PUBLIC LIBRARY, MUSEUM, AND ART GALLERY
OF SOUTH AUSTRALIA

RECORDS

OF THE

SOUTH AUSTRALIAN MUSEUM

Vol. VI, No. 1

Published by the Board of Governors, and edited by the Museum Director
(Herbert M. Hale)

ADELAIDE, NOVEMBER 30TH, 1937.
PRINTED AT THE HASSELL PRESS, 104 CURRIE STREET

NOTES ON THE WEANING OF A YOUNG KOALA *(PHASCOLARCTUS CINEREUS)*

By A. KEITH MINCHIN, Koala Farm, Adelaide.

Plates i and ii.

In June, 1933, a member of my staff informed me that one of the female Koalas in the Adelaide Koala Farm appeared ill with diarrhoea. This female had been thriving and only five weeks before the baby she was carrying in her pouch had been seen with its head out for the first time. Six months previously (January, 1933) a slight swelling in the mother's pouch had first indicated the presence of the juvenile (at birth the young is about the size of a man's finger nail).

On inspection I discovered the Koala sitting back in the position illustrated on pl. ii, fig. 1. Only the head and forelegs of the young Koala were protruding from the mother's pouch, and its face was covered with a yellowish-green slime. The baby was forcing its nose into the mother's anus, and as it nuzzled it attempted, with its front claws, to enlarge the opening into which it was thrusting its snout.

The baby was energetically eating the substance from the mother's rectum. Although the parent appeared uncomfortable while this was going on, she remained quiet and made no attempt to "claw" the baby or to stop its activities by moving her position, as happened on other occasions when the young one became annoying. The posterior areas of the mother and the fur up to the pouch opening were saturated and stained with the yellowish-green material; at times the baby would cease eating from the anus to suck and claw at the stained fur.

This particular meal took an hour to complete and during that time the baby avidly and actively fed, giving the impression that it had at last discovered the food for which it had been craving. The substance appeared to be peptonized gum leaves, and in no way resembled faeces passed during diarrhoea.

On the ground immediately beneath the female was a mound of faeces somewhat like fresh cow manure. This mound was fresh, and on examination I found beneath the soft shapeless manure, soft well-formed pellets, mixed with hard dark pellets, such as are passed by any Koala under normal conditions. This seemed to indicate that the mother's lower bowel had been emptied so that the peptonized gum leaf from her upper bowel might be hurried along to nourish a baby requiring more than milk but yet still too young to digest such a coarse diet as gum leaves.

If a Koala becomes sick with diarrhoea its fur invariably remains matted and stained for a long period; in the case described, within three hours both the mother's posterior and the face and fore limbs of the baby were dry and clean.

For almost a month the baby Koala took food in this manner every second or third day, but always between 3 p.m. and 4 p.m. My observations point to the probability that the mother Koala does not produce this food entirely voluntarily, but that the young Koala brings about the operation by massaging her anus with the nose and mouth. Before commencing this diet the baby had appeared weak and undeveloped (pl. i, fig. 1); twenty-four hours after the first meal it had grown and appeared so much stronger that it was difficult to believe that it was the same animal. Within two weeks its body weight appeared to have doubled and it began to take an interest in the tips of the youngest gum leaves. Within a month the baby was definitely weaned and had transferred its attention from the mother's anus to gum leaves alone.

The writer has observed the same procedure in the case of each young Koala reared in his park, although the length of the period during which the young continue to take food from the rectum varies according to seasonal or local conditions affecting the young edible tips of the gum leaves. If plenty of tender tips are available, the baby may be weaned in a month; on the other hand I have seen a young Koala feed from the mother's anus for as long as six weeks.

In June of this year I watched the fifteenth young Koala reared under observation take food from the mother's anus as had all the others. The weaning of this baby occupied five weeks, and during that period it took food from the mother always between noon and 2 p.m.

It may be well to mention that the Koalas were not under surveillance at night, and observations were made only between 9 a.m. and 6 p.m. It is possible therefore that the young feed upon partly-digested gum leaves more frequently than is thought, but I do not consider this probable as it would weaken the females too much.

A cinematograph record in colour of this strange method of weaning has been made by the writer. This film has been viewed by a number of interested persons, including the Professor of Human Physiology and Pharmacology at the University of Adelaide, Sir Stanton Hicks. The last-named has furnished the following comment:

"I have witnessed a showing of Mr. Minchin's film of the phenomenon recorded in the above notes, and have seen a specimen of the material passed by the bowel of the parent Koala subsequent to the stimulation by the young animal. I have no doubt that the phenomenon is a more extensive one than that generally known as reflex colonic peristalsis following rectal dilation and stimulation. It acquires greater interest in view of the fact that the dietary of the Koala is so limited, and that the presence in it of poisonous essential oils involves special metabolic processes to ensure detoxication. The subject is one deserving extended biochemical and physiological investigation, and it is hoped that this may follow on Mr. Minchin's interesting and important observation."

EXPLANATION OF PLATES.

Plate i.

Fig. 1. Young Koala just prior to taking first meal of partly digested gum leaves. Note undeveloped hind-quarters.

Fig. 2. Young Koala twenty-four hours after first meal.

Plate ii.

Fig. 1. Attitude of mother when feeding young on partly digested leaves; note paw of the infant gripping its mother's body.

Fig. 2. Young Koala one month after taking its last meal of partly digested gum leaves.

WEANING OF A YOUNG KOALA.

WEANING A YOUNG KOALA.

ABORIGINAL CRAYON DRAWINGS

By C. P. Mountford, Acting Ethnologist, South Australian Museum

Summary

When examples of aboriginal art from various parts of Australia are examined, it is noticeable that those originating from the Northern Coast and, to a lesser extent, from the Eastern coastal fringe north of Sydney, are largely representations of various animals, fish and human beings. Some of the cave paintings from Napier Broome Bay (Mountford, 1937, pp. 30-40), Prince Regent River (Bradshaw, 1891, p. 100), and adjacent localities are drawn with a freedom of style that is not known in any other part of Australia.

ABORIGINAL CRAYON DRAWINGS FROM THE WARBURTON RANGES IN WESTERN AUSTRALIA RELATING TO THE WANDERINGS OF TWO ANCESTRAL BEINGS THE WATI KUTJARA

BY C. P. MOUNTFORD, HON. ASSISTANT IN ETHNOLOGY, SOUTH AUSTRALIAN MUSEUM.

Text fig. 1–27.

THIS paper places on record a series of aboriginal crayon drawings and the relevant details, which concern incidents in the life of two mythical ancestors, the Wati Kutjara, who belonged to the Ngadadjara tribe of the Warburton Ranges of Western Australia.

Tindale has already published a summary and map of the wanderings of these ancestral beings (Tindale, 1936, pp. 169–185). His paper deals with the songs, ceremonies and wanderings, while the present paper describes the drawings, the information gathered at the time that they were made, as well as an analysis of the designs, the colours used, and the ages of the artists concerned.

The drawings were collected in August, 1935, during an expedition carried out under the auspices of the Board for Anthropology at the University of Adelaide, assisted by funds from the Rockefeller foundation and administered by the National Research Council. They form a small part of an extensive collection. A general report on the Expedition appears in *Oceania* (Tindale, 1936, pp. 481–485, map).

The method of obtaining the drawings was as follows: Sheets of brown wrapping paper, approximately 50 cm. by 30 cm., were distributed, together with crayons of the only colours available to the natives, i.e. red, yellow, black and white. The Australian aborigine is particularly susceptible to suggestion, and it was especially desired that nothing external should influence the choice either of the subject, the colours chosen or the method of drawing; therefore no subject was nominated, and the native was asked only to make marks (*walka*) on his paper. On the completion of the drawings, the meanings of the various designs, and if possible, the mythological ideas associated with them, were obtained through an interpreter and the details noted on the sheet concerned. The registration number of the native and the date were also included. The registration symbol for the Warburton Range Expedition is K, and this letter precedes the numbers of the natives mentioned.

Before the confidence of the natives had been gained (this being fully established at the end of the first week) simple drawings of everyday things of aboriginal life were made, such as kangaroos, emus, trees, camps and waterholes. At the end of that time, drawings relating to the travels and exploits of the aboriginal's mythical ancestors began to be produced by the older men. From that time onward, no difficulty was experienced in obtaining designs, in fact, it was unfortunate that, as only a limited amount of time was available for the interpretation of the detail, and the recording of the data, the distribution of the sheets had to be curtailed.

Although no attempt was made to conceal the work from any member of the expedition, drawings would be covered if a woman, child, or uninitiated youth approached within 50 metres. In fact, in order to preserve further secrecy, the old men insisted that the sheets should be carried into our tent in a folded position.

The drawings secured, particularly those of the aged men, are mostly ceremonial in character, and refer to the exploits of such mythical beings as the kangaroo (*malu*), the wallaby (*tawalpa*), the snake (*wanambi*) who was responsible for most of the permanent water holes, two separate groups of ancestral women, and several human beings, including one called Jula, and the Wati Kutjara.

Other ancestors were mentioned, but this paper deals in detail only with drawings relating to the Wati Kutjara (Wati = man, Kutjara = two).

In order to secure accurate copies, the drawings were photographed, the designs outlined on the print and the photographic image bleached away. Thus unintentional alterations are not introduced in the process of copying for reproduction.

The Wati Kutjara, according to our interpreter Pitawara (K.6), were good looking and kindly young men, who made the best camping places for the natives, and were generally held up as models to the young men of the tribe.

After many adventures, they climbed into the sky and can be seen on any clear night, β Gemini representing Kurukadi, the elder, and α Gemini the younger, Mumba.

Fig. 1 depicts an incident in the life of the Wati Kutjara at Njidibunga, an unlocalized place some distance west of our base camp at Warupuju. The drawing was made by a middle-aged native, Mungalu (K.14). The two designs on the right hand side represent Kurukadi, the elder, while those on the left hand side picture Mumba, the younger. The latter was a lazy individual, who sat about most of his time, leaving his companion, Kurukadi, to do the greater share of hunting and cooking.

Mumba, A, is depicted as seated upon a stone, B, with fires (shown as small circles) on either side of him. The stone, B, is now a large hill at Njidibunga.

Kurukadi, C, is shown without fires. The upper pair of figures depicts Kurukadi, D, returned from the hunt and still carrying a kangaroo on his head. The upper black line on the forehead of D represents the powdered charcoal and grease on his forehead, while the lower line refers to the red ochre rubbed around the nose (1). The fires are shown as adjacent to Kurukadi, and possibly represent cooking hearths. Mumba, E, is shown without legs, seated on some unspecified object. In

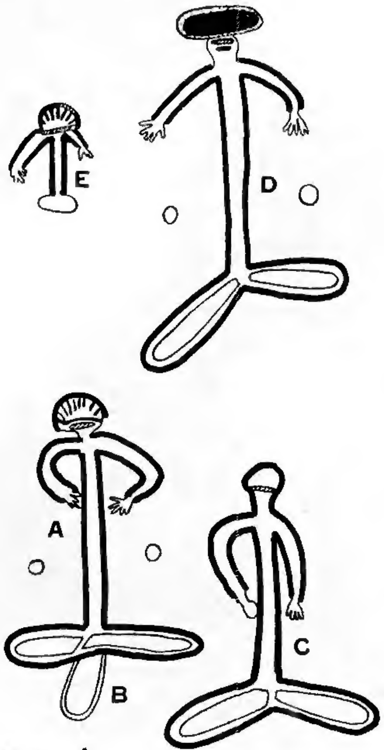


FIG. I

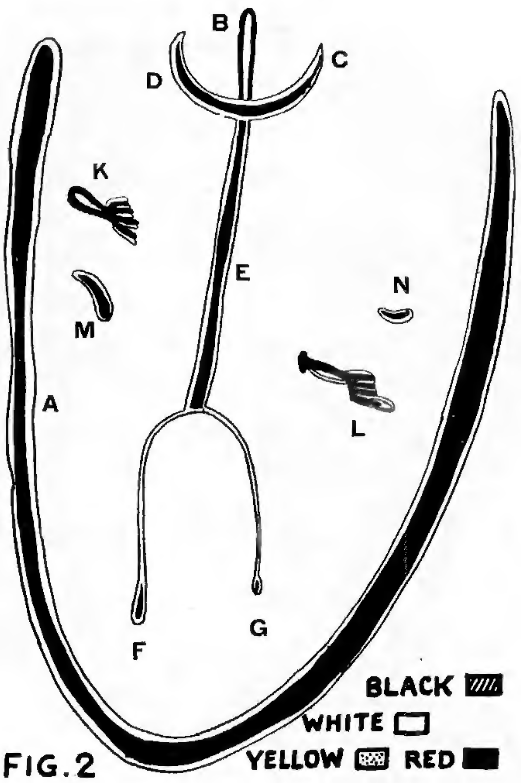


FIG. 2

both A and E, Mumba is depicted as wearing a head-dress, whilst Kurukadi, at C, has only a black line across the face, and at D, as previously mentioned, the face was covered with powdered charcoal and ochre. Our informant, Mungalu, also indicated that these ancestors made extensive journeys through the country, creating many hills, waterholes and other natural features.

The placing of the figures, the choice of the colours, and the execution of this drawing make it one of the most attractive obtained from the area.

Fig. 2 is of unusual character, and like fig. 1 forms one of the more decorative sheets in the series. Tolaru (K.3) was responsible for this design. It refers to a waterhole, Lelele (see fig. 15) some distance north-west of Warupuju, where one

(1) The custom of greasing the face and the body, and rubbing on crushed red ochre or powdered charcoal was often witnessed during our stay.

of the Wati Kutjara threw a boomerang, its circuitous path being illustrated by the incomplete ellipse A. He named the spot Lelele, picked up the boomerang, and continued his journey; the ancestor is pictured in the centre. B indicates his head (*kata*), C and D the arms (*ngaruka*), F and G the feet (*tjena*), and E the body (*jananggo*). The footprints and chest scars are shown at K, L and M, N.

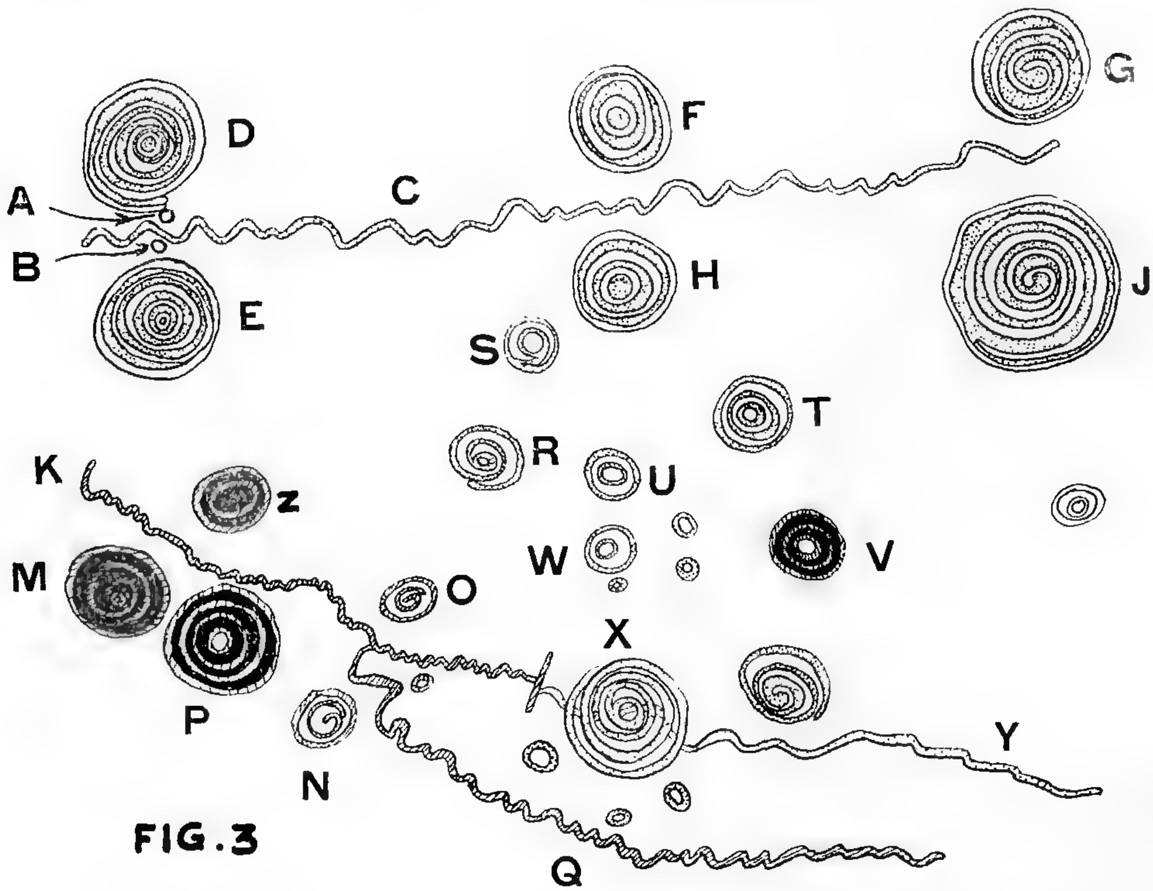


FIG. 3

Fig. 3 was made by a middle-aged native, Windinja (K.51), and illustrates the natural features made by the Wati Kutjara during their journeys in country adjacent to two small water holes, A and B, known to the natives as Julduda and Jalatja. These are situated in a creek lined with gum trees. The trees are indicated by six series of concentric circles and spirals, D. E. F. G. H and J. The creek, Warumba, C, is shown as a meandering line across the top of the drawing. The only waterholes indicated are those at A and B, but Windinja when making the drawing stated that other small water supplies could be found along the whole length of the creek.

