There are considerable differences between Sowerby's figure and the photograph of the type-specimen reproduced in the *Palæontologia universalis* (ser. II, fasc. 1, No. 92a), but it should be mentioned that Sowerby's figure, besides being reversed (as usual) and somewhat restored, represents the fossil *without* the natural internal cast of the body-chamber (which, as Sowerby himself observed, is separated from the rest of the shell), whilst in the photograph this portion of the fossil has been placed in its natural position.

VII.—NOTES ON THE MORPHOLOGY AND GENERIC NOMENCLATURE OF SOME CARBONIFEROUS ARACHNIDA.

By R. I. Pocock, F.L.S., F.Z.S.

1. ON *ANTHRACOMARTUS* AND *PROMYGALE*.

IN his monograph of Palæozoic Arachnida published in 1904, Dr. Fritsch divides the order Araneæ into two suborders—the Arthrarachnæ, Haase, containing the Arthrolycosidæ, and the Pleuraraneæ, Fritsch, containing the Hemiphrynidæ (*Hemiphrynus*) and the Promygalidæ (*Promygale*).

Haase, Beecher, and others, whom Fritsch follows, were no doubt right in referring *Arthrolycosa* and allied genera to the order Araneæ, but the Pleuraraneæ are in my opinion nothing but Anthracomarti, the genus *Promygale* itself being synonymous with *Anthracomartus*. The form of the carapace and structure of the appendages are the same in the two. The constriction between the prosoma and opisthosoma occurs in both. The segmentation of the opisthosoma is similar in the two, even in the presence of a longitudinal sulcus dividing the pleural laminæ into an external and an internal moiety, and in the angulation of the posterior border of the posterior sternal plates.

Certain discrepancies in the figures published by Fritsch inevitably rouse a feeling of scepticism on the score of the accuracy of the restorations they represent. In *Promygale bohemica* (fig. 20) there are eight dorsal plates; each of the anterior seven is furnished with a divided pleural lamina, the posterior border of the eighth being produced in the middle line to form an unpaired plate. But in fig. 21, showing the ventral side, the last-mentioned plate is paired by a longitudinal sulcus. In *P. elegans* (fig. 26a, dorsal view), on the other hand, there are only seven dorsal plates. On the seventh the inner moieties of the pleural laminæ are not shown, but on each side of the opisthosoma ten sclerites represent the outer moieties of these laminæ. It is impossible to refer these with any certainty to their appropriate somites, and impossible to say which of the original seven pleural laminæ have been subdivided to add to the number. A similar augmentation is shown in fig. 23, representing *P. rotundata*. This feature, if existent, should constitute a generic difference between *P. bohemica* on the one hand and *P. elegans* and *P. rotundata* on the other; but the drawings of the actual specimens of *P. elegans* (pl. xv, fig. 2) and of *P. rotundata* (text-fig. 24, p. 20) afford, so far as I can see, no support to the view that the pleural laminæ are numerically in excess of the somites. On the contrary, there appears to be complete agreement between them in this particular.

Again, in the dorsal view of *P. bohémica* (text-fig. 20, p. 19), the outer moieties of the posterior four pairs of pleural laminæ are marked with an additional concentric sulcus, which is continued across the unpaired lamina of the last tergal plate. This is no doubt the sulcus defining on the ventral side the outer plate of the laminæ, which is present in all the well-preserved specimens of *Anthracomartus* that I have seen.

One other difference, already referred to, between *Promygalé bohémica* and the species of *Anthracomartus* is the presence in the former, to judge from the drawings, of an additional tergal plate, cut off by a sulcus from the posterior half of the seventh tergum, making eight of these plates visible on the dorsal side. Apart from the fact that this plate is not so divided, either in *Eophrynus*, *Anthracosiro*, or *Anthracomartus*, a fact sufficient in itself to cast doubts upon the reality of its segmentation in *Promygalé bohémica*, it is noticeable that Fritsch himself omits the sulcus in question from his drawing of *P. elegans* (fig. 26, p. 21), and thus does not ascribe even a generic value to its presence in *P. bohémica*. Without further evidence I find it hard to believe in its existence.

