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THE fourth University of Colorado Expedition to Florissant, in the summer of 1908, was only about three weeks in the field. The earlier expeditions, in 1905, 1906 and 1907, obtained a very large amount of material from the Miocene shales of this locality, and much of this still awaits study and description. A general account of Florissant appeared in the *Popular Science Monthly* for August, 1908, while briefer statements, more or less inaccurate, may be found in the current geological textbooks;[1] so it will not be necessary at this time to give a description of the place or the fossil-beds. It is pro-

[1] In Dr. W. B. Scott's valuable "Introduction to Geology," 2d ed. (1907), p. 756, it is stated that there were "very few palms." As a matter of fact, there is no reason for believing that there were any. The Rhus sp. on p. 755 is *Weinmannia phenacophylla* Ckll. In Vol. III (1906) of "Geology," by Professors Chamberlin and Salisbury, Florissant is referred to the Oligocene, following Scudder and others. It is stated that "palms are barely represented," and yews are said to occur. We do not know of any yews. It is also stated that over 700 species of Florissant insects were described by Scudder; the actual number is 569. In Handlirsch's admirable work "Die Fossilen Insekten," which would naturally be regarded as representing the best modern knowledge, numerous identifications of Tertiary insects are cited, which certainly have no value. Thus Scudder had a specimen for Florissant which looked like a Bombus: this appears in the list, without any query, as Bombus. I have seen the specimen, and it is not a bee. In Dr. Folsom's "Entomology" (1906) masses of Sialid eggs are said to occur; the eggs in question were not from Florissant, but from the Laramie beds at Crow Creek.

posed, instead, to call attention to a few of the most interesting finds of this year, especially those which can readily be illustrated by photographs. Most of the work this year was done at what we call Station 13 B, close to, and apparently of the same materials as, Station 14, from which the best things of former years have nearly all come. Superficially, 13 B seems to dip under 14, but this appears to be due to a fault; both beds belong to the older series of the locality, being covered by extensive deposits of rock and shale, the greater part of which, at 13 B, has been removed by erosion.

The shale at 13 B proved extremely uneven in quality. During the first week the results were perhaps better than in any week of former years; but the last two weeks were relatively barren, and, as we were getting a large proportion of duplicates, it was doubtful whether the work justified the expenditure. It is highly important, of course, that the Florissant beds should be further explored, and no doubt the treasures yet to be uncovered there are innumerable; but with limited resources, and great accumulations of unworked materials on hand, it has seemed better not to continue digging at the present time.

At the University of Colorado an exhibit of the Florissant fossils has been arranged. It is probably the best in existence, although the insect specimens in the Scudder collection at the Museum of Comparative Zoology, none of which are on exhibition, far exceed ours in number and variety. From the recently gathered materials, a series will be prepared for Colorado College, and also one to be sent to Dr. R. F. Scharff, for the Dublin Museum.

The members of the 1903 expedition were the same as in 1907, with the addition of Mr. Melford Smith, and, for a shorter time, Miss Gertrude Darling.

THE FISH-GENUS TRICHOPHANES

In 1872 Cope published Trichophanes, a new genus of Perciform fishes, represented by a small specimen obtained in the coal shales north of Osino, Nevada. In 1878

two other species, *T. foliarum* Cope, and *T. copei* Osborn, Scott and Speir, were added from the Florissant shales. *T. copei,* which has not been figured, is stated to differ from *T. foliarum* by its smaller scales. The genus is one of quite unusual interest, because it appears to belong to the suborder Xenarchi, an old group with peculiar anatomical characters, represented to-day by a single species, *Aphredoderus sayanus,* confined to the eastern United States. According to Jordan and Evermann, the Xenarchi are related to the Percopsidæ, of which two liv-

