THE GEOLOGY OF OXFORD*

PROFESSOR PHILLIPS'S new work on the Geology of Oxford and of the Thames Valley is a most important contribution to the knowledge of the ancient history of the earth, and supplies a need which happens just at this time to be keenly felt. The Palæozoic rocks had been described and the forms of life which they contain unfolded, in "Siluria." The second, or Mesozoic chapter, is written with remarkable ability in the present work.

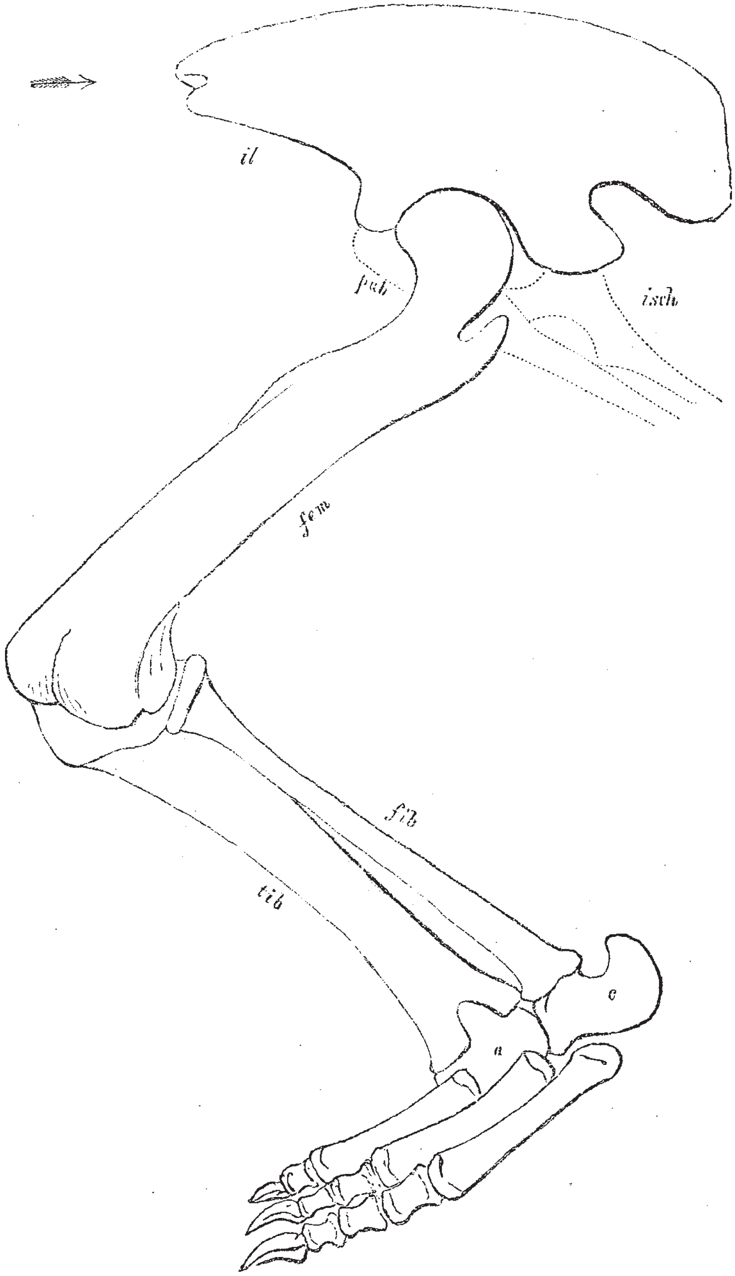

FIG. 1.—Megalosaurus—hind leg. Scale, one-tenth of nature.

This restoration in outline of the left hind limb of Megalosaurus is drawn from specimens, with the exception of the fibula, calcaneum, and ordinary phalangal bones—the claw-bone is known. Dotted lines represent the probable position of the pubic and ischial bones (according to the view of Professor Huxley); these being preserved in the British Museum and in the collections of the University of Oxford.

The principal bones are marked:—il. = ilium, pub. = pubis, isch. = ischium, fem. = femur, tib. = tibia, fib. = fibula, c. = calcaneum, a. = astragalus. Cuvier supposed the calcaneum to be smaller than here represented.

