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ORIGINAL ARTICLES.

I.—ON A NEW GENUS OF ORTHOPTEROUS INSECTS OF THE FAMILY PHASMIDÆ (*PROTOPHASMA DUMASII*), FROM THE UPPER COAL-MEASURES OF COMMENTRY, DEPT. ALLIER, FRANCE.¹

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(PLATE IV.)

WE possess only a few elements of the Insects of the Coal Period—Articulata are rare in these beds, and it is only after long research that we are able to collect sufficient materials for a special work on the Entomology of this epoch.

Prof. Goldenberg has made us acquainted with the fauna of the Coal-measures of Saarbrück, and has quite recently (1877) published the second part of his work, entitled "Fauna Saræpontana Fossilis," in which he describes fairly preserved wings of Neuroptera and Orthoptera, one of which (*Eugereon Boeckingii*) also exhibits the remains of the body.²

In America, Mr. Samuel H. Scudder has ardently studied the Insect-remains from the Coal-measures of the United States. Lastly, Dr. H. Woodward has published several works on the fossil Articulata, and amongst others, in 1876, an interesting note on a very complete Orthopter from the Coal-measures of Scotland (*Lithomantis carbonarius*).³

The insect-remains found in the Coal-measures belong principally to the running Orthoptera, such as the BLATTIDÆ, some species of MANTIDÆ, and some NEUROPTERA, such as *Termites* and *Hemerobius*.

Prof. Goldenberg has given the name of *Fulgurina* to certain insects, which would indicate the presence of HEMIPTERA in the Coal epoch.⁴

¹ Translated from the "Annales des Sciences Naturelle," 6^e Série, 1878, Zoologie, Tome vii. Art. No. 4, by A. P. Wilson, Esq.

² See papers by Dr. Anton Dohrn on *E. Boeckingii*, Paleontographica, 1866, Bd. xiii. p. 333, taf. xli. and 1869, Bd. xvi. p. 129, taf. viii.

³ See Quart. Journ. Geol. Soc. 1876, vol. xxxii. p. 60, pl. ix. fig. 1.

⁴ I possess some wings of insects very like those figured and described by M. Goldenberg, but more complete, and showing the reticulations of the wing, but

I am indebted to my friend, M. Grand'Eury, for the opportunity of adding a new form to the running Orthoptera hitherto described.¹

It was obtained from the Upper Coal-measures of Commentry, Allier.

I ought at the same time to describe several other fossil Articulata from St.-Étienne, which this able palæontologist has procured for me, but the very perfect state of preservation in which this fossil has been found, and the interest of its zoological affinities, induces me to make it known immediately.

The fossil is sufficiently well preserved to be seen, as represented in our Plate, without the aid of a magnifying glass, and we at once recognize an Orthopterous insect allied to the *Phasmidæ*, from which it differs, however, by certain characters to be presently referred to.

It is the first example of this family which has been obtained in a fossil state. On the intaglio one observes a brownish matter, which is darker in some places, and probably represents the substance of the integument.²

This magnificent Orthopter is preserved in profile lying on its right side, and every portion of its body except the abdomen is preserved. One can see (even with the naked eye) the limbs with their serrated margins; the head, the eye, the antennæ, and the palpi, lastly the elytra, of which one is very well preserved, and the fine second pair of wings, both of which are almost entire.

The *Phasmidæ* have been carefully studied by MM. Audinet-Serville, Westwood, and Gray. The last of these authors divides the "Spectres" into two great groups; the *Apterophasmina*, or wingless Phasmians, and the *Pterophasmina*, or winged Phasmians.

The Orthoptera included in the family of the PHASMIDÆ have very different forms. Some have the antennæ very long, and very slender (*Phasma*); others have them on the contrary short and very robust (*Cyphocrana*). One has the prothorax very short (*Phasma*); with others it is longer (*Prisopus*). Lastly, certain genera have the legs smooth and destitute of spines (*Phasma*); in others, on the contrary, they are very angular and serrated (*Diura*, Gray, *Cyphocrana*).

