NOTES ON

USEFUL AND ORNAMENTAL STONES

OF

ANCIENT EGYPT.

BY

SIR J. WILLIAM DAWSON, C.M.G., LL.D., F.R.S.

BEING A PAPER READ BEFORE THE VICTORIA INSTITUTE.

AUTHOR'S COPY

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WHEN, in the winter of 1883–4, I had the pleasure of visiting some parts of Egypt and Syria, I had prepared myself, by previous study of books and collections, to devote as much of my time as possible to the investigation of certain critical and uncertain questions in the geology of those regions, and especially of the geological facts bearing on the advent and early history of man. Preliminary notes on these points were published in a short series of papers in the *Geological Magazine* (1884), and a paper on the "Bone Caves of the Lebanon," in the *Transactions* of this Society (vol. xviii), and the results were more fully given in my work *Modern Science in Bible Lands*, published in 1888, although the pressing occupations of the intervening three years did not leave sufficient time to work up all my notes and specimens.*

* Reference may also be made to Professor Hull's Paper, "A sketch of the Geological History of Egypt and the Nile Valley," in vol. xxiv of the Institute's Journal.

Among these are some relating to a subject which impresses itself very strongly on a geological traveller in the Nile Valley, namely, the various rocks and minerals used by the Egyptians from very early times, the purposes to which they were applied, and the manner in which they were quarried and worked. I made large collections to illustrate these points; not, however, I may be excused for saying, by defacing monuments, but by collecting broken fragments lying on old sites, and by visiting quarries and natural exposures. Egypt affords unlimited material of this kind to a lithological collector, without detriment to existing works of art, and much may also be obtained from the people, who quickly understand the value both of rock specimens and fossils when pointed out to them, and who cannot fabricate these in the manner of clay scarabs and other imitations of antiques.

The present notes may be considered supplementary to what is stated in the work above referred to.

1. Granitic, Dioritic, and Gneissic Rocks.

To these groups belong a large part of the monumental stones of Egypt; and from the First Cataract and the hilly ranges east of the Nile they were transported to every part of the country, even to the shores of the Mediterranean and the neighbourhood of the Isthmus, and this not in small blocks but often in great masses much more weighty than any used in modern architecture or sculpture. For this, no doubt, the navigable water of the Nile and its canals, and the variations of its level in the inundations, afforded great facilities.

The most important of all these rocks is the celebrated red granite of Syene, so generally employed in the greater Egyptian monuments. I have given detailed descriptions of this rock and its varieties in the Appendix to *Modern Science in Bible Lands*, and may merely say here that it is essentially a holo-crystalline rock, often coarse-grained and consisting mainly of orthoclase and plagioclase felspars, with a little microline—associated with hornblende and quartz, the latter usually in small quantity. When mica is present, it appears to be biotite, and there are sometimes minute crystals of apatite, sphene, and magnetite.

The study of this rock in place at Assouan convinces me that in regard to its mode of occurrence it is sometimes an intrusive or indigenous granite, and sometimes a true bedded

gneiss. Though the minerals in these two kinds of rock may be the same, they are distinct both in macroscopic and microscopic characters and mode of occurrence, and should not be confounded by geologists. Though the granites may in some cases be locally impressed with a laminated texture, there is no necessity for confounding them with gneisses, which are true bedded rocks; and their practical value, as well as the natural products derivable from the two classes of rocks (as soils and sands, for instance), are quite different. Huge dykes of the intrusive granite occur at Assouan, traversing the gneissic beds, and thick beds of the gneiss, interstratified with micaceous and hornblendic schists. Both species were worked by the ancient Egyptians. The great obelisks and the lining stones of the Temple of Bubastis, or some of them, are examples of the former. The broken colossus of Rameses at the Ramesseum, in Thebes, is a good example of the latter. The stupendous fragments of this statue confirm the description of Diodorus, who commends it not only for its great size, but for the "excellence of the stone." This is, in fact, not a granite, but a mass taken from a thick bed of gneiss of fine colour and uniform texture, and more dense and imperishable than any true granite. It must have sat 60 feet high, and before it was sculptured must have weighed about 900 tons. It was surpassed by but one other statue in Egypt, that gigantic one discovered by Petrie at Tanis, known only in fragments, which seems, without its pedestal, to have been at least 80 feet in height. It also was of the red stone of Syene. Of the two kinds of so-called Syene granite, the gneissic variety is the more compact and durable, and the more resisting to the action of the weather. This is a usual circumstance elsewhere, and probably depends on the fact that the gneisses have been subjected to extreme pressure during their crystallisation. The orthoclase gneisses and granites of Assouan are not distinguishable from those of the Laurentian series of North America. The gneissic variety used in some of the older structures at Gizeh is porphyritic, or an "augen-gneiss," having large crystals of pale-reddish felspar.

