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ORDINARY MEETING.

PROFESSOR EDWARD HULL, LL.D., F.R.S., IN THE CHAIR.

The Minutes of the last Meeting were read and confirmed.

The following paper was read :—

THE CLIMATE OF EGYPT IN GEOLOGICAL, PREHISTORIC, AND ANCIENT HISTORIC TIMES. By Dr. GRANT BEY.*

(Read May 18th, 1896.)

A. ON THE CLIMATE OF EGYPT IN GEOLOGICAL TIME.

IN treating of the climate of Egypt in Geological Time, very naturally you will expect me to take you back along the thread or scroll of geological history to that period when the nebulous mass† of this globe (thrown off during the formation of the Solar System) took on somewhat of a definite shape and had already laid the foundation of its present crust.

It would seem that the Primitive Waters of ancient mythology and tradition, during the contraction of this shapeless nebulous mass, formed a universal sea of water with a universal sea of steamy vaporous atmosphere above it, which entirely obscured the sun, although it was much larger and nearer then than now. At this epoch, darkness

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* Being the revised substance of MS. notes, read at the Pan-Amer. Med. Cong., Washington, 6 Sept. 1893.

† The fact that some of the principal constituents of this earth are non-existent in the Sun, should not militate against the nebular formation of the Solar System, seeing that *Nebulæ* are not homogeneous but heterogeneous in character, and have even many different *vortices* of varying composition within them.

covered the face of the deep, and the climate must have been very hot and very damp; but there was nothing as yet to make it malarious, for no vegetation could have existed at this period.

As the cooling process went on, the misty steam that filled the atmosphere would, in time, take on more of the nature of clouds suspended in the air, thus permitting the direct rays of the sun to penetrate here and there, so as to light up the Primitive Waters that now enveloped the central mass of this globe.

During the formation of these waters the excessive heat had caused to be dissolved in them many of the primitive elements of our earth, which, as the water cooled, were slowly deposited in crystalline form and made a solid bottom for this primitive and still comparatively hot sea. In the upper stratum of this deposit, Sir J. W. Dawson has discovered the fossil remains of a species of foraminifera showing that the climate had so far changed as to allow of the existence of, at least, a low type of vegetable and animal life.* The origin of such life does not come within the scope of this paper, as we have only to deal with things as we find them, and draw our inferences as to the kind of climate that would allow of their existence, modification, or extinction.

As shrinkage went on owing to the continuance of the cooling process, the rocky bed of the sea would become crumpled up every here and there from the external pressure causing the shell of the earth to fall in. Thus projections of crystalline rocks would appear above the surface of the water and form the first dry land as islands or even continents in this vast sea.

No doubt, at different places on the inner side of the crust of the earth, we should also find, at this early epoch, that pressure from within caused by igneous action forcing up the crystalline shell or even bursting through it, had already produced elevations, geysers, burning mountains and granite formations.

These rocks, now exposed, were being continually washed by a hot shallow sea, while they were acted on at the same time by drenching rains, thus causing their slow disintegration, the débris of which settled at the bottom of the sea and

* The author appears to refer to the *Eozoon Canadense*, the organic ature of which is not universally admitted, and is, in fact, strongly contested by Professor Möbius, Professor Ferd. Roemer, and others.—Ed.

formed the geological stratum known in our day as the Nubian Sandstone.

After a period of geological time the Egyptian part of the crust of the earth was still more upheaved, exposing a larger surface above water, and laying bare a great deal of the Nubian Sandstone that had been deposited at the bottom of the sea.

The climate was still damp and very hot all through the rest of the succeeding formations, and extending to nearly the end of the Second Geological Period. Egypt lost in area instead of gaining; for the more than tropical rains continued to disintegrate the rocks, and washed the greater part of the Nubian Sandstone into a sea, which was becoming more and more animated by organisms that were rising in the scale of existence, and which was depositing layer upon layer at its bottom an illustrated history of its inhabitants and its work.

At this time the eastern part of the island, that represented Egypt, became submerged, and on it, at the bottom of a still warm sea, a cretaceous deposit took place enclosing in its substance the remains of animals of a much higher type of organisation than we have yet met with. Some of these animals were amphibious, so that they could come out of the water and bask in the sun on the sandy shore of the sea. They were all representatives of the fauna of a warm climate.

The Tertiary Period was ushered in by a general though unequal submergence of all that is known as the Egypt of the present day, except the region about Assouan, which continued to appear as a rocky island in the Tertiary Sea, just as it had done in the early Primary and late Secondary Seas.

