VISIT TO THE MUSEUM OF THE GEOLOGICAL
SOCIETY, BURLINGTON HOUSE;
INSPECTION OF THE SOUTH-AFRICAN COLLECTION;
APRIL 1st, 1876.

Director—Professor T. RUPERT JONES, F.R.S.

(*Report by* PROFESSOR RUPERT JONES.)

Before offering any observations on the fossils and rock-specimens from South Africa in the Geological Society's Museum, Professor Rupert Jones drew the attention of the Members of the Association to several maps and sections of the country, some borrowed from the Society's library, and some brought by himself. The collection laid open before the audience comprised specimens obtained by numerous observers*—Basil Hall, Herschel, Bain, Atherstone, Rubidge, Garden, Sutherland, Grey, Roche, Stow, Longlands, Harvey, and others, in various districts of the Cape Colony, and Natal.

The *slates and schists* of the south-western extremity of Africa were first referred to, and their intrusive *granite*. These schistose rocks extend northwards into Namaqualand, and eastward to George and the Eastern Province. No fossils have been detected in the schists of the maritime districts of George, Swellendam, Stellenbosch, Western Clanwilliam, and Namaqualand; but these are succeeded inland by fossiliferous schists, with Devonian fossils in abundance, especially in the Bokkevelde, and at intervals from the Warm Bokkeveld to the Zwartberg and the Kromme Hills, ending in Cape St. Francis, also in the Coxcomb Range of the Great Winterhoek in Uitenhage. Great folded quartzites and siliceous schists represent this formation in

* List of works treating of the Geology of South Africa are to be found in the *Transact. Geol. Soc.*, Ser. 2, Vol. vii., pp. 176, 177; in Dr. E. Cohen's "Geological and Petrographical Sketches of South Africa," *Neues Jahrbuch für Mineralogie*, &c., 1874, pp. 462, 463. Some other references are given with this Report; and other papers will be found in the "*Geologist*," Vol. iv., 1861, p. 238; Vol. v., 1862, pp. 47, 56, and 366; "*Geological Magazine*," Vol. ii., p. 274; iii., p. 88; v., pp. 201, 558; vi., p. 208; viii., p. 49; "*Popular Science Review*," Vol. x., p. 169; "*Eastern Province Magazine*," 1856, p. 7; "*Eastern Province Monthly Magazine*," Vol. i., p. 187, 456, 518, 580; "*Cape Monthly Magazine*," Vol. v., p. 65; *ib.*, Vol. vii., p. 1; Wyley's "*Reports*," 1856 and 1859; "*Annales des Mines*," Ser. 5, Vol. viii.; Dunn's "*Notes on the Diamond-fields*," 8vo., Cape Town, 1871; *Quart. Journ. Geol. Soc.*, Vol. xi., pp. 1, 453, 465, 532, 541; xii., p. 237; xiii., p. 233; xv., p. 193, 195, 555, 642; xvi., p. 49; xxi., p. 439; xxiii., pp. 1, 139; xxv., p. 169; xxvi., p. 516; xxvii., pp. 35, 53, 497, 523; xxviii., pp. 3, 21, 28; xxx., pp. 54, 406, 581; xxxi., pp. 106, 529.

the Zuurberg of Somerset and Albany, and may be a development of the narrower band of siliceous schist at Ceres (accepting Rubidge's interpretation of the section) on the extreme west. Near Port Elizabeth, in Uitenhage, the quartzose strata, intercalated with the argillaceous beds, have resisted the process of cleavage, whilst their softer associates have been rendered schistose, with cleavage at various angles; and thus the broad folds and arches of quartzite, coming to the surface, have remained as a relatively flat, hard capping to the hills, which are mainly formed of more or less vertical schists. The original undulating lines of stratification in the latter are often obliterated by cleavage, the obscure oblique traces of fossils alone remaining as evidence of the real bedding.*

Fossil plants and coal accompany the Devonian Schists of the Cape Colony at Swellendam, Riversdale, and elsewhere, especially at the mouth of the Kowie in Albany. It is quite possible, in accordance with the late Dr. Rubidge's view, that the *whole* mass of schists forming this great southern portion of the region, 120 miles broad at the Cape, and 60 in the Eastern Province, where it is cut off by the sea, is of Devonian age. Whether the Kowie coal-beds belong to this Devonian series, or overlie it and belong to the Carboniferous, is not clear. At no other place along the northernmost edge of these Devonian schists are any coal-measures yet known.