The shallower sculptures on many monuments of this stone seemed to have been chiselled in the usual way, but the more deeply-cut hieroglyphics and figures were probably worked in the first instance with the hollow drill.

A very remarkable stone employed in Egyptian sculpture is that variety of gneissoid rock known to Canadian geolo-

gists as anorthite rock or gneissic anorthosite. It occurs in various parts of the Laurentian districts of Canada, and more especially in those portions held by Logan to be Upper Laurentian. In Egypt, this rock first attracted my attention as the material of a magnificent statue of Kephren, the builder of the second pyramid, now in the Gizeh Museum. In this statue the lines of black hornblendic matter which mark the foliation are distinctly visible, especially on the right side. I was informed by M. Emil Brusch Bey that several similar statues in a broken condition had been found, and was enabled, through his kindness, to obtain some chips for examination. These were subsequently studied by Dr. B. J. Harrington, and compared with the analogous rocks of the Laurentian of Canada.*

More recently, some new slices were cut and were examined by Mr. F. D. Adams, whose description is as follows:—

"In the hand specimen, it cannot be distinguished from a variety of anorthosite found at New Glasgow, P.Q., and elsewhere in the Laurentian system of Canada.

"When the slide is examined under the microscope, the rock is seen to be very fresh, and to be composed essentially of felspar with a very small amount of hornblende, which, in one place, is intergrown with a little pyroxene.

"Nearly one-half of the felspar grains show polysynthetic striations, and are, therefore, plagioclase; the remainder, although occurring as untwinned individuals, show in almost every case good cleavages, and a biaxial figure when cut normally to an optic axis, and in appearance differ in no way from the twinned grains. They are probably also plagioclase, since, as Hawes pointed out several years ago, the plagioclase in Canadian anorthosite rocks frequently shows no striations.

"The hornblende is present in very small amount as compared with the felspar, and occurs in irregular-shaped grains. It is pleochroic in green and yellowish tints. No quartz, iron ores, mica, or other minerals are present.

"In the thin section, as in the hand specimen, it bears a strong resemblance to many of our Canadian anorthosite rocks."

I have placed in the Redpath Museum a specimen of

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* *Modern Science in Bible Lands*, pp. 270, 573.

anorthosite from a Canadian locality with the Egyptian specimen to show the resemblance.

I did not see this rock in place, but Newbold seems to have found it in the mountain range eastward of the Nile, and it will no doubt be found to be related to the Laurentian axis of that range. The banded varieties or anorthosite gneisses, to which the material of the statue belongs, used to be regarded as altered sedimentary rocks. They are now more usually classed with igneous products, as either intrusive masses laminated by pressure or bedded igneous rocks consolidated and altered. In all probability, the latter is the more correct view.

It has been usual to call the material of these anorthosite statues diorite. For this there is a justification in the fact that the materials are in great part similar to those of that rock; but the lamination, the crystalline structure, and the proportions of the constituents are different. A singular conjecture has also been started, to the effect that this material was derived, as well as the diorite found on the old Chaldean site of Tel-loh, from quarries in the Sinaitic Peninsula, and it has even been imagined that a primitive school of sculpture existed at Sinai. Such hypotheses are, however, altogether baseless. The Chaldeans could obtain such materials from the mountains on the Persian frontier, and the Egyptians from those of their own eastern territory, and neither could easily have transported large masses of stone from the Sinaitic district.

