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A FOSSIL ISOPOD BELONGING TO THE FRESH-WATER GENUS PHREATOICUS.

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Professor of Biology, Canterbury College, New Zealand.

(Communicated by R. J. TILLYARD, M.A., etc.)

Read before the Royal Society of N. S. Wales, October 3, 1917.
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1. Introduction.

In May, 1917, Mr. R. J. Tillyard, who is investigating the Mesozoic and Tertiary Insects of Queensland and New South Wales, wrote to me saying that among the fossils from the Wianamatta Shale of St. Peter's Brickworks, Newtown, Sydney, New South Wales, he had several speci-

mens of a Crustacean which he felt convinced belonged to the genus *Phreatoicus*, and he very kindly offered to hand over the specimens to me for examination. In his paper describing the fossil insects, (1916, p. 11),[1] he had mentioned the fossil Crustacean as "a fine Peracarid Crustacean," and in his MS. he had given it the provisional name of *Phreatoicus wianamattensis*.

I received the specimens on June 16th, and a careful examination soon convinced me that Mr. Tillyard was perfectly correct in his identification, and that the specimens all belonged to a single species of *Phreatoicus* closely similar to existing Australian species, such as *P. australis* Chilton and *P. shephardi* Sayce. None of the specimens is complete, and the head and first peraeopods are not clearly represented in any of them, but several of the other peraeopods are very distinct in some of the specimens and so are the segments of the peraeon (with the exception of the first) and of the pleon. The downward prolongation of the segments of the pleon, which is so distinctive a character of *Phreatoicus*, is quite evident in most of the specimens, and the conical terminal segment is clearly shown in one. These points, with the evidence afforded by the peraeopods, some of which are very perfectly preserved, leave no doubt as to the correctness of the identification.

The stratigraphical features relating to the Wianamatta Shales are given by Mr. B. Dunstan, Chief Government Geologist of Queensland, in the introduction to Mr. Tillyard's paper, and he concludes his remarks by stating that—

"The shales containing the fossil remains—insects, fishes, labyrinthodonts, coprolitic fragments and plants—belong to the Wianamatta Shales, a series probably equivalent to the Upper Clarence Series in Northern New South Wales, and the Darling

[1] The references are given by the year of publication to the list at the end of this paper.

Downs-Walloon Coal Series in Southern Queensland. This position for the St. Peter's fossil beds places the horizon in the Jurassic and above the fossil bed at Ipswich, which is probably Upper Triassic" (1916, p. 10.)

Further information is given by Mr. Tillyard in his paper under the "Summary of St. Peter's Results" (1916, p. 43).

In forwarding the specimens Mr. Tillyard writes on May 31st, 1917:—

"The beds are usually classed as Trias-Jura, but evidence is accumulating that will probably place them in the Upper Trias, probably as the nearest Australian equivalent of the Rhætic."

The species of *Phreatoicus* is represented in the specimens sent to me by about ten impressions. Of these Mr. Tillyard writes (June 5th, 1917):—

"Most of the Crustacea appear to have been found in the actual 'Nodules' of the 'False Coal' band formation, from which the Fish, the Unios, and most of the insects were also derived. Some, however, come from the paler unaltered shales with plane fracture-surfaces. All the specimens are much carbonised, so you will have to rely solely on outline drawings to illustrate the fossils." In addition to the specimens sent to me there are, Mr. Tillyard says, "a large number of less satisfactory specimens as well, some being on large hand-specimens of rock of considerable weight."

All the specimens are the property of Mr. B. Dunstan, Chief Government Geologist of Queensland.

Of the specimens described below, the first three are from impressions on dark coloured rock, the remainder are from the paler unaltered shales.

I proceed to describe these impressions in detail, starting with the most complete, *i.e.*, in the order in which I first examined them. The measurements given were made direct from the specimens without reference to specimens of the existing species, comparison with which was not made till after I had examined all the fossil specimens.

2. Description of Specimens.

SPECIMEN 1, Fig. 1. (Block 237, larger impression.)

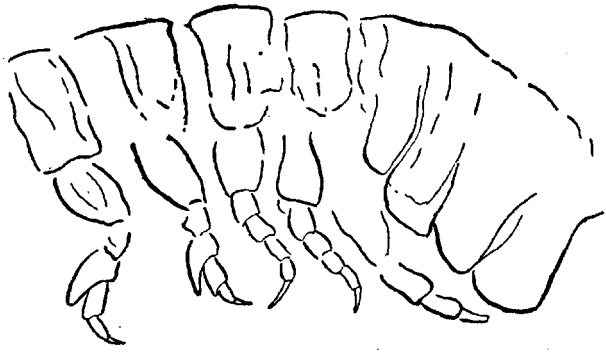


Fig 1. *Phreatoicus wianamattensis*, (No. 237*a*); × 5.

