

ART. XXV.—*Triassic Insects from the Rocky Mountains*; by
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EARLY in 1882, Mr. Arthur Lakes, Professor in the Colorado School of Mines, discovered a bed of plants and insects near Fairplay, Colorado, in rocks much older than any that have before yielded insect remains west of the Great Plains; the two or three specimens he sent me were sufficient to prompt a more thorough exploration of the locality, which I was able to make the following summer, resulting in the discovery of a fauna and a flora of considerable interest.

The plants have been studied by Mr. Lesquereux,* who pronounces the species, some thirty in number, but in a very fragmentary condition, to belong to Permian types, and declares the evidence to be decisive on this point.

The animal remains consist almost exclusively of insects, and are two-thirds as abundant in species as the plants—an exceptionally large ratio in beds where both occur. These insects form an assemblage wholly different from anything before known and, in contradiction to what Mr. Lesquereux says of the plants, clearly belong to types of a more modern character than any the Paleozoic series has yet disclosed. It is not often that one may speak so positively in the discussion of fossil insects, especially when not a single one of the species and only the smaller portion of the genera found have been previously known. But in this case all but two or three of the specimens obtained (some eighty in number) belong to a group which of all Paleozoic insects has received the most attention, namely, the cockroaches. This great preponderance of cockroaches, and the fact that the few known genera found in this collection have hitherto been discovered only in Carboniferous and Permian rocks, would lead us at first to refer the beds in which they occur to one of the Paleozoic series; but the presence of the other forms, and even the characteristics of those which are referable to Carboniferous and Permian genera, unmistakably point to a later horizon.

Paleozoic cockroaches are distinguished from living types by the complete interdependence of two of the veins of the front wing, and by the fact that the anal veins of the same wings invariably impinge upon the inner margin, and never, as in existing forms, upon the anal furrow. For these ancient types the name of *Palæoblattariæ* has been proposed, and all Paleozoic cockroaches whose front wings are preserved (and we know them almost exclusively from these organs) fall into this

* On some specimens of Permian fossil plants from Colorado. Bull. Mus. Comp. Zool., vii. 243.

group. So far as I can discover there is not a single exception to this difference between ancient and modern types. Since this was first stated five years ago the number of Paleozoic species has been increased 25 per cent, and it is still true.

In the paper in which these points were first discussed no allusion was made to Mesozoic cockroaches, as none had been found in this country, and the illustrations we possess of the European species are in many cases by no means sufficient to expose their structure; their study was therefore left until the imperfection could be remedied. It was however recognized, though not stated, that Palæoblattariæ exist in Jurassic rocks; it is shown, for instance, by figures of Wealden species on the fifth plate of Brodie's work on the "Fossil insects of the secondary rocks of England" (London, 1845), and by Dr. Eugen Geinitz in his recent paper on the Dobbertin insects,* in which one species is figured from the lower Jura; but the great mass of Jurassic species are plainly more closely related to living forms, and neither in the independent existence of the veins which are characteristically distinct in Paleozoic types, nor in the course of the anal nervules, do they show any affinity to the Palæoblattariæ.

Eleven of the seventeen species of cockroaches, and five of the nine genera found at Fairplay belong to the Palæoblattariæ. These five genera are the following: Etoblattina (1 sp.), Petrablattina (2 sp.), Anthracoblattina—very doubtful, the specimen being very imperfect—(1 sp.), Spiloblattina, nov. gen. (4 sp.) and Poroblattina, nov. gen. (3 sp.). Only four of the eleven species therefore belong to known genera and one of these is doubtful; but the difference is more marked than this; for the species referred to Etoblattina is an aberrant form with an excessively long internomedian vein; and both the species of Petrablattina agree in differing from those heretofore known to a very considerable degree. Of the new genera, Spiloblattina is very peculiar in the strongly divergent and then convergent curve of the externomedian and internomedian veins around a large stigma near the middle of the wing, unknown in any other cockroach, ancient or modern, so far as I know; but otherwise it is related to Etoblattina; while Poroblattina is more nearly related to Petrablattina, and especially to the two new species of that genus from this locality.

The average size of these Fairplay Palæoblattariæ is much less than that of the Paleozoic Palæoblattariæ in general. The average length of the front wings of the Paleozoic species is 26^{mm}; that of these Fairplay Palæoblattariæ, 16^{mm}. This fact has its value, for the Jurassic species are nearly all of very small size, and the wing-length of the remaining species from

* Zeitschr. deutsch. geol. Gesellsch., 1880, p. 510.

Fairplay (i. e. those which do not belong to the Palæoblattariæ) is less than 8·5, ranging from 6·5–11·5^{mm}. This agrees completely with the size of Mesozoic species already known. The average of all the Fairplay cockroaches is less than 13·5^{mm}.

