mental laws of matter and of motion, the existence of any distinctive entity, or principle that does not fall within the chain of physical causation or that contravenes the general laws of physics, then, I protest, to accept 'vitalism' as a principle of interpretation is deliberately to abandon the scientific method in biological study.

Edmund B. Wilson.

THE AMERICAN PALEONTOLOGICAL SOCIETY. SECTION A—VERTEBRATA.

Section A of the American Paleontological Society held its third annual meeting in common with the other societies on December 27, 28 and 29, and greatly enjoyed the admirable arrangements made by the officers of the University of Pennsylvania, especially by Professor Conklin. The President, Professor Henry F. Osborn, presided. At the close of the meeting Professor W. B. Scott was elected president and Dr. Marcus S. Farr secretary, both of Princeton University.

The meeting included a series of eighteen papers presented in person or in manuscript by Messrs. Osborn, Eastman, Sinclair, Case, Lull, Patten, Brown, Gidley, Hay, Loomis, Farr, Scott, Petersen, Douglass, Williston, Matthew and Granger. These were presented on Tuesday afternoon and on Wednesday and Thursday mornings. On Wednesday forenoon the president delivered his annual address, entitled 'Ten Years' Progress in Mammalian Paleontology.' In this address, which will be printed in full elsewhere, the history of the science during the last decade was followed in detail, and the principal advances, in the discovery of new forms, principles, and methods of work, were outlined. On Thursday morning the principal feature was the discussion of the phylogeny and classification of the Reptilia, in which Messrs. Osborn, Williston, McGregor and Hay participated. In this discussion Professor Osborn opened with a general review, pointing out the gradual development of the idea of a double grouping of the reptiles, beginning with Baur's phylogeny published in 1889 and continued in the phylogenies and discussions of Cope, Smith Woodward, Broom, Nopcsa, Williston, Boulenger, Osborn and McGregor. The following table is that of Osborn, 1904.

The chief differences of opinion at present relate to the position of the Ichthyosauria, Sauropterygia and Testudinata, some authors placing the Ichthyosauria as intermediate between the two groups, others placing them frankly with the descendants of the rhynchocephaloid reptiles, as suggested by Baur. Boulenger derives both the Sauropterygia and the Testudinata from the rhynchocephaloid, or diapsidan, group; whereas all other authors take them off from the synapsidan group.

Professor Williston continued the discussion, speaking especially of the Sauropterygia. He first stated that he considered the Sauropterygia and Testudinata as fundamentally separate groups, all their points of likeness being due to analogous evolution, while their points of difference are fundamentally distinctive. He considered the Triassic plesiosaurs Nothosaurus and Lariosaurus, as not ancestral to the Jurassic and Cretaceous plesiosaurs, but as representing an independent offshoot. He maintained that the Proganosauria, represented by the Permian genera *Mesosaurus* and *Stereosternum,* were certainly not ancestral to the plesiosaurs, as held by Seeley and Boulenger. The Testudinata are also widely separated from the Placodontia, and are probably of direct Cotylosaurian origin. The points of convergence are partly correlated with the large size of the paddles of plesiosaurs and turtles, the short tail being correlated with the long propodials in the plesiosaurs, whereas in the

Subclass **SYNAPSIDA** Osborn 1903. Order **Cotylosauria** Cope 1880 (Pareiasauria Seeley 1889).
Superorder ANOMODONTIA Owen 1860. (Theromorpha Cope 1878, in part.)
- Order **Theriodontia** Owen 1876. Suborder Therocephalia Broom 1903.
- Suborder Cynodontia Owen 1861.
- Order **Dicynodontia** Owen 1860.
- Order **Placodontia** *auct. ex* H. von Meyer 1863 Incertæ Sedis.
- Order **Sauropterygia** Owen 1860. Suborder Simosauria *auct. ex* Gervais 1845. (Nothosauria Seeley 1882.)
- Suborder Plesiosauria *auct. ex* Quenstedt 1852.
- Order **Testudinata** *auct. ex* Shaw 1802.
- Suborder Pleurodira *auct. ex* Duméril and Bibron 1835.
- Suborder Cryptodira *auct. ex* Duméril and Bibron 1835.
- Suborder Trionychia *auct. ex* Pictet 1853.

Subclass **DIAPSIDA** Osborn 1903.
Superorder DIAPTOSAURIA Osborn 1903.
- Order **Procolophonia** Seeley 1867.
- Order **Protorosauria** Seeley 1887.
- Order **Proganosauria** Baur 1887.
- Order **Gnathodontia** Owen 1680. (Rhynchosauria Osborn 1903).
- Order **Pelycosauria** Cope 1878.
- Order **Choristodera** Cope 1877.
- Order **Rhynchocephalia** Günther 1868.
- Order **Parasuchia** Huxley 1875.
- Suborder Aëtosauria Nicholson and Lydekker 1889.
- Suborder Phytosauria Baur 1894 *ex* Jaeger 1828.
- Order **Ichthyosauria** Blainville 1835 *ex* Jaeger 1824. (Ichthyopterygia Owen 1860.)
- Order **Crocodilia** Wagler (?) 1830.
- Suborder Mesosuchia Huxley 1875.
- Suborder Eusuchia Huxley 1875.
- Suborder Thalattosuchia Fraas 1901.

Superorder DINOSAURIA Owen 1840.
- Order **Theropoda** Marsh 1881.
- Suborder Megalosauria *ex* Fitzinger 1843. (Thecodontia Owen 1860.)
- Suborder Symphypoda Cope 1867. (Compsognatha Huxley 1870.)
- Order **Opisthocœlia** Owen 1860. (Sauropoda Marsh 1881.)
- Order **Orthopoda** Cope 1866. (Predentata Marsh 1894.)

Superorder SQUAMATA Oppel 1811.
- Order **Lacertilia** Owen 1839.
- Order **Mosasauria** *auct. ex* Gervais 1845.
- Order **Ophidia** Brogniart 1802.
- Order **Pterosauria** *auct. ex* Kaup 1834.

ichthyosaurs the long tail is correlated with short propodials. In both plesiosaurs and turtles the ilium is directed downward and forward, in correlation with the backward thrust of the paddles; in both, the scapula acquires secondarily a proscapular process. The fundamental characters distinguishing the two groups may be summarized in the table given below.

Continuing the discussion, Dr. J. H. McGregor maintained and expanded his previous argument for the derivation of the Ichthyosauria from the Diapsida, and for the probably secondary nature of the closed condition of the temporal arch region of the skull.

Turtles.	Plesiosaurs.
Vomer (parasphenoid) unpaired.	Paired prevomers.
No posterior parasphenoid process.	A separate parasphenoid.
Opisthotic separate	Opisthotic not separate.
Cervicals eight.	Cervicals 13–76.
Ribs intercentral in attachment.	Ribs diapophysial in attachment.
Ten dorsals.	Twenty dorsals.

Dr. O. P. Hay pointed out the now convincing evidence that the original Testudinata had a closed, or solid, temporal roof

to the skull, as seen in the primitive Amphychelydia, and persisting in the Cheloniidæ; in other words, the production of an open temporal roof is secondary, in the more primitive families it is less reduced, in the lowest families it is still closed. From this original condition reduction has taken place in most forms from behind; in others, as some pleurodires, from below. There is thus no true supratemporal fossa. The parieto-squamosal arch in some pleurodires is proof of the presence originally of a solid roof. The turtles have been derived from the Cotylosauria, possibly through the Chelydosauria. With the Cotylosauria the turtles agree in possessing eight cervical and ten dorsal vertebræ. He pictured the primitive turtle as having a short, broad head, with overroofed temporal region and a short supraoccipital; a short neck consisting of eight vertebræ, with short neural spines, long transverse processes and bicœlous centra; a distinct proscapular process representing a procoracoid; caudal vertebræ with chevrons; a dermal armature consisting of plates of bone overlying the ribs and neural arches, and above this a mosaic of small bones embedded in the skin; a plastron consisting of the clavicles and interclavicle and the lateral elements of a parasternum, outside of which was a dermal armor of small plates. He maintained further that the turtles and the plesiosaurs are so different that they should be placed in different subclasses.

Dr. F. B. Loomis read a paper on 'The Amherst College Expedition to the Wasatch and Wind River Basins in 1904.' A rich collection of Wasatch forms will supplement several of the less known species. One *Eohippus* in which the paraconid is bifid, and a tiny *Anaptomorphus*, only two thirds the size of *A. homunculus*, are among the species. The beds are 2,180 feet thick. In the Wind River basin a new and rich locality was found, six miles above the mouth of Bridger Creek. There were collected at least three species of *Hyopsodus*, four of *Notharctus*, one of *Anaptomorphus*, three of *Paramys*, one of *Oxyæna*, one of *Esthonyx* and two of *Coryphodon*. The latter is represented by teeth and a nearly complete skeleton.