This impression is about 18 mm. in length, but the head and one or two anterior segments of the peraeon are wanting, and so also is the terminal portion of the pleon. There are indications of five peraeopoda, some of them being remarkably perfect, and enabling the separate joints to be determined with considerable certainty. These apparently represent peraeopoda 3, 4, 5, 6 and 7, that is to say, those attached to the five posterior segments of the peraeon. Of these, peraeopoda 3 and 4 are very distinct, and quite similar. In each the basis is somewhat expanded; the ischium moderately long; the merus broader, subtriangular and produced at the antero-distal angle into a lobe extending fully half way along the carpus; the carpus appears to be about as long as the propod, and of rather greater width; the dactyl is about half as long as the propod and slightly curved, being in both peraeopoda directed backwards. Peraeopod 5 is about as long as either of the two preceding, but evidently belongs to the posterior series of three, having its dactyl facing forwards; the basal joint is about as broad as that of peraeopod 4, and the other joints show a general agreement, the merus, however, being not so much pro-

duced at the postero-distal angle. The 6th peraeopod is slightly longer than the 5th, but shows quite the same structure, though the more distal joints are rather obscure. The 7th peraeopod is still less perfectly preserved, but is evidently longer than the sixth, apparently reaching backwards as far as the posterior margin of the 4th segment of the pleon; only the distal joints are represented; the merus does not appear to be expanded.

Of the pleon, the first four segments can be made out, particularly the downward prolongations of the pleural portions, which are very distinct. Of these, the first is the shortest or narrowest, and is not produced so far downwards as the second, which is considerably broader than the first and has its anterior margin rounded, somewhat as in the first segment. The third segment appears about as long as the second, and reaches downwards to about the same level, both the anterior and posterior angles being rounded. The impression of the 4th segment is less distinct, but it appears to be about as long as the third, and produced a little further downwards; its posterior margin shews a slight concavity in the middle portion. The remaining segments are absent. The upper portion of these pleon segments cannot be made out with any certainty, but the distinctly marked pleura, as described, are so characteristic of *Phreatoicus* that they alone would be sufficient evidence that the impression is actually that of a *Phreatoicus*, and this conclusion is abundantly confirmed by the well preserved peraeopoda. The impressions of the segments of the peraeon are by no means clear, but they appear to represent the five posterior segments and to correspond to the peraeopoda already described; the dorsal margin is fairly distinct, so that the depth of the segments can be measured with fair accuracy. The depth of the peraeon appears to be rather greater in comparison with that of

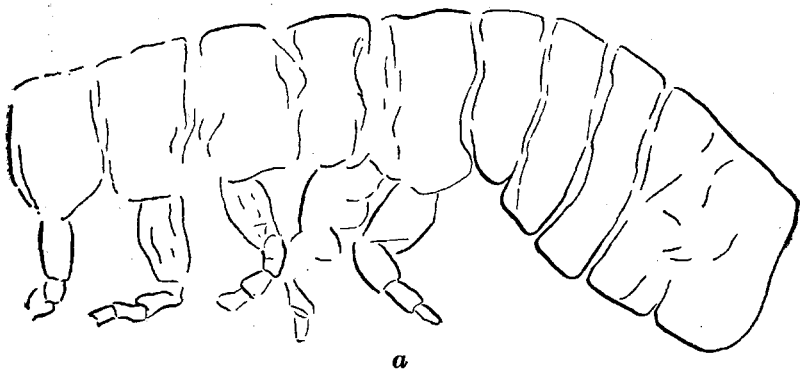
the pleon than in existing species, but this is probably merely the result of compression, which would produce a greater effect on the subcylindrical peraeon segments than on those of the pleon, since this is already considerably flattened in the living animal.

The following measurements may be given in addition to the description:—Total length of impression 18 mm., so that the whole animal would have measured probably about 23 mm. Length of peraeopods 3 and 4, 4·5 mm.; of 5, 4 mm.; of 6, 4·5 mm.; of 7, 5 mm. Depth of peraeon segments 3 mm.; depth of pleon segments 5 mm. (? or more).

