

species (see 'Manual of Conchology,' vol. ix. pl. xxii. figs. 7 & 8), but it is less than a third of the size; both are from the same locality. In the new species it will be observed that of the two basal tubercles that one nearest the columella is remarkably strong and bends towards the left, the other, which is much smaller, in the opposite direction.

LXXII.—*On Three Blind Victorian Freshwater Crustacea found in Surface-water.* By O. A. SAYCE.

DURING a collecting excursion in the district of Gippsland, Victoria, I found, amongst a number of normal inhabitants of a little freshwater runnel, three blind species of Crustacea. Two of these are Isopods, but members of different tribes, and the other one is an Amphipod.

The fact of these widely separated forms, each being blind, inhabiting surface-water in the same locality, with proof of their breeding there, is, I consider, of special zoological interest, pointing, as they apparently do, to a cave or subterranean origin; but when and how they have changed their habitat, and, reverting back, entered the struggle for existence with the surface-fauna, I am unable to decide.

I shall now enumerate the blind species and describe the place in which they were found and the leading geological features of the surrounding country so far as my limited knowledge will allow.

Enumeration of the Species.

No. 1. *Phreatoicoides gracilis*, Sayce (9).—This species was taken from running water, and in all some twenty individuals were collected, comprising males and females of different sizes, and one with eggs in the marsupium. They were found mostly within crevices of logs and amongst the matted fibres of dead tree-fern trunks lying in the water.

No. 2. *Janirella pusilla*, Sayce (11).—About a dozen males and females were collected from a bunch of dead moss in a small pool within a few yards of the streamlet formed through the uprootal of a large Eucalypt. Many of them had developing young in the marsupium.

No. 3. *Niphargus pulchellus*, Sayce (10).—Only three individuals were found, and each was taken from the same little pool as *Janirella pusilla*.

Description of Locality.

The locality is not far from the township of Thorpdale, in Gippsland, and the tiny streamlet previously mentioned, which eventually feeds the Narracan River, runs somewhat rapidly between the bases of two steep hills, but is interrupted in its course by logs and fallen tree-fern trunks and other forest débris, so that the water is often dammed back and turned aside, and sometimes it widens out and forms shallow areas, over which the water slowly flows. It is evidently fed by spring-water. The valley has a virgin growth of larger and smaller forest-trees and ferns, forming a dense undergrowth, which shuts out to a large extent the direct rays of the sun.

The locality is richly inhabited by ordinary forms of life, such as are found in similar situations elsewhere; amongst these may be mentioned two other species of Crustacea living in the water in association with the blind forms—one a crayfish (*Astacopsis* sp.) and the other an Amphipod (*Atyloides Gabrieli*, Sayce). Both of these were in considerable numbers and have been found in other localities.

It will thus be understood that the locality is not shut off and isolated by any barrier, but that the struggle for existence amongst the inhabitants is in as full force as elsewhere.

The district generally is of a hilly character and heavily timbered. The altitude of the place where the specimens were taken is between 800 and 900 feet above the sea-level, and distant about 30 miles from the sea-board. The geological formation of the district is, according to the government map, Mesozoic, which is overlaid at the locality mentioned by a small area of Volcanic. At some distance to the south and also northward there are Upper Tertiary deposits, and north of this, less than 20 miles distant, there is an extensive area of Upper Silurian, stretching for miles northward and also eastward and westward.

Relation of the Species to known Forms.

The nearest known allies of the several species were considered in the original papers describing them; I shall, however, briefly allude to them here, but first I shall enumerate the known members of the peculiarly Australasian Isopod family Phreatoicidæ, to which *Phreatoicoides* belongs.

Phreatoicus typicus, Chilton, and *P. assimilis*, Chilton, both blind inhabitants of subterranean waters in New Zealand.—These two, together with other New-Zealand subterranean

Crustacea, are described by Dr. Chilton in a very complete and valuable paper (1), to which I am greatly indebted, which contains not only descriptions and drawings of the species, but many questions are debated concerning the fauna of caves and wells, and also there is a carefully compiled bibliography upon the subject and notes thereon.

Phreatoicus australis, Chilton (2).—This species, which has normal eyes, is described as occurring under stones in a boggy flat near the summit (5700 feet) of Mount Kosciusko, which is within 200 miles of Thorpdale in a north-easterly direction. Mr. G. M. Thomson also records it from freshwater pools on the top (4100 feet) of Mount Wellington in Tasmania (6), and from the same island I have also received specimens of it from a mountain-lake situated at an elevation of 2900 feet, and compared them with co-types (14).