I shall not speak of the other genera, as they have no points of resemblance with our fossil, but proceed to compare it with the groups above cited in the latter part of my report.

I dedicate this beautiful Orthopter to my uncle, M. J. B. Dumas, Member of the Academy of France, and Perpetual Secretary of the Academy of Sciences.

they have no relations to the HEMIPTERA. They are, I believe, the wings of NEUROPTERA, which probably belong to the genus *Chauliodes*, of Westwood. (See J. O. Westwood, "Oriental Entomology," *Chauliodes subfasciatus*, p. 70, pl. 34, Fig. 5.)

¹ This fossil was discovered by M. Fayol, Engineer, in a bed of compact micaceous shale of the Upper Coal-measures of Commentry (Allier), in the Forest-pit, at 5 mètres 50 from the top of the great Coal.

² An analogous observation has been made on fossil plants; one has noticed the impressions of leaves in the Coal-measures, in particular the leaves of *Ferns* which could be detached from the surface of the shale and examined separately.

PROTOPHASMA, nov. gen.

Protophasma Dumastii,¹ Ch. Brong. (Plate IV. Fig. 1.)

	LENGTH.	BREADTH.		
Palpi	4 mill.	$\frac{1}{2}$ mill.		
Antennæ	21 "	$\frac{3}{8}$ "		
Head	9 "	6 "		
Prothorax	12 "	6.50 "		
Mesothorax	11 "	10 "		
Metathorax	11 "	11 "		
Abdomen	95 ?	8 " at the base.		
Limbs	{ 1st pair	femur	16 "	3 "
		tibia	18 "	2 "
		tarsus	10 "	1 "
	{ 2nd pair	femur	16 "	3 "
		tibia	17 "	2 "
		tarsus	8 "	1 "
	{ 3rd pair	femur	22 "	4 "
		tibia	22 "	2.50 "
		tarsus	10 "	1 "
	Elytra	13 "	7 "	
	Wings	85 "	32 "	

The head of *Protophasma*, like the rest of the body, is seen in profile, and is of an oval form; it is longer than broad. Only one of the eyes is visible; it is rather long and prominent. The antennæ are attached to the front of the head in the centre; they are short, being only 21 mm. long. This character of the antennæ distinguishes the fossil from the *Phasmidæ*, properly so-called, and relates it to the genus *Cyphocrana*. The first joint is small and round; the second is larger, rather long, and increases in size at its distal end. I cannot clearly define all the other articuli, but those which can be seen distinctly are long, slender, and smooth.

The two palpi are well preserved; they are composed of four articulations almost of the same length; but the last is smaller than the others. One sees the upper labrum and one mandible; but the details cannot be clearly made out. The left mandible, which is alone visible on the surface of the matrix, is broad at its lower part.

Amongst the insects of this family the thorax is divided into three portions, the prothorax, the mesothorax, and the metathorax; and to each portion a pair of legs is articulated. In the living forms (*Phasma*) the prothorax is usually short, and it seldom in any case exceeds the length of the mesothorax (*Prisopus*). In *Protophasma* this section is longer than the mesothorax, in which character it resembles *Prisopus*.

The prothorax is cylindrical, and expands near the head so as to form a collar. It is the only part of the thorax which can be clearly seen; the other divisions are not so well preserved.

The abdomen, as already stated, is wanting in the fossil, but I am enabled approximately to estimate its probable length.² In order

¹ From *πρῶτον* 'first' and *φάσμα* 'a spectre.'

² For example:—Total length in millimètres of living forms.

	Length of the thorax.	Length of the abdomen.
10	3	7
20	6	13.50
15	4.50	10
16	5.50	11

that these insects may maintain their equilibrium, the weight of the abdomen must at least be equal to that of the head and thorax; this relative proportion is constant in the living species; indeed, the abdomen generally exceeds the wings in length by one or two centimètres.¹ I am supported in this conclusion by a number of examples. For instance, in a Phasmian which has a total length of 16 centimètres, the head and thorax are $5\frac{1}{2}$ centimètres, and the abdomen 11 centimètres long. We see that the abdomen is twice as long as the head and thorax together.