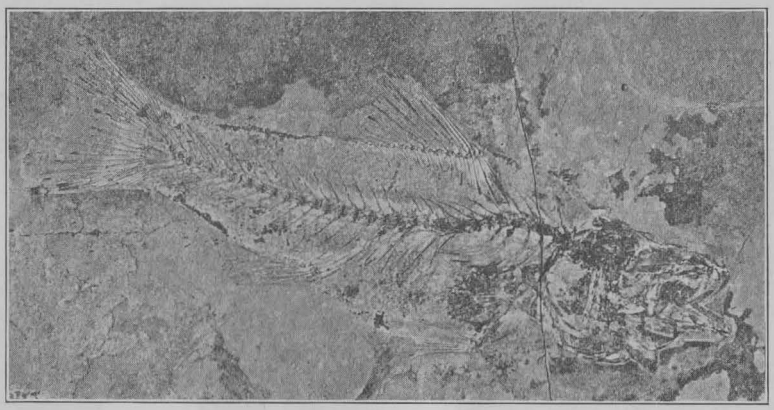

FIG. 1. *Trichophanes foliarum* Cope.

ing species are known—*Percopis guttatus* Agassiz, from the Great Lakes and surrounding regions, and *Columbia transmontana* Eigenmann, from the Columbia River. These fishes are evidently remnants of an ancient fauna, which in Tertiary times included a variety of genera and species. Agassiz, when describing Percopsis, was much impressed by its generalized features, combining characters which commonly existed together in Cretaceous fishes, but are widely separated in modern forms. "Now my new genus Percopsis is just intermediate between the Ctenoids and Cycloids; it is what an ichthyologist at present would scarcely think possible, a true intermediate type between Percoids and Salmonidæ" (Agassiz, 1850). It is remarkable that this relic of earlier days should now

have its headquarters in the area which was covered by the glacial ice; it is possible, perhaps, that it lived through the glacial period in some northern locality which was unglaciated, but cut off from the southern fauna. In this way, it might have been protected from the stress of competition, and when the great lakes were opened up, it found in them a comparatively free field—a field apparently not yet populated with anything like the maximum number of species.

FIG. 2. *Trichophanes foliarum* Cope.

Trichophanes is not precisely typical of Aphredoderidæ; it certainly seems to have some characters resembling those of the Percopsidæ, no doubt indicative of real relationship. It is readily recognized by its peculiar scales, which are ultra-ctenoid, with the marginal teeth produced into quite long bristle-like structures. According to Cope, they are "without or with very minute sculpture," but under the compound microscope they are seen to be covered with fine concentric striæ.

Cope's type of *Trichophanes foliarum* was obtained by Dr. Scudder, and consists of the anterior half of the fish only. This year my wife found at Station 13 B two prac-

tically complete specimens, herewith illustrated. These reveal many characters not visible in the type, and emphasize the Percopsis-like tendencies. In Jordan and Evermann's "Fishes of North and Middle America," plates CXXI and CXXII, are given excellent figures of Percopsis, Columbia and Aphredoderus. Our Trichophanes agrees with Aphredoderus in the thick (deep) caudal peduncle, the projecting lower jaw, and the scaly sides of the head. The dorsal fin, as in Aphredoderus, has three spines, the first very short, the third long (about 12.5 mm.), the second intermediate. The anal, as in

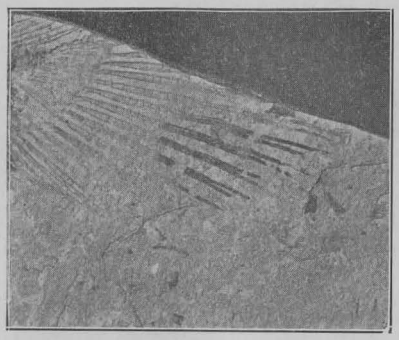

FIG. 3. Caudal fin of Amia.

Aphredoderus and Columbia, but not as in Percopsis, has two spines, one long, the other short; the longer spine is nearly straight, as in Aphredoderus. The shape of the dorsal is very much like that of Percopsis, not very like that of Aphredoderus; while the forked caudal is very unlike that of the latter genus, but rather closely resembles that of Columbia. There is no adipose fin (it is present in Percopsidæ); the ventrals are inserted about 5 mm. posterior to the bases of the pectorals, and the same distance anterior to the level of the beginning of the dorsal. In the last character the fish is nearly intermediate between Aphredoderus and the Percopsidæ.

