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PRELIMINARY REPORT
ON SOME GEOLOGICAL SPECIMENS
FROM THE "CHEPHREN DIORITE" QUARRIES,
WESTERN DESERT

BY

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Following on the rediscovery of the ancient quarries for "Chephren diorite", after they had been lost for more than 3,500 years, an expedition was recently made to the site, with Mr. Engelbach of the Egyptian Museum as one of the party. In his report on the archaeological results of the expedition, pp. 65-74, Mr. Engelbach gives an account of the rediscovery of the site of the quarries, a description of the antiquities discovered and also records the approximate position of the outcrops of the different rocks in the quarry area.

The quarries are situated approximately in latitude 22° 49′ N., and longitude 31° 16′ E., and as this is a remote and arid region of the Western Desert the opportunity was taken of collecting numerous and varied rock specimens. Most of these, to the number of fifty large specimens as well as many smaller ones have been handed over to the Geological Museum. The greater number were collected in the neighbourhood of the "diorite quarries"; the remainder being obtained near some cairns on a ridge 13 kilometres to the north. These northern cairns mark the site of ancient excavations, possibly for amethyst.

Archaeologists and geologists have long been interested in the origin of the banded dark-green and white rocks used for statues, vases etc.

during the Protodynastic period, the Old and, to a certain extent, the Middle Kingdoms. As long ago as 1898, Ball collected a specimen which resembled the Chephren diorite from Khôr Basîl, on the right bank of the Nile, about 65 kilometres south of the Aswân Dam (in latitude 23° 28′ N.). He stated [1] that the floor of the wide khôr for nearly a kilometre from its mouth is formed of schistose diorite and gneiss with red granite intrusions, these rocks passing into the base of the Nubian sandstone hills at the sides of the khôr. His specimen was collected from the schistose diorite.

Barthoux, in 1908, published [2] a description of some of the rocks which had been employed by the ancients, basing this on the examination of specimens in the Egyptian Museum; among these was the statue of Chephren. In the same year he suggested [3] that these rocks would be found to occur close to Aswân.

Having seen the specimens from Khôr Basîl in the Geological Museum he decided to examine that locality in his search for the long-lost quarries. Some of the rocks of Khôr Basîl resemble the Chephren diorite, but the only quarries Barthoux discovered in the neighbourhood were for Nubian Sandstone and he concluded that this was not the locality from which the material for the statues had been obtained. He described [4] the rock of the wadi-floor as a finely crystalline hornblende-gneiss (formed of rounded grains of quartz, andesine felspar and hornblende), but with lateral variations; some of these approach anorthosite yet contain sufficient quartz and orthoclase felspar to be classed as granite. Other granites similar to the above but containing no hornblende have been intruded into the hornblende-gneiss in this locality.

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[1] J. Ball. *On the Topographical and Geological Results of a Reconnaissance Survey of Gebel Garra and the Oasis of Kurkur* (Survey Department, Cairo, 1902), p. 28.

[2] Jules Barthoux (Couyat), *Détermination et nomenclature de quelques roches du Musée égyptien du Caire* (*Bulletin de l'Institut français d'archéologie orientale du Caire*), t. VI, 1908, p. 49.

[3] Barthoux, *Les anorthosites égyptiennes des statues de Khéphren* (*Bull. Soc. franç. Min. Paris*), t. XXXI, 1908 p. 273.

[4] Barthoux, *Sur la nature et le gisement de la pierre des statues de Khéphren du Musée égyptien du Caire* (*Bull. Inst. franç.*), t. VII, 1909, p. 38.

In a subsequent publication [1] he again referred to the rocks of Khôr Basîl and described the occurrence of similar rocks in Wadi Shellâl, between Aswân and Shellâl. These are diorites (containing the felspar bytownite, also hornblende and a little mica, but no quartz), and he regarded them as being related to the anorthosites. Judging by the amount of variation observed in the diorites, he believed that all the varieties of the rock employed by the ancients would be found in the same mass, and he thought that one day the lost quarries would be rediscovered beneath the sands that now fill Wadi Shellâl.

Mr. Engelbach on p. 67 of his report, mentions that the diorite occurs in the Nubian sandstone desert in one locality only, where it outcrops over an area of about six kilometres by three. There is a small ridge of quartz about the middle of the outcrop and fine-grained pink granite and white opaque quartz occur in close conjunction with the diorite. The white rock with black specks seems to occur to the west of the quartz ridge, where plenty of fragments of it were found but no boulders could be seen. A very dark diorite which was used for pounders occurs at a higher level than the Chephren diorite.

The darkest varieties when weathered frequently have a greenish tinge but on freshly broken surfaces they are seen to be composed of white and black or very dark green crystals. The dark minerals are arranged in parallel bands or laminae, but in some specimens are also disseminated fairly uniformly throughout the white material (felspar).

