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NEW FOSSIL INSECT WINGS (PROTOHEMIPTERA, FAMILY MESOTITANIDÆ).

By

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(Plates iv-vii, and Figures 1-3.)

THE present paper contains descriptions of a new genus and two species of fossil insects of the family Mesotitanidæ, Order Protohemiptera from the Middle Triassic beds of Beacon Hill, Brookvale, N. S. Wales. They occur in a lenticular mass of shale, about twenty-five feet in thickness, enclosed in the Hawkesbury Sandstone. From the same beds a large series of fishes has been obtained; these have been described by Dr. R. T. Wade.¹ I have also included notes on a fossil wing of *Mesotitan scullyi* Till., which is in a more complete state of preservation than the type specimen.

A few notes regarding *Clatrotitan andersoni*, sp. nov., and its discovery will be of interest. The fossil was collected by Mr. W. Bass, foreman of a brick quarry at Beacon Hill, Brookvale, near Manly, to whose interest this Museum has been indebted for many interesting specimens from time to time. From Mr. Bass the specimen was obtained by Dr. C. Anderson, Director of the Australian Museum.

The specimen is probably one of the most magnificent fossil insect wings in existence, on account of its large size, its beauty and the perfect state of its preservation. From this wing it is possible to estimate that the insect in life attained a wing-span of some twelve inches, but further reconstruction is impossible since we have no indication of the form of its body and appendages. In view of the perfect preservation of the single wing which remains to us, one cannot but regret that some portion, at least, of the body had not been included in the block of stone containing the specimen.

Although the Mesotitanidæ are provisionally included in the order Protohemiptera, doubt has been expressed in some quarters as to their actual affinities, and whether they can validly be considered to have Hemipterous characters. There is no doubt that a study of the venation, and especially of the remarkable "resonating area", should throw considerable light upon this problem.

Had the wing-tip only been preserved, it would have been possible to have prepared a reconstruction of the venation of the remainder on conventional lines, but such a reconstruction would have given not the slightest indication of the remarkable tympanum which occupies the basal two-thirds of the wing—a fact which emphasizes the danger of attempting such reconstructions from a small, and in many cases minute, fossil fragment.

¹ Wade.—The Triassic Fishes of Brookvale, New South Wales. British Museum (Natural History), 1935.

Dr. R. J. Tillyard has suggested that the insect is probably the male of *Mesotitan scullyi*, but in view of the paucity of the fossil material of members of this family that has, as yet, been discovered, and our present knowledge, such a conclusion seems unwarranted, and it has been considered advisable to consider it as a new species, and to erect a new genus for its reception.

I desire to record my sincere thanks to Dr. C. Anderson, Director of the Australian Museum, for permitting me to describe this remarkable specimen, and for his ever willing assistance and advice. I wish, also, to acknowledge indebtedness to Dr. R. J. Tillyard for assistance in solving complexities of venation, Professor L. A. Cotton, University of Sydney, for the loan of material from the Geology Department of the University, Miss N. B. Adams for executing the drawings, the beauty and accuracy of which are a tribute to her patience and skill. To Messrs. H. G. Gooch, University of Sydney, and G. C. Clutton I am indebted for the fine photographs which illustrate this paper.

Family MESOTITANIDÆ Till.

Genus *Clatrotitan*, nov.

Insects of very large size: main venation of wings strong; cross-veins somewhat obliquely arranged in regular single rows. Subcosta and radius nearly parallel and close together. Rs six-branched, pectinate. M two-branched. Cu₁ four-branched, pectinate, Cu₂ nine-branched, pectinate. A large "grid" (probably a resonating area) consisting of three rows of more or less regular oblong cells, traversed by the two branches of M. Cubito-median Y-vein strongly developed. Wings pigmented.

This genus is proposed for the reception of *Clatrotitan andersoni*, sp. nov.

Clatrotitan andersoni, sp. nov.

(Plate iv and Plate v, figs. 1-3; text-figures 1-3.)

The type specimen is a forewing in an extremely fine state of preservation.