The position of Oxford relatively to the formations which traverse Britain diagonally from the north-east to the south-west, equidistant on the one hand from the Malvern Hills which overlook the low-lying vale of Tewkesbury, and on the other from the basin of the Lower Thames, renders it a convenient centre around which to group observations which are primarily local, but which also affect the general question of Mesozoic Geology. In its latter aspect the book demands a most careful attention. The large number of plates and the carefully prepared lists

* "Geology of Oxford and the Valley of the Thames." By John Phillips, M.A., F.R.S., F.G.S. (Oxford Clarendon Press; 1871).

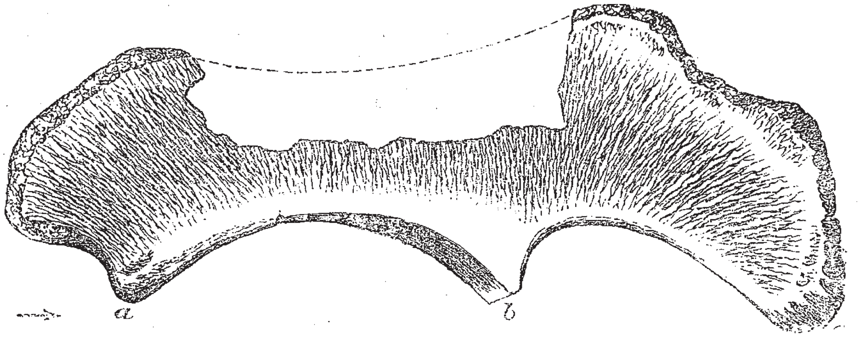

FIG. 2.—Ilium of Ceteosaurus, seen on the external face. Scale, one-tenth of nature. *a b*. The acetabulum.

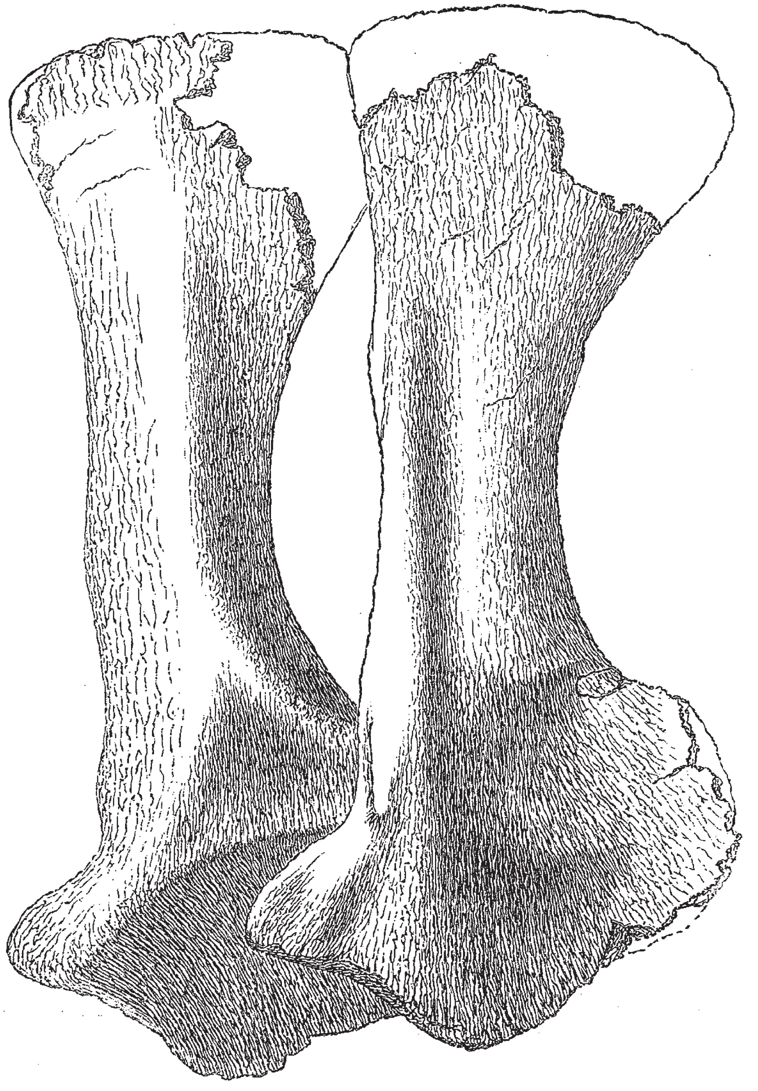

FIG. 3.—Scapulæ of Ceteosaurus. Scale, one-tenth of nature.

of fossils will be welcomed by all palæontologists; and those who enjoyed the advantage of studying geology at Oxford will find in this book the subject-matter of many of the lectures, and will have recalled to their minds the many pleasant associations connected with the expeditions of the Professor.