With regard to the restoration of the ventral side of the same species (text-fig. 21), since the posterior margins of the sterna are represented by dotted lines, it may be assumed that these plates were cracked and obliterated beyond the possibility of accurate decipherment. All the more remarkable, therefore, must be regarded the circumstance that the so-called comb-like organs are so well preserved as to admit of detailed restoration. I suggest that these alleged organs are really the two deep impressions which lie, one on each side, of the anterior sternal plates in *Anthracomartus*. The settlement of this question, however, must be left until an opportunity of examining the fossil has been afforded to some competent Arachnologist.

Respecting the shape of the sternal plates as indicated on this drawing, it is noticeable that Fritsch has represented them by dotted lines running parallel with each other and at right angles to the longitudinal axis of the body, whereas the drawing of the original specimen of *P. elegans* (pl. xv, fig. 4) shows quite clearly that the sterna, at least in the posterior part of the body, are angularly curved in the middle line, exactly as in the examples of *Anthracomartus* that I have seen, thus establishing another point of similarity between this genus and *Promygalé*.

In referring the genus *Promygalé* to the Aranææ and *Anthracomartus* to the Opiliones, in spite of the striking similarity between them, Fritsch relies upon his alleged discovery of jointed appendages, representing the spinning mamillæ of the Aranææ, upon the lower side of the opisthosoma in *Promygalé* and their absence in *Anthracomartus*. In the restoration of *P. elegans* (text-fig. 26, B, p. 31) these appendages are shown as two pairs of slender three- or four-jointed limbs attached to the second and third sternal plates, each limb of a pair being widely separated from its fellow of the opposite side. I cannot think the drawings of the original specimens justify this conclusion. In fig. 3, pl. xv, showing the ventral side of *P. elegans*, the author has portrayed pieces of what he regards as small limbs scattered

without order, amongst other foreign bodies, over the exposed surface of the ventral side of the opisthosoma. Each piece consists of three or four segments, but they differ from each other so greatly in length and thickness that no successful attempt can be made to pair or homologize them. Moreover, no clue is afforded as to their original situation, and it is permissible to suggest that perhaps after all they are not appendicular in nature but fragments of the sternal skeleton; or indeed they may not belong to the organism at all like the so-called parasitic Spiroglyphs with which the fossil is strewn. And if appeal be made to fig. 4 on the same plate, representing the ventral side of another specimen, referred to the same species, and showing what might be interpreted as a pair of stout two-jointed limbs diverging from each other and from the middle line a little in front of the centre of the lower surface of the opisthosoma, it may be replied that, apart altogether from being in contact in the middle line, these segments bear no sort of resemblance to the restored opisthosomatic limbs depicted by Fritsch. I venture to suggest that, if appendicular in nature, the segments in question belong to one of the prosomatic appendages misplaced. But the angle they form coincides suspiciously with the angular curvature of the sterna of the mid region of the opisthosoma in *Anthracomartus*. In the specimens of the latter genus that I have seen, as well as in Ammon's drawing of *A. palatinus*, the borders of the sterna show up as angular ridges, the anterior and usually the strongest lying near the middle of the opisthosoma.

With respect to the eyes, two pairs are represented in the restoration of *Promygal bohemica*; but the drawing of the original specimen shows only a single pair placed differently from either of the pairs outlined in the restoration.

Since, then, critical examination of Fritsch's drawings of *Promygal* fails to produce any trustworthy evidence that this genus can be separated from *Anthracomartus*, there is no choice but to regard the two as identical.

As regards the Hemiphrynidæ, I have no doubt that these Arachnida must also be assigned to the Anthracomarti, since, so far as can be judged, they have the characters of that order. Most emphatically they do not belong to the order Araneæ. The genus *Hemiphrynus* was based upon two species—*H. longipes* and *H. hofmanni*; but since these cannot be congeneric, if the restorations approach reality, I propose to select *H. hofmanni* as the type.

