

ing, the whole cycle of operations occupying two hours, during which time the gallery must not be left. The rough nature of the road, the cramped headway, the murkiness of the atmosphere and its poisonous condition, combined with the almost total darkness, impose a severe strain upon the men's nervous system. Upon issuing from the gallery, each man is again medically examined. In this manner conclusive data concerning the effect of the respective apparatus upon each man and his physical capabilities for such work are secured.

The team equipped with life-saving apparatus passed through their ordeal with complete success, and emerged from the gallery showing but slight traces of exhaustion. This no doubt was due not only to the efficiency of the appliance, but to the fact that they had already passed through the ordeal of a real catastrophe, since they accomplished heroic work at the Hamstead colliery, and had no doubt become accustomed to the peculiar surroundings and working within a confined breathable atmosphere as represented by the mouth-piece.

NEW FOSSIL WONDERS FROM THE FAYUM OF EGYPT.
BY WALTER L. BEASLEY.

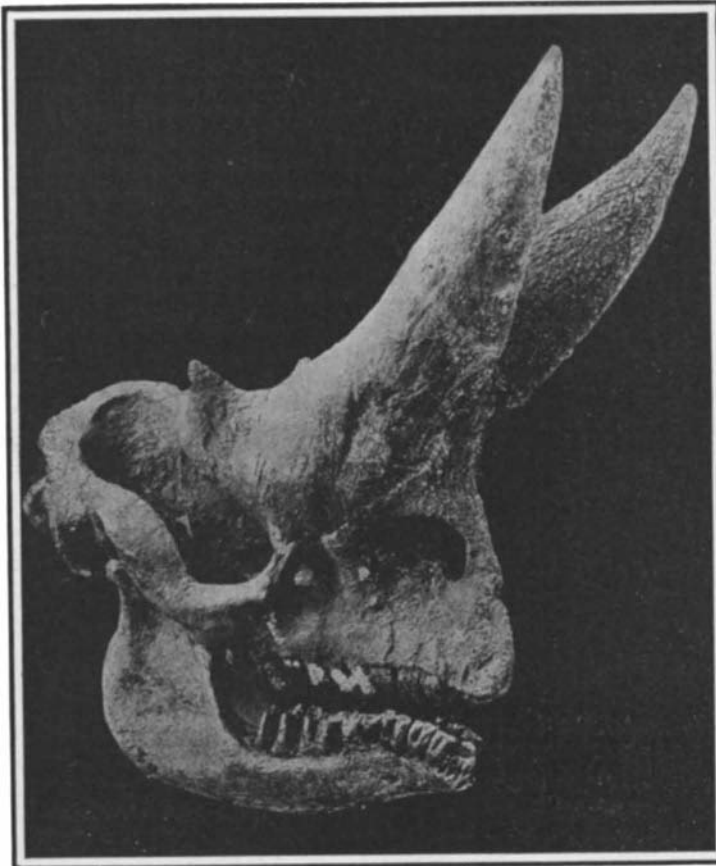
Prof. Henry F. Osborn, who planned and directed the expedition of the American Museum of Natural History to the Fayum Desert of Egypt, made possible through the generosity of the late Morris K. Jesup, is just now placing on exhibition some of the remark-

able and interesting fossil remains there discovered—remains which illustrate the peculiar and little-known ancient land animals of Africa. These brilliant researches and successful explorations of Prof. Osborn have not only added much to earlier discoveries, but

After awaiting the appearance of the monograph compiled by Dr. C. H. Andrews of the British Museum, setting forth the prior field work and discoveries of the Egyptian Survey, which released in a sense the region to other investigators, Prof. Osborn seized the exceptional opportunity of forming an expedition in order to unearth possibly unknown types of the former mammalian life of Africa. Through energetic and systematic excavating and quarrying, the expedition recovered some 550 specimens, including the more or less complete remains of nearly all the fossil forms so far known to be characteristic of this famous region, together with several new members of animal types and families, hitherto not encountered by previous collectors. These include several species of primitive carnivores and two genera of rodents.