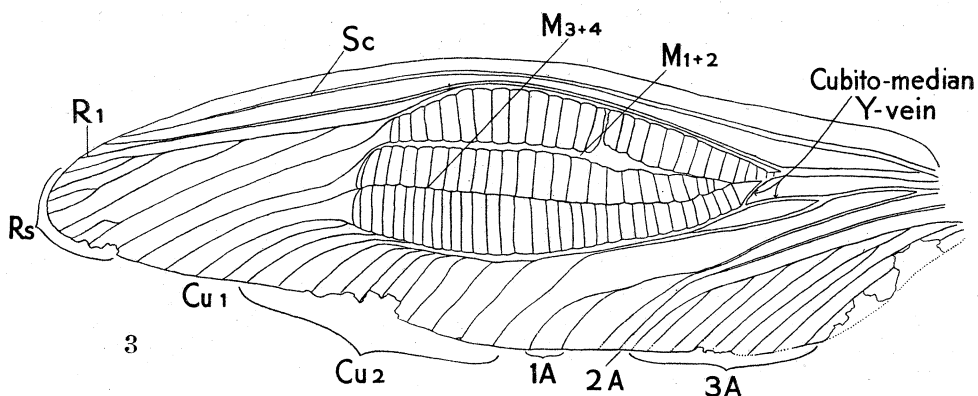
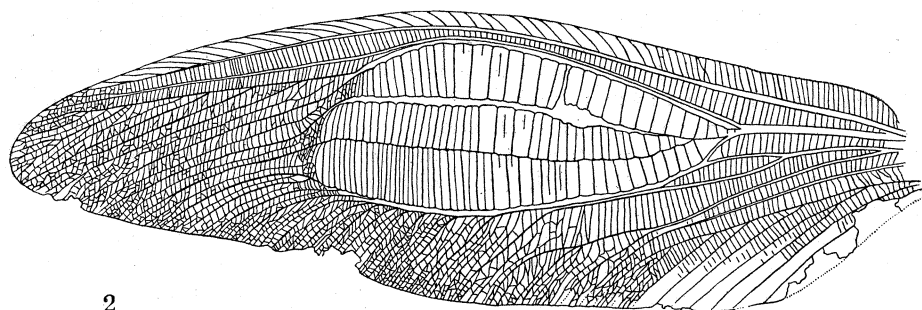
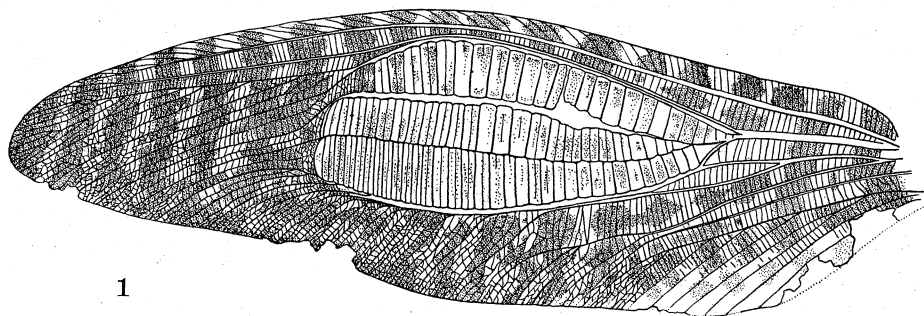
Total length of wing 138 mm., indicating a wing expanse of about twelve inches. Greatest breadth 44 mm.

Apex of wing somewhat obtusely pointed slightly nodding. Sc strongly concave, stout, with slender but clearly marked costal veinlets arising throughout its whole length; end of Sc about 15 mm. before apex of wing. R₁ strongly convex, as stout as Sc, running below and subparallel to it and ending just above apex. Rs slender, concave, unbranched until about two-thirds length of wing, when it gives off an obliquely descending pectinate series of fine veins. M with two branches only, viz., M₁₊₂ and M₃₊₄, running subparallel to one another and also to Rs above and Cu₁ below. M₁₊₂ and M₃₊₄ traverse the tympanum, and are unbranched throughout their length and strongly concave. MA is absent. Cubito-median Y-vein strongly developed. Cu₁ markedly convex and terminating in four drooping pectinate branches; it runs subparallel to, and a little above, the well-developed concave Cu₂, which has a strongly descending series of nine pectinate branches. 1A with one branch; 2A unbranched throughout its length; 3A with a pectinate series of descending branches, of which eight are visible (Figs. 1-3).