The following features in Fritsch's restoration of *Anthracomartus* call for comment (text-fig. 41, A dorsal, B ventral side). In the figure representing the dorsal side, the palpi (appendages of the second pair) show six segments with a terminal knob, projecting beneath the fore border of the carapace. The subequality in the length of the segments is quite unusual in the Arachnida, and if the terminal knob be a segment there is one segment in excess of the normal found in the class. The following four pairs of appendages consist of eight segments, including the coxæ. This number also exceeds by one the normal found in Arachnida, the additional segment arising from the division of the femur. But in the first two pairs of these appendages the proximal segment

of the femur is twice the length of the distal, whereas in the last two it is only one-third of the length. Since the femora are sometimes segmented in the Chelonethi (Pseudoscorpiones), it would be rash to reject unhesitatingly on *a priori* grounds Fritsch's restoration of the legs in *Anthracomartus*; but since the legs of the specimens of the genus that I have seen, as well as of the allied genera *Eophrynus* and *Anthracosiro*, have normal and unsegmented femora like a great majority of the Arachnida, there can be very little doubt, I imagine, that Fritsch has mistaken fortuitous cracks for intersegmental joints. And this is by no means a solitary case where a knowledge of the constancy of certain morphological features in the Arachnida enforces the imposition of such an interpretation upon his restorations.

2. ON THE STRUCTURE AND CLASSIFICATION OF THE PHALANGIOTARBI.

The name Phalangiotarbi was proposed by Haase in 1890 for a group accorded subordinal rank under the Opiliones. It contained the genus *Phalangiotarbus* created for the species described by Dr. Henry Woodward as *Architarbus subovalis*. I agree with Haase in thinking the type-species of *Architarbus* and *Phalangiotarbus* generically distinct, and with Fritsch in regarding them as belonging to the same order of Arachnida. But whereas Fritsch referred them to a family of Opiliones, the Architarbidae, it appears to me necessary to give them higher systematic rank. I therefore retain the term Phalangiotarbi, leaving open for the moment the question of their right to inclusion in the Opiliones. In addition to the genera just mentioned I assign to this group *Geratarbus*, *Geraphrynus*, and the new genus *Opiliotarbus* described below.

The morphology of this series of genera has hitherto baffled research; and I am indebted to well-preserved material kindly lent to me by Dr. Wheelton Hind, Mr. S. Priest, the late Mr. W. Madeley, Mr. H. Johnson, F.G.S., and Mr. Walter Egginton for the new interpretation of the facts set forth in the following pages.

Since more than one species has in some cases been referred to the genera, I take this opportunity of stating that the type-species of each is as follows: *Architarbus*, Scudder, 1868; type, *A. rotundatus*, Scudder. *Geraphrynus*, Scudder, 1884; type, *G. carbonarius*, Scudder. *Geratarbus*, Scudder, 1890; type, now selected, *G. lacoeii*, Scudder. *Phalangiotarbus*, Haase, 1890; type, *Architarbus subovalis*, H. Woodw. *Opiliotarbus*, nov.; type, *Architarbus elongatus*, Scudder.

In the diagnosis of *Geraphrynus* published by Scudder in 1890, the genus is said to possess a "posterior shield of the cephalothorax, the anterior triangular fragment of which slopes upwards to the ridge [of the cephalothorax], while the hinder portions with their transverse scorings and ridgings lie on a plane below . . . this post-thoracic plate crowds down the middle of the six following segments".

Comparing the dorsal and ventral views of my specimens of *Geraphrynus* with Scudder's figure of *G. carbonarius*, I am forced to conclude that the so-called post-thoracic plate has no existence as such, but is composed of the anterior two or three sternal plates of the opisthosoma and the posterior projection of the carapace. It is

the latter area which "crowds down the middle of the six following segments"; the sternal plates are the anterior "triangular fragment" sloping upwards to the ridge as well as the "hinder portions with transverse scorings and ridgings" that "lie on a plane below"; and the median ridge is the sternal area of the prosoma. In a crushed specimen confusion might easily arise between these dorsal and ventral elements of the skeleton.

