

4. *On a COLLECTION of INSECT-REMAINS from the SOUTH WALES COALFIELD.* By HERBERT BOLTON, F.R.S.E., F.G.S., Curator of the Bristol Natural History Museum. (Read January 11th, 1911.)

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I. INTRODUCTION.

I AM indebted to the courtesy of the Director of H.M. Geological Survey, for the opportunity of examining and describing an interesting suite of blattoid remains obtained by the officers of that Survey from the South Wales Coalfield.

Insect-remains of Carboniferous age are so rare in this country that the finding of no less than nine specimens, three of them with their counterparts, constitutes an event of considerable palæontological interest. The South Wales Coalfield has thus yielded more examples and more species than all other British coalfields together. All the specimens, with one exception, are blattoid in character.

The total number of fossil cockroaches known from the Carboniferous is now great, and nearly all the numerous genera and species are founded upon the anterior wings or tegmina alone. Only once in this country, so far as I am aware, have larval stages been recognized.¹

The number of specimens and of species recorded from the British Coal Measures is singularly small, the great bulk of known forms occurring in Continental and North American coalfields. Dr. Henry Woodward,² in quoting S. H. Scudder's³ census of blattoid forms, mentions 14 genera and 69 species as recorded from all Carboniferous sources.

He also mentions that Miall & Denny⁴ quote Scudder as recording the number of Palæoblattariæ at 70 species. Scudder was followed by Dr. E. H. Sellards,⁵ who took a broad survey of the whole

¹ H. Woodward, 'On the Discovery of the Larval Stage of a Cockroach, *Ettoblattina peachii*' Geol. Mag. dec. iii, vol. iv (1887) p. 433.

² 'Some New British Carboniferous Cockroaches' *Ibid.* p. 49.

³ 'Palæozoic Cockroaches: a Complete Revision of the Species of both Worlds, with an Essay towards their Classification' Mem. Boston Soc. Nat. Hist. vol. iii, pt. 1 (1879) pp. 23-134 & pls. ii-vi.

⁴ 'Structure & Life-History of the Cockroach, *Periplaneta orientalis*' London, 1886, 8vo.

⁵ 'Study of the Structure of Palæozoic Cockroaches, with Descriptions of New Forms from the Coal Measures' Amer. Journ. Sci. ser. 4, vol. xviii (1904) pp. 113-34, 213-27 & pl.

subject, describing the structure of Palæozoic cockroaches with remarkable detail, and adding eight new species and one genus. Dr. Sellards was fortunate in securing several remarkably good forms, which he figured and described.

Still more recently, Dr. Anton Handlirsch¹ has subjected the whole of the American forms to a critical examination and revision, and has modified to a considerable extent the work of Scudder and Sellards, more especially that of the former. According to Dr. Handlirsch, the Palæozoic cockroaches, all of which he groups under the order Blattoidea, number close upon 74 genera and 271 species. About 70 of these species cannot as yet be referred with certainty to any known genus. The genera are divided into nine families.

The British forms at present known are comparatively few, and are as follows, arranged in order of their date of publication:—

ETOBLATTINA (BLATTIDIUM) MANTIDIOIDES (Goldenberg) ('Fauna Saræpontana Fossilis' 1877, p. 20).

J. W. Kirkby, 'Remains of Insects from the Coal Measures of Durham' Geol. Mag. vol. iv (1867) pp. 388-90 & pl. xvii, figs. 6-7. ('Portions of the forewing or tegmina [*sic*] of an Orthopterous insect nearly allied to *Blatta*, from the Coal Measures opposite Claxheugh, near Sunderland,' referred to *Blattidium mantidioides*.) S. H. Scudder, Mem. Bost. Soc. Nat. Hist. vol. iii, pt. 1 (1879) pp. 72-73, woodcut, subsequently transferred the species from Goldenberg's genus *Blattidium* to *Etoblattina*.

ETOBLATTINA JOHNSONI H. Woodw. 1887.

LITHOMYLACRIS KIRKBYI H. Woodw. 1887.

LEPTOBLATTINA EXILIS H. Woodw. 1887.

Dr. Henry Woodward² described the foregoing new species in 1887 from four examples, three of which had been obtained from the clay-ironstone band between the 'Brooch' and the 'Thick Coal' at Coseley near Dudley: they were all preserved in nodules of ironstone. The fourth specimen had been obtained by the late James W. Kirkby from the Upper Coal Measures, near Methil on the Fifeshire coast. This specimen is the *Lithomylacris kirkbyi* of the above list.

ETOBLATTINA PEACHII H. Woodw. 1887.

In the 'Geological Magazine' for the same year (p. 433), Dr. Woodward described the occurrence of the larval stage of a new species, which had been found in a light brown nodule of clay-ironstone obtained at Kilmaurs (Ayrshire).

¹ 'Revision of American Palæozoic Insects' [Transl. L. P. Bush] Proc. U.S. Nat. Mus. vol. xxix (1906) pp. 661-820.

² 'Some New British Carboniferous Cockroaches' Geol. Mag. dec. iii, vol. iv (1887) pp. 49 *et seqq.*

FOUQUEA CAMBRENSIS Allen, 1901.

Two previous occurrences of insect-wings are recorded from the South Wales Coalfield. Mr. H. A. Allen¹ described and figured a wing found in shale overlying the 4-foot seam in the Lower Coal Measures of Llanbradach Colliery (Cardiff), to which he gave the name of *Fouquea cambrensis*. The genus *Fouquea*, to which Mr. Allen referred his specimen, was created by Charles Brongniart,² who pointed out its close agreement with *Lithomantis* in the neuriation, while it greatly differs in its reticulation, the nervules being so numerous as to anastomose and form a complex network.

ARCHIMYLACRIS (ETOBLATTINA) WOODWARDI Bolton (1910).

In the early part of 1910 I described³ a new species of cockroach, *Archimylacris (Etoblattina) woodwardi*, from a tegmen found by Mr. David Davies, F.G.S., in dark blue shale overlying the No. 2 Rhondda coal-seam at Clydach Vale. Both these horizons are represented in the collection obtained by the Geological Survey.

II. GEOLOGICAL HORIZONS.

The specimens now to be described are nine in number, and have been obtained from the Mynyddislwyn Vein, the Swansea 4-foot seam, the Graigola Seam, and the well-known Rhondda No. 2 Seam. The Mynyddislwyn Vein is a noted house-coal, and is taken by the Geological Survey as the base of the Upper Series of Coal Measures.⁴ It is generally correlated with the Llantwit No. 3, the 4-foot or Maesmawr Seam, and the Bedwas Vein.

The officers of the Geological Survey regard the Wernffraith or 4-foot Seam of Swansea as the equivalent of the Mynyddislwyn Vein of Monmouthshire; but by some authorities the Graigola seam is believed to correspond to that vein.⁵ In accordance with the former view, the Swansea 4-foot Seam (under a variety of names, such as Llanely 6-foot, Box Big Vein, Primrose Seam, and Broad Oak Vein) forms the base of the Upper Series in the Swansea district, just as the Mynyddislwyn Vein does in the Monmouth area.⁶

The Graigola or 6-foot Vein lies 250 yards below the Swansea 4-foot Seam, and is therefore, according to the Survey classification, in the Pennant Series. The Rhondda No. 2 Seam occurs at the base of the Pennant Series.

If we take the Geological Surveyors' view of the correlation

¹ Geol. Mag. dec. iv, vol. viii (1901) pp. 65-68.

² 'Recherches pour servir à l'Histoire des Insectes fossiles des Temps primaires' St. Étienne, 1893, p. 372.

³ Geol. Mag. dec. v, vol. vii, pp. 147-51 & pl. xv.

⁴ 'Geology of the Country around Newport' Mem. Geol. Surv. 1909, p. 76.

⁵ 'Geology of the Country around Swansea' Mem. Geol. Surv. 1907, pp. 34, 35.

⁶ *Ibid.* pp. 33, 35, 104.

of the Mynyddislwyn and Swansea 4-foot Seams as correct, it follows that of the nine specimens obtained, six came from the Mynyddislwyn horizon at the base of the Upper Series. Two specimens have been obtained from shales associated with the Graigola Seam, and a 22-inch seam 40 yards below it; while one specimen comes from shales near the Rhondda No. 2 Seam, and therefore on the same horizon as the example of *Etoblattina* (*Archimylacris*) *woodwardi* Bolton, already described by me.¹

It thus appears that the whole of the insect-remains are referable to three horizons, one at the base of the Upper Series, and two in the upper part of the Pennant Series. The specimens, the register-numbers of which in the books of the Geological Survey are 24501, 24502, 24503, 24504, 24505, 24506, 24507, 24508, all come from the Mynyddislwyn Vein; 24501-24503 having been obtained from the Gellideg level, and 24504-24508 from the Gwernau level, both in Monmouthshire, near Maes-y-cwmmwr. No. 24510 is from the 4-foot Seam of Swansea, and therefore, as supposed, on the Mynyddislwyn Vein horizon. Nos. 24511 and 24512 are from shales associated with the Graigola Seam, and a 22-inch seam 40 yards below it; while 24509 is from the No. 2 Rhondda Seam.

III. DESCRIPTION OF THE SPECIMENS.

ARCHIMYLACRIS sp. indet. (Pl. VII, fig. 2.) [Reg. No. 24508.]