Trichophanes should apparently be taken as typical of a family Trichophanidæ, falling in the Xenarchi, and

standing between Columbia and Aphredoderus in the serial arrangement.

Another waning group of fishes (with a single living species) found at Florissant is Amia, the bowfins. The accompanying figure shows a tail of this genus we found; much hunting failed to discover the rest of the specimen.

A PRIMITIVE DRAGONFLY

The Zygopterous dragonflies are divided into families known as Calopterygidæ and Agrionidæ. The Calopterygidæ are further divided into subfamilies, separable

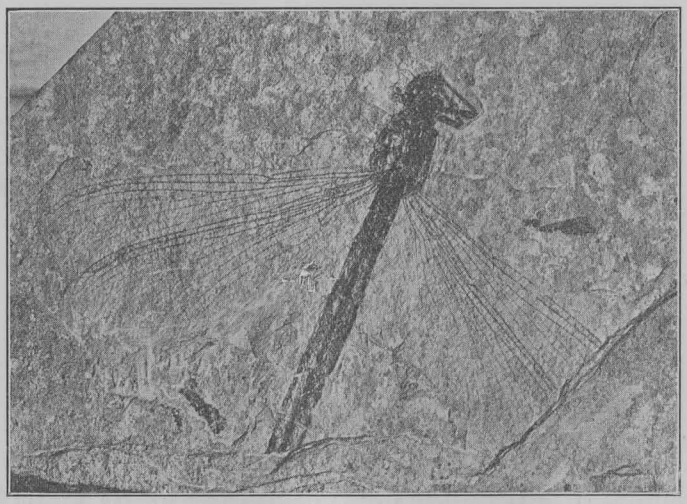

FIG. 4. *Phenacolestes parallelus* Ckll.

by the character of the costal region toward the base of the wing. In the Calopteryginæ, this area, before the nodus, is crossed by four or more veins, called antenodals; in the other subfamily, the Lestinæ, these have been reduced to two. In the family Agrionidæ, which is very abundant in the modern fauna, the reduction to two antenodals is practically universal. There is, however, an extinct subfamily, which I have called Dysagrioninæ, in which this reduction has not gone so far, and four or more antenodals remain. Of this group we know two genera, Dysagrion Scudd, from the Green River beds, and Phenacolestes Ckll. from Florissant. The latter genus,

published early in 1908 (*Bull. Amer. Mus. Nat. Hist.*) was known only from the wings. A photograph of a wing was sent to Dr. Needham, who wrote: "It is indeed a most interesting fossil, another synthetic type. . . . De Selys' Podagrion group of Agrioninæ includes the most primitive members of that subfamily, and this fossil is more primitive in several characters than any living forms." Very fortunately, a splendid specimen of *Phenacolestes parallelus* was uncovered this year by Mr. Geo. N. Rohwer. As the illustration shows, it is nearly complete, lacking, however, the apex of the abdomen. The wings are not so heavily clouded as in *P. mirandus,* the type of the genus, and there are differences in the venation. *P. parallelus* was originally described from the apical half of a wing.

Some Fossil Bees

In 1906 (*Bull. Mus. Comp. Zool.*) I described a bee's wing found at Florissant by Scudder, regarding it as the type of a new Anthophorid genus, Calyptapis. A very

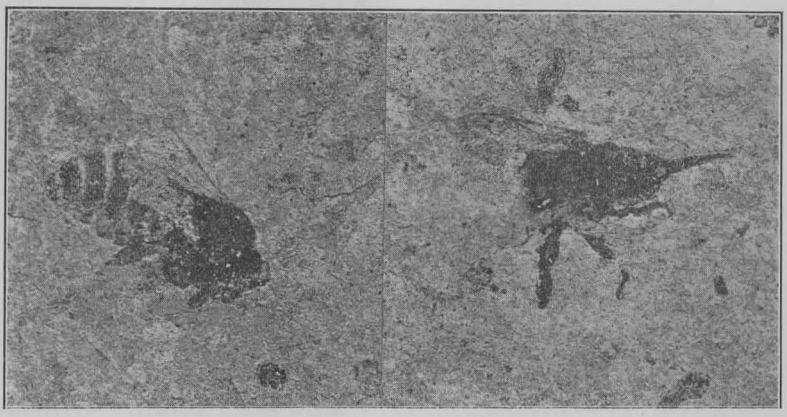

Fig. 5. Fossil bee, *Calyptapis florissantensis* Ckll.

