## THE RELATIONSHIPS BETWEEN DINOSAURS AND BIRDS.

PROF. B. VETTER[1] has recently published a striking article upon this question, which offers strong evidence that the view so long held of the descent of birds from dinosaurian reptiles must be abandoned. The author gives several pages to a *résumé* of the more or less discordant opinions of previous writers; but these lack of space forbids us to notice, as Dr. Vetter's own views must claim our attention.

The oldest known dinosaurs occur in the trias, and are representatives of the Theropoda and Sauropoda, — the former typical carnivores, walking entirely upon the three-toed hind-feet; the latter herbivorous, little differentiated, having the fore and hind limbs plantigrade, pentadactyl, and of nearly equal length. From this it appears that the earliest members of the dinosaur line existed long before the trias, and must have been quadrupeds, with skull, limbs, and pelvis approximating the lizard type. Of the mesozoic dinosaurs, we know at least five or six divergent lines which show more or less likeness to birds in the pelvis and hind-limbs. These do not form a single connected series gradually leading to the birds, but rather a number of divergent series. Let us examine some of these groups.

Stegosauria show many bird-like features of the pelvis and hind-limb, but in every other respect are very different from birds, having a lacertilian skull, an immense tail, and grasping fore-limbs. They are too specialized to be bird ancestors. The Ornithopoda have, with Compsognathus, usually been regarded as forerunners of the birds. Iguanodon will serve as a type of the group. It walked on its elongated hind-legs. The jaw was toothless in front, and very probably had a horny beak. The pelvis is very like that of a Ratite, though with large reptilian pubes; the femur has a third trochanter; and the tibia is as long as the femur. The foot corresponds very closely to the embryonic condition of the bird's foot. The specializations of Iguanodon, however, will not allow us to regard it as a bird ancestor. These are, the entire configuration of the skull, the peculiar tail, the absence of clavicles, the dermal armor, the structure of the fore-limb (which is much shortened). The first finger possesses a dagger-like weapon; the second, third, and fourth, hoof-like, ungual phalanges; and the fifth, which diverges strongly from the others, a claw. May we not, however, imagine a more generalized form as the common ancestor of both Iguanodon and the birds? But it was merely the specializations of Iguanodon that suggested it as a bird ancestor. If we remove these, the simpler sauropodan or even lizard characters appear. Here, at least, we must not speak of homologies with the bird foot and pelvis, but only of analogies. This does not render the facts uninteresting, as they prove anew, how, by the steady operation of the same needs, nearly the same result may be produced from similar raw material, be the remaining structures never so different. For similar reasons Dr. Vetter rejects Coelurus and Hallopus from the category of possible bird ancestors.

In Compsognathus the hind-limb is remarkably bird-like, in the following respects more so than in the Ornithopoda: femur considerably shorter than tibia; distal end of fibula a mere style; astragalus anchylosed with tibia, calcaneum with fibula; tarsus, metatarsals, and phalanges exceedingly similar to those of embryo birds; (in almost all these respects Archaeopteryx comes nearer the modern bird-type, without quite reaching it.) On the other hand, Compsognathus possessed a long ischiadic symphysis, very probably long pubes, greatly shortened fore-limb, the hand clawed and three-fingered, non-pneumatic bones, a lacertilian skull, long neck and tail. Such an animal may represent a further developed side-branch of the Ornithopoda, but was already spoiled as a flyer. Dr. Vetter rejects the opinion that Compsognathus could have been an ancestor of the Ratitae, as he derives both classes of birds from a common form. The result, then, of this investigation, agrees quite closely with that of Seeley and Vogt, that there is no direct connection between dinosaurs and Carinatae at least, and probably none with the Ratitae. If, as seems in every way probable, the Carinatae and Ratitae are descended from a common ancestor, the latter cannot be derived from the dinosaurs.

[1] Festschrift der naturwiss. gesellsch. 'Isis' in Dresden, Mai, 1885. pp. 109-122.

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## PHOSPHORESCENCE OF MARINE ANIMALS.

EHRENBERG, in his 'Das leuchten des meeres,' published in 1835, quotes four hundred and thirty-six authors who had written upon this subject up to that time; and very many additional observations have been since recorded. The property of phosphorescence is common to certain members of the Protozoa, and to the coelenterates, echinoderms, worms, rotifers, crustaceans, molluscoids, mollusks, and fishes, among the Metozoa. Fully three-fourths of Professor McIntosh's interesting address was devoted to a review of the phosphorescent forms belonging to these several groups; their distribution, and the appearance, intensity, and character of the luminosity being described in some detail. We limit ourselves to a short abstract of the concluding portion of his remarks.

As regards the causes of phosphorescence, Professor McIntosh said, "I do not deem it necessary to go into detail with regard to the numerous views which have been advanced to account for the phosphorescence of marine organisms, for these range over a very wide area, — from its production by electricity, by the constant agitation of the water, by putrefaction, by luminous imbibition, to its manifestation as a vital action in the animals, or a secretion of a phosphorescent substance. . . .

"It will be observed that in the Protozoa, the structure of the minute but often very abundant animals,

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