In the varieties of intermediate colour the dark minerals also occur as bands or layers and disseminated throughout the felspars, but their distribution is more irregular and the dark bands are less pronounced. The proportion of ferro-magnesian minerals is less, and the rock appears lighter in colour.

The lightest varieties are predominately white with irregular patches and parallel laminae of dark minerals. These laminae are frequently composed of single prisms of hornblende etc., arranged end to end. Some

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[1] Barthoux, *Chronologie et description des roches ignées du désert arabique* (*Mém. de l'Inst. d'Égypte*), t. V, p. 146.

specimens are white, flecked with black spots, while others have a more greyish appearance.

The principal constituents of these rocks are dark ferro-magnesian minerals and white felspars, the latter sometimes translucent with a greenish tinge.

Under the microscope the dark minerals are seen to be green to brown hornblende, augite frequently altering to hornblende, chlorite and magnetite, the latter fairly abundant in some specimens. The white minerals are chiefly felspars, which in the darker rocks range from andesine to anorthite and in the lighter rocks from andesine to bytownite, sometimes with oligoclase. Quartz occurs occasionally and calcite as a secondary infilling in veins.

The specific gravity of this suite of rocks decreases with the proportion of ferro-magnesian minerals, that of the darkest rocks being 2.95, while some of the very light-coloured specimens have a specific gravity of 2.72.

Mr. A. Lucas had microscope slides made from some fragments of statues in the Egyptian Museum and he kindly lent the rocks and slides to the Geological Survey. Comparison of these with the specimens collected in the Western Desert show that they are remarkably alike and there is no doubt that the quarries recently discovered are those long sought for, as the source of the material used by the ancients.

The banded rocks collected in the Western Desert range from the dark-greenish varieties employed by the ancients for statues, to the white varieties flecked with black which were chiefly used for vases. These include rocks which may be classed as anorthosites, altered gabbros and diorites, with examples approaching quartz-diorites, but all these have been called diorites by archaeologists. If diorite-gneiss were substituted for diorite it would be more correct, though this term is not applicable to all the varieties. A number of the specimens are meta-diorites.

The specimens from the Western Desert are mostly quarried blocks with their surface weathered and their edges rounded by the action of wind-borne sand, therefore it is not possible to say what their field-relationships were. The specimens indicate that in this area more or less altered gabbro, anorthosite, diorite, quartz-diorite, and granitic rocks all

occur. Mr. Engelbach mentions that the pink granite and quartz are closely associated with the diorite so that the granite may be intrusive in the diorite, as is the case at Khôr Basîl. It is, however, probable that the structures observed in the Chephren rocks are partly due to differentiation in the magma, as well as to earth-movements, and the geological mapping of this area should prove to be very interesting.

The other specimens from the diorite quarry area are :

Fine-grained pink granite (containing quartz, orthoclase, microcline, oligoclase and hornblende), aplite, red rhyolite, opaque white quartz with some red bands, and two specimens of metamorphic rocks. One of the latter is an altered limestone containing felspars (anorthite being predominant but some labradorite also occurs), diopside, garnet and a little calcite; the other approximates to an amphibolite with chromite in veins throughout it.

Five balls which were used as pounders in quarrying the diorite were also brought back. Three of these are a very dark variety of the local diorite and two are dolerites such as occur in the cataract regions of the Nile and in many localities in the Eastern Desert.

Two samples were collected of the powdery material from between the blocks of diorite. The first sample was taken at less than a metre from the surface and is a reddish-brown, ferruginous sandy clay, plastic when wetted. It contains much kaolin and iron oxide, also quartz, felspar and calcite. The second sample was taken below one metre from the surface and is a white sand with some black particles. It contains kaolin, calcite, much quartz and hornblende, some felspar, chlorite and iron oxide.

From the ridge 1 3 kilometres north of the diorite quarries there were collected some blocks of reddish-brown, resinous looking, brecciated quartz, with white to brown siliceous and ferruginous cement deposited in layers around the brecciated fragments.

Some lumps of white material obtained from the dumps in this neighbourhood are similar in composition to the powdery material from between the diorite blocks. They consist of cemented particles of wind-borne sand and weathered material from the granites etc. They contain abundant kaolin, with quartz, felspar, iron oxide, carbonate of iron and a very little carbonate of calcium. Two specimens contain thin bands of

agate, in the form of layers of quartz and chalcedony faintly tinged red or amethyst in places.

Many small chips of amethyst, mostly of inferior colour, were obtained from the interior of one of the cairns. The edges on some of the chips are as sharp as if freshly broken, so that they must have been placed in the cairn soon after they were quarried. This suggests that they had been found in the neighbourhood of the cairns, probably in veins in the white material now found in dumps.

A number of specimens of Nubian sandstone were also collected, near a solitary hill in latitude 23° 17′ N., and longitude 32° 05′ E. Most of these are ferruginous and have been delicately etched by wind-borne sand, which enhances their concretionary appearance.

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