Fig. 6. Fossil bee, *Anthophora melfordi* Ckll.

fine example, showing the body, was found this year, and from a close examination I am able to ascertain its true position. It is not an Anthophorid at all, but is a genus of Bombidæ, in other words a bumble-bee. The genus is valid, and gives the first indication of the former history

of this group in America. The insect was especially interesting to me, because I had just been studying the bees in Baltic Amber, which include various genera and species of still earlier bees related to Bombus.

Another bee of great interest was a species of Anthophora, with the mouth-parts exserted and plainly visible. Some of the amber bees show the mouth-parts very well, but it is extremely rare for those in shale to show anything of the kind. The genus Anthophora is common in Colorado to-day, but it was not previously known from the American Tertiaries.

A Problematical Flower

Last year we found, among other flowers, one which was so interesting, and so well preserved, that Dr. Arthur Hollick made it the subject of a special article in *Torreya*, September, 1907. Dr. Hollick named it *Phenanthera petalifera*, new genus and species, but was unable to place

FIG. 7. Fossil flower, *Phenanthera petalifera* Hollick.

it definitely in any known family. A new specimen, figured herewith, is clearly of the same species, and on the whole confirms Dr. Hollick's description. The stamens, with long filaments and large anthers, are certainly eight in number. The supposed appendages of the calyx seem to me to be emarginate, and to resemble rather closely the small petals of certain *Ribes*. Following this clue, the large, thin "petals" may be interpreted as petaloid calyx-lobes, also as in Ribes. The short pedicels, about the length of the hypanthium, suggest that

the flowers were borne in clusters, and so in all respects they seem to agree sufficiently with Ribes, except for the insuperable difficulty of the eight stamens. The eight stamens would agree with Weinmannia, but the flower otherwise seems discordant, judging from the descriptions—I have never seen a Weinmannia flower. Both Weinmannia and Ribes are represented by leaves in the shale.

The Problem of the Proteaceæ

The Proteaceæ constitute a rather large and very characteristic family, with over 950 living species, almost confined to the Southern Hemisphere. Nearly 600 are Australian; New Caledonia has 27, New Zealand 2, Chile 7, tropical South America 36, South Africa over 250, Madagascar 2, and the mountains of tropical Africa about 5. These particulars are taken from Engler (1894), probably the numbers should now be somewhat increased. The genus Helicia, with some 25 species, is Indo-Malayan, and extends north of the equator as far as the Himalayas.

One of the most remarkable discoveries—if such it be—of paleobotany is that of the occurrence of Proteaceæ in abundance in the Tertiaries of the Northern Hemisphere. In Ettinghausen's work on the fossil flora of Häring (1853) numerous remains of leaves are figured, together with drawings of recent species of Proteaceæ. The resemblances are not merely close; it is not too much to say that the oligocene leaves look practically identical with their modern representatives. Furthermore the resemblances are not shown in one or two types only, but extend throughout a considerable series; nor are they confined to the leaves—the determinations in some instances are fortified by characteristic-looking seeds. Even the peculiar fruits of Persoonia are shown. Such evidence looked convincing enough to Ettinghausen, and *a priori,* there seemed to be no obstacle. The distribution of the Proteaceæ to-day seemed to be that of a group once world-wide, but now driven to the ends of the earth by the stress of competition. This would agree well with

the case of the marsupial mammalia, and others such as the recently elucidated one of the Chrysochloridæ, or golden moles.