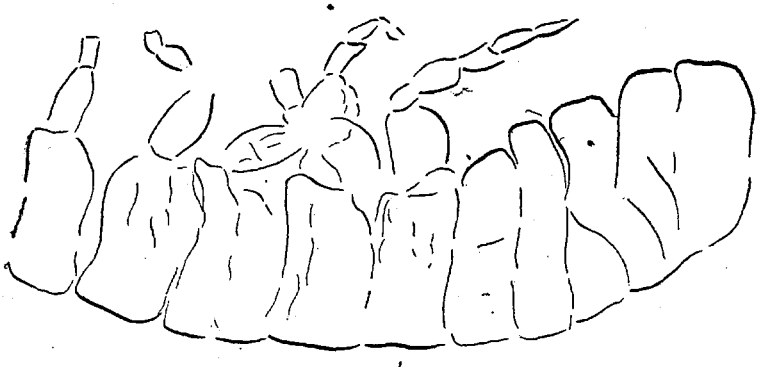
On the block that bears Specimen 1 there are also two imperfect impressions, but they do not show any additional details.

SPECIMEN 2, Fig. 2, *a* and *a'*. (Block 240, the larger impression, with its counterpart on Block 241).

This specimen is considerably larger than specimen 1, the total length of the impression being 23 mm. It shows apparently the five or six posterior segments of the peraeon, with portions of the corresponding peraeopoda, and the first five pleon segments, the fifth being more or less imperfect; the total length of this animal would therefore probably have been about 30 mm. The peraeopoda are less distinctly shown than in specimen 1; but, as in that specimen, the three posterior ones are directed backwards and the anterior ones forwards. Of peraeopod 2 only one or two of the basal joints are shown indistinctly. Peraeopod 3 shows portions of the basis and three other joints, apparently merus, carpus and propod. Peraeopod 4 is similar, but less distinct. Peraeopods 5 and 6 appear to be overlapping, and are not distinct, though the broadened basal joint is pretty clearly shown. Peraeopod 7 is more distinct, and shows a structure apparently corresponding



a



a'

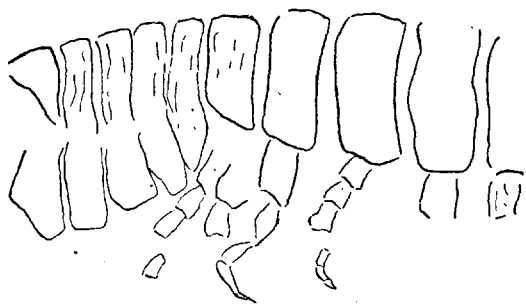
Fig. 2. *Phreatoicus wianamattensis*, (No. 240 and 241; *a*, impression, *a'*, its counterpart. × 4.

with that of existing species, such as *P. australis;* the basis is large and broad, the ischium long, merus of about equal length and not broadened nor produced at the postero-distal angle; the rest of the limb is not distinct, but the whole reaches apparently as far back as the middle of the 4th pleon segment. Of the pleon, the first five segments can be made out with tolerable certainty, though the division between the 4th and 5th is not clear. These segments agree pretty closely with those already described for specimen 1. The inferior margin of the first segment

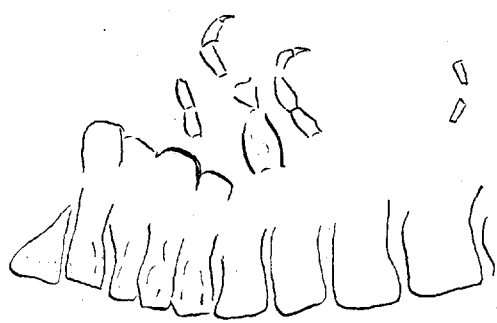
is indistinct, but apparently it does not reach down so far as that of the second segment. The terminal segment of the pleon is absent.

The depth of the peraeon segments is about 4 mm. and the greatest depth of the pleon 7 mm.

SPECIMEN 3, Fig. 3, *b* and *b'*. (Block 240, the smaller impression, with counterpart on portion of Block 241).



b



b'

Fig. 3. *Phreatoicus wianamattensis*, (No. 240 and 241); *b*, impression, *b'*, its counterpart. × 5.

This specimen is rather smaller than specimen 1, the total length of the impression being 13 mm. It shows part of the third segment of the peraeon and segments 4, 5, 6 and 7, and the first five segments of the pleon, so that the whole animal would probably have a total length of about

18 mm. The segments of the peraeon that are represented are very distinct, and have a depth of about 3 mm., while the greatest depth of the pleon segments, which are also pretty distinctly shown, is 5 mm. The peraeopoda are not very well preserved, but the portions of them that are present correspond with those already described for specimens 1 and 2; the three terminal joints of the 6th peraeopod are very distinctly marked, and there are portions of the 7th peraeopod extending back about as far as the third segment of the pleon, the extremity being imperfect. In the pleon the first four segments are very well preserved, showing the downward prolongation of the pleural portion very distinctly; that of the second segment reaches further downwards than the first, and is slightly narrower than the third, which is about equal to the fourth. Of the fifth only the anterior portion is present. The terminal portion of the pleon is unfortunately missing in this specimen also.