The lower part of fig. 2 refers to the meeting of the two men with one of a group of ancestral Kunkarunkara women. This woman made the creek, K, and camped at Jabu Muluta, M (jabu = hill). The Wati Kutjara quarrelled about the women, and one drove the other away, after which he rested at P, and slept with the woman. The following morning, the two men made up their quarrel, spirals N and O, indicating where they rested. (Although not specified by the artist, these spirals doubtless represent natural features, probably hills). In this place, the ancestral men laid down lines of bushes at Q, which, as time went on, were transformed into a range of hills.

From their resting places at N and O, one of the men travelled to a locality, R, near two hills called Jabu Njinga, where, in order to play a joke on his companion, he impersonated a kangaroo. The other man was about to spear the supposed animal when the joker revealed himself. The above-mentioned hills, R and S, were created from the two nose-bones (2) left behind by the ancestors at this place.

From these hills they travelled to a spot, T, where a waterhole, Kapi Jiljudi, was created. Leaving this they camped or rested at U, Kapi Murara (*kapi* = water, or waterhole), journeyed past an unnamed water to V, Muludumbi, rested at W, and finally camped at X, Kapi Ngalbari. At the latter place a number of small waterholes, in addition to the larger ones shown at X, were made. The lines of spinifex at Y grew under the feet of the Wati Kutjara as they walked about.

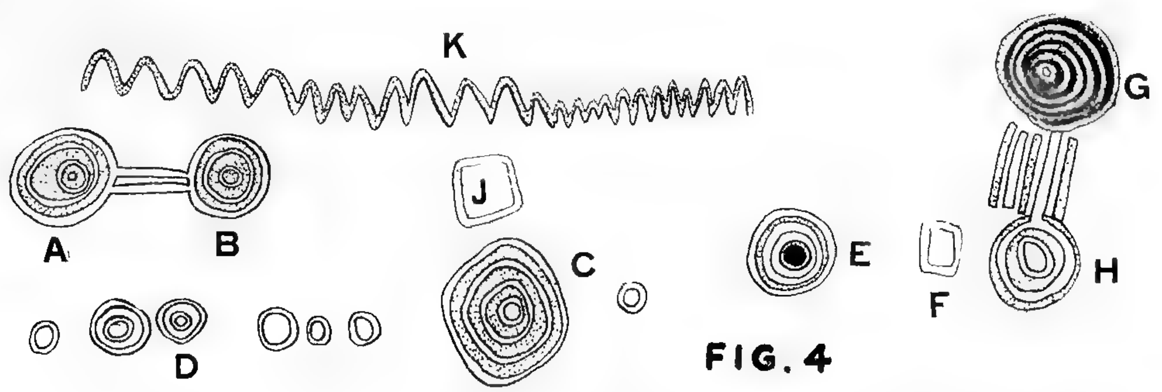


FIG. 4

An ancestral human being, Wati Muluta, camped at Z. This individual is not recorded in any other drawing, and is probably an unimportant mythical being. M (Jabu Muluta) is associated with this ancestor.

An examination of fig. 3 will give some indication of how intimately these ancestors (for the Wati Kutjara is only one of many) are associated with the country, every natural feature being attrbiuted to the agency of one or the other of them. The drawing also indicates the importance which natives of this arid country attach to water supplies.

(2) A short piece of bone pushed through a hole in the nasal septum for purposes of decoration.

Fig. 4 was drawn by Wanpiri (K.49) and deals with the wanderings of the Wati Kutjara near Kapi Konapurul. The being or beings lay down and slept at A and B. Where the buttocks rested, Kapi Kunpural, A, was formed, and the depression made by the head became Kapi Kulpudjara, B. An unnamed creek, which connects the two waterholes, was formed in the hollow made by the weight of the body. The ancestors then travelled to C, where another waterhole appeared, while a small unidentified waterhole to the right of C was made at the same time.

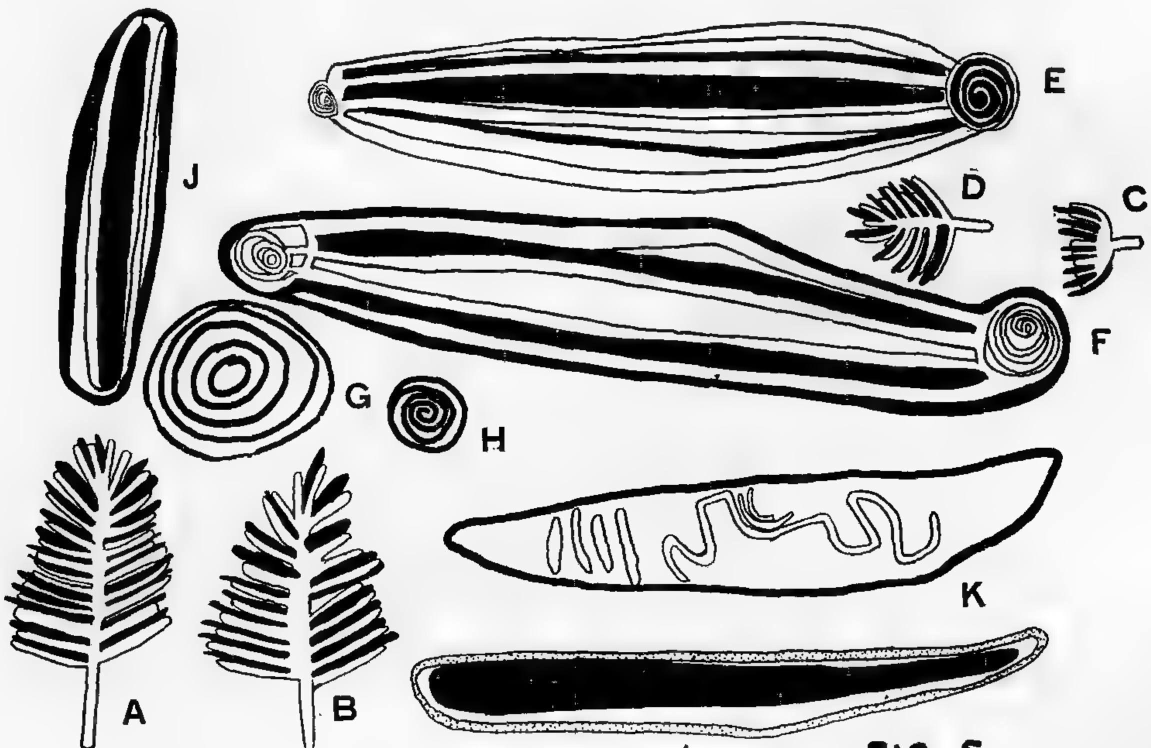


FIG. 5

From here they went to D where a series of small waterholes named Kapi Wangu now exist. Returning on the same track the Wati Kutjara passed through C, camped at E, forming Kapi Kanari (which is situated in a direction N.N.E. from our base camp at Warupuju). Travelling through F, Kapi Kumbul, the mythical beings camped at G, H.

Here again, as at A, B, two waters, Kapi Marltadara, G, and Kapi Kumpulta, H, appeared where the buttocks and head had rested. As before a creek connecting these two waters resulted from the gutter made by the weight of the body. No explanation was given as to the maker of Kapi Wiwara, J.

On being asked why a square design (an unusual symbol) was used to represent J, Wanpiri stated that he drew both this water and Kapi Kumbul, F, in that manner because that was their shape.

The zig-zag line K represents a range of hills made by the ancestral kangaroo. This he did by laying down bushes. On the same sheet were further drawings relating to the wanderings of this ancestor, and also those of the mythical wallaby. As these were not relevant to this series they are not reproduced.

Fig. 5 was drawn by Katabulka (K.1), the aged owner of Warupuju Spring (our base camp). The drawing relates to a time when the Wati Kutjara left two *wanigi* ([3]) at Kalkakutjara (Tindale, 1936, p. 179).

A and B represent the *wanigi.*

Although designs E and F were marked on the sheet as representing two additional *wanigi,* it is likely that Katabulka was misunderstood. Fig. 4 was one of the first sheets of ceremonial drawings obtained, and considerable initial difficulty was experienced, even with the help of the interpreter, in understanding the explanations of the artist. The spiral designs at either end of E and F, and the more or less parallel lines connecting them, resemble AB and GH in fig. 3. Further as E and F are associated with the pubic tassels C and D, it is reasonable to suppose that the former are symbolic of the Wati Kutjara.

It is also likely that G, H and J, which Katabulka explained were painted on the backs and abdomen of the sub-initiates, represent the body decorations of the ancestors themselves. This supposition is strengthened by the fact that Pitawara (one of our interpreters) when referring to the Wati Kutjara ceremonies, at Kanba, of which he was the owner, made the following statement: "We must do the same as did Wati Kutjara. We sing the same songs, and have the one mark (i.e. identical marks) on our bodies."

G, F and J, the designs painted on the bodies of sub-initiates, may be representative of the marks on the bodies of the two ancestors. It is likely, then, that E and F are the two men, B and C their pubic tassels, G and H the designs painted on the back, and J that on the abdomen, while A and B stand for the two *wanigi* left behind at this locality.

The design at K was given the name of Merejawara. The transverse lines are the marks on the chest, and the meandering lines a trail made by some being. For the same reason as mentioned earlier, the meaning of the word, or the significance of the symbol, could not be obtained. A rendering of *Merejawara* as *mere* = dead or dying, and *jawara* = a mark made by a dragging object, would appear literally to mean "the trail made by a dying animal or man". This interpretation, however, may not be correct.

The two *wanigi,* A and B, were made at Turarurana (see fig. 8) and left at Kalkakutjara (Tindale, 1936, p. 179).

([3]) A sacred object emblematic of some totemic animal or plant. Spencer and Gillen (1899, page 231) give an excellent description. The Aranda name is Waninga.

Fig. 6 was drawn by a fully initiated young man (K.8), and illustrates waterholes and hills made by the Wati Kutjara. Reading from A across the centre of the figure the names of the waters are as follow: A, Wanatara; B, Parlka-parlka; C, Walbawati; D, Kindingara; E, Kalitara; F and G, Kalianda; H, Lutja; J, Muri.

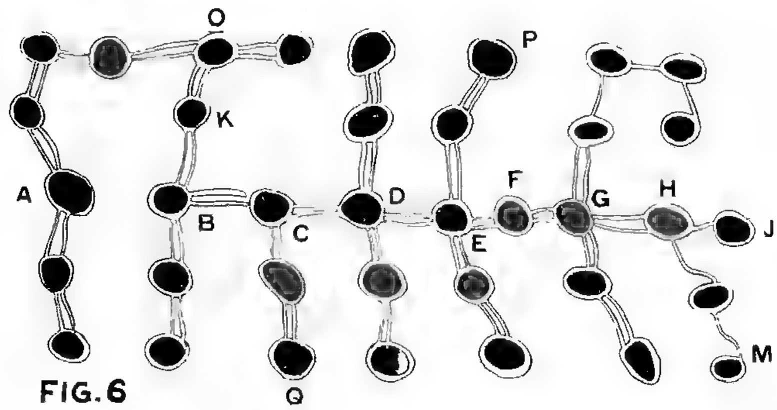


FIG. 6

FIG. 7

The remainder of the circles, O, P and Q, and similar designs, are hills, while the parallel lines are the game pads made by present-day euros as they travel between the waterholes and the hills.

On fig. 7 the Wati Kutjara are depicted as carrying a sacred object between them at Kanba (Ghanda, P.B. 197 (4)). Tindale (1936, p. 174) gives the following description of the making of a sacred *inma* board at this place. "The Wati Kutjara cut off a slab of wood from the solid trunk of a large mulga tree, and made an *inma* (or large wooden object of the type called *tjurunga* in Central Australia). Two parallel marks were made up the trunk of the tree, and for three "nights" they hacked along the marks until they had cut out two deep grooves; a *kandi* or adze stone, mounted on the end of a spear-thrower, was used for the work. On the third night the slab of wood came off in their hands. . . . The long line of dark patches in the Milky Way, between *α* Centauri and *α* Cygnus, called *pulinu pulinu,* represents the *inma* (totem board) which the Wati Kutjara made, and then left at Kanba. It remains there in the sky always, notwithstanding that the material *inma* board still exists on earth. . . . They left the *inma* in a cave near Kanba."

The sacred object being carried by the ancestors is the same as that described in the above legend. The attempt to show some peculiar form of head-dress on each of the men is of interest.

Fig. 8 relates to the doings of the Wati Kutjara at an unlocalized place, Tura-

(4) P.B. 197 is one of a series of official bench marks made in 1932, and may be found in Western Australian maps of this area, e.g. Plan IX/800.

ruranja, south-east from Julia (Tindale, 1936, p. 179). A and B represent two rock holes, C an echidna which the men had killed and eaten at this place, and D the trail made by a *wanigi*, which after having been constructed by the Wati Kutjara, was dragged away. Although the writer was not told that these ancestors were responsible for the creation of the rockholes (5) A and B, it is more than likely that it was so, the men having camped there, thus becoming ceremonially associated with the place.

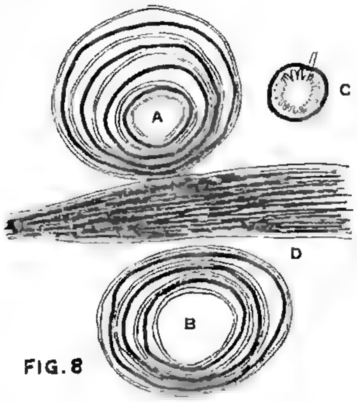


FIG. 8

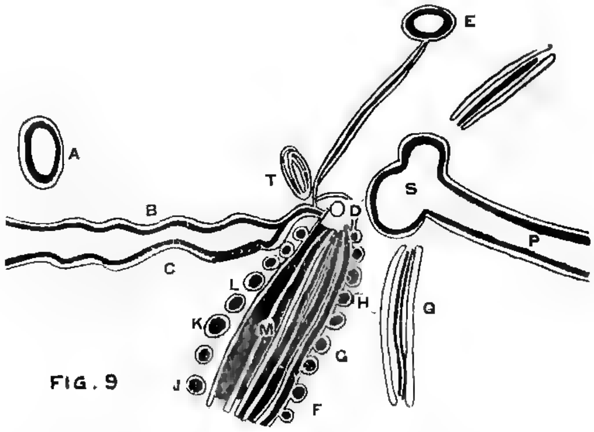


FIG. 9

Fig. 9 relates to the meeting of the Wati Kutjara with the aged "Moon man" and his grandson. This drawing was made by Mungalu (K.14) towards the end of our stay, when comparative freedom from routine enquiries made possible the obtaining of a more complete story.

At the place A the old man and the boy camped for the night. The following morning they set out on a journey to a spot, D, the tracks made by the two being indicated at B and C respectively.

Kidjili, the aged moon man, was feeble and partly blind, and therefore unable to see that game was plentiful in the country. His grandson was anxious to obtain meat for the evening meal, and seeing a cat called out, "There is a *wilka*. Let us kill it for food." "No," said the old man crossly, "leave it alone. We have a long way to go, and there is no time for hunting."

After this rebuff the boy was silent until he saw an opossum. He again asked to be allowed to catch meat, but the old man refused, on the same grounds as before. On several occasions during the journey the boy made similar requests, only to receive a gruff denial.

