Woolnorth, and several islands in Bass's Straits. The alterations of level at Point Nepean, Port Phillip, have already been observed and recorded by my able friend the late Dr. E. C. Hobson, in the 3rd vol. of the Tasmanian Journal.

1855

VIII. — *On Australian Entomostracans. By the* Rev. R. L. King, B.A. [*Read 12th July*, 1854.]

SUB-KINGDOM.

ANNULOSA.

Class Crustacea. Division Entomostraca.

Legion I.

Branchiopoda.

(See "Papers and Proceedings," Vol. 2, Part II., January 1853.

Legion II.

Lophyropoda.

Lophyropa. Latreille.

Lophyropoda. Leach, &c.

Branchiopodis. Frange's (pars) Lamarck.

Character.—Mouth furnished with organs fitted for mastication; branchiæ few, attached to the organs of the mouth; body having an envelope (either in the form of a buckler inclosing head and thorax), or in the shape of a bivalve shell, inclosing the whole animal; feet few in number; articulations more or less cylindrical, and serving the animal for the purpose of locomotion; two pairs of *antennæ*.

many years must have elapsed since the shore upon which they grew had been visited by the waves of the sea. Even so early as 1837, I remember Mr. Curr, the intelligent Chief Agent of the Van Diemen's Land Company, informing me that the sea had made considerable inroads upon the eastern side of the Peninsula, from the time of his arrival there (about 1828).

This he attributed to the greater and increasing prevalence of easterly winds. On the west coast, my recollection did not enable me satisfactorily to determine whether the sea was encroaching or not; my impression is, however, that it was. On the east coast a like result is, I am informed, taking place, and I would be glad to receive information from old residents on the coast east from George Town, and on the east coast of the colony, in confirmation or refutation of the opinion now advanced.

In connection with this subject, I may observe that it is stated that reefs now exist at the entrance of Port Phillip, upon which several vessels have recently struck, not laid down accurately in the charts, and which are believed by some nautical men to be nearer to the surface of the sea than they formerly were. Whether this is true, or whether the present greatly increased traffic has led vessels to go over places not previously examined, I know not; but it is now worthy of consideration whether permanent marks ought not to be made upon rocks in favourable situations, to ascertain positively whether the land at Port Phillip is rising and that of Tasmania slowly sinking.

This was done in Sweden, and I suggested it to be done here some ten years ago. That revolutions of this kind have taken place in comparatively recent times, there is abundant evidence in the raised beaches at Hunter's Island, near

Order I. Ostracoda.

Ostracoda. Latreille.

Character.—Body enclosed entirely in a covering of two valves, resembling a bivalve shell; posterior jaws branchiferous; no external ovary; feet two and three pairs, adapted for progressive motion. This order contains three families, *Cypridæ*, *Cytheridæ*, and *Cypridinadæ*. I shall confine myself to the first of these.

Fam. I. Cypridæ.

Cypris. Muller et Auctorum.

Character.—Two pairs of antennæ; superior, long with numerous joints, and a pencil of long filaments; inferior, stout, and pediform. Feet, two pairs. *

It would be unnecessary in this place to describe minutely the animals of this family; such a description has already been published in the Natural History of the British Entomostraca, one of the publications of the Ray Society, 1849. I need therefore but refer to that work, and add a very brief description, laying stress only on those particulars in which the Australian species appear to differ from the European.

"The body of the animal is completely enclosed within a shell of two valves of a horny cretaceous substance, which in general appearance closely resembles a small mussel:" the body consists of two rounded portions of unequal size. The thoracic, from which spring the antennæ, the antennules or rami, the organs of the mouth, and the first pair of feet and the abdominal, from which spring the second pair of feet and the tail, and which contains the generative system.

* I have copied the above almost verbatim from Mr. Baird's work;—omitting only the notice of the eye, which the discovery of *Newnhamia* proves to be a generic, and not a family characteristic.

The eye is simple, no traces of crystallines having been discovered. It varies much in colour. It is generally single, but there are two eyes in *Newnhamia*. The superior antennæ, consisting of seven articulations, which carry a pencil of long setæ, and the inferior or the antennules (or as I shall henceforth call them the rami), composed of five joints, form together the principal organs of progression. Except in *Candona*, the rami carry a pencil of long setæ, springing from the extremity of the third joint,* and by means of these rami with the antennæ, the little creature is able to swim through the water with considerable rapidity and steadiness.

The mouth is situated on the inferior surface of the thoracic portion of the body, and consists of a lip, an inferior lip, a pair of palpiferous mandibles armed with strong teeth, and two pairs of foot jaws, both of which, at least in Australian species, carry a branchial plate fringed with long thick setæ.