Phreatoicus tasmanice, Thomson (7).—This was collected from the Great Lake, Tasmania, which lies at an elevation of 3800 feet above sea-level; it also has normal eyes.

Phreatoicus Shephardi, Sayce (12).—This was taken from a tiny streamlet on the north side of the Dividing Range, near Whittlesea, Victoria, at an elevation of about 2000 feet. It is without the slightest appearance of any eyes.

Phreatoicopsis terricola, Spencer & Hall (8).—This species is of terrestrial habit, and is recorded as being obtained burrowing in earth on the hills in the dense forest near Colac, Victoria. It has normal eyes.

In the following characters those of the above species having the closest resemblance to *P. gracilis* will now be given. I have not, however, seen the New-Zealand forms, but judge them from the very careful descriptions and drawings of Dr. Chilton.

1. *Shape of body and comparative length of antennæ*.—*P. gracilis* is much more slender than any other species, due in part to the pleura not being produced. I omitted to mention in my original description that the males have considerably longer antennæ than the females; they are more than half the length of the body. In these respects it compares closely with the New-Zealand subterranean forms, and of these two most closely with *P. typicus*. The body of that species is longer than *P. assimilis* and the pleura only moderately developed, but both are more slender than any of the other surface-forms except *P. gracilis*.

2. *Want of colour*.—It is in agreement with the New-Zealand forms; all the rest have more or less of colour-markings.

3. *Want of eyes*.—Agrees with the New-Zealand forms and also with *P. Shephardi*.

4. *Mouth-parts*.—Of the New-Zealand forms, nearer to *P. assimilis* than to *P. typicus*, but nearer to *P. australis* and *P. Shephardi* than either, on account of their stouter mandibles.

Janirella pusilla.—This species agrees in general shape and leading features with Leach's genus *Janira*, also with Sars's genus *Ianiropsis*, which so far contains only one species, viz. *I. breviremis*, from the west coast of Norway. Sars says that there are no known freshwater Ianiridæ (5); but from Stebbing I notice that *Jæra Guernei*, Dollfus, of the same family is an inland river species of the Azores, and also that *J. Nordmanni* (Rathke) and *J. albifrons*, Leach (two British species), are often at home in runnels of fresh water traversing sea-beaches (4. p. 379).

Niphargus pulchellus.—Mr. G. M. Thomson describes two species closely allied to the genus *Niphargus* from Tasmanian surface-freshwater (6). These species differ considerably from *N. pulchellus*, but of the two it is nearest to *N. montanus*, obtained from pools on the summit of Mount Wellington, where also *Phreatoicus australis* was taken. In contradistinction it has the antennæ and terminal uropoda very short, the body stouter, and it possesses eyes. My species appears to be nearer to some of the English forms, but I have no specimens for comparison.

Special Characteristics of the Species.

The special characteristics of the three species are:—

1. *Loss of eyes*.—In each there is a total loss of the crystalline lens and pigment. In *Janirella pusilla* there is, however, on the dorsal surface of the cephalon of some, but not to be seen in all, a pair of small circular areas somewhat clearer of colour than the surrounding parts, which may be vestiges of eyes, but of which I have doubt. As mentioned in my paper (9), after examining serial sections through the head of *P. gracilis* I failed to detect any trace of optic lobes or nerves.

2. *Colour*.—In both *P. gracilis* and *N. pulchellus* the colour is quite white, without any trace of pigment; but a female, with eggs in the marsupium, had the eggs of a decided yellow colour. *J. pusilla* has a slight general ochreous colour, but without any definite markings or pattern.

3. *Compensation for loss of eyesight.*—For loss of eyes one would expect to find some specialization of other sense-organs or in some way a compensation. So far as touch is concerned this is apparent in the species under consideration, as is shown by the following table of measurements of the eminently tactile antennæ as compared with the nearest known allies possessing eyes; but in this relation it is important to bear in mind that these allies are not of close affinity except in the case of *P. gracilis*.