On the other hand, it was pointed out that there were other leaves resembling those of the Proteaceæ. In 1870 Bentham went so far as to say, in regard to detached leaves, "I do not know of a single one which, in outline or venation, is exclusively characteristic of the order, or of any one of the genera." Quite recently Dr. Schönland (*Trans. S. African Phil. Soc.*, 1907, p. 321) has written: "The supposed identifications of southern types of plants in the Tertiary deposits of the Northern Hemisphere are considered by most eminent botanists, such as Sir Jos. Hooker, the late Mr. G. Bentham, A. Schenk, etc., as worthless. Laurent has recently tried again to prove that the Proteaceæ originated in the North, but the evidence on which he relies seems to be altogether untrustworthy." Without having seen the European fossils, it may be hazardous to attempt any contribution to this controversy; but it must be pointed out that those who regard the paleontological evidence with contempt seem to have forgotten one or two things. They have not sufficiently remembered the great antiquity of the genera of flowering plants, as shown by indisputable evidence; they have failed to consider the great lapse of time, which would permit migrations from one end of the world to the other (continuous land provided), even at the slowest rate; and more especially, they seem to have forgotten the unquestioned cases of Sequoia, Comptonia, Liquidambar, etc., in which wide-spread types have been reduced to comparatively small areas within quite recent geological times. It may also be added, that they have overlooked the analogous cases among animals, which can by no means be explained away. With all this, it must be confessed that the dicta of paleobotany are not so reliable as we could wish, and that an attitude of scepticism is often more than justified.

Lesquereux believed that he could recognize a considerable series (8 species) of Proteaceæ in the Florissant

shales. They are by no means so convincing as the European fossils; but they appear to represent an element now wanting in the North American flora, and no one has been able to show that they are *not* Proteaceous. I give figures of two of the most characteristic—*Lomatia acutiloba* and *Lomatia tripartita.* Our new material of *L. tripartita* is especially interesting as showing—what Lesquereux did not know—that it has compound leaves.

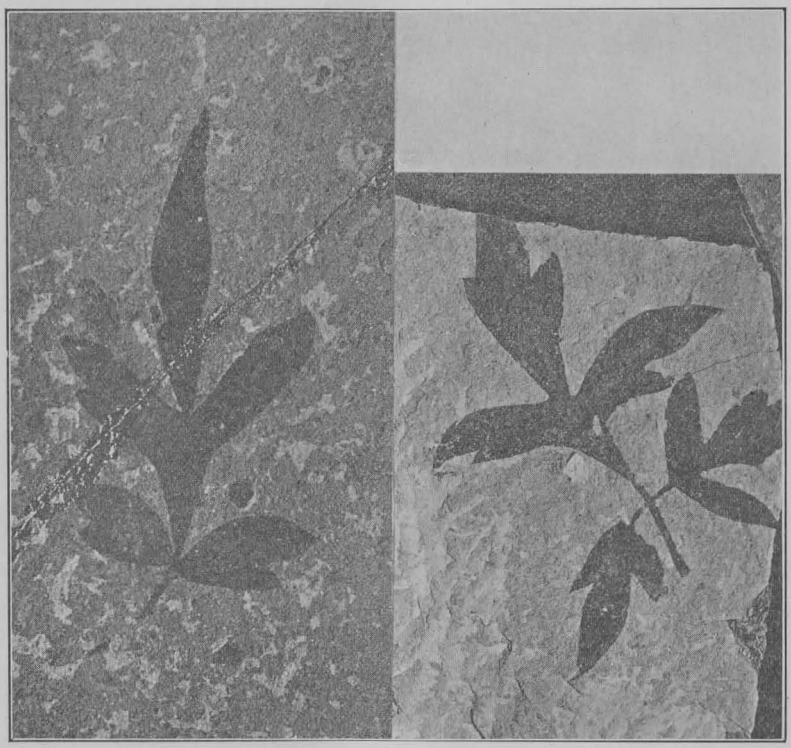

FIG. 8. *Lomatia tripartita* LX. FIG. 9. *Lomatia tripartita* LX.