There are two pairs of feet, the first of which is used in creeping on plants, or on the mud. These spring from the thoracic portion of the body, and are directed forwards, and terminated by a long hook; the second pair are slender, directed backwards, and seem intended to support the ovaries; the abdomen is terminated by a moveable bifid tail. I have been much interested in finding, in two instances, the reproductive organs largely developed; I believe they have not previously been met with, or at least described, in any of the Ostracoda. In *Cypris carinata*, and in *Newnhamia fenestrata*, the sexes are easily distinguished, and the males

* Mr. Baird calls this the fourth joint, from which the setæ spring. But if this be the case, (which I will not venture to dispute, though I have not been able in that case to find the first joint), the Australian species must have six joints in each ramus.

are not uncommon, the generative system being nearly the same in both. I shall describe that of the former, although it was first discovered in the latter. The male organs consist of two testes, placed parallel to each other within the abdomen, and connected by a duct, each with its respective penis, Pl. IX., A. 10, C. 3. Each testis consists of a long narrow muscular cylindrical vessel, surrounded by hairs arranged in pyramidal tufts, the whole being enclosed within a membranous covering, so as to form an oblong capsule.

When the membrane is broken the testis assumes a curved shape, proving a considerable degree of muscular tension in its original condition. The penis, which is double and placed on the abdomen, is a pyriform organ, carrying at its extremity two short joints turning towards each other, and forming a clasping apparatus.

The female parts are simple, Pl. IX., C. 4., being composed of two long pyriform (?) ovaries, each consisting of an envelope of tubular hairs enclosed within the abdomen.

The only points of difference peculiar to *Newnhamia* are, the testes are shorter and stouter, while the penes are altogether smaller. This, however, is counterbalanced by the shape assumed by the abdominal feet of the male, Pl. IX., A. 11-12, which are evidently calculated for clasping.

In *Newnhamia* coition takes place while the animals are swimming at the surface; during the operation they sink towards the bottom. In *Cypris carinata*, on the contrary, the same operation is performed at the bottom or on the stem of a plant.

Habits.—The Cypridæ are certainly carnivorous. They are, in fact, the scavengers of the ponds in which they live. In the small basin in which I have kept several species for

many months, under almost daily observation, I have frequently seen them attack other ENTOMOSTRACA, such as *Limnadia* and *Daphnia*, almost before death; and soon after death the shell has been found emptied of all its contents by these minute gourmands. A dead *Limnea* or *Planorbis*, or other small mollusk, is quite a dainty; and hundreds may be seen heaped one upon another in a perfect turmoil of delight, each striving to get at the savoury morsel. "Nec mora nec requies." And no alderman quits a civic feast with greater reluctance than these Cypridœ manifest when driven away from the sumptuous repast. This habit makes them of essential service in preventing the water from being corrupted by decaying animal matter; as soon as a leaf or stalk begins to decay, it is covered with these little crustacea. Yet I have doubted whether they attack it for its own sake, or for the sake of the animalculæ which may be feeding on it, for they generally desert it before it has quite disappeared. This is not the case when they are feeding on dead animal matter.

If we may judge from the shell of the genus *Cythereis*, (Jones), the genus *Newnhamia* supplies another link between the marine and fresh water ENTOMOSTRACA. Mr. Baird has discovered a fresh water *Cythere* in England; and here in Australia we have an animal closely connected with the marine genus *Cythereis*. Both *Newnhamia* and *Cythereis* have two eyes, and a very tuberculose shell, and, indeed, the shell of the former is only separated from that of the latter by the flat plate at the ventral margin, by which it is enabled to cling to the surface of the water. I would therefore suggest the following as, in my opinion, a natural arrangement of the genera of the OSTRACODA :—

2 pairs of feet	3 *Newnhamia*	rami natatory	having two eyes and a tubercular shell.
	2 *Cypris*		
	1 *Candona*	unable to swim	
3 pairs of feet	5 *Cythere*		
	4 *Cythereis*		

6 *Cypridina.*—Two eyes and two pairs of feet. Appears to me to form a connecting link between the OSTRACODA and the LYNCEIDÆ ; its peculiar terminal segment of the abdomen, as well as its rami, being closely analogous with those of many of the CLADOCERA. *

There are three genera belonging to the family Cypridæ in Australia.

Cypris;—(MULLER), rami provided with a pencil of long setæ; animal swimming, partly on its ventral edge; eye single.

Candona;—(BAIRD), rami destitute of the long setæ; amimal creeping on the ground or on plants; eye single.

Newnhamia;—nov. gen., rami as in *Cypris;* animal swimming freely through the water on its back; eyes two.

GENUS I. *Cypris.*

1. *Cypris carinata,* Pl. IX. C. 1–4.