SPECIMEN 4, Fig. 4. (Block 233).

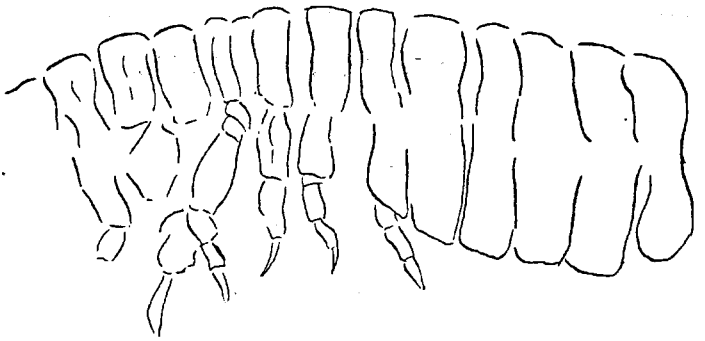


Fig. 4. *Phreatoicus wianamattensis,* (No. 233). × 5.

On this block, which is brown in colour, much paler than those bearing specimens 1, 2 and 3, the impression shows approximately the same parts as those of other specimens, that is, the posterior segments of the peraeon and the anterior segments of the pleon; but here, apparently, the

six posterior segments of the peraeon are represented, with possibly also a portion of the first. Portions of corresponding peraeopoda are present, but they are somewhat confused, and scarcely show anything additional to what has been already described in the other specimens. The broad basal joints of peraeopoda 5 and 6 are, however, distinct, and apparently these limbs had a close general resemblance to those of the living *P. australis*. As in other specimens the depth of the peraeon segments is about 3 mm., while the greatest depth of the pleon is about 5 mm.

The first five segments of the pleon are clearly indicated, especially the inferior margins of the pleural portions. The surface bearing the sixth is depressed below that of the others, and the impression on it is imperfect.

The total length of the part of the body preserved is 16 mm., and, as only the head and part of the first peraeon segment and the terminal segment of the pleon are wanting, the animal was probably about the same size as specimen 3, *i.e.*, measuring 18 or 19 mm. in length.

SPECIMEN 5, Fig. 5. (Block 236).

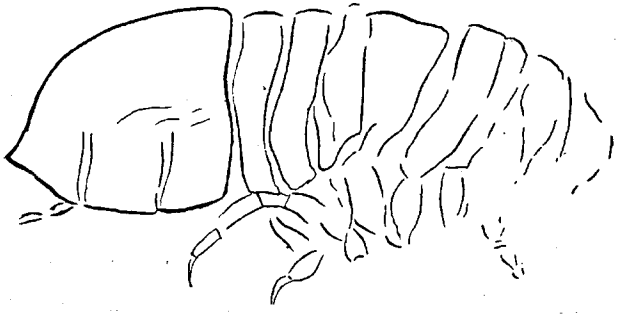


Fig. 5. *Phreatoicus wianamattensis*, (No. 236*d*). × 5.

Of this specimen only the posterior portion of the peraeon is present, and that is considerably distorted, and too imperfect to add any further information; but fortunately

the whole of the pleon is present, and, although parts of it are indistinct, the conical terminal segment is clearly marked, and shows a regular projection at the posterior end as indicated in the figure. This appears to have the upper and lower sides nearly similar and evenly curved into the general outline of the segment, so that the actual projection is not marked off by a depression at its base, as in *P. australis* and others of the existing species. It appears to resemble most nearly the terminal segment of *P. tasmaniæ* G. M. Thomson and *P. spinosus* G. W. Smith; these two, however, being probably identical. The existence of this terminal segment was not observed until I had already become quite confident that the other impressions were those of a *Phreatoicus*, and the possession of this characteristic terminal portion of the pleon fully confirms the correctness of that decision.

The segments 1, 2, 3, 4 and 5 of the pleon are fairly distinctly marked so far as their inferior margins are concerned, and the general line of their dorsal surface is also clear, though the upper lateral portion of the fourth and fifth segments has been broken away. At the infero-posterior angle of the fifth segment there is an indication of an appendage which possibly represents the uropod, but this is not distinct enough to make out anything of its special structure.

The depth of the pleon segments in the specimen is about 5 mm.; the peraeon segments are hardly sufficiently marked to admit of accurate measurement.

SPECIMEN 6, Fig. 6. (Block 236).

In this impression the posterior and dorsal portions of the pleon are absent, though the lower portions of segments 1, 2, 3 and 4 can be distinctly identified, and the whole of the peraeon and apparently the head are also present, although much confused and difficult to make out.