In the following table the length of the body of each species is taken as 100, and the antennæ in relative proportion:—

<i>Phreatoicoides gracilis</i> , ♂ ...	$\frac{67}{100}$	<i>Phreatoicus australis</i> , ♂	$\frac{33}{100}$
" " ♀	$\frac{49}{100}$		
<i>Niphargus pulchellus</i>	$\frac{68}{100}$	<i>Neoniphargus montanus</i>	$\frac{24}{100}$
<i>Janirella pusilla</i> , ♂	$\frac{139}{100}$	<i>Janiropsis breviremis</i> , ♂	$\frac{95}{100}$

As to the question whether there are a greater number of setæ generally over the surface of the body and legs, and also of olfactory and auditory setæ, than in allied species with functioning eyes, I think it is not so in the species under consideration; it is, however, hard to judge, but at least I have not observed any notable increase of either simple or specialized sensory setæ.

The shape of the body of both *P. gracilis* and *N. pulchellus* is remarkably slender by comparison with other surface allies. This has been observed by Chilton in his two subterranean species of *Phreatoicus*. He says, "In the two species of *Phreatoicus*, *P. typicus* and *P. assimilis*, the body is more slender and the antennæ and legs longer, especially in *P. typicus*, than in the surface species *P. australis*" (1. p. 262). An explanation for which he offers: "It appears probable that, in the case of species living in underground waters, the greater slenderness of the body has been acquired in order to adapt the animal for its life in the restricted spaces between the stones and shingle in which it has to live."

General Considerations.

In the orders to which the three species under consideration belong the normal forms possess eyes; we must conclude therefore that atrophy has taken place in the ancestors of the blind species. Packard, who has given earnest consideration to and investigation of the cave-fauna of North America, publishes in an extensive paper a list of blind or eyeless

animals that are not inhabitants of caves (3). From a study of this list it may be seen how very exceptional is the absence of eyes in orders and classes of animals in which they are generally present, other than inhabitants of dark caverns, subterranean water, or ocean and lake abysses, but that there are exceptions must not be forgotten. In the order Amphipoda there are no blind forms recorded from lighted situations in the list just mentioned, and I am unaware of any other than the present instance of widely separable forms, each being blind, living and breeding in one place amongst normal surface-forms.

That they possess the peculiar characteristics of a subterranean or cave life—viz. loss of eyes and want of colour, to which may be added slenderness of form,—will, from the foregoing, be obvious; and when it is remembered that they belong to widely separated groups and are found in the same locality, one is justified in assuming that their near ancestors were inhabitants of subterranean waters or caves; but how long since such was their habitat and in what way the change has been accomplished I am unable to offer any opinion. It is at least clear that they have been and are still successful in the sharper struggle incident to a surface-life; and on account of this one would expect to find greater modification of sensory organs, to endow greater sensibility, than in the subterranean forms, where there are so few competitors. This, however, does not appear to be the case except in the *Niphargus*, in which the terminal pair of uropoda is characteristically increased in length. As previously stated, there does not appear to be any appreciable difference in the number of olfactory and auditory setæ. Regarding the other two species, it must be remembered that they are Isopods and that the members of this group are normally frequenters of secluded situations.

To say how long a time has elapsed since the blind Thorpdale species have inhabited total darkness such as would have led to entire atrophy of the eyes would be pure speculation, for there appears to be no data to reason from. Any subterranean waters that may exist in the locality must, on geological evidence, be quite local, for the extensive Silurian area mentioned as existing less than 20 miles northward would prevent the possibility of remote subterranean waters reaching this locality. Neither is there any evidence, nor indeed is there any probability, of any large cavernous recesses existing either at the surface or underground.

As a matter of interest, certainly not for comparative deduction, I may mention that Packard, for one, quotes several

facts (3. p. 139), which, he says, tend to show that the bleaching of the body and atrophy of the eyes, as well as the adaptation to a life in darkness, may have been induced after but a few generations, perhaps but one or two only, resulting in the comparatively rapid evolution of cave-species; but I am unaware of any facts to shed light upon the possible length of time that might ensue to regain organs that have suffered decadence.

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A Handbook of British Birds. By J. E. HARTING, F.L.S., F.Z.S.
New and Revised Edition. Pp. xxxi+520 and 35 Plates.
London: John C. Nimmo, 1901.

THIS book should find a place in the library of every working ornithologist, for it contains much that is not to be found in any other work of the kind with which we are acquainted.

It is primarily intended as a source of quick reference as to the precise status of every species which has occurred in Great Britain and Ireland to the end of 1900. Although we notice some omissions, perhaps inevitable in a work of this kind, perfect reliance may be placed on the work as a whole. Mr. Harting has done much more