Archedictyon typical of the known Protohemiptera.

The "grid" or resonating area is a remarkable, somewhat irregularly lenticular area, 62 mm. long by 27 mm. broad, bounded by R₁ and Cu₁. The branches of

M , viz., M_{1+2} and M_{3+4} , traverse this area, which is formed of three rows of oblong cells, 78 in number, of which 25 are in the upper, 21 in the median, and 32 in the lower row. The cells comprising the central row are, on the average, the widest, while those of the third are the narrowest of the series. The average dimensions of the cells are as follows: Row 1, 7 mm. \times 2 mm.; Row 2, 7 mm. \times 2.4 mm.; Row 3, 7 mm. \times 1.78 mm. Each cell is roughly oblong in shape, clearly and



Figs. 1-3.—Wing of *Clatrotitan andersoni*, sp. nov.
1. Pigmented areas, etc. 2. Venation. 3. Key to main venation.

N. B. Adams, del.

deeply defined on the lateral margins with a somewhat lunular area with a raised border, with an elevated hour-glass-shaped area in the centre; ends of cells rounded. The structure of the "grid" and its component cells is splendidly shown in Plate iv, fig. 1, so that further detailed description is unnecessary.

Pigmentation is present. Seventeen clearly defined dark blotches on costal area; apex of wing heavily clouded with dark pigment, with a few irregular light areas. Toward base, and especially on anal region, the pigmented patches become sparse and irregular. Some indications of pigmentation are present on the "grid", particularly on the upper row of cells, but are very indistinct. On some sections of the wing the dark areas tend to form irregular fasciæ.

It appears probable, from the study of the tympana of recent insects, that the grid-like structure of the wing is a resonating area, and it may, therefore, be presumed that the wing is from a male example of the species. Nothing that could be regarded as stridulating apparatus is distinguishable on the wing, and, in the absence of the body of the insect, it is not apparent how any sound could have been produced, but it may be surmised from the large area of the tympanum that it must have been considerable.

Further material has been available for study in a complete wing in a very bad state of preservation, both original (obverse) and counterpart being badly shattered, and each is traversed by numerous fractures. Both specimens are in the Geology Department of the University of Sydney.

Total length of wing 118 mm., indicating a wing expanse of about $9\frac{1}{2}$ inches. Greatest width 40 mm. A smaller specimen than the type. Fourteen cells of the upper row of the "grid" are wholly or partially preserved; only one cell and indications of a second remain of the second row; the third row entirely destroyed. Costal area and apex of wing in a fair state of preservation. Section of anal area present showing a small portion only of the anal venation. The greater part of Sc and R_1 preserved, together with the basal portions of M and Cu, and the basal portions of Cu_2 and 3A.

Pigmentation present, there being seven squarish patches on the costal area; apex clouded with dark pigment with indications of irregular wavy light bands.

The species is dedicated to Dr. C. Anderson, Director of the Australian Museum, Sydney.

Holotype: Australian Museum, Sydney (F 36274). Middle Triassic, Beacon Hill, Brookvale, near Manly, New South Wales (W. Bass).

Paratypes: Paratype ($\begin{smallmatrix} I \\ 1 \end{smallmatrix}$) and paratype counterpart ($\begin{smallmatrix} I \\ 2 \end{smallmatrix}$), Beacon Hill, Brookvale, near Manly, N.S.W., Geology Department, University of Sydney, Sydney.

Mesotitan tillyardi, sp. nov.

(Plate vi, fig. 2.)