The stone in question has many good points as a material for sculpture. It is of uniform texture and of moderate hardness, between that of marble and quartz. It is free from the quartz grains that render granite intractable. It is tough and takes a high polish. Its colour is agreeable, like that of a banded white and grey marble, and its lustre is superior to that of marble. It is extremely durable and resisting, and not liable to discoloration by weathering. Such properties, no doubt, commended it to the sculptors of the remote period of King Kephren, and it is perhaps remarkable that a stone with so many good qualities has been neglected by more modern artists. The statue of Kephren now in the Gizeh Museum bears testimony by its excellent preservation to these properties, and probably the other statues which accompanied it would have been equally perfect had they not been wilfully broken. In the later times of Egyptian art this stone seems to have lost its attractions or fallen out of fashion, except for small objects.

It would be extremely interesting to examine the quarries from which it was obtained, and to ascertain, if possible, the date when they began to be worked.

Diorite of many varieties—black, greenish, black with white blotches or mottled with black and white—forms great dykes and eruptive masses in the crystalline district of Upper Egypt, and was always and deservedly esteemed by the Egyptians. I have elsewhere remarked that, as diorite is one of the best materials for the formation of polished stone hatchets, it must have very early attracted attention; and its toughness, lustre, and susceptibility to a good polish must have indicated it as a material for sculpture. Accordingly, it is applied to a great variety of uses, from colossal statues down to platters and trays. A large proportion of the finest Egyptian statues are cut in diorite.

A dark grey granite has also been employed. It differs from the diorite in containing a little free quartz, and in having orthoclase felspar; but hornblende is usually its chief constituent. I have observed this black granite in a doorway at Karnak, in loose pieces on the site of a temple at Gizeh, in a sarcophagus at Thebes, in one of the Apis sarcophagi at Sakkara, in statues of Bast, and in a figure of Nectanebo and a hawk from Pithom in the British Museum.

True diorite occurs in the Rosetta Stone and the Great Scarabæus and several sarcophagi in the British Museum,* in the Pithom Sphinxes now at Ismailia, and in the Hyksos Sphinx and the fish offerers in the Gizeh Museum, and a great number of statues. One of Rameses II in the British Museum is a stone from the junction of red granite and diorite, and thus consists of two distinct kinds of rock.

2. Basalt with Olivine.

The term basalt has been used in a somewhat loose sense by writers on Egypt, apparently to designate any dark crystalline or subcrystalline rock. Some of the objects designated by this name prove to be dark-coloured hornblendic granites, others are diorites. One rock to which the name very properly applies, occurs plentifully in loose chips on some parts of the pyramid plateau, as if portions of the temples or tombs which have disappeared from that area had been composed of it. A chip from this place has been sliced and has been examined for me by Mr. Frank D. Adams, of McGill University, with the following results:—

* Professor T. Rupert Jones, F.R.S., in Proc. Geol. Association, vol. viii.

"*From Old Temple, Gizeh.*

"This is a medium-grained basalt (plagioclase basalt), in all probability belonging to the subdivision of olivine Basalts.

"It is composed of plagioclase, augite, olivine (?), iron ore, and apatite, with a small amount of glass.

"Under the microscope, the rock is seen to be porphyritic, a few larger individuals of plagioclase and augite occurring scattered through the rock. These porphyritic plagioclase crystals are occasionally somewhat decomposed. The rest of the plagioclase occurs in well-twinned, lath-shaped crystals, and is quite fresh. The augite is often well crystallised, and shows its characteristic cleavage and inclined extinction. There are also a number of more or less rounded grains which seem to have been olivine, but which are now almost entirely altered to a brown decomposition product, showing aggregate polarisation, and which is apparently for the most part hydrated ferric oxide. This material stains the other minerals of the rock, and seems in some cases to result also from the decomposition of the augite or the glass. The iron ore, which is black and opaque, resembles magnetite, and occurs in irregular-shaped grains. The apatite is somewhat abundant, occurring in long, slender needles."

A rock of this kind is described by Zittel and by Beyrich and Schweinfurth as forming eruptive masses in Lower Egypt, and probably of Tertiary age. One locality is at Abu Zabel less than 20 miles to the north-east of Cairo, and other localities occur in the Lybian Desert to the westward. Schweinfurth has found a rock of similar aspect in hills near the Red Sea, where it appears to have been quarried. The description given by Arzruni of the variety found at Abu Zabel closely corresponds with that of Mr. Adams quoted above.