The old man Kidjili knew that the Wati Kutjara, who were following, would catch and kill any game seen by his grandson. The boy, however, was not aware of this, the grandfather having intentionally kept such knowledge from him.

(5) An Australian term to signify a water catchment in a rocky outcrop.

When the two moon people reached D, the boy was given a wooden dish, and sent to a neighbouring rockhole, E, in order to bring water to the camp. On his arrival he found that the dish leaked so badly that long before he reached the camp it was empty. After several ineffectual journeys he achieved his purpose by blocking the holes in the dish with human excrement.

On his arrival he found to his surprise that the old man had already obtained fresh meat and had cooked it in the oven, T.

It transpired that during the boy's absence the Wati Kutjara had approached the camp from another direction, and, laying the captured game on the ground for the blind man, retired to their camps at Q and R. The unused portion of the meat was transformed into a range of hills (see parallel lines M); the footmarks of the Wati Kutjara, now large gum trees, are indicated by circles F, G, H and I, J, K.

The boy, knowing his grandfather to be too blind to catch game, said to himself: "I wonder where my grandfather obtained his meat?"

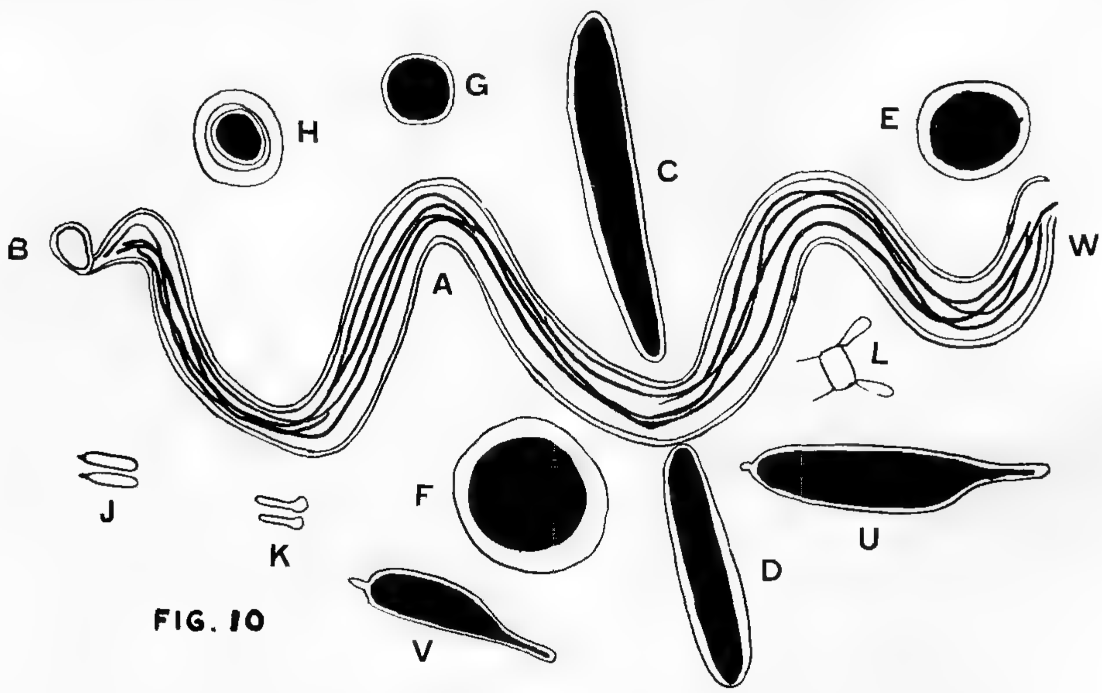


FIG. 10

The same thing having happened on several occasions, the boy became suspicious and, instead of going for the water as instructed, watched the doings of the old man from the cover of some bushes. To his surprise two good-looking men came up and gave meat to the old man. The boy then showed himself, and the old man, finding that further subterfuge was useless, told the grandson that the Wati Kutjara were his "uncles".

The camps of the Wati Kutjara are now two large hills, Q being called Nangulpa, while R is unidentified. The depression S was made by the buttocks of one of the men when he sat down to comb his beard, the creek P appearing where the beard had rested on the ground.

It is interesting to note the difference between Kidjili, the moon man, who was a relative of the Wati Kutjara, and Kulu, the man who pestered the Kunkarunkara women, and who was finally killed by the Wati Kutjara at Tjilandi (Tindale, 1936, p. 176). In a drawing by our interpreter, Pitawara (K.6), which shows influences of his European associations, Kulu is described as "the 'boss' of the Moon, as well as the morning and evening star".

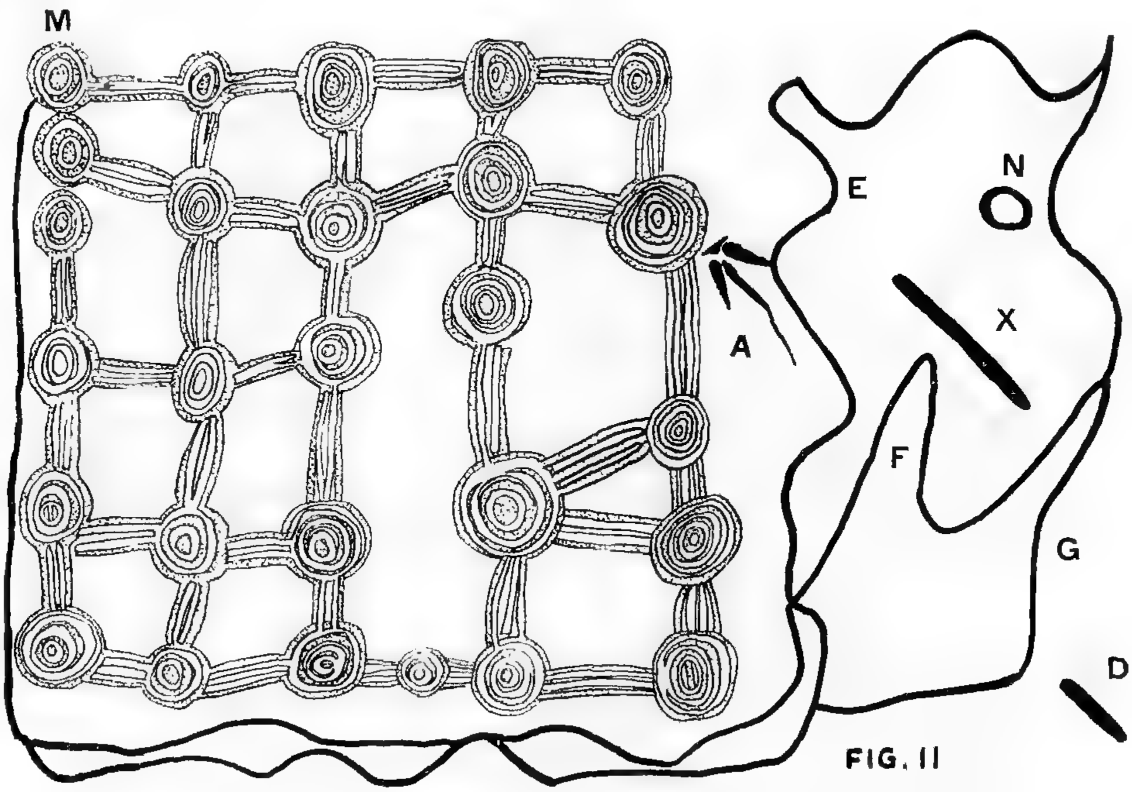


FIG. 11

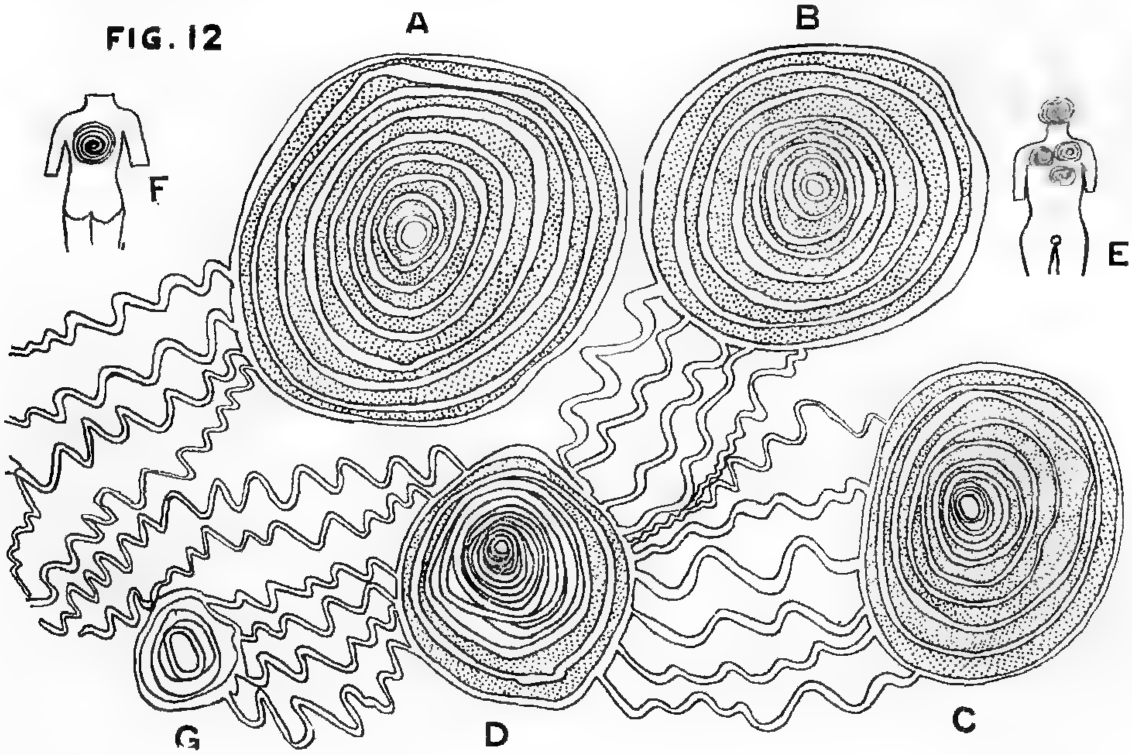
Fig. 10 refers to a place situated some distance east of the base camp called Tjukata. The drawing, the work of Mungalu (K.14), is included in this series because it was at this place that the Wati Kutjara are stated to have killed and eaten the ancestral kangaroo, Malutjukur (*malu* = kangaroo, *tjukur* = relating to the long distant past).

Several mythical beings, in addition to the Wati Kutjara, were responsible for the hills, waterholes and creeks in this part of the country. The great snake, *Wanambi,* as it travelled between B and W, forced the hills, C and D, apart and created the creek A. The two hills are known as Jabu Tjukata. The ancestral eaglehawk was responsible for the waterholes E, F, G and H, the first two being called Tjukata and Wakaelabunga respectively; the latter was described as a rockhole inside of a hill, and it is interesting to note that the artist has attempted to picture it in a different manner to the others.

The paired tracks J and K belong to the ancestral kangaroo who was killed and eaten by the Wati Kutajara, who, after they had finished their meal, left the head of the kangaroo behind. U and V are spear-throwers that belonged to the hunters. Although not specifically mentioned these are probably natural features, most likely hills.

Fig. 11 drawn by Windinja (K.51) relates to the incidents surrounding the meeting of the Wati Kutjara and a group of "Sun" women at a place called Bubul.

FIG. 12



The story given as an explanation of this drawing is as follows: At the end of a day's journey the Wati Kutjara made a camp at A, and while resting heard the sound of natives talking. The ancestors called out to the people "Come over here", but received no reply. The ancestral men than said to one another, "I wonder who they can be," and continued to call. As the people who were talking in the bush did not show themselves, the Wati Kutjara became angry, and set fire to the spinifex that covered the surrounding country. The fire burnt these unsociable people, who, it transpired, were a group of "Sun" Women (6). At every spot

(6) These women were called *Tjindulakalnguru*. This word refers to one of the subdivisions in the social organization of the Ngadadjara tribe, and literally translated means "Those who sit, or camp in the sun". They thus belonged to the same generation as the Wati Kutjara. It will be seen that the translation, given by the interpreter as "sun women", is a reasonable one.

where a woman was burnt (indicated by the series of concentric circles) a spring arose. These are connected by large hills, drawn as parallel lines.

After the burning of the women the men travelled to D, where they lit a fire. The hill that stands at this spot rose out of the ashes of that camp fire.

X is another hill, N a spring of water, and A the first camp of the Wati Kutjara, a large group of gum trees. The meandering lines E, F and G, represent a series of creeks which flow into a waterhole at M.

Fig. 12 refers to a totemic centre called Julia (which place is identified by Tindale, 1936, p. 170, as Sladden Waters in the Rawlinson Range). The sketch was associated with the Wati Kutjara, but being one of the earlier drawings full details were not secured. According to the artist, Katabulka (K.1), the concentric circles A, B, C and D were painted on the chest and forehead, and G on the back, of the sub-initiates during the time they were undergoing ceremonial training at this centre.

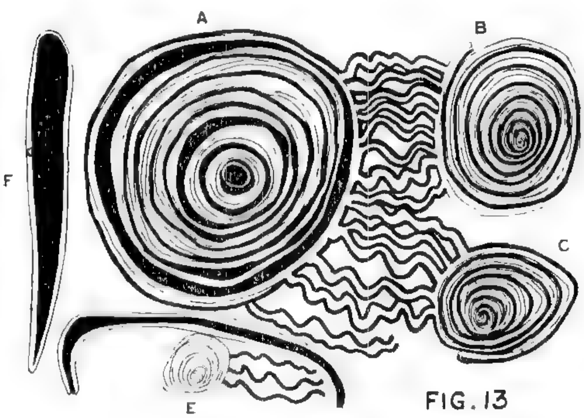


FIG. 13

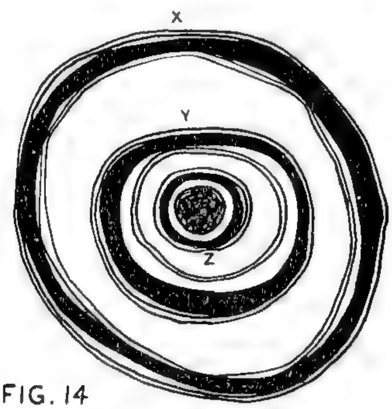


FIG. 14

The rough sketches E and F were made by the writer, and Katabulka was asked to show the exact positions of the markings on the boy's body. This he did, explaining at the same time, that although the design covered the whole face of the rough figure E, the actual symbol was painted on the forehead only.

The meandering lines connecting the various groups of circles were named *wanajawara*, i.e. the trail made by the dragging of a digging stick (7) (*wana* = digging stick, *jawara* = the trail made by a dragging object). This word suggests the possibility of women being associated with this place, for the digging stick is essentially a woman's implement.

It is almost certain that A, B, C, D and F have a topographical significance, but, as explained in connection with fig. 4, full details were not obtained.

(7) *Wana*, a stick about 5 cm. in diameter and 1·5 metres long, sharpened to a chisel point at one end by means of fire. It is used by the women for digging out yams and small marsupials.

Fig. 13 was drawn by Katabulka (K.1) and its details recorded by Tindale. It relates to the adventures of the Wati Kutjara at Tjawan, some two days' walk west of Windalda (Tindale, 1936, p. 175). At Tjawan the Wati Kutjara made a damper ([8]) from an unidentified fruit called *turuba*. The larger series of concentric circles, A represents a heap of the fruit, B and C the cooked dampers. The latter were made by mixing the ground or pulverized fruit with water, and cooking the mixture in the ashes.