Shell nearly elliptical, but higher on the back ; the valves are unequal, the right being produced beyond the left at the

* Professor M'Coy, in his late work on the "British Palæozoic Rock Sand Fossils," has expressed his opinion that "all the *Cytherecæ* of Palæozoic rocks are more properly Phyllopoda than Lophyropoda." I confess that the analogy of these fossils with the latter, through the recent species of *Cythereis,* appears to me to be almost established by the discovery of *Newnhamia.*

posterior part of the dorsal edge, giving the shell the appearance of a heel; the valves are polished, of a transparent greenish yellow colour, with a darker quadrangular mark in the middle.

In the females the ova seen through the shell give it a beautiful scarlet colour towards the abdominal parts. The males are generally darker and somewhat smaller.

The thick setæ on the branchial plate of the first pair of foot jaws are plumose; there is also a small branchial plate on the second pair, which I do not find noticed in European species. It also exists in *Cypris Scottii* (Pl. X. C. a.) The third (fourth of *Baird*) joint of the rami carries on the inner side a remarkable short but stout and rather clavate seta, which is moveable. I cannot conjecture its use. It exists, I believe, in all the Australian species of *Cypris*. The present species is very active in the day-time, and swims very rapidly in an undulating line. Its habit is to swim about from one mass of *conferva* to another, while each mass seems alive with the multitudes moving about among its tender threads. It is also a very social animal. Five or six will often place themselves side by side among the *conferva* touching each other, and remain in this position for several minutes, as if enjoying each other's company. These are generally females.

Locality;—Denham court, a large and very productive pond in the flat, about a mile from the turnpike.

2. *Cypris Stobarti.* Pl. IX. B.

The shell is oblong, and slightly sinuated on the posterior dorsal margin. The valves are unequal, the left being the larger. They are polished, and apparently of a yellowish colour. I have seen but a single specimen, which I am unwilling to destroy by dissection. I found it in a bottle

of fresh water insects, collected for me by my friend the Rev. A. Stobart, in the vicinity of Moreton Bay.

Locality;—Moreton Bay.

3. *C. Bennelong.* Pl. X. A.

A small species, in form somewhat like *carinata*, but of equal valves sinuated at its ventral edge; hairy; of a greenish colour, darker on the back. The animal is large, as compared with the shell. The setæ at the extremity of the rami are very strong.

Locality;—pond near Sydney Cove, close to the edge of the Saltwater.

I have named it after an Australian chief.

4. *C. Clarkii.* Pl. X. E.

Shell oval, slightly reniform, the valves very convex, variegated, with brown and a light reddish green in well defined notches of irregular but constant shape; the eye is yellow, shell punctured, pilose. The male appears to differ from the female only in having large irregular masses of a yellowish substance in the abdomen, together with a considerable quantity of red globules, such as are seen in the male *Daphnia*.

This species generally prefers small shallow ponds, where it can have plenty of light and heat. It is sometimes seen in swarms in the soft mud at the edge of the water, when a pond is drying up.

I have named it after my friend the Rev. W. B. Clarke. It is one of the most beautifully-coloured of all our Cyprides.

Locality;—Sydney: Parramatta.

5. *C. Scottii.* Pl. X. C.

In shape somewhat like *C. Clarkii*, but higher in the back. It is much larger, (being nearly the tenth of an inch in length), of a transparent green colour; the shell marked with very minute reddish spots. It is thinly pilose.

It is readily distinguished from all the Australian species

hitherto known by its size. The shell is so transparent that the eggs are readily seen through the back. The thick setæ of the branchial plate on the first pair of foot jaws are plumose, as in *C. carinata*, and the second pair carry the small branchial plate already referred to in the description of that species. These peculiarities also distinguish it from *C. tristriata*, described by Mr. Baird. It generally lives near the bottom, on the mud.

I have dedicated this species to my friend W. Scott, Esq, of Ash Island, to whom I am under much obligation for his kind encouragement of my researches into this interesting family.

Locality;—Denham Court, with *C. carinata*.

6. *C. Minna*. Pl. X. B.

Shell nearly globular, sinuated on the ventral edge, punctured, pilose; the valves are very convex, and generally of a transparent green colour. They are also found more opaque, and of a dark brown, and in this variety the back is more depressed; a larger variety has its shell of a bright chestnut colour. Setæ of antennæ and rami are very plumose.

I have been inclined to consider that the chestnut variety is of a different species, but as yet have observed no other difference than those of size and colour from the ordinary form of the species named above.

The brown variety is rather more depressed; and thus it is quite possible that there may be three species, when I have named but one. I must leave this to be determined by other observers. It is a very active species, and easily kept under observation. I have had some in my Vivarium*

* The Entomostraca are easily kept under observation in a basin containing three or four gallons of water, with a little mud at the bottom, and a few plants, Villarsia, Damasonium, Azolla, Lemna. The plants absorb the carbonic acid generated by the respiration of the animals, and supply oxygen for their inspiration, as well as provide them with food. A few mollusks assist in consuming the vegetable matter as it decays.

for several months, and in the autumn they all disappeared; but in the winter a multitude almost suddenly started into life. In their occupation as scavengers, they materially assist in keeping their habitation in proper order.