During the deposit of the lowest stratum called Eocene (Nummulitic) of the Tertiary Geological formation, the geographical position of Egypt was still occupied by a comparatively warm sea, as shown by the fossils that are now found in what must have been its bed.[1] In due time the crust of the earth was pushed up out of the water by volcanic action and became dry land.[2] After a space of geological time, alluvium was formed on the now exposed Eocene stratum—vast forests grew, that must have been well watered in the ordinary way, by the rains of heaven.[3] Naturally there would be a watershed somewhere, and therefore a river. This condition of things must have lasted many thousands of years, when another volcanic disturbance, or natural shrinkage took place, and a portion of this part of the globe became

again the sea bottom; the alluvium was all washed away leaving only sand, and fallen decaying trees, water-logged in a silicified sea, which was rendered all the more silicious by the presence in it of geysers. As the sea cooled down, the trees became silicified, and lay like rocks embedded in the sand at the bottom of the sea; while in the immediate vicinity of the geysers themselves, the loose sand became solidified into a heterogeneous mass, containing many of the silicified trees in the lowest part of its structure.[4] Some of the trees are palms, showing that Egypt continued to have a tropical climate similar to that of the Soudan in our time. This new stratum formed what is called the Miocene, and when it in turn was upheaved and became dry land, all its loose sand was gradually blown away, leaving the Eocene towering up at places to the height of 600 feet, as the Mokattam range at Cairo, while the petrified trees were exposed, lying on the surface of the Eocene. Of course, where the sand itself was glued together by silica, it remained as a sandstone hill, such as "Gebel Ahmar" near Cairo, where traces of two geysers may still be seen, with petrified wood embedded in its lower stratum; thus showing, as if it were written on the pages of a book, the exact position in geological history to which these petrified trees belong, and the climatic conditions of that period when these natural forests existed.[5] The areas of marine Miocene however in Egypt are rare, indicating that this region had already assumed in a great measure a continental character.

According to Sir J. Wm. Dawson at the close of the Eocene Period the Gulf of Akabah, which had been, up till then, in communication with the Mediterranean, was closed, but the Gulf of Suez continued to be a Strait; and the Mediterranean, which washed the base of the Mokattam range, extended even to the east of Gebel Attaka on the Red Sea. This remained so through the Miocene Period, so that there was free communication between the Red Sea and Mediterranean and the disconnection could scarcely have taken place till the first continental period of the Pliocene, when the Blue Nile lost itself in a lagoon of the isthmus on the Red Sea side, and contributed considerably to the enlargement of that isthmus.

This was the first separation of the waters of the Red Sea and Mediterranean in geological history.

The climate was then a little warmer than now as may be gathered from the shells and animal remains of the

Pliocene formation—the Pliocene age was probably still more continental than the Miocene Period.

After this came the great Pleistocene submergence (about 20,000 years ago) when the Red Sea and Mediterranean again intermixed freely for a short geological period, while the present valley of the Nile (without any Nile) was a long fiord of the sea stretching as far inland as the rocky barrier at Assouan, and being gradually deepened by the erosive action of the sea.* The raised beaches near Cairo belong to this period.[6] The scattering of boulders from the eastern crystalline mountains over the Libyan Desert seems to imply the action of floating ice in some part of the Pleistocene Period.[7] The softer parts of the Miocene sandstone must also have been wasted away at this time.

This submergence was succeeded not long after by a re-elevation partially restoring the conditions of the first continental period, and finally connecting Asia and Africa by a permanent isthmus.

A divergence is now manifested between the fauna of the Mediterranean and Red Sea; the fauna of the Mediterranean taking the type of the Atlantic, and that of the Red Sea the type of the Indian Ocean,[8] showing a complete change between the climates of these two regions.

The oldest part of the isthmus is the Miocene bed at Shaloof, about 13 miles from Suez, and only 6 to 9 feet above the level of the Red Sea. This bed is covered in part by the old Blue Nile deposit of the Pliocene, or as some geologists contend of the later Pleistocene, both these having been continental periods with an abundant rainfall. The highest parts of the isthmus are at El Gisr to the north, and Serapeum to the south of Lake Timsah. These elevated portions of the isthmus are composed of the Old Nile deposits.

Thus the ancient Blue Nile built up a considerable portion of the isthmus at a time when the climate was warmer than at present; for this limestone stratum extending from El Gisr to Shaloof, and stretching to a considerable distance east and west, contains freshwater shells that are now confined to the Upper Nile, and that have somewhat of a modern character as compared with what we might expect in a Pliocene bed.

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* The author has somewhat inverted the order of things in the above statement. There could not have been a Nile valley before a Nile river! The Pleistocene Period began with a great elevation of the land and sea bed following the Pliocene submergence.—Ed.

In the later Pleistocene it would appear that the Blue Nile debouched into the lagoon of the isthmus, which at that time of continental elevation was much more extensive than now.