This interpretation, if correct, disposes of Haase's view of the morphology of *Architarbus*. This author modified Scudder's drawing to suit his idea that *Architarbus* belongs to the Amblypygous Pedipalpi. The anterior part of Scudder's post-thoracic plate he regarded as the posterior sternal plate of the prosoma and its posterior part as the genital plate of the opisthosoma. Scudder's drawing, however, does not justify Haase's rendering of it, full of ingenuity though his interpretation was.

Commenting on Haase's opinion, Hansen states that of the three specimens figured by Scudder as *G. carbonarius* "only one, the one figured on pl. xl, fig. 12, can with any certainty be classed amongst the Amblypygi"; and in an explanatory foot-note he adds that the figure shows eleven distinct sternites of exactly the same shape as those of *Phrynus*. This statement, however, is not true. No *Phrynus* has four narrow sterna following and curving round the genital plate nor the posterior sterna so well defined and large as shown in Scudder's figure. Hansen, moreover, ignores the existence of the plates in front of the backwardly bulging plate which, by implication, he takes for the genital operculum; and he is compelled to assume that the first pair of appendages exhibited by the fossil has been quite wrongly drawn. He seems, in fact, to trust to the accuracy of the drawing where it compares favourably, as he thinks, with a *Phrynus*, and assumes inaccuracy where the discrepancies are irreconcilable. The figure admittedly resembles a *Phrynus* superficially. So much so, indeed, that I feel sure the artist, Mr. H. Emerton, made use of a *Phrynus* to help his delineation; and this supposition is borne out by certain discrepancies between Scudder's description of the fossil and Emerton's figure of it.

The difficulties, then, that have hindered the understanding of the skeletal morphology of these fossil Arachnida are due to confusion between the dorsal and ventral elements. It appears to me that in nearly all cases the dorsal surface is exposed; but that owing to the removal or crushing of the carapace the underlying coxæ and sternal area of the prosoma and the anterior sternal plates of the opisthosoma are also shown. The figures of the following species bear out this view: *Architarbus rotundatus*,¹ *Geraphrynus carbonarius*,² *Geraturbus lacoei*,³ *Phalangiotarbus subovalis*.⁴

Judging from the figures published by Fritsch and Scudder of the species they name *Geraphrynus* (or *Architarbus*) *elongatus*, and from the material I have examined, I am convinced that in this group the

¹ Geol. Survey, Illinois, 1868, p. 568.

² Mem. Bost. Soc. Nat. Hist., vol. iv, pl. xl, figs. 1, 10, 12.

³ Ibid., fig. 11.

⁴ Geol. Mag., Vol. IX, p. 385, 1872 (*Ph. 'Architarbus' subovalis*, H. Woodw.).

carapace is large, unsegmented, and has either a straight or convex or considerably produced posterior border; at least, the coxæ of the four posterior pairs of appendages are large and radiate from a central broader or narrower sternal area. The dorsal surface of the opisthosoma consists of five or six straight or curved but always short or very short anterior terga, and of three or four much longer posterior terga; and the ventral surface of seven, possibly eight, sternal plates, of which the posterior are long and the anterior short, the first being triangular and wedged between the coxæ of the last pair of legs.

The following notes on the genera above mentioned will explain my reasons for admitting them:—

1. In *Phalangiotarbus subocalis* the anterior five terga of the opisthosoma are short and straight, and the posterior three large, there being eight in all. The posterior border of the carapace is straight, the anterior border widely rounded. The chief peculiarities of the genus, however, lie in the facts that the sternal area of the prosoma is large and oval and that the coxæ of the legs of the first pair do not meet in the middle line beneath those of the palpi. Only one specimen of this genus has been discovered, and I judge of its character from the figure published by Dr. Woodward.