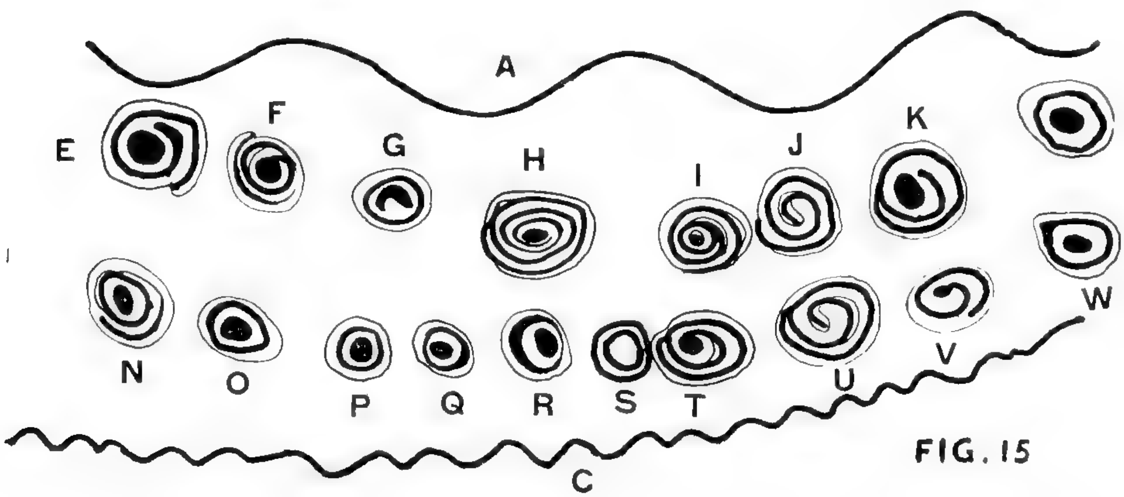


FIG. 15

The meandering lines connecting A, B and C depict the fruit spilling out on the earth from the large heap at A. This may be a symbolic device by which an aborigine expresses the presence of a plentiful supply. The meanings of A, B, C and F apparently relate to the topography of the country. D and E are known to be a water supply and a hill respectively.

Fig. 14 drawn by Tolaru (K.3) refers to ranges of hills and a waterhole north-east of Warupuju. These hills were the handiwork of the Wati Kutjara. The two outer circles picture the ranges named Jabu Neridji, and the inner circle a waterhole called Kapi Palguduna.

Fig. 15 was drawn by Ngawanti (K.48) and relates to the country a few miles east of our camp. In this district the Wati Kutjara were responsible for eighteen waterholes, a creek and a low range, A, called Bimulba. The latter grew up from a game trap which had been constructed from the branches of trees for the purpose of catching wallabies. One man hunted the animals into the trap while the other killed them as they became entangled in the bushes. The two lines of concentric circles refer to the previously mentioned water supplies. Reading from the left the names of those on the bottom are N, Wildjeri; O, Karnka (Tindale considers

([8]) An outback Australian term applied to a scone-like bread cooked in the ashes of a camp fire. The name is not without its humorous side.

this is likely to be Barlee Springs, P.B. 332); P, Katajungili; Q, Jili; R, Lelele; S, Talunba; T, Ngundul; U, Kamini (Gamminah Soak, west of Mount Herbert). The last two, V and W, are unnamed.

The names of the upper line, in the same order, are: D, Duira; E, Puntapila; F, Katata; G, Palkuta; H, Kakili; J, Kapibura; K, Juara; M, Tarnaja. Spinifex country surrounded these waterholes.

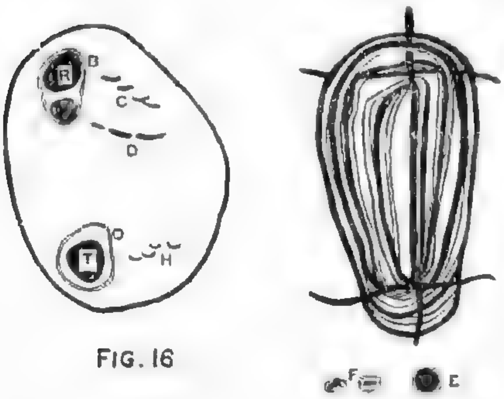


FIG. 16

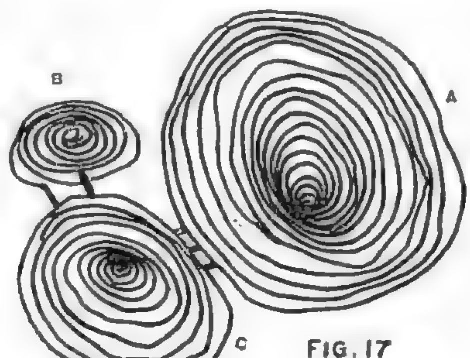


FIG. 17

The natives believe that the creek C was formed where the loosened hair string (9) of the Wati Kutjara rested after the wind had blown it along the ground.

Fig. 16 was drawn by K.8 and suggests that the Wati Kutjara were transformed from crested pigeons into human beings at one time in their existence. The large oval A represents a wet weather camp, the small upper oval B the camp of the mother of the Wati Kutjara and her two children (apparently the youthful Wati Kutjara). The mother is at R and the children at S, and their tracks at C and D lead away to the right. In the lower oval O are the Wati Kutjara, T, their tracks, being shown at H.

Included in the same sheet are the drawings of a crested pigeon, E, with its tracks at F. K.8 explained that this pigeon or pigeons later became the Wati Kutjara. The camp of the crested pigeons at E is now a well known waterhole Windurn (Windarro, P.B. 280), while the large oval A is a place in the spinifex country known to the natives as Jaralubulba. J is a wanigi left behind by the Wati Kutjara.

This fragmentary sidelight touches on another aspect of the Wati Kutjara legend. It suggests that a group of pigeons were thansformed into human beings. This transformation is not unusual in aboriginal mythology (Spencer and Gillen, 1904, pp. 400–410) quote several such instances. Tindale has shown that the

(9) The hair is bound in the form of a chignon with a considerable length of fur string. Only fully initiated men are allowed to wear their hair in this fashion.

totem of the father of Pitawara (a Wati Kutjara totem man) was the *mutumutu* or pigeon (Tindale, 1936, p. 182).

Fig. 17, the work of an elderly aborigine, Tolaru (K.3) illustrates a group of three fig trees, *jili* [10], which grow adjacent to a water supply called Kapi Tukuntjara, some distance north-west of Warupuju. The Wati Kutjara who came from the south-west, camped at this place, and wherever they rested groups of fig trees sprang up. A, B and C are but three of these trees.

Several sheets of drawings having a bearing on the Wati Kutjara legend were drawn by our interpreter Pitawara (K.6). On all sheets, with the exception of two figured by Tindale (1936, fig. 5 and 6), the designs used to illustrate the legendary stories were typically European. This was probably due to the fact that the aborigine had been in contact with missionaries and police officers since he was a young man, and thus had a restricted education in ceremonial matters. Pitawara thus had little or no knowledge of the traditional symbols used by his countrymen, although he appeared to be conversant with many of the legendary stories, particularly those relating to his own totem, the Wati Kutjara.

This would suggest that, although the legends are a matter of common knowledge to the men and to a lesser extent, the women, the method of depicting such stories would only be acquired after years of association with the secret life of the tribe.

In another of Pitawara's series of drawings, a story relating to Kulu, the morning and evening stars, and the new and full moon, is illustrated. The body of Kulu is marked to show the manner in which the Wati Kutjara decreed that all men should be decorated when they danced in the ceremonies relating to Kulu, who was killed by the Wati Kutjara for interfering with women called the Kunkarunkara (Tindale, 1936, p. 176). As mentioned in connection with fig. 9, Kulu should not be confused with Kidjili, the moon. According to Pitawara, Kulu is the master of the moon and morning and evening stars. The two latter, which the natives recognize as one and the same, is called *Murunba,* the new moon *Kidjili pilda,* and the full moon *Kidjili takanba.* The moons were depicted in the conventional European manner, i.e. a crescent and a circle respectively, Murunba, five pointed stars, and Kulu as a man in the usual manner.

Another drawing by the same aborigine shows a native dancing in the Wati Kutjara ceremonies. It depicts him as wearing shaved sticks in his hair and with his body marked with lines of down.

---

(10) A tree (*Ficus platypoda*) which grows on rocky outcrops, the fruit of which is an aboriginal food.

ANALYSIS OF DESIGNS.

When examples of aboriginal art from various parts of Australia are examined, it is noticeable that those originating from the Northern Coast and, to a lesser extent, from the Eastern coastal fringe north of Sydney, are largely representations of various animals, fish and human beings. Some of the cave paintings from Napier Broome Bay (Mountford, 1937, pp. 30–40), Prince Regent River (Bradshaw, 1891, p. 100), and adjacent localities are drawn with a freedom of style that is not known in any other part of Australia.

When, however, the art of the natives from Central and South Australia, Tasmania and Western Australia is examined, it will be noticed that by far the greatest number of designs in use are so highly conventionalized as to be indecipherable without the assistance of the artist who produced them.

The identifiable figures of men, animals and reptiles form a small percentage of the designs to be seen at the various sites. An examination of Basedow's work on the rock carvings of South Australia (Basedow, 1915, p. 195–211), and the writer's work on the same subject (Mountford, 1928, p. 337–366), will make this point clear.

The drawings in the Wati Kutjara suite and, for that matter, all those collected at the Warburton Ranges, showed characteristics similar to the designs from Central, Southern and Western Australia.

For that reason, it was decided to analyse the Wati Kutjara suite under six headings, as follows:

(*a*) Types of designs used.
(*b*) Number of occasions on which a particular design appears.
(*c*) Meaning attached to a specified design in each particular figure.
(*d*) The numbers of each type design used.
(*e*) The choice of colours.
(*f*) Age of aborigines responsible for the production of the drawings.

(*a*) TYPE OF DESIGN USED.

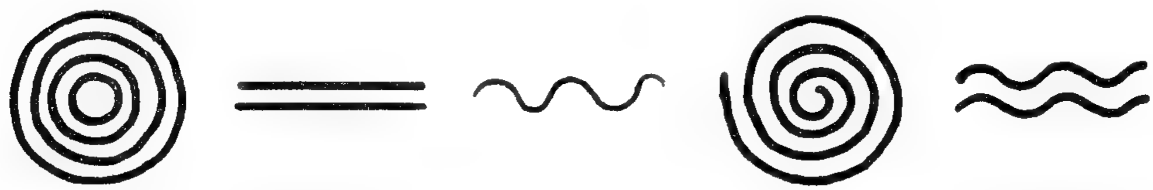
Figs. 1 and 2, being anthropomorphic, are excluded from the analysis, figs. 3–17 only being considered.

An examination of the various figures showed that the symbolical designs used could be grouped under ten headings. The drawings of miscellaneous objects, including human, animal, and animal tracks, may be set under another two, making a total of twelve categories in all.

The ten symbolic designs are shown in figs. 18 to 27. Three of the figures, i.e.

18–19, and 22 are considered to be amplifications of simpler figures such as 20, 23 and 25.

Each of the figures, i.e. 18–27, was used by the natives to convey different meanings, and will be considered as a separate element.



18 19 20 21 22

23 24 25 26 27

As mentioned previously, the analysis excluded designs from figs. 1 and 2. These, however, would not influence the averages to any extent as they only contain 17 only in a total of 357 designs.

(*b*) NUMBER OF FIGURES IN WHICH A PARTICULAR DESIGN IS USED.

Concentric circles (fig. 18)	10
Parallel straight lines (fig. 19)	8
Meandering or zigzag lines (fig. 20)	5
Spirals (fig. 21)	6
Parallel meandering or zigzag lines (fig. 22)	4
Circles (fig 23)	5
Ellipses (fig. 24)	2
Straight lines (fig. 25)	2
Squares (fig. 26)	1
Fern leaf (fig. 27)	1

(*c*) MEANINGS ATTACHED TO EACH DESIGN ELEMENT.

Fig. 18. Concentric circles (10 figures).

Fig. 3—Hills, waterholes and gum trees.

Fig. 4—Waterholes and ceremonial marks placed on the bodies of the natives (which may refer to some totemic centre).

Fig. 6—Waterholes and hills.
Fig. 8—Waterholes.
Fig. 9—Hills, gum trees and waterholes.
Fig. 10—Waterholes.
Fig. 12—Ceremonial body markings (see fig. 4 above).
Fig. 13—A "damper" made from ground or pounded fruit.
Fig. 15—Waterholes and hills.
Fig. 16—Waterholes.
Fig. 17—Ceremonial fig tree.

Fig. 19. Parallel straight lines (8 figures).

Fig. 4—Creeks between two waterholes.
Fig. 5—Ceremonial marks on aborigine's chest.
Fig. 6—Paths made by euros.
Fig. 7—The Wati Kutjara and an *inma* board.
Fig. 8—Mark made by dragging a ceremonial object.
Fig. 9—Creek and range of hills.
Fig. 11—Range of hills.
Fig. 17—No meaning obtained.

Fig. 20. Meandering or zigzag lines (5 figures).

Fig. 3—Creeks, ranges of hills, lines of spinifex.
Fig. 4—Ranges of hills.
Fig. 5—Trail made by dragging object.
Fig. 7—Creeks.
Fig. 15—Creeks and ranges of hills.

Fig. 21. Spirals (6 figures).

Fig. 3—Waterholes, hills and gum trees.
Fig. 5—Ceremonial marks on backs of initiates. Similar meaning on same plate for concentric circles.
Fig. 12—Ceremonial marks on backs of initiates.
Fig. 13—Damper made from ground fruit.
Fig. 15—Waterholes.
Fig. 17—Fig trees.

Fig. 22. Parallel meandering and zigzag lines (4 figures).

Fig. 9—Paths made by ancestral beings.
Fig. 10—Creek made by ancestral snake.
Fig. 12—Trail made by the dragging of digging sticks.
Fig. 13—Paths made by fruit as it rolled from large heap.

Fig. 23. Simple circle (5 figures).

Fig. 3—Small waterholes.
Fig. 4—Waterholes.
Fig. 6—Waterholes.
Fig. 10—Waterholes.
Fig. 16—Opossum being's camp and windbreak.

Fig. 24. Ellipse (2 figures).

Fig. 9—Native oven.
Fig. 10—Hills.

Fig. 25. Simple straight lines (1 figure).

Fig. 11—Hills.

Fig. 26. Square (1 figure).

Fig. 11—Waterholes.

Fig. 27. Fern leaf design (1 figure).

Fig. 5—Pubic Tassels, *Wanigi.*

SUMMARY OF ANALYSIS OF MEANINGS ATTACHED TO VARIOUS DESIGN ELEMENTS.

Fig. 18. Concentric circles.

These are largely used to represent a geographical feature, a locality, or a waterhole.

Fig. 19. Parallel straight lines had a broad range of meaning, such as was to be expected with so simple a design. In general, it represents creeks, ranges of hills, paths and ceremonial markings.

Fig. 20. Meandering or zigzag lines.

The meanings attached to fig. 20 were similar to those associated with fig. 19, representing ranges, creeks and tracks followed by the various ancestors.

Fig. 21. Spirals.

These were used side by side with the concentric circle, fig. 18. In many cases the figure was started as a spiral and completed as a concentric circle (see fig. 3, G.J.M.).

Fig. 22. Parallel meandering and zigzag lines.

This is an amplification of fig. 20, and the meanings used for the one are equally applicable to the other.

Fig. 23. Plain circles.

This figure, like that of the spiral, has similar significance to the concentric circles.

Fig. 24. Ellipse.

Used twice only, once picturing a native cooking hearth, and in fig. 8 in a somewhat more elongated form depicting hills.

Fig. 25. Straight line.

Although a simplified form of fig. 19, the single isolated straight line was used twice. On each occasion it represented ranges of hills.

Fig. 26. Square.

This unusual pattern was used on fig. 3 to represent rock holes; the native drew the square to indicate particular rock holes of that shape.

Fig. 27. Fern leaf.

Well known to students of primitive art from many parts of the world (Mountford, 1935, p. 213), the fern leaf design appeared only in fig. 4. In this case, it had two totally unrelated meanings, i.e. a pubic tassel and a *wanigi*.

Various tracks of animals and men were noted in figs. 2, 10, 11 and 16. It is more than likely that, in suites of drawings relating to the personal experiences of the aboriginal artists, or to the doings of the animal ancestors, such as the kangaroos, emus or opossums, a greater percentage of footprints would occur. Nevertheless, they would not approach the percentage of human and animal foot tracks seen among the rock carvings in South Australia (Mountford, 1928, p. 348). In some localities, in the rock carving sites of South Australia, various footprints form the bulk of the petroglyphs present.

(*d*) THE NUMBERS OF EACH DESIGN USED.

Fig. 18	64	Fig. 23	80
Fig. 19	104	Fig. 24	5
Fig. 20	5	Fig. 25	2
Fig. 21	27	Fig. 26	2
Fig. 22	41	Fig. 27	4

These figures reveal an interesting fact. Out of 340 figures drawn, the circular designs, i.e. figs, 18, 21, 23 and 24 represent about one half, i.e. 176.

As most of the drawings are, in reality, crude maps of the country, it is to be expected that the circular figures should predominate, for, as has already been shown, such designs usually represent some well known topographical feature such as a hill, a waterhole, or an especially large tree. The predominance of circular designs is also evident in Aranda drawings (Mountford, 1937A, p. 193).