Overlying the schists, throughout a great part of the region above indicated, are massive sandstones and quartzites, forming hills and mountain-ranges of great extent. Table Mountain, overlooking Cape Town, consists of this sandstone, resting on denuded schists and granite, and presenting a typical example of this flat-bedded rock, which once extended far north and east, but has been reduced to long narrow ranges by the destructive action of water, and possibly ice. No fossils have been found in this great sandstone formation in the Cape Colony; but Mr. Griesbach found a few obscure shells in a shale-bed of the "Table Mountain Sandstone" in Natal, where he recognised it as holding the same relative position with regard to the schists and granite below as it holds at the Cape.

Immediately north of the Devonian schists, and succeeding in geological sequence all along a line nearly parallel with the

* A section of partially cleaved rocks in Pembrokeshire, illustrative of the relationship of nearly horizontal sandstone to nearly vertical schists, is given by De la Beche, in the "Memoirs of the Geological Survey of Great Britain," Vol. i., p. 226.

coast, and reaching at least from Clanwilliam (on the west), at about 100 miles inland, to the sea in the Eastern Province, near the Great Fish River, is a remarkable band of rock, which in most places has a veritable volcanic aspect, consisting of some kind of dioritic matrix, with included blocks and small fragments of quartz, granite, schist, and other rocks. This, the "Trap-breccia" of some geologists, attains a thickness of five, or even eight hundred feet. At places it appears to be a hardened trap-ash with numerous rounded and angular fragments of older rocks (Wyley). Mr. G. A. Bain regarded this rock as a "claystone-porphry," from its local aspect. Amygdaloidal at some spots, and basaltic at others, where seen by Dr. Atherstone in the Cape Colony, it has quite a different appearance in Natal, where Dr. Sutherland and Mr. Griesbach have described it as a Boulder-clay. In the Eastern Province the late Dr. Rubidge looked on this rock as being metamorphic. Here it exhibits several parallel outcrops, which both Bain and Rubidge considered to be the result of great folds, conformable with the folding of the older quartzites of the Zuurberg. The latter (1,000 feet thick) are of Carboniferous age, according to Bain and Wyley, but Devonian if we follow Rubidge. The occurrence of real Boulder-beds in India under strata equivalent to the Karoo formation supports the hypothesis of the sedimentary origin of the South-African "Breccia;" but in some places of the latter country it may really present a decomposed condition of a trap-breccia, and thus only simulate a Boulder-clay; whilst at other places the disturbances that broke up the rocks, to make the breccia, may not have been accompanied by volcanic phenomena. Both below and above the trap-breccia are dark shales, with obscure plant-remains, the Lower (800 feet) and Upper (1,200 feet) "Ecca beds." The Lower set is supposed to be of Devonian or Carboniferous age; whilst the Breccia and the Upper Dark Shales are referred to the Karoo Series above.

This vast KAROO FORMATION, next succeeding, is of great interest. It covers 200,000 square miles, and more, of South Africa, from N. lat. 35° northwards, and from E. long. 19 45° eastwards. These strata are horizontal (slightly inclined on their southern verge), and are traversed and overlain, but not much disturbed, by frequent trap-dykes. The lowest division of the Karoo formation, next above the Ecca Beds, comprises the "Koonap Beds" (1,500 feet), having a comparatively narrow

outerop north of, and parallel with, that of the Ecce Beds and the Breccia, and concentric therewith. Next are the "Beaufort Beds" (1,700 feet), on which stand both Beaufort West, north of Prince Albert, and Fort Beaufort on the east. The denudation of these horizontal Beaufort strata forms a very broad exposure north of and within the Koonap outerop, and reach up to the Colesberg district. To the west and north of this, the lower series of Karoo shales and sandstones are more or less exposed, until they end against the old rocks of the Kalahari Desert and Griqualand-West (Stow); but on the east they are surmounted by the remnant of the uppermost or "Stormberg" portion (1,800 feet) of the Karoo series; and these, with their trap-rocks, form the top of the Drakensberg or Quathlamba range (11,000 feet), overlooking Natal, and resting, as a whole, on the primary rocks of that district.*

The Karoo formation consists mainly of alternations of shales and sandstones, at many places rich with reptilian remains,† and here and there yielding fossil fish allied to *Palæoniscus* and *Amblypterus* (*Hypterus*, Owen), a few Bivalves (*Iridina*, &c.), and a rare *Estheria*. Plant-remains (ferns and *Phyllotheceæ*?) and fossil wood are abundant in several beds, and there are some workable coal-seams in the Stormberg series.‡

In his elaborate "Catalogue of the Fossil Reptilia of South Africa in the British Museum" (4to, 1876), Professor Owen describes and illustrates the following (all, but one, from the Karoo formation):—

CLASS—REPTILIA.