It is to this period that we must ascribe the Sahara Sea, and the large inland sea of Geikie, which included the Black Sea, and Caspian, and a large tract of country to the west of the Ural Mountains.[9] As long as these existed the rainfall in Egypt and in Arabia must have been excessive, and this accounts for the manner in which the surfaces of the anorthosite gneiss (diorite) and schist show such an amount of wasting and disintegration. Professor Hull has also found evidences of a chain of ancient freshwater lakes in the Sinaitic peninsula that must date from this period, and that disappeared when these inland seas dried up and the rainfall ceased.

At the close of the Pleistocene elevation, or in other words in the early modern geological epoch, we find the Red Sea shells at the Bitter Lakes quite like the recent shells.[10]

The ridge at Shaloof must have been at this time under water as we may judge by the shells now to be seen in its upper layer. Its elevation, therefore, is quite modern geologically speaking, and the elevating process continues, though slowly as measured by the geological clock.

At a date more immediately preceding the Prehistoric Period[11] the land of Egypt was higher than at present; but owing to the earth's shrinkage the whole country sank considerably, thereby causing two fractures that are evident, one along the Mokattam range from Cairo to Suez, and the other along the present Valley of the Nile whereby a depression of upwards of 150 feet on the Libyan side took place.

Even at the present day, were the Nile to dry up, the sea would again reach this ancient limit near Memphis along the empty bed of the river.

NOTES.

[1] One of these fossils was presented by Dr. Grant Bey to the late Professor Sir Richard Owen, who described it fully in the *Quarterly Journal of the Geological Society* for February, 1875. It proved to be the fossil skull of an Eocene Sirenian mammal, of the same type as the Dugong which still exists in the Red Sea.

[2] There is abundant evidence of volcanic action in various parts of Egypt, at Abu-Zabel near Cairo, at the Cataracts, and along the Red Sea coast plutonic rocks are met with.

[3] These forests contain exogenous and endogenous trees. Several species

of the exogenous ones have been classified, and a species of endogenous tree has also been discovered, which was described by the late Sir Richard Owen in a letter (September 27th, 1875) to Dr. Grant Bey as being "*undoubtedly palm*," but it has not yet been further classified.

[4] The sand was formed ultimately from the crystalline rocks of the interior, and proximately from the waste of the Nubian sandstone, and the sandy upper Eocene beds. The thickness of the Miocene sandstone stratum would be about 100 feet (Dawson).

[5] The igneous rocks at Aboo-Zabel about 11 miles north of Cairo belong to this period of the geysers, or perhaps even a little later (Dawson).

[6] At Het-el-Qorab hill a little to the south of the Great Pyramid, and at an elevation of 40 feet above the plain, there is an old sea beach of the Pleistocene period.

[7] Sir J. William Dawson inclines however to the water rather than the ice agency. In fact there is no trace in the geological history of Egypt of there ever having been the cool summers necessary for the formation and continuance of a glacial period.

[8] At the present day the shell fish of the Red Sea are quite distinct from those of the Mediterranean.

[9] It must have been during the existence of this sea that it was possible for the mammoth to live in Siberia, as such a large inland body of water must have much modified the climate around it.

[10] In Strabo's time (24 B.C.) the Red Sea extended but to the north end of the Bitter Lakes, and that only by means of a canal originally dug by Darius Hystaspis (520 B.C.) from the south end of the Bitter Lake to the Red Sea, about 10 miles in length.

[11] Prehistoric as far as Egypt is concerned.

B. Climate of Egypt in Prehistoric Time.

The Prehistoric Period of Egypt was preceded by the formation of the present Nile and the fluviatile deposits that have made the country rich and inhabitable. This took place only about 8,000 or 9,000 years ago.[1]

The Nile, however, did not find its way to the Mediterranean without encountering formidable obstacles in the shape of crystalline rocks, granite and sandstone dykes, and calcareous beds, which one by one were either swept before it at once, or else the pent-up water formed large lake districts, and overflowed the obstacles as cataracts. Most of these have become gradually rubbed down,[2] and form now only rapids. Some of them, however, were broken through, suddenly causing a regular deluge in the lower country; and several of these floods must have taken place in historic times, for when Solon visited Egypt, about 600 B.C. and asked the Egyptian priests if they had in their

history any mention of the universal flood, such as is recorded in Greek history,[3] they replied that they had records of *several* floods, no doubt referring to the sudden giving way of cataract barricades. The first obstacle to yield to the ever conquering water in the Prehistoric Period, was the sandstone dyke at Silsilis, about 50 miles to the north of Assouan. At this time the ancient Ethiopia, commencing at Assouan, was in a great measure under water, as the cataracts at Assouan and Semneh (near Wady Halfa) had not yet been worn down, nor had they given way. The same, no doubt, may be said of many of the other cataracts that simply made the Nile Valley a series of lakes, while at the same time there was a large inland sea where the Sahara is now. These vast sheets of water, under a tropical sun must have made the neighbouring countries quite rainy, and this amply accounts for the abundant evidences we have that the Nile had a larger volume of water then than it has now, and was fed by local rains, and streams that rushed into it like so many Niagaras. (Petrie's *Ten Years Digging in Egypt.*)[4]

Professor Sayce tells us (*Ancient Empires in the East*) that the wadies and cliffs of the Nile valley are waterworn and covered with boulders and pebbles which bear witness to the former existence of mountain torrents and a considerable rainfall; and the discovery of palæolithic implements near the little petrified forests and in other places, makes it clear that the geographical and climatic changes the country has undergone have taken place since it was first inhabited by man.