Impression of the basal portion of the left tegmen. A good portion of the base is hidden; the anal area is either concealed under a large pronotal shield or is absent; and two-thirds of the distal part of the wing are also gone. This is all the more to be regretted, because of the presence of a detached pronotum, which will be described later.

The sub-costal area is strap-shaped, the vein running parallel to a very slightly curved outer wing-margin. The vein is thin, much less robust than the adjacent radius, and gives off a single branch low down, which passes obliquely forward, forking just before reaching the margin. The main stem of the sub-costa also forks at the same level, and sends two large branches to the distal end of the sub-costal area. Only the main stem and its terminal forks can be seen in the photograph. The radial vein, while stronger than the sub-costal, is less so than the median vein, and its branches are correspondingly feeble. Three branches, all directed outwards, can be distinguished, and all follow the same oblique direction as those of the sub-costa. Whether the radius reached the tip of the wing, it is of course impossible to say, but the obliquity of the veins renders this very likely.

The media is small, and branches high up, near the middle of the wing. Only faint traces of two branches are discernible near

¹ Geol. Mag. dec. v, vol. vii (1910) p. 147.

the broken edge. The course of these vein-fragments indicates that the marginal area of the median was confined to the apex of the wing.

The cubitus is a strong vein. Four backwardly directed branches are distinguishable, beyond which the main stem continues outwards in an almost straight line. The branches have the same obliquity to the margin, but in a direction opposite to those of the scapula. A raised line some distance out from the base, at its lower end touching the pronotum, may represent a basal branch of the cubitus or may lie in the anal area. It is doubtful whether it can belong to the anal area, as its course is perfectly straight and fairly parallel to the branches of the cubitus. I am inclined to regard it as a basal branch of the cubitus, and to think that its present position is due to fracture of the wing, and subsequent displacement.

It is impossible to form any idea of the length or breadth of the wing, so little is preserved, the total length of the fragment being only 10 millimetres. This fragment has been broken along the line of the median vein, and a portion of the wing is missing. I have already alluded to a possible displaced portion of the cubitus. The wing-surface was destitute of wrinkles, and the interspaces between the veins slightly convex (concave in the cast).

Affinities.—The general characters of the branching of the veins, and the strap-shaped sub-costal area are, I think, sufficient to justify the classification of the specimen with *Archimyliacris*. Specific determination of so small a fragment is impossible.

Horizon.—Mynyddislwyn Vein, Gellideg Level, near Maes-y-cwmmer (Monmouthshire).

Associated with the impression of the fragmentary wing No. 24508 is a pronotum wholly unlike that of any blattoid known to me. It is in actual contact with the base of the impression, and lies with the dorsal side uppermost. It consists of a raised axial division, convex from side to side, and narrowest anteriorly. It appears to swell out backwards, assuming a somewhat pyriform shape. The sides are plate-like expansions, semilunar in outline, and with a very slightly convex dorsal surface, the convexity being greatest over the inner concave portion of the plate, and dying out on the free margin. The front portion of the axial division has been broken away, and there is nothing to indicate whether a rostral prolongation was present or not. The hinder central portion is also missing, and rising up out of the stony matrix filling the gap are the edges of two coriaceous body-segments. The central axial portion of the plate is black, while the lateral expansions have the colour of the matrix. Both sides preserve traces of the superficial texture, the left side being far the best in that respect. The surface is finely wrinkled longitudinally, the wrinkles gathering strength and becoming crowded together at the inner angles of the lateral plates. At the base of the left side are a few very small areas of a rich ochre colour spotted with black. The inner lower angle of the left side is rounded inwards, suggesting that the

raised median portion was incurved and shorter than the sides. The whole outer margin was thickened.

Affinities.—The appearance presented by this pronotum somewhat suggests the prothoracic shield with wing-like expansions of *Lithomantis carbonarius*.¹ The resemblance to that species is little more than superficial: for, while in *Dr. Woodward's* species the lateral lobes are veined like the wings, in this case there is no trace of veins, the surface being covered with longitudinal wrinkles, nor is there any clear evidence of a rostral prolongation. On the other hand, the recent Mantidæ and *Lithomantis* seem alone to possess this form of prothoracic shield, so far as I have been able to determine. Certainly it is not present in any fossil member of the blattoids, nor have I seen anything suggestive of it among the pronota of recent cockroaches. If the pronotal shield were of an undoubted mantid type, one would naturally turn again to the wing-impression, expecting to find its blattoid determination erroneous. The fact, however, that the two central main veins throw off their branches in opposite directions effectually disposes of any possibility of affinities with *Lithomantis*. That the prothoracic shield is that of a *Lithomantis* or allied form, which has been accidentally preserved in close contact with the wing of a blattoid, seems hardly likely. I am more inclined to think that the pronotal shield and the wing-fragment are parts of the same insect, and that future discoveries in older rocks may indicate that the apparent Lithomantid appearance of the pronotum points to a common origin for the blattoids and the mantids.

HEMIMYLACRIS OBTUSA, sp. nov. (Pl. X, figs. 4 & 5.) [Reg. No. 24510.]

A stout, obtuse, rounded right wing, 23 millimetres long and 14 broad. The wing lies in a soft fire-clay full of Stigmarian rootlets, and is distorted by pressure. It has been fractured obliquely across the lower third and along the anal furrow.

The outer margin is well rounded, the inner, judging by the course of the anal veins, being almost straight. The proximal half of the sub-costal area is smooth, broadly triangular, and 11 millimetres long. The sub-costa is sunken, and passes in a straight line from near the middle of the wing-base to the outer margin, forking into two short branches just before reaching the latter. On its outer side it gives off near the base two short branches, the outermost of which forks once, and the inner twice, before reaching the margin. Owing to the perfectly straight course followed by the veins, the sub-costal area is long, nearly equal to two-thirds of the length of the wing in fact, and separable into a basal smooth area, and a distal one crossed by few veins.

The radius is large, much divided, and reaches distally almost to the apical point. The lower half is characterized by a regular

¹ H. Woodward, Q. J. G. S. vol. xxxii (1876) pp. 60-65 & pl. ix, fig. 1.

dichotomy. Arising from the middle of the base, the vein stands out in relief for a very short distance, after which it becomes and continues sunken. Its general course is arcuated forward to the middle of the wing, after which it bends a little inwards, and then again outwards in the marginal veins of the innermost branch. It divides into two equal branches at a distance of about 6 millimetres from the base, and these divide again at the same level 3 mm. beyond the first division. Of the four branches thus produced, the outermost passes straight outwards towards the margin and parallel to the main stem of the sub-costa. It appears to die out before reaching the margin. The inner branch of this bifurcation passes straight out to the margin, giving off two smaller veins on its outer side which also reach the margin, all the three marginal veins being parallel to the sub-costa. The inner branch, which forks at the same level, also possesses two dissimilar veins, the outer agreeing in character with the adjacent vein of the outer branch; that is, it continues straight out to the margin, giving off two lateral veins on its outer side. All these branches of the radius pursue a straight course. The innermost gives off two simple branches passing out to the apex of the wing, and then forks, the outer of the two resultant veins forking again. The course of the marginal branch-veins of the radius is such that the radial area must have extended over almost the whole of the anterior third of the wing-tip.

The median vein is sunken along its whole length, and apparently continuous with the cubitus at its base. The crumpling which the base of the wing has undergone prevents accurate determination. Appearances suggest that the cubitus first divides at the top of the lower third of the wing, giving off a backwardly directed branch which forks twice at least before reaching the hinder apical margin. In all probability, the branch sends five or six veins out to the wing-margin. Near the middle of the wing, two more inwardly directed veins are given off, the innermost continuing unbranched to the broken edge of the wing, and the other forking before the edge is reached. The vein then continues almost straight out to near the apical point. The marginal portion of the median area extends from the wing-apex, or a little in front of it, to the inner border, of which it forms the distal portion.

The cubitus has little if any share in the tip of the wing. The cubitus is strongly curved inwards. It bifurcates soon after leaving the media, the inner branch vein passing outwards and inwards without division to a little distance above the middle of the hinder margin. The more central branch-vein soon forks again into two fairly equal divisions, the outer median one breaking up into four marginal veins, and the inner into three. The marginal extent of the cubitus includes the distal third of the inner wing-margin. All the veins are sunken.

The anal area is large, broadly triangular, and convex dorsally. It is marked off by a strong arcuate furrow, the anal vein standing out in relief. The subordinate anal veins are very numerous. They consist of (1) a short stem, which sends off a simple inner

branch to the margin, and then bifurcates twice, the resultant four veins pursuing a course parallel to the simple members of the main stem, and filling up the space between it and the anal furrow; (2) of a series of seven or eight straight veins, only three of which possess a single bifurcation. Not less than fourteen anal veins impinge upon the wing-margin. The base of the anal area is prolonged into a short, stout, subacute pedicle, presenting all the features of an articular surface. The wing, considered as a whole, is leathery in texture, and there is an entire absence of cross-veins or wrinkles.

Affinities.—The essential features of this wing are its broad and shortened character, the triangular sub-costal area, doubly-branched radius, the backwardly directed branches of the media, and the large anal area. This assemblage of characters is only to be found in one family, that of the Mylacridæ. The somewhat radial character of some of the anal veins, the backwardly directed branches of the media, and the long anal area limit the specimen to the genus *Hemimylacris*. In this genus also the inner division of the radius is much the largest, and covers most of the radial area, a feature in which the specimen here described agrees. I have, therefore, no hesitation in classing it as belonging to *Hemimylacris*. It is a broader wing than *H. ramificata*, and the greater humeral area is destitute of veins, while the marginal extension of the cubital area is not so large, and the general course of those veins more arcuate. It is, however, a closely related species, to which I would give the name *Hemimylacris obtusa*.