2. *Architarbus*, represented by the single species *rotundatus*, has the carapace rounded in front and strongly produced in the middle line behind, with the anterior terga of the opisthosoma curved round its bulging area. There are nine terga in the opisthosoma, and they appear to increase progressively in length from before backwards, the anterior five or six being short. The sternal area of the prosoma is small and subcircular, and round it radiate four pairs of coxæ of the ambulatory limbs, those of the first pair meeting in the middle line and concealing the basal segments of the palpi. This species is only known to me from Scudder's figure and description.

3. *Geraphrynus* has the carapace angular in front and convex or produced behind. The opisthosoma has nine terga, the posterior three being much longer than the anterior six, two or more of which follow the curvature of the carapace. The sternal area of the prosoma is long and narrow, and the coxæ of the legs of the first pair meet in the middle line and underlie those of the palpi, as in *Architarbus*. From the latter *Geraphrynus* seems to be separable by the anterior angulation of the carapace, the long and narrow sternal area of the opisthosoma, and the marked enlargement of the posterior three terga of the opisthosoma. When characterized in 1884¹ this genus was based upon a single species represented by a specimen from Mazon Creek, Illinois. In 1890 the species was redescribed by Scudder,² several additional specimens being used for the purpose, but it is quite clear from the context that the example illustrated by fig. 10, pl. xl of the later work is the type. It is from the figure and description of this specimen and from examples of other species in my hands that the characters of the genus have been taken. Beyond recording my belief

¹ Proc. Amer. Acad. Arts & Sci., vol. xx, pp. 17-18.

² Mem. Bost. Soc. Nat. Hist., vol. iv, pp. 446-7.

that the other specimens described by Scudder as *G. carbonarius* were correctly referred to the genus *Geraphrynus*, despite the opinion of Hansen, I have nothing further to say about them. I cannot find any characters to justify the separation of *Hadrachne*, Melander,¹ from *Geraphrynus*.

4. *Geratarbus* was based upon two species, *G. scaber* and *G. lacoei*, which apparently belong to different orders of Arachnida, *G. scaber* being probably one of the Ricinulei. I select *G. lacoei*, therefore, as the type. Judging from the figure and description of *G. lacoei*, it seems that the posterior border of the carapace in *Geratarbus* is straight; the opisthosoma has nine terga, of which the anterior five are short and straight from side to side and the posterior four much longer, gradually increasing in length from the sixth to the ninth, the ninth equalling the sum of the seventh and eighth. The sternal area of the prosoma is narrow and elongate, and the coxæ of the first pair of legs meet only at their proximal ends and diverge at an acute angle. *Geratarbus* differs from *Geraphrynus* and *Architarbus* in the straightness of the posterior border of the carapace and of the anterior terga of the opisthosoma, in the difference in relative size of the posterior terga, and in the divergence of the anterior coxæ.

5. *Opiliotarbus*, nov. Carapace evenly rounded in front, its postero-lateral angles squared, and its posterior border straight. Opisthosoma nearly parallel-sided, somewhat widely rounded at its anal extremity, with apparently the normal number of sterna but only eight terga, of which the anterior five are short and straight and the posterior three very large. Sternal area of prosoma small, oval, longer than wide. Coxæ of legs of first pair in contact throughout. Type, *Architarbus elongatus*, Scudd.,² 1890, from Mazon Creek, Braidwood, Illinois.

Fritsch³ published figures and descriptions of what he believed to be the dorsal and ventral views of Scudder's type of this species. So far as the dorsal surface is concerned this view is probably correct; but it is perfectly clear that the figure of the ventral side, if approximately accurately drawn, was taken from another specimen. I have no doubt that it represents a species of *Geraphrynus*. Neither in its proportions nor in the position of its limbs can it be made to agree with Emerton's figure of the ventral view of the type or with Fritsch's own figure of the dorsal view of the latter.