NOTES.

[1] The depth of the Nile deposit across the Delta in the latitude of Zagazig was ascertained by means of a series of borings in 1883 to be between 30 and 40 feet; and as authorities are agreed that the rate of deposit is between 4½ and 5 inches in a century we thus find that the convulsion of Nature referred to in Part A, must have taken place about the time here stated.

[2] In the whole of the Nile valley, from Edfu northward, the geological formation is calcareous (Eocene) which the Nile has scooped out to the depth of 200 feet.

[3] The flood of Deucalion and Pyrrha.

[4] On the subject of the "Origin of the Nile Valley," see paper by Professor E. Hull in *Trans. Vict. Inst.*, vol. xxiv, p. 307. The period of great rainfall referred to by Dr. Grant Bey is known as the Pluvial period, which occurred at the close of the Pleistocene.—Ed.

C. The Climate of Egypt in Ancient Historic Time.

As we advance to the historic period which has been characterised by the deposition of much fluviatile sediment especially in the Delta, and probably by a slight depression of the Mediterranean coast, accompanied by a slight elevation from the latitude of El Gisr, southward,[1] we find that the primitive prehistoric immigrant tribes that had come from a northern region, and had settled as independent colonies all along the valley of the Nile, were, in time subjugated by another and stronger race,[2] coming from the East, or land of Poun-t.[3] It is only now that we find anything like a concentrated government, and the establishment of a monarchy. The first historic dynasty began about 4800 B.C., and Manetho gives the name of the first king as *Mena*, the word itself meaning "the establisher."

The name may have been given to him in recognition of the power and ability he displayed by bringing all these different colonies under the rule of a central government. The exploits of Mena, as recorded by Manetho, throw considerable light on the physical conditions and climate of Egypt at this early date.

The cataract at Silsilis had either broken through, or had become gradually worn away, thus liberating the large body of water which had been impounded above it, and so diminishing the rainfall in the vicinity. Before this water was liberated, a large amount of alluvium was deposited for probably 1,000–1,400 years, and it may be mentioned as an interesting fact, that these large tracts of land then left high and dry, now only await the magic touch of irrigation to become highly productive. The cataract (granitic) at Assouan was still high (100 feet higher than now) and a branch of the river swept round by the still existing ancient quarries and re-entered the main channel a little to the north of Assouan, making Assouan an island. The cataract at Semneh was also intact, making Ethiopia an extensive lake district. Many of the other cataracts however had given way, and were now only rapids. Notwithstanding the emptying of many of these inland lakes and consequent destruction of vegetation, the rainfall must still have been considerable in those regions that are now rainless. Mena with his followers seems to have entered the valley of the Nile by way of Arabia, and the Red Sea. His first seat of government was at This or Abydos,

situated between Assiout and Luxor. At that time, even as now, Abydos was on the border of an extensive fertile plain that required no great skill for its irrigation. Mena no doubt visited Silsilis and could see at a glance how much was to be gained even by a partial restoration of the cataract there; but for some reason or other he did not attempt it although he had no mean engineers in those days, who had already built the Temple of the Sphinx, and hewed the Sphinx itself in the native rock at Gizeh (Maspero). No, Mena's exploits were carried out in the northern Egypt of that day. In the region between Heliopolis and the Temple of the Sphinx, he saw a battle going on amongst the watery elements—the sea and the river—striving for the mastery. The river was throwing its mud in the teeth of the sea, and wherever there was a sand island there the mud was thrown up, and rank vegetation with dense forests soon appeared. The sea, little by little, had to retire leaving swampy morasses behind it, where the crocodile and hippopotamus were at home; but making the whole of this region malarious and unhealthy to man. Mena, who was his own minister of health, set himself to remedy this state of matters. He caused a great dyke to be raised, about 30 miles to the south of where Cairo now is, and directed the channel of the river into the centre of the valley, as it was then flowing by the foot of the Libyan range on the west side of the valley.