Total length of wing preserved 87 mm., indicating a full wing-length of at least 145 mm., and an expanse of wing of about 12 inches. Greatest width 36 mm.

Base and apex of wing wanting. The preserved portion of the wing consists of the central portion, equalling about half the total area. The greater part of the anal area is wanting, together with the posterior marginal area, which is badly broken and crumpled.

Sc markedly concave, very strongly developed, with slender but clearly marked costal veinlets arising along its whole length, slanting very obliquely toward apex. R_1 markedly convex, almost, but not quite, as stout as Sc, running below and sub-

parallel to it. R_s a slender concave vein, unbranched for 51 mm. from its origin, when it gives off an obliquely descending vein, R_{4+5} ; the other branches from R_s have been destroyed. M dividing into two branches only, both of which are concave, and there is no MA present. M_{1+2} runs subparallel to M_{3+4} . Both veins curve somewhat sharply downward, causing them to run parallel to each other and to the first branch of R_s , viz., R_{4+5} . Cu_1 not very strongly developed, but markedly convex, running subparallel to and a little above Cu_2 . Portion preserved unbranched. A short section only, 17 mm. in length, of Cu_2 is present; no trace of branching remains in the specimen. A section only, 14 mm. in length, remains intact of $1A$ and $2A$. $1A$ convex, $2A$ concave.

Archedictyon typical of the Mesotitanidæ, but transverse veins much coarser and more prominent than on other species.

Pigmentation present, the wing being irregularly mottled and blotched with alternating areas of dark pigment with light areas intervening; these dark areas are squarish, tending to form irregular and broken transverse fasciæ. Some ten such fasciæ can be made out crossing the wing from the costal margin on the part preserved. Patches of dark pigment most distinct on costal area; elsewhere poorly defined.

The cell formation in the area between R_s and Cu_1 is large and well defined, the dividing veinlets being very marked and strongly defined, and might almost be described as an incipient "grid", or at least as indicating the primitive type of cell structure giving rise to the "grid" or resonating area so strongly developed in *Clatrotitan andersoni*. A very interesting specimen forming, perhaps, a transitional stage intermediate between *Clatrotitan* and *Mesotitan*, but until further material is forthcoming may be left in the latter genus.

Holotype: Holotype specimen (GD), Beacon Hill, Brookvale, near Manly, New South Wales; in Coll. Geology Department, University of Sydney, Sydney.

This species is dedicated to Dr. R. J. Tillyard, whose work has greatly advanced our knowledge of the fossil insects of Australia.

Mesotitan scullyi Tillyard, 1925.²

(Plate vi, fig. 1; Plate vii.)

A further specimen of this species was included in the material studied during the preparation of this paper, and has been compared with the type wing fragment. Since this specimen is more complete than the type, it is considered advisable to give an account of it here.

Total length of wing preserved 131 mm., indicating a full wing length of at least 145 mm., and an expanse of wing of about 12 inches. Greatest width 34.5 mm.

Extreme apex of wing wanting. The preserved portion of the wing consists of the proximal nine-tenths; the anal area is wanting, together with portion of the posterior margin, which is somewhat badly crumpled.

Sc markedly concave, very strongly developed, with many slender but clearly marked costal veinlets arising along its whole length, erect on basal third of wing; slanting very obliquely toward apex on distal two-thirds. R_1 markedly convex, but quite as stout as Sc , running below and subparallel to it. R_s is a slender concave vein diverging from R_1 33.75 mm. from base of wing and continuing unbranched for 54.5 mm., when it gives off an obliquely descending pectinate

² Tillyard.—Proc. Linn. Soc. N. S. Wales, 1, 1925, pp. 374-377.

series of two veins, the first being R_{4+5} , the second R_2 . It would appear probable, on the analogy of the type wing-tip of *Mesotitan scullyi*, that there are a third and fourth short terminal branches from R_2 . M diverges 37 mm. from base of wing into two branches only, M_{1+2} and M_{3+4} . Both these branches are concave and there is no MA present. M_{1+2} runs subparallel to M_{3+4} , also to Rs and R_{4+5} above and Cu below for about 51.5 mm., when it dips sharply toward M_{3+4} and then rises again toward the apical portion of the wing. Cu_1 not very strongly developed, but markedly convex, running subparallel to and a little above Cu_2 , and forking distinctly in a descending branch at a point about two-thirds its length. Cu_2 well developed, concave, with a descending pectinate series of branches, of which five can be distinguished. Three anal veins can be distinguished, but the whole of the anal area is much crumpled and broken.