Locality;—Ponds every where.

Var. *(a) Castania* pond:—at Varroville, near Denham Court

Var. *(b) Brunnea* pond:—in Government Domain, Sydney.

7. *C. lateraria.* Pl. X. G.

Shell clavate. The dorsal margin being straight posteriorly and the ventral margin deeply sinuated. The anterior extremity is the larger, and is much rounded. Shell greenish, pilose.

Locality;—Pond in a Brickfield near Sydney.

I have received it, with *Cypris Stobarti*, from Moreton Bay.

The preceding seven species are able to swim freely through the water. The three following are indeed provided with the long hairs on the rami, which distinguishes the genus *Cypris*, but they are weak; and in consequence of the small size of the bodies as compared with the shells, they are hardly able to swim at all. Thus they lead into the next genus,

8. *C. Sydneia.* Pl. X. M.

Shell oval, both ends being nearly alike; the ventral edge is nearly straight. The valves are very convex, polished, yellowish, and almost opaque. The animal can swim a little, but not in a horizontal line, and cannot at all raise itself in the water. It is generally seen crawling about on the mud, or at times half buried in it in company with several of its own species.

Locality;—a swamp near Wooloomooloo Bay, Sydney.

9. *C. Candonioides.* Pl. X. F.

Very like *C. Sydneia*, but the anterior end is much smaller than the posterior, the shell is polished, of a yellowish colour, tinged with chestnut on the back. I have never seen this species attempt to swim.

Locality ;—Varroville.

10. *C. Varrovillia.* Pl. X. D.

Shell ovate, elliptical, slightly concave at the ventral margin. Valves very flat. Deeply striate transversely, pilose, greenish, and semi-transparent. The hairs on the rami are very short and weak, and consequently the animal cannot lift its shell vertically, except in creeping. When it attempts to swim it does so on its side.

Locality;—Varroville, Sydney.

Genus II. *Candona.*

1. *C. Stanleyana.* Pl. X. H.

Shell oblong, slightly sinuated at the ventral margin. Valves deeply striate, of a dark green colour. On the rami are three strong hairs, where the long pencil is found in *Cypris*. In the centre of the valves are a few round spots. These spots, or similar ones, were noticed in several English species by Mr. Baird. But this is the only Australian species in which I have noticed them.

I have named the species after my lamented friend Capt. Owen Stanley, R.N., to whom I have been personally under very great obligation in the study of natural history, when at sea in 1846-7, on board H.M.S. *Rattlesnake*, then under his command.

Locality ;—Ponds on the top of the sandstone rocks, overlooking the sea near Coogee, associated with *Limnadia, Stanleyana*, and *Newnhamia fenestrata.*

2. *C. lutea.* Pl. X. G.

Somewhat like the preceding, but the anterior extremity is smaller than the posterior. The shell is polished, and the rami are entirely destitute of the pencil of hair; colour dark green.

Locality;—Pond near Sydney Cove, with *Cypris Bennelong.*

Genus III. Newnhamia.

Character.—Antennæ like those of *Cypris,* rami furnished with a pencil of long hairs; eyes two, distinct, pedunculated, and having a large corresponding tubercle in the shell on each valve. A boat-shaped plate on the ventral margin. The animal swims on its back, and generally is found at the under surface of the water

1. *N. fenestrata.* Pl. IX. A. 1—12.

The shell is very tuberculose. Towards the margin are a few short setæ springing from the tubercles: the back is of a light greyish colour, the ventral parts dark, the two extremities are also dark. The eyes, as seen through the ocular tubercles, are very brilliant. The tubercles are rounded at their extremities. In one instance I observed them to be of a different shape and a pointed form. The anterior extremity was larger than the posterior. This may prove a distinct species, but as I am unable to give a more detailed description of it, I can merely suggest that, should it prove distinct from that with rounded tubercles, it may be called *N. Gulielmi.*

The male differs in appearance from the female in being smaller, and of a slighter form. The female, when swimming, its valves being slightly open, appears of almost a cordate form. The rami of the male (fig. 8, 8 *a*,) carry at their extremity, instead of the four or five stout setæ found in *Cypris,* a single long and jointed seta, each joint carrying

a kind of tooth. Doubtless the object of this is to assist in clasping in *coitu*. The legs are also modified to assist in the same operation, carrying stout hooks instead of the long and sharp points found in *Cypris*.

In the female the rami and legs are exactly similar to those of *Cypris*, except that the last joint of the former is very long, being nearly half as long as the preceding.

It is terminated by only two stout setæ, fig. 9.

The mandibulary palpus is very stout; it is similar in its general form to that of *Cypris*.

The first foot jaw has its extremity opposite to the branchial plate divided into three fingers, instead of four, as in many species of *Cypris*; the fourth, which is generally jointed in the latter genus, being here wholly wanting.