For the same reason, designs 20 and 22 (parallel straight and meandering lines) symbolical of creeks and ranges, were used 149 times, leaving 75 figures to represent other features.

The drawings of tracks, objects, and animal and human forms, which number 17 in all, are excluded from the above analysis.

(*e*) THE CHOICE OF COLOURS.

As mentioned previously, the native was given the free choice of four coloured crayons, i.e. red, yellow, black and white. Especial care was taken to see that these colours were always on hand. One red crayon was, by chance, of a brighter hue than the others, and it was interesting to note that this crayon was in constant demand.

The colours used were also analysed, with the following results:

Combinations of colours used.

(Number of figures in suite, 17.)

Red and white	11
Red, yellow and white	2
Red, yellow, white and black	2
Yellow and white	1
Red	1

It will be seen that the most commonly used colours were red and white, each appearing in 16 out of the 17 figures. Yellow was used in only five sketches, and black in two.

In the majority of cases, white was used as an outline of the main design, whilst red, and in two cases, yellow, formed the main design. ([12]).

Red is the favourite colour of the aborigines, it being considered to be the sign of good health by the Narrinyeri peoples of the Lower Murray. During the smoke drying of the dead body, it was anointed with red ochre and grease for the same reason.

The colour is used most extensively in ceremonial as well as personal decoration, and long journeys are undertaken to obtain this valued cosmetic. The most famous of these journeys recorded was that undertaken by the Deiri tribe of the North-East of South Australia to the red ochre deposit at Blinman in the Northern

([12]) The key to the colours used in Figs. 1–17 can be seen on Fig. 2.

Flinders Ranges in South Australia, a distance of 300 miles (Gason, 1879, p. 280). During a recent expedition to the Northern Flinders it was ascertained that natives travelled from Charlesville, S.W. Queensland, to Blinman, a journey of over 900 miles, for the same purpose.

Black, as the figures show, was used in two drawings. Dislike of this colour could hardly be the reason for a not greater use, for on many occasions during his stay at Warupuju the writer saw the natives decorating themselves with grease and powdered charcoal.

Ages of the men who produced the drawings.

The majority of the drawings collected on this expedition were the handiwork of the older men.

In the series under review, 15 figures were produced by men over 30 years of age, one by a native of about 21 years of age, and two by a youth of 18.

Figs. 5, 8, 12 and 13,	drawn	by	K.1	estimated	age	50.
Figs. 2, 14, 17	„	„	K.3	„	„	55.
Fig. 7	„	„	K.4	„	„	21.
Figs. 6 and 16	„	„	K.8	„	„	18.
Figs. 1, 9 and 10	„	„	K.14	„	„	46.
Fig. 15	„	„	K.48	„	„	40.
Figs. 3 and 11	„	„	K.51	„	„	38.

(K.6), the interpreter Pitawara, also made four sketches (not reproduced); his estimated age was 24.

It will be seen that the average age by the seven artists responsible for the fifteen figures is estimated to be thirty-seven years.

Younger men, with the exception of K.8, made sketches of simple objects, or lines of waterholes, similar to fig. 6. These men volunteered little detail. This is to be expected, for the acquisition of a full knowledge of the legendary stories requires years of training, as well as many long and arduous journeys to the various totemic centres.

K.8, who drew the sketch indicating the origin of the Wati Kutjara (fig. 16), although quite a young man, 18 years old, took a prominent part in the ceremonies.

He showed more personality than his companions of the same age and it is likely that this, coupled with a higher degree of interest, enabled him to acquire a deeper knowledge of the ceremonial life than that obtained by other young men.

SUMMARY.

This paper records a suite of aboriginal drawings relating to the wanderings of two legendary men, the Wati Kutjara. The drawings are the work of men of the Ngadadjara tribe of the Warburton Ranges of Western Australia.

The first part of the paper deals with a detailed description of each sheet, and the second, an analysis of the designs used, the meanings thereof, the favourite colours, and the ages of the aboriginal artists concerned.

LITERATURE.

Tindale, N. B. (June, 1936) : Oceania, Vol. vi, No. 4, pp. 481–485.

Tindale, N. B. (Dec., 1936) : Oceania, Vol. vii, No. 2, pp. 169–185.

Spencer, B. and Gillen, F. J. (1899) : Native tribes of Central Australia.

Spencer, B. and Gillen, F. J. (1904) : Northern tribes of Central Australia.

Mountford, C. P. (1937) : *Trans. Roy. Soc. of S. Aust.*, pp. 30–40.

Bradshaw, Jos. (1891) : *Journ. Roy. Geog. Soc. Aust., Vic.*, p. 100.

Basedow, H. (1935) : *Journ. Roy. Anthrop. Inst.*, xliv, pp. 195–211.

Mountford, C. P. (1928) : *Aust. Ass. Adv. Sci.*, pp. 337–366.

Mountford, C. P. (1935) : *Aust. Ass. Adv. Sci.*, p. 213.

Gason, Samuel M., Taplin, G. and others (1879) : Native tribes of South Australia, p. 280.

Mountford, C. P. (1937) : *Trans. Roy. Soc. of S. Aust.*, p. 93.

TASMANIAN ABORIGINES ON KANGAROO ISLAND SOUTH AUSTRALIA

By Norman B. Tindale, B.Sc., Ethnologist, South Australian Museum

Summary

Scattered through early accounts of South Australia there are brief references to Tasmanian women who were brought to South Australia by sealers and escapees from Van Diemen Land during the early years of last century.

The present paper summarizes some facts relating to four Tasmanian women and places on record a few words still known to the descendants of the Tasmanians. It also gives an account of two small pieces of archaeological work carried out by Dr. H. L. Movius of the Department of Anthropology, Harvard University, N. de Crespigny, and the writer at Cape Hart and at Antechamber Bay, in March, 1936.

TASMANIAN ABORIGINES ON KANGAROO ISLAND SOUTH AUSTRALIA

By NORMAN B. TINDALE, B.Sc., Ethnologist, South Australian Museum.

Plate iii, and Text fig. 1–3.

INTRODUCTION.

Scattered through early accounts of South Australia there are brief references to Tasmanian women who were brought to South Australia by sealers and escapees from Van Diemen Land during the early years of last century.

The present paper summarizes some facts relating to four Tasmanian women and places on record a few words still known to the descendants of the Tasmanians. It also gives an account of two small pieces of archaeological work carried out by Dr. H. L. Movius of the Department of Anthropology, Harvard University, N. de Crespigny, and the writer at Cape Hart and at Antechamber Bay, in March, 1936.

There are many references in the literature to the lawless people of Tasmanian, Australian and European origin who lived along the Southern coasts of Australia between 1803 and 1836. A useful account is given by Moore (1925), while Berry (1907) described a then living half-caste Tasmanian descendant of one of the Tasmanian women. Tindale and Maegraith (1931) have also given a brief account of these people during the course of their description of the archaeological remains of an ancient occupation of Kangaroo Island.

In more recent years the collating of the reminiscences of some of the oldest inhabitants of the island and a study of official documents and records has enabled the main outline of the story of the Tasmanian native women to be traced down to the time of the death of the last one about the year 1888.

Among those who have contributed to these details are Mr. Robert Snelling, born in 1853, whose parents issued Government rations to the blacks on Kangaroo Island; Mr. Fred Buick, born in 1856; the late Mr. C. J. May, Curator of the Flora and Fauna Reserve at Flinders Chase, and Mr. A. Daw. I am indebted also to Mr. M. T. McLean (Protector of Aborigines) for information contained in official docket No. 390/1894 in the Aborigines Office and in docket No. 280/1894 of the Destitute Board Office. Mr. H. T. Condon kindly made drawings Nos. 12–15.

The only pictorial record of the Tasmanian women of Kangaroo Island is probably the one given in a sketch by Leigh (1839) opposite p. 105 of his account where three women are shown as squatting with legs folded before a fire, behind a low breakwind (pl. iii, fig. 1).

THE NATIVE WOMEN OF KANGAROO ISLAND.

The lack of originality shown by the sailors in naming their native womenfolk has helped to confuse the record but numerous accounts attest to the presence of four Tasmanian women on the island. The South Australian census returns for 1866 (5) for example record the native population of Kangaroo Island, and a footnote states that "4 natives of Van Diemen Land" were also present. In Destitute Board Office docket No. 28/1894 there is correspondence which discusses the status, for relief purposes, of Mary, the half-caste daughter of Betty, one of these Tasmanians (italics are ours): "The applicant is not an aboriginal of S.A. blood, but it has been the practice to assist aborigines from the other Australian colonies when located in South Australia. *There were three (3) Tasmanian women, native blood, living in Kangaroo Island for many years, the last of these aborigines died about six years ago*, and she was receiving rations from this department. The present applicant is believed to be the very last of this race, and on the ground of Intercolonial reciprocity would, I submit, have some claim on S.A. for assistance. (Signed) E. H. Hamilton, 8th. Sept. 1894."

This official record indicates the probability that the last Tasmanian survived on Kangaroo Island until 1888.

In addition to the Tasmanian women at least two Australian aboriginal women are mentioned in early records and it seems advisable therefore to list the names of both the Tasmanian and Australian women and also to give supplementary details mentioned by my informants and a list of some other notes found in the ephemeral literature.

TASMANIANS.

(1) *Bumble-foot Sal = Big Sal.*

"Fine-looking big black", bunble-footed, had lost two toes by burning in a fire; her hair was "wonderfully curly as in Suke and Betty". Old accounts state that she had dark skin and woolly hair. She is supposed to have died somewhere near the waterfall at Middle River. She is mentioned by Bull (1878, p. 8) as "a Tasmanian blackwoman, called Sal, who had lost half of one of her feet when young by sleeping with them too near the fire".

(2) *Betty = Pole-cat = Old Bet.*

Brought from Van Diemen Land about 1819 by Robert Wallen. She lived with Nat Thomas at Antechamber Bay and had a son and two daughters. These children are mentioned in a newspaper article ("South Australia Register", 25th September, 1844): "Nat Thomas has . . . . a native woman who catches wallaby for him. By her he has three very interesting little children, who combine the intelligence of the white with the activity of the native." The son went to sea and was not heard of again. The daughters both had children of whom five were still living in 1936. There are also numbers of octoroon descendants. Detailed genealogies have been gathered as a basis for a study of the descendants of the two families. Her grandson Joseph, living on Kangaroo Island, states that Betty died in 1878 and was buried at Antechamber Bay; the approximate site of her grave is known to be in a small field opposite the point where the main road turns abruptly northwest away from the banks of Chapman River (Section 75, Hundred of Dudley). Unfortunately the surface indications have been obliterated accidentally by ploughing. Tolmer (1882) mentions Old Bet as a Tasmanian and one of her daughters, Mary, as the child of Nat Thomas. Mary was studied and described by Berry (1907). Her photograph is also published by Hallack (1905, p. 43). Mary's previously mentioned 1894 application to the Government for sustenance was approved, and in return for the surrender of her property she was allowed rations from the Aborigines Office until her death on the 9th September, 1913. A few days after her death her eldest daughter Emma applied for permission to retain the use of the cottage property until it was sold by the Government. Emma was then 60 years of age. Her brother Joseph wrote to the Surveyor-General from Penneshaw on August 31, 1914, asking for particulars regarding the "property lately occupied by my late mother Mary".

The other daughter of Betty is stated to have married a fair-haired man from Lincolnshire, and three of her four sons and several grandchildren survive.

(3) *Old Suke = Sal (not to be confused with Little Sal).*

A Tasmanian who was of a retiring nature. She was seldom seen in the later days except when she gathered her rations. According to R. Snelling she was the last to die, but there is doubt as to her burial place. In 1844 she was arrested with another woman by Tolmer for complicity in the killing of Meredith, an early visitor from Van Diemen Land.

(4) *Puss.*

A fourth Tasmanian woman is mentioned under the name of Puss.

Puss and Polecat (Betty) are described as having been brought, together, from Van Diemen Land by Robert Wallen (Worley, Whalley, Wally, Walker, Wallens) who escaped from custody there about 1817 (arriving at Kangaroo Island about 1819). There seems to be little remembrance of Puss on the island.

AUSTRALIANS.

In addition to the above Tasmanians, several mainland natives are believed to have lived on the island and one or two have been at times confused with the foregoing. Two of them are given particular notice:

(1) *Little Sal = Sal.*

In Tolmer's (1882) account of Kangaroo Island Little Sal is mentioned as having been abducted from Port Lincoln about 1827. According to R. Snelling she claimed to be a mainlander. Two other informants emphasize that in contrast to Betty and Suke she had straight, or at most wavy hair, an Australian characteristic. It appears from local information that she was buried at Springy Water, near Stokes Bay, about the year 1877.

Two other informants, the late Mr. C. J. May, and Mr. A. Daw, regarded Little Sal as a Tasmanian, and Hallack (1905) states that the last of the Tasmanians is buried at the place called Springing Vale, near Stokes Bay, Kangaroo Island. This seems to be the same place as Springy Water.

The weight of evidence seems to be that Little Sal was a native of Port Lincoln.

(2) *Sally Walker.*

This woman was well known as a native of the adjoining mainland. She lived at Hog Bay and had no associations with the Tasmanian women.

It seems that at most four Tasmanian women were among the permanent native inhabitants of Kangaroo Island during the lawless days preceding the foundation of the State. The earliest date suggested for their arrival is 1810. They were definitely present in 1819. Official records indicate the presence of four in 1866, and one of them lived on until about 1888. One (Betty) had children and some ten quadroon and octoroon descendants live in South Australia to-day.

ARCHAEOLOGICAL TRACES OF THE TASMANIANS ON KANGAROO ISLAND.

Mr. H. M. Cooper, who has displayed much interest in the systematic collecting of implements from camp sites on the mainland of South Australia, several years ago, was asked by the writer to extend his activities to Kangaroo Island. During the years 1935 to 1937 he found no fewer than 47 sites indicative of the ancient highly characteristic native occupation of Kangaroo Island. Some details of his discoveries are given in another paper in this series. In February, 1936, after one of his periodic visits to the island he brought back to the Museum a European gun flint and several strange bluish-grey flint implements of a type not previously found on the island.

At first glance these seemed to be of Tasmanian origin. Some of the flint implements and the gun flint had been found on a small rectangular site indicated by stones and by the remains of a stone chimney at Cape Hart. The others, even more characteristically Tasmanian, were found on a wind-swept rise less than two hundred metres from the sea at Antechamber Bay beside the well on Section 393 which appears in the 1910 edition of the Hundred map of Dudley.

The flint from which the implements were made proved to be similar to that found commonly in the Tertiary Marine limestones of the South-East of South Australia, several occurrences of which have been noted by Tindale (1933, p. 138) and by Howchin (1934, p. 15).

Through the courtesy of Dr. C. T. C. de Crespigny in organizing a visit to the island, Dr. H. L. Movins, N. de Crespigny, and the writer, visited the sites in March, 1936. Examination led to the recovery of further flint flakes at the Cape Hart site, while flint boulders were found to abound on the adjoining beach and several broken ones were found associated with the flint chippings present within the wind-swept area covered by the hut site and in its immediate vicinity. The flint chippings were confined to an area little more than 10 m. x 15 m. on the seaward edge of a flat limestone shelf some six metres above sea level immediately to the west of Cape Hart. Wind scour had dropped all remains to the limestone and had removed most traces of food debris except for a few weathered bones.

The Antechamber Bay site, which was situated approximately 50 metres due north of the mouth of Chapman River and about 200 metres inland from the beach line, proved to be more productive and notwithstanding that some wind scour had already taken place it was possible to dig into and sieve a thin layer of undisturbed debris on the site of what was once a hut. Several additional flint implement flakes were recovered and the productive layer, only a few centimetres in thickness, was found to consist of ashy material, remains of shellfish (all *Turbo undulatus*) and bones, principally those of the Sooty or Kangaroo Island Kangaroo (*Macropus fuliginosus*). Fragments of glass bottles, a small hand-carved bone, forming part of a domino piece and several flints were recovered.

Examples of the flint implements, the game piece (the half of the two of dominoes), a kangaroo jaw bone, a *Turbo undulatus* shell and a fragment of glass bottle are shown in plate iii, fig. 2, and one of the flints and the game piece are shown in the text figures 1 and 3.