This he followed up by raising other dykes as he required, so as to get the control of the river, and drain off the marshes. This was evidently the beginning of reclaiming the Delta from being a morass, which would no doubt change the climate considerably and make it much less malarious. On part of this reclaimed land Memphis was built, which continued to be a city of some considerable importance down to mediæval times. While Mena was directing his irrigation schemes he was attacked by a hippopotamus or crocodile and killed, after a reign of sixty-two years. The presence of the hippopotamus or crocodile would indicate a warm climate, but not necessarily much different from what we have now, for Dr. Abd-el-Lateef writing at the beginning of the 13th century of our era has recounted that hippopotami were very common in the Damietta branch of the Nile at that time, and even so late as Mohammed Aly's time (1811-48), a hippopotamus was killed near Mansoura in the Delta.[4]

No doubt the good example set by King Mena was followed by his successors, so that the river was guided in its course, and land was reclaimed whenever possible. By the time of the IInd dynasty (4634 B.C.) Bubastis, near Zagazig, was founded and inhabited. The vast proportion of the present Delta, however, was still a gulf of the sea, with the muddy Nile running into it, and gradually forming the Delta. By the VIth dynasty (3500 B.C.) some of the sand islands, in the gulf had become inhabitable through the pioneers reclaiming the morass around them. On one of these islands Tanis or Zoan was founded, a city which played an important part in the history of Egypt in later dynasties. When we reach the XIIth dynasty, the sixth king of that dynasty (Amenemhat III) took great interest in reclaiming the swamps and in the proper watering of the land already reclaimed. He is celebrated for having conferred great benefits on his country by the construction of dykes and reservoirs for controlling the water supply. He caused a Nilometer to be chiselled on the rocks at Semneh, a few miles south of Wady Halfa, and in connection with it a series of hieroglyphic inscriptions, recording the rise of the Nile during his reign; from which we learn that the waters of the inundation rose on one occasion 27 feet, and at other times on an average 11½ feet above the greatest rise of the Nile at the present day. At that time, therefore, the cataract at Semneh had not yet broken down, and Ethiopia must, therefore, have been a well-watered country. The rock inscriptions also show that the Nile below Semneh rose some 10 feet above the highest Nile of our day, proving that the cataract at Assouan was only being slowly rubbed down; the island of Philae being of course then under water.

It was in connection with the XIIth dynasty (2500 B.C.) that Dr. Flinders Petrie found in Upper Egypt traces of an Ionian colony of workmen that had been employed by one of the Usertesens. This economical measure would seem perfectly excusable, even for such an exclusive people as the Pharaohs, for at this early epoch in Egypt's history the native population must have been sparse. But by the middle of the second century of the Christian era, when Ptolemy the Astronomer lived, the population of Egypt had so increased that it exceeded the population of our day by two millions. This points not only to an admirable climate but also to an intelligent population for those ancient times.

Were it not that the present inhabitants are so deeply sunk

in ignorance, and live in the midst of insanitary surroundings that they have produced themselves, and that they need a paternal government to raise them out of, we should have had such a continuous surplus of population that the whole of Africa might, by this time, have been filled with thriving Egyptian colonies and federations. The decrease in population cannot be attributed to the climate which will compare well with the climate of the most favoured parts of the world; nor to the sterility of the race, for it is remarkably prolific, nor to intemperance, for the people are sober and peaceful.

Ignorance and filth, its twin sister, make sad havoc amongst the population, so that all the weak die early, and only the fittest survive, who in turn easily succumb, when, in more advanced years, disease attacks them. It seems altogether inexcusable, that Egypt, blest as she is with such an excellent climate, and with a prolific and sober population, should be crippled in her supply of agricultural labourers, owing to an excessive but remediable death-rate. Public instruction and public health are two very necessary and very important portfolios to hold; but public instruction has to take the first step, as ignorance must be dispelled, in part at least, before health measures can be satisfactorily carried out.

At a very early date there were direct commercial relations between Egypt and India, as well as indirect through Mesopotamia, so that Egypt was often exposed, then, as now, to the importation of Indian and Mesopotamian communicable diseases. Thus, notwithstanding the extraordinary attention given to sanitary science by the ancient Egyptians, we find, from history, that every now and then, plagues among men and beasts devastated the country, showing that, although these diseases were not indigenous to the soil, there is every reason to believe that the personal sanitary condition of the people left much to be desired; and we must not forget that the Egyptian campaigns introduced into Egypt a very large slave population, which to say the least, had not been educated in sanitary science. No doubt there was much squalor and filth in the old days, but surely not so much as now. At any rate we know for certain that the ancient Egyptians revered the Nile as a god, so that it was kept scrupulously free from anything that would pollute it. How different now-a-days when the Nile is looked upon as a common sewer, and is used as such.