The work, as might be expected from the great and varied knowledge of the writer, is many-sided. In it the physical geographer will find the delicate questions of denudation, and of the excavation of hill and valley, discussed; the meteorologist will find the rain-fall tabulated; the hydraulic engineer the amount of water which is available for the use of Oxford and of London; the physicist the temperature and the prevailing winds; and the surveyor the position and thickness of the various strata from the Malverns eastward to London.

Prof. Phillips has, however, devoted his main strength to the description of the wondrous forms of reptilian life which

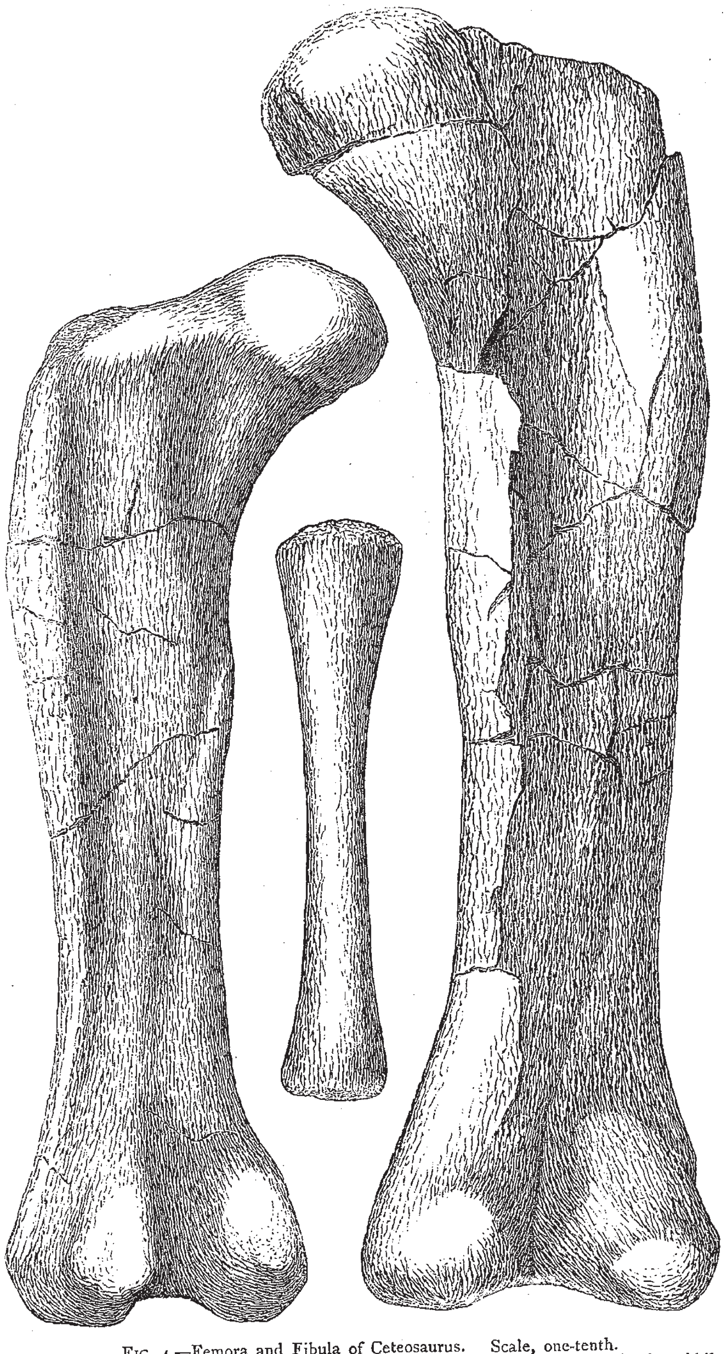

FIG. 4.—Femora and Fibula of Ceteosaurus. Scale, one-tenth.
The left-hand figure represents the specimen found in 1848: the right-hand figure that found in 1868; in the middle a small fibula found in 1848 is shown.

have been furnished by the neighbourhood of Oxford, and which are preserved in a museum which is worthy of an old and wealthy University. The description of the Megalosaurus, and especially of the Ceteosaurus, is a most valuable addition to Palæozoology.