The Museum expedition left New York in January, 1907. Mr. Walter Granger, an able fossil explorer of fourteen years' experience of work in the Bad Lands of western America, and Mr. George Olsen, a Dane,

highly trained in the technique of the getting out and preservation of fragile and delicate remains, were selected to conduct the field work and prepare the specimens for transportation. On February 5, 1907, just a month after leaving New York, the American caravan of twenty-one camels and eight tents and a complete camp outfit for life in the desert, together with twenty-five Arab, Bedouin, and Egyptian workmen, reached the Fayum, the goal of the expedition. Vertebrate fossils were first discovered in this region in 1879 by



Figs. 2 and 3.—Front and side views of the *Arsinoitherium* skull now in the Cairo Museum, found by the Egyptian Geological Survey.

have thrown new light on the little-known animal world of ancient Africa. The "Dark Continent," hitherto supposed of little paleontological interest, proves surprisingly rich in early fossils, including types hitherto unknown. Through the courtesy of Prof. Osborn, the writer was afforded facilities for presenting in the pages of the *SCIENTIFIC AMERICAN* a general narrative, covering the main features and scientific results of this the first American paleontological expedition into Egypt's famous fossil country.



Fig. 4.—The finding of the great skull of the *Arsinoitherium* in the Fayum Desert, Egypt.



Fig. 5.—The American Museum Expedition entering the Fayum Desert, Egypt.



Fig. 6.—Egyptian and Arab helpers at work in the fossil quarries. Specimens were found six and eight feet below the top of the sandy surface.



Fig. 7.—Mr. Olsen and Egyptian workman preparing the fragile desert fossils for transportation to New York.

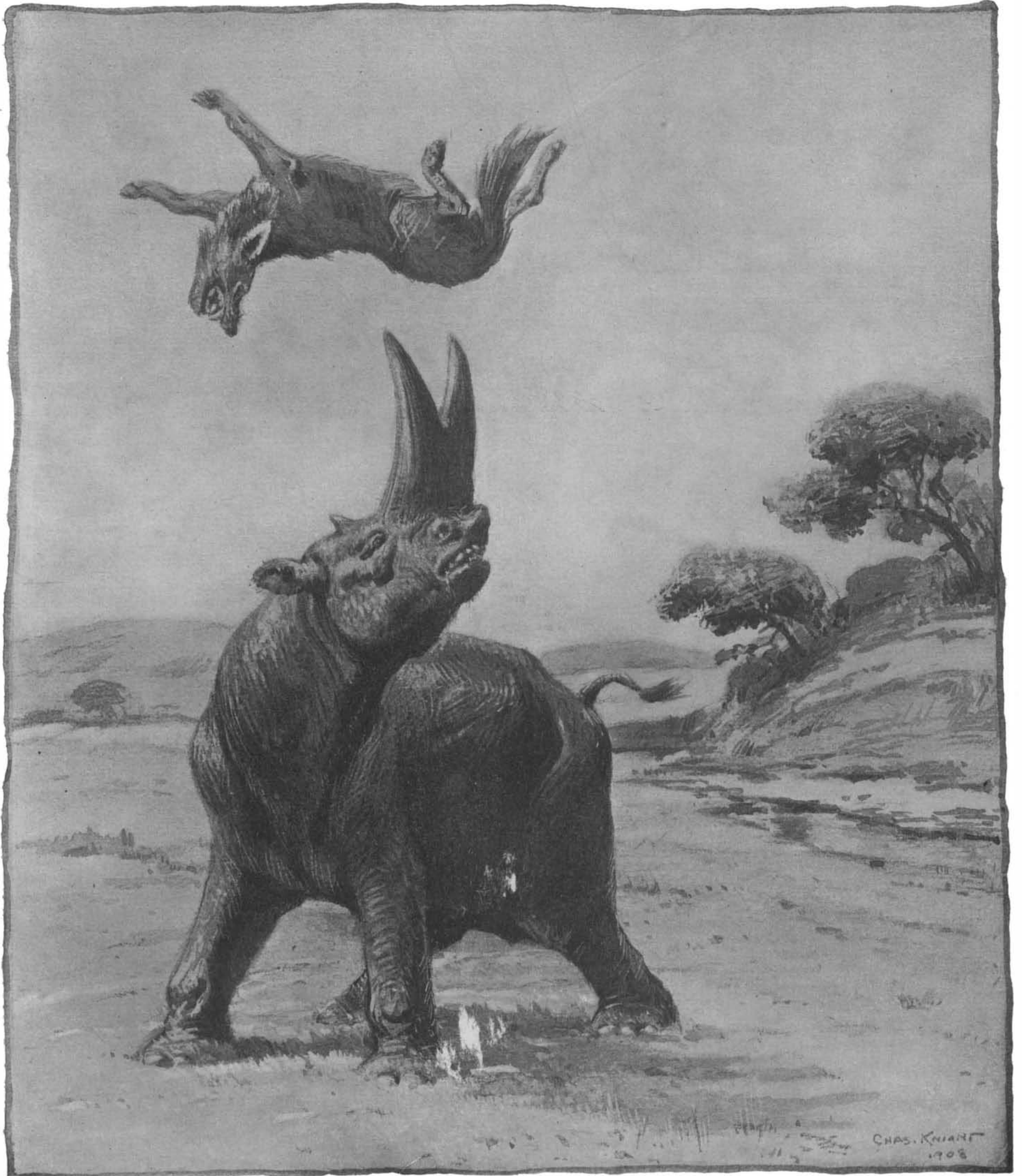
SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y., as Second Class Matter. Copyright, 1906, by Munn & Co.]