The climate of Upper Egypt would still (under the XIIth dynasty) be somewhat rainy, although by this time, the

Sahara inland sea would be very much contracted from what it used to be. The great dam at Silsilis had broken through its barrier in prehistoric time, and apparently not any attempts had been made to restore it, unless perhaps on paper, as has been done in more modern times. Amenemhat III has rendered himself immortal by having created an inland freshwater sea in a natural depression in the Libyan Desert, not far from the Nile and quite near to Memphis. Suffice it to say here that water was conveyed to it from the Nile by means of a canal (the Bahr Yousef of our day), and when the basin was filled, it was said to be 450 miles in circumference, and at parts 350 feet deep. It was called by the Greeks Lake Moeris, but in hieroglyphic language it was called Ta She—the lake country.[5] It continued to act as a reservoir for the Nile surplus water, and to irrigate the country around till the Roman period, when the dykes were neglected, the sluices fell out of repair, and the water thus ran to waste; so that in the time of Pliny, 70 A.D., it was already dry, with the exception of what still remains under the name of Birket-el-Qoroon, or Lake of Horns, so named from the form of the lake being like the shape of a pair of horns. Very naturally this depression in the desert, after having been constantly filled with the muddy Nile water, and partially emptied for irrigation purposes, year after year for a period of nearly 2,400 years, is, now that it is dry, one of the richest provinces of Egypt. Its present name "Faïoum" is simply the Coptic name "Phiom" or "the Sea," carrying us back to the time when, instead of the 231,283 acres of rich arable and cultivated land of to-day, this was a veritable sea. This large body of water must have modified considerably the climatic conditions in its neighbourhood; for we must not forget that where we have freshwater to deal with in a warm climate, we have always an abundance of trees and vegetation that materially and sensibly affect the temperature and rainfall.[6] The Faïoum now is a malarious district, but more especially in the vicinity of Lake Qoroon which is brackish, and the rainfall is almost *nil* throughout the whole of this region.[7]

Amenemhat III died about 2266 B.C., and was succeeded by a number of kings of little account as far as this paper is concerned, till about 2200 B.C., the fourth Pharaoh of the XIIIth dynasty made a record on the Nilometer at Semneh, showing that the cataract there was still holding out; yet

under the sixth Pharaoh of this dynasty, monuments were erected on the island of Argo, considerably to the south of Semneh, but below the level of the formerly dammed back waters of the cataract. Sometime therefore between these two reigns—a period of only sixty-six years—the Semneh cataract must have rather suddenly given way, and caused a destructive flood all along the course of the Nile to the sea, and famine would have been the natural result of such a sudden catastrophe.[8]

Ethiopia was now left high and dry, and became more or less a barren waste, even as it is to-day. It is with great labour that the natives now raise the water from the Nile to irrigate their little patches of ground simply to grow sufficient to keep them alive, and I fear that famine is not uncommon among them. Here then another rainless district has been produced, and so it remains. We may now say that the whole stretch of country from Assiout to Berber, which had an abundant rainfall in ancient times, is now almost without rain. No doubt, this would be reversed if the cataracts were restored, a new Lake Moeris created at the border of the ancient one, the Sahara[9] refilled with sea-water, and the Eurasian Sea of Geikie restored, for under these circumstances the rainfall would again be excessive. As far as the restoration of the cataracts and Lake Moeris is concerned, this has been studied by the Egyptian Government for several years past, and the study is still being pushed forward by American,[10] French,[11] and English[12] engineers.

When we go up the Nile as far as Berber, 17½° N. latitude, we enter the region of tropical rains, that, following the course of the sun, and falling in torrents on the Abyssinian mountains, and in the equatorial regions, create the White and Blue Nile, which uniting at Khartoum form the river that makes Egypt a habitable country. These rains are periodical, and produce the annual rise of the Nile to which we in Egypt are so accustomed, that we often forget that a few feet above, or a few feet below the average annual rise, means famine and disease. The usual difference between *high* and *low* Nile may be stated as 25½ feet at Assouan,*

* If the river rises at Assouan 29 ft. above the usual low water mark it means peril to the whole of Egypt; but if the rise is only 20 ft. above the minimum, then whole tracts of the valley will never be submerged. A poor flood, however, is more serious than the devastation caused by the most violent excess. (Moncrieff.)

19 feet at Cairo, and only 4 feet at Damietta and Rosetta; but in ancient times with a greater rainfall and a fuller river these figures would have to be considerably higher. We have seen that reclaiming the Delta was a very gradual process, and even at the present time the Government is draining the swamps and lakes to make the land available for cultivation; and reclamation must proceed as long as the Nile continues to bring down such large deposits of alluvium from Abyssinia and Central Africa. Formerly, the Delta swamps formed an inaccessible hiding-place for culprits, refugee kings and their followers; and they were also the home of the plague, pestilence, and other serious forms of disease recorded in history; or at least favoured their propagation when imported. The rainfall in the Delta for 30 miles inland is now as much as 10 to 12 inches annually, influenced in some measure, no doubt, by the large salt marshes and lakes lying across the 160 miles of Mediterranean front: viz., Mareotis, near Alexandria, covering 250,000 acres; Edko 100,000 acres; Burlos 300,000 acres; Aboukir 50,000 acres; Menzaleh 500,000 acres, and Sirbonis near the Palestine frontier, 100,000 acres.