On our visit to Antechamber Bay we were accompanied by a grandson of the Tasmanian woman Betty, who was able to indicate the site as being at the landing place favoured by sealers who visited Antechamber Bay. It was the first home of his grandmother, who, later on, lived in a cottage at Section 63, south of Chapman River, until her death in 1878. Betty's children were educated by the wife of the lighthouse-keeper at Cape Willoughby, a few kilometres away. This statement corroborates one mentioned by Hallack.

SIGNIFICANCE OF THE IMPLEMENTS.

The Tasmanian implements, made on Kangaroo Island in the years immediately after 1819, are of considerable theoretical interest.

They are entirely unlike the coarse and large implements characteristic of the many sites of the archaic Kangaroo Island culture. They were found on two small and restricted areas, associated with hut sites, and remote from places where implements of the Kangaroo Island industry have been found.

They indicate how, when conditions are favourable, even such a transient occupation as is indicated to us by our historical knowledge of Kangaroo Island, may become recorded in archaeological debris.

The presence of the Sooty Kangaroo as the principal mammalian food, places the period of occupation of the Antechamber Bay hut site at an early date, within the period of lawless occupancy before 1836, for it is stated that owing to the depradations of the sealers these animals soon became rare. In later years pigs, wallabies and goats provided the principal animal foods used on the island. Flinders in 1802, and Sutherland in 1819, both noticed the amazing abundance of emu and kangaroo at the eastern end of the island, in contrast with Bull (speaking of the year 1836) and Leigh (of 1837) who both comment on the absence of these creatures.

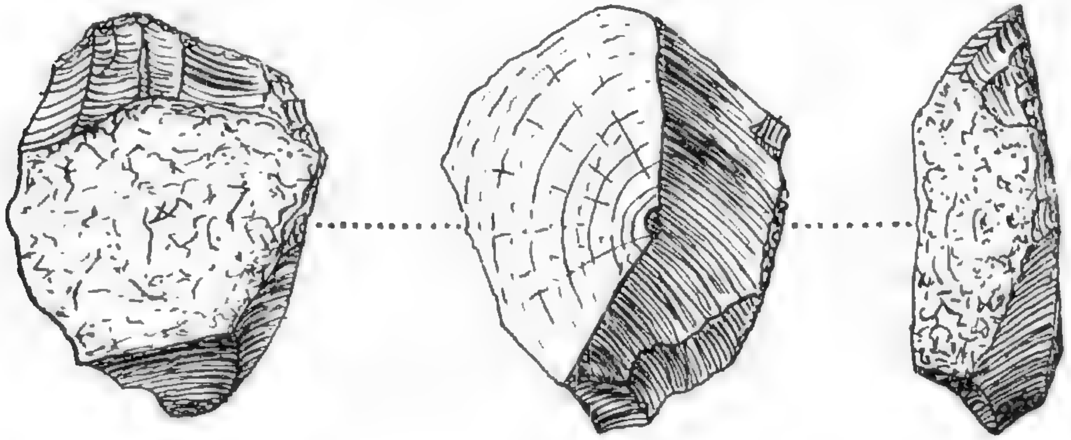
The home-made game-piece from Antechamber Bay suggests that for the refugees and sealers, the tedium of life in their isolated home was made easier by means of games.

The flint implements indicate that their Tasmanian women partners had not yet become entirely divorced from their old culture.

The implements themselves are of considerable interest.

In April, 1936, at the request of the Royal Society of Tasmania, the writer made a visit to Tasmania and examined and reported on the rock carvings found by Mr. A. L. Meston (1934) at Mount Cameron West. He was accompanied on his visit by the Director of the Tasmanian Museum, Dr. Pearson, and by Mr. A. L. Meston. A passing visit was made to Rocky Cape Cave where, some years ago, a narrow trench had been cut by Mr. Meston through the occupational debris, to a depth of more than two metres. It was then noticed that flints and implements from the basal strata of the cave were strongly patinated, while those from the superficial layers were not so affected. When the collections made by Mr. Meston in the Rocky Cape section were separated, arbitrarily, into a patinated and non-patinated series, it was apparent that important typological differences were present in the two. It should be emphasized that these preliminary indications should be tested by a carefully controlled excavation of the considerable portions of the site which remain undisturbed.

A few months later while on a visit to Oxford, Dr. Henry Balfour informed the writer that some time previously he had determined the presence of two typologically distinct series among the Tasmanian implements in the Oxford Museum collections. Thus it is evident that when careful excavations are made, considerable light will be thrown on the development of Tasmanian implement cultures.



1

2

3

N.B.T.

Text fig. 1–3. 1. Three views of a flint implement from Antechamber Bay ($\times \frac{6}{7}$). 2. Flint implement from N.W. Tasmania ($\times \frac{6}{7}$). 3. Portion of a hand-made domino piece ($\times \frac{6}{5}$).

Implements of the Old Tasmanian series are typically made from flakes which have been struck off from an unprepared platform. These flakes are trimmed around the edges before and during use, and while often of highly characteristic form generally conform to the shape of the primary flake from which they were made. Specialized implements of the Newer Tasmanian series are typically made by striking off a flake from a prepared striking platform. The angle between that portion of the striking platform retained on the implement and the flake surface produced, is an obtuse one, usually tending to about 110°. Such implements are characteristic in form. Text fig. 1 shows a typical flint implement from Antechamber Bay, Kangaroo Island. It may be compared with fig. 2, an example from North Western Tasmania (A.23192 in the S. Aust. Museum). Both of these implements agree in possessing the characters peculiar to the Newer Tasmanian series. That the implements made by Tasmanian women in the period shortly after about 1819, were of this specialized form, is therefore of some interest and importance to our study of Tasmanian culture sequences, since it helps to confirm what we have already noticed in Tasmania.

TRACES OF A TASMANIAN VOCABULARY SURVIVING ON KANGAROO ISLAND.

Joseph, a grandson of Betty, the Tasmanian woman, a man of perhaps 80 years of age, was interrogated for a short while during our stay at Penneshaw. He complained of loss of memory and it was difficult for him to talk for long on one subject, but it was felt that much could have been learned if time had permitted. The following words were written down in a phonetic system in use at the University of Adelaide and described by Tindale (1935). They were clearly enunciated by Joseph, who remarked that they were taught to him by his grandmother, who had told him that they were in the "Hobart Town Language".

'nina tu:'napari	you understand.
lil tu:'napari	do you understand?
'bulunta	go straight ahead.
ma:bir, ma:bier	go around.

The material is scanty. Two of the words have a nautical flavour. The pronoun ['nina] appears to be the same as the neena = you, recorded for one of the Southern tribes of Tasmania. According to another grandson of Betty the two families at one time used many words which were not understood by other people, but the children had forgotten most of them.

SUMMARY.

Some details are given of the Tasmanian women who formerly lived on Kangaroo Island together with some notes on the mixed blood survivors.

Some stone implements, made on Kangaroo Island by the Tasmanian women, are described together with an account of the circumstances in which they were found.

Several words, believed to be of Tasmanian origin, are transcribed in phonetic form.

REFERENCES CITED.

Moore, H. P. (1925): Notes on the early settlers in South Australia prior to 1836. *Roy. Geog. Soc. of Australia, South Aust. Branch, Proceedings*, xxv, pp. 81–135.

Berry, R. J. A. (1907): Living descendant of an extinct (Tasmanian) race. *Proc. Roy. Soc. of Victoria*, xx (n.s.), pp. 1–20, pl. i, with bibliography.

Tindale, N. B. and Macgraith, B. G. (1931): Traces of an extinct aboriginal population on Kangaroo Island. *Records of the S. Aust. Museum*, iv (3), pp. 275–289, figs. 1–11.

Leigh, W. H. (1839): Reconnoitering Voyages, travels and adventures in the new colonies of South Australia, London.

South Australian Parliamentary Papers, 1866, No. 8, p. 12.

Bull, J. W. (1878): Early experiences of colonial life in South Australia, Adelaide.

Tolmer, A. (1882): Reminiscences of an adventurous and chequered career at home and in the antipodes. 2 vols., London.

Hallack, E. H. (1905): Kangaroo Island. Adelaide.

Tindale, N. B. (1933): *Trans. Roy. Soc. S. Aust.*, lvii, pp. 130–142.

Howchin, W. (1934): Stone implements of the Adelaide tribe of aborigines now extinct. Adelaide.

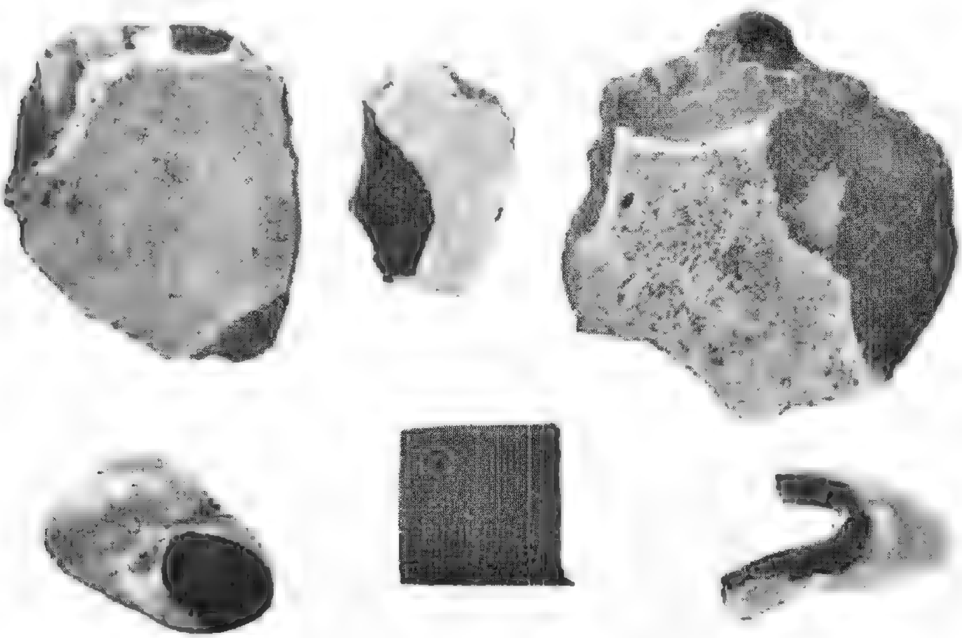
Meston, A. L. (1934): Aboriginal rock-carvings in Tasmania. Antiquity, 8, pp. 179–184, pl. 1–4.

Tindale, N. B. (1935): Legend of Waijungari, Jaralde Tribe, Lake Alexandrina, South Australia; and the phonetic system employed in its transcription. *Records of the S. Aust. Museum*, v (3), pp. 26–274.

EXPLANATION OF PLATE III.

Fig. 1. Leigh's encounter with the Tasmanian women of Kangaroo Island in 1836 (after Leigh).

Fig. 2. Remains from Antechamber Bay. a–c. Flint implements, d. *Turbo undulatus* shell, e. gaming piece, f. base of a glass bottle.



EVIDENCES OF EARLY NINETEENTH CENTURY OCCUPATION OF KANGAROO ISLAND.

RELATIONSHIP OF THE EXTINCT KANGAROO ISLAND CULTURE WITH CULTURES OF AUSTRALIA TASMANIA AND MALAYA

BY NORMAN B. TINDALE, B.SC., ETHNOLOGIST, SOUTH AUSTRALIAN MUSEUM

Summary

An account of some observations on the former human occupation of Kangaroo Island was given by Tindale and Maegraith (1931). At the time of its first discovery by Matthew Flinders in 1802, this island was devoid of inhabitants. Additional details regarding this occupation have come under notice in recent years and there has been opportunity for comparison with similar industries on the adjacent mainland; other discoveries have been made on mainland sites, which appear to bear some relation to the island one. The valued opportunity presented by the receipt in 1936 of a Carnegie Travelling Grant has enabled the writer to discuss the problem of these implements with research workers in Europe and America and also to see examples of similar objects, characteristic of the Upper Palaeolithic of Malaya, in the Royal Colonial Institute, Amsterdam, and at the Peabody Museum, Harvard University. The following observations summarize the results obtained by several field workers.

RELATIONSHIP OF THE EXTINCT KANGAROO ISLAND CULTURE WITH CULTURES OF AUSTRALIA TASMANIA AND MALAYA

By NORMAN B. TINDALE, B.Sc., Ethnologist, South Australian Museum.

Fig. 1–16.

INTRODUCTION.

An account of some observations on the former human occupation of Kangaroo Island was given by Tindale and Maegraith (1931). At the time of its first discovery by Matthew Flinders in 1802, this island was devoid of inhabitants. Additional details regarding this occupation have come under notice in recent years and there has been opportunity for comparison with similar industries on the adjacent mainland; other discoveries have been made on mainland sites, which appear to bear some relation to the island one. The valued opportunity presented by the receipt in 1936 of a Carnegie Travelling Grant has enabled the writer to discuss the problem of these implements with research workers in Europe and America and also to see examples of similar objects, characteristic of the Upper Palaeolithic of Malaya, in the Royal Colonial Institute, Amsterdam, and at the Peabody Museum, Harvard University. The following observations summarize the results obtained by several field workers.

In December-January 1931–32, Mr. F. J. Hall accompanied the writer to the south coast of Kangaroo Island in order to examine Mount Taylor Cave. Although this cave proved to be unproductive implements of the Kangaroo Island Industry were found on surface sites at several other places, and *in situ* in estuarine silts at Rainy Creek. In December, 1934, a party of naturalists visited Flinders Chase at the western end of Kangaroo Island. Some general notes on the physiography of the island were published by Tindale, Fenner and Hall (1935), and several additional sites for implements were found.

Mr. H. M. Cooper, who has extensively and systematically collected implements on mainland sites, was requested to search for implement sites on Kangaroo Island, and in the years 1935–37 found traces of occupation at no fewer than forty-seven sites of this ancient native industry; more than forty of these occurrences were previously unnoted. Of the implements brought together by Mr. Cooper, half have been donated to the South Australian Museum, and are studied herein.

The implements found below a marine horizon, at Fulham, South Australia, by Capt. S. A. White, were recently lent by their discoverer for study.

The area in the vicinity of Fulham where White (1919) found these implements, has been under examination for several years by a committee of members of the Anthropological Society of South Australia. Some shallow bores have been drilled to depths of 2·5 metres in search of information. The actual site excavated by White is now an artificial lake and is inaccessible, but bores drilled within the nearest practical distance have passed through the tenacious blue-black clay of a lake bed and then the marine horizon recorded by White and by Howchin (1919).

There has been no opportunity to test the Fulham site by excavation, but the presence of consolidated matrix adhering to one of the original implement specimens which, under the microscope, seems identical with that established by our bores as being below the lacustrine horizon, is a useful piece of evidence. These implements are figured in this paper.

This year Mr. Cooper and the writer made a close study of a recently ploughed surface site on the western portion of Section 562, Hundred of Noarlunga, on the shoulder of the hill just below Hallett Cove Railway Station. Implements of Fulham type were found, which had been buried in the surface layers of the soil. The implements were apparently confined to an area of some 10 acres on a site where calcareous clay and sand is present on the flat top of a hill. Food debris and other signs of recent occupation were lacking. Three small superimposed areas of recent campsite with black ash soil, each forming a mound, are present, and on the best preserved of these abundant food debris and a few implements of the so-called "Murundian" type were gathered.

Howchin (1934) published a most interesting account of the typology of implements found in the area once occupied by the Adelaide tribe. It is the result of many years spent in collecting specimens from surface sites in the coastal districts of South Australia near Adelaide. Howchin is careful to indicate that the implements are all archaeological and that they are not necessarily the implements belonging to the historical Kaurna, or Adelaide tribe. A sad commentary on the rapidity with which the aborigines disappeared is the fact that, despite active search and enquiry, not one authentic stone implement, mounted for use by a member of the Kaurna tribe, has yet been found in any ethnographic collection, either in Australia or abroad.

Howchin deals with the implements of all peoples who may have lived in the Adelaide area, without reference to any cultural sequences which may ultimately be established.

It is one of the purposes of the discussion concluding this paper to indicate the probability that, near Adelaide, there may be well defined sequences, similar to those established by Hale and Tindale (1930) for the Lower Murray Valley.

THE KANGAROO ISLAND INDUSTRY.

NEW LOCALITY RECORDS AND A DESCRIPTION OF THE RAINY CREEK SITE.