Vol. XCIX.—No. 16.
ESTABLISHED 1845.

NEW YORK, OCTOBER 17, 1908.

[10 CENTS A COPY
\$3.00 A YEAR.]



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Drawing by Charles R. Knight.

THE GIANT ARSINOITHERIUM, THE NEWLY DISCOVERED HORNED MONSTER OF PREHISTORIC EGYPT.

The first skull of this wonderful extinct beast has just reached New York at the Museum of Natural History.—[See page 261.]

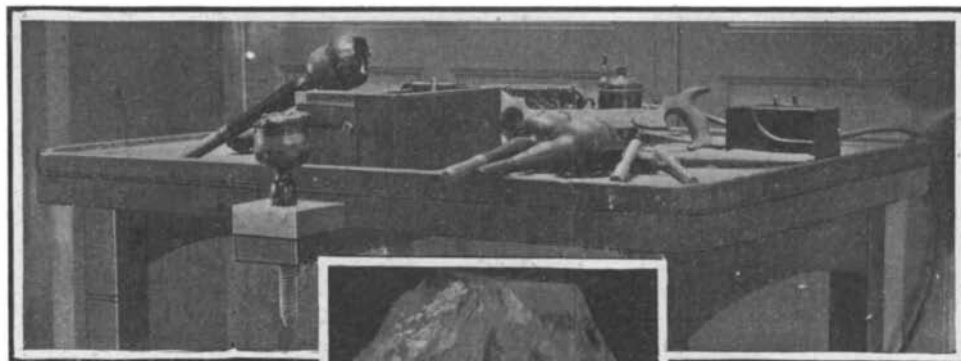
the German explorer Schweinfurth, but no collecting of importance was done until 1898, and then by Mr. H. J. L. Beadnell, of the Geological Survey of Egypt, and Dr. C. H. Andrews of the British Museum. In 1901 the discovery of land animals was first announced. Between 1901 and 1905 a vast number of fossils were collected, which are now in the Cairo and London museums. The Fayum district is a natural depression about fifty miles in diameter situated in the Libyan Desert, fifty miles southwest of Cairo, and separated from the Nile valley by a narrow strip of desert land. In this basin was the ancient Lake Moeris, some 300 feet above the present brackish shallow sheet of water now known as Birket-el-Qurun. This depression is divided into a series of terraces, or fossil-bearing beds, some reaching to the height of 1,000 feet. These imposing formations rise tier upon tier, amphitheater-like. The principal bone-bearing layer, composed of loose red sand in which scattered bones could be seen imbedded, was only forty feet in thickness, but miles in horizontal extent. It was along the northern shores and in the Upper Eocene deposits or fluvio-marine that the expedition carried on the most energetic search and secured the most specimens.

Just why the astonishing and extraordinary number of the ancient animals of Africa found their burial place in this particular spot of the Fayum, is attributed by Prof. Osborn to the following circumstances: In remote times, long before the Nile had come into existence, a mighty river flowed north and emptied its waters into the Mediterranean, then 140 miles south of its present boundaries. Here, at this point, a sandbar had checked the river current. The animals had evidently drifted some distance downstream with the sand and gravel, all the bones floating apart or having been pulled apart by turtles and crocodiles, so that a skeleton of an animal could never be found intact. In this manner animals of every kind, big and little, herbivorous and carnivorous, in every degree of preservation, a few being hard and perfect, others soft and crumbling, had been washed down and heaped together. In every case the bones were only partly petrified, a condition entirely different from the hard and rocklike state in which fossils are found in the sandstone matrix in western America. Seldom were two bones of one animal found together. The skulls were as a rule badly broken.