The generative organs correspond almost entirely with those of *Cypris carinata*.

Habit.—This very common but interesting species lives almost wholly near the surface of the water;—its boat-like plate enabling it to walk along the under surface, while its eyes, directed downwards, give immediate notice of the approach of an enemy. When alarmed, it immediately sinks to a little distance, and then swims off, only coming to the surface when all becomes tranquil. The hand passed over the water near the surface, so as to intercept the light, or the surface being disturbed by the slightest breath, instantly alarms them. They are the most active when the sun is shining; and often a whole troop of them may be noticed swimming round and round, and in and out, with a most lively and graceful motion, about an inch beneath the surface, in some spots more favoured than others by the warmth of the sun. I have never looked at them whilst thus engaged without receiving the impression, that, under such circumstances, they were perfectly happy. I have named

the genus after my old college friend the Rev. W. O. Newnham, in memory of many pleasant excursions in his company in the neighbourhood of Cambridge and Farnham, in search of zoological and botanical wonders. The ocular tubercle, being in fact the *window* through which the little animal looks out upon the world around him, has supplied a specific name.

Locality ;—common in ponds.

Entomostraca.

It may be useful to add here a list of the *Fluviatile Entomostraca,* so far as they are known to the author, with a short note of each of the particulars by which these species may be distinguished from each other. I have deposited a drawing of each species in the Australian Museum.

Legion I. Branchiopoda.

Order I. Phyllopoda.

Fam. I.

Apodidæ.

Genus I. *Apus.*

I have not seen this Australian *Apus,* but know only that it has been found in the Hunter River district, and at the Murrimbidgee: I should be very much obliged to any observer who would send me specimens in spirits. The Tasmanian species have been described by Mr. Baird in the Annals of Natural History, under the name *Lepidurus viridis.*

I am indebted to R. C. Gunn, Esq., for some specimens of this very interesting *Entomostracon,* which I hope ere long to compare with our Australian species.

FAM. II.

LIMNADIADÆ.

GENUS I. *Limnadia.*

1. *L. Stanleyana.* Branchial legs in female, 17 pairs. In male, 15. Tridactyle feet of male, 2 pairs; third finger, two jointed: last segment of body with about eleven spines on each side.

Locality;—Coogee, near Port Jackson.

2. *L. sordida.* Branchial legs as in *L. Stanleyana;* third finger of tridactyle feet, three jointed; last segment of the body with nineteen or twenty spines on each side. This species is larger than the preceding, and bears considerable resemblance to *L. Mauritiana,* (Guevin).

Locality;—Pond near Bondi Bay; Botany Swamps.

GENUS II. *Limnetis,* (LOVEN).

1. *L. Macleayana.* Branchial legs, 11 in female, 10 in male. Tridactyle legs, 1 pair.

Locality;—Denham Court, Botany Swamps.

FAM. III.

BRANCHIAPODIDÆ.

GENUS I. *Artemia.*

1. *A. proxima.* External ovary pyriform.

Locality;—Salt Pans, Newington; Parramatta.

ORDER II. CLADOCERA.

FAM. I.

DAPHNIADÆ.*

GENUS I. *Daphnia.*

1. *D. carinata.* The head and back strongly carinate;

* NOTE.—This family with the next has already been described in the Papers and Proceedings of the Society, Vol. II., Part 2, January 1853.

dorsal margin produced to a long straight point. Beak sharp. Antennæ composed of a few short setæ. It is subject to very great varieties.

Locality ;—common in horse-ponds.

2. *D. Elizabethæ.* Dorsal margin not produced ; superior antennæ, with a long seta springing from near the base ; otherwise very like *D. Sima :* very common.

3. *D. honorata,* like *D. reticulata.* The first joint of the inferior branch of the rami as long as the first three joints of the superior.

Locality ;—Sydney ; Parramatta, &c.

4. *D. mucronata,* Müller. Anterior margin produced into two sharp points.

Locality ;—Parramata, South Creek, &c.

GENUS II. *Macrothrix.*

1. *M. spinosa.* The first joint of the long setæ on the rami is produced into a spine.

Locality ;—South Creek, Liverpool Road.

GENUS III. *Moina.*

1. *M. Lemnæ.* The first pair of legs in the female are adapted for clasping.

Locality ;—pond near the Dam at Cook's River.

2. *M. Macleayii.* A seta on the basilar joint of the rami as long as the branchi.

Locality ;—Pond on the hill above Elizabeth Bay, Sydney.

FAM. II.

LYNCEIDÆ.

GENUS I. *Eurycercus.*

1. *E. spinosa.* The setæ of the rami having the spine as in *Macrothrix spinosa.*

Locality ;—Pond on Liverpool Road.

2. *E. Cookii.* Of a larger size than the rest; of a deep chocolate colour.

Locality;—Lagoon near Botany, Moreton Bay.