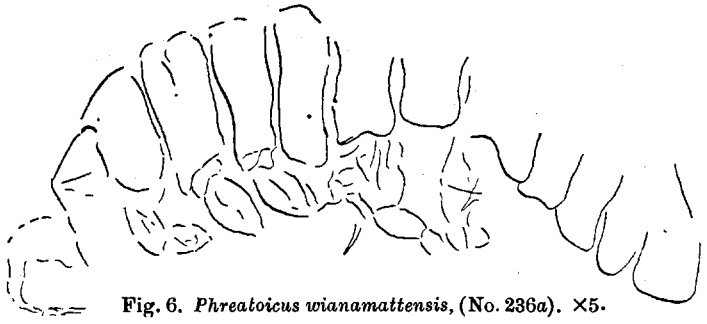


Fig. 6. *Phreatoicus wianamattensis*, (No. 236*a*). ×5.
(Counterpart of No. 235*a*.)

Of the head itself no definite structure can be ascertained, but projecting in front of it there are indications of an appendage which, in length and position, would correspond with the lower antenna, although it is too indistinct to show any details, except perhaps two or three segments of the multi-articulate flagellum.

The peraeon segments are very indistinct, but they are apparently all present; and, in the second, the inferior margin, projecting anteriorly into a subacute point, can be made out, with below it apparently the epimeron or coxal joint of the peraeopod.

SPECIMEN 7, Fig. 7. (Block 236).

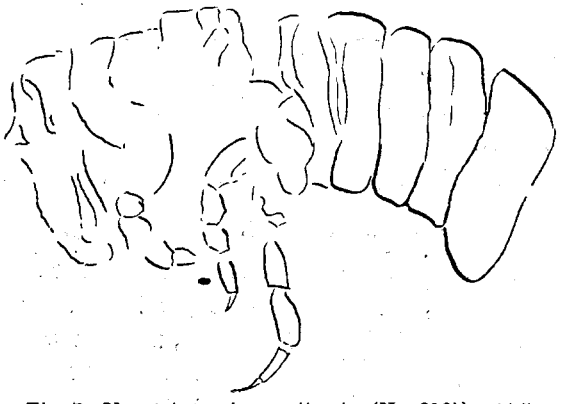


Fig. 7. *Phreatoicus wianamattensis*, (No. 236*b*). × 5.
(Counterpart of No. 235*b*.)

This specimen is also imperfect, but shows the four anterior segments of the pleon, with the same structure as in the other specimens. Two of the peraeopoda, apparently the sixth and seventh, are fairly well preserved, especially the terminal portion of the seventh, which shows the merus, carpus and propod very distinctly, and of apparently the same shape and proportions as in *P. australis*.

SPECIMENS 8 and 9, Fig. 8. (Block 239).

Fig. 8. *Phreatoicus wianamattensis*, (No. 239*a*). × 5.

These specimens are very imperfect, but show distinctly certain segments of the body, apparently the posterior segments of the peraeon, with the basal joints of the corresponding peraeopoda.

In specimen 8 (fig. 8) apparently the last four or five segments of the peraeon are represented, with indications of the first two segments of the pleon.

Specimen 9 shows two or three similar segments, but it is impossible to say which they are. They look quite like those shown in fig. 8, and I have therefore not given a figure of them.

SPECIMEN 10, Fig. 9. (Block 239).

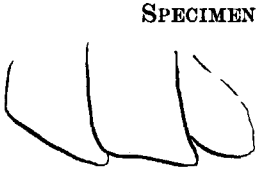


Fig. 9. *Phreatoicus wianamattensis*, (No. 239*c*). × 5.

In this impression there is only a very small portion preserved, which by itself would be probably quite unrecognisable, but which, considered in connection with the other specimens found near it, may perhaps be taken to represent the fourth and fifth segment of the pleon, with a portion of the sixth.

[In the foregoing detailed account I have dealt with all the specimens which were first sent to me by Mr. Tillyard. After the MS. of the whole paper had been completed and forwarded to Mr. Tillyard for publication, he sent me several other specimens; and, as some of the impressions on these, especially those on Block 235, show additional points, I give a brief account of them here. I am leaving the rest of the paper in its original form, although, as will be seen, one or two of the statements with regard to the head, antennæ and uropods will require slight modification, in view of the fuller information now available with regard to them.

Block 235, which had not been sent to me at first owing to an oversight, is a particularly valuable one, as the specimens on it not only confirm the statements already made, but show additional points, especially with regard to the uropods. On it there are impressions of four specimens, with the terminal portion of a fifth, and in three out of the five the terminal segment of the pleon and the uropods are more or less distinctly marked. The following detailed descriptions will be sufficient:—

SPECIMEN 11, Fig. 10. (Block 235).