Camp was pitched midway between the two large quarries which had been opened by the Egyptian Survey, in which the Museum party were permitted to dig. These were strewn with heaps of bones discarded. Here the bone layers were from four to six feet below the surface. The force of Egyptian workmen, as directed and coached by Messrs. Granger and Olsen, were soon trained into first-class excavators. Their tools were the primitive mattocks, and baskets to dump the large quantities of loose sand. A few were picked men who had worked for the Survey Department previously, and were familiar with the handling and getting all the labor possible out of the slow-moving sons of the desert. They received forty cents a day, and additional reward for the finding of a large and important fossil. Several of the accompanying illustrations show these men at work in the desert quarries. On the top of the delicate and crumbling bones, often mere powdered dust, shellac was poured, and not until the specimen was hardened, could it be removed safely from the sand. In about a fortnight's time, one of the most important and significant finds was made, in the shape of the skull of the giant *Arsinoitherium*, one of the most extraordinary land mammals of ancient Africa, or of the whole known fossil world. This remarkable beast is entirely new to science and paleontologists. Its existence was unknown and undreamed of until a few years ago.

The dominating and all-powerful feature of the *Arsinoitherium* was the long pair of sharp-pointed horns, protruding upward and outward above the nose for nearly two feet, an appendage both dangerous and fantastic. Undoubtedly no contemporary could cope with and withstand a mad rush and furious charge

from an animal thus armed. *Arsinoitherium* was the brute king of the Fayum during Eocene times, some two or three million years ago. The discovery of this strange beast by the members of the Egyptian Geological Survey only a few years back, is said to have afforded one of the greatest surprises of modern paleontological explorations. From the skull and other bones secured by Prof. Osborn's party, together with the material of English investigators, the make-up of the queer animal's body has been pretty accurately determined. Of exceptional interest, therefore, is the spirited and realistic restoration of this giant inhabitant of the Egyptian Fayum, as seen from the accompanying drawing by Mr. Charles R. Knight, the well-known animal artist. His picture gives a vivid



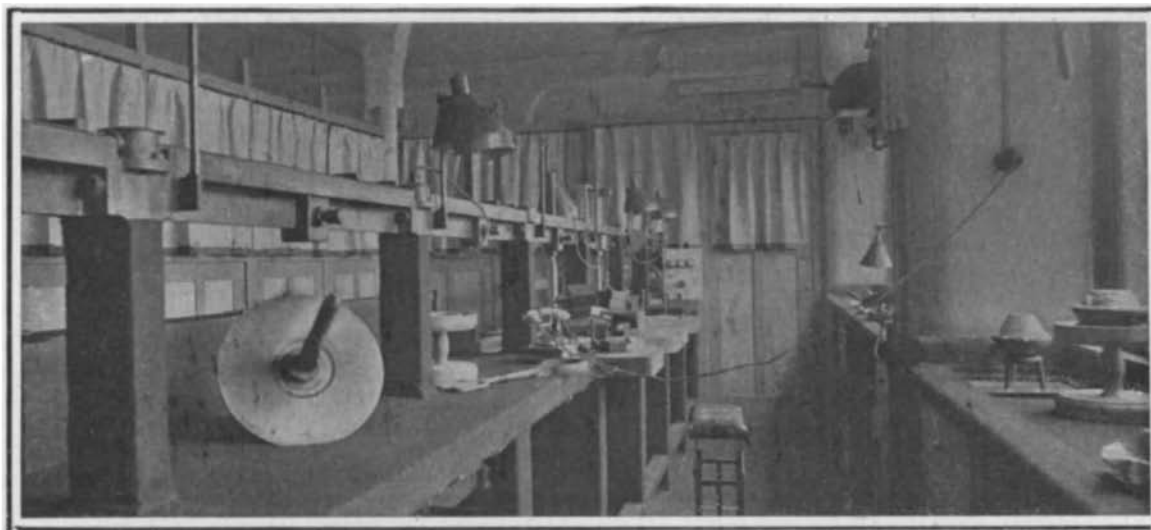
Implements used in



The Cullinan diamond $\frac{1}{4}$ size.

splitting the diamond.

glimpse of the life appearance of this wonderful horned beast, and depicts a scene of probably frequent occurrence in Eocene Egypt. The animal's body combined the shape of the rhinoceros and elephant. The monster was named after the Egyptian Queen Arsinoë, famous for her beauty. She was the second wife of Ptolemy II. (285-227 B. C.), and after her death the patron goddess of the Fayum. The animal stood about six feet high and was nearly ten feet in length; the bones of the skeleton were massive and the body heavy. The neck was short, and could be freely moved up and down, and was therefore well adapted to toss an enemy up in the air. The feet were short, the five toes spreading out like those of the modern elephant. The teeth consisted of high-crowned, sharply-crested grinders fitted for grazing upon the harder kind of herbage. The narrow muzzle of the head indicated that the animal did not



