not clearly different from that seen in sea water. The synthetic artificial solution seemed equally favorable to most forms, but distinctly less so to a few.

FRANCIS B. SUMNER.

*SOCIETY OF THE VERTEBRATE PALEONTOLOGISTS OF AMERICA.*

THE second meeting of this society was held at Philadelphia, December 29, 1903, in the Biological Hall of the University of Pennsylvania. In the absence of the president, Professor S. W. Williston, the chair was taken by Professor H. F. Osborn.

The following are abstracts of papers which were read and discussed:

*A Remarkably Preserved Specimen of a Pelycosaur Collected During the Last Summer in Texas:* DR. E. C. CASE.

The specimen has afforded a nearly complete skull and the anterior part of the vertebral column, with the incomplete fore limbs of both sides. The most important addition to our knowledge is in the anatomy of the articular region of the skull and lower jaw. The specimen shows that the author, in collaboration with Dr. Baur, was in error in ascribing to the articular region of the skull what belongs to the articular region of the lower jaw. The quadrate is, therefore, not a depressed bone largely covered by the bones of the temporal region, squamosal and jugal, but it is elevated and very similar in appearance and relations to the same bone in *Sphenodon*. There is a foramen between the lower end of the quadrato-jugal and the quadrate, as in *Sphenodon*. The finding of this foramen removes the last possible question as to the position of the Pelycosauria in the order Rhynchocephalia. There are two temporal arches present.

*In the Matter of Menaspis:* DR. BASHFORD DEAN, Columbia College.

Professor Bashford Dean discussed the relationship of the puzzling Permian fish, *Menaspis*, pointing out that on the evidence of an unfigured specimen in the Berlin Museum, which, thanks to the courtesy of Professor Jaekel, he had recently had the privilege of examining, there were grounds for regarding this form as distinctly chimæroid. The present specimen retains the dental plates, and from their size leads us to conclude that the region of the fossil regarded by earlier writers as the hindmost trunk region (terminating in blunt spines) is in reality the occiput. He compared the tuberculated spines of *Menaspis* with those of *Myriacanthus*, referring especially to an unfigured specimen of this form to which Professor E. T. Newton called his attention in the Paleontological Museum in Jermyn Street. The puzzling non-tuberculated spines of *Menaspis*, on the other hand, best correspond to the so-called lip cartilages of *Squaloraja*. Such structures, moreover, would be apt to take a position dorsal to the antero-ventral lateral head spines during fossilization. Accepting this comparison, *Menaspis* indicates that in matters of dermal defenses and teeth the Permian chimæroid resembled contemporary cestraciont sharks.

*On Some Famous Old Collections and Early Studies of Monte Bolca Fishes:* C. R. EASTMAN.

This paper reviewed the pre-Linnæan discussions as to the nature and origin of the famous fossil fish fauna of Monte Bolca, in northern Italy, with a notice of the principal contributions to the literature made during the last century. The history was given of several large Veronese collections containing important type material, and where the latter had become dispersed, the present location was indicated of such as is now preserved amongst different museums.

*On the Finding of Skulls of Trionychidæ in the Bridger Deposits of Wyoming:* Dr. O. P. Hay, American Museum of Natural History.

More than twenty species of fossil Trionychidæ have been described from the Cretaceous and Tertiary deposits of North America. All these have been based on more or less incomplete shells. No skulls have hitherto been found. During the past summer a party from the American Museum of Natural History was engaged in collecting in the Bridger Eocene of Wyoming. Among many other turtle remains secured were two skulls of Trionychidæ. One of these is very large, having a total length of more than six inches. The lower jaw is missing. The form is strikingly like that of the skull of *Platypeltis ferox* of the southern states; but the snout is broader, the inter-orbital space is wider and the choanæ are constricted, as in *Aspidonectes sinensis*. The species is named *Aspidonectes tritor*. A skull of another species is much smaller and is accompanied by the lower jaw.