Order—Dinosauria.

Section—Tretospondylia.

Genus—*Tapinocephalus*; 1 species.

Family—*Serratidentia*.

Genus—*Parieasaurus*; 2 species.

„ *Anthodon*; 1 sp. (Jurassic).

* See Mr. Griesbach's Memoir on Natal, Quart. Journ. Geol. Soc., Vol. xxvii. p. 53, pl. 2.

† These fossils are often invested or permeated by very hard, tough rock, related to that of the trap-dykes; and in some cases they seem to have been derived from other beds, as they differ from the rocks in which they occur, and yet do not appear to be in concretionary nodules.—Dr. G. Grey.

‡ "Mining Journal," January 14, 1871. For the distribution of the Karoo fossils, as known up to 1867, see Quart. Journ. Geol. Soc., Vol. xxiii, pp. 142-144.

Order—Theriodontia.*Family*—Binarialia.*Genus*—Lycosaurus; 3 spp.

„ Tigrisuchus; 1 sp.

Family—Mononarialia.*Genus*—Cynodracon; 2 spp.

„ Cynochampsia; 1 sp.

„ Cynosuchus; 1 sp.

„ Galesaurus; 1 sp.

„ Nythosaurus; 1 sp.

„ Scaloposaurus; 1 sp.

„ Procolophon, 2 spp.

Family—Tectinaria.*Genus*—Gorgonops; 1 sp.*Order*—Anomodontia.*Family*—Bidentalia.*Genus*—Dicynodon; 11 spp.

„ Ptychognathus; 6 spp.

Family—Cryptodontia.*Genus*—Oudenodon; 7 spp.

„ Theriognathus; 1 sp.

„ Kistecephalus; 7 spp.

Family—Endothiodontia.*Genus*—Endothiodon; 1 sp.

SUB-CLASS—DIPNOA.

Order—Labyrinthodontia.*Section*—Æquidenticulata.*Family*—Coccoganoidea.*Genus*—Petrophryne; 1 sp. (qy., the same as *Micropholis*, Huxley, Quart. Journ. Geol. Soc., Vol. xv., p. 654, pl. 21.)

„ Saurosternon, Huxley; 2 spp. (Lacertian, according to Huxley, "Geological Magazine," Vol. v., p. 201, pl. 11.)

Professor Owen has also noticed, in former years, vertebral indications of fossil Reptiles from the Karoo formation, which he designated *Massospondylus*, *Pachyspondylus*, and *Leptospondylus* (Quart. Journ. Geol. Soc., Vol. xvi., p. 62).

Professor Huxley has described a species of *Dicynodon* *

* Quart. Journ. Geol. Soc., Vol. xv., p. 649, pl. 23.

(*Ptychognathus?*); remains of two large Dinosaurians* (*Euskelesaurus* and *Orosaurus*); a serratident, *Pristerodon*; † and his lacertilian *Saurosternon* and batrachian *Micropholis* (see above). All of these are also from the Karoo formation.

The only evidence of marine life among the fossils of the Karoo formation is one fragment of an encrinite ‡ in a calcareous breccia from the Rhenosterberg, a spur of the Sneeuwbergen (Quart. Journ. Geol. Soc., Vol. xv., p. 194). This may have been derived from older Devonian beds.

The probable lacustrine character of the Karoo formation has been dwelt upon by Bain and others; and the existing analogy of wide expanses of fresh water in Central Africa has been pointed out by Murchison and Livingstone. The probably vast extent of land in early Mesozoic, if not in late Palæozoic, times, but since destroyed, has been ably treated of by Huxley, Blanford, and others, in explication of the occurrence of wide-spread terrestrial conditions during the Permian-Triassic ages in different parts of the world.

Elsewhere in Cape Colony, especially on the Sunday, Zwartkop, and Gamtoos Rivers, there are JURASSIC strata, known as the "Uitenhage Formation;" § and these groups appear to have been deposited in great hollows or seas of the period, quite disconnected from the older "Karoo formation." They opened out eastward; and on the west they rested against the old Primary rocks, which formed, and still form, the great south-eastern boundary of that terrestrial and lacustrine area.

An underlying conglomerate ("Enon") and a remarkable series of plant-bearing beds ("Wood-bed," &c.) belong to this series.

Traces of similar Jurassic rocks are known higher up the coast, near the Zambesi, and far down on the south and west in the George district.

Some similar, but less extensive, patches of CRETACEOUS strata occur on the Natal coast; and these also have lost, by denudation, their connection with far greater deposits, continuous, probably, with the old Indian and West-Asiatic Cretaceous seas, and associated with the "Lemurian" lands of the past.