Mr. O. A. Petersen sent a paper entitled 'Suggestions Regarding the Probable Origin of *Dæmonelix*.' It has been regarded as a plant, but the author concludes that it represents the burrow of the extinct rodent *Steneofiber*. In his explorations he found, in the materials filling the burrows, portions of skeletons of the rodent mentioned.

Mr. Earl Douglass presented a paper on 'A New Monotreme-like Mammal from the Lower White River Beds.' The skull was described and drawings of it shown. While presenting numerous resemblances to the monotremes the author expresses some doubts on the relationships.

Professor W. B. Scott, referring to recent work of Roth on the South American Ungulates, held that the ordinal term Notoungulata suggested by Roth should include three grand divisions and subdivisions as follows:

I. Toxodontia.
  Toxodontia.
  Homalodontotheria.
  Typotheria.
II. Astrapotheria.
III. Litopterna.

Among the common characters are the following:

1. The double ankle joint.

2. The pillar on the inner side of the posterior crescent in the lower molars, the homologies of which are at present obscure.

Division I., including the Toxodontia, Typotheria and Homalodontotheria is especially distinguished by (1) swollen auditory region, (2) zygomatic arch ending on

the top of the skull. The Astrapotheria stand apart in the enlargement of the canines, showing analogies with the Amynodontidæ, which are, however, deceptive. Like the Litopterna they lack the auditory expansion. All these ungulates are further distinguished by being entirely hornless.

Dr. O. P. Hay read a paper 'On the Group of Fossil Turtles known as the Amphichelydia.' The author's studies are based on a very complete skeleton of the Jurassic *Compsemys plicatula* in the American Museum and several fine specimens of *Baena,* collected in the Bridger beds of Wyoming. In the members of this superfamily the temporal region is roofed in, there are nasals and a lachrymal bone; the pterygoids exclude the quadrate from contact with the basisphenoid; the cervical vertebræ may be biconcave or one or both ends may be convex; the neck short and adapted for motion in all planes, but more like that of the Pleurodira; the pelvis not suturally articulated with the shell. The group has evidently given origin to the Cryptodira and the Pleurodira, the former retaining the skull structure, the latter group retaining the neck and shell structures.

Papers were also read by Mr. W. J. Sinclair on 'The Marsupials of the Santa Cruz Formation'; by Dr. Wm. Patten, 'On the Structure of the Ostracoderms'; by Dr. M. S. Farr, 'On Mammals from the Fort Union Beds.'

Professor Wm. Patten described the structure of *Bothriolepis,* based on the study of a large number of well-preserved specimens recently obtained by him in New Brunswick. Many specimens were exhibited which illustrated and confirmed the most important features of the description. The structure of the mouth parts, the position of the gills, anus, anal fin and other organs indicate that the Ostracoderms must be separated from all other known subdivisions of the Chordata and raised to the dignity of a separate class.

Professor S. W. Williston reported on an important new locality for Triassic vertebrates on the east side of the Wind River range, near Lander, Wyo., yielding the most important remains which have yet been found in the American Triassic. The collections, which as yet have not been prepared and studied, represent four great groups, as follows: The Labyrinthodontia are represented by very large forms allied to *Metoposaurus,* of Wurtemberg, but generically distinct from it. The Dicynodontia, or Anomodontia, heretofore not represented in America, are apparently represented in portions of a skeleton, including a humerus resembling that of *Platypodosaurus,* and a pelvis remotely suggesting that of *Tapinocephalus.* The teeth named *Palæoctonus* by Cope and referred to a dinosaur, probably belong to members of this group, the affinities of which still require further study. The third group is widely distinct, including an animal with a slender humerus, a scapulo-coracoid with very prominent glenoid fossa, the blade of the scapula being placed at right angles to the lower portion of the arch, the humerus without entepicondylar foramen; the resemblances are rather with the Pterosauria than any other group. The fourth great group is the Phytosauria; here no less than four skulls of the Belodontia were found, all different, probably representing four genera, differing in the elongation of the snout and position of the nostrils, and adding substantially to our knowledge of this group. The author incidentally remarked that he had positively determined that the *Hallopus* Beds near Cañon City, Colorado, are of Triassic and not Jurassic age; these beds contain labyrinthodonts and crocodiles which belong to a higher horizon than that discovered near Lander.

The author further stated that he placed the Como beds as equivalent to the Wealden, and as representing either the upper or middle part of the Lower Cretaceous.

Dr. E. C. Case read on 'Characters of the Chelydosauria.'

The Permian genus *Diadectes* was shown to be a member of the order Chelydosauria of Cope. This order was founded on the genera *Otocœlus* and *Conodectes* and was considered as ancestral to the turtles.

The discovery that *Diadectes* is a member of this order permits a more complete description of its characters from especially perfect specimens collected by the author of the paper.

The members of the Chelydosauria (Diadectidæ and Otocœlidæ) differ from the Cotylosauria (Pareiasauridæ, Pariotichidæ, Elginidæ(?)) by the following characters; and in the same characters approach the Testudinata.

1. There are three pairs of openings through the roof of the skull instead of two; the extra pair being the openings of the *meatus auditus externus.*

2. The palate is very degenerate and the transverse bone is lost or nearly so.

3. The form of the quadrate and its relations to the surrounding bones are directly comparable to those of the turtles.

4. There are no teeth on the pterygoids and palatines.

5. There is no anterior process (parasphenoid) on the basisphenoid bone and correlated with this.

6. There are no prevomers but a single, anteriorly placed vomer (parasphenoid?).

7. The internal carotid arteries do not penetrate the lower surface of the basisphenoid, as in the *Rhyncocephalia,* but enter from the side as in many turtles.

8. The presence of paired descending plates from the under side of the parietal and the possible absence of the epipterygoid.

9. The presence of dorsal plates overlying the dorsal ribs and the presence of eighteen presacral vertebræ (the last common to Cotylosauria).

There is no trace of a beginning plastron.

It is concluded that the characters of the skull establish the validity of the order Chelydosauria and indicate the direct origin of the turtles from the Cotylosauria.

On Eocene Insectivora and on Pantolestes in particular: W. D. Matthew.

The genus *Pantolestes* Cope, variously referred to the Primates, Creodonta and Artiodactyla, turns out to be a fossorial insectivore of an archaic and peculiar type. A well-preserved skull and jaws and a large part of the skeleton were obtained by the American Museum Expedition in the Bridger Basin last summer. The teeth resemble those of the most primitive creodonts, the skull is most like that of the Centetidæ, and unlike the creodont or condylarth skulls; the limbs and feet are specialized for digging, more than in the badger but less than in the moles; the tail is long and very massive, the postsacral vertebræ being larger than the presacrals. *Palæosinopa* Matthew is the Lower Eocene ancestor of *Pantolestes; Pentacodon* Scott, of the Basal Eocene, appears to be a related genus. The addition of the Pantolestidæ and of some undescribed genera recently discovered, and also, if Wortman's assertion is supported by evidence, of the Hyopsodontidæ, to the list of Eocene Insectivora, greatly increases the importance of that order among the Mammalia of the early Tertiary. The present distribution of the Insectivora indicates that they must once have been an abundant and varied group; but fossil insectivores have hitherto been quite rare and for the most part nearly related to the three common living families, the hedgehogs, moles and shrews.

We now recognize the order as an important group in the Eocene, including a considerable variety of primitive types, and showing relationship on the one hand to the Primates, on the other to the Creodonta. *Trigonolestes* Cope, of the Lower Eocene, is not related to *Pantolestes* but is a true artiodactyl.

Dr. R. S. Lull read a paper on 'Footprint Interpretation' of which this abstract is given. The first dinosaur was found in the Connecticut Valley at New Windsor in 1818; but not until the civil war was a specimen brought to light of sufficient perfection to be considered in footprint interpretation. Even then little was known of the true nature of these forms other than that they were saurians. Marsh's restorations, based upon further material discovered at New Windsor, gave the first opportunity for a correlation of the osseous remains with the footprints. The tracks fall into three classes—truly bipedal forms; those of bipedal gait and quadrupedal resting posture; and finally true quadrupeds.

Of the first group the track genus *Anchisauripus* may be correlated with the family of Dinosauria known as the Anchisauridæ; *Gigandipus* has resemblances to *Allosaurus*, though a somewhat smaller form having a sinuous tail trace; in *Grallator* the feet are very small, with limbs of great proportionate length, representing a group of aberrant compsognathoid dinosaurs probably of habits similar to the wading birds. These genera were all Theropoda, or carnivorous dinosaurs. *Eubrontes* includes truly bipedal forms, large, bluntly clawed, probably of herbivorous habits; hence a predentate dinosaur.