These specimens show that since the Eocene there has been no important change in the structure of the Trionychidæ. Dr. Baur was led to the same conclusion regarding the Trionychidæ of the Upper Cretaceous, from the examination of shells and limb bones from the Laramie of Wyoming. Shells from the still older deposits of the Judith River and Belly River beds similarly give indications that the members of this group have undergone little change since the early periods of the Upper Cretaceous. We must, therefore, look to discoveries in the fresh-water deposits of the Lower Cretaceous or of the Jurassic for light on this group.

*The Grasping Power of the Manus of Ornithomimus altus Lambe:* Lawrence M. Lambe, of the Geological Survey of Canada.

The description of the manus is based on materials found by the writer in the Belly River deposits of Alberta, Canada. The pes of *O. altus* shows that the animal was adapted to swift running. The manus can not yet be wholly reconstructed, but the claws were quite different from those of *O. sedens*. *O. altus* may be regarded as the successor of *Ornitholestes hermanni* Osborn, and there are many similarities in the manus of the two. The manus of *O. altus* is much stouter and less elongate, but it probably had equally great grasping power. The phalanges of what is supposed to be the second finger were described. A channel between the condyles of the distal end of the first phalanx extends through an angle of about 223°. The amount of rotation which the second and distal phalanges may make is very great. *O. altus* probably pursued a rapid prey and grasped it tenaciously with its fore limbs. Evidently the claws were long and sharp.

*On Some Marine Fossils in the Titanothere Beds:* Dr. F. B. Loomis, Amherst College.

On Bear Creek, near the Cheyenne River, South Dakota, in the lower part of the Titanothere horizon of the Oligocene, were found about seventy-five baculites and parts of a *Platecarpus,* these being Ft. Pierre species. These occurred in concretions and had a limited distribution. Their presence was explained by river action, the fossils having been excavated from the Ft. Pierre and redeposited during the building up of the Titanothere beds.

*The Relationships of the Phytosauria:* Dr. J. H. McGregor, of Columbia University.

This group of reptiles, represented by the belodonts of the European and American Triassic, were regarded by Huxley as constituting a primitive division of the crocodiles, for which he proposed the sub-

ordinal name Parasuchia. Though Huxley's view has received quite general acceptance, several paleontologists, notably Marsh, Baur and E. Fraas, have observed certain resemblances to *Sphenodon* and the dinosaurs. The present studies of the group, based chiefly upon extensive material recently discovered in Germany and in North America, have cleared up most of the doubtful points of the skeletal morphology, and it may be said that, save for the carpus and tarsus, the phytosaurian skeleton is now pretty well known. Nearly all the newly discovered structures indicate that the affinity to crocodiles is much more remote than Huxley supposed, and certain characters of the skull and atlas alone preclude the possibility that these forms were ancestral to crocodilia. The strong general resemblance between the two groups is chiefly superficial or parallel adaptation to similar habit and environment.

The relationship of phytosaurs to carnivorous dinosaurs, on the contrary, is obscured by the adaptive or secondary differences correlated with bipedal habit in the latter animals; but careful comparison of the skeletons shows that the relationship in this case is scarcely more remote than the relationship with crocodiles. The group which undoubtedly stands nearest the phytosaurs comprises the small armored Aëtosauria; in fact, the phytosaurs are chiefly distinguished from these animals by the prenarial elongation of the snout. For this reason it seems best to place the two groups as suborders within a single order, to designate which Huxley's subordinal name Parasuchia may be taken in a more inclusive sense and raised to ordinal value. The derivation of these Parasuchia from Rhynchocephalian ancestors scarcely admits of doubt; they might be briefly described as Rhynchocephalia which have acquired strongly bicipital ribs, thecodont dentition and a dermal armature.

Evidence was also adduced to show genetic affinity between Phytosauria and Ichthyosauria. Many structures, especially in the skull and limb girdles, indicate derivation of both from a common ancestor at no very remote period.