This kind of rock, probably because of its accessibility and abundance, or perhaps because of the good polish of which it is capable, and the slight play of colours of the felspar and olivine when seen in a bright light, was much used for small objects, especially in Lower Egypt. As examples of this, I have in my collection a palette for grinding colours, a polisher, a perforated disk, two scarabs, some beads, and one of the sacred eyes used as charms. Statues and ornamental work in temples seem also to have been made of it; but it is not well suited to long exposure to the weather, as the olivine and augite are acted on by the atmosphere, and become rusty.

In *Modern Science in Bible Lands*, I have referred to this rock as an olivine-dolerite, and some of the varieties of it seem to contain more olivine than that examined by Mr. Adams. The use of this material suggests the question whether the artists who first employed it may have taken a lesson from the ancient nations who used a similar material so extensively in Northern Syria, or whether, on the other hand, Egyptian masons may have been employed in Bashan. In every country, however, the builder seeking for material comes to similar conclusions, according as he attaches more or less importance to accessibility, durability, or beauty.

3. The Nubian Sandstone.

This takes precedence in point of architectural use of all stones in Egypt, except, perhaps, the Eocene limestones. It is not only a soft and easily cut stone, and one which in the climate of Egypt is sufficiently durable; but where the Nile cuts through its outcrop in the gorge of Silsilis, or Silsileh, it presents exposures and facilities for shipment unsurpassed in the world. It was, however, quarried at other places, as in the vicinity of Assouan and in Nubia, where the great temple of Abu Simbel is excavated in this rock. Here, and in the great colossal figures of Amenophis, in the Plain of Thebes, its use in sculpture of the colossal sort is seen, and at Karnak, Kom-ombos, Edfou, and Denderah, its architectural employment on the most gigantic scale. That it is the material of the stupendous hypostyle hall of Seti I at Karnak, should perhaps give it precedence over all other stones of construction. The way in which in interiors it was coated with a gypseous cement and painted, I have elsewhere explained. In one quarry behind Assouan the patient excavator, instead of cutting rectangular blocks, had cut out at one operation large drums for columns, leaving semi-circular niches in the face of the rock. Regarded as a rock, it is a siliceous sandstone, composed of angular grains very loosely cemented, so that it is easily crumbled, and its colour varies from a light cream colour, or nearly white, to a yellowish-brown. Its age probably ranges from Permian to Lower Cretaceous,* and it differs from the newer sandstone of Jebel Ahmar in its less amount of siliceous cement and of red oxide of iron, and in the absence of any rounded grains. Its

* Fossils and stratigraphical arrangement seem to indicate that there may be two Nubian sandstones, one later Palæozoic, the other Cretaceous; but they cannot at present be separated with certainty. I have discussed this question elsewhere.

date is evidently altogether anterior to the operation of that wind-drift which has produced the modern rounded desert sand.

4. Limestone, &c.

In a country where cliffs of this rock present themselves on every side, it is necessarily of great importance, both as a stone of construction and as cement. It is mostly of Eocene age, though some Cretaceous beds have been locally quarried, and it is of very various qualities. It may be coarse and unequal in grain, or filled with fossil shells, as Nummulites, &c., or may be fine and uniform in texture. It is sometimes hard as marble, in other cases soft and chalky. It may be grey or brown, or of a pure white. All these varieties were more or less used, the coarser and more unsightly for cores of pyramids, foundations, and other structures not intended to be seen. The stepped pyramid of Sakkara, one of the oldest known, is wholly composed of a brownish limestone, found in the vicinity. The pure white and fine grained varieties were employed for lining and casing buildings, and for ornamental work and sculpture.

The finer varieties present under the microscope various characters. The most common and softest is of the nature of an indurated chalk; a congeries of microscopic foraminiferal shells, and must be an oceanic deposit similar to chalk and globigerina ooze. This is the variety employed for casing the Great Pyramid, for lining many temples and tombs, for statues and monumental tablets, and it is the whitest kind quarried at Turra at present. A variety observed at Abydos is of a light grey tint and earthy aspect, but this has been coated with a white cement and coloured. Other varieties used in sculpture have a fine concretionary or oölitic structure, or are so cemented with infiltrated matter as to assume a minutely crystalline character. The fine-grained foraminiferal limestone lends itself to the cutting of hieroglyphic inscriptions of all kinds, and to the art of the colourist, so that it is admirably adapted to the uses to which it was applied in tombs and temples.