Horizon.—Four-Foot Seam of Swansea, Gladys Colliery. 1 mile east-south-east of Penller-gaer Church (Glamorganshire).

HEMIMYLACRIS CONVEXA, sp. nov. (Pl. VII, fig. 3.) [Reg. No. 24512.]

Proximal half of a tegmen, much distorted and crumpled at the base. The part remaining does not exceed 10 millimetres in length. The sub-costal lobe has been broken and crushed in upon itself: it was apparently smooth. Very little is left of the sub-costal area, which appears to have been triangular, and to have run out upon the margin at about the level of the tip of the anal furrow. Traces of two marginal veins are present.

The radius arises in the middle of the base, and almost immediately bifurcates. The outer branch divides again into two marginal veins, while the inner first sends off a long simple vein, then passes straight outwards in the direction of the apical point of the wing, bifurcating just before the broken edge of the wing is reached. While the fragmentary marginal branches of the sub-costa appear curved, those of the radius are straight. The intervening areas are flat in both cases.

A comparatively wide interspace divides the radius from the media. It is scarcely possible to separate the latter vein from the cubitus with certainty, so little of the wing being present. I am

inclined to regard the single vein shown next to the radius, as the basal end of a comparatively small media. This vein-stem shows a bifurcation at the end of the middle third of its visible length, and a second bifurcation on the outer branch near the broken edge of the wing. It is difficult to determine whether the next inner long simple vein belongs to the media or not. It approaches the base of the media very closely indeed, but, as I believe, does not fuse with it. The crumpling of the wing at the critical point prevents positive determination either way.

The next inner vein is a part or the whole of the cubitus. I interpret it as the lower or inner division, regarding the long vein previously noted as the outer branch of the cubitus. The inner division consists of a stem gently arcuated, and bifurcating twice, ending on the middle third of the inner margin in four branches. The anal furrow follows a course parallel to the inner branch of the cubitus. The wing has broken along the course of the furrow, and thus obscured its characters somewhat. It can be determined, however, that the furrow is shallow and the vein thin. The anal area is crossed by three small veins arising from one basal point, and radiating outwards to the margin. Owing to the fracture, the anal area has become a little displaced inwards.

Affinities.—Owing to the fragmentary and crumpled condition of the wing, the affinities are by no means easy of determination. By far the most important features determinable are the almost equal sub-costal and anal areas, the restriction of the radial area to the outer half of the wing-apex, and the corresponding expansion of the median veins over the inner half. The few anal veins distinguishable seem to radiate from one point. All these are features characteristic of the family Mylaeridæ of Scudder. The generic relationships are clearly those of Handlirsch's genus *Hemimylacris*, and the correspondence with the lower half of that author's *Hemimylacris ramificata* is remarkably close. Differences there are, but of specific value only. I may instance the few anal veins in the South Wales fragment, and the clear suggestion of an almost straight inner margin. Careful comparison with the characters of *Etoblattina*, *Gerablattina*, and *Archimylacris* have satisfied me that it can be none of these, and I therefore place the specimen in the genus *Hemimylacris* of Handlirsch.

Although the full characters of the wing cannot be determined, it seems desirable to give the species a name, as it is clearly not *H. ramificata*. I assign to it, therefore, the name of *Hemimylacris convexa*.

Horizon.—Shales associated with the Graigola Seam. Clydach Merthyr Colliery, Clydach Valley (Swansea Vale), Glamorganshire.

ARCHIMYLACRIS (SCHIZOBLATTA) OBOVATA, sp. nov. (Pl. VII, figs. 4-6.)
[Reg. Nos. 24506 & 24507.]

A markedly obovate left tegmen, the portion preserved being 23 millimetres in length, and 10 mm. in greatest breadth. The

whole of the anal and a portion of the cubital areas are missing, as also a small portion of the base. The dimensions of the perfect wing are hardly likely to have exceeded 25 millimetres in total length and 12 to 13 mm. in breadth.

The anterior margin forms a broad convex curve, almost straight as it approaches the base, and more rounded towards the narrowed and blunt apex. Beyond the apical point the inner margin is complete for half of its length, and has a well-rounded convex outline, much more pronounced than that of the outer margin. The sub-costal area is narrow, somewhat strap-shaped, but widest in the middle, and terminating acutely a little beyond the middle of the outer margin. A little of the base of the sub-costa and the proximal costal lobe are absent. The former gives off three veins, the basal one remaining single to the margin, the second giving off a simple basal branch and then forking just before reaching the margin, while the outer and final branch bifurcates near the middle of its length. Traces of a more basal vein can be seen, but whether it is a still lower branch (which is most probable) cannot be determined. All the branches of the sub-costa pass out very obliquely to the margin. The areas between the secondary veins are widest in the middle, and hollowed, the veins standing out in relief.

The radius is much the largest of the series, being separated over the greater part of its length by an unusually wide interval from the sub-costa. At a distance of 3 millimetres from the present base of the wing, it divides into two diverging branches, each of which again forks at a height of 4 mm. beyond the first bifurcation. The first branch sends off a long vein, which forks before reaching the margin, and approaches the outer vein of the sub-costa so closely as to make the interval between them about equal to that of the adjacent area. The inner division of the branch sends off, forward and outwards, a long vein which forks almost on the margin; passing forwards, it then forks at the level of the outer angle of the sub-costal area, and runs on to the outer margin. The two branches of the middle division pass out to the middle of the wing, the inner branch being concave outwards. The outer branch divides a little below the inner, and sends the resultant two veins straight to the outer margin. The inner branch first sends a simple undivided vein backwards, which reaches the margin just below the apical point; a little farther out, a simple vein is directed forward in advance of the apical point of the wing. The area of the radius is thus large, and as it passes beyond the apical point back to the inner margin, the area of the media is correspondingly reduced.

The full character of the median vein is to some extent a matter of conjecture, owing to the missing portion of the wing having carried away the basal union of the veins. A portion of the main stem is visible, from the level of the second double bifurcation of the radius, and is seen passing straight out towards the apex, until the middle of the wing is reached, where it divides

into two equal branches which curve gradually backwards to the inner border. On the inner side of the main stem, and disconnected from it, is a branch giving off a single long vein from the level of the second bifurcation of the radius, and a little farther out dividing into two equal branches. All three veins follow the same general curve of the ultimate branches of the main stem of the radius, and run out on to the inner margin. Basally, their course is such that we should expect the axis to merge into the main stem of the media, and I naturally assume that they are a part of that vein. Strong presumptive evidence of such a union is also afforded by the basal course of the next marginal veins, which appear to be separated by an interval that widens basally. The median area thus marked out is very small, and does not occupy more than a fifth of the inner wing-margin.

The cubitus is represented by six marginal veins, of which only the penultimate one to the apex is forked. Their basal direction points conclusively to a common origin; probably, however, only a little over half of the whole vein is present. There is no trace of the anal portion of the wing.

The wing is thick, coriaceous in texture, and was somewhat rounded on the upper surface. This roundness has been modified in the lower half of the wing by a little crumpling from before backwards. It is, perhaps, to the same shrinkage that we must assign the transverse wrinkles present between the veins over the radial and median areas. Unlike the purely transverse wrinkles, so evident a feature in many of the *Archimyla*cridae, those in the specimen here described are oblique to the veins, and not at right angles. Where they are most conspicuous, as in the marginal veins of the radius, they are seen to be very irregular in character. In some places, a close-set series start out from the side of a vein, and die out in the interspace. In other places, sets of wrinkles are interrupted by smooth interspaces, this arrangement occurring at haphazard. There are a few, but not many, cases where the wrinkles anastomose.

Affinities.—There can be no doubt as to this specimen being an *Archimyla*crid. Dr. Handlirsch, who has raised *Archimyla*cris to the dignity of a family, *Archimyla*cridae, has also in the same paper¹ founded a new genus, *Schizoblatta*, and with the type-species of this genus the specimen here described is in close agreement. The points to which I attach importance are the following:—

In both, the sub-costal area extends for a short distance beyond the middle line, the veins in each case passing out obliquely to the margin. A very wide interval separates the stem of the sub-costa from that of the radius in the middle of their length, and this area is narrowed distally in each case by the approach of the marginal veins. The radius is a large and much branched vein, and separates into two main divisions, which fork at the same level and reach to the apical point of the wing—in our specimen just beyond it. The media is relatively small, while the cubitus has few branches, passing very

¹ 'Revision of American Palæozoic Insects' Proc. U.S. Nat. Mus. vol. xxix (1906) p. 722.

obliquely out, like those of the sub-costa, to the margin. The anal area in the type, *Schizoblatta alutacea*, is long, attaining nearly half the length of the wing. In the specimen here described the whole of this part is missing, as also a part of the cubitus. The missing portion of the inner margin extends beyond the middle of its length, and with a knowledge of how frequently the anal vein determines the line of fracture, this extended broken area becomes significant. The fact that our specimen does not wholly agree with the definition of the genus, does not invalidate the species, as the definition is founded upon one specimen of the type-species only. Dr. Handlirsch's definition is as follows:— 'Front wing elliptical, about two and two-fifths times as long as broad. Costal area extending about three-fifths the length of the wing, with about nine or ten normal veins; not expanded at the base. Radius divided into two principal stems, the superior of which separates into six branches and the inferior into eight, the majority of the latter ending in the apical border. The media likewise divides into two main stems, the anterior of which forms five branches and the posterior four, all of which fuse in the apical margin. The eight branches of the gently vaulted cubitus take up the entire inner border. The anal area attains nearly half the length of the wing. Cross-veins area not to be distinguished, but instead there is a fine-grained leathery structure.' (*Loc. cit.*)

I would suggest an emendation, basing the characters of the genus upon the obliquity of the marginal veins of the sub-costa and cubitus, the presence of a wide interval between the former and the radius, and the wide area occupied by the latter. The division of the radius into two unequal branches, together with its symmetrical double bifurcation, is also, I venture to think, a feature of primary importance.