Archedictyon typical of the Mesotitanidæ.

Pigmentation present, the wing being irregularly mottled with areas of dark pigment alternating with light blotches; these dark areas are squarish in shape, tending to form very irregular and broken transverse fasciæ; some ten such fasciæ can be made out crossing the lighter parts of the wing from the costal margin on one portion preserved. The fasciæ are darker and more regular towards the base.

This specimen (Plate vi, fig. 1) is preserved in the Collection of the Geology Department, University of Sydney, Sydney. $\frac{US}{GD}$ 310, Beacon Hill, Brookvale, near Manly, New South Wales.

In order to make as much information as possible available to workers on our fossil insects of the family Mesotitanidæ, I reproduce herewith (Plate vii) a photograph of an almost complete forewing, together with portion of another ? hind-) wing below. The specimen represented in the photograph was, it is understood, in the possession of the Geology Department of the University of Sydney, but its present location, at the time of writing, is unknown; it has therefore been impossible to examine it.

The basal third of the large wing has been broken and forced downward from the costal margin with consequent crumpling, especially of the anal area, and portion of the branching of Cu_2 .

The second wing consists of approximately the posterior half of the wing; the section between the costa and the main stem of Cu_2 is in a good state of preservation. Then venation is similar to that of the large wing.

Rs has its origin very close to the base of the wing, about 6/7 of the distance from the apex. The forking of M is also very clearly shown. Cu_1 unbranched. Portion of Cu_2 is preserved, and shows indications of five pectinate branches. Sections of two anal veins (unbranched) remain, but almost the whole of the anal area and the posterior branches of Cu_2 are buckled and destroyed.

Apex of the wing is strongly pointed, slightly nodding.

Details are well shown in the photograph.

It is impossible in the absence of the specimen to state the dimensions, but the breadth of each wing is about $\frac{1}{4}$ of its total length.

The wings appear to be identical with those of *Mesotitan scullyi* Till. As far as I can ascertain, the specimen was secured, like the others, at Beacon Hill, Brookvale, N. S. Wales.

EXPLANATION OF PLATES.

PLATE IV.

Photograph of type of *Clatrotitan andersoni*, sp. nov. Beacon Hill, Brookvale, New South Wales.

PLATE V.

Fig. 1.—Portion of resonating area of wing of *Clatrotitan andersoni*, sp. nov. (type) (greatly enlarged).

Fig. 2.—Paratype counterpart of *Clatrotitan andersoni*, sp. nov. Beacon Hill, Brookvale, New South Wales.

Fig. 3.—Paratype of *Clatrotitan andersoni*, sp. nov. Beacon Hill, Brookvale, New South Wales.