In the fossil, this part, the head and thorax, measures $4\frac{1}{2}$ centimètres, the wings $8\frac{1}{2}$ centimètres; therefore, for the insect to be in a state of equilibrium, the abdomen must have been about 10 centimètres in length. I make this statement with all reserve. Another specimen of this insect, in a more perfect state, must be discovered in order to justify this conclusion.

The legs are perfectly preserved. The first two pairs are almost of equal length, but shorter than the third pair. They are all angular, and serrated, and in this respect they resemble those of *Cyphocrana*, and differ from those of PHASMIDÆ.

The trochanter is robust and short in the three pairs; in the first two pairs the femur is triangular, and is finely serrated along its inferior margin. The tibia is also angular and serrated, and is contracted near the proximal end; it terminates in two points at the distal end. The tarsi are alike in all the three pairs of feet, and are divided into 5 joints, of which the first is the longest; the last is provided with a pair of recurved, pointed, and widely-divergent claws, separated by a small rounded pad. The terminal articulation of the tarsus is broadest at its distal end; the three middle joints are of equal length. The third pair of legs are the longest. The femur is more robust and less angular than in the two other pairs, and is armed with seven sharp spines along its lower margin.

The tibia is angular, and bordered with fine denticulations, nine of which are larger than the rest, and placed at regular intervals apart.

The elytra of *Protophasma* do not offer any special characters, and are of moderate size, measuring about one centimètre in length. A stout longitudinal nerve marks the mesial line.

The true wings, or the second pair, are quite distinct, but are neither of them quite complete. Fortunately, what is wanting in one is preserved in the other, so that I have been enabled to reconstruct them, as seen in the accompanying plate (Pl. IV. Fig. 2). In the existing Phasmians, the wing is divided into two parts; the anterior portion supported by three or four straight nerves, which reach to the extremity of the wing, and united by irregular polygonal reticulations; the posterior portion traversed by slender and straight nerves, which radiate, fanwise, from the base of the wing, and which are united together by finely reticulating cross-nerves.

The wings of *Protophasma* differ from those of the living Phasmians. In the fossil form, the division between the anterior and posterior portions of the wing is not so well marked as in the living

¹ Except certain species which have very short wings.

species. In both, however, the posterior portion of the wing is the largest. To facilitate the description of the neuration, we will divide the wing into parts, as in the living species. The total length is 85 mm., and the breadth, near the middle of the wing, 32 mm. The upper marginal nerve (*a*) is a little curved towards the middle of the wing (Fig. 2*a*); the upper sub-marginal (*b*) is parallel to the marginal (*a*), but straighter, and at the broadest portion they are 6 mm. apart. The externo-median (*c*) is 1 mm. from the upper sub-marginal (*b*), and at the extremity of the wing it is distant 5 mm. from it. The median (*d*) follows the same direction as the preceding one, but it is more curved.

A branch formed by the union of the reticulations, and which becomes a true nerve, divides into two branches near the extremity of the wing. The interno-median (*e*) is one mm. from the median nervure, and at a distance of 13 mm. from the base of the wing it dichotomises; the upper branch, at 14 mm. from the margin of the wing, is divided into two branches. The second branch of the internal median, which is given off from the principal trunk at 14 mm. from the edge of the wing, separates into two branches, the upper one of which alone dichotomises. The lower sub-marginal (*f*), which is 2 mm. from the preceding one, divides into two branches, the upper one of which subdivides again into two. The anal nerve (*g*) is very short, and splits up almost immediately into two branches; then, at a distance of 7 mm. from the base of the wing, we see 14 straight and slender nerves, which alternately subdivide into two branches near the ventral margin. All these nerves are united by numerous straight and delicate reticulations.

The wings of the existing species of Phasmians are generally covered with colour-bands, either brown or blue, on a ground of a lighter hue; this was evidently the case in *Protophasma* also. We see, in fact, with the naked eye, darker bands which traverse the wings transversely to the general direction of the nerves. In the neuration and coloration of the wings, the fossil form resembles most nearly the *Phasma variegatum*, Stoll.