In the wide divergence of the radius and the media, the specimen here described is in agreement with Scudder's genus *Spiloblattina*; but in this case the veins do not again converge to enclose an elongate or oval area.

Horizon.—Gwernau Level of the Mynyddislwyn Vein, near Maes-y-cwmmwr (Monmouthshire).

ARCHIMYLACRIS (ETOBLATTINA) HASTATA, sp. nov. (Pl. IX. figs. 1-3.)
[Reg. Nos. 24501 & 24502.]

An oblong, broadly elliptical, left tegmen, twice as long as broad: the length of the wing being 33·4 millimetres, and its breadth 16·5 mm. A portion of the base of the wing and a considerable portion of the distal and inner margins are missing; but sufficient of the wing is preserved to make these measurements approximately accurate. The wing has a strong outline, especially along the anterior margin—partly owing to the presence of a broad, shallow, concave depression, which runs almost the whole length of the sub-costal and radial areas, on their outer side, and causes the anterior margin to be reflexed dorsally. Of the inner margin, only the greater part of the anal border is left, although but little of that portion which bounds the cubital area can be missing. The posterior two-thirds of the apical margin are gone, the absence of which gives an acute lobate appearance to the wing, negatived by a closer study of the inner margin. In all probability the apex was narrowly and bluntly rounded, more so than is usual in forms of this group—though not wholly unknown, as, for example, in *Archimylacris acadica* Scudder.

The most nearly related species appears to be *Archimylacris*

(*Etioblattina*) *venusta*, but the differences are sufficiently strong to merit specific rank, where, as in this group, specific identity is wholly dependent upon wing-structure. The sub-costal vein is strongly curved proximally, reaching almost to the middle of the base of the wing. Farther away it is parallel to the margin, and then passes rapidly forward and outwards in an oblique line, reaching the margin at the outer edge of the middle third of the wing. The subcostal area is thus wide at the base of the wing, and narrows outwards, ending in an acuminate peak against the tip of the distal vein. It gives off anteriorly nine, possibly ten, branches, of which the 4th, 5th, 6th, 9th, & 10th are forked, the 6th forking twice. The direction of the veins becomes more oblique to the margin from the base outwards, the last two being almost in a straight line with the sub-costa itself. The sub-costal area forms a shallow concave trough, bounded by the upturned margin anteriorly, and posteriorly by a flattened ridge which bears the bases of the radius and the median vein. A wide interval separates the sub-costa from the main stem of the radius, the interval being as wide at the base as at the level of the first forking of the latter. The first four branches of the sub-costa are slightly elevated above the general surface, the rest being flat, or, in the outer branches, sunken.

The main stem of the radius is gently arcuated, and follows a course parallel to that of the sub-costa, until the first fork is reached, when it begins to curve backwards, so that the two anterior veins are in this region separated by an unusually wide interval. The proximal third of the radius is strongly elevated, as is also the first branch up to its bifurcation. The latter arises at a point a little in advance of the level at which the first branch of the cubitus is given off, and, curving first forward and then a little backwards, passes out to the margin, giving off three forked branches of considerable length in its course. The marginal veins are parallel with one another, and with those of the sub-costa; and so the greater part of the anterior margin is marked out into eighteen to twenty strips with parallel sides. Beyond the first bifurcation the radius forks twice, once just above the middle of the wing, and again at a point apparently equidistant between the first fork and the apical margin of the wing. The precise position cannot be determined, owing to the alar structure being torn away around the critical area. All the minor veins are sunken, those of the anterior branch in the concave depression which passes outwards from the sub-costal area, those of the posterior branches passing across a flat apical area. The whole course of the radius follows a somewhat sigmoidal curve, the latter becoming flattened in the hinder portion of the radial margin.

The media arises in actual contact with the base of the radius, or is united thereto. It rapidly diverges until it becomes parallel with the inner branch of the radius, with which it keeps parallel until the first forking is reached at the end of the first third of the

wing; beyond this point the media bends backwards, and follows an almost straight course to the upper third of the inner margin, giving off four branches on its anterior side. Of these, the first forks a little above the middle of the wing, and probably the rest forked also; but the wing is torn away over the hinder half of the apical area, and this point cannot be determined.

The regularity of the minor veins over the whole of the rest of the wing makes this bifurcation a certainty. Up to the first branching, the media is raised in moderately high relief, in this respect agreeing with the basal portion of the radius. Beyond the first branching, the veins become sunken, the intervening areas being gently convex. The median area stretches along almost the entire hinder half of the apical margin, and apparently extends forward to the actual apical point. The area is much larger than in *A. venusta*, owing to the backwardly directed main stem of the media, and the short and arcuate cubitus.

The cubitus arises in close proximity to the bases of the radius and media, and gradually diverges from the latter, the divergence increasing up to the point at which the fifth branch is given off, after which it approaches the media very gradually, but still keeping a wide interval between the two. The width of this interval opposite the proximal forking of the media is especially wide. Ten branches are given off from the cubitus on its inner face, only one of which, the proximal one, is forked. This is also a little arcuated at its point of origin, and then passes out to the inner margin, bending very slightly towards the apex of the wing in its outer half, as do all the rest.

The cubital area stretches from the end of the first third of the inner margin to a little within the distal third. It is much shorter than in *A. venusta*. The first anal vein is robust, elevated in its basal half, and depressed in the distal portion. It lies in the middle of a deep broad valley, being widely separated from the base of the cubitus and the base of the succeeding anal vein. It is strongly arcuated, much more so than any of the chief veins, while it is marked off from the second anal by the swollen or tumid inner flank of the trough in which it lies. It reaches the margin about the end of the first third of the wing. Eleven other anal veins are present, which diminish in strength and also increasingly approach one another backwards. They are wider apart distally on the wing-margin than at their bases, so that the smaller inner veins appear to pass obliquely and in straight lines to the wing-margin. The inner wing-margin over the anal area is almost straight.

Viewing the wing as a whole, one is at once struck with the appearance of great muscularity, shown in two oblique ridges: an anterior one passes forwards and outwards, and bears upon its crest the main stem of the radius, being bounded in front by the base of the sub-costa, while upon its hinder face lie the bases of the median and cubital veins.

The hinder oblique ridge follows the course of the second anal, the first anal vein bounding its anterior border. Its hinder border is not defined, the convexity dying out gradually over the anal area. A median and less evident ridge carries the middle portion of the cubitus, and lies a little in advance of the other two. The whole surface is covered with a close-set series of narrow wrinkles at right angles to the veins. They are most evident over the anal area, where many of them fork between the veins, and also pass directly over the latter in places. They are least evident over the sub-costal and radial areas.

Affinities.—In the strongly arcuate outer margin and almost straight inner margin, the specimen agrees with *Anthracoblattina spectabilis* of Goldfuss. The sub-costal vein is not, however, parallel to the anterior margin, while its width at the base is more than a third that of the wing, whereas in *A. spectabilis* it is but a quarter. The radius forks much nearer the base, being subdivided practically into two main divisions. The cubitus is comparatively simple, and only the lower branch is forked, whereas in *A. spectabilis* this vein forks twice, and the succeeding three branches also fork. *A. spectabilis* is a much larger wing, having a length of 44 mm., its estimated length when complete being 54 mm., and a breadth of 22 mm., the present species being about 33 mm. in total length as now shown, but when perfect probably about 40 mm. When compared with *Archimytlacris (Etoblattina) venusta* mihi, it exhibits an equally close correspondence in shape, and in the origin of the veins near the middle of the wing. Considerable differences exist, however, in the sub-costal area, that of *A. venusta* being the longest; the branches of the radius in the latter are sixteen or more in number, in the South Wales specimen there are not more than ten or eleven, and the latter reach the wing-margin very obliquely. The cubitus is a much longer vein in *A. venusta*, reaching the hinder part of the apical border, while in this specimen it runs out to the inner margin, the apical area being entirely occupied by the radial and median areas. A careful comparison with other species shows a greater divergence in structure, and I therefore regard this as a form closely allied to *A. venusta*, but with decided specific differences. The powerful muscular ridges at the base of the wing, the marked convexity of the outer margin, and its upwardly reflexed edge are characters peculiar to the species, and mark it off from all other species that I have seen.

Owing to its general spear-shaped form, I have applied to the specimen the name of *Archimytlacris (Etoblattina) hastata*.

Horizon.—Gellideg Level of the Mynyddislwyn Vein, near Maes-y-cwmmer (Monmouthshire).

ARCHIMYTLACRIS sp. indet. (Pl. X, fig. 3.) [Reg. No. 24503.]

