. *Thiede*.—The Quaternary deposits of this locality may be divided into three horizons. The uppermost, about 14ft. thick, begins immediately beneath the vegetable soil, and has the aspect of a Diluvial loam (Loess). From 1 to 9 feet downwards it is more or less dark-coloured by the admixture of carbonaceous substances, and most of its lime has been washed away by percolating waters. Fossil bones are scarce. Remains of a large species of *Bos* have been found at a depth of about 7 or 8 feet; and the remains of Mammoth at 10 feet, close to where the skeleton of a Lion was met with, at a depth of 12 feet, some years ago. At about 12 feet the loam is very calcareous, clear-yellow, fine-grained, and of tubular structure, without any trace of stratification or of plasticity. Not unfrequently it here contains Loess shells, as *Pupa muscorum*, *Succinea oblonga*, and species of *Helix*. This uppermost deposit is so situated that the nearest river (the Ocker) could reach it only when swollen exceptionally high; and wind-action must have been essential to its formation, with occasional local floods after heavy rainfalls.

In the second horizon, from about 14 to 22 feet depth, the material is, for the most part, a highly calcareous Diluvial marl. This includes an abundance of flint pebbles, with both rolled and angular fragments of siliceous schist, Pläner limestone, granite, and quartz. A block of granite weighing about 20lbs. has been found at 16 feet depth,—a subangular fragment of Beyrichia limestone, bearing a distinct impression of *Rhynchonella plicatella* (Kloeden),—an *Ostrea*, possibly from the White Jura north of the Hartz,—and a number of small *Belemnites* (*B. ultimus* or *B. minimus*), much worn, are met with among these fragments. Most probably all these objects have been brought to their present situation, together with the flint implements and fragments of charcoal,¹ by the swollen waters of the River Ocker. The rolled and angular fragments are derived from northern Diluvials, and in part from the Hartz and its outposts. The second horizon may be palæontologically designated as a “Mammoth-deposit,” from the frequency of generally well-preserved remains of *Elephas primigenius*. These and the bones of *Rhinoceros tichorhinus* are frequently incrustated or agglutinated with calcareous concretions. Remains of *Hyæna spelæa* and of *Cervus tarandus* are scarcer than those of *Equus caballus* and of a species of *Bos*.

The third horizon, called the “Lemming-deposit,” from the prevalence of the remains of this Rodent, reaches from 22 feet depth down to the clefts filled with gypsum, 30 to 35 feet, and at places 40 feet deep. The second and third horizons are connected by palæontological transitions. The prevalent fossil forms are Lemmings; in the upper portion *Myodes lemmus*, and in the lower part less frequently *Myodes torquatus*. *Arvicola gregalis* is rather common. Bones of Reindeer

¹ Rough stone axes under the soil, and flint implements and charcoal in the lower part of the Loess, were found at Thiede by Dr. Nehring, who also met with flint flakes, bits of charcoal, and split bones at Westeregeln.

and Arctic Foxes, both young and adult, are not rare, but much scattered. Remains of *Equus*, *Arvicola raticiceps*, *A. amphibia* (or *Myodes Obensis*), *Lagomys* sp., *Lepus* sp., *Spermophilus* sp., and of a species of Bat, seem to exclusively belong to the upper portion. The loam of this horizon contains a notable proportion of sand, and is divided into distinct horizontal strata, two to three centimètres thick, layers with coarse-grained sand generally alternating with beds either containing fine-grained sand, or quite loamy. Here and there large pebbles, up to the weight of 200 grammes, are found, but not so large nor so abundant as in the "Mammoth horizon." The proportion of lime is rather considerable, and calcareous concretions are not of rare occurrence, especially in connexion with the fossil bones.

III. *Conclusions.*—The ossiferous deposits of Thiede are essentially the result of violent currents of flood-waters. During the intervals between two inundations, winds, more frequent in the dry summer months, may have brought a considerable amount of sand and dust over this the exposed region, depositing these substances among the gypsum cliffs of Thiede. The effects of atmospheric currents are chiefly conspicuous in the upper horizon, less distinct in the lowermost, and not at all perceivable in the middle horizon. This assertion is proved, first, by their high level above the present level of the nearest river; secondly, by their petrographical constitution; thirdly, by their organic remains belonging nearly all to land-animals, and mostly to forms proper to Steppes, which are continually subject to subaërial accumulations of sand and dust, such as Von Richthofen has observed on a very large scale in the undrained Steppe-regions of Central Asia. The few traces of water-action may be explained by local inundations, in consequence of occasional heavy rains. If we suppose the "Lemming deposits" of Thiede to belong to the Glacial (and, if we admit two such periods, to the Second Glacial period), the middle and upper horizons at Thiede, as also the whole of the deposits at Westeregeln, should be ranked among those of the Post-glacial period, when Western and Central Europe had taken a more continental form, and certain regions were subjected to a dry Steppe-climate.

R E V I E W S.

I.—THE GEOLOGICAL SURVEY OF ENGLAND AND WALES.

THE GEOLOGY OF THE N.W. PART OF ESSEX, AND THE N.E. PART OF HERTS, WITH PARTS OF CAMBRIDGESHIRE AND SUFFOLK. [Explanation of Sheet 47 of the Geological Survey Map of England and Wales.] By W. WHITAKER, W. H. PENNING, W. H. DALTON, and F. J. BENNETT. 8vo. pp. 92. (London, 1878.)

THE Geological Survey is gradually extending its labours over the northern and eastern counties; and there now remains not an English county which has not been partially surveyed, nor one of which some account has not been published "by order of the Lords Commissioners of Her Majesty's Treasury."