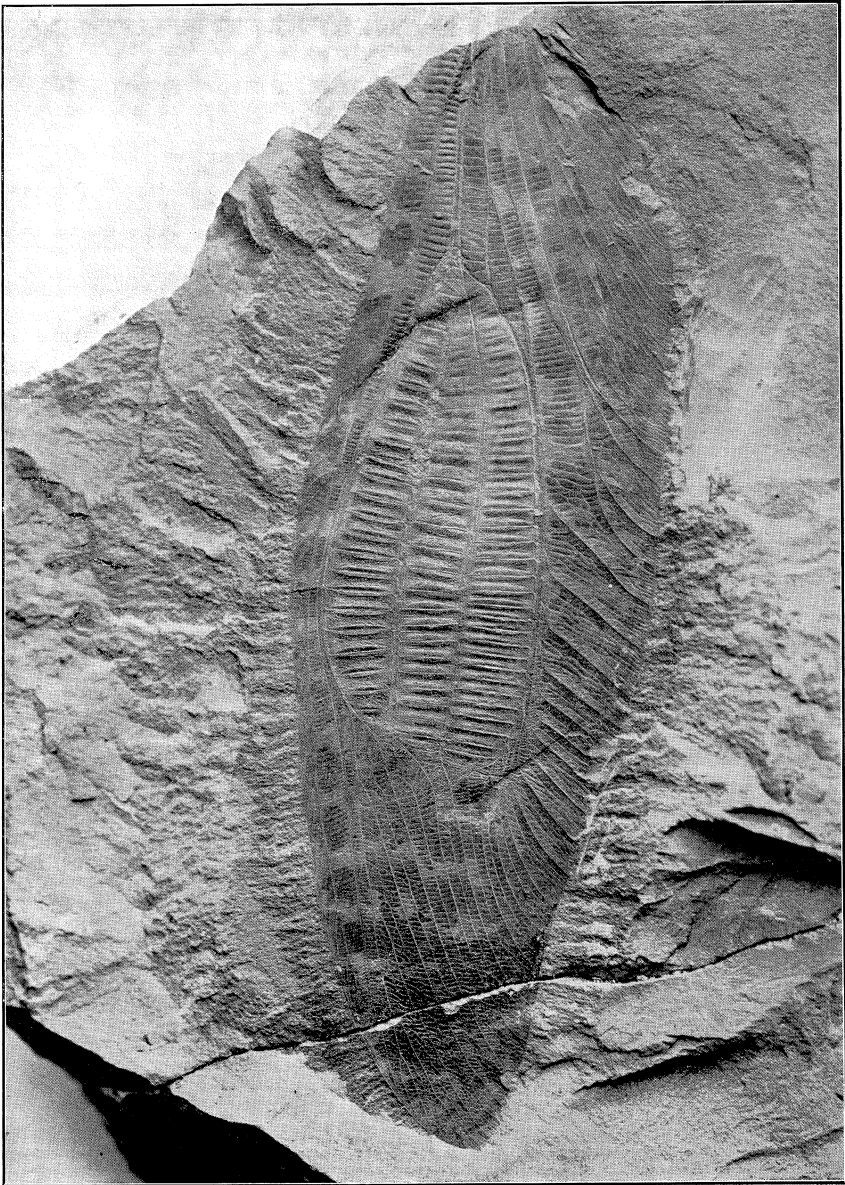
PLATE VI.

Fig. 1.—Wing of *Mesotitan scullyi* Tillyard. Brookvale, New South Wales.