3. *E. Cuninghami.* Deeply striate on the carapace in three directions.

Locality;—Botanic Gardens, Sydney.

GENUS II. *Chydorus.*

1. *C. Leonardi.* Almost globular. The ephippial ova placed side by side.

Locality;—Sydney.

2. *C. Augustus.* Ova placed one above the other; a large species.

Locality;—Sydney.

GENUS III. *Alona.*

1. *A. Bairdii.* Setæ of rami spinous, as in *Macrothrix spinosa.*

Locality;—The Lachlan Swamps.

2. *A. pulchella.* Anterior margin concave.

Locality;—Denham Court, Sydney.

3. *A. diaphana.* Anterior margin convex.

Locality;—Sydney.

4. *A. Karua.* Beak very much produced.

Locality;—R. Karua, Port Stephens.

5. *A. mascula.* First pair of legs having hooks like *Pleuroxus hamatus.* (Baird.)

GENUS IV. *Dunhevedia,* (nov. gen.)

The carapace oval, the anterior spine ending in a margin directed downwards.

1. *D. crassa.* When seen from the back, the outline is wholly convex.

Locality;—South Creek, at Dunheved. Denham Court.

2. *D. podagra.* When seen from the back, the outline is concave at the middle.

Locality;—Parramatta.

Legion II. Lophyropoda.

Order I. Ostracoda.

Fam. I.

Cyprididæ.

Genus I. *Cypris.*

1. *C. carinata.*
2. *C. Stobarti.*
3. *C. Bennelong.*
4. *C. Minna.*
5. *C. Scottii.*
6. *C. Clarkii.*
7. *C. lateraria.*
8. *C. Sydneia.*
9. *C. Candonioides.*
10. *C. Varrovillia.*

Genus II. *Candona.*

1. *C. Stanleyana.*
2. *C. lutea.*

Genus III. *Newnhamia.*

1. *N. fenestrata.* With rounded tubercles.

Locality;—common in ponds and slow streams.

2. *N. Gulielmi.* With pointed tubercles.

Locality;—Dunheved. South Creek, in a shallow pond.

ORDER II. COPIPODA.

FAM. I.

CYCLOPIDÆ.

GENUS I. *Cyclops.*

1. *C. Australis.*

Locality ;—in all ponds.

FAM. II.

DIAPTOMIDÆ.

* Nearly transparent ; male larger than female.

GENUS. *Diaptomus.*

1. *D. Pollux.* Male spindle-shaped.

Locality ;—Parramatta. Sydney, &c.

2. *D. uxorius.* Male, clavate.

Locality ;—Port Stephens.

** A deep red colour, male smaller than female.

3. *D. Maria.* Last thoracic ring, in female, with processes shorter than the abdomen.

Locality ;—Denham Court.

4. *D. Cookii.* Last thoracic ring with processes longer than the abdomen.

EXPLANATION OF PLATES.

PLATE IX.

A. 1.—12. *Newnhamia fenestrata.*

1. Side view when walking.
2. Ventral view of the female, showing the flat plate.
3. Dorsal view of male, showing the eye tubercles.
4. Ventral plate.
5. Antenna.
6. Antenna and eyes.
7. Eye-tubercle much magnified.

8. Ramus of male.
9. Ramus of female.
10. Generative apparatus of male.
11.—12. Feet of male.

B. *Cypris Stobarti.*

C. 1.—4. *Cypris carinata.*

1. Side view; 2, front view; 3, abdomen of male, showing the generative organs in situ.
4. Abdomen of female, showing the position of the ovaries, and the eggs after leaving the ovaries.

PLATE X.

A. *Cypris Bennelong,*
B. „ *Minna*
C. „ *Scottii.*
D. „ *Varrovillia.*
E. „ *Clarkii.*
F. „ *Candonioides.*
G. „ *lateraria*
H. *Candona Stanleyana*
K. „ *lutea*
M. *Cypris Sydneia.*

a. Second foot jaw of C.
b. *Second foot jaw of Cypris carinata.*
c. Ramus of B.
d. Ramus of H.
e. Striæ of H.

On the Potato Grub of Tasmania. *By* Capt. H. Berthon, H.E.I.C.S. [*Read 14th March*, 1855.]

The grub, which did so much injury to the Potato crops in certain parts of this island last year, and which threatens during the present season to commit still further devastation, is the production of a small moth of the Tineidæ family, and appears to be identical with the insect which has of late years been making such ravages amongst the tubers in New Zealand. In fact, it is by no means improbable that it was introduced into Tasmania in some infected importations from that country.