Most of these lakes did not exist in comparatively ancient times, for the districts now covered by them were richly cultivated, and supported a numerous population. Lake Menzaleh was formerly a district celebrated for its fertility, but in 535 A.D., the sea broke in and submerged the eastern portion, and by 540 A.D. the whole of this region was totally under water, so that all the towns on the low levels were destroyed by submergence, and only those that were built on the high grounds escaped; but even they became so malarious and unhealthy that after a time they were abandoned. Besides, the country around that was not submerged became swampy, unhealthy, and ruined for agricultural purposes just as it is to-day, so that the population in this region has ever since remained scanty.

The present Lake Mareotis was originally a small sweet water lake, surrounded by a famous vine-growing district, celebrated in ancient times for its fertility and salubrity; but in 1801 A.D., the sea was intentionally let in for military purposes, and thus the whole district was entirely destroyed and converted into a malarious environment of Alexandria, which otherwise would be a much healthier city than it has been ever since this regrettable event.

About the beginning of the Christian era, Lake Sirbonis

was 125 miles in circumference, and more anciently was much larger. It is said to have even engulfed a whole wing of the army of Ochus king of Persia (340 B.C.). It is now an insignificant lake having little or no perceptible effect on the climate in its neighbourhood.

Lake Aboukir has recently been drained and its bed is now being cultivated. This will do away with the malarious swamps in its vicinity, and render this part of the country once more healthy.

I cannot close this paper without saying something about the influence of the condition of the Isthmus of Suez on the climate of Lower Egypt.

In even late geological times we have seen that Africa was an island, so that the Isthmus of Suez is of recent formation. While "the tongue" of the Red Sea still came as far north as El Gisr it increased the rainfall in Lower Egypt and modified the climate in its vicinity. When it dried up, naturally the rainfall depending on it, ceased.

This is proved by the fact that since the refilling of the Bitter Lakes, and opening of the Suez Maritime Canal in 1869, we are having a greater rainfall in Lower Egypt. No doubt this is also influenced by a more extensive irrigation and planting of trees which the Government is wisely encouraging. This however brings me to speak of the climate of Modern Egypt, which I have discussed elsewhere.[13]

NOTES.

[1] All areas of great deposition tend to be areas of subsidence, hence the highland of El Gisr has in modern geological time been the axis on which the isthmus has oscillated; the south side rising, the north side sinking.

[2] These two races had not amalgamated at the beginning of the IVth Dynasty (4034 B.C.) as in the tombs of this period, Professor Dr. Flinders Petrie noticed that the bodies of those he judged were the subservient race, were desiccated in a doubled up form, like the ancient Inca Indians, lying with their heads to the north, and their faces to the east—while those he judged were the ruling race were buried full length. The skeletons of these two primitive divergent human types are now being studied at the museum of the Royal College of Surgeons, London, and before long we may hope to have more light thrown on the subject.

[3] Poun, according to Brugsch, means "East," but, according to others, it means "Red." The name was applied in later times to the southern part of Arabia, and the Somali country, and no doubt, as the ancient Egyptian tradition was that their forefathers came in this way to settle in Egypt, Arabia was always referred to in the hieroglyphic text, as the Ta-Nuter (the Holy Land). For there is no doubt now that Mena and his followers brought with them a purer worship of the Sun than they

found among the primitive dark-skinned colonies, who, besides the Sun, that all revered, had each a distinctive *totem* of their own. At a later period in man's history another race followed in the footsteps of Mena—passed through Arabia and crossed the Red Sea, and after lingering in Egypt for some time ultimately concentrated their government on the northern coast of Syria, and at Carthage. They were called Pounians—Phounians—or as we have it now, Phœnicians.

[4] Within my own memory there was a rendezvous of crocodiles at Gebel-Abu-Fayda, about 200 miles to the south of Cairo. I saw a whole family of them in 1867. They have since then been exterminated by travellers. As crocodiles and hippopotami live in the same climate the disappearance of these animals from Lower Egypt has not occurred from any change of climate, but from the presence of hostile man. The same may be said with regard to the lion which used to be hunted by the Pharaohs in the vicinity of the pyramids of Gizeh, and by the Emperor Hadrian near Alexandria. This animal has now retired to the Soudan and equatorial regions (J.A.S.G.).

[5] The Greeks, who never acquired any intelligent knowledge of the ancient Egyptian language, would often hear the natives call this lake "meri," which simply means "the lake," and they evidently concluded that it was the name of the Pharaoh who had created it, hence the erroneous appellation—Lake Moeris—has been handed down through Greek historians.

[6] The ancient Egyptians were much more fond of *arboriculture* than the modern Egyptians. The sculptures tell us that Rameses III (XXth Dynasty, 1200 B.C.) "planted over the whole land of Egypt, trees and shrubs, to give the inhabitants rest under their cool shade."