A fragmentary blattoid tegmen showing the middle third of the alar area, the proximal portion being concealed under a *Cordaites* leaf, and the outer third missing.

The specimen is much too fragmentary for any attempt at specific determination. The sub-costa is represented by three branches, two of which fork low down, and therefore presumably near their points of origin. The single vein, which is the lowest, may be the upper member of a forked vein similar in character to the other two. The veins stand out in relief, the interspaces being flat. There are indications that the outer margin was bent downwards.

Judging from the course of the veins, which are very oblique, the radial area extended for a considerable distance along the outer margin. The radius is represented by three branches, the outer two forking, and the fork of the first branch being at a lower level than the second. The veins are sunken, well defined, and with flat interspaces as in the case of the radius. The direction is almost straight outwards, and there can be no doubt that the radial area reached the apical point of the wing.

The media shows five branches, the inner two converging towards a common point basally. They represent, therefore, the secondary branching of one of the lower offshoots. A somewhat wide interval separates the radius from the media, and the interspaces between the branches of the latter are narrower than those of the radius, but not so narrow as those of the sub-costa, which are the smallest. The general course of the media is outward and backward, the direction being such as would bring the branches out upon the margin behind the apical point. The median area probably included the inner half of the marginal tip of the wing.

The cubital portion of the wing is partly obscured by a much wrinkled superficial layer, the wrinkles in some cases passing straight across between the veins, and in others being thrown into crenulated lines, the convexities of which are directed basally. Some of these crenulated wrinkles pass across the interspaces from one vein to another, while others stretch across two interspaces. Over the two outer veins, two sets of straight wrinkles intersect one another, forming a small patch of irregular network. The general effect of the wrinkles is similar to that which would be produced if an easily separable epidermis or superficial layer had been pushed towards the base of the wing.

The inward inflection of the wrinkles at the veins indicates that the outer layer was attached at equidistant points along their length, while the fact that wrinkles which dip into the veins may, and occasionally do, die out in the next interspace, would seem to show that a wrinkle is a superficial corrugation, and not a lateral commissure of the veins themselves. The latter view is also negated by the two crossed sets of wrinkles on the two outer veins. Seven cubital veins are present, the four inner being simple so far as shown, and the three outer arising from a common stem. The interspaces are convex. There is no trace of the anal area.

Scudder and others have commented upon the general association of the wings of blattoids with leaves of *Cordaites*. The base of

the wing in this case was concealed by a leaf of *Cordaites*, and others occur upon the same slab of shale. While Carboniferous blattoids may have been wholly phytophagous, it is interesting to note that all the leaves of *Cordaites* (in the present case) are impressed with shallow pits, which show faint traces of a spiral. I have, in very many previous instances, found that such pits owed their origin to attached shells of *Spirorbis pusillus*. Whether these leaves were partly submerged in water during life is an open question; but, in all cases, the plant-tissues of the pittings are depressed, and are accurate impressions of *Spirorbis*. If the Carboniferous blattoids were not wholly vegetable feeders, the occurrence of *Spirorbis pusillus* upon the *Cordaites* may supply a reason for their frequent association.

The character of the wing-fragment is typically that of an Archimylaerid. It was undoubtedly broad, and the chief veins were well defined, deep, and distinct in character one from the other.

Horizon.—Gellideg Level of the Mynyddislwyn Vein, near Maes-y-cwmmwr (Monmouthshire.)

GERABLATTINA (APHTHOROBLATTINA) SULCATA, sp. nov. (Pl. VIII, figs. 1-3.) [Reg. Nos. 24504 & 24505.]

Greater part of a right tegmen. Under surface alone shown. Only a short portion of the outer margin of the wing is preserved, an estimated two-thirds of the middle, and a small portion of the anal area. Although the wing is thus fragmentary, it is fortunate that the parts preserved include the sub-costal angle and the greater part of the base with slight evidences of attachment. The inner sub-costal angle is much produced, bluntly rounded, and very broad, forming apparently a full third of the width of the base. The angle bends sharply inwards to the point of attachment, a small portion of the latter forming a narrow ill-defined neck projecting outwards from the middle of the wing-base.

The anterior margin has the appearance of having been thickened or infolded. The inner portion of the triangular sub-costal area is smooth, and separated from the venated portion by an oblique ridge arising near the base of the sub-costa, and passing obliquely forwards and outwards to the margin. The sub-costa is thin, elevated basally, and somewhat crenulated, doubtless owing to *post-mortem* changes or pressure. Its course, so far as can be judged, was parallel to the wing-margin, and in the portion exposed five branching veins are shown, all of which fork very close to the main stem. All the branches of the sub-costa pass out very obliquely, pursuing a course which would indicate a sub-costal area occupying nearly all the outer margin. The areas between the veins are flat, except in the angles of the forks, where they become convex.

The radius follows a course parallel to the stem of the sub-costa, up to the point at which it gives off the first forward branch;

beyond this point, the branch vein approaches the radius a little. The main stem of the radius follows a course parallel to the sub-costa, the parallelism being maintained by the first branch vein and the outer branch that results from its bifurcation. The portion of the radius preserved shows six branches, the first and third of which are forked. Beyond the first forking the main stem of the radius bends gently backwards, up to the middle of its length, where it begins to curve very slightly forward. The general direction is such, that in all probability the scapular area extended a little backwards behind the apical point of the wing.

The median vein arises quite close to, but is totally distinct from, the radius. The media is the least evident of all, and its course, especially in the basal half, is only determinable with difficulty. It is slightly convex outwards in its lower half, then passes straight to the apical margin. Four parallel branches are shown, one or more almost certainly bifurcating before the margin was reached. This is purely conjectural, the apical portion of the wing being broken away. The first two-thirds of the length of the media is regularly curved, the outer third passing in a straight line to the margin. The distal portion of the wing being missing, the full extent of the median area cannot be determined, but sufficient is present to show that the area did not extend outwards to the apical point, reaching the margin at about the middle distance of the lower outer half of the margin.

The cubital vein is but faintly outlined proximally, where it is almost in contact with the anal vein. It gives off eight backwardly directed and parallel branches, only the third showing bifurcation.

The anal furrow is broad and shallow at the base, passing backwards to the inner margin in a narrowing groove and by a wide and gentle curve. As a result, the anal area is unusually long, being quite a third of the length of the wing. It is somewhat convex proximally, owing to the raised, rounded inner border of the anal groove, but more remotely becomes slightly hollowed. Five subsidiary anal veins are distinguished, in addition to the primary one. Of these, the first and second fork—the first a little below the middle of its length, and the second at about two-thirds of the length. All the veins are sharp and in good relief. The wing-border all along the inner margin is curved ventrally, so that the full course of the veins to the margin cannot be followed. Not much, however, of the wing can be hidden, and probably not more than three anal veins at the most are thus obscured. The whole of the anal area is covered with multitudinous fine transverse wrinkles, anastomosing in all directions between the veins. So abundant are these branches and fusions of the wrinkles, that in some portions of the area they assume a fine reticulation.

The portion of the wing preserved has a length of 38 millimetres, and a breadth of 16 at its widest part. There can be little doubt that the perfect wing had a length of at least 45 millimetres, and

a breadth of 25. Transverse wrinkling occurs over the whole wing, the wrinkles anastomosing between the veins. Although it cannot be stated as a positive fact, the bases of the media and cubitus appear to have had a common root, or to arise in actual contact with the primary anal vein, which is much stouter than either. Both the media and the cubitus are weaker veins than any others of the series. The slight indication of the anterior margin of the wing in the basal sub-costal area shows that that margin was convex.

Affinities.—In the general characters of the veins this specimen shows an agreement with Scudder's *Gerablattina* (*Aphthoroblattina* of Handlirsch), the points in common being the weakly developed sub-costa, especially in its lower half, and the apparent union of the bases of the radius, media, and cubitus with the first anal vein. In Scudder's *G. fascigera* this union is clear, and continues along the middle line of the wing for some distance; while in the specimen here described the general structure points to a common root of no great length. In the character of the surface-wrinkles and a subordinate reticulation there is also agreement. The veins arise a little above the middle of the wing, a feature more indicative of *Archimydris*, but scarcely confined to that family. I consider that the wing agrees most closely with the genus *Gerablattina* as defined by Scudder,¹ and with that section which Dr. Handlirsch has erected into a new genus under the name of *Aphthoroblattina*,² although the difference in development of the united veins constitutes a wide difference between this species and *Aphthoroblattina* (*Gerablattina*) *fascigera*, which Handlirsch takes as the type-species of his new genus. I propose for this species the name *sulcata*.

Horizon.—Gwernau Level of the Mynyddislwyn Vein, near Maes-y-cwmmwr (Monmouthshire).

ORTHOMYLACRIS LANCEOLATA, sp. nov. (Pl. X, figs. 1 & 2.) [Reg. No. 24511.]

A left wing 23 millimetres long and 10 wide, elongate-lanceolate, and tapering from the outer and inner margins to the subacute apex. Both margins are slightly convex, the greatest width of the wing being at the distal end of the anal area. The apical portion of the wing has been bent inwards, producing an irregular cross-wrinkle. In its uniform tapering towards the apex, and the long bluntly-pointed appearance thus produced, the wing departs from the typical blattoid type, this departure being also emphasized by the uniform convexity of the upper surface and the character of the chief veins, which we shall presently consider.