* Quart. Journ. Geol. Soc., Vol. xxiii., p. 1.

† "Geological Magazine," Vol. v., p. 204, pl. 12.

‡ This specimen, in the Geological Society's Museum, was specially pointed out.

§ See Mr. Tate's Memoir on South-African Fossils, with Notes by T. Rupert Jones, Quart. Journ. Geol. Soc., Vol. xxiii., p. 149.

TERTIARY, or rather POST-TERTIARY deposits, succeed in the Eastern Province; and, whether in isolated patches or over broad areas, on the Primary or on the Secondary rocks, they were formed on the eastern slopes of the country, facing the Indian Ocean, and were continuous with its floor previous to some of the latest alterations of level, which have raised them above the sea-level.

The *Alluvial* flats near the Cape and further inland present, as usual, varied evidences of atmospheric agencies in having arranged mud, sand, pebbles, lignite, &c., by gentle or by violent means. The great sandy flats of the interior, and the shingle and boulders of the river-valleys, all indicate enormous lapse of time and effectual work of Nature's every-day forces; and even the results of glacial action have been demonstrated by Mr. G. W. Stow (*Quart. Journ. Geol. Soc.*, 1871, Vol. xxvii., p. 544, &c.) in these subequatorial regions.

Some remarks were offered, in conclusion, on the conditions under which diamonds are found in South Africa, both in the valley-gravels and in the diggings on and near certain old trap-dykes, which have traversed the Karoo shales. A visitor, who had lately returned from the Cape, exhibited a quantity of small diamonds which he had obtained, and kindly replied to enquiries made by the Associates. Professor Tennant made some remarks on the quantity and size of the South-African diamonds.

Professor Morris, after some instructive remarks, tendered the thanks of the Members to Professor Rupert Jones for his interesting lecture, and expressed the obligations of the visitors to the President and Council of the Geological Society for their courtesy in opening their Museum on this occasion.

Mr. B. B. Woodward, Assistant Curator of the Museum, has kindly furnished the following notes:—

In illustration of Prof. Rupert Jones' remarks, the original large MS. map of South Africa, geologically coloured by Mr. A. G. Bain, and a large series of South-African rocks and fossils were exhibited. The latter included specimens from the Tertiary deposits of Algoa Bay; Jurassic fossils from the Sunday and Zwartkop Rivers; and plant-remains from the Jurassic "Wood-bed," at Geelhoutboom, Sunday River; trilobites, encrinites, spirifers, and other Devonian fossils from the Warm and Cold Bokkevels, north of Cape Town; rock-specimens from the diamond-fields; jaspers from the ranges of the Potgieter's and Rooi Kopjes;

and reptilian bones, ammonites, and other Cretaceous fossils from the coast of Natal.

This South-African collection is composed of the donations that have been from time to time made to the Society by travellers and residents; among others, Mr. A. G. Bain, Dr. Atherstone, Dr. Rubidge, Captains Garden and Rocke, and Mr. Stow, men whose names will always be associated with South-African geology. Many of the specimens contained in it are unique, and many have been described and figured in the Society's publications.

The Members of the Association also inspected an interesting series of rock-specimens (jaspers, quartz, chalcedony, &c.), and silicified woods and corals from Antigua, which were exhibited in illustration of a paper that had been read before the Association a short time before, by Prof. Rupert Jones.

Amongst the many objects of interest in the possession of the Geological Society, an original MS. geological map of England, by William Smith, "the Father of English Geology," and the MS. table of strata by the same renowned pioneer of the science, attracted perhaps the greatest attention.

ORDINARY MEETING, APRIL 7TH, 1876.

WILLIAM CARRUTHERS, Esq., F.R.S., &c., President, in the Chair.

The following Donations were announced :—

"The History of Rutherglen and East Kilbride," by David Ure; from the President, William Carruthers, Esq., F.R.S.

"Geological Map of Ireland," from the President, William Carruthers, Esq., F.R.S.

"The Geology of Camberwell," by Arthur Bott, F.G.S.; from the Author.

"List of Works on the Geology of Hertfordshire," by W. Whitaker, B.A., F.G.S.; from the Author.

"Notes on the Geology of the North Midlands," by W. J. Harrison, F.G.S.; from the Author.

"Description of Sopwith's Geological Models," by F. Sopwith, F.R.S.; from Professor James Tennant, F.G.S., &c.

"Notes on the Geology of the Coast of Labrador," by Oscar M. Lieber; from John Hopkinson, Esq., F.L.S., &c.