Fig. 10. *Phreatoicus wianamattensis*, (No. 235*a*). × 5.
(Counterpart of No. 236*a*.)

This specimen shows the whole body, with the antenna fairly well marked at the anterior end, the joints of the

peduncle are indicated and the flagellum shows distinctly. Apparently all seven segments of the peraeon are present, with the basal joints of some of the peraeopods, but the head and first peraeon segment are not clear. All six segments of the pleon are represented, showing the pleural portions as in specimens already described, the terminal segment having a broadly conical point as in Specimen 5. Below it the uropods are distinctly seen, both the right and left uropods being shown owing to compression, the left apparently above the right, and there are indications of the two branches of each uropod.

SPECIMEN 12, Fig. 11. (Block 235).

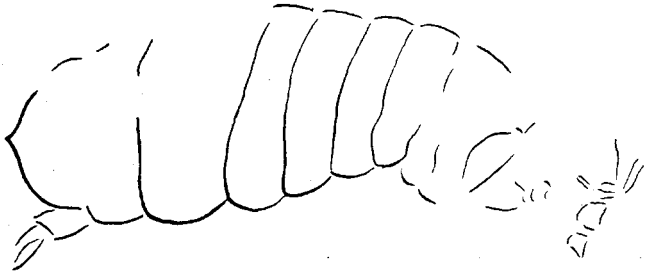


Fig. 11. *Phreatoicus wianamattensis*, (No. 235*b*). × 5.
(Counterpart of No. 236*b*.)

This specimen shows clearly all the segments of the pleon, including the terminal segment, which has the same shape as in the other specimens. The first pleon segment is distinct; it is not as deep as the second, and shows the shape as already described in other specimens, perhaps even more distinctly than in them. The basal joint of the uropod is also clearly seen, and there are indications of the two branches.

SPECIMEN 13, Fig. 12. (Block 235).

This specimen (near the margin of the block) shows clearly the shape of the terminal segment, and below it the peduncle and the two branches of the uropod.

Fig. 12. *Phreatoicus wianamattensis*, (No. 235c). × 5.

The other two specimens on this block do not add any further particulars to our information, though they are undoubtedly impressions of *Phreatoicus*, and the parts that are clear are quite similar to those described for the other specimens.

SPECIMEN 14. (Block 238).

This block shows a small specimen, 10 mm. long, with the pleon curved downwards, the only distinct part of which is the terminal segment, and below it the uropod showing basal joint and two branches, but apparently a good deal flattened.

On Block 234 there are impressions of two specimens, close together and somewhat confused. On one of them the terminal segment of the pleon with the uropods can be recognised, but the rock fracture is very uneven, and it is impossible to make out clearly any details. The other specimen situated near it shows apparently the greater part of the whole body with peraeopods, but not distinctly enough to add further details to what is already known from other specimens.

On Blocks 210 and 211 (counterpart) there are impressions which seem to represent a dorsal view, showing about 11 or 12 segments, and on one side towards the posterior end indications of the pleura of what appear to be the second and third pleon segments.]

3. Diagnosis of the Fossil Species.

It is so evident from the foregoing descriptions and figures that we are dealing with a species of *Phreatoicus* that it is unnecessary to attempt to give a reconstruction of the animal. In place of doing so, I give in Fig. 13*a*, a reproduction of the figure of *Phreatoicus australis* published in 1891 in the Records of the Australian Museum, Vol. I, pl. 23, fig. 1. In the general figure the individual joints of the peraeopoda are not quite accurately shown, and I therefore also give (fig. 13 *b* and *c*) from the same source, reproductions of the figures of peraeopoda 3 and 7. If these

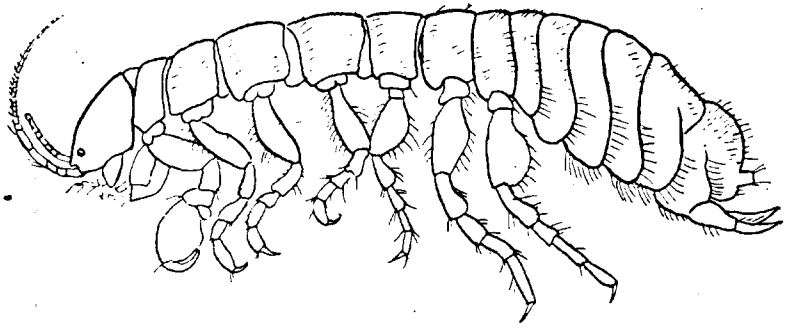


Fig. 13*a*.

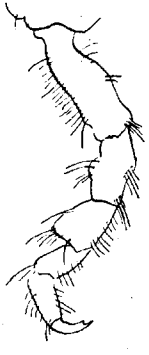


Fig. 13 *b*.