The habits of the Phasmians are but little known, but they are vegetable feeders, whereas the MANTIDÆ are carnivorous. These insects crawl sluggishly on plants, and feed upon the young shoots of resinous trees, their habits are generally solitary.

In the Carboniferous period we find evidence of the existence of numerous trees of the family Coniferæ (and Lycopodiaceæ), such as *Sigillaria*, *Calamodendron*, *Arthrophytis*, *Cordaites*, etc., all resinous trees suitable for *Protophasma*.

It is remarkable that the insects of the Carboniferous epoch appear to differ but little from those which exist at the present day; but it is not in France, nor even in Europe, that we must look for insects like those which existed at the epoch of the Coal-formation. It is in the hot regions of America, Asia, Africa, and Australia, that we find their homologues; and the Orthopter which we have just described adds another example in support of this assertion. All that we know of the Flora and Fauna of the Coal-period, proves

to us that the Earth was covered with a sheet of water of little depth, from which numerous islands emerged, over which a luxuriant vegetation spread. There, in the water, lived the *Palæocypris* and the *Palæoniscus*, on the banks of the water, upon the *Sigillarias*, lived the Phasmidæ and Mantidæ, of which several species have been discovered. In the interior of these islands, in the earth formed of leaves, stems, and branches of plants, lived a great number of *Blattidæ*.

The knowledge we possess of the Carboniferous period, that is to say, of the plants and animals, proves to us that there was at this epoch a higher temperature and intense sunlight. The presence of these two insects supports this conclusion, since all the existing representatives of these groups live in the open sunlight in the hotter and more humid regions of the globe.

EXPLANATION OF PLATE IV.

- FIG. 1. *Protophasma Dumasii*, Ch. Brong. *a*, head; *b*, antennæ; *c*, eye; *d*, palpi; *e*, prothorax; *ff*, first pair of legs; *gg*, elytra; *hh*, second pair of legs; *jj*, third pair of legs; *k*, abdomen, restored; *n*, wing folded on itself; *m*, wing border of the second pair, restored; *rr*, wings of second pair.
 „ 2. Wing of the second pair, restored (the letters are explained at p. 101).
 „ 3. Part of Fig. 2. twice natural size. FIG. 4. Elytron.
 „ 5. Wing and Elytron of *Diura Japetus*, Gray. *a*, upper portion of wing with straight nerves; *b*, lower portion with nerves radiating from base of wing; *c*, elytron.
 „ 6. Head of *P. Dumasii*, twice natural size; *a*, prothorax; *b*, head; *d*, palpi; *e*, labrum; *f*, eye; *g*, mandibles; *h*, antennæ.
 „ 7. Head of *Diura Japetus*, Gray. FIG. 8. Half of same, twice natural size.
 „ 9. One of the third pair of legs of *P. Dumasii*, twice natural size.

II.—POST-TERTIARY GEOLOGY OF CORNWALL.¹

By W. A. E. USSHER, F.G.S.

PART II.—PLEISTOCENE PERIOD.

THE materials for a classification of the later Pleistocene deposits of Cornwall are so voluminous that it was found impossible to embody them in a single paper. Having submitted to the Geological Society a general classification with such notices of the deposits as seemed necessary to show the grounds whereon it was based, I purpose in the following paper to complete the notices of deposits. As an apology for the amount of compilation thus rendered necessary, I must plead the object of the papers, viz. to place in one view all that has been written on the subject, as references alone would entail more time and trouble in looking up than many readers would be disposed to concede.

The paper is divided into the following sections:—

1. Oldest superficial deposits; 2. (*a*) Boulder Gravels, (*b*) Raised Beaches, and (*c*) “Head.” 3. Submerged Forests and Stream-Tin Gravels. 4. Recent Marine and Blown Sands.

Oldest Superficial Deposits.—From their isolated positions, and evident relations to an entirely different surface configuration, the gravels of Crousa Down and Crowan, and the sands and clays of St.

¹ Continued from the February Number, p. 81.