During 1931-32 additional implements of this industry were found by F. J. Hall and the writer at Hawks Nest, principally on some areas of ti-tree scrub which

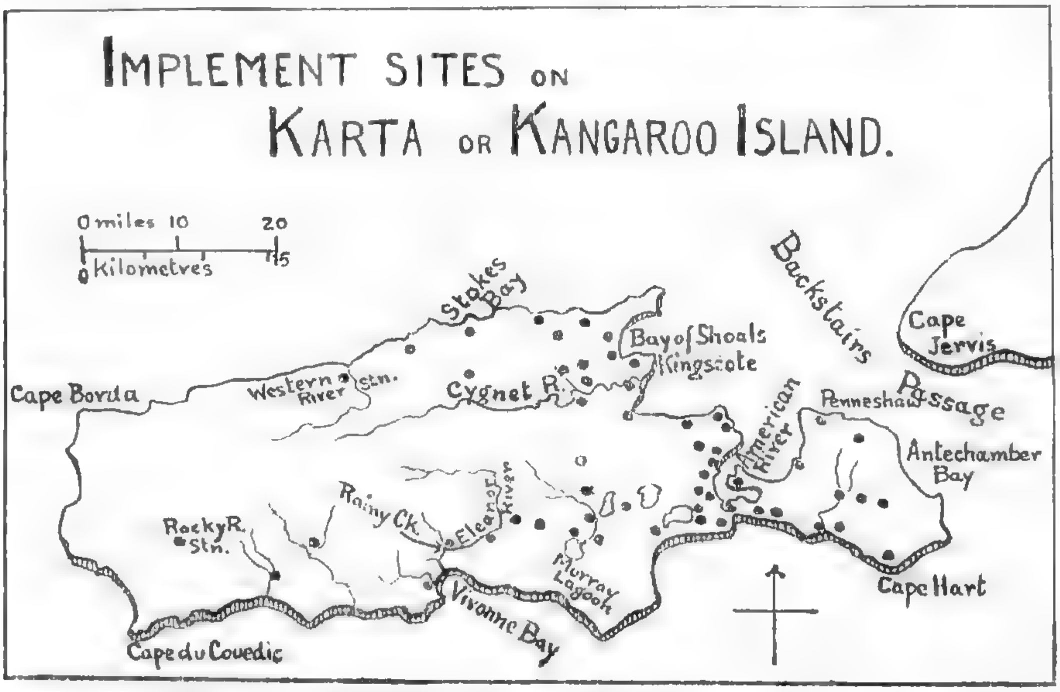


Fig. 1. Sketch map of *Karta* or Kangaroo Island, to show implement sites.

had been cleared and ploughed since our earlier visit. Other sites (Text fig. 1) were:

(*a*) *Big Timber*, 1·6 kilometres east of "Fords".

(*b*) *Mount Pleasant*, on eroded laterite-gravel-covered ground.

(*c*) *Eleanor Station.*

(*d*) *Kaiwarra* or *Mount Pleasant Station*, 3·2 kilometres S. of the station on the higher bank of Eleanor River.

(*e*) *Redbank Station*, near the southern gate on the road to Hawks Nest, on eroded laterite soil.

(*f*) *Cygnet River*, eroded from soil near the bridge on the Penneshaw road.

(*g*) *Rainy Creek*, near the homestead of Eleanor Station. At this site a wash-out, caused by the artificial cutting of a ditch across a flat, has caused the stream to cut to a depth of some two metres into a series of clay beds and silts; apparently of estuarine origin (Text fig. 2–4). These are situated at an estimated height of five-six metres above present sea level. The silts in this basin seem to have accumulated behind a bar of calcareous dune limestone which marks the seaward margin of a former shoreline of Vivonne Bay into which the waters of Rainy Creek once flowed. At present its waters are captured by the Eleanor River which, after flowing for 0·3 kilometre further west parallel to the shore-line, turns south

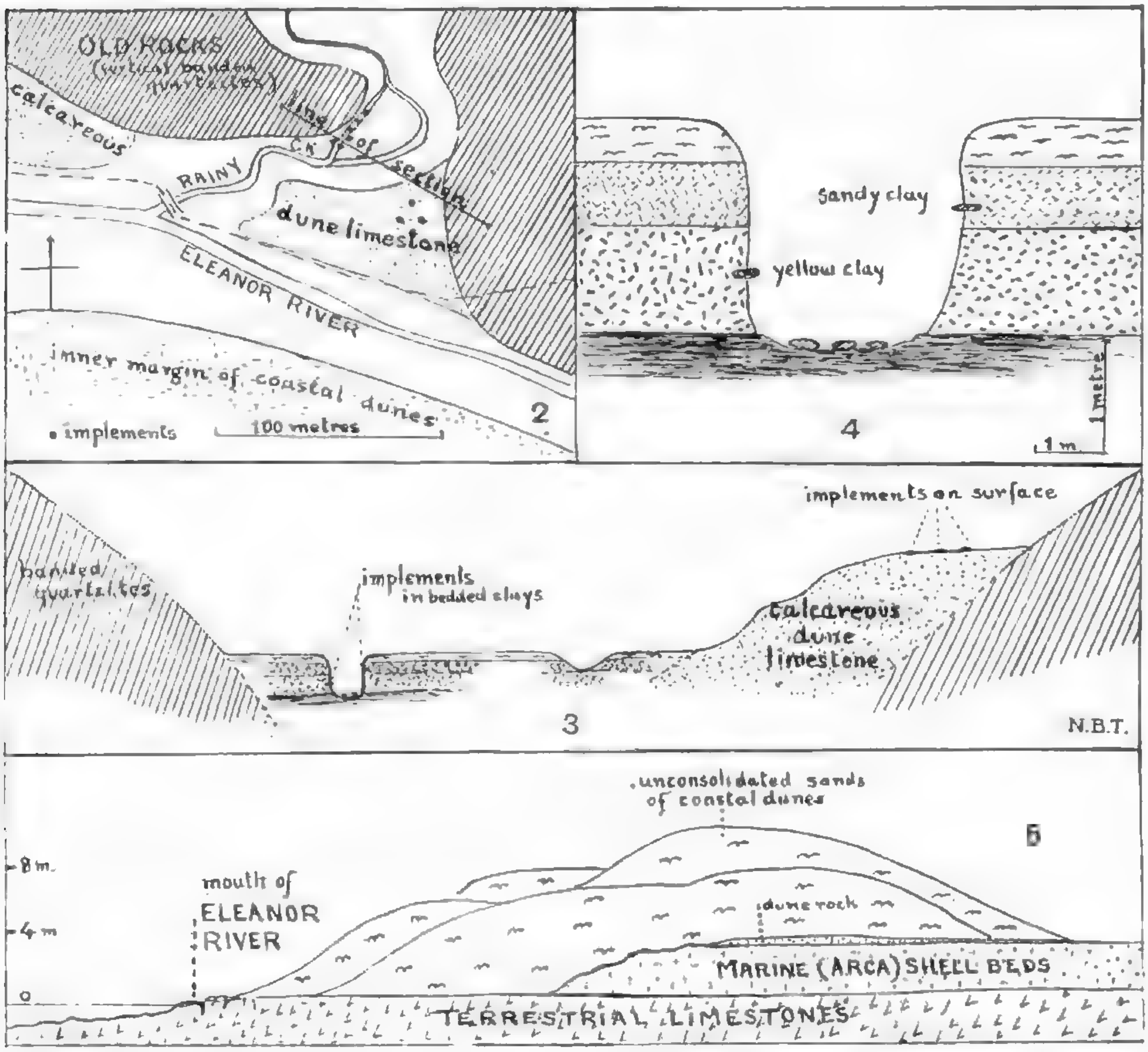


Fig. 2–5. 2. Sketch plan of the vicinity of the junction of Eleanor River and Rainy Creek, Kangaroo Island. 3. Sketch section, across Rainy Creek. 4. Enlarged section of clay beds, containing implements, Rainy Creek. 5. Natural section revealed along banks of Eleanor River in its passage through the coastal sand dunes.

and breaks out through the present coastal dunes. In doing so it has cut through some four metres of a consolidated limestone sea floor in which one of the dominant shells is the locally extinct *Arca* (*Anadara*) *trapezia* (see sketch section, Text fig. 5). This sea floor overlies an old calcareous land surface which is exposed at about present sea level along the river banks and on the foreshore.

The clay beds exposed at Rainy Creek (Text fig. 4) consist of a dark clay (forming the lowest layer visible in the section) upon which there rests a metre thickness of yellow clay, followed by 0·5 metres of light yellow sandy clay, above which is the dark sandy soil of the present day surface.

Implements were present in the yellow clay at a depth of 1·3 metres and in the sandy clay at 0·8 metres from the surface, while seventeen others including both hammerstones and cutting implements were found on the floor of the washout where they had been deposited by the erosion of the clay. No traces of food remains or ash have been preserved. Samples of yellow clay when washed and examined microscopically unfortunately do not seem to furnish any direct indications of the associated fauna.

Other implements are present on the weathered surface of the calcareous dune limestone near its junction with the old quartzites east of Rainy Creek as is also indicated in the section.

The local physiographic conditions seem to indicate the possibility that the clays were laid down during a period when the beds were at or near sea level, whereas at present Rainy Creek is engaged in entrenching itself, to a shallow depth, in its own sediments.

Estimations of the area over which the implements were distributed suggest that the twenty-four implements recovered were derived from an area of 275 square metres by the natural washing of some five hundred cubic metres of clay.

During the 1934 visit to Kangaroo Island a few further implement sites were noticed.

(*h*) At *Rocky River* one excellent example of a hammerstone was picked up by the caretaker of the Flora and Fauna Reserve (Mr. H. Hansen) near the top of the old limestone dune immediately south of the Station house. Up to the present no examples have been turned up by the plough on the neighbouring flats, which have yielded bones of many recently extinct mammals.

(*i*) About two kilometres downstream from the Station the Rocky River suddenly entrenches itself and drops into a rather deep limestone gorge excavated in dune limestones. On its northern bank the steep walls are hollowed, in places, into shallow caves. One of these is sufficiently large to serve as a shelter. A small occupational horizon had been discovered here a few years ago by one of the settlers, who had been in search of guano. The whole of the floor debris had been sifted and the finer dust and ash packed into sacks. Several sacks full of the sifted earth had not been taken away. The sacks were old and now decayed. The coarse rejectamenta of the sieve yielded *Turbo undulatus* shells, a few marsupial bones and some charcoal, but no implements were present. The paucity of the remains and their disturbed condition prevented our arriving at any certain conclusions as to their significance.

(*j*) At *North-East River*, on the flat just above its junction with North-West River, a hammerstone was found on the surface.

(*k*) On hillside above Penneshaw School house.

(*l*) Between 1935 and 1937 Messrs. H. M. Cooper and R. Peake were able to devote several holiday periods to a search for additional sites on Kangaroo Island. They collected numerous examples of the implements and have donated the first set of their finds to the South Australian Museum. The localities are too numerous for detailed description but the Cooper collection number and name of the site will be given below together with summaries of their field notes:

Anxious Bay (83). Waterworn pebbles from this locality probably furnished the stone used in making many implements.

Muston (84). Property of E. Davies; from cultivated land running down to a fresh water lagoon, dry in summer.

Muston (85). Property of W. Davies, on cultivated ground near a lagoon on ironstone rubble country. Several Port Lincoln Oyster (*Ostrea sinuata*) shells were also present.

Pennington Bay (86).

Salt Lagoon (87). East side of American River, Muston. Near a small lagoon on cleared but uncultivated land, on property of F. Buick. One quartzite implement was enclosed in a block of loose limestone; limestone ridges surrounding the lake yielded no implements.

Hog Bay River Station (89). On cultivated land sloping to the creek.

Deep Creek, Eastern Cove (91). On raised flat of cultivated ground adjoining the creek. Coastal sandhills in the vicinity yielded no sites.

Red Banks, Nepean Bay (92). Behind the coastal sandhills and inland on the ironstone rubble country.

Taylor Lagoon (93).

Cape Hart (96). On wind-swept high limestone ground 0·4 kilometre north-east of the sealer's hut site where Tasmanian implements were found; one trimmed core was of Cape Willoughby granite.

Hog Bay River (97). Site on the cliffs above the river mouth.

Creek Bay Station (98). Cultivated area on bank of creek running into Lashmar Lagoon. The largest specimen so far discovered, a chopping implement weighing 108 oz. was found on this site.

Wallers (100). Three kilometres east of Pennington Bay.

Bay of Shoals (101). An extensive site on cultivated land on the property of W.

Turner. Many implements occurred on limestone ridges associated with an extensive swamp.

Discovery Lagoon (102). Eleven kilometres S.W. of Kingscote. This must have been a well occupied area. Five inspections resulted in the largest collection of chopping implements found on any site in this list.

Ten Mile Lagoon (103). Five kilometres W. of Kingscote.

Pennington Bay (120). Six kilometres east of the Bay.

Muston-Red Banks road (121).

Thomas Station, Point Morrison (122).

Muston Jetty (123).

Flour Cask Bay (156), south-west of Salt Lagoon. Two hammerstones found on wind-swept limestone ridges together with many shells. The coastal sandhills themselves were examined, without result, for three kilometres to the westward and more than one kilometre eastward of the Australian Salt Company's Lake.

Hog Bay River, above mouth (157). Another site on the banks of Hog Bay River which, together with sites 98, 101, 102 constitute the most important localities found.

East of Hog Bay River (158).

S.W. of Point Tinline towards Cape Linois (159). One large flint flake, one hammerstone and a few unworked quartzite chippings in the sandhills.

Lagoon inland from D'Estree Bay (ten kilometres S.W. of Kingscote-Muston turnoff (160). On cultivated ground.

East of White Lagoon (161). A ridge of cultivated ground revealed implements.

Bulcara Station (162). Some very much worn hammerstones.

Hawk Nest Station (163).

Kaiwarra Station (164).

Eleanor River (165).

Karatta Station (166).

Sou'West River (167).

Cape Borda Road (168). Ten kilometres S. of Stokes Bay turnoff. A single chopping implement in scrub-covered ironstone gravel country.

Western River (169). One hammerstone behind the coast sandhills; on the steep incline above the high cliffs were several chopping implements and stone flakes.

Middle River (170). Although there are extensive coastal sandhills here, results were negative. One excellent hammerstone was collected a short distance inland.

Stokes Bay (171). On cultivated ground.

Smith Bay (172).

Emu Bay, 1·3 kilometres inland from the seashore (173).

Wisanger (174). Near the Gap.

Cygnet River-Gap Road (175).

Lagoon N.W. of Cygnet River Post Office (176).

Gum Creek, near Cygnet River (177). Light sandy soil on its banks yielded implements.

Near Bay of Shoals (178). On Bell's homestead.

Railway, four kilometres inland from Muston Post Office (179).

Creek on property of C. Buick, American River (180).

The distribution of the above localities on the map of Kangaroo Island seems to indicate a concentration of the occupation on the eastern half of the island, but it must be remembered that the eastern end has been subjected to a far greater amount of clearing than the western extremity, and it is generally in ploughed ground and occasionally in disturbed and drifting sandy ground, that finds have been made. The western end of the island is still largely uncleared and uncultivated and a large area is enclosed within the Flinders Chase Flora and Fauna Reserve, and is thus not subjected to clearing operations. Mr. Cooper writes: "On present imperfect information it could perhaps be suggested that the more eastern portions of the island carried the bulk of the population—the more open nature of the country, warmer climate and lower rainfall, together with the abundance of lagoons and swamps would tend to substantiate this; the rugged and damper western end was used perhaps more for hunting expeditions. However, later working of the land in the latter localities may disprove such an opinion."

Only two sites have yielded information regarding the foods of the island people. At Muston a few Port Lincoln Oyster (*Ostrea sinuata*) shells may have been ones left by these people, while in a wind-blown area on site 120, east of Pennington Bay, where the specimens often have a thin coating of white lime deposit, "fragments of emu eggshells, also oyster, mussel and limpet shells were obtained as well as a few choppers and hammerstones". According to "Mr. James Waller, another old resident of Kangaroo Island, this drift commenced about forty years ago after a period of clearing and burning".

IMPLEMENTS OF THE KANGAROO ISLAND INDUSTRY.

In the light of the augmented collection of implements brought together since 1931 it is possible to make some detailed observations.

The dominant implement of the culture is undoubtedly the elongate pebble-core implement, hammer-flaked along one margin, which was described by Tindale and Maegraith (1931, p. 281) as "elongate-oval trimmed core" (*l.c.* fig. 9).

Among the well-worked implements they are second only to the hammerstones in abundance.

These elongate-oval trimmed cores have become known to archaeologists in South-Eastern Asia as "Sumatra-type implements", for in Sumatra and the Malay Peninsula they occur in several sites considered to belong to the Upper Palaeolithic. Sites of this type are described by Küpper (1930) and others.