These leaves are exceedingly variable, and have very much the cut of certain species of Phacelia.

This question of the Proteaceæ is one of wide importance, for it is not only a test of the accuracy of paleobotanical conclusions, but, according as it decided one way or the other, it provides or removes an argument for the former existence of great southern lands between the present continents.

A FOSSIL MILKWEED

On the same piece of shale as the *Lomatia acutiloba,* found by Mr. S. A. Rohwer at Station 20, is the follicle of a species of milkweed. It is 54 mm. long, 14 wide in the middle, dark colored as preserved, with a longitudinal suture and without tubercles. It closely resembles the follicle of the modern *Acerates auriculata,* but is rather less tapering. It may be known as *Acerates fructifer,* n. sp. A similar follicle was described by Heer as *Acerates veterana,* and was found at Œningen and other localities.

FIG. 10. *Lomatia acutiloba* LX., and follicle of *Acerates fructifer* n. sp.

A SERVICEBERRY

I give a figure of large serviceberry leaf, *Amelanchier typica* of Lesquereux. It is like that of the modern American *A. canadensis,* but the more cuneate base resembles that of *A. intermedia.* Other species of Amelanchier have been found at Florissant, all having a completely modern appearance, and showing that the minor groups of the genus were separated in the miocene.

A PRICKLY ARALIACEOUS PLANT

At Station 13 B Mr. S. A. Rohwer found a leaf with five oblong, long-stalked leaflets, as preserved light red-

dish in color, with the petiolules provided with small but very distinct recurved prickles. The leaflets are about 48 mm. long and 24 broad, with a cordate base, and the margin with broad rounded teeth or pronounced crenations, each about 2.25 mm. long. The principal lateral veins, leaving the midrib at an angle of perhaps 50°, are about seven in number on each side, and are only moderately curved. The petiolules differ greatly in length, from 26 to 5 mm., and bear a moderate number of irregularly-placed prickles, these being about 2 mm. long.

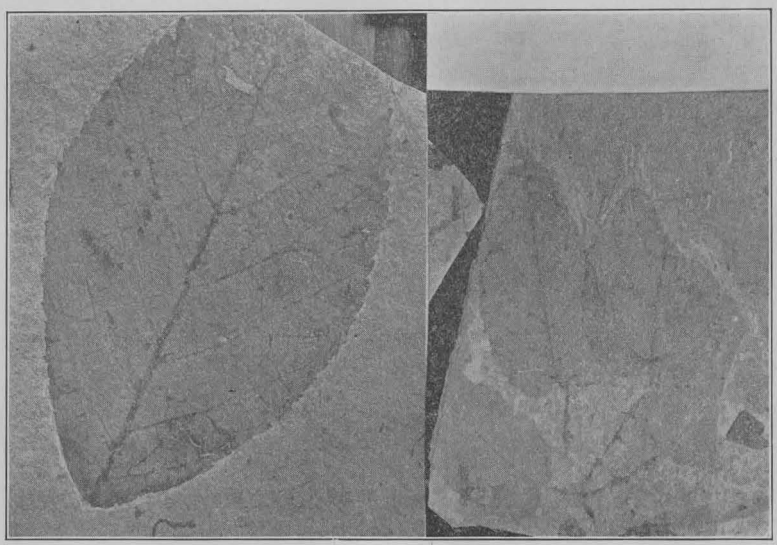

FIG. 11. Serviceberry leaf, *Amelanchier typica* Lx.

FIG. 12. *Panax andrewsii* n. sp.

Mr. D. M. Andrews, of Boulder, suggested to me that this fossil was Araliaceous, and upon looking the matter up, I felt satisfied that this must be correct. I sent a photograph to Dr. N. L. Britton, who kindly replied: "There is no doubt that the photograph that you send represents some species of Araliaceæ, but I am not personally acquainted with anything quite like it. A good many of the woody Araliaceæ have prickles." From the leaf alone, the restricted genus must remain somewhat doubtful, but it may be permissible to refer the plant to *Panax*, under the name *Panax andrewsii* n. sp.