Phreatoicus australis Chilton, *a*, general view, *b*, third peraeopod, *c*, seventh peraeopod.

(Copied from the original figures in Rec. Austr. Museum, Vol. I, pls. 23 and 25, *b* and *c* reduced.)

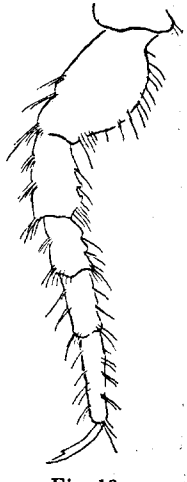


Fig. 13 *c*.

are compared with the figures of the fossil specimens given above, which have been drawn by my assistant, Miss Herriott, as accurately as possible to represent the actual impressions, it will, I think, also be evident that the fossil species comes near to *P. australis* itself, a species which again is very similar in general appearance to *P. capensis* from South Africa.

It may, therefore, be classified and described as follows:—

Order ISOPODA Latreille 1817.

Tribe or Suborder PHREATOICIDEA Stebbing 1893.

Family Phreatoicidæ Chilton 1891.

Genus *Phreatoicus* Chilton 1883.

Phreatoicus wianamattensis sp. nov.

Specific Diagnosis.—Similar in general appearance to *P. australis* Chilton. Body apparently smooth and not sculptured or tuberculated. Peraeon segments deeper than long, but not more than two-thirds the depth of the pleon. All the pleon segments with pleural portions much produced downwards, that of the first reaching further down than the last segment of the peraeon, but not so far as the second pleon segment; segments 2, 3 and 4 about subequal in length with depth gradually increasing posteriorly; fifth segment only slightly longer than the fourth; terminal segment conical in side view and ending in a subacute point with curving sides, the terminal process not being sharply defined from the general outline of the segment.

Peraeopoda similar to those of *P. australis*; (the first missing), second, third and fourth directed forwards, subequal in length, with basal joints expanded, merus produced at antero-distal angle about half-way along the carpus; the fifth, sixth and seventh directed backwards, fifth about as long as the fourth, sixth longer than the fifth, and seventh

still longer, reaching posteriorly to the hind margin of the fourth pleon segment; basal joints of all rather widely expanded, other joints longer than the corresponding ones in anterior series; merus only slightly produced at postero-distal angle.

Total length of animal up to 30 mm.

Occurrence.—Wianamatta Shale of the St. Peter's Brick-works, Newtown, Sydney, New South Wales.

Remarks.—For this species I have pleasure in adopting the specific name "*wianamattensis*" which Mr. Tillyard had assigned to it in his MS. To Mr. Tillyard belongs the credit of being the first to recognise that the fossils were the remains of a *Phreatoicus*.

While the animal in general appears to come close to *P. australis*, the terminal segment so far as it can be determined from the fossils appears to approach more nearly to that of *P. spinosus* G. W. Smith, a species from Tasmania, which is almost certainly identical with *P. tasmaniæ* G. M. Thomson. In general appearance the fossil species also comes very close to the South African species *P. capensis* Barnard.

4. Historical Account of the Phreatoicidea.

The Phreatoicidea form such a distinct and interesting group of Isopoda that it is desirable to give the following brief history of its members.

The first species, *P. typicus*, a blind one, was described by myself (1883, p. 89) from the subterranean waters of the Canterbury Plains, New Zealand. For it I established the genus *Phreatoicus*, and after discussing its relationships to several of the main groups of the Isopoda I said (1883, p. 92):

"The precise place of *Phreatoicus* in any system of classification cannot as yet be indicated with certainty, but one thing is made clear by the discussion, viz., that *Phreatoicus*, possessing as it does

affinities to several distinct groups, must be of very considerable antiquity."

This was written in 1882, though not published till 1883; I little thought then that in 1917 I should be able to describe a fossil *Phreatoicus* from the Triassic of Australia.

In 1891 I described a species, *P. australis*, with eyes, which had been obtained in surface waters at a height of nearly 6,000 feet, on Mount Kosciusko, Australia, and established the family Phreatoicidæ for the reception of the two species then known. In 1893 Stebbing placed the family in a separate tribe Phreatoicidea (1893, p. 388).

In 1894 I gave fuller descriptions of these two species, and described a third species, *P. assimilis*, also blind, from the underground waters of the Canterbury Plains. In connection with the origin of the subterranean species of *Phreatoicus*, I expressed the opinion that species would some day be found in the surface waters of New Zealand. This prophecy was fulfilled by the discovery of *P. kirkii* in 1906.