As to the six cockroaches from Fairplay which do not belong to the Palæoblattariæ, the characteristics of their venation, as well as their small size, show them to be closely allied to Jurassic forms, although the three or four genera to which they belong are distinct from any yet characterized. Two of them are distinctly allied to *Rithma*, a genus established rather loosely by Geibel for some species from the English Purbecks figured by Westwood. They all have a decided Mesozoic aspect, and would at once be considered Liassic or at least Jurassic by any one familiar with the forms already known from these deposits. They have on the other hand an entirely different aspect from any and all Paleozoic forms, and present no points of close comparison with any Palæoblattariæ excepting some of those mentioned above from the same Fairplay beds, notably with the genus mentioned under the name of *Poroblattina*, which one of the genera not a little resembles.

This resemblance is of special interest because it points out the method in which the change from Paleozoic to Mesozoic forms has taken place, and does not bear out the suggestion made in my memoir on Paleozoic cockroaches (based on a comparison of the venation of the front and hind wings of existing cockroaches), that the scapular and externomedian were the two veins which were amalgamated in the historical development of the group. For when we compare the series of genera near the boundary line of the departure of the Palæoblattariæ toward later forms (those Paleozoic cockroaches allied to *Petrablattina*) and especially those brought to light by the discoveries at Fairplay, we find that in the Mesozoic species at least, it is the mediastinal and not the externomedian vein which has blended with the scapular, although the externomedian also may become blended with the others in living types. This amalgamation has proceeded by the enlargement of the scapular area, which has crowded the mediastinal toward the base of the wing, whose few remaining branches finally become attached to the scapular vein, no trace of their former dependence remaining visible.

We have then at Fairplay an assemblage of forms altogether different from any thing hitherto found in the Paleozoic series on the one hand, or in the Jurassic beds on the other. They show a commingling of strictly Jurassic forms with a larger proportion of types which may be called Upper Carboniferous or Permian with a distinct Jurassic leaning. There is therefore a strong probability that the beds in which they occur belong to the intermediate formation, the Triassic.

If this should be proved, Mr. Lake's discovery will have an added interest, from the fact that almost nothing is known either of the plants or of the insects of this formation. Of the plants, it is only necessary to point out that in the paucity of data, the upper Paleozoic aspect of the few vegetable remains from Fairplay can have but a negative value beside the positive proof of the alliance of the insects to Mesozoic forms. Of Triassic insects our knowledge is exceedingly meager; a single neuroppterous larva from the Connecticut valley is all that the formation has hitherto yielded in this country. In Europe we know of only four species, each, I believe, from a single specimen; one of these is a cockroach, but it is entirely different from any of the Fairplay species, and indeed from any other known forms, so that we get no light from this quarter.

It may be urged that as much the larger proportion of known Paleozoic cockroaches come from Europe, our own fauna being comparatively unworked, this discovery may only indicate for America an earlier advance within Paleozoic times toward later types. Besides the important consideration that this would be in direct opposition to what we know of subsequent periods in America, there are only two facts known to me among fossil insects bearing on this point, one in favor of this hypothesis, the other against it. The first is the recent discovery in beds at Kansas City, Mo., said by the state geologists to have eight hundred feet of Carboniferous rocks above them, of the wing of a heteropterous Hemipteron, which I have called *Phthanocoris*. In Europe no instance is recorded of any insect belonging to this great group of Hemiptera in Paleozoic rocks, the three or four Hemiptera so far found belonging to the homopterous division. The other fact is brought forward in my memoir on Paleozoic cockroaches, and is of far more importance, not only because it is of broader significance, but also because it is drawn from the same group as that under discussion. The Palæoblattariæ are divisible into two groups, the Mylacridæ and the Blattinariæ, the former of which is in point of structure the more primitive type. Now the Mylacridæ occur only in America and form indeed about two-thirds of the species known from this continent. In Carboniferous times, therefore, as regards cockroaches, America was *more* old fashioned than Europe, and we should look for the introduction of new elements earlier in Europe than in America; yet the better explored Carboniferous and Permian deposits of that continent have yielded no traces of anything akin to the Fairplay insects. The first appearance of any such is in Mesozoic strata, and notably in the Lias.

So far as I know this is the first attempt to determine the age of a deposit from its insect remains alone, and it is unfortunate for its acceptance by naturalists that the plants give it, to say

the least, no support, but rather are deemed by one competent to judge, to be decidedly adverse to what is here claimed.

The paleontological contradiction shown in the plants and animals of the Fairplay beds is not unknown to **A**merican geology, as every one is aware, but I do not know that it has been pointed out in this country at this horizon or in this direction—the discordance appearing later in time, and the plants indicating a younger and not an earlier age than the animals. An exactly parallel case appears to be shown in Eastern Russia, for in discussing the poorer strata of Kargalinsk, which he refers to the Permian, Twelvetrees says, “as regards the flora [11 species] the list has a Paleozoic aspect, but a secondary one as respects the reptilian remains” [4 species cited].*

Exploration of the locality will continue, and it is hoped that future material may throw more light upon the question. It may, however, be added that the few other insects found appear to have no Paleozoic relations whatever.