Opiliotarbus has the posterior border of the carapace and the anterior terga of the opisthosoma straight as in *Geratarbus*, but it differs from that genus in having only eight terga on the opisthosoma, of which five are short and three very long.

When the characters of the genera above described are analysed, it seems that *Phalangiotarbus* stands quite apart from the others in the large size of the sternal plate of the prosoma and the wide separation of the coxæ of the legs of the first pair. For this reason I propose to follow Haase and refer it to a distinct family, *Phalangiotarbidæ*. To comprise the rest the family name *Architarbidæ* is available.

In the following key to the genera I have juxtaposed them

¹ Journ. Geol. Chicago, vol. xi, p. 179, pl. v, fig. 1, and pl. vii, fig. 1, 1903.

² Mem. Bost. Soc. Nat. Hist., vol. iv, p. 449, pl. xl, fig. 1 (ventral view).

³ Pal. Arachn., pp. 33, 34, fig. 37A (dorsal view), not fig. 37B.

according to my conception of their affinities based upon the figures and descriptions. If the latter are erroneous with respect to the distinctive particulars relied upon, *Opiliotarus* and *Geraphrynus* will probably fall as synonyms of *Geratarbus* and *Architarbus* respectively.

- a. Sternal area of prosoma elliptical and wide; coxæ of legs of first pair not meeting in the middle line beneath those of the palpi; opisthosoma with eight terga, the anterior five short and straight, the posterior three long.
Fam. PHALANGIOTARBIÆ (*Phalangiotarbus*).
- a'. Sternal area of prosoma quite narrow, generally linear; coxæ of legs of first pair meeting in the middle line beneath those of the palpi. Fam. ARCHITARBIÆ.
- b. Posterior border of the carapace straight; the anterior terga of the opisthosoma also straight.
- c. Opisthosoma with only eight tergal plates, the sixth three times as long as the fifth and three times as wide as it is long. *Opiliotarus*.
- c'. Opisthosoma with nine tergal plates, the sixth twice as long as the fifth and five or six times as wide as it is long. *Geratarbus*.
- b'. Posterior border of the carapace evenly convex or considerably produced in the middle line; opisthosoma with nine tergal plates, of which at least the first and second are curved round the posterior border of the carapace.
- d. Sternal area of the prosoma short and subcircular; terga of the opisthosoma progressively increasing in length from before backwards. *Architarbus*.
- d'. Sternal area of the prosoma long and narrow; last three terga of the opisthosoma markedly longer than the others. *Geraphrynus*.

VIII.—NOTE ON THE DISCOVERY BY PROFESSOR C. DE LA TORRE OF FOSSIL MAMMALS IN CUBA.

By Dr. J. W. SPENCER, M.A., B.A.C., etc.

AT the recent meeting of the International Geological Congress in Stockholm, Professor C. de la Torre, of the University of Havana, made the announcement of a discovery of fossil mammals of Pleistocene age, in cavern deposits of Central Cuba. Hitherto the known fossil Vertebrates were few. Mr. T. W. Vaughan, in America, had published a long paper discrediting those previously reported, but before that time the late Professor E. D. Cope (America's great Vertebrate Palæontologist) had passed over the doubtful forms, and accepted especially one species of Edentate, supposing that other forms were buried and submerged during the subsequent depressions of the land.

Professor de la Torre's investigations have now established Cope's hypothesis that many other fossil mammals occur in Cuba. Some of the specimens, representing half a dozen species of Rodents, Edentates, and other forms, were shown at Stockholm, while others are at the Central Port Museum, New York, under Professor Osborn.

It may be added that the writer has also found the remains of *Amblyrhiza* (a Rodent as large as a deer) in a cavern on St. Martin, one of the north-eastern of the West Indian Islands—a notice of its occurrence in that island not having been published until the present time.

Apart from the palæontological interest, the value of this great discovery of fossils lies in its confirmation of the recent connexion of the islands with the continent, and the late high continental elevation as shown in the "Reconstruction of the Antillian Continent"