¹ 'Palaeozoic Cockroaches' Mem. Boston Soc. Nat. Hist. vol. iii, pt. 1 (1879) p. 97.

² 'Revision of American Palaeozoic Insects' Proc. U.S. Nat. Mus. vol. xxix (1906) p. 719.

The sub-costal area is a little less than half of the length of the outer margin, broadly triangular, and only sends six veins to the margin. The sub-costa is thin, sunken, and gives off three forked branches which pass out in straight oblique lines. The area of the sub-costal or humeral lobe is smooth, and the outer marginal edge, up to the termination of the sub-costal area, is slightly upturned. The first two branches of the sub-costa arise very low down.

The radial vein has numerous branches, and its area occupies the greater portion of the fore part of the wing, the most distal vein reaching the margin a little short of the apical point. The main stem is thin, sunken, and divided into four principal branches, the first three of which are doubly forked, the last forking only once. The main stem has a slight sigmoidal curve, being directed forward over the first third of its length, backwards over the middle third, and forward and outwards over the last branch. All the veins are very oblique and arise low down; and thus, notwithstanding the narrowness of the wing, they are relatively long. A wide interval separates the outer branch of the sub-costa from the lower innermost branch of the radius, the interval being widest in the middle and narrowing at the wing-margin and at the base.

The media has the same general characters as the previously described veins, but does not branch until the middle of the wing is reached, and on a level with the third branching of the radius. The proximal branch curves very slightly backwards and then forward, forking twice, the hinder of the distal veins reaching the margin in the apical point. Before doing so, it forks, then reunites, the two branches enclosing a long lenticular area. Beyond the union, it forks again quite close to the margin. The second branch of the media is single throughout its length, and is a very long vein, almost half the length of the wing. A little beyond the origin of this second branch, the main stem divides into two, the inner or proximal one passing out undivided to the inner margin, which it reaches some little distance behind the apical point. The distal branch is somewhat remarkable: branching at about half the length of the proximal branch, it sends off two unequal veins. Of these, the anterior is long, and bent forwards in a strong curve, reaching the margin at the apical point, and but little removed from the tip of the long simple vein that has been already described; the inner branch is short, and passes obliquely outwards to the inner margin, leaving an unusually wide double wedge-shaped area between the two branches. As a result of this curious disposition of two branches having a common origin, a large section of the inner apical margin is destitute of veins.

The cubitus arises near, or may be united to, the base of the media. This is a point which cannot be determined, the wing-base being broken away. It at once divides into two main branches, the

outer being simple and forking once far forward, after which the branches curve gently backwards and then outwards to the margin. The inner ramus gives origin to three branches, the first and third being forked, the central simple and unbranched. The veins follow a similar course to those of the outer ramus.

The anal area has been broken away along the line of the anal furrow, the latter passing in an open curve from a little below the middle of the base of the wing outwards to the margin, which it reaches a little below the middle line.

Affinities.—The distinguishing feature of this wing is the basal branching of all the veins with the exception of the median, and the width of the area occupied by them at their origin. Usually, in the blattoid wing, the chief veins arise as nearly as possible in contact with one another; or else two or more may have a common stem. In this case they are well separated, and are spread over nearly a third of the wing-base. Another feature of unusual character is presented by the wide interspaces between the veins in the middle of the wing. These wide interspaces are well seen between the lower ends of the branches of the radius, the wide interval between the main stem of the latter vein and that of the media, and again between the latter in the middle of its length and the outer branch of the cubitus. While this open spacing is a distinctive character of Handlirsch's family *Spiloblattinidæ*, it is not confined to that group; and, as it is accompanied in the present instance by a markedly triangular sub-costal area, in place of a strap-shaped one, it cannot be assigned to any genus of that family. It may be noted, however, that in general form, and in wide interspaces, it agrees with the genus *Atactoblatta*. Believing that the character and the mode of branching of the veins furnish the most reliable evidences of relationship, I am of opinion that the relationships of this form must be sought for among the members of the family *Mylacridæ* of Scudder. Within this family Dr. Handlirsch constituted a new genus *Orthomylacris*, with the definition of which the specimen closely agrees. His definition is as follows:—

'Front wing two to two and a third times as long as broad, of subordinate outline. Costal area extending one-half to two-thirds the length of the wing. Radius continuing to the apical border, with a variously large number of offshoots branching forward. The superior branch either simple or forked, more rarely strongly compound. Media with few veins directed obliquely backward to the apical and inner borders. Cubitus never continuing to the apical margin, with few branches. Anal area very long, at least twice as long as high, and extending two-fifths to one-half the length of the wing, with numerous more or less compound veins. Structure leathery, more or less distinctly cross-wrinkled.' (Proc. U.S. Nat. Mus. vol. xxix, 1906, p. 768.)

Only a very few somewhat oblique cross-wrinkles can be detected upon the specimen on the inner side of the apex. Elsewhere the wing-structure is smooth or somewhat granular, the granularity being perhaps due to the impress of the material in which the wing lies embedded. The surface of the wing is flatly and regularly

convex, with the exception of the inner portion of the sub-costal margin, which is slightly upcurved. No definite trace can be detected of an anal furrow.

Owing to its marked elongate character and doubly convex margins, I apply to this form the name of *Orthomylacris lanceolata*.

Horizon.—Shales associated with the Graigola Seam, Clydach Merthyr Colliery, Clydach Valley (Swansea Vale), Glamorganshire.

LAMPROPTILIA TENUITEGMINATA, sp. nov. (Pl. X, fig. 6.) [Reg. No. 24509.]

A right hinder wing of large size and considerable tenuity. The greatest length and breadth are 29 millimetres and 7 mm. respectively. The tenuity of the wing is so great that underlying plant-remains can be seen and traced easily. A leaf of *Lepidophyllum majus* overlies and partly conceals the base.

The venation is at first sight of the same general type as that of a blattoid tegmen; the branching is more extensive, however, and the distal expansion of the wing-surface much greater. The wing appears to have been somewhat quadrangular in outline, with a sinuous inner margin, and the base is much broader than in the ordinary form of blattoid. The outer margin is probably represented by a shadowy line along the middle third of the outer wing-margin, in which case it must have been fairly straight, in this region bending in a well-rounded angle to the tip of the wing, and the latter similarly merging in the delicate sinuous inner border.

The sub-costal area is narrow, strap-shaped, and probably extended over the whole length of the outer margin. No definite trace of veins can be discerned upon it.

The radial vein divides low down near the base into two rami, the outer being the smallest. The latter first divides about the middle of the wing, sending off a simple branch which reached the broad apical margin, and curving gently backwards as it approaches the latter. Farther out, the radius sends off at equal distances two more simple branches, which follow a course parallel to the first. It is then continued as a small vein, which bends somewhat abruptly inwards at the point of forking, and approaches close to the outermost marginal vein of the inner ramus. Its backward sweep is thus greater than that of the other marginal veins of the same ramus, and its course must have brought it out upon the margin near the middle point of the tip of the wing. The inner ramus of the radius forks low down, much nearer the base than the corresponding bifurcation of the outer ramus, and the two branches into which it is divided fork again nearly at the same level near the middle of the wing. Of the four branches thus produced, the outermost remains simple to the margin, the inner branches forking on a level with the second branching

of the radius. The course of the veins is irregular, the interspaces widening and narrowing along their length. This may be due to distortion of the wing when deposited upon the mud. The marginal veins arising from the radius extend over the whole inner portion of the wing-tip, owing to their strong backward course in the final portion of their length, the direction being almost at right angles to the basal portion of the stem-vein.

The media divides almost at its point of origin, the outer branch forking a little below the middle of the wing, beyond which the veins become so attenuated that their course is but faintly outlined to the distal end of the inner margin. The inner vein forks low down, and again in the middle of the wing, the resultant four branch-veins thinning out much as do those of the outer branch. They are impressed as very faint lines, the continuity of which cannot be traced back to the inner margin.

The course of the cubitus is obscured by a reed-like plant which underlies it. It is much less distinct than the rest, only two basal portions being distinguishable.

The anal area is filled by a broad series of thread-like veins, which sweep outwards and backwards in a fan-like form to the inner margin, and occupy fully one-half of it. The innermost anal veins are quite geniculated close to their origin, so that they bend abruptly backwards. They all seem to arise from a comparatively few (four to six) stems.

The inner margin of the wing to a third of its total depth is quite filmy and veil-like, the veins crossing the area as faint shadowy lines. The outer two-thirds is more strongly impressed, while indications are present which lead to the inference that in the broad base of attachment the stem-veins were more than usually robust. No trace of transverse veins, of wrinkles, or of a reticulation is shown.

The specimen lies in a small fragile block of brown mudstone or shale, crowded with plant-remains, among which I have distinguished *Lepidophyllum majus* and *Cordaites*.

Affinities.—Hind wings of insects are so rarely found in the Coal Measures, that generic or specific determination is a matter of no small difficulty. Unless found in association with the tegmina, it may well happen that they may be referred to a different genus. Dr. Sellards,¹ who devotes more than usual attention to blattoid hind wings and also figures several, says that they did not fold longitudinally as in recent forms, and that cross-veins are not known. The inner border was full and well rounded, making the wing broad in proportion to its length. Dr. Sellards's types may best be described as broadly ovate, and much unlike the form here described. They are indeed but little removed from the tegmina in shape. Scudder, Handlirsch, and others have hardly touched this question,

¹ 'Structure of Fossil Cockroaches' Amer. Journ. Sci. ser. 4, vol. xviii (1904) p. 119.

and have frankly avowed that, in the present state of our knowledge, the classification of the Palæozoic cockroaches is largely artificial and a matter of convenience. That such is the case I believe few will venture to dispute.