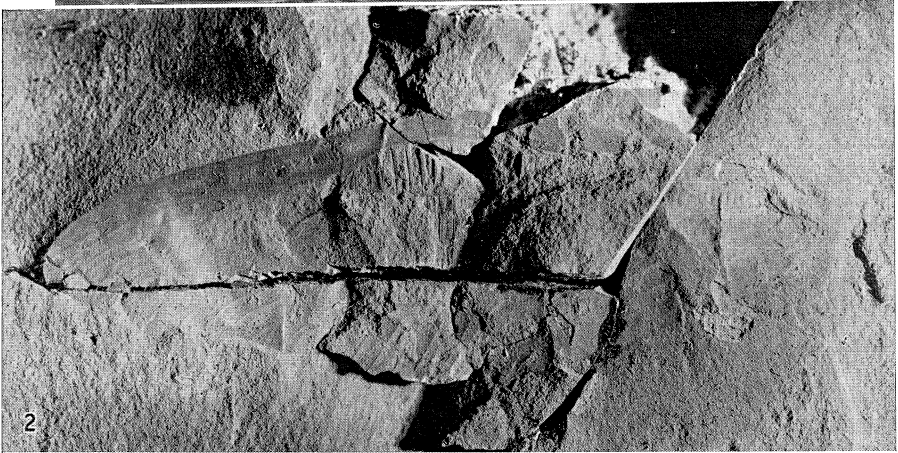
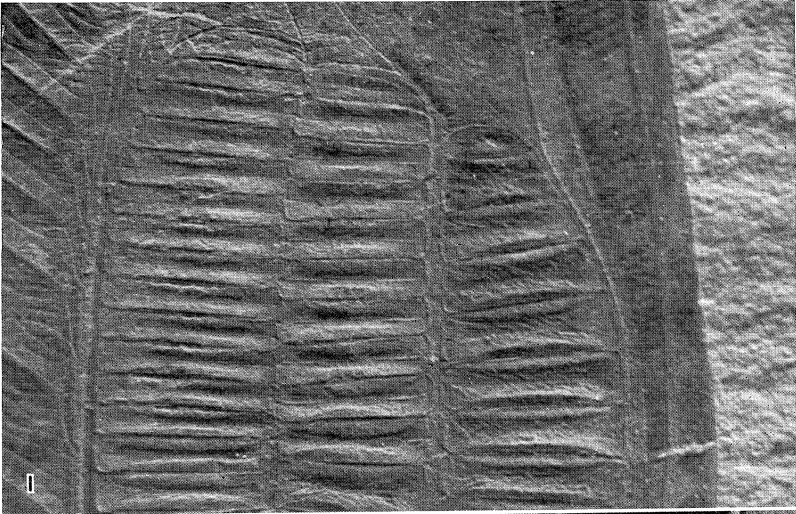
Fig. 2.—Wing of *Mesotitan tillyardi*, sp. nov. (type). Beacon Hill, Brookvale, New South Wales.

PLATE VII.

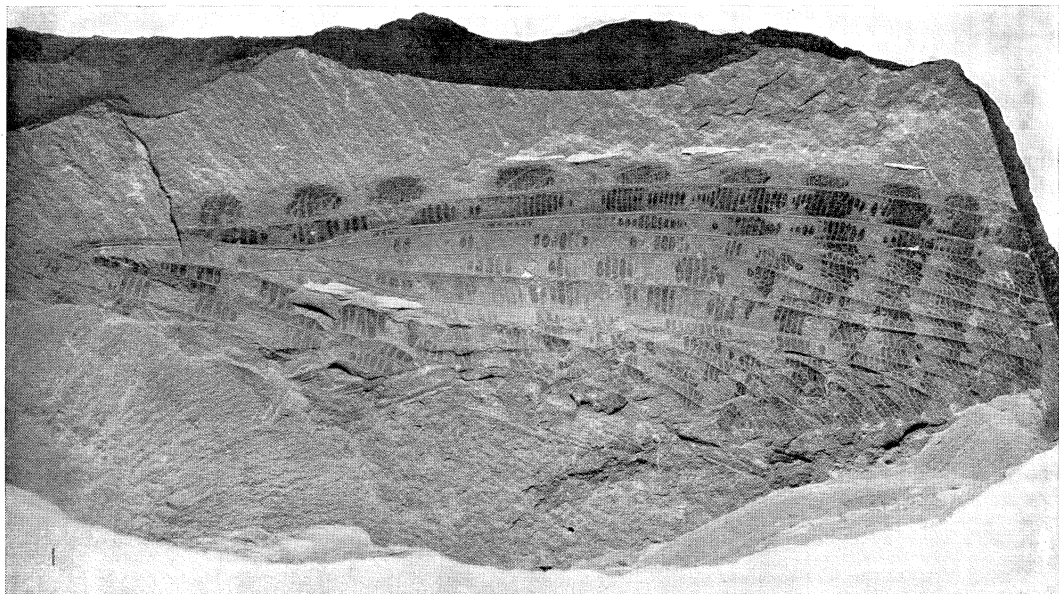
Wings of *Mesotitan scullyi* Tillyard. ? Brookvale, New South Wales.