[7] Lake Qorūn is now about 35 miles long and 7 miles broad, and is on an average 28 feet deep. It rises and falls with the Nile, although it is always many feet below the Mediterranean.

[8] A very interesting hieroglyphic inscription, discovered by Mr. Wilbour on one of the rocks near Assouan, records a famine of seven years under an early Pharaoh. Another seven years famine is recorded as having commenced 1064 A.D.

[9] M. de Lesseps projected a scheme for letting the Mediterranean into the Sahara depression, by cutting a wide canal to the south of Tunis, commencing in the Gulf of Gabes.

[10] Mr. Cope Whitehouse, an American engineer, has for years been very enthusiastic over a new Moeris "nest" or depression (Wady Raïan), he thinks he has discovered in the Faïoum district, which would act admirably as a reservoir for the surplus water at high Nile, and be a source of water supply at low Nile.

[11] M. de la Motte, a French physician, has been for years advocating the restoration of the Silsilis cataract.

[12] The English engineers of the Egyptian Government have proposed to construct a dam at the first cataract, but, let us hope to the south of the Island of Philae, so as to save that island and other monuments of antiquity from submergence. Should their plan be adopted, may Providence preserve us from a second Noachian flood, in case the "Daraweesh" get possession of the Assouan and Silsilis reservoirs even for a few hours. In Ancient Babylonia the water of the Euphrates was economised by means of a series of "barrages" that were almost harmless even though they should fall into the hands of an enemy.

Since the above was written, a commission of engineers composed of

M. Boulé (French), Sig. Torracelli (Italian), and Sir Benjamin Baker (English) came to Egypt to favour the Egyptian Government with their opinion concerning the different reservoirs that had been proposed to be constructed. They were unanimous against the Wady Ryan. The Italian and English engineers were in favour of the project that would swamp Philae, while the Frenchman was entirely against having any large reservoir whatever, but recommended the Egyptian Government to construct a series of "barrages" up and down the Nile valley (April, 1894). We live in a utilitarian age, and much as we may regret the destruction of the Pyramids for the construction of magnificent mosques and puny hotels, the work of destruction will continue, unless antiquarianism can prove itself to be of more commercial value than utilitarianism in any given case.

[The embankments for reservoirs are now in course of construction at Philae and Assiout, August, 1900.—Ed.]

[13] Paper on "The climate and health resorts of Modern Egypt," read at the Climatological Congress of the World's Fair Congresses, Chicago, 1893.

GEOLOGICAL ARRANGEMENT OF THE CRUST OF THE EARTH.

(To illustrate Dr. Grant Bey's paper on the Climate of Ancient Egypt.)

Rocks.	Systems.	Groups.		Periods.	Order of life shown by fossils.	Ranges of life
Range of Volcanic Rocks.	Quaternary.	In progress. Recent.		Cainozoic (recent life).	Man, plants and animals, of existing species, a few genera recently extinct.	Range of exogens (growing without).
	Tertiary.	Pleistocene (most recent). Pliocene (more recent). Miocene (less recent). Eocene (dawn of recent).			Placental mammals, plants and animals of existing orders; a large proportion of extinct genera and species.	
Range of Trappean Rocks.	Secondary.	Cretaceous { Chalk. Greensand.		Mesozoic (middle life).	Marsupial mammals, birds, reptiles, fishes, shell-fish, crustacea, zoophytes, palms, coniferæ, ferns, lycopods, sea-weeds.	Range of Endogens (growing within).
Range of Granitic Rocks.		Oolitic { Oolite (egg-stone); Lias (layers)	Not represented in Egypt as this part of the globe was continental during this long period.			
		Triassic (three groups). { Saliferous marls, muschelkalk. Upper New Red Sandstone.			Marsupial mammals, reptiles, fishes, shell-fish, crustacea, zoophytes, palms, cycads, coniferæ, ferns, lycopods, sea-weeds.	
	Primary.	Permian. Lower New Red Sandstone.		Palæozoic (ancient life).	Reptiles, fishes, shell-fish, crustacea, zoophytes, coniferæ, ferns, lycopods, sea-weeds.	Range of Gymnogens (growing from naked seeds).
		Carboniferous. Coal measures.				
		Old Red sandstone. { Red Sandstone, Conglomerate.			Fishes, shell-fish, crustacea, zoophytes, ferns, lycopods, sea-weeds.	Range of Vertebrata and Acrogens (top growers).
		Silurian { Limestones, Slates.			Shell-fish, crustacea, zoophytes, sea-weeds.	
		Cambrian. Sandstone.				Range of Invertebrata and Amphigens (growing from all sides).
		Laurentian. Gneiss. Quartzites.		Eozoic (dawn of life).	Crustacea and zoophytes. Traces of foraminiferal organisms (?)	