In 1894, Mr. G. M. Thomson described a species, *P. tasmaniæ*, from the Great Lake, Tasmania.

In 1896, Spencer and Hall established an allied genus, *Phreatoicopsis*, for the species, *P. terricola*, found burrowing in the banks of the upper Gellibrand River, Victoria, Australia.

In 1900, Sayce described another blind species of *Phreatoicus*, *P. shephardi*, from a spring at a height of 2,000 feet in the Plenty Ranges, Victoria; in 1916 this species was recorded from Barrington Tops (4,600 feet), New South Wales, by myself and more fully described. In the same year (1900) Sayce established another genus, *Phreatoicoides*, for the blind species, *P. gracilis*, from surface runnels, Gippsland, Victoria.

In 1902, he established another genus, *Hypsimetopus*, for a blind species, *H. intrusor*, found in the burrows of the land cray-fish, *Engœus*, in Tasmania.

In 1906, I described a species, *P. kirkii*, with variety *dunedinensis*, which though blind was found in surface streams in southern parts of New Zealand.

In 1909, G. W. Smith recorded the existence of *P. australis* from numerous localities in Tasmania, and described another species, *P. spinosus*, from the Great Lake; this, however is most probably identical with *P. tasmaniœ* G. M. Thomson. Smith drew special attention to the importance of the evidence supplied by *Phreatoicus* and other freshwater Crustacea of Australia for an Antarctic connection between New Zealand, Southern Australia and South America (1909 *a*, p. 69).

In 1914, K. H. Barnard recorded the existence of a species of the genus in freshwater streams on Table Mountain, South Africa, the species being named *P. capensis*, and after referring to the statement made by Sayce in 1902 to the effect that it would be interesting to know if any representatives were found in South America, added:—"The discovery of a species on Table Mountain, South Africa, is therefore of great interest, as being one more fact in support of the existence of an ancient land-mass connecting the southern continents (Gondwana land)" (1914, p. 233).

5. Other Fossil Isopoda.

The fossil Isopoda hitherto described are few in number, and, as Calman (1909, p. 208) says, "The little that is known of their morphology leaves their systematic position in most cases doubtful and throws no light on the phylogenetic history of the group." No palæozoic forms are known with any certainty; *Oxyuropoda ligioides* Carpenter and Swain has been described from the Devonian of Ireland

and in general shape looks like a *Ligia*, but "its appearance earlier than the primitive caridoid forms may, however, justify some suspicion as to its affinities. *Praearcturus* Woodward, from the Old Red Sandstone of Herefordshire, has very slender claims to be admitted into this order, and the same may be said of *Amphipeltis* Salter (Devonian of Nova Scotia), and *Arthropleura* Jordan (Coal Measures)."[1] Undoubted Isopoda do, however, appear in Secondary Rocks. *Cyclosphæroma* Woodward, from the Great Oolite and Purbeck and *Archæoniscus* Milne-Edwards from the English Purbeck appear to belong to the Sphæromidæ, and if so, would indicate that that family was differentiated as far back as the Jurassic Period. *Eosphæroma* Woodward from Eocene and Miocene also appears to belong to the same family. *Palœga* Woodward and *Proidotea* Racovitza and Sevastos, resembling the existing *Æga* and *Mesidotea* respectively, are known from Oligocene beds.

Urda Münster from the Jurassic of Solenhofen appears to resemble the male of *Gnathia*.

The existence of *Phreatoicus* as a fossil in the Triassic beds of Australia is therefore quite in harmony with the little that is known of the fossil Isopoda and forms a most important addition to their geological history.

6. Analogy with the Anaspidacea.

It is perhaps worth while calling attention to the fact that in Tasmania species of *Phreatoicus* are found in the same waters as the peculiar fresh-water shrimps *Anaspides tasmaniæ* and *Paranaspides lacustris*. These shrimps have been shown by Calman (1896) to be nearly related to *Palœocaris*, *Prœanaspides*, etc., from the Permo-carboniferous of Europe and North America, the whole forming a group which Calman has named Syncarida. Another living

[1] Calman, in Zittel's Palæontology, Second Edition, p. 758.

member of this group, *Koonunga*, was found in fresh-water near Melbourne by Sayce in 1907, and was more fully described by him in 1908. All these forms have been fully investigated by G. W. Smith (1909 *b*), who had visited Tasmania in 1907; as yet no fossils belonging to the group have been recorded from Australia.

Anaspides, *Paranaspides* and *Koonunga* are the living representatives of a primitive and generalised group of Crustacea, the *Syncarida*, and similarly the members of the *Phreatoicidea*, a primitive group of the *Isopoda*, have continued to exist in the fresh waters of Australia, Tasmania, New Zealand and South Africa from early Secondary times.

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