A more modern limestone of later Tertiary age exists on the coast near Alexandria, and is quarried for building purposes. It is an organic rock, made up of fragments of shells, and is apparently similar in age and origin to the Pleistocene limestones found near Jaffa and Beyrout, on the Syrian coast, and to the modern shelly sandstones of the coast of the Red Sea, which are used for purposes of construction at Suez.

Alabaster, as distinguished from limestone, is a crystalline, translucent material, deposited in the manner of stalagmite, in veins, or filling caverns in the limestone. It is thus a local and irregular deposit; but the Egyptians managed to obtain it in several places, in quantities not only sufficient for vases and minor ornamental purposes, but in blocks and slabs sufficiently large to form shrines and to line portions of tombs, and even of temples. One locality where it has been extensively quarried is in the cliffs on the west side of the Nile, near Beni Suef.

The Egyptian alabaster is sometimes colourless, but more frequently banded with agate-like lines of grey and light brown, whence the name onyx-marble sometimes given to it.

Gypseous or soft alabaster does not seem to have been much used in Egypt, but small vases and other objects made of it are sometimes found.

Cleavable transparent calc-spar, probably obtained from veins in the limestone, was sometimes used by the Egyptians for minor ornaments and beads, probably as a substitute for rock crystal.

5. Miocene Quartzite of Jebel Ahmar, &c.

My first acquaintance with this stone dates from a time long anterior to my visit to the locality. My late friend, Dr. Douglas, of Quebec, had formed in successive visits to Egypt a large and interesting collection of antiquities, in examining which I noticed a small slab, or funereal stela, inscribed with hieroglyphics, and which specially attracted my attention from the fact that it was executed in quartzite of so great hardness as to defy ordinary sculpture with steel tools. At the time, I knew such rocks only as occurring in the old Cambrian series in Canada, and had not learned that they occurred in Egypt. The choice of a stone so hard seemed strange on the part of a people whom I had scarcely supposed capable of dealing with material so refractory, the use of the diamond drill by the ancient Egyptians being then unknown. I remarked at the time that the sculptor, or his employer, had evidently determined to possess an indestructible monument, "regardless of expense," but it seemed impossible to understand how he could by any expenditure have succeeded in his purpose.

Jebel Ahmar, the Red Mountain, lies a little to the east of the Mokattam Hill, in the vicinity of Cairo, and from its

peculiar rugged and dark-coloured appearance attracts, more or less, the attention of all travellers, who have usually regarded it as of volcanic origin. Geologists, as Russegger, Newbold, Schimper, Fraas, Delesse, Schweinfurth, and Owen, have naturally given attention to it, and have discussed its relation to the fossil wood of the so-called petrified forests in its vicinity.

Stratigraphically it consists of beds of more or less indurated siliceous sandstone resting on the Upper Eocene limestones of the Mokattam hill, but differing entirely from them in appearance and mineral character. The stratigraphy thus proves that these sandstones are newer than the Eocene, and they have usually been regarded as of Miocene age, so that we have here an example of an intensely indurated rock of comparatively modern date. Quite recently Mayer-Eimar has, on the ground of certain fresh-water shells found in connection with these beds, assigned them to the Tongrian, or Lowest Miocene age,* and with this view the evidence of the fossil trees is sufficiently in harmony. Of the older authorities, Russegger and Newbold seem to have very clearly understood the character and relations of these singular deposits. In point of fact, Jebel Ahmar, and some neighbouring eminences of similar character, constitute the undenuded remnants of thick beds of sandstone once spread uniformly over this region on both sides of the Nile, and deposited in shallow water succeeding the deeper water in which the Eocene limestones were laid down. Into this shallow water drifted many trunks of trees, principally of the genus *Nicolia*, and other exogenous trees believed to be allied to certain modern species of interior Africa.† With these are trunks of palms, and of Coniferous trees allied to the yew. The wood was silicified, and the sandstone in places hardened into quartzite by the percolation of siliceous waters. The action of the sea and of atmospheric agencies in later Tertiary times have removed the less consolidated portions, leaving the silicified trees scattered about, while there remained as rugged eminences those portions of the beds which had been hardened into quartzite by siliceous infiltration.

That this is the origin of these hills is evident from the

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* *Bulletin Zurich Academy*, 1889.

† R. Brown, *Quart. Journ. Geol. Soc.*, iv. Carruthers, *Geol. Mag.*, vii. Schenk, in Zittel's *Lybischen Wuste*. One of the Conifers in my collection is a *Taxites* of modern aspect.

nearly horizontal position of their layers, from their containing silicified wood so distributed, and with its cracks filled by sandstone, &c., as to show that it was embedded in the natural state, and afterwards silicified, and by the irregular pipes or craters passing through the hardest parts of the beds, and apparently the channels of geysers, or fountains of heated water. The date of these aqueous outflows must have been little later than that of the beds of sand, and while they were still unconsolidated, and their drift wood in a recent state. Direct volcanic action is not known in connection with Jebel Ahmar, but volcanic masses of Tertiary age exist near Abu Zabel, between Cairo and Ismailia, and also in the Nubian Desert, which may be of the same age. These have been described by Beyrich, Schweinfurth, and Arzruni, and by Zittel.* They afford the basalt mentioned in previous pages.

The Miocene or "Tongrien" sandstone of Jebel Ahmar may be estimated at 400 feet in thickness. It consists of siliceous sand partially rounded like the desert sand, but with many angular grains, and with the interstices more or less filled in with hyaline silica, sometimes entirely consolidating the mass. In some of the beds are layers of pebbles of quartz, agate, and jasper, many of which are evidently derived from the siliceous concretions in the underlying Eocene limestones. The colours vary from pure white to light red and dull purple, and the rock is often beautifully striped and mottled. From the enormous mass of chips around the hill, and the deep excavations in its sides, these beds of sandstone would seem to have been quarried from the earliest times, and they still furnish materials for millstones and for macadamising the streets of Cairo.

The harder varieties must have afforded the earliest colonists a desirable material for hoes, diggers, hatchets, and war-clubs, and their successors continued to use it largely for hammers and polishers and pestles, as well as for mortars and millstones. But from the earliest periods of Egyptian sculpture and architecture, the beauty and durability of this rock were recognised, and the perfecting of the art of drilling hard stones in the palmy days of ancient Egypt enabled this refractory material to be employed even for the formation of monolithic shrines and colossal statues.

Of the former, a shrine taken from the temple of Pithom,

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* *Proceedings of Royal Academy*, Berlin, 1882.

and now in the square of Ismailia, forms a good illustration. I have already described this relic,* and may here merely remark that it is a rectangular, monolithic chamber, 6 feet long and 4 feet high, with a sphinx, left in hollowing the rock, in the centre. It is formed of the red variety of the stone, with the bedding in a vertical position, and appears to be of the age of Rameses II. A similar shrine is noticed by Petrie, as found in the ruins of Tanis, but I have not seen specimens of the stone of which it is made.

One of the six monolithic statues, each about 20 feet high, sitting in front of the southern propylon of Karnac, is of a hard, light-brown variety of this rock with rows of agate pebbles, and though the upper part of the figure is gone, what remains impresses one very strongly with the audacity and perseverance of the Egyptian artist, who could attempt such a work in a material as hard as agate. Petrie informs us that the remains of the two colossal statues described by Herodotus as standing on pyramidal pedestals in Lake Moeris, show that they were of this stone. That such statues should have been broken up seems strange; but it is accounted for by the demand for millstones and pestles, &c., of this material, so that a statue of quartzite was more likely to be destroyed than one of limestone.

Among smaller works of this material the most perfect I have seen are two square slabs or tables of offerings, about 4 feet wide, with bowls elaborately worked on their upper sides, and hieroglyphic inscriptions round their margins. They are in the Gizeh Museum. They are wonderful trophies of skill and patient work, apparently belonging to a very ancient period.

Some travellers have stated that the two great Colossi of the plain of Thebes are of this stone, but this is an error. They are of a much softer rock, the Nubian Sandstone. The quarrying of this material may have been done by wedging out blocks, taking advantage in this of the joints and bedding of the stone. It could then be roughly shaped by chipping and hammering, but the finishing, especially in shrines and statues and in cutting inscriptions, must have been effected with the hollow drill, armed, perhaps, with diamond, as in the modern diamond-drill. Finally, the surface was probably polished by rubbing with sand of emery or other hard stones. Petrie has shown that the use of the hollow metallic drill, armed with gems, was well known in

* *Modern Science in Bible Lands*, p. 279.

Egypt, and Pliny (xxxvi. 1 and 14) mentions its use in classical times, while, in sculptures in the Roman catacombs, we see the sculptor's journeyman hard at work drilling the sides of Roman sarcophagi of stone.

Small objects, as pestles, polishers, and drill-sockets, were made of this stone. I have one of the latter with the depression for receiving the drill finely polished by long use.

6. Various Stones and Gems.

The following occur in the collections which I made in Egypt, and in specimens presented to the Peter Redpath Museum by the Egypt Exploration Fund.

Talcose schist and *talc rock*, images of Osiris, moulds for casting small objects.

Serpentine, scarabs, images of Osiris or ushebti, small vase.

Chlorite schist, a small figure of Osiris.

Argillite or *clay slate*, small figures or charms of various kinds, spear or knife.

Red carnelian, beads and seals.

Agate, peculiar variety of moss agate with circular ferruginous markings, also various agates and jaspers, some rudely shaped, others finely worked as beads, &c.

White milky quartz, fragment of circular object.

Green jasper, cubical bead, with angles truncated.

Amethyst, beads and ornaments.

Flint, knives, scrapers, piercers, arrow-heads. All are of the kinds of flint common in the Eocene limestones.

Garnet, beads in carbuncle and rosy varieties.

Lapis lazuli, scarab, Otus eye, bead, &c.

Steatite, small figures of animals, &c.

Hematite, black and finely-polished Otus eye.

Labradorite, oval button or knob, broken at base.

Fluor spar, purple beads.

Porphyry, red and other colours in various small objects.

Fuchsite, or chromiferous green variety of mica schist, a rude fragment, possibly used for inlaying. This rock is found in the Tyrol, and in Maine, in the U.S. of America. No Egyptian locality is known. The specimen came from Naukratis.

Mica schist, perhaps a whetstone, also fragments unworked.

Turquoise, a ring stone.

Emerald or *beryl*, in beads.

The precise dates of these objects are of course unknown, but they were obtained mostly by Arabs from old Egyptian

graves, and some of them may be of great antiquity, while others are probably comparatively modern.

7. Flint Flakes, Knives, Saws, &c.

It may be well to add here a few words as to the use of flint among the ancient Egyptians. There has been much unprofitable discussion as to whether the numerous flakes which may be picked up on the surface, especially near ancient sites, are natural or artificial, and if the latter, whether they are "prehistoric," or belong to the historical era. A few general statements of fact may serve to dispose of these questions.

(1.) The Eocene limestones of Egypt are rich in flint concretions. Some beds are especially stored with these; and even in the fine-grained white limestones used for the more important architectural purposes, the artist was often troubled by kernels of siliceous matter. Where the limestones have been denuded, great numbers of these concretions remain on the surface, just as in the chalk districts of England, and the gravel beds belonging to the older deposits of the Nile Valley, as near Thebes, at Helouan, &c., are largely composed of flints. Hence at all periods flint has presented itself to the Egyptian as an available material for tools and other purposes, and at many localities, as at Helouan, at Jebel Assart, Thebes, and in the desert, east of the Nile, ateliers with cores as well as flakes, and arrow-heads, saws, &c., may be found.

(2.) Besides the flints worked by man, innumerable chips exist that have been produced by nature. Some flints split or scale off under changes of temperature, and small rounded flakes produced in this way, and flints with conchoidal depressions are not uncommon. Torrential action, in all countries of flint gravel, has struck off numerous irregular flakes, and split the more friable flints into pieces, so that in some of the gravels a large proportion of the flints have been broken. On the one hand, there is little doubt that such naturally broken flints have been used as implements. On the other hand, any one who supposes all flint chips to be of human workmanship, even when they show a "bulb of percussion," is unduly credulous.

(3.) As to date, there is abundant proof that in historic times flints were used for surgical purposes, for incisions in corpses, for circumcision, for sacrificial purposes, and probably for common arrow-points. Careful study of the finer hieroglyphics of the calcareous tombs has also convinced me

that these were scraped in the soft limestone with pointed flints, such as are often found abundantly in the vicinity of such tombs.

(4.) It is, however, probable that in very ancient times when metals were scarce and dear, flint implements were in much more common use than in later times. Perhaps the most interesting case of this is the comparison made by Petrie (*Nature*, Dec. 5th, 1889) of two towns, Kahun and Gurob, 50 miles south of Cairo, and on the two sides of the entrance to the Fayum. The former town belongs to the early time of the 12th Dynasty, the latter to the 19th. In the former flint flakes are abundant, of various forms, and evidently applied to many uses. Among other tools a wooden sickle was found, armed with saw-edged flint flakes on the cutting side, thus connecting flint flakes with the reaping of grain. Petrie figures an example of this. In the other and later site flint flakes scarcely occur, and are rude and evidently applied to fewer uses. This seems to be an excellent illustration of the progress in one locality from a stone to a metal age. The interval of time amounts, however, to at least a thousand years, and the earlier period, that of Usurtasen II, was a time of high civilisation and great progress in the arts of life, though farmers in the central district of Egypt were still reaping their fields with flint flakes. A parallel to this is found in the prevalent use of stone for hoes, &c., among the more civilised American nations, to which I directed attention in a paper on "Fossil Agricultural Implements," in the *Transactions* of this Society several years ago.

This continuous use of flint flakes among a civilised people, and the fact remarked by Petrie, and which has been observed also in Scotland and America, that the flint implements become ruder and more coarse as they are supplanted by metal, should furnish a caution against sweeping generalisations as to ages of stone and metal, and of progress in the manufacture of flint tools and weapons. While at some times and in some localities there has been an advance from rude to finer implements, in other instances the process has been reversed.

In connection with the materials referred to in this paper, certain geological and historical facts impress themselves very strongly on our minds.

All the rocks of the Nile Valley, from the ancient crystalline and probably Laurentian granites and gneisses to the modern

limestones on the coast, have furnished materials for construction and sculpture in Egypt, and this from a very early period. This is an indication of the mental activity, observation, and intelligent industry of the people and their rulers, and, with their other achievements in irrigation and in utilising animals and plants, shows the enterprise of an early and active-minded state of society, as distinguished from the fixity and conservatism which appear in later times.

In connection with this, it is, however, to be observed that no country in the world presents greater facilities for the discovery and exploration of its mineral treasures. The proximity of the different kinds of stone to the river in cliffs easily accessible, and the unrivalled facilities for transport are important factors in this matter. Still, in the hands of an unintelligent and unprogressive people, these facilities might have long remained undeveloped.

It is also to be observed that from the earliest colonisation of Egypt there seems to have been a settled and orderly state of society, an exemption from foreign aggression, and an abundance of food, all tending to a large population, and giving facilities for the execution of public works: while the necessity of combination of effort in the irrigation and embankment of the land gave the habit of united action under leaders.

The great works of Egyptian construction thus indicate to us a country rich in materials and having admirable means of conveyance and an abundant population, and a surplus of food products. On the other hand, they show that there was an educated class capable of forming and executing great plans with precision and taste, and this again, aided by a multitude of skilled artisans, and by ample command of unskilled labour, especially at certain seasons of the year.

Historically, it is worthy of note that the great works of the Egyptians in stone, if we except the Pyramids, culminated in that period in which there is reason to believe the Hebrews had their residence in Egypt—the time of the great 18th and 19th Dynasties. Within this time fall the Temple of Karnac and the greater buildings of Thebes, as well as the greatest works in statuary. We cannot, however, regard these works as other than purely Egyptian, for this was their plan and style; but the fact that the Pharaohs of this period had at their disposal the peoples and the wealth of Western Asia must have been no unimportant determining cause of their enormous expenditures of material and labour. It was a time when the artistic skill and ambition of the Egyptians

had at command an abundance of men and means, and these they employed in quarrying and working stone for temples and statues on a scale which has not since been equalled in any part of the world. In more modern times there may be equally great triumphs of design and mechanical execution, but they run in different directions, and aim at different results from those of the ancient people of Khemi, who, with all their ordinary wants superabundantly supplied by the fertility of their soil and their own eminent agricultural skill, could afford to spend a vast amount of energy in great works of art, commemorative of their lives and national achievements or tributary to their religion.

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