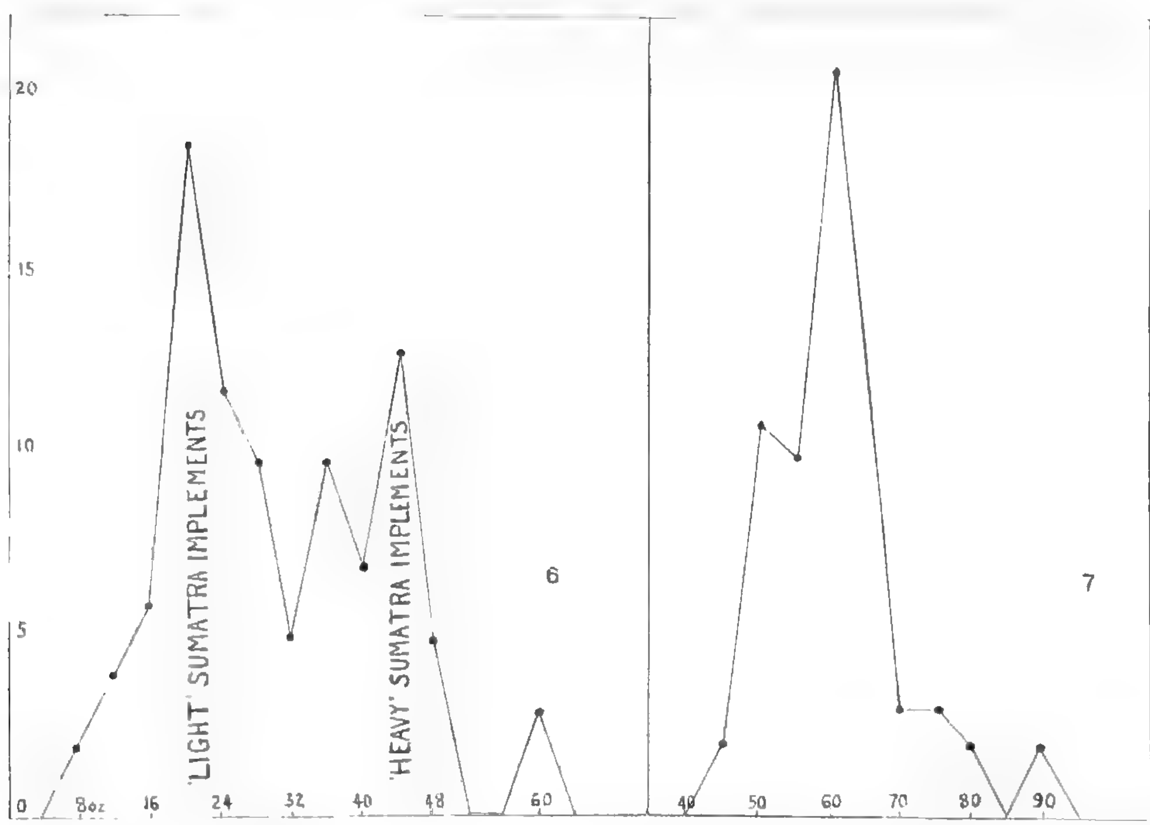


Fig. 6–7. 6. Weights of 96 *sumatra* implements from Kangaroo Island. 7. Length-breadth index of 57 *sumatra* implements from Kangaroo Island.

Examples of this type of implement from Malaya have been examined by the writer at the Royal Colonial Institute Museum, Amsterdam, and at the Peabody Museum, Harvard. Specimens from Kangaroo Island seem to be morphologically indistinguishable from these, and in this paper it is proposed to use therefore the term "Sumatra type implement" or briefly "sumatra" as a convenient name for the implement.

An analysis of the dimensions and weights of nearly one hundred examples of Kangaroo Island sumatra implements, reveals the presence of two sub-types which may be arbitrarily called "heavy" and "light".

When the weight in ounces is plotted, using intervals of 4 oz., the graph (Text fig. 6) indicates that peaks occur at 20 oz. and 44 oz. If the trough between these two (at 32 oz.) is taken as a dividing line it will be noticed that, with one exception (15 cm.), all "light sumatra" are 14 cm. or under in length while all "heavy sumatra" are 15 cm. or over. The length-breadth index $\frac{(\text{Br} \times 100)}{\text{length}}$ indicates that although there is considerable variation in proportions, as shown by the range of indices from 45–90, yet the natives, unconsciously or otherwise, strove to make implements of the proportions indicated by a length-breadth index of about 60 (Text fig. 7). "Heavy" and "light sumatra" implements have approximately the same range in their proportions.

It would be of considerable interest to compare these results with those for the same type of implement found in Malaya, while the application of accurate statistical data to series of implements in various areas, might give significant clues as to their origin and uses.

The discovery of further examples of the discoidal implements called "trimmed flakes" by Tindale and Maegraith (1931, p. 281, fig. 6-7) has enabled a clearer idea to be obtained of the form and method of manufacture of these highly characteristic implements. It is now evident that there are fundamental differences between them and the so-called *arapia* implements of Central Australia, and that they should not have been classified together.

Examination of a long series suggests that, while all the Kangaroo Island examples are either made from cores or from pebbles broken at random, all true *arapia* agree with the type example from Undala, Central Australia (l.c. f.10) in being struck off as flakes from prepared core. A blow directed against a prepared platform detached a characteristically shaped flake. Technically the *arapia* is a much more advanced implement than the implements found on the island.

The Kangaroo Island core implements which superficially resemble the *arapia* are thus trimmed from pieces of broken stone which approximate to the desired form. A few examples are really made from what are technically flakes, but as they do not seem to be obtained by any specialized technique the specimens should be recorded as in the main a "core industry".

It seems convenient that the Kangaroo Island implements of this type should be known by a different name from the *arapia* and it is proposed to use for them the term *karta*, a native word, belonging to the mainland Raminjeri tribe, meaning Kangaroo Island. The example described and figured by Tindale and Maegraith (1931, p. 281, fig. 6) may be regarded as the type example.

Mr. H. M. Cooper has found that on most sites *karta* are not as common as the larger *sumatra* implements. At Hawks Nest, during the 1931 survey they proved to be somewhat more abundant, but the significance of this apparent difference is not yet known.

Trimmed cores of the "horse-hoof" type described by Tindale and Maegraith (1931, p. 281, fig. 8) continue to be found in considerable numbers and it is evident that they must have functioned as implements. All are characterized by closely set stepped, secondary flaking scars margining the right-angled cutting edge.

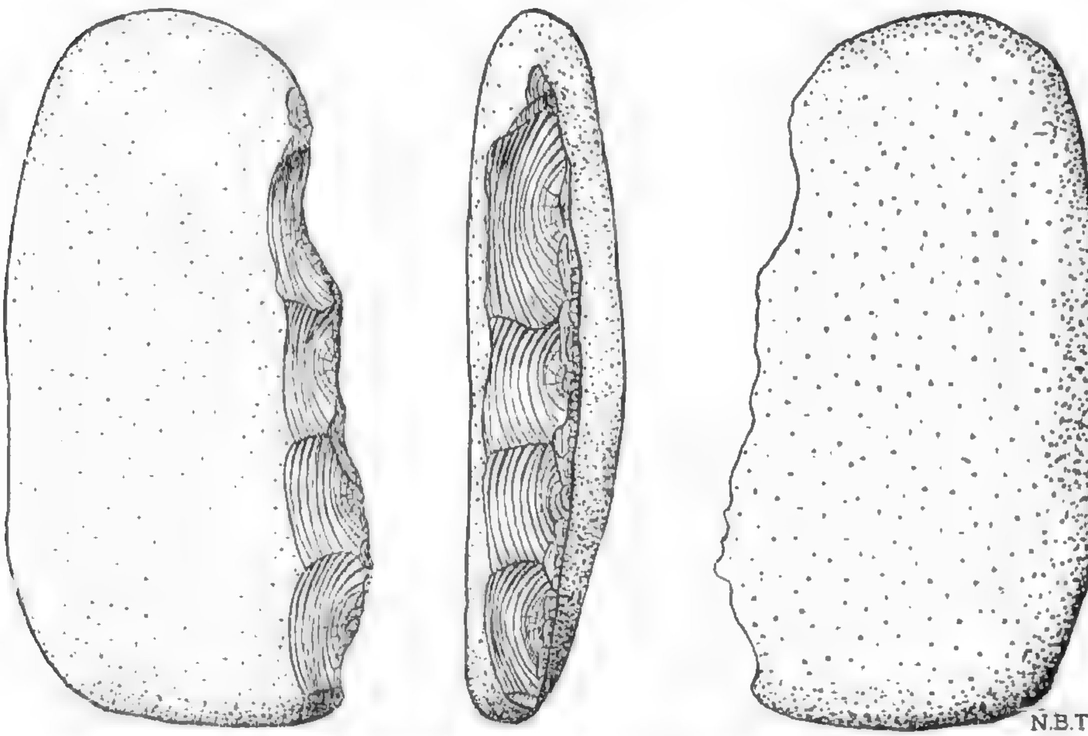


Fig. 8. *Sumatra*-like implement from Balcoracana Creek, South Australia (× 5/6).

In addition to the above mentioned implements and hundreds of hammer-stones, a great many simple flakes, frequently of white quartz, are found in association with the implements. Simple irregular flakes of quartzite are also abundant. Occasional examples of white quartz seem to have been shaped to a definite form, approaching some of the crude discoidal stone implements characteristic of the Tartangan Industry described by Hale and Tindale (1930, p. 167, figs. 21, 29, etc.). However, quartz is a refractory material and it is difficult to compare them with certainty; detailed description of the type may therefore be reserved for the future, when examples made in a more satisfactory material may be discovered.

Before discussing the Kangaroo Island industry and its significance it is proposed to mention several series of implements from the mainland.

SUMATRA-LIKE IMPLEMENTS FROM BALCORACANA CREEK, S. AUSTRALIA.

During a recent visit to the Flinders Ranges, Mr. H. M. Cooper found a site on a rock-strewn ridge, on the north bank of Balcoracana Creek at Red Banks (his site No. 209), where two sumatra-like implements occurred. One of these weighed 16 oz. and measured 15 x 8 cm. It is figured herein (Text fig. 8). The other was smaller and only weighed 6 oz.

On the opposite bank of the creek, within 0·5 kilometre, there is a native site (his No. 144) where many *pirri* implements may be found.

After this paper had been prepared for press Mr. Cooper revisited the Flinders Range and found eight additional sites where implements resembling those from Kangaroo Island and Fulham occur. At Mount Chambers Creek (183) near a site possessing many rock carvings *karta*, horsehoof implements and sumatras occur alone. At several other waters Pirrian types of implements occur with them, e.g. Emu Springs (136), while at Yappala Lagoon (187) and Little Bunkers (195) the only other implements seem to have a Murundian facies.

IMPLEMENTS FROM TASMANIA RESEMBLING THOSE FROM KANGAROO ISLAND.

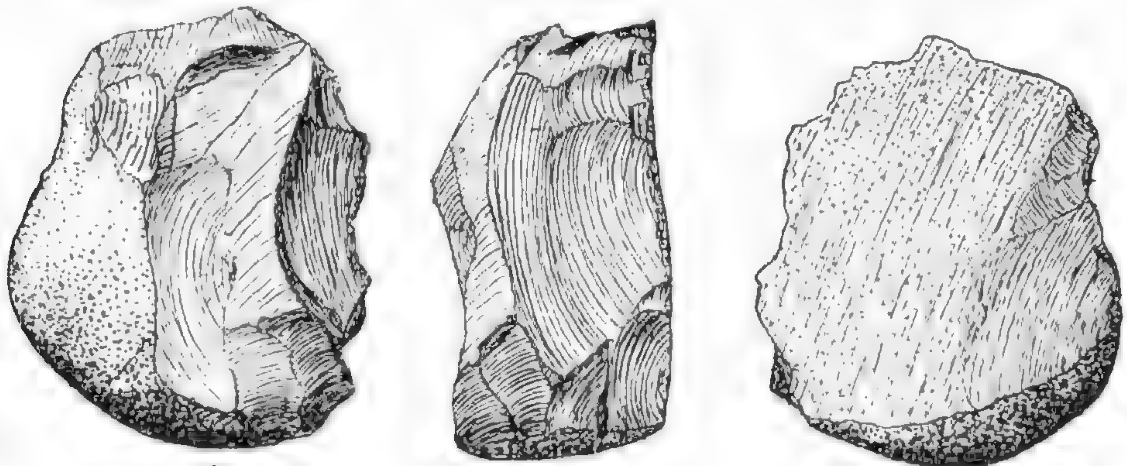
For several years the writer has been in communication with Mr. Adrian C. Smith, of St. Helens, Tasmania, who has kindly presented to the South Australian Museum many interesting Tasmanian implements. In a recent consignment he sent a series of large specimens including several which appeared to be comparable with the *sumatra* implement, the *karta* and even the ''horsehoof'' core of Kangaroo Island.

Text fig. 9 shows a *karta*-like implement of quartzite from St. Helens, weighing 9 oz.

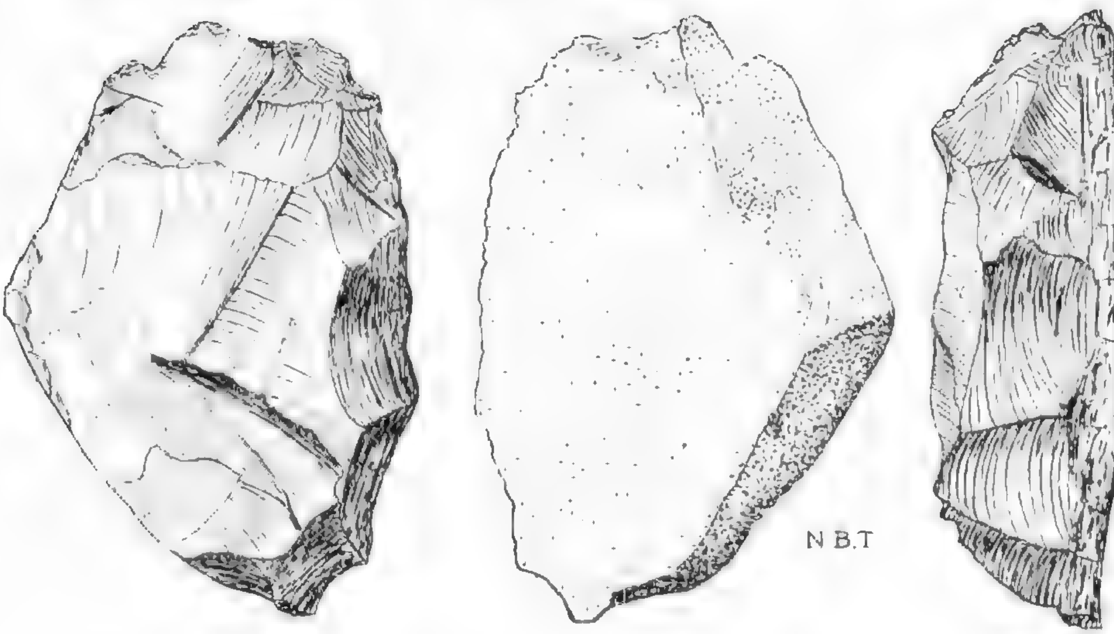
The average of the weights of three sumatra-like examples is 16 oz. and the length/breadth index is 72. Text fig. 10 shows an example from St. Helens weighing 11 oz. and with a L/B index of 71. The original pebble from which this was made is more angular than are those from Kangaroo Island, but the method of manufacture is similar.

An examination of the fine collection of Tasmanian implements belonging to Mr. A. L. Meston at Launceston, suggests that *karta* and *sumatra*-like implements are found in several places in Tasmania, but that relatively little attention has been paid to them. The smaller and finer implements are of considerable interest to collectors and in the past the large ones seem to have been passed over. Another explanation may be considered. In a letter dated 13th June, 1937, Mr. Adrian Smith writes:

"The large stones of pebble type were not, as far as I remember, found on the ocean beaches where the small flake types were found. The one from 'St. Columba



9



10

Fig. 9–10. *Karta* and *sumatra*-like implements from St. Helens, Tasmania (× ¾).

Falls' was found in the heart of the bush, in myrtle and fern country. The others were found on Georges Bay on the golf links."

It may be suggested therefore that these relics may occur on sites where the ordinary Tasmanian implements are not present.

IMPLEMENTS OF THE FULHAM SITE DESