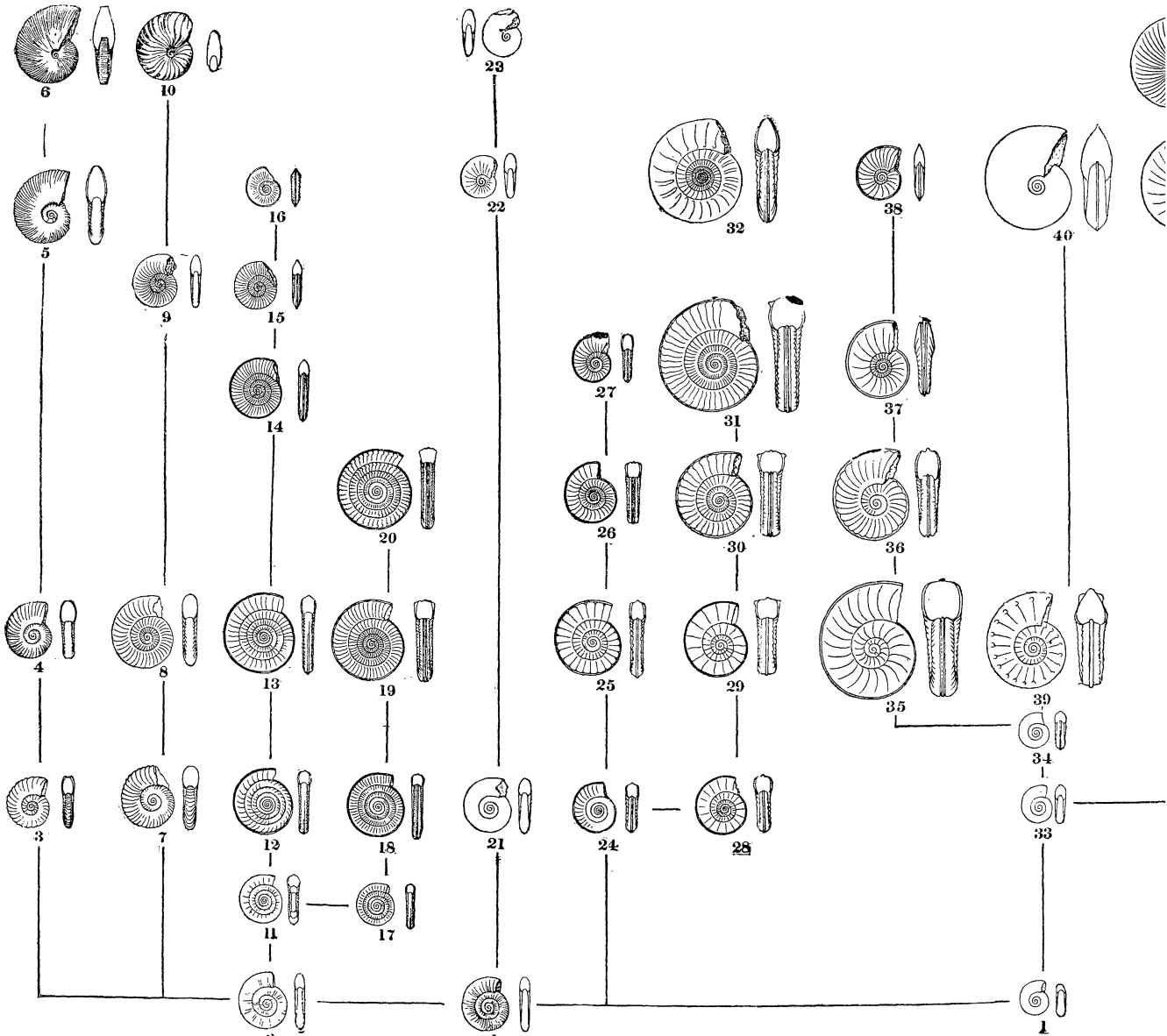
General Notes.

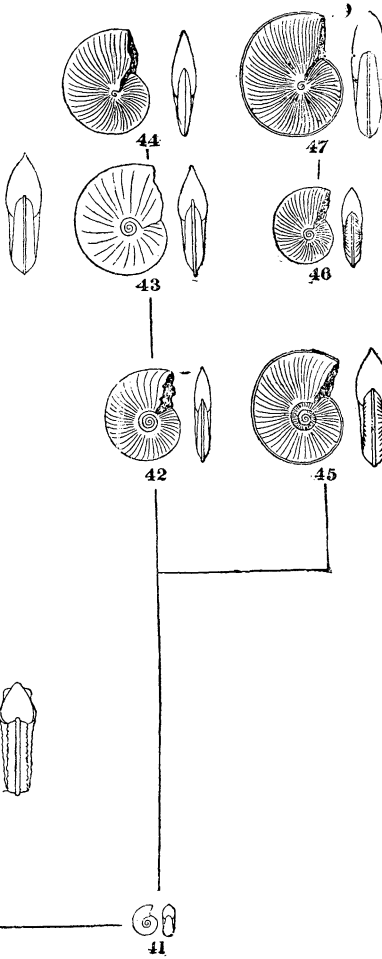
GEOLOGY AND PALEONTOLOGY.

The Genesis of the Arietidae.—This important memoir, by Prof. A. Hyatt, is the result of an effort to find a real demonstration of the theory of evolution. The methods of analysis used show the origin and rise of the ten series of species from one variety of one species, *Psiloceras planorbe*, the *Ammonites planorbis* Sow., and *Ammonites psilonotus* of Quenstedt. There are two varieties of this species, one smooth and one plicated. The smooth variety is the oldest in point of time of occurrence, and the development of the plicated variety, as well as its more recent station in time, show that it is a descendant of the smooth variety. The smooth variety is the ancestor of a series in which the forms become more involute and have more complicated sutures, but are smooth and have no keels, so that they may be accurately said to belong to the same genus, Psiloceras, as their smooth ancestor. This is pictured in Summary Plate XIV. as the central stock. On the right of this six series or genera are arranged, showing how these sprang, either directly or indirectly, from the same smooth variety of *Psil. planorbe*. On the left of the central stock or genus Psiloceras, four series are represented so as to show how these arose from the plicated variety of *Psil. planorbe*. Each series is in each case described as a distinct genus,—in fact the idea of the genus is founded upon its separability as a series of species branching off from the main stock or radical form. The last allusion to a cycle is due to the fact as shown in the Summary Plate XIV. that in each of the series there is a similar succession of forms. The forms from which each series arose were discoidal or open shells, with rounded whorls showing the internal coils plainly. As each series of forms was evolved from central stock or radical form in diverging lines like the spokes of a fan, each produced with curious iteration quadragonal whorls with keels and channels, or one or the other of these, along the periphery, and became covered with ribs on the sides. After this the successive species in each series became more and more involute in eight out of the eleven series; they lost their keels and channels, and their whorls became compressed, the abdomens at the same time tending to become acute. Thus the series of species, although

PLATE XIX.



PHYLOGENY OF ARIETIDAE.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diverging very much as compared with the smooth discoidal shell of *Psil. planorbe*, they were in reality parallel to each other, that is to say each went through with a similar cycle of changes; the discoidal smooth whorl became quadragonal, and acquired keel, channels, and ribs in the species representing the acme of their progress, while after the acmatic period of the species there was a tendency to produce shell, having more involute compressed and acute whorls. Throughout all of these, however, in each series a few characteristics were acquired and transmitted by which each series might be distinguished from its allied series.

Another result is that the whole of the group of the Arietidae arose and died out within the limits of the Lower Lias, and that there are three grand faunas, the earlier, the central, and the latest in time, these three agreeing in their general characteristics with the development and decline of the individual and with the cycle shown by each series. Thus the earliest faunas are everywhere composed in the mass of simple discoidal forms, the central of still discoidal shells, but these have keels, channels, and ribs; the latest faunas are characterized by the prevalence of involute, compressed, and often smooth shells. The method of classification was the result of practical work during which the young, adolescent, adult, and old age stages of many of the species mentioned, and in most of these species all of their known varieties were studied, these observations were correlated in all directions with the observed difference and resemblance of the species. Thus the characteristics of the young and adolescent stages were compared with the adult characteristics of the ancestral forms in each series, and the characteristics of the old age of each form with those of the descendants in the same series whenever they exhibited any similar degradational characters, which was the case in nearly all series. After the series had been established by this process, succession and relation of the forms was compared with their actual succession in the rocks, and the results showed agreement in every series, except where a series, as sometimes happened, occurred altogether on the same level. In order that the evidence could be judged by the reader, lists of names of species and their level of occurrence have been given in six different tables from five different basins in Europe. It was found while following out this last investigation that in some localities new forms had arisen, and that others had received their Ammonitic population wholly or in large part by migration. The former, which were called aldainic basins, are in strong contrast with the analdainic or unproductive basins. It was found that the aldainic basins formed a band running westward, beginning in the

region of the Northeastern Alps, and that north and south of this band the basins were unproductive or analdainic. Among the aldainic basins, that of the Northeastern Alps showed by far the most ancient fauna, and all those in the aldainic zone to the westward exhibited less of the primitive or radical Psiloceran forms. Thus it is shown that even taking the minute sub-divisions of the Lower Lias, those heretofore supposed to be of the same age, by studying the life histories of the species and following out their genesis, it may be shown that they belong really to a successive series whose relations in time can be determined by the relations of their faunas.

This memoir is issued in one of the volumes of the Smithsonian Contributions to Knowledge, and also in the series of the memoirs of the Museum of Comparative Zoology, Cambridge, Mass. It is illustrated by fourteen plates, four of which are arranged phylogenetically. Plate XIV. is here reproduced as Plate No. XIX.

Explanation of Plate No. XIX.

The three preceding plates do not illustrate the biological relations of the Arietidæ as a whole with sufficient clearness, and this plate has been added for the purpose of supplying the deficiency. The series of Psiloceras has been placed in what may be deemed its true position, between the plicatus stock and the levis stock; otherwise, the arrangement is the same. The resemblances of the morphological equivalents in each series can be readily seen by following the forms along horizontal lines from left to right. The independence of the origin of these representative forms can be studied by following up the series in vertical lines, which represent descent. To a large extent, also, the more obvious differential characters which distinguish each series become appreciable by the same process.

Psil. planorbe, var. *leve*, Fig. 1; var. *plicata*, Fig. 2.

Schlot. catenata, Fig. 3, is the radical of this series.

Schlot. angulata, Fig. 4, is evidently a transition to the next species.

Schlot. charmassei, Fig. 5. The whorl is more involute, but the degenerate characters of compression in the whorls and shallowing of the abdominal channel begin to appear.

Schlot. boucaultiana, Fig. 6. The involution has attained its maximum, and the degeneration of the pilæ and channel is well marked.

Wæh. curviornatum (sp. Wäh.), Fig. 7, is undoubtedly distinct from *Schlot. angulata*, and is one of the radicals of this series.

Wæh. haploptychum (sp. Wäh.), Fig. 8.

Wæh. toxophorum (sp. Wäh.), Fig. 9, is a degenerate shell, having compressed whorls, and pilæ crossing the abdomen, as in the proximate radical *Wæh. curviornatum*. It is, however, more involute.

Wæh. emmerichi (sp. Wäh.), Fig. 10, shows a notably involute shell, with degenerate pilæ and compressed whorls.

Cal. tortile, Fig. 11, is the radical of this series.

Cal. carusense, Fig. 12, has similar young to that of *tortile* below.

Cal. nodotianum, Fig. 13, is very similar to *carusense*, but with more compressed whorls and better developed pilæ.

Cal. cycloides (sp. Wäh.), Fig. 14, shows compressed degenerate whorls.

Cal. castagnolai (sp. Wäh.), Fig. 15, is more degenerate than the last, but slightly more involute.

Cal. abnormilobatum (sp. Wäh.), Fig. 16, is a dwarfish and more degenerate form than *Castagnolai*, but has more involute whorls.

Cal. laqueum, Fig. 17, is an extreme form of this species, which approximates very closely to a true *spiratissimum*. This figure is therefore placed to the right, and under *Verm. spiratissimum*.

Verm. spiratissimum, Fig. 18, shows typical form, with but slight channels.

Verm. conybeari, Fig. 19, shows normal untuberculated variety, with stout whorls and deep channels.

Verm. ophiodes, Fig. 20, exhibits the tuberculated pilæ of this species.

Psil. aphanoptychum (sp. Wah.), Fig. 21, is one of the Plicatus stock of Psiloceras.

Psil. kammerkarense (sp. Wäh.), Fig. 22, shows the more involute and plicated form of this subseries.

Psil. mesogenous (sp. Wäh.), Fig. 23, is an involute shell belonging to the true Levis stock.[1]

Arn. semicostatum, Fig. 24. The figure represents the nearly full-grown shell; but if the keel were absent, the smooth whorls of the young would closely resemble the adult whorls of *Psil. planorbe*, var. *leve*.

Arn. hartmanni, Fig. 24, exhibits young and adult characters like those of the preceding.

Arn. tardecrescens, Fig. 26, belongs to another subseries of forms than that in which it is placed, but it serves to show that quadragonal whorled shells with channeled abdomens existed in this genus.

Arn. bodleyi, Fig. 27, shows a slightly degenerate compressed whorl, and is the terminal form of the subseries containing *Hartmanni*.

Arn. kridioides. Fig. 28 gives a view of the transition between Arnioceras and the lowest species of Coroniceras. The smooth young straight pilæ and divergent side of the adult whorl are clearly shown.

Cor. sauzeanum. Fig. 29 shows the later nealogic and ephebolic stages, having the peculiar divergent sides, flattened abdomen, and prominent

[1] Two subseries ought to have been shown here, but in trying to reduce the size of the plate the forms have been placed in the same line. A similar liberty has been taken with the subseries of Caloceras and Arnioceras, but this does not interfere with the truthful presentation of the general zoölogical relations of the forms.

tubercles of a typical coroniceran form. The young, however, still retain the smooth aspect, indicating derivation from Arnioceras.

Cor. rotiforme. Fig. 30 represents a form similar to *Cor. coronaries.*

Cor. lyra, Fig. 1. This is as a rule much smaller than *rotiforme.* The sides are more convergent, and the whorl more compressed and less numerous than in that species.

Cor. trigonatum, Fig. 32, exhibits the effects of the premature development of old age characters. Fig. 1 on the extreme right shows the dwarfed form of *Psil. planorbe,* var. *leve,* from which both the arnioceran as well as the agassiceran series may have been derived in Central Europe.

Agas. lævigatum. Fig. 33 shows the more compressed variety of this species.

Agas. striaries, Fig. 34. The striations were too fine to be represented.

Ast. obtusum. Fig. 2 shows the stouter variety with well marked channels with stout gibbous whorls and broad abdomen. This has young almost identical with the adults of the stout varieties of *Agas. lævigatum.*

Ast. turneri. Fig. 36 shows typical variety, with flattened sides and deep channels. It is notable more involute than *obtusum.*

Ast. brooki. Fig. 37 shows an extreme involute variety of this species, with very convergent sides and narrow abdomen. The channels are almost obliterated, and the keel very prominent.

Ast. collenoti. Fig. 38 gives a view of this remarkable dwarfed form, in which degeneration of the pilæ and the channels and convergence of the sides have produced morphological equivalence with *Oxyn. oxynotum* and *guibali.* The amount of the involution is greater than in any preceding species of the same series.

Agas. scipionianum. Fig. 39 shows the stouter, heavily tuberculated variety, which has young almost identical with the stouter varieties of *Agas. striaries.*

Agas scipionis. Fig. 40 shows an aged specimen in the Museum of Comparative Zoology, with extreme involute whorls, but keel still prominent. The degeneration of the adult as regards the pilæ and form can, however, be inferred from this figure. The old of *Scipionianum* at the same age is much less changed, and does not exhibit increased involution of the whorls.

Oxyn. oxynotum, Figs. 41, 42. The first figure shows the young of a variety in which at an early stage there is close likeness to the young of *Agas. striaries,* and the adults of *Agas. lævigatum.*

Oxyn. simpsoni. Fig. 43 shows the stouter form and slightly greater involution of the whorls in this species when compared with *oxynotum.*

Oxyn lymense. Fig. 44 shows the greater involution of whorls as compared with any preceding form of the same subseries, and the very acute degenerate whorl.

Oxyn. greenoughi. Fig. 45 shows the stout form of the whorls better defined, and pilæ of this subseries as compared with the *oxynotum* subseries.

Oxyn. lotharingum. Fig. 46 shows the smaller size of this species, and the degeneration of the pilæ. The involution of the whorls is, however, greater than in any preceding species.[2]

Oxyn. oppeli. Fig. 47 shows the extremely involute form of the Middle Lias. The stout whorls indicate that no great amount of degeneration had taken place. It may have been a direct descendant of *greenoughi.*

The Age of the Gay Head Bluffs at Martha's Vineyard.—At the last annual meeting of the Geological Society of America, Mr. Lester F. Ward remarked: "My principal object in coming to this meeting was to listen to this paper, as I was associated with Mr. White in his work and am deeply interested in it.

"I desire merely to emphasize the great importance of the results at which he has arrived. Not until the past season has anything definite been known of the fossil flora of Martha's Vineyard, the few fragments figured by Hitchcock not having been determined, and having no geognostic value. As Mr. White has remarked, the ablest geologists in the country have long been at work upon the question of the age of the Gay Head beds, and, as shown by the older as well as by recent papers, especially those of Professor Shaler, great differences of opinion and doubt as to their age have prevailed.

"The discovery by Mr. White of undoubted Cretaceous fossil plants has settled that question as far as the particular strata from which these plants were found are concerned. In all his recent papers, including the one read before the Society on Thursday last (pp. 443–452), Professor Shaler has insisted that all except the very base of the Gay Head section is Tertiary and even Miocene or Pliocene.

"I do not pretend that the entire section at Gay Head and Nashauitsa cliff is necessarily Cretaceous. The plants were found in the Gay Head section near the middle, and it is very possible that, considering the extent of the beds and the length of the section the overlaying strata may be Tertiary, even Miocene. But if if there is a great thickness lying above these beds, so there is a great thickness lying beneath them, and therefore the section must extend far down into the Cretaceous. It would seem then that Mr. White's investigations during one short season have done more to settle the age of these beds than all that has been done before.

[2] The extreme old age of this form is marked by decrease in the amount of involution of the whorl, and also by the loss of the prominent hollow keel.

"I gladly testify to the indefatigable zeal with which Mr White pursued his investigations against the greatest difficulties and discouragements. It required much careful thought and labor to ascertain in what particular manner the plants were preserved; but after this had been fully settled he was very successful in finding them, although they were not abundant; and he persisted until his collection amounted to five barrels of very excellent material, which is being elaborated at the National Museum."

F. J. H. MERRILL said: "It is seldom that an opportunity is afforded for determining the true stratigraphy of the Gay Head section. The speaker visited it in 1884, and concluded as a result of his examination that the beds were extensively repeated by faulting; but on visiting the locality in 1887, with Professor N. S. Shaler, he found the aspect of the section so much altered by landslides that he was unable to show the evidence upon which he had based his conclusion. Subsequent exposures have again revealed the truth as reported by Professor Shaler at this meeting (*ante*, pp. 443–452). During his first visit the writer found a number of clay-ironstone nodules enclosing fragmentary leaf-prints, which were considered by Dr. Newberry to be of Cretaceous age, but the impressions were poorly preserved and their nidus in the section was uncertain, so that no decisive value could be attached to them. Although the Cretaceous leaf-prints reported by Mr. White were undoubtedly in place, they do not prove the Cretaceous age of the whole Gay Head section. They are from the lower half of the series. The greensand beds, which are in the upper half, contain Miocene Tertiary fossils, shark teeth of the genera *Charcarodon* and *Oxyrhina*, bivalve casts, probably of *Tellina biplicata*, Say, and fragments of crustaceans. This greensand deposit is apparently secondary, having been derived from some pre-existing bed and redeposited under conditions of disturbance and violence abnormal to greensand beds. The crustacean fragments in particular have been much rolled and wave-worn. On this evidence we may conclude that the greensand beds were laid down not earlier than the close of the Miocene.

"The opinion of the writer that the Gay Head strata were post-Pliocene was chiefly based on the evidence of a stratum of post-Pliocene sand, which is the uppermost member throughout the section, being repeated frequently by faults at one point containing fragments of *Venus mercenaria* and other Quaternary shells. As this bed is apparently comformable to those beneath it, the writer concluded that a considerable portion of the Gay Head series, if not the whole of it,

was laid down in post-Pliocene time. It may be, however, that future investigation will demonstrate the presence of Cretaceous, Tertiary, and Quaternal strata at Gay Head."—*Bulletin Geol. Society of America, Vol. I.*

The Age of the Laramie.—At the meeting of the Geological Society of America, held at New York, December, 1889, Mr. Lester F. Ward remarked: "I take it that the discussion here to-day should avoid, as far as possible, repetition of the statements that have already been published. Like Dr. Newberry, I have in my hands a large amount of material, both from the typical Laramie group and from the Fort Union group, which has not been published. A few years ago, as you all probably know, I did publish a paper on the Laramie group, to which I prefixed a prefatory discussion in regard to the probable age of that group. In that discussion I admitted that there was the same lack of identity between the Fort Union fossil plants and those of the lower Laramie which Dr. Newberry has pointed out. In further investigations of this material (for at that time I had only studied a small portion of it, except in a very general way) I have not had any occasion to alter my opinion in that respect, and I am to-day prepared to say what I said then and what Dr. Newberry has said this morning, viz., that so far as the floras of the Fort Union group and of that which was originally called the Laramie beds of Colorado, Wyoming, and New Mexico are concerned, they are not identical—they are very different.

"I hazarded a possible explanation in case the geologists and animal paleontologists eventually establish the synchrony of those beds, viz., that possibly the latitude taken in connection with a different topography such as may have existed in the two regions might account for the great difference in the floras. But I also expressed the opinion that in all probability there would eventually be found a difference of age—how great it would be premature for me to say. The great difference is not so much in the species as in the general facies of the two flora. There are eight or ten identical species[1] in the Laramie and Fort Union, but these weigh very little in comparison with the more important fact that

[1] The species common to the Laramie of Colorado and Wyoming and the Fort Union group, as shown in the table of distribution given in my Synopsis of the Flora of the Laramie Group (Sixth Annual Report U. S. Geol. Survey, 1885, pp. 443-514), as follows: *Sequoia langsdorfii, Sabal campbellii, Quercus olafseni, Juglans rhamnoides, Juglans rugosa, Ficus tiliæfolia, Magnolia hilgardiana, Trapa microphylla.*

These are exclusive of several species thus far only found in the Laramie of British Columbia, one of the America areas, as also of a number of more or less doubtful cases.

in the lower Laramie—the original Laramie formation—there is a large predominance of such genera as *Ficus*, and also many palms, which, to the mind of a paleobotanist naturally and probably correctly suggest a warmer climate.

"Whatever may be true in regard to the difference of age—and it seems to me that the two must go together—I am quite satisfied that a warmer climate prevailed during the period of the deposition of the Wyoming and Colorado beds than that which prevailed during the deposition of the Fort Union beds. Among the leading genera of the upper beds are *Populus* and *Platanus*. Some of these forms are, I admit, very irregular and peculiar, but they are not found in any such abundance least, grow in the colder climates, and very few species of *Ficus*, very few in the lower beds. They are more northern forms—forms which now at genera of palms, are found, so far as my own collection is concerned, in the Fort Union beds. Moreover, as Dr. Newberry has stated, there are forms in the Fort Union which have an exceedingly recent facies, but I am very loath to argue from this a Tertiary age. For instance, there are what seem to be the leaves of the identical species of hazel which grows now in the eastern parts of the United States; yet I hesitate to argue from this that the formation is necessarily very recent.