The moth is about one-third of an inch in length, of a silvery grey colour, barred with brown, with the usual jointed antennæ, trunk, and other peculiarities of formation which characterise the order "Lepidoptera." It is distinguished from many others of the class by a peculiar pair of palpi, springing from the base of the trunk, and curving backward over the head. The ova are elliptical in shape, of the size of a very minute grain of sand, and pearly white in hue. The larva, when full-grown, are about five-twelfths of an inch in length, of a semi-transparent yellowish white, forcibly reminding one of the colour of the white currant, to which is occasionally superadded a tinge of pink. As in other members of the order, they are furnished with six thoracic legs; and four of the remaining eight sections of the body are provided with pro-legs. The pupa, or chrysalis, is of a dark amber colour, little more than half the length of the full-grown larva, and is ordinarily placed in one of the eyes

of the potato, or other convenient indentation of its surface, and protected by a cocoon of very flimsy and inartificial construction.

What may be the usual period that the ova lie unhatched, it would perhaps be assuming too much to assert on the strength of only a couple of experiments. It is probable that the time varies with the temperature, with the position of deposit, and perhaps also with other concurrent circumstances. All that can be confidently made known is this, that in the experiments, which were conducted under the eye of the writer of these notes, the time that elapsed between the laying and the hatching of the eggs was ten days.

The existence of the larvæ, from their birth to their transformation into pupæ, is of about a fortnight or three weeks' duration. Their voracity, however, is so great, and their diligence in their vocation so untiring, that a couple of individuals will thoroughly riddle and destroy a potato of fair size during their brief but mischievous career.

The pupa state, it is to be presumed, as in the case of other *Lepidopterous* insects, extends over a period of some months, and it were vain, therefore, on the part of the writer, to expect that any further transformation will take place in the specimens which he has preserved until the revolution of the seasons shall have brought round the appointed time of revival. The moth itself lives but a few days, and the deposit of its ova is speedily followed by death.

Under the supposition that the root of the potato is unapproachable, and safe from the attacks of the insect, it has been surmised by some that the moth deposits its eggs on the stalk of the plant, whence the larvæ continue to draw their nourishment as long as it remains sufficiently succulent

for the purpose, and whence they descend into the root itself, when desiccation ensues. This theory is opposed to the writer's experience. He has invariably found that the moth attacks the root. The uppermost potatoes, those that are nearest the surface, are of course most easily reached, nor is it by any means a difficult matter for the insect to penetrate to the depth of three or four inches when the soil is open, uncompressed, or lumpy. Not a single case of an infected stalk has been yet detected; but constant and numberless have been the instances in which, when uncovering the potatoes at the depths just indicated, moths have been dislodged, and flown uninjured away.

Before the writer correctly understood the nature and routine of the insect's tactics, and while he yet believed that its grub form was the only one in which the depredations were to be guarded against, he caused a crop of infected potatoes to be dug up, and exposed for some days to the effects of the atmosphere, thinking that the heat of the sun would put a stop to the further ravages of the larva: but this turned out to be a woeful mistake. The potatoes while lying thus exposed in rows were again attacked by the insects, and so insidious were their proceedings, that the damage had been greatly increased before their presence was discovered. And it is not unworthy of remark, that the underside of the potato, or the side in contact with the ground, was invariably the part that was selected by the moth for the deposit of the ova. This was doubtless owing to the greater security that the unexposed side of the potato afforded against the weather, as well as against birds and predatory insects, than the upper surface would have done; and it was afterwards noted, that the moths, when unengaged in laying eggs, were almost always to be found beneath the clods of earth with which the

ground was encumbered, where it is to be presumed they sought shelter from the sun's rays, and protection against their natural enemies.

From the facts just narrated, it would seem that the following conclusions may not unreasonably be drawn :—

First.—That the best soil to sow potatoes in, supposing that the sole object were to exempt them from the grub, would be that which is impervious to the moth ; such, for instance, as sand, or a compact loam.

Second.—That if no such soil be available, the deeper the potatoes are sown, the safer they will be from the inroads of the moth.

Third.—That when there is reason to apprehend the presence of the moth, not a moment should be lost in housing the potatoes after they are dug up.

It has been stated in the course of these notes, that the transformation of the larva into the perfect insect is not to be expected for some months to come—not, indeed, till the ensuing winter and spring shall have run their accustomed course. Such is the ordinary routine of nature. Having found numerous empty pupa cases on potatoes of this year's growth, the writer has strong grounds for believing, however, that there has been more than one generation of the insect during the summer that is now drawing to a close ; and if this be true, it can hardly be doubted that the long continued drought, and unchequered heat of the weather, must have been the immediate cause. Rain or variable weather would in all likelihood have diminished their fecundity, and it is possible that a severe storm at the proper time might have annihilated them altogether.

Previous to concluding these notes, the writer cannot refrain from drawing attention to the peculiar palpi before

alluded to, which doubtless are designed to answer some useful purpose to the insect. It may not be too fanciful a theory to suppose that they may be of great advantage to the moth in penetrating the earth, and in lifting or partially removing such particles as would otherwise impede its progress in its descent to the roots of the potatoes. This must at present be received, however, as an unsupported conjecture, for the writer has not yet been enabled to establish the fact by ocular demonstration.