After a considerable amount of comparison and research, I have abandoned the possibility of blattoid affinity, and find the nearest analogues to this wing in the genus *Lamproptilia* of Charles Brongniart. That author described and figured two species, *L. grand'euryi* and *L. stirrupi*,¹ which show a close agreement with the form here described. This is more closely related to *L. stirrupi* than to *L. grand'euryi*, it is more quadrangular in outline than either, and the costal area is much broader. The anal portion of the wing is of greater tenuity, and occupies fully half of the inner margin, while the latter is almost straight in its distal half. To distinguish it as a species, I assign to it the name of *Lamproptilia tenuitegminata*.

HORIZON.—Level in No. 2 Rhondda Seam, $1\frac{3}{4}$ miles north-east of Resolven Station (Glamorganshire).

IV. GENERAL OBSERVATIONS.

One feature of some interest is the marked association of these blattoid wings with vegetable remains, especially the leaves of *Cordaites* and the pinnules of *Neuropteris*. In several cases the wings are interbedded with *Cordaites* leaves. The wing of *Hemimylacris obtusa* occurs in a typical underclay, and that of *Lamproptilia* in a yellowish-brown shale crowded with plant-remains. The proximity of the deposits to a land-surface seems evident. I have elsewhere alluded to the presence of sunken pits in the *Cordaites* leaves, and the possible bearing which these may have upon the use of *Spirorbis pusillus* as food by the blattoids. Seudder, Sellards, and several others have noticed the association of blattoids with fossil plants, Dr. Sellards suggesting that they were fond of moist low places with abundant vegetation, such as would be found along the banks of rivers and marshes.² From such situations the transference of dead insects and loose vegetation into the water would be inevitable.

Any attempt to discuss the relationship of these South Wales blattoids with those of North America or Europe could only be based upon somewhat vague conjectures. The presence of Archimylacrid and Orthomylacrid forms, no less than the presence of *Lamproptilia*, is indicative of a considerable advance in insect development in this country beyond the more primitive palæodictyopteran types; and from their abundance we may fairly

¹ 'Études sur le Terrain Houiller de Commeny' vol. iii (1893) pp. 467-70 & pl. xxxv (19), figs. 7-9.

² E. H. Sellards, 'Structure of Palæozoic Cockroaches' Amer. Journ. Sci. ser. 4, vol. xviii (1904) p. 122.

expect to find more lowly types in the Lower Series of the South Wales Coalfield at some distant date, or even traces of their presence in rocks of Older Palæozoic age. Their occurrence may also be regarded as indicating the possibility of a terrestrial fauna somewhere in the South Wales Coalfield.

In conclusion, I wish to acknowledge my indebtedness to the Director of H.M. Geological Survey, who placed the specimens in my hands for study; to Dr. Aubrey Strahan, F.R.S., for information respecting localities and the stratigraphy of the South Wales Coalfield; to Mr. J. W. Tutchter for his kindness in photographing the specimens amidst the pressure of much other work; to Mr. R. E. J. Bush, A.R.C.A., who has prepared the wing-diagrams with great skill and accuracy; and to Mr. John Pringle, of the Geological Survey.

EXPLANATION OF PLATES VII-X.

[The photographs are by Mr. J. W. Tutchter, and the line-drawings by Mr. R. E. J. Bush, A.R.C.A. All the figures are magnified 2.6 diameters; the specimens are in the Museum of Practical Geology, Jernyn Street, London, S.W.]

PLATE VII.

Fig. 1. Figure of *Gerablattina arcuata* Sellards, to illustrate the terminology of the wing:—

Redtenbacher.	Heer.
I. Costa.	I. Marginal.
II. Sub-costa.	II. Mediastinal.
III. Radius.	III. Scapular.
IV. Media.	IV. Externomedian.
V. Cubitus.	V. Internomedian.
VI. Anal veins.	VI. Anal veins.

The terminology of Redtenbacher is followed in the text.

2. *Archimylacris* sp. indet. and pronotum. [Reg. No. 24508.] (See pp. 152, 153.)

Horizon.—Mynyddislwyn Vein, Gellideg Level, near Maes-y-cwmmwr (Monmouthshire).

3. *Hemimylacris convexa*, sp. nov. [Reg. No. 24512.] (See p. 156.)

Horizon.—Shales associated with the Graigola Seam, Clydach Merthyr Colliery, Clydach Valley (Swansea Vale), Glamorganshire.

Figs. 4 & 5. *Archimylacris* (*Schizoblatta*) *obovata*, sp. nov. [Reg. Nos. 24506 & 24507.] (See p. 157.) Left tegmen and impression. A large portion of the inner half of the wing is missing. The impression is more complete.

Horizon.—Mynyddislwyn Vein, Gwernau Level, near Maes-y-cwmmwr (Monmouthshire).

Fig. 6. Diagram showing the course of the veins in *Archimylacris* (*Schizoblatta*) *obovata*.

PLATE VIII.

Figs. 1 & 2. *Gerablattina* (*Apthoroblattina*) *sulcata*, sp. nov. [Reg. Nos. 24505 & 24504.] (See p. 165.) Greater part of the right tegmen and impression of the same. The under surface of the wing is shown.

Horizon.—Gwernau Level of the Mynyddislwyn Vein, near Maes-y-cwmmmer (Monmouthshire).

Fig. 3. Diagram showing the course of the veins in *Gerablattina* (*Apthoroblattina*) *sulcata*.

PLATE IX.

Figs. 1 & 2. *Archimylacris* (*Etoblattina*) *hastata*, sp. nov. [Reg. Nos. 24501 & 24502.] (See p. 160.) Impression of and greater part of the left tegmen. The proximal portion and the inner half of the apex of the wing are missing.

Horizon.—Gellideg Level of the Mynyddislwyn Vein, near Maes-y-cwmmmer (Monmouthshire).

Fig. 3. Diagram showing the course of the veins in *Archimylacris* (*Etoblattina*) *hastata*.

PLATE X.

Fig. 1. Left tegmen of *Orthomylacris lanceolata*, sp. nov. [Reg. No. 24511.] (See p. 167.) A portion of the base of the wing and the whole of the anal area are missing.

Horizon.—Shales of the Graigola Seam, Clydach Merthyr Colliery, Clydach Valley (Swansea Vale), Glamorganshire.

2. Diagram showing the course of the veins in *Orthomylacris lanceolata*.

3. *Archimylacris* sp. indet. [Reg. No. 24503.] (See p. 163.) A fragmentary blattoid tegmen showing the middle third of the wing-area, the rest being concealed under *Cordaites* leaves. The impressions made by the attachment of shells of *Spirorbis pusillus* can be seen upon the *Cordaites* leaf to the left.

Horizon.—Gellideg Level of the Mynyddislwyn Vein, near Maes-y-cwmmmer (Monmouthshire).

4. Right tegmen of *Hemimylacris obtusa*, sp. nov. [Reg. No. 24510.] (See p. 154.)

Horizon.—Four-Foot Seam of Swansea Gladys Colliery, a mile east-south-east of Penlller-gaer Church (Glamorganshire).

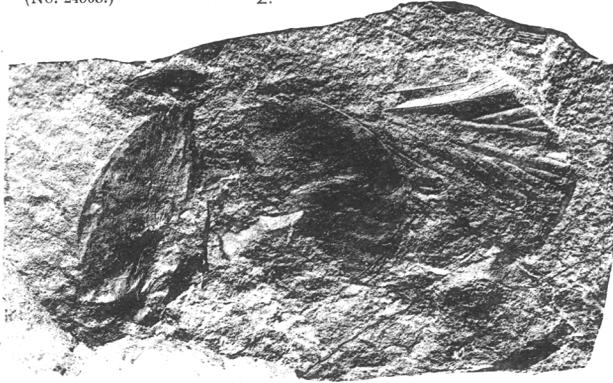
5. Diagram showing the course of the veins in *Hemimylacris obtusa*.

6. Right hinder wing of *Lamproptilia tenuitegminata*, sp. nov. [Reg. No. 24509.] (See p. 170.) The extreme tenuity of the wing and the almost straight inner margin are well seen in the figure.

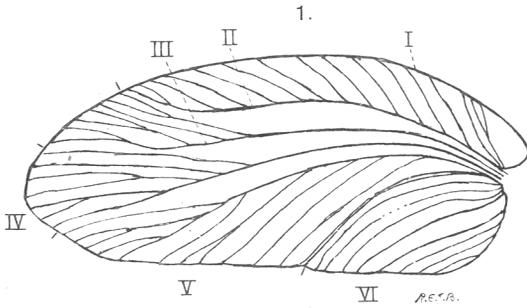
Horizon.—Level of No. 2 Rhondda Seam, 1½ miles north-east of Resolven Station (Glamorganshire).

(No. 24508.)

2.



