in the "Bournemouth" Well, but in all other wells, and the exhaustion is certainly felt as far as Kingston Lacy, two miles distant. The total yield of water is anticipated at 3 million gallons per day.

Attention should be drawn to the difference between the Bovington and Wimborne waters as regards their mineral contents; and, considering that they both proceed from the Chalk, this is all the more remarkable. The amount of solids obtained by evaporation in the case of the Bovington water, according to an analysis made at Devonport, is returned at 16·8 grains per gallon. Of this amount carbonate of lime contributes but little, whilst the chlorides are comparatively abundant. Hence the water must be soft. The analysis of the water of the Wimborne waterworks shows 22·19 grains per gallon, of which 14·8 grains may be expressed as carbonate of lime. Thus the Wimborne water is fairly hard, and much pains are taken to soften by artificial means the supply intended for Bournemouth.

It is evident that position with regard to existing contours is an important factor in an artesian well, and the valley of the Allen at Wimborne seems to fulfil the requirements of the case in a remarkable degree. But there is also another element in the problem, viz., the character of the Chalk encountered during operations. It has been said that permeability in the Chalk depends not so much on the nature of the Chalk itself as on the fissures by which it is traversed. This is well illustrated by the experience of the headings in the Bournemouth Waterworks at Wimborne. At the same time it is not incorrect, in a general sense, to regard the Chalk formation, with very limited exceptions, as a sponge, owing to the facility with which the water-level moves up and down, according to the amount of rainfall in those areas, such as the Hampshire and Wiltshire plateau, where the Chalk itself forms the surface. That the surface contours, and consequently the surface-flow, has some influence on the underground flow may be conceded, yet the controlling factors of the latter are in the main "the difference of pressure along the lines of flow, the varying texture of the strata traversed, and the disposition of contiguous impermeable strata."[1] In regard also to the degree of artesian pressure existing at any given spot, this may sometimes be modified by the action of springs, which, like excessive pumping, tend to bleed the underground arteries, and thus lower the general water-level for considerable distances.

III.—On some Fossil Reptilian Bones from the State of Rio Grande do Sul, Brazil.[2]

By Arthur Smith Woodward, LL.D., F.R.S.

A FEW fossil reptilian bones discovered by Dr. Jango Fischer in 1902 at Santa Maria da Bocca do Monte (Serrito) in the Rio Grande do Sul, which have been submitted to me by Dr. H. von

[1] Baldwin-Wiseman, on the "Motion of Sub-surface Water": Quart. Journ. Geol. Soc., vol. lxiii, p. 98. A sketch-map of sub-surface water-levels in the Chalk of Dorset, Wiltshire, and Hampshire is appended to this paper.

[2] Reprinted from Revista do Museu Paulista, vol. vii (1907), pp. 46–57. See also abstract in Rep. Brit. Assoc., 1903 (1904), p. 663.

Ihering (San Paulo Museum), are of much interest. They not only appear to determine the geological age of the formation from which they were obtained, but also foreshadow the discovery of an early Mesozoic South American land fauna, which has long been expected.

They comprise three nearly complete vertebral centra and a fragment of a fourth centrum, with one digit of four phalanges and a separate ungual phalange. The bones were found together under such circumstances that they probably all belong to one individual.

The vertebral centra are remarkable for (i) their very short antero-posterior extent, (ii) the deeply ovoid shape of their articular ends, and (iii) the considerable constriction of their sides.

The best-preserved specimen (Figs. 1, 1A) is evidently not much crushed, and shows that both the articular ends are slightly concave.

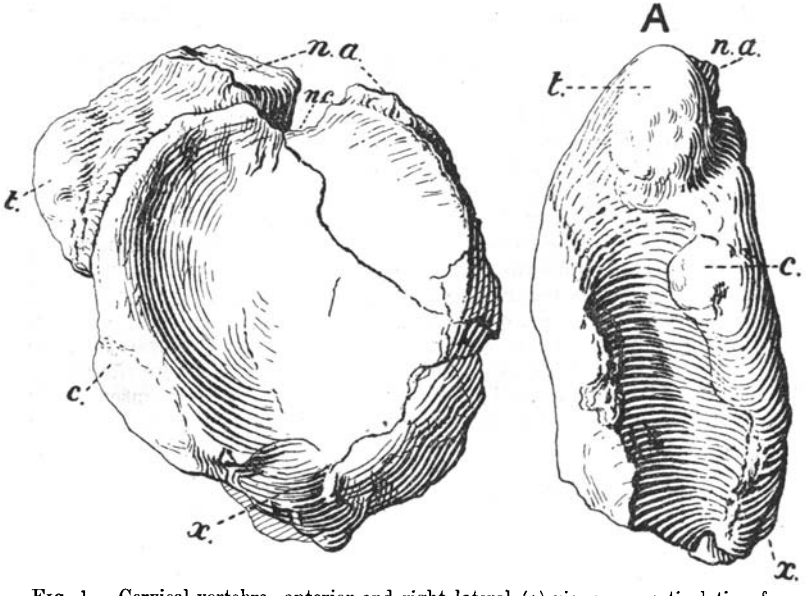

FIG. 1.—Cervical vertebra, anterior and right lateral (A) views. *c.* articulation for capitulum of rib; *n.a.* base of neural arch; *n.c.* neural canal; *t.* articulation for capitulum of rib; *x.* facette for intercentrum. $\frac{2}{3}$ nat. size.

It also exhibits the characteristic constriction of the sides, with the prominent anterior rim, which bears a deeply ovoid, rounded boss (*c.*) for the articulation of the capitulum of a double-headed rib. The lower part of the same rim is bevelled in such a way (*x.*) as to suggest that an intervertebral wedge-bone may originally have been present. The neural canal (*n.c.*) produces a shallow groove in the centrum. The base of the neural arch (*n.a.*) still remains, and proves that it is firmly fused with the centrum, not merely articulated by suture. This arch extends from end to end of the centrum, but leaves a slight rim of the latter projecting in front. Its lateral portion is produced somewhat downwards and ends in a deeply ovoid, rounded

boss (*t.*), for the articulation of the tuberculum of the rib already mentioned. It is thus evident that the rib must have been stout, deep, and antero-posteriorly compressed at its double-headed upper end.

One of the most imperfect vertebral centra is essentially identical with that just described, showing a similar rib-articulation and a space for a wedge-bone. The other good specimen (Figs. 2, 2A), however, is somewhat smaller, with no clear indication of a facette on the centrum either for a rib or for a wedge-bone. Its articular ends are slightly concave. The base of its neural arch seems to show that it agrees with that of the other vertebra in being fused with the centrum, while the neural canal similarly forms a shallow groove.

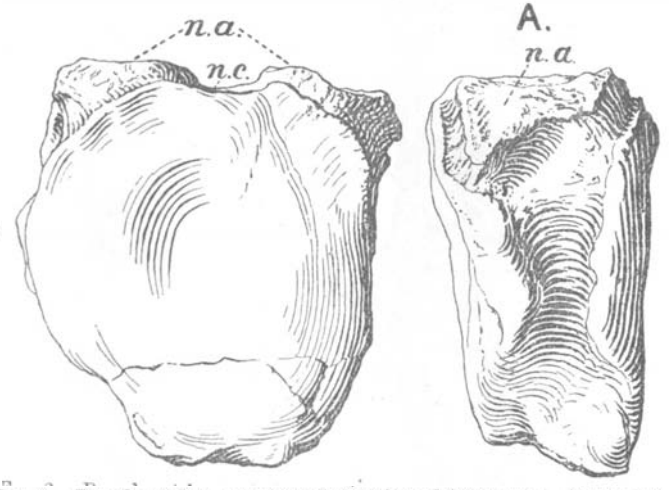

FIG. 2.—Dorsal vertebra, anterior and right lateral (A) aspects. $\frac{2}{3}$ nat. size.

The first type of vertebra (Fig. 1) obviously belongs to the cervical, while the second (Fig. 2) must be referred to the dorsal region. If, therefore, these specimens represent one and the same individual, the neck must have been comparatively large and stout, doubtless for the support of a heavy head.

The digit of four phalanges (Figs. 3, 3A) is interesting on account of the shape of the claw. The ungual phalange is laterally compressed and unsymmetrical, the left or less deep side being flattened or almost hollowed, while the other side is slightly convex. The bone is not marked by any lateral groove, but its lower face is considerably excavated and has a sharp rim. The two phalanges following the ungual are short and broad, and much constricted round the middle. The next bone, which perhaps admits of more than one interpretation, is more elongated than those just mentioned, but not so long as the ungual. It seems to be displaced in the fossil, being, in fact, accidentally turned on its long axis to an extent of 45°, so that its imperfect right side only is seen in Fig. 3, its left side in Fig. 3A. If this interpretation be correct the bone is another phalange, with the saddle-shaped proximal articular face somewhat deeper than wide.

The detached ungual phalange (Figs. 4, 4A, 4B) resembles the corresponding bone of the digit just described in the concavity of its lower face (Fig. 4A) and in its lack of bilateral symmetry; but it is relatively large and expanded. Its articular face (Fig. 4B) is oblique and much deeper than broad; its slightly convex side (Fig. 4) is excessively large, owing to the expansion of the thin, rounded, distal border; while its flattened left side (Fig. 4A) is a comparatively small triangular area.

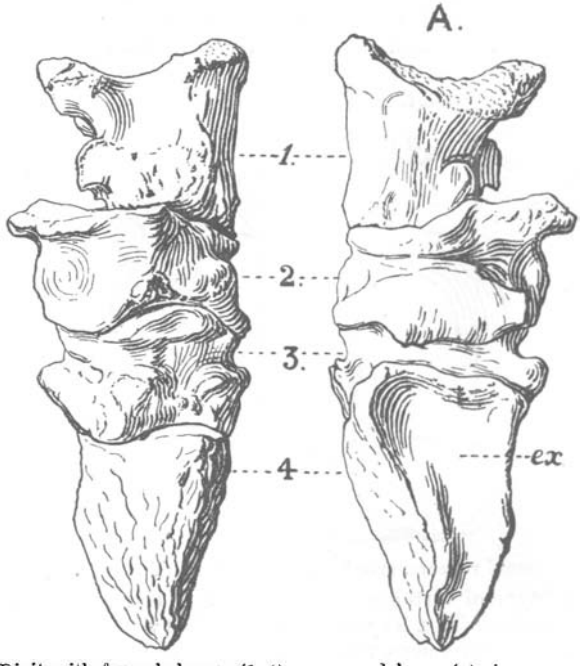

FIG. 3.—Digit with four phalanges (1–4), upper and lower (A) views. *ex.* excavation of lower face of ungual phalange. ⅔ nat. size.

The two ungual phalanges evidently belong to one and the same foot, which must have had obliquely-curved digits. If constructed as in the Sauropodous Dinosaurs this foot would be of the left side, the large claw belonging to digit I, while the series of four phalanges would probably represent digit III.

It is difficult to determine the affinities of a reptile known only by remains as fragmentary as those now described. It is evident, however, that the bones are those of a land-reptile; and the characters of the vertebræ suggest that they belong either to an Anomodont or to a primitive Dinosaur. The fact that the dorsal vertebral centrum shows no clear mark of an articular facette for the rib seems to prevent its reference to an Anomodont; while the shape and characters of the cervical vertebra are so closely similar to those of a corresponding vertebra from the Karoo Formation of South

Africa ascribed to the Dinosaurian *Euskelesaurus* by Seeley[1] that the new Brazilian reptile is probably allied to the latter. The striking inequality in the size of the obliquely-curved toes is also less suggestive of an Anomodont than of a Dinosaur; and although it is possible that some of the larger Anomodonts had a digital formula like that of lizards and crocodiles, this was not the normal condition, and a digit with four phalanges is more likely to have belonged to a Dinosaur than to a member of the more primitive order.

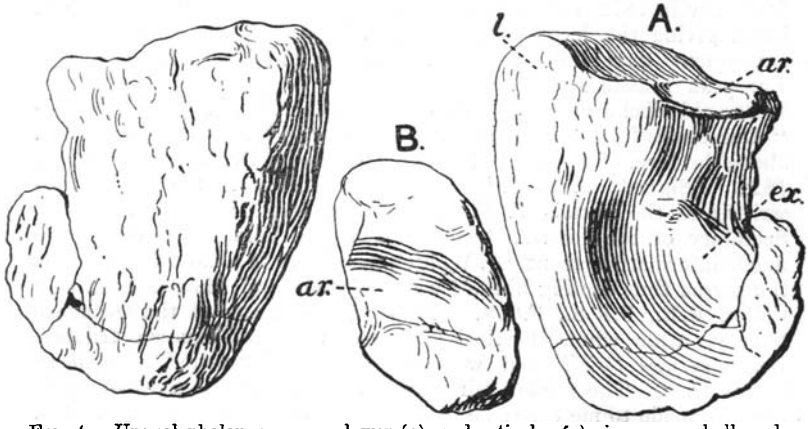

FIG. 4.—Ungual phalange, upper, lower (A), and articular (B) views. *ar.* hollowed articular face; *l.* flattened inner face; *ex.* excavation of lower face. ⅔ nat. size.

I therefore refer the new Brazilian fossils to a short-necked Dinosaur allied to *Euskelesaurus*, and I propose to name this reptile *Scaphonyx* in allusion to the unique inferior excavation of the ungual phalanges. The species may be known as *Scaphonyx Fischeri*.

If this determination be correct, the rocks in which the bones were found may be regarded as of Triassic age. *Scaphonyx* is also to be considered as the first fossil land-reptile discovered in South America which clearly belongs to the fauna of 'Gondwana Land.'

Postscript, April, 1908.—The preceding paper was written in 1904, when Professor Seeley's determination of the cervical vertebra of *Euskelesaurus* had not been questioned. Since that time Baron F. von Huene (Palæont. Abhandl., N.S., vol. viii, 1906, p. 123) has expressed the opinion that the vertebra in question does not belong to a Dinosaur, but to an Anomodont; while Dr. R. Broom has described similar vertebræ from the Upper Beaufort Beds of the Karoo Formation under the new generic name of *Erythrosuchus* (Ann. S. African Mus., vol. v, 1906, p. 193). According to Dr. Broom's description this reptile is not a Dinosaur, but exhibits many resemblances both to Belodonts and to Anomodonts. From new specimens submitted to me by Dr. I. C. White, I am now of opinion that *Scaphonyx* is an Anomodont.—A. S. W.

[1] H. G. Seeley, "On *Euskelesaurus Brownii* (Huxley)": Ann. Mag. Nat. Hist. (6), vol. xiv (1894), p. 339, fig. 7. Original vertebra now in the British Museum.