

THE note under criticism purports to be a "proof" that the base originally used by Napier was the reciprocal of e , and not e itself. In reality, it is nothing of the sort. The arithmetical details are both unnecessary and insufficient for the purpose, and their insertion is unfortunately calculated to deceive many readers by obscuring the real points at issue. The same "proof" might equally well be employed to show that the original base was e instead of its reciprocal, but that the minus sign had been omitted from the logarithms of sines. If your correspondent will read any treatise on the history of mathematics, he will see an account of the train of reasoning which led Napier to the discovery of logarithms before the existence of a base or the connection between logarithms and indices had been suspected. There are doubtless many historical points connected with the discovery of logarithms that deserve closer study than they commonly receive, but the publication of a book of this kind is not likely to advance our knowledge of them. If one could be certain that all readers would take the book for what it is worth, no harm would be done. But there are, unfortunately, many people who possess a "little knowledge" (which is, of course, a "dangerous thing") who will derive a large amount of misinformation from the interpretation they will place on the contents of the book, and this misinformation will be very difficult to eradicate.

THE REVIEWER.

Distribution of the Forms of *Corvus cornix* and *C. corone*.

I SHOULD esteem it a favour if the writer of the review of Ralfe's "Birds of the Isle of Man" (NATURE, May 31, p. 195) would more clearly explain his reference to the dimorphic forms of *Corvus cornix* and *C. corone*, and the "border-line, i.e. along the line from the Firth of Clyde to the Adriatic, &c."

The Firth of Clyde is not the limit of the line where they are known to interbreed. They interbreed north of the Firth of Forth, and as far north as Moray at least.

And as regards the Adriatic, the forms are known to interbreed and produce every variation of crosses or diverse plumages in Siberia.

No doubt your reviewer will be able to explain his meaning, but, as at present expressed, it is somewhat difficult to understand (v. p. 105).

The "carrion crow" (*corone*) seems to me to be the more aggressive of the two, and is slowly but surely pushing north in Britain, as I think references to our series of Scottish faunas will show.

J. A. HARVIE-BROWN.

Dunipace, Larbert, Stirlingshire, N.B., June 2.

THE precise line—if there be one—marking the distribution between the breeding areas of *Corvus cornix* and *C. corone* is of little importance to the "problem" suggested to the readers of NATURE in the review mentioned. Its direction, however, was taken from Newton's trustworthy "Dictionary of Birds," p. 117, where it is stated to be "an irregular line drawn diagonally from about the Firth of Clyde to the head of the Adriatic." The reviewer cited that statement as authoritative, since he has had no opportunity of personal observation on the subject. It is further stated on the page last cited, "it has now been incontestably proved that along or near the boundary where these two birds march, they not infrequently interbreed, and it is believed that the hybrids which sometimes wholly resemble—italics by the reviewer—one or other of the parents . . . pair indiscriminately among themselves or with the pure stock." If these be established facts, then the hybrid wholly resembling the black variety must, if it occur in any considerable numbers, retire to breed "to the south-western part of this quarter of the globe," and the hybrid wholly resembling the "grey neck" "to the north-eastern portion." How has this discrimination been acquired? Two further questions may be asked: Can the wholly black and wholly grey hybrids be recognised after they have left the nest? Can the proportion of pure breeds to hybrids in the general crow-population be determined?

The facts given in Mr. Harvie-Brown's letter seem to

NO. 1912, VOL. 74]

indicate that the crows in their nursery arrangements behave less perplexingly than the reviewer had deduced from the statements he has quoted above. The black and the grey crows may really be, therefore, not dimorphic forms of one species, but two distinct species.

THE REVIEWER.

The Date of Easter.

IN your issue of April 5 an empirical formula is given for determining the date on which Easter falls in any year from 1900 to 2100. Having tried the formula for certain years within the limits stated, I find that it fails in the case of 1954. For that year it gives April 25, whereas the correct date is April 18. Perhaps some of your correspondents may be able to explain the cause of the discrepancy.

ALEXANDER D. ROSS.

Glasgow, June 1.

YOUR correspondent is correct in saying that the empirical formula of Gauss for determining the date of Easter gives April 25 for the year 1954, and I must confess my inability to assign a reason for its failure in this particular instance.

CHAS. LEIGH.

The Victoria University of Manchester, June 12.

Geological Survey of Canada.

IN the issue of NATURE of April 26, under the heading of "Notes," is a paragraph concerning changes in the organisation of the Geological Survey of Canada. This paragraph is liable to be misleading, and I shall be greatly obliged if you will kindly state the facts as they are. On March 27 last Mr. A. P. Low was appointed deputy head and director of the Geological Survey Department, and, at the same time, Dr. R. Bell simply returned to his former position of assistant-director and chief geologist, to which he had been appointed in 1892.

A. P. Low (Deputy Head and Director).

Geological Survey of Canada, Ottawa, Ontario, May 29.

THE FOSSIL VERTEBRATES OF THE FAYUM.¹

A FEW years ago it was the fashion among vertebrate palæontologists to say that, at least so far as the Tertiary period is concerned, the Old World was played out in the matter of their special science, and that the scene of advance was shifted to America, where alone important and epoch-making discoveries were to be expected. All this has been changed by the discovery of the wonderful Lower Tertiary vertebrate fauna—or, rather, series of faunas—in the Fayum, or lake-province, of Egypt, which Dr. Andrews (who, we are glad to say, has now the privilege of adding the letters F.R.S. to his name) has so admirably and lucidly described in the handsome quarto volume before us. Indeed, it is not saying too much to assert that these discoveries have practically revolutionised our conceptions of the mutual relationships of several mammalian groups, and also our ideas on many points connected with the past distribution and migrations of the mammals of the Old World. Perhaps the most important problem which Dr. Andrews has succeeded in solving is the origin of the Proboscidea; and if this had been the only result of his labours he would have been well entitled to undying fame. As it is, this discovery is only one of several of the highest importance in regard to mammalian evolution we

¹ "A Descriptive Catalogue of the Tertiary Vertebrata of the Fayûm, Egypt; based on the Collection of the Egyptian Government in the Geological Museum, Cairo, and on the Collection in the British Museum (Natural History), London." By C. W. Andrews. Pp. xxxvii+324; pls. 26, and text-figures. (London: Printed by order of the Trustees of the British Museum, 1906). Price 35s.

owe to him, and in some degree to others who have been working on the extinct Egyptian faunas.

Before proceeding further we may take the opportunity of expressing, on behalf of all palæontologists, our appreciation of the generosity of the Egyptian Government in putting at the disposal of the trustees of the British Museum, for the purpose of this catalogue, the whole of the valuable collection of vertebrate remains from the Fayum preserved in the museum at Cairo. We may likewise respectfully tender to the trustees of the national collection our sense of the benefit they have conferred on science by sanctioning the publication of the work before us. Nor must we omit to mention the name of Mr. W. E. de Winton, who has generously defrayed the expenses connected with some of the visits of Dr. Andrews to Egypt to explore and collect the palæontological treasures of this wonderful district.

It will not be necessary on this occasion to refer in detail to the history of the discovery of fossil vertebrates in Egypt. Suffice it to say that the first discovery was not made by the author of the volume before us, although it appears that he was present when the remains of ancestral proboscideans and other primitive mammals were first brought to light.

With a few unimportant exceptions, the whole of the remains described in the volume were derived from strata of Middle and Upper Eocene age lying on the northern side of Lake Moeris. In the author's opinion it appears that the Fayum strata, as we advance from earlier to later times, were, speaking generally, deposited nearer and nearer to some land-mass.

"In the early Eocene the presence of thick marine beds far to the southward shows that the shores of the Ethiopian continent were still remote from the area now under discussion; and this state of things seems to have continued till the Middle Eocene, as shown by the thick nummulitic beds of the Wadi Rayan series, and the exclusively marine character of the fossils both of those beds, the Ravine beds, and the Birket-el-Qurun series above. In the Qasr-el-Sagha series, on the other hand, there is much evidence that the shore was not far off, the presence of thick beds of clay, often current-bedded and containing numerous impressions of leaves, as well as the occurrence of land-mammals, pointing to this conclusion. In fact, the deposits at this horizon may be regarded as partly marine and partly littoral, there having been many small oscillations of level. In the Fluvio-marine (Upper Eocene) beds above, the near presence of a large land-mass is still more obvious, these deposits being, in fact, almost entirely fluviatile, and probably representing the remains of the delta of a great river which, for various reasons, Mr. Beadnell considers flowed from the south-west. At or near the end of the Eocene period this state of things was interrupted by an outburst of volcanic activity, which gave rise to the interbedded basalt-sheets of the Jebel-el-Qatrani; but after this the fluviatile conditions were again resumed, and appear to have continued with some interruptions throughout the Oligocene, Miocene, and, in part at least, the Pliocene periods. Throughout this vast epoch there seems to have been a general tendency towards a gradual advance of the coast-line northwards, and such interruptions and oscillations as did occur are marked by the presence of interbedded marine, littoral, and perhaps, in a few cases, lacustrine deposits."

Obviously, such a state of things affords just the conditions necessary for the preservation of the remains of a series of faunas, and as a matter of fact such remains have been found in two horizons in addition to those forming the subject of the catalogue.

The mammals may be divided into three groups. First, terrestrial forms, such as ancestral proboscideans, hyracoids, and the remarkable *Arsinoitherium* which appear to have been endemic to the Ethiopian region,

and occur in both the upper and lower beds, and are unknown elsewhere. Secondly, terrestrial types like *Ancodon* and *Hyænodon*, represented in other parts of the world, and found only in the upper beds. Thirdly, primitive genera of sirenians and cetaceans, confined to the lower beds, some of which are widely spread, while others are unknown elsewhere, and may be endemic. All the genera in the first group are ungulates, and, with one exception, belong to that generalised assemblage frequently known as subungulates.

The most striking of all these wonderful ungulates is undoubtedly the huge and powerfully horned *Arsinoitherium* (Fig. 2); but interesting as is this creature morphologically it adds but little to our knowledge of mammalian evolution, although there is a possibility that it may prove to be an offshoot from the hyrax-stock. In any case the occurrence of this and several other specialised types at such an early stage is one of the most remarkable features of the Fayum fauna.

Although *Arsinoitherium* is certainly the most ex-

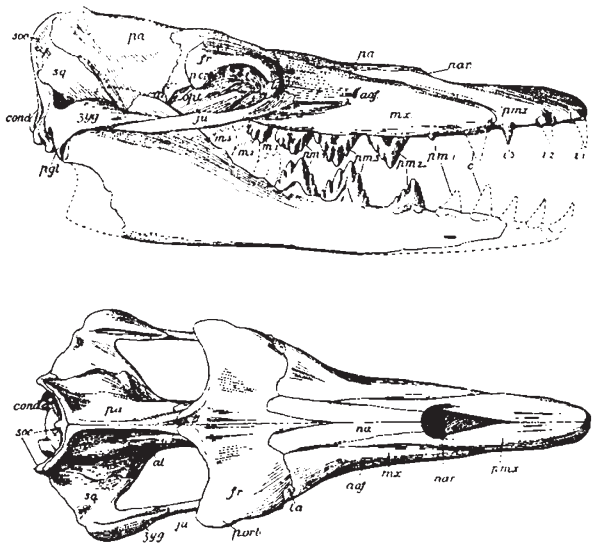


FIG. 1.—Lateral and superior views of the skull of *Proceuglodon atrox*, a primitive Egyptian Cetacean. The letters refer to the names of the bones; $\frac{1}{2}$ natural size. From "The Catalogue of Fayum Vertebrates."

traordinary of the Eocene Egyptian ungulates, it undoubtedly yields place in point of interest to the ancestral proboscideans. The probability that Africa would prove to be the original home of the Proboscidea was suggested, among others, by Prof. H. F. Osborn, who also conjectured that the hyraxes and certain other groups might likewise be of Ethiopian origin. In regard to the two groups mentioned, the truth of this bold prophecy has been fully demonstrated by the discoveries and investigations of Dr. Andrews. Since the evolutionary history of the Proboscidea, as revealed by these discoveries, has already been made familiar to the public in several journals—*NATURE* among the number—it will be unnecessary to go over the ground again, and it will suffice to mention that in *Moeritherium*, the earliest known representative of the group, we have an animal but little removed from the generalised common type of primitive ungulates. It may be added that while the Ethiopian origin of the Proboscidea has now been proved, it is nearly as certain that the passage from the mastodons to the elephants took place in

south-eastern Asia, or in a lost land between the latter and Africa.

Next, perhaps, in point of interest is the discovery of comparatively giant forms nearly related to the modern hyraxes, which are now as isolated as the elephants. Unfortunately, these Eocene hyraxes—*Saghattherium* and *Megalohyrax*—throw little or no light on the ancestry of the group, although serving to show that it was certainly Ethiopian in origin. Whether certain Tertiary South American ungulates are related to the group is left by the author an open question.

Of not less importance are the discoveries and conclusions with regard to the origin and relationships of that isolated aquatic group of mammals now represented by the manatis and dugongs. On this point the author remarks that there seems to be much evidence in favour of the original view of de Blainville that the Sirenia are intimately related to the Proboscidea.

"In the first place, the occurrence of the most primitive Sirenians with which we are acquainted in the same region as the most generalised proboscidean *Mœritherium* is in favour of such a view, and this is further supported by the similarity of the brain-structure and, to some extent,

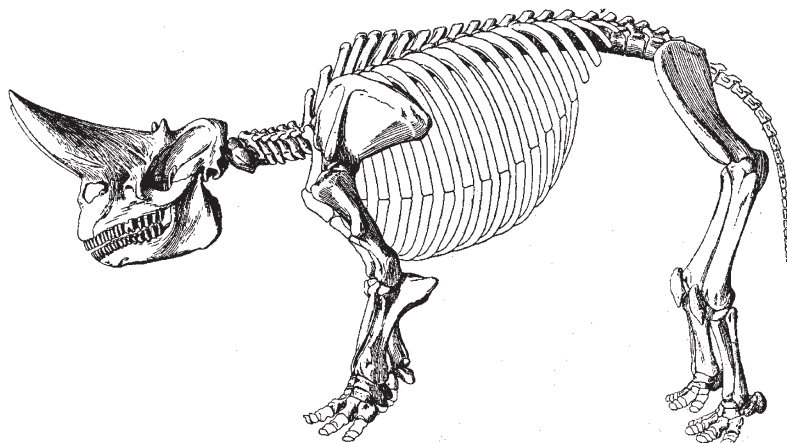


FIG. 2.—Skeleton of *Arsinoitherium zitteli*, $\frac{1}{2}$ nat. size. From "The Catalogue of Fayum Vertebrates."

of the pelvis in the earliest-known members of the two groups. Moreover, in the anatomy of the soft-parts of the recent forms there are a number of remarkable points of resemblance. Among these common characters may be noted the possession of: (1) pectoral mammae; (2) abdominal testes; (3) a bifid apex of the heart; (4) bilophodont molars with a tendency to the formation of an additional lobe from the posterior part of the cingulum. The peculiar mode of displacement of the teeth from behind forwards in some members of both groups may perhaps indicate a relationship, although in the case of the Sirenia the replacement takes place by means of a succession of similar molars, while in the Proboscidea the molars remain the same numerically, but increase greatly in size and number of transverse ridges."

These and certain other facts referred to by the author in a later paragraph point very strongly to the conclusion that not only are the Sirenia and the Proboscidea derived from a single ancestral stock, but that the Hyracoidea—and so *Arsinoitherium*—are also derivatives from the same stock, which must necessarily have been Ethiopian.

While thus definitely establishing the herbivorous ancestry of the Sirenia, Dr. Andrews appears to be equally convinced that the Cetacea (as, despite views

to the contrary that have been expressed, we should naturally expect) are derivatives from a carnivorous ancestral type. On the evidence of specimens obtained from another part of Egypt, Dr. E. Fraas, of Stuttgart, has demonstrated the derivation of the whale-like *Zeuglodon* (Fig. 1) from that group of primitive carnivora known as creodonts. Dr. Andrews not only brings forward additional evidence in favour of this most remarkable line of descent, but he is confident—which Prof. Fraas was not—that *Zeuglodon* itself is an ancestral cetacean, and consequently that whales are the highly modified descendants of creodonts. It must be admitted, however, that the links between *Zeuglodon* and typical cetaceans are at present unknown; but it may be hoped that these will be eventually brought to light from the deposits of the Mokattam Range.

Of the other classes of vertebrates represented in the Fayum series we can say but little. Reference should, however, be made to the occurrence of a presumed ratite bird, which if rightly identified is the earliest known representative of the group, and suggests the Ethiopian origin of some members at least of the ostrich group in Africa. Such an ancestry, as the author remarks, would explain the resemblance existing between the true ostriches and the extinct *Æpyornis* of Madagascar, and might likewise serve to connect the former with the South American rheas.

Giant land tortoises are likewise proved by the Fayum discoveries to have occurred in this part of the world at a much earlier date, so far as is known, than elsewhere, and it is noteworthy that the extinct Egyptian species are near akin to the recent Mascarene and Malagasy forms. The association of tortoises belonging to the pleurodiran section, now confined to the southern hemisphere, is another fact of prime importance, as tending to throw light on the dispersal of that group and the former relations of the southern continents.

With regard to the latter point, Dr. Andrews comes to the conclusion that the new facts fully endorse the theory of a former land connection between Africa and South America. "Speaking generally, it appears that (1) probably in Jurassic times Africa and South America formed a continuous land-mass; (2) in the Cretaceous period the sea encroached southwards over this land, forming what is now the South Atlantic. How far this depression had advanced southwards at the end of the Secondary period is not clear, but it appears certain that the final separation of the two continents did not take place till Eocene times, and that there may have been a chain of islands between the northern part of Africa and Brazil which persisted even till the Miocene."

It will thus be apparent that from whatever point of view we regard the Eocene vertebrate fauna of the Fayum—whether from the morphological, the phylogenetic, or the distributional—it is practically impossible to overestimate its extreme importance. When we reflect that what has been discovered can only be the mere fringe of a most extensive Eocene and Upper Cretaceous Ethiopian fauna we shall be in a position to realise what a great part Africa has played in the past as a birthplace and centre of dis-

persal of mammalian groups, and how profoundly even the present discoveries have modified our conceptions of the past history of the mammalia and of the globe in general.

After a careful study of the volume before us, we have found no occasion for a single word of hostile criticism. The author knows his subject from every possible point of view in a most thorough manner, and has treated it in a thoroughly philosophic way from first to last, while the introduction is written in a style that will appeal to the general reader as well as to the specialist. It is, perhaps, not too much to say that it is the most important contribution to mammalian palæontology that has ever appeared within our own recollection on this side of the Atlantic, and if the twentieth century were to see no other work on mammals—either recent or fossil—it would still have a vast achievement to its credit.

R. L.

THE CALIFORNIAN EARTHQUAKE OF APRIL 18.

THE accounts which are reaching this country enable us to form a better idea of the character of the Californian earthquake of April 18 last than could



FIG. 1.—The Burning of the Business District of San Francisco after the earthquake on April 18. From the *Scientific American*.

be done from the telegraphic reports of the daily papers, and one of the most striking facts which stand out is the wonderfully small amount of damage done in San Francisco by the earthquake proper. This does not seem to have exceeded the sixth or seventh degree of the Rossi-Forel scale, and the damage to buildings was practically confined to the overthrow of chimneys and of buildings which were either old and badly constructed, or of a design which rendered them especially liable to earthquake damage. The *Scientific American* of May 12 contains a view of the business part of the city, taken after the earthquake, but before the spread of the fire, in which the buildings show little signs of damage, beyond the overthrow of some of the chimney stacks. Where the city was built on made ground settlements and disturbances of ground level led to fractures of the water-mains, but it is not clear from the accounts which have reached us whether there was not also an interruption of the main conduit at some point between the city and the source of supply. Whatever the cause, the conse-

quences of the failure of water were disastrous, and the fire, started by the earthquake, was able to spread unchecked.

Apart from the loss of buildings and lives, San Francisco has lost its most important libraries and scientific collections; the Bancroft library of books and manuscripts relating to the history of the Pacific coast has been saved, as have most of the type-specimens of plants in the collection of the Academy of Sciences, but that is practically all. On the other hand, the Lick Observatory and the University of California have escaped damage, and the working part of the Leland-Stanford University has escaped the complete destruction which has been the fate of the memorial buildings of that institution.

The area over which the earthquake did serious damage was confined to a narrow strip of country extending from the town of Ukiah, on the Russian river, to the town of Salinas near Monterey Bay. Beyond these limits the country is sparsely settled and may have been vigorously shaken without the fact being reported, but the limits indicated lie about 205 miles apart, or 125 miles north and 80 miles south of San Francisco; within this strip the damage was very capriciously distributed, and died out rapidly to the east and westwards; at Berkeley town many buildings were ruined, but the University of California escaped; San Jose was partly ruined, and most of the buildings of the Stanford University, at Palo Alto, were destroyed, but the Lick Observatory, about fifteen miles to the eastward, was uninjured, nor is any serious injury reported from the towns on the coast. These peculiarities in the distribution of the earthquake damage are explained in an article on the probable cause of the San Francisco earthquake by Mr. Frederick Leslie Ransome, published in the May number of the *National Geographic Magazine*. The article is illustrated by a very clear structural map of the San Francisco peninsula, and an equally clear description of the structural conditions of the region. Probably nowhere in the world have greater displacements taken place in geologically recent times than this district has witnessed; strata of Quaternary age have here been compressed, contorted, and lifted from 1500 to 2000 feet, and right

through the peninsula run three nearly parallel faults, two of which, the Pilarcitos and San Andreas faults, are marked by lines of pools and lakes, proving the recent date of the disturbance to which they owe their origin. The third fault, known as the San Bruno fault, is the most important of the three; it has a throw of more than 7000 feet near San Francisco, and has been traced, with more or less certainty, from Point Arenas, 100 miles to the north-west, through Southern California, where it is known as the "earthquake crack," almost to the Gulf of California. A movement along this fault, and others parallel to it, appear to have been the cause of the earthquake, or at any rate of the curious localisation of damage noticed above. The San Bruno fault passes close to the Stanford University and to the city of San Jose, and crosses the main line of water-supply from the Crystal Springs reservoir to the city of San Francisco; it is, presumably, along this fault that the displacement reported in the newspapers took place. There are indications,