"In fact, the material from the Fort Union formation which is still in my hands (partly for the reason that I was unable to identify it with the published flora of the globe, and partly because I was unable to publish more at that time) inclines me to believe that there would really be, as I then stated, no inconsistency in assigning to the Fort Union an age as ancient as the closing period of the Cretaceous system. Some of the facts I might enumerate here, but this would be perhaps tedious; but some of the forms are certainly not to be identified with any of the genera that have been found in the fossil or the living state. Such forms cannot be regarded as having geological importance in fixing age, yet they go a long way in the direction of showing us that the age may be more ancient than has been supposed. The genus *Trapa* has been found in both groups, but I am not thoroughly satisfied that the species are identical. In my anxiety not to multiply species, I called it by the name given to the form described by Lesquereux from the Point of Rocks beds, though it may prove to be a distinct species; yet we may never know, from the fact that the material collected by him was inadequate. I have collected from the Fort Union beds specimens of that plant containing entire rosettes of leaves as they would lie on the surface of the water, and showing to my mind

that it must have belonged to the genus *Trapa* or a closely related form. The Point of Rocks material contained nothing but isolated leaves—that is to say, there were no rosettes and there were no stems —simply the form and nervation of the leaves. These point to the genus *Trapa*, and the probability is that they belong to that genus.

"The evidence afforded by the beds at Black Butte station, where the great saurian was discovered by Professor Cope, is perfectly conclusive of the identity of the age of the beds from which that fossil was taken with that from which the leaves of that particular locality were taken. We have at the National museum a specimen of the bone from that creature, adhering to the opposite side of which is one of the characteristic Laramie leaves. I have been on this spot, and collected other fossil plants from the same immediate locality.

"Now, with regard to the error, if error there be, in harmonizing or identifying the Laramie and Fort Union deposits: I suppose the responsibility for this must largely rest upon Dr. C. A. White, who has made a very thorough and exhaustive study of the entire region, as he defines it from the standpoint of its molluscan fauna; and it seems to me that his identification of the two groups—and I have conversed with him very freely and very much upon this subject, and what I say is from memory of the oral statements made by him—was in the nature of a broad, geological generalization. He, in his extensive labors in that field, simply came upon the salient fact, that throughout the larger part of the region now occupied by the Rocky Mountains is abundant evidence that there existed at a remote period, somewhere near the close of the Cretaceous or beginning of the Tertiary period, a great land-locked sea, originally somewhat salt, later brackish, and finally nearly fresh; and that the deposits which were made at the bottom of the sea are apparently continuous all the way up from the pure marine deposits of the upper Fox Hills group to the highest of Fort Union deposits; and he even ventures to say he has traced it in some places still higher into strata which are admitted to be Tertiary.

"I have one fact of my own observations which may be worth stating, and which may not be known to all. About 15 miles above the town of Glendive, on the right bank of the lower Yellowstone river, there is a cliff, known as Iron bluff, which is colored very bright red from having the carbonaceous matter burned out, and which is full of fossil plants. It is also full of the characteristic Laramie shells, such as Dr. White has described and has daily met with throughout the Laramie series. These shells, he informs me, are identical all the way through the Laramie from bottom to top. There is nothing to indi-

cate that there is any difference in the age, so far as the indication from the shells is concerned. This bluff is right on the bank of the Yellowstone river, and the railroad cuts through it, which makes the cliff there conspicuous. Immediately below there is a short anticline, apparently a little island about a mile in extent, filled with characteristic Fox Hills Cretaceous fossils. I have been on the ground and collected large numbers of them, and everywhere we meet with them: the wheels of the wagon as one drives over them crush the shells, so abundant are they; and there is do doubt that this is a typical Fox Hills bed, in Dr. White's understanding of the term "Fox Hills." Now, as far as I can tell, and so far as he could tell from a careful study of the ground, this Iron bluff deposit—this Laramie or Fort Union leaf-bed—rests directly and immediately upon the Fox Hills bed. If there is any difference of age there is no indication at that point that it has been wanting from lack of comformity or from any other cause; and it is certainly a very natural conclusion that when one deposit rests comformably upon another at one point, and when at another point two formations, the lower one being the same as in the first case, have the same order and arrangement, the age of the overlying beds in both regions is the same. That seems to be as clear a case of geological reasoning as we have.

"I observe that our friends across the border, of whom we have representatives here, are still using the term Laramie for this formation. It seems to me that the bulk of their Laramie is nothing more or less than our Fort Union, and they seem to be somewhat in doubt (at least so I learn from reading a paper which reached me only a day or two before I left Washington, with a Christmas greeting from Sir William Dawson); and I do not know but that we might as well settle the question in the way he has settled it in that paper as in any other way. He simply says that the time may yet come when, in fixing our arbitrary position for the line between the Cretaceous and the Tertiary, we may be obliged to draw it through that continuous deposit which we call the Laramie group.

"Dr. Newberry's memory is entirely at fault when he says that in my "Synopsis" I called the Laramie and Fort Union group Tertiary. I have been criticised for arguing that they are Cretaceous. As a matmer of fact, I did not call them the one or the other, or argue for either view. I first gave a perfectly unbiased review of opinion, in which the advocates of each view were allowed to state their case in their own words. I then did what had never before been done. I presented the evidence from the fossil plants upon both sides in tabular form, getting

together for the first time a fairly complete list of all the upper Cretaceous species the existence of which had generally been ignored in the discussion of the question. These as well as the Eocene species of all parts of the world were directly compared with the Laramie species. The very careful analysis of this table which I made showed that the Laramie flora occupies an intermediate place between that of the upper Cretaceous (above the Dakota group and Cenomanian) and that of the Eocene. The only conclusion I drew, if conclusion it can be called, was that the whole discussion was a war of words, often unworthy of the talent that had been expended upon it."

PROF. J. J. STEVENSON said: "I should like to say a word or two about the section that Dr. Newberry has put on the board. The statement that the Colorado group cannot be differentiated in Colorado is not altogether correct. It is true that in a considerable area beyond the Arkansas range it is a very difficult thing indeed to differentiate the Colorado group; but along the plain in front of the Rocky Mountains in Colorado and New Mexico there is not the slightest difficulty in recognizing the Fort Brenton as a mass of black shale; the Niobrara above that, gray to blue limestones separated by black shale; then the Fort Pierre, drab to yellow sandy shales, containing nodules of limestone and iron ore, while above that and quite easily separable from it we find in northern and central Colorado the Fox Hills group. This is the Cretaceous along the waters of the South Platte, where the Fox Hills group is characterized all the way, from the bottom to the top, by a nodose fucoid, *Halymenites major*, which was at one time a very interesting topic of discussion. The Fox Hills group in central Colorado is upwards of one thousand feet thick, consisting mostly of sandstones, some of them calcareous and rich in Fox Hills fossils, with some beds of coal, which have been opened in the neighborhood of Greely. At Cañon City, Colorado, the Fox Hills group is only about 250 feet thick, that being the vertical extent of the *Halymenites*. In that interval are the important coal beds and numerous sandstones or shales containing plants which doubtless answer to those of the plant bed which I found on one occasion near Evans, on the South Platte, but which I could never find again. Further southward, near Trinidad, Colorado, the Fox Hills is only 80 feet thick, that being the vertical range of the *Halymenites*. In that field, however, the Fox Hills has been included in the Laramie; but the Laramie group above the great coal-bearing series is easily separable from the *Halymenites* sandstone. Southward, in New Mexico, the *Halymenites* or Fox Hills sandstone entirely disappears.

"The point I wish to make is that the upper Missouri section of the Cretaceous is distinctly recognizable as far south as central Colorado. Beyond that southward the Fox Hills thins out until it disappears in New Mexico, but the other members of this section can be recognized without any difficulty in front of the Rocky Mountains and around their southern end to the Rio Grande."

PROF. E. D. COPE said: "It seems to become more complicated the more we investigate, and a greater number of problems arise to be solved. What Professor Stevenson has just stated is established. I can demonstrate from my own observation what Dr. Hayden has stated —that is, the conformity of the four or five gradations with the Laramie above. There seems to be absolutely no disturbance or want of conformity in the upper Missouri between those three horizons. I could get the Pierre fossils in the bottom of the bluff and Fox Hills in the middle and Laramie at the top. On the question of the Laramie's position in the Cretaceous or Tertiary series the vertebrate fossils throw some light. The reptiles and saurians are Cretaceous. I have discovered in New Mexico the Puerco series just above the Laramie, and in that I have about a hundred species of the mammalia. I have also discovered mammalia in the Laramie. Professor Marsh has added some species to those previously known. These species are of identical character with the Puerco mammals, although there is no species identical with any in the Puerco, where there is not a single Cretaceous reptile. The mammals of the Laramie are, like the saurians, rather Cretaceous than Tertiary; but the character is not so pronounced."—*Bulletin Geol. Soc. Amer., Vol. I.*

Prof. Marsh on Hallopus and other Dinosaurs.—In the May number of the *American Journal of Science* a paper is published by Prof. Marsh, entitled, "Distinctive Characters of the Order Hallopoda." The conclusions which I have reached, after a study of the type specimen, do not agree at all with those of the Professor. I cannot find sufficient evidence for the correctness of the following statements:

1. "There were but four digits in the manus, the first being short and stout, and the other slender."

2. "The fibula was slender and complete, but tapered much from above downward. Its position was not in front of the tibia below, as in all known Dinosaurs, but its lower extremity was outside, and apparently somewhat behind, the tibia."

3. "The calcaneum is compressed transversely, and much produced backward. It . . . strongly resembles the corresponding bone in some mammals."

There is no definite proof that the bone called "calcaneum" represents this element, or that the first digit of the hind-limb was entirely wanting.

Hallopus is a true carnivorous Dinosaur, near to Compsognathus, there can be little doubt. This opinion was expressed already by Prof. Williston in 1878, in a paper published in a Journal of the Kansas Academy of Science, the title of which I cannot give at this moment.

In the following paper a new order of Dinosaurs, "Ceratopsia," is created. *Ceratops* Marsh, 1889, is the same as *Monoclonius* Cope, 1876. This I can state with absolute certainty, having examined the types of Ceratops and Monoclonius. Neither "Ceratopsidæ" nor "Ceratopsia" can be adopted on this reason. The so-called "Ceratopsia" are characterized by Professor Marsh in the following way:

"(1), The skull surmounted by massive horn-cores; (2), a rostral bone forming a sharp, cutting beak; (3), the teeth with two distinct roots; (4), The anterior cervical vertebræ coössified with each other; (5), the pubis projecting in front, and no post-pubis."

To this I have to make the following remarks:

1. The skull of Phrynosoma is surmounted by stout horn-cores, but nobody will place it on that account in a separate order. On the same reason the horned members of the Cervidæ could be placed in a different order from the hornless forms.

2. Some of the pigs and edentates have a peculiar bone in front of the nose, not present in other mammals, but nobody places these forms in a separate order on this account.

3. If the teeth would really have two distinct true roots, as Prof. Marsh states, this perhaps would be of ordinal character, but I do not believe it. These "two roots" are probably produced by splitting of the tooth by the young one following.

4. In Buceros among birds, also in some of the Plesiosauria and Ichthyosauria, the first two vertebræ are firmly coössified; are they placed in separate orders therefore?

5. "The pubis projecting in front, and no post-pubis." Everybody knows to-day that what is called by Prof. Marsh the pubis is the pectineal process, and that his post-pubis is the true pubis. The statement that there is no post-pubis I do not believe before it has been demonstrated that the bone called pubis by Prof. Marsh and repre-

sented complete, is really complete. I doubt it, and believe that there was a "post-pubis," which is simply broken away in the specimen.—GEORGE BAUR, Ph.D. *New York, May 7th, 1890.*

[NOTE ON THE ABOVE.—The "two-rooted teeth" described by Prof. Marsh, and referred to above by Dr. Baur, are not such in point of fact. The appearance of two roots is produced by the absorption of the middle part of a single root by the crown of the successional young tooth. After the absorption has progressed sufficiently far, the less direct of the two branches is generally broken off, so that teeth with both preserved are less abundant than those with a single half-root. Teeth of this kind were figured by Leidy as belonging to Trachodon, and were described by me as representing the new genus Dysganus in the Proceedings of the Philadelphia Academy for 1876. They are very abundant in the Laramie formation.—E. D. COPE.]

Extinct Quadrumana.—Professor Gaudry has published in the new Memoirs of the Geological Society of France an interesting paper on the *Dryopithecus fontanii* Lartet, of which a new mandible has been recently discovered in France. This mandible is more perfect than any hitherto obtained, as it has the symphysis with the incisor teeth, and all the molars except the last of one side. Prof. Lartet supposed that the genus Dryopithecus approached nearer to Homo than any of the existing apes, on account of the probable later appearance of the m^3 (wisdom tooth) than in the latter. Prof. Gaudry's specimen shows that the symphysis is longer than in any of the existing anthropoids, and that the anterior premolar is relatively larger. Its relationships are therefore not towards Homo, but away from him, and towards the true monkeys. The last inferior molar was evidently erupted at about the same time as the inferior canine, and not before it, as in many monkeys; but Gaudry shows that in several monkeys and apes the period of protrusion of the m^3 is the same as that seen in the Dryopithecus. The latter is nearer to the gorilla in dentition than to either the orang or chimpanzee. It was smaller than either.

Under the name of *Dolichopithecus ruscinensis*, M. Charles Deperet describes in the *Comptes Rendus*, a species of monkey, of which a skull was found by Dr. Bonneman near to Perpignan, together with numerous other bones. The dentition is in general that of Macacus, but the limbs have the slender proportions of those of the Semnopithecus. The genus is then close to the Mesopithecus of Gaudry, from which, indeed, M. Deperet does not satisfactorily separate it. It differs from the *M. pentelici* by its larger size, larger face, and larger heel of the last inferior molar. The monkey of the Val d' Arno, *Aulaxinus florentinus*, is still smaller, and has a much shorter muzzle.