THE ROOM IN WHICH THE CULLINAN DIAMOND IS BEING POLISHED, SHOWING THE STEEL DISK IN THE FOREGROUND.

graze, but browsed upon the low bushes and herbage. As to the character of the landscape and the natural environment surrounding the primitive group of animals inhabiting the area of the Fayum and the Libyan Desert in the days of *Arsinoitherium*, Prof. Osborn advances the opinion, based on the structure of the fossilized remains, that it was a savannah country, partly open, partly wooded, with about the same temperature as to-day. The animals were those which might have lived almost exclusively in a fairly well-watered delta or estuary country bordering the sea, not densely forested, but with stretches of sandy plains or muddy bottom lands, traversed by large streams, having currents of considerable velocity. These land mammals, twenty-seven of which

have so far been discovered, with several new ones by the Museum, were all relatively short-footed and slow-moving, only two swift-running types being known, one an active carnivore. From a study of the structure of the limbs and feet, it has been determined that these ancient groups of land animals were adapted and fitted for walking on partly sandy or sinking ground. A special exhibit comprising some of the principal finds, notably the large skull of *Arsinoitherium*, and likewise a series of skulls illustrating the first stages in the evolution of the elephant, is now installed in the Fossil Mammal Hall. A popular account of the hunt for the ancestral elephant in the Fayum, and the remarkable discovery of the missing link, the little tapir-like *Moeritherium*, the earliest and first known ancestor of the elephant race, will be presented and pictured in a forthcoming article. The writer acknowledges indebtedness to Prof. Henry F. Osborn for courtesies extended in the preparation of this article and the reproduction of field photographs.

POLISHING THE GREAT CULLINAN DIAMOND.

When the Cullinan was found about three years ago it was a problem of the Premier Company as to what disposition could be made of it. Its mere size, weighing as it did something over $1\frac{1}{2}$ pounds, made it unmarketable and unsalable, and to cut it up into small pieces would destroy, to a large extent, not only its intrinsic but its sentimental value. The diamond hence remained in the vaults of the Premier Company for nearly three years, when it was decided by the Transvaal government to present it to the King of England on the anniversary of his sixty-sixth birthday. In the rough the stone was valued at about \$1,000,000, and about this price was actually paid therefor, viz., \$400,000 in cash and \$600,000 representing 60 per cent of the interest they had therein, on account of the fact that the government is entitled to this percentage of the output of all diamond mines in South Africa.

Consul Henry H. Morgan, of Amsterdam, furnishes the following information concerning the polishing of the great Cullinan diamond in that city:

It was necessary in the first instance to cleave the stone in three pieces in order to remove two very bad flaws therein. This cleaving is done by first making an incision into the stone with a diamond-cutting saw at the point where it is to be split and following the grain to a depth of one-half to three-quarters of an inch. Before this cleaving operation was undertaken crystal models were made and cleaved, in order to ascertain, as far as could be known, just what would happen when the same process was applied to the real stone. After the incision the cleaver inserted into the slit a specially constructed knife blade made of the finest steel, and then with a thick steel rod struck it a hard blow and cut the stone in two exactly at the point where it was proposed it should be cut. It was an exceedingly well-executed piece of work. Not infrequently it happens that a stone flies into a great number of pieces.

The stone having been successfully split, the next and final operation is the polishing, and this process is now being carried on.

To give an idea of the hardness of diamonds, it may be interesting to state that the disk on which this diamond is being polished is made of cast iron and steel, and revolves at a rate of 2,400 revolutions per minute. The disk will turn constantly from 7 A. M. to 9 P. M., including Sundays, for ten to eleven months before the polishing operation will be completed.

When polished it will be many times larger than the *Excelsior*, which was up to the discovery of the Cullinan, the largest diamond in the world. The Cullinan weighed in its rough state 3,027 carats. The part of the stone which is on the mill will possibly be given 58 facets, which is the number given to all other diamonds of whatever size, and it will weigh, when finished, between 500 and 600 carats.

The actual commercial value of the completed stone will be about \$2,500,000, but its unique character will possibly make it priceless.