*On the Position of the Bones of the Forearm in the Opisthocœlia or Sauropoda:* HENRY FAIRFIELD OSBORN.

In the Sauropoda the forearm is modified in adaptation to support a very great weight in a manner entirely analogous to that in the Proboscidea, namely, the forearm is completely rotated inward, bringing the thumb, or first digit, on the internal side of the foot; the ulna is also enlarged proximally until it covers the entire posterior face of the radius. This gives rise to a deceptive appearance of the shafts of the radius and ulna, and has led to the statement that these elements do not cross. Careful study of the entire forearm, however, shows that the upper end of the radius rises from the radial condyle which is on the external side of the lower end of the humerus below the deltoid crest; on the front surface of this condyle is a groove for the main flexor of the forearm; immediately below this condyle the radius is articulated, and on its front face is seen the rugosity for the attachment of the flexor tendon which passes through the groove in the radial condyle above; these relations fix the radius on the *external* side of the limb proximally; distally the radius is found on the *internal* side articulating with the scapho-lunar and supporting the radial digit, or thumb. The ulna is also strongly developed on the external side of the limb proximally, and extends behind the radius around to the internal side, its primary position; the shaft of the ulna descends and articulates with the ulnare on the external side of the limb inferiorly. Thus when seen in front view the shafts of the radius

and ulna actually cross each other, although as in the Proboscidea this crossing is much less apparent, owing to the great proximal expansion of the ulna.

*On the Use of the Sandblast in Cleaning Fossils:* Henry Fairfield Osborn.

The introduction of the compressed air chisel by the Field Columbian Museum has greatly reduced the cost of removing rock from fossils. This chisel has been introduced also in the National Museum with success. For larger masses of rock it answers every purpose. The writer has recently been experimenting with a sandblast, driven by a compressed air engine, with admirable results. This method is peculiarly adapted to the finer work. It should be used under fifty-pound pressure, with tubes of fine diameter. Although not thoroughly tested as yet it promises to give remarkable results both in cleaning surfaces and in removing the matrix in the cavities of small skulls. Combined with the compressed air chisel it will probably reduce the cost of preparing fossils to one third of that involved by the use of hand tools.

*Conclusive Paleontological Evidence for the Tritubercular Theory:* Henry Fairfield Osborn.

That part of the tritubercular theory which homologizes the cusps composing the main triangle in the upper and lower grinding teeth of mammals, has been seriously questioned of late; first, because it does not accord with all the embryological evidence, second, because the superior premolar teeth appear to afford a demonstration that the upper molar teeth evolved in a manner which was subsequently pursued by the premolars. The tritubercular theory has been steadily losing ground; some authors have recommended that the cusp homologies and terminology be totally abandoned. A fresh investigation of the paleontological material available has, however, demonstrated beyond question the truth of the theory in its original form.

The superior molars of *Triconodon* and of *Peralestes* in the British Museum support the original view that the cusp (protocone) homologous with the reptilian cone is internal or lingual in position. Through the kindness of Professor Charles E. Beecher, the superior molar teeth of the Jurassic *Dryolestes* in the Yale Museum have been reexamined, and are found to correspond exactly both with the original description of Marsh and with the conditions set forth in the original tritubercular theory. The main cusp, or protocone, is internal and supported on a stout fang; the secondary cusps, representing the para- and metacones, are external and supported on lesser fangs. This evidence, together with that deduced from comparative anatomy and paleontology, establishes the tritubercular theory beyond further question.

*A Reclassification of the Reptilia:* Henry Fairfield Osborn.