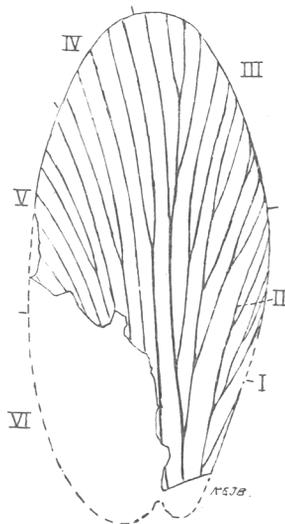
(No. 24512.) 3



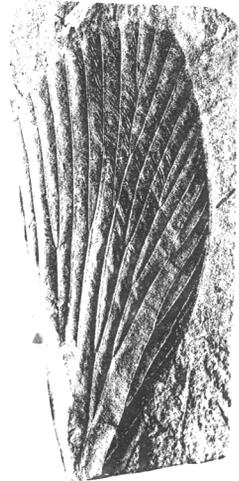
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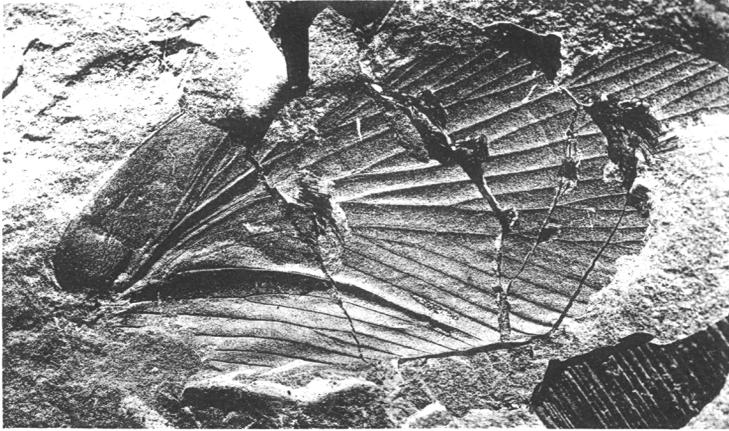


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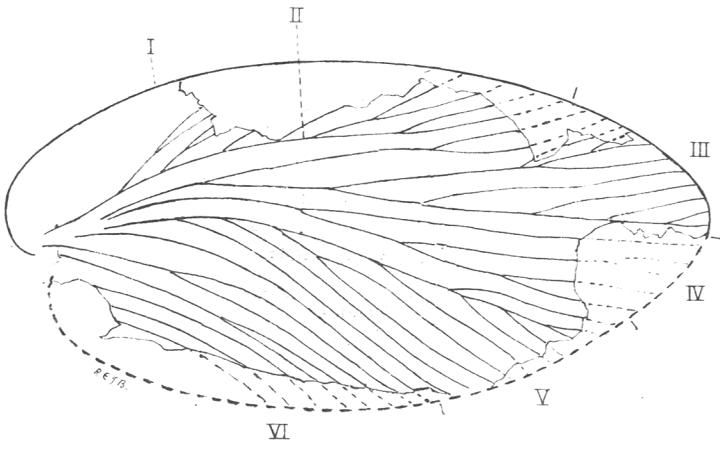


J. W. Tutcher, Photogr.

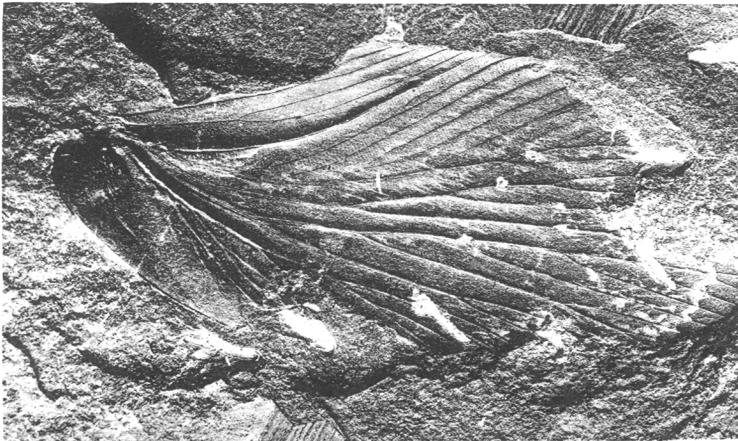
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1.



3.

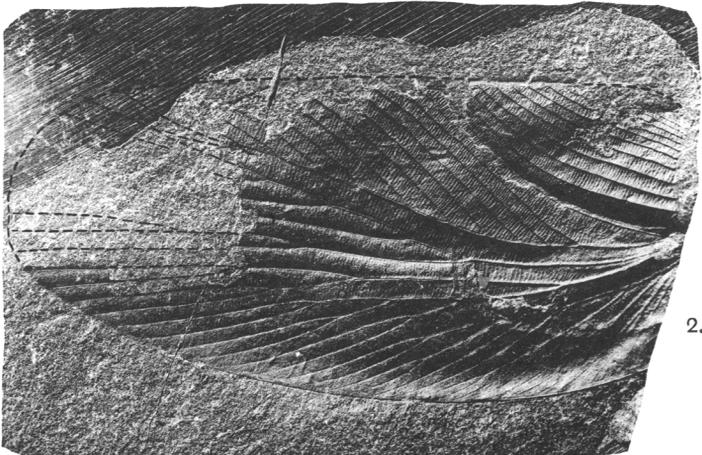
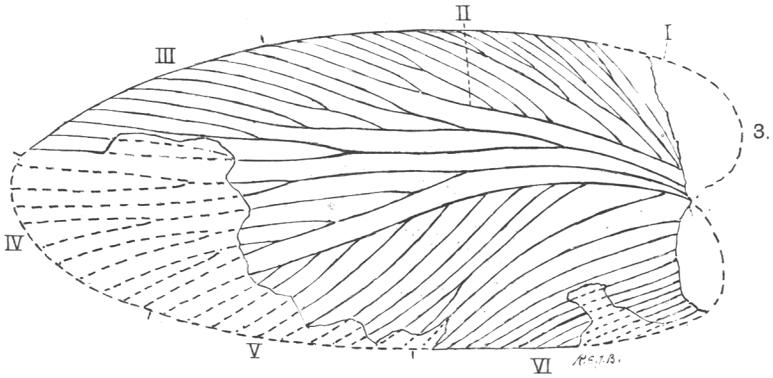


2.

J. W. Tatcher, Photogr.

Bemrose Ltd., Collo., Derby.

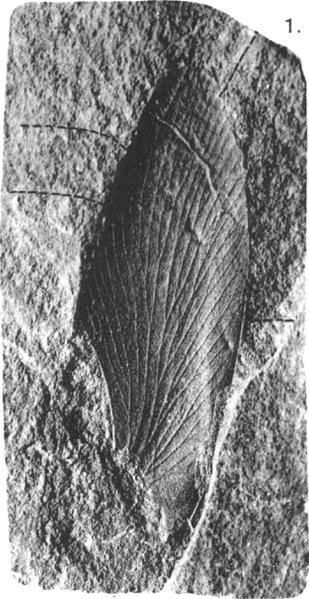
GERABLATTINA (APHTHOROBLATTINA) SULCATA.



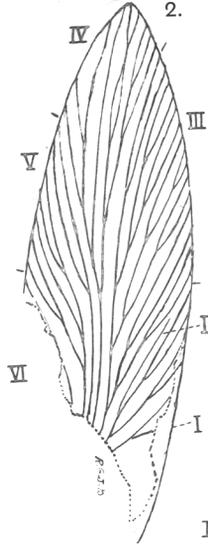
J. W. Tutchet, Photogr.

Benrose Ltd., Collo., Derby.

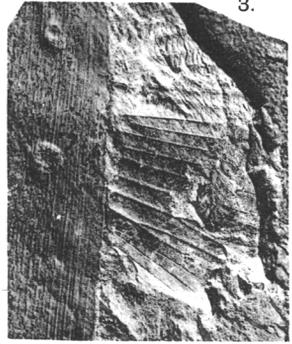
ARCHIMYLACRIS (ETOBLATTINA) HASTATA.



1.



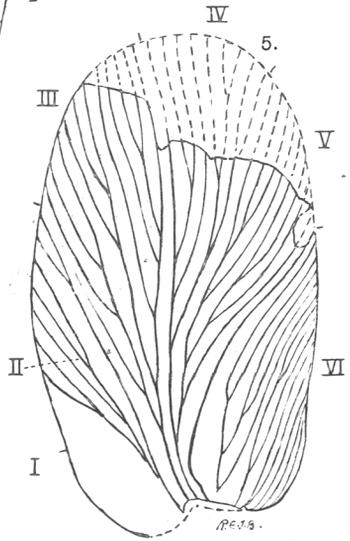
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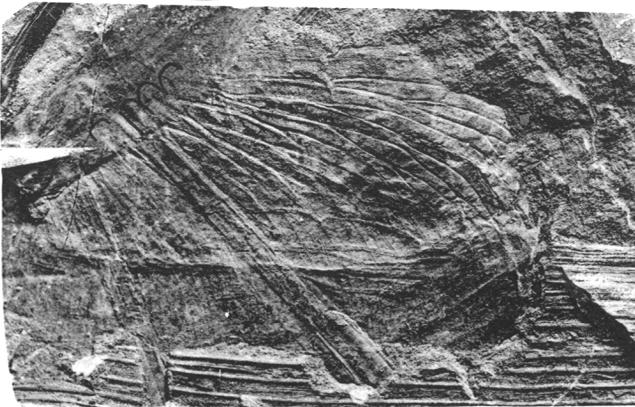


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ORTHOMYLACRIS, ARCHIMYLACRIS, LAMPROPTILIA, ETC.