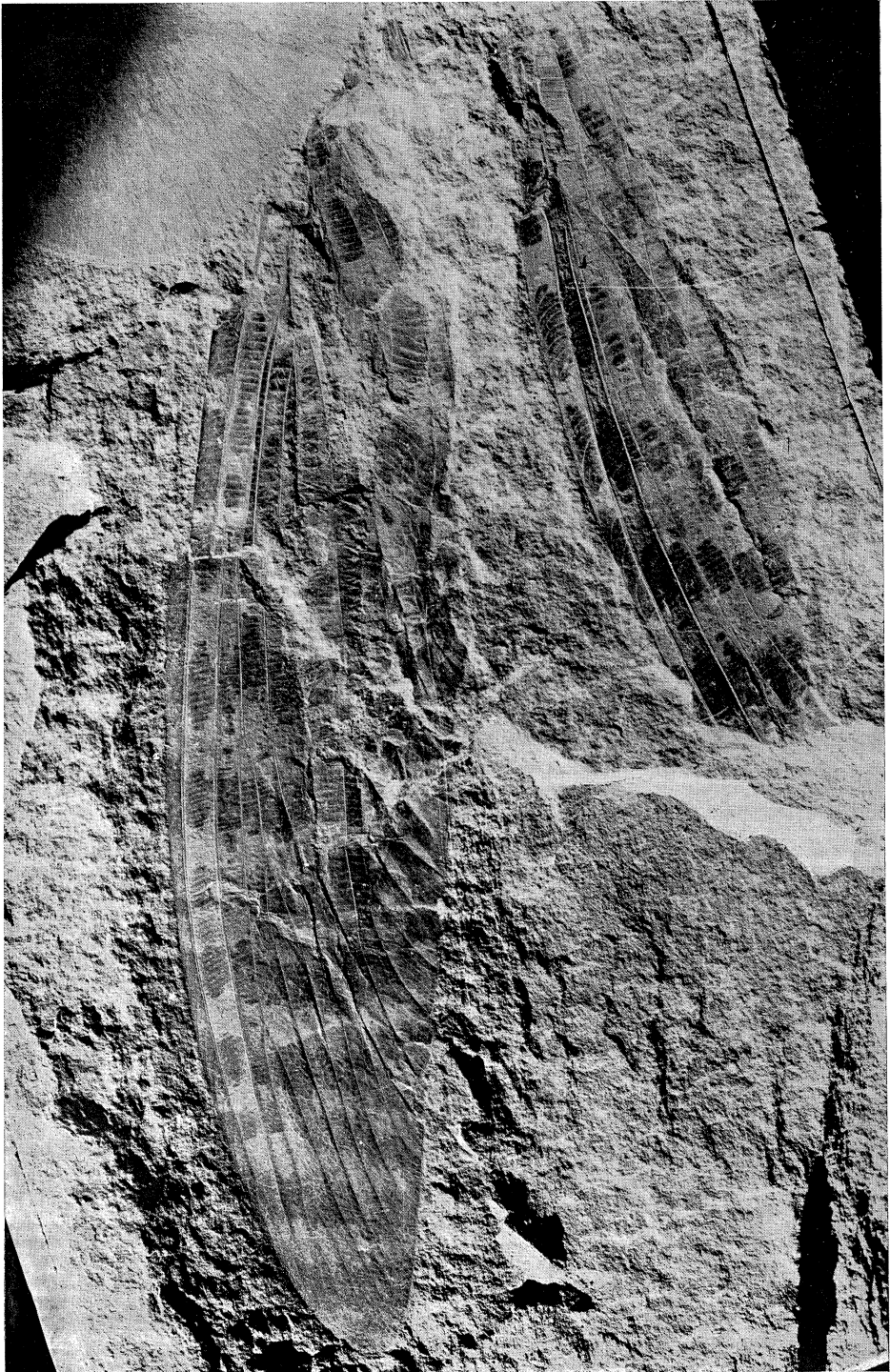
G. C. CLUTTON, photo.



G. C. CLUTTON, photo.



H. G. GOOCH (1), photo.
G. C. CLUTTON (2), photo.



H. G. Gooch, photo.