The Reptilia are divided into two subclasses: (1) Synapsida, including the Cotylosauria, Anomodontia, Sauropterygia and Testudinata. The Anomodontia are divided into the Therocephalia (Broom), the Theriodontia (Cynodontia Owen), the Dicynodontia, representing progressive phases of evolution of the skull and specialization of the teeth. Of these the Theriodontia stand nearest the Mammalia. (2) Diapsida, embracing the new superorder Diaptosauria, which includes the seven orders and suborders Procolophonia, Protorosauria, Proganosauria, Gnathodontia, Choristodera, Pelycosauria and Rhynchocephalia. The remaining Diapsidan orders are the Parasuchia (= Phytosauria), Ichthyopterygia, Crocodilia, superorder Dinosauria, superorder Squamata and the order Pterosauria. Birds sprang

from a stem near that which gave rise to the Dinosauria.

The paper is an abstract, with some additions, of the memoir 'The Reptilian Subclasses Diapsida and Synapsida and the Early History of the Diaptosauria' (*Mem. Amer. Mus. Nat. Hist.*, Vol. I., November, 1903).

*On the Primary Components of Vertebræ and Their Relations to Ribs:* HENRY FAIRFIELD OSBORN. Read by title.

The vertebræ of the Stegocephala and of certain Permian Reptilia and the embryonic vertebræ of *Hatteria* establish beyond question the fact that there are four pairs of primary components, to which the names neurocentra, pleurocentra, hypocentra and hypocentra-pleurale may be given. Each is present in pairs on opposite sides of the notochord and neural tube. The 'neurocentra' correspond with the neural arches or neuropophyses of authors. The 'pleurocentra' (Cope) form the main components of the vertebræ in the Reptilia, Aves and Mammalia, and probably also in the Amphibia, although this fact has been questioned by Baur and Cope. The 'hypocentra' were first named by Gaudry, and subsequently termed 'intercentra' by Cope; they are primarily paired elements lying on either side of the notochord below and anterior to the pleurocentra; by Cope and Gadow it has been held that they form the main components of the vertebræ in certain if not in all Amphibia. The 'hypocentra-pleurale' (Fritsch) lie in pairs below and posterior to the pleurocentra; they are only found in certain Stegocephala. The vertebral complex thus made up is modified by the degeneration of the hypocentra-pleurale and in many forms of the hypocentra; by the development of the pleurocentra uniting with the neurocentra to form the centrum and neural arches.

Both on paleontological and embryological evidence the ribs always rise primarily opposite the hypocentra; they are thus placed between the pleurocentra and may be described as 'intervertebral' or 'intercentral.' The capitulum of the rib is hypocentral while the tuberculum is pleurocentral in attachment. Secondarily the capitulum may migrate to the side of the pleurocentrum, and the tuberculum to the side of the neurocentrum. This rib migration, observed independently in many different orders of reptiles, proves that the position of the head of the rib can not be adduced as evidence of the homology of that portion of the vertebral complex to which it is attached.

Mr. G. I. Adams, of the U. S. Geological Survey, read a paper entitled 'The Differentiation of the Permian in the United States, and the Diagnostic Value of Reptiles as Indications of Permian Age.' No abstract has been furnished.

Other papers by Messrs. J. C. Merriam, H. F. Osborn, Wm. Patten, E. S. Riggs, W. J. Sinclair and S. W. Williston were read by title.

Before adjournment Professor H. F. Osborn was elected president and O. P. Hay secretary for the ensuing year.

O. P. HAY,
*Secretary.*

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*THE MEMBERSHIP OF THE AMERICAN ASSOCIATION.*

THE following persons have completed membership in the association since the publication of the list contained in SCIENCE of December 25, 1903:

Adams, Charles Francis, Head of Science Dept., Central High School, Detroit, Mich.

Aitken, Robert G., Lick Observatory, Mount Hamilton, Cal.

Alt, Adolph, M.D., 3819 W. Pine Ave., St. Louis, Mo.

Andrews, Clement Walker, Librarian, The John Crerar Library, Chicago, Ill.

Banta, Arthur M., Instructor, Indiana University, Bloomington, Ind.