The occasionally quadrupedal creatures were as truly bipedal types as those of the first group while moving, but always brought the hands in contact with the ground while resting. The most important genus is *Anomœpus*, an herbivorous dinosaur whose proportions suggest *Hypsilophodon;* while *Otozoum*, a huge creature with a plantigrade foot, having a shelf-like extension of skin around it presumably to support the great weight of the animal in soft mud, has no counterpart among known dinosaurs; and one can form no conception of its probable appearance. Except for its bipedal gait it presents some interesting points of comparison with *Chirotherium* of the Bunter.

Quite a host of quadrupedal tracks are known which must include both Amphibia and Reptilia, but one genus only, *Batrachopus*, can with any degree of certainty be correlated with known types. *Stegomus longipes*, a small Aëtiosaur from Longmeadow, Mass., seems to show proportions, size and length of limb which would make its relationship with *Batrachopus* fairly assured. In this track genus the stride is extremely long and the trackway narrow, implying a form with high stilted limbs and a gait like a cursorial mammal.

Thus far only can we at present interpret fossil footprints with any degree of assurance.

Dr. C. R. Eastman sent a paper entitled 'Fossil Bird Remains from Armissan.' This paper, which is in course of publication by the Carnegie Museum, discusses the paleontological history of gallinaceous birds, and offers a description of a new species of *Taoperdix*, a form related to existing pheasants, and noteworthy as appearing as early as the Upper Eocene. From the type species it differs chiefly in the relative proportions of mandible and wing-bones. The original is preserved in the Carnegie Museum at Pittsburgh, and has been courteously loaned by Dr. W. J. Holland.

Also a paper on 'Anaximander, Earliest precursor of Darwin.' The doctrine of evolution, far from being a purely modern conception, was anticipated in its essential

features by Ionian philosophers of the sixth century B. C. Writers, however, are disagreed as to which of these may properly be considered as the earliest evolutionist. A collation of the extant fragments of Anaximander, with critical interpretation of the same, reveals an acuteness and suggestiveness on the part of their author such as entitle him to high estimation amongst the founders of the main theory.

A paper entitled 'Recent Exploration of a Pleistocene Fissure in Northern Arkansas,' by Mr. Barnum Brown, describes what might be termed a bone mine from which nearly ten thousand identifiable bones were taken.

It is shown that a large number of the animals entombed here have been dragged in by weasels, which are actually found in their lairs in the wall of the fissure. Other carnivorous animals, such as the saber-toothed tigers, probably inhabited this fissure and brought in the remains of deer and hogs.

Thirty-four genera and fifty-five species are recognized. A new genus of skunks, *Brachyprotoma,* is described; also nine new species of different animals.

The fauna is compared with recent and fossil forms and tends to show that the fossil forms are boreal types and that the climate at this latitude was much colder during the Pleistocene period than at present.

Although many of the fossil species can not be separated from living forms, the large number of extinct species places the age of this fauna at some time prior to the middle Pleistocene.

O. P. Hay,
Secretary.

THE ASSOCIATION OF AMERICAN GEOGRAPHERS.

The Association of American Geographers was organized in Philadelphia, December 29, 30, with about fifty members, of whom about twenty-five were present. The following officers were elected:

President—W. M. Davis, Cambridge, Mass.

Vice-Presidents—G. K. Gilbert, Washington; A. Heilprin, Philadelphia.

Secretary and Treasurer—A. P. Brigham, Hamilton, N. Y.

Councillors—R. S. Tarr, Ithaca, N. Y.; Cyrus C. Adams, New York; H. C. Cowles, Chicago.

The object of the association is "The cultivation of scientific geography in all its branches, especially by promoting acquaintance, intercourse and discussion amongst members, by encouraging and aiding geographical exploration and research, by assisting the publication of geographical essays, by developing better conditions for the study of geography in schools, colleges and universities, and by cooperating with other societies in the development of an intelligent interest in geography among the people of North America." No regular publication will for the present be issued by the association, it being the opinion of its members that existing geographical journals afford sufficient opportunity for bringing out their essays. The annual meetings of the association will ordinarily be held in connection with the winter meetings of the American Association; but it is probable that the meeting next year will be held in New York city. A summer field meeting is in consideration.

The desire of the organizers of the association is to bring together the investigating geographers of the country, and to lead those who are working on the organic and inorganic sides of geography on the human, economic, zoological, botanical, climatic, oceanographic and geologic sides of this many-sided subject—to present their results in each other's presence. While full membership is limited to those who have already accomplished some original work, it was suggested that inquiry be made to