But it is the only portion of the notes which partakes of the nature of theory or conjecture—all the rest are ascertained facts; and it is to be hoped that they may not only be of sufficient interest to attract the attention of the naturalist and the practical farmer, but that their further consideration and discussion may lead to the discovery of some effectual means of putting a stop to the ravages of this rapacious insect.

As a precaution against the spread of the infection throughout the island, all seed potatoes coming from places where the insect is known to prevail should be carefully sorted, and the bad ones rejected; and not only should the potatoes themselves be scrutinized, but the bags or baskets which contain them should be also closely examined, and, if infected, burnt or cleansed.

Any one who will be at the trouble of carefully inspecting a basket or sack in which infected potatoes have lain for some time will find a lot of little earthy-looking excrescences adhering to the inside;—these are the cocoons of the chrysalides covered with and concealed by earthy matter. They are the media through which the evil is spread throughout the country, and conveyed from one country to another; and they are the pests in embryo, of which every one ought to try and make a clean sweep.

PLATE IX.

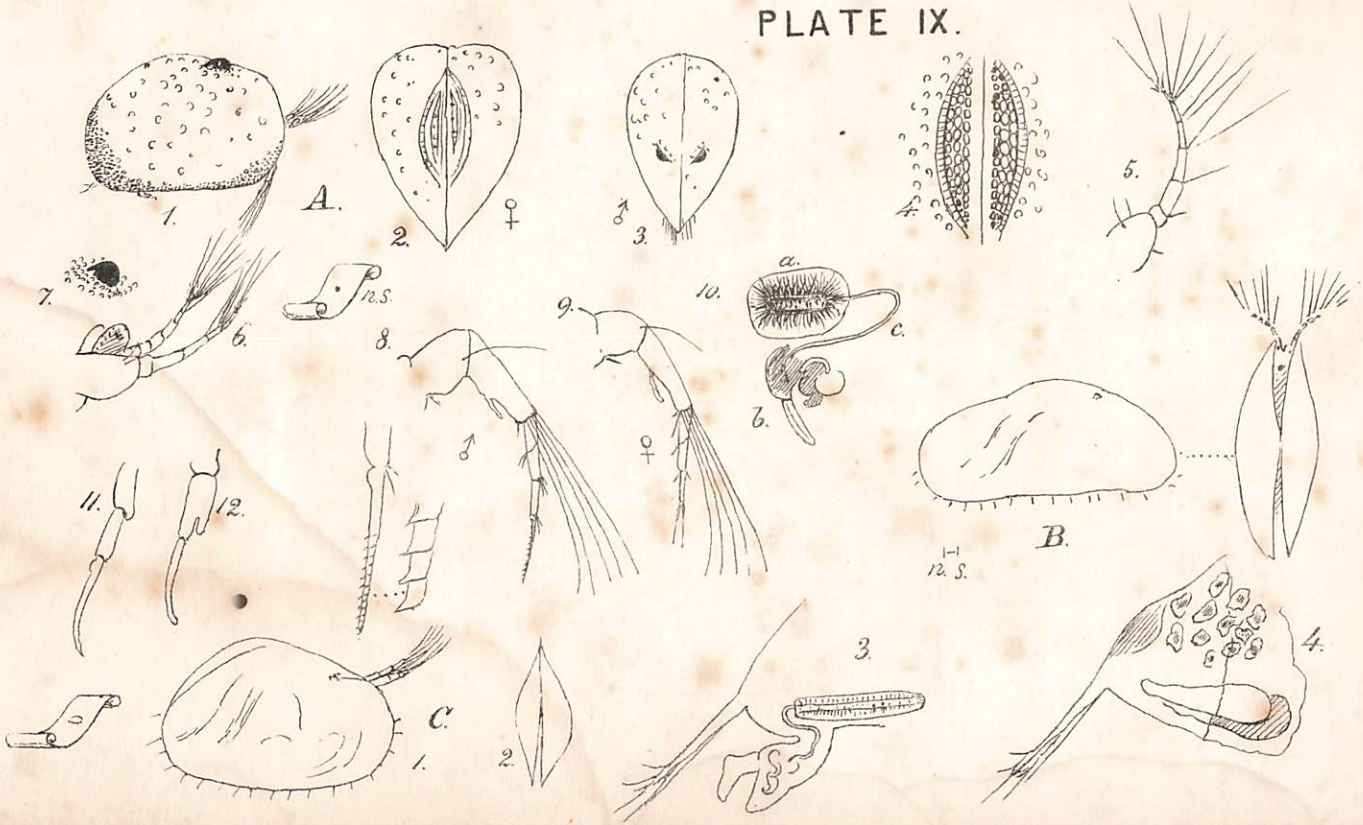

PLATE X.