We owe to Prof. Huxley the clue to the right interpretation of the bones of both these animals, and the right definition of the whole group of Deinosauria, or Ornithoskelida, to which they belong, as being intermediate in character between the struthious birds and the reptiles. To this conclusion, however, he was largely aided by Prof. Phillips, and that it is true is rendered almost certain by the independent observations of Prof. Cope on the fossil reptiles of America. When the large pelvic bone from Stonesfield had been assigned to its true position in the skeleton of its possessor, and the so-called "clavicle" shown to be in all probability a long, stiliform, bird-like ischium, there could no longer be any doubt as to the

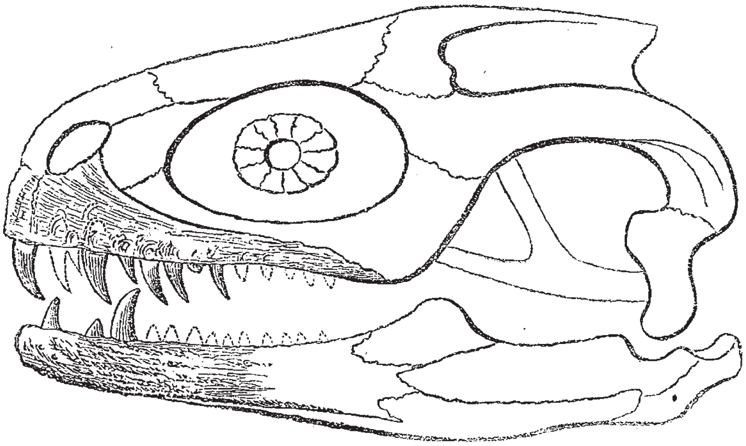

FIG. 5.—Head of Megalosaurus. Scale, one-tenth of nature.

Restoration of the head and lower jaw, of which, however, only the anterior portions are known. These are shaded. The type of Varanus is followed in general, but the postorbital arrangement is different, the bony circle there being completed from considering iguana and other lizards with some eye to crocodile. The length of head as thus drawn (thirty-nine inches) is less than that usually allowed (five feet).

The posterior part of the maxillary bone is separated from the orbit, notwithstanding its smooth, apparently free edge, by an intervening continuation of the jugal. This may be objected to. The nasal cavity is supposed to be divided by a median ridge (the single nasal continuous with the intermaxillary bone) into two openings, as in some of the monitors. The intermaxillary bones, which originally included four teeth each, appear united to the maxillary in this adult specimen.

kind of animal to which it belongs. The massive anchylosed sacrum of five vertebræ, and the whole arrangement of the pelvic arch, as well as the peculiar form of

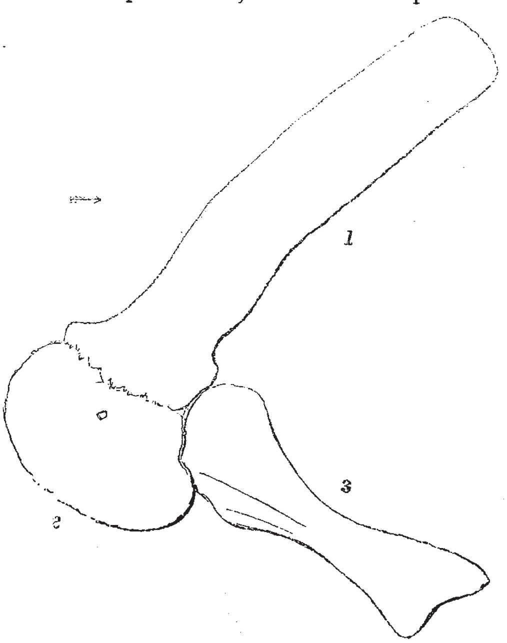

FIG. 6.—Megalosaurus. Scale, one-tenth of nature.

The left aspect of the shoulder girdle is here restored in outline from specimens in the Oxford Museum, which are complete except in regard to the lower end of the humerus. It will be remarked how bird-like in the general arrangement and the forms of the bones is the humero-scapular structure, and specially how closely it resembles Apteryx.

1. Scapula. 2. Caracoid. 3. Humerus.

the astragalus and the shape of the coracoid and scapula, indicate a close alliance with the birds; while, on the other hand, the rest of the structure is mainly reptilian. The specimens which are preserved in the Oxford Museum, and which have been figured by Prof. Phillips, afford a very complete idea of the creature. The magnificent upper maxillary described by Prof. Huxley in the "Geological Journal," enables the front portion of the cranium to be restored with considerable certainty, and the accompanying woodcut (Fig. 5) may be taken to represent the entire head.

The premaxillaries of the Megalosaurus from the Oxford clay, in the collection of Mr. James Parker, are traversed by foramina which may indicate the presence of a small horny beak, or snout.

The arrangement of the shoulder girdle may be seen in Fig. 6, in which 1 = Scapula; 2 = Coracoid; and 3 = Humerus, as well as that of the pelvic arch and hind leg (Fig. 1), and the comparison of the two diagrams, will show the enormous disproportion of the hind to the fore limb in respect of size. All these three figures are drawn to one-tenth of natural size, and enable us to realise the form of one of the most remarkable of the fossil reptiles. The recent discovery of a nearly perfect skeleton by Mr. James Parker establishes the fact that some, at least, of the opistho-cœlian vertebræ, on which the genus Streptospondylus has been based by Prof. Owen, belong really to this animal. In point of time, the Megalosaurus lived from the Liassic to the Wealden age, and was one of the most formidable inhabitants of the great Mesozoic continent. The pains and labour which Prof. Phillips has bestowed in collecting and putting together the fragments and *disjecta membra* of the animal, and the careful criticism to which he has subjected each bone, render this portion of the work peculiarly valuable.

Nor is the chapter on the most gigantic of the fossil reptiles, the Ceteosaurus, inferior in interest to that which relates to Megalosaurus. The bones discovered in the Great Oolite at Enslow Bridge, near Oxford, in 1870, settled for ever all doubt as to the animal having been aquatic or terrestrial. The scapula (Fig. 3) and the ilium (Fig. 2) resemble in general outline those of Megalosaurus, and show that the animal belongs to the same Deinosaurian class, although "its fore limbs are more crocodilian," and "its pelvic girdle more lacertian." And the evidence offered by the articular ends of the bones of the extremities being adapted for movement in particular directions, the possession of large claws, and the hollowness of the long bones, indicate that it was of terrestrial, and not, as its name seems to imply, of marine habit. It may, however, have been, as Prof. Phillips suggests, "a marsh-loving or river-side animal." Its gigantic size may be gathered from the fact that one of the femora measures no less than 64, and a humerus 51·5 inches (Fig. 4).

Nor is there evidence wanting as to its diet. From the mutilated fragment of a tooth in the Oxford Museum, Prof. Phillips infers that its possessor lived on vegetables, since it resembled "that of an iguanodon in general shape (as far as can be known, one edge being broken), with a similar sweep of the concave surface seen in the diagram, and corresponding alternation towards the edge. The edge is not serrated, but the striæ of accretion are so arranged as to suggest that it may have been." The truth of this conclusion is proved by the subsequent discovery of a nearly perfect crown by Mr. Burrows, one of my students, in the Enslow Quarry, which has very much the appearance of a young tooth. It presents the serrations which have been worn away in the specimen above described, and bears out completely Prof. Phillips's description.

I have chosen merely these two animals as illustrating the subject-matter of the book, which is in every sense worthy of the high reputation of its author. W. B. D.

PARTHENOGENESIS AMONG THE LEPIDOPTERA

THE part of the *Archives Néerlandaises*, published by the Societé Hollandaise des Sciences à Harlem, for 1870, contains the results of some very interesting experiments undertaken by M. H. Weijenbergh, jun., on the above subject, one fraught with considerable interest to others besides entomologists. By Parthenogensis is meant the power that is possessed by females of producing eggs endowed with vitality, and from which young ones are produced, without impregnation taking place on each occasion. This subject has been extensively treated by von Siebold in his "Wahre Parthenogenesis bei der Schmetterlinge und Bienen," Leipzig, 1856, but confirmatory and new investigations were much needed. Those of M. Weijenbergh were conducted with every possible care and precaution, so that they can be relied upon. In the autumn of 1866 he saw a male and female of the species *Liparis dispar* together, and some days afterwards he saw in the same place a great quantity of the eggs, about 500 in number. In order to leave the rearing of these to natural processes, as far as possible, he left them exposed all the winter in the open air, and in April 1867, he removed them into his house. Before the end of the month the caterpillars had successively made their appearance. These were regularly fed, and by the middle of July each of the chrysalides which had been formed during June gave birth to a perfect butterfly. It was easy, with a little practice, to distinguish the sexes whilst in the caterpillar state, and all the males were removed as far as possible, and the females were placed in a box closed to all access from without. So successfully was this separation of the sexes effected, that only one male butterfly made its appearance among the females; and, as these had been successively removed to a third closed box as soon as they escaped from the chrysalis state, it was only necessary to sacrifice the three or four females which were in the box at the time. In all, about sixty females were obtained, to which there was absolute certainty that no male could by any possible chance have had access. Of these, two-thirds laid eggs in the autumn,—some, one, two, or three eggs only; others as many as ten or twenty, but yet even at the most not one-twentieth of the eggs of their mother. The other one-third laid no eggs at all. In all about 400 eggs were collected, which were removed and carefully packed up till April 1868, when a large number of little caterpillars were seen. These were immediately placed on leaves in a large glass vase and watched carefully. It was easily to be seen that this batch of caterpillars possessed far less vitality than those of the previous year. A large number of the eggs dried up and were worthless, some fifty caterpillars alone appearing, and of these only about forty survived to become chrysalides. From these, by the end of July, twenty-seven butterflies made their appearance. The same precautions having been taken as before, the number of females was found to be fourteen. Of these, when again there had been no possibility of male access, one half laid no eggs, the remaining half, however, laying in all a fair number. As in previous years, these were removed and left all the winter carefully packed up, till, in April 1869, three years after the commencement of the experiments, young caterpillars again made their appearance. From these, strange to say, the number of butterflies obtained was in excess of those obtained in the previous year. The number of females as compared with males, was almost the same, in contradiction to the results of other investigators, which had indicated the probability of the ratio of the males to the females greatly increasing with each additional year. The eggs laid by the females of this year, carefully isolated as before, were packed up during the winter, but when examined in the spring of last year, 1870, no caterpillars made their appearance, the eggs became shrivelled up, and the experiment was at an end. There is every reason to believe that it was most carefully conducted, and that every regard was paid to strict accuracy during the whole three years or more that the experiment was being carried on. The results amount to these:—

(1.) Aug. 1866, eggs laid by impregnated female; April 1867, caterpillars appear; and, in July, perfect butterflies.

(2.) Aug. 1867, eggs laid by females of this year without impregnation; April 1868, caterpillars appear, and, in July, perfect butterflies.

(3.) Aug. 1868, eggs laid by females of this year without impregnation; April 1869, caterpillars appear, and, in July, perfect butterflies.

(4.) Aug. 1869, eggs laid by females of this year without impregnation; April 1870, no results—the eggs all dried up.

Thus, after the first impregnation of the female in the autumn of 1866, three successive broods of caterpillars and, ultimately, of butterflies made their appearance; and four successive times were eggs laid without further impregnation, in three of which they proved endowed with vitality. It would take a long series of experiments, each conducted with the same care as this, before an average could be drawn to determine the limit of this strange reproductive power. These experiments are so easily performed, and yet so valuable when accurately made, that a wide field is opened to those who do not care to undertake long and elaborate scientific investigations, and to such we most cordially commend them. Their value, as bearing on the theories of spontaneous generation, is very great, as there is much apparent probability that this power of Parthenogenesis will increase as we descend in the scale of life just as it decreases as we ascend. By its aid many phenomena, now apparently very strange and perplexing, will be found to be but obeying one great and universal law of nature, which becomes less visible the higher we ascend in the scale of life, but yet never ceases.

In conclusion, it may be stated that this power of Parthenogenesis has been found in many species of butterflies, and also among bees; and M. Weijenbergh, at the