4. *On the GEOLOGY of the NEIGHBOURHOOD of NÁGPUR, CENTRAL INDIA.* By the Rev. MESSRS. STEPHEN HISLOP and ROBERT HUNTER.

[Communicated by J. C. Moore, Esq., F.G.S.]

[Abstract.]

IN the first place the authors describe the physical features of that portion of the Nágpur district to which this Memoir particularly refers, and give a full account of the geological observations already made in that and the neighbouring territories.

In pointing out the general geology of the district, they show that the basis of the country is gneiss, quartz-rock, mica-schist, and granite, on which reposes a sandstone very much interrupted, but stretching far and wide. It is without fossils at Nágpur, but fossiliferous elsewhere; and, according to the authors, of the Jurassic age.

Near Nágpur this sandstone is overlaid by a thick mass of trap rock, an isolated patch of which forms the mass of the Sitábaldi Hill. This trap is compact below and vesicular towards the top, and is surmounted by thin patches of a nodular trap. Between these two trap-rocks is found a thin clay or cherty bed full of the remains of freshwater shells and other fossils. In some places (as in the Tákli plains) the freshwater bed rests immediately on the sandstone, in which case the vesicular trap is wanting, and the overlying trap is sometimes present and sometimes absent. Sometimes a single thin sheet of trap is present without any sedimentary deposit.

The extent and relations of these several formations and of the superficial deposits having been pointed out, the authors proceed to describe their characters and contents, and to offer some observations on their respective ages.

The superficial formations are the black soil (Regur), sometimes 20 feet deep; and the red soil, which is occasionally 50 feet thick, and sometimes contains bones and freshwater shells. Each of these rests on a brown clay, which has an underlying conglomerate, with occasional mammalian remains.

The next oldest formation appears to be the laterite or lateritic grit, which seldom exceeds in thickness 10 feet in this district, and, as usual, is unfossiliferous. Diamond mines have been opened in it to the east of Nágpur. And in connexion with this subject, Mr. Hislop remarks that the diamond matrix probably throughout India is not sandstone in the several localities where the diamonds are found, but an overlying breccia or conglomerate, frequently resting on sandstone, but also occasionally on limestone or gneiss.

The next series of rocks is the trapeean—with the enclosed sedimentary deposit.

The upper trap is from 15 to 20 feet thick, and of very great extent.

The freshwater deposit ranges from 1 inch to 6 feet in thickness, and varies in colour and composition; sometimes cherty, sometimes argillaceous. Its fossils also are as variable in their distribution.

Occasionally it appears to be repeated more than once in the escarpments of the trap hills.

This thin deposit has an enormous range; it has been traced more or less interruptedly to a distance of 1050 miles in a direct line, from Rajmahal (on the Ganges) to Bombay, and of 660 miles from the N. to the neighbourhood of Padpangali, near the mouth of the Godaverī.

From the collections made by Messrs. Hislop and Hunter and their friends from this deposit*, the authors mention the following fossils:—

Small bones, probably Reptilian.

Remains of a freshwater Tortoise.

Fish-scales, both Cycloid and Ganoid, in great numbers.

Insects, found at Tákli: Mr. Hunter enumerates about ten species of Coleoptera.

Entomostracans; five or six species of Cypris.

Mollusca, land and freshwater, in great numbers. The following genera are enumerated:—

Bulimus.

Paludina.

Succinea.

Valvata.

Physa.

Limnæus (Camptoceras).

Melania.

Unio.

Plant remains: Mr. Hunter enumerates

Fruits and Seeds, about fifty species.

Leaves, exogenous, six forms.

—, endogenous, three or four.

Stems, exogenous, few species; some specimens six feet in girth.

—, endogenous.

Roots, six or seven kinds.

Chara, seed-vessels.

Of the age of this deposit it is difficult to speak. The flora appears to have some resemblance to that of the London Clay. With two exceptions, all the species of the Molluscs are extinct; and two of the genera (*Valvata* and *Physa*) have disappeared from the plains of Central and Southern India; whilst the *Planorbis* and *Ampullaria*, now so common in India, are altogether absent from this deposit. As an isolated and probably lacustrine formation, though evidently possessing a high antiquity as compared with the superficial deposits of the district, its age cannot at present be predicated with any certainty.

The underlying or vesicular trap is 100 feet thick in the Sitábalí hill; but it dies out towards Tákli, where the freshwater bed rests on the sandstone. Near Nágpur, Mr. Hislop observes, this lower trap appears to have been forced up beneath the overlying mass of freshwater deposit and upper trap, and to have either filled up and

* An extensive series of organic remains and of rock-specimens, from this deposit, the fossiliferous sandstone, and other formations, has been presented to the Society by Messrs. Hislop and Hunter. The fossils, however, have not yet been worked out.

scattered the superincumbent rocks, or to have raised them horizontally above the level of the plain, forcing itself between the sandstone and the freshwater deposit. This thin fossiliferous band, when not tilted up altogether, is often entangled in this lower trap and much altered in lithological character.

The authors notice the apparent absence of craters throughout the great trap district of Central India. Nor is any spot known where either of the two trap-rocks could be said to have come up from below.

The upper trap appears to have flowed along for immense distances, filling the great ancient lake or lakes, and forming flat and arid plains; and the lower trap, as above stated, appears to have been perhaps nearly as co-extensive in its subterranean intrusions and superficial outbursts. Thus both traps are regarded by the authors as of more recent date than the freshwater formation.

Sandstones and shales of variable character, but possibly referable to one and the same formation, occur in four districts, viz. :

1st. In the vicinity of Nágpur the sandstone occupies a comparatively narrow and irregular stripe along the eastern border of the great trap region, under which it is seen to pass.

2nd. Isolated patches on the south appear to connect the Nágpur sandstone with the extensive sandstone district of Chándá, above and below the junction of the Wardhá and Pranhitá Rivers, extending to Kotá, near the junction of the latter river with the Godaveri.

3rd. To the east of Nágpur there are some outlying patches eastward of the Wein Gangá River.

4th. To the north-west, at the distance of thirty or forty miles from the Nágpur sandstone, there is a broad tract of sandstone around the Mahádewa hills.

The exact relations of these several areas of sandstone and shale are not yet quite settled; but the following is the descending order of the series according to the observations of the authors.

1. Soft ferruginous sandstone; sometimes hard, with iron bands, and affording millstone. This contains fragments of the underlying sandstone, large plant-remains and numerous leaves.

2. Fine and coarse argillaceous sandstones, rich with plant remains. These have afforded

Labyrinthodont reptile* (from Mangali).

Fishes; Lepidoid scales.

Crustaceans; *Estheria*.

Plant-remains.

Fruits and seeds; numerous and undescribed.

Leaves; Conifer, Zamites, Poacites, and Ferns (*Pecopteris*, *Glossopteris*, *Taniopteris*, *Cyclopteris*, *Sphenopteris*).

Roots, exogenous and endogenous.

Acrogens: *Aphyllum*?, *Equisetites*?, *Phyllothea*, *Vertebraria*?

The thickness of Nos. 1 and 2 together, near Nágpur, is about 300 feet; and in the Mahádewa Hills it is estimated by Lieut. Sankey at 2700 feet.

* See the next following paper.

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3. Red shales, 50 feet thick, and green shales, 30 feet. In the former of these there were observed at Korhádi

Reptilian foot-tracks.

Worm-tracks.

Phyllothea?

4. White and coloured limestones and marbles (dolomitic), with chert. Not less than 100 feet thick.

In Southern India these limestones (No. 4) are 300 feet thick, and are succeeded by another series of sandstone, termed by Dr. Carter the "Tara sandstone."

All these sandstones, shales and marbles are much disturbed and often changed by the plutonic rocks in the district treated of in this memoir. Beyond the Nágpur district to the N.W. at Chotá Barkoi, according to Lieut. Sankey*, the sandstone proper is succeeded downwards by

Bituminous shales, with fossils; and

Sandstone;

and at another locality, near the foot of the Pachmahari Hills, by

Indurated clay-stone.

Green shale.

Bituminous shale, with fossils.

Mr. Hislop compares this sandstone formation with the sections of the neighbouring regions published by Newbold† and Malcolmson‡ and supplied to him by Dr. Bell, and he finds that often the position of the shale with reference to the limestone seems to vary; and that these shales, sandstones, and limestones appear (from Dr. Bell's Sections) to be interstratified at Kotá to the S.E., where the shale and limestone have yielded fossil fish of the genera *Lepidotus* and *Æchmodus*, associated with plants and Teleosaurian remains§.

From a general consideration of the character and fossils of the sandstone formation, the authors regard it as lacustrine in origin, like the Bengal coal-field, and of the Lower Jurassic age.

The metamorphic and plutonic rocks are also noticed in detail. The latter probably belong to several epochs; and the authors consider it probable, that, whilst one granitic outburst raised and broke up the old sandstones previously to the formation of the tertiary fresh-water deposits, the pegmatite of Nágpur was protruded at a date even subsequent to that of the traps which had covered and again disturbed these lacustrine beds.

5. DESCRIPTION of the CRANIUM of a LABYRINTHODONT REPTILE (*BRACHYOPS LATICEPS*) from MANGALI, CENTRAL INDIA. By Prof. OWEN, F.R.S., F.G.S.

[Abstract.]

THIS fossil was obtained by the Rev. Messrs. Hislop and Hunter in the sandstone at Mangali, about sixty miles south of Nagpur,

* Quart. Journ. Geol. Soc. vol. x. p. 55. † Journ. As. Soc. vol. viii. p. 167.

‡ Trans. Geol. Soc. 2 ser. vol. v. p. 541 *et seq.*

§ Quart. Journ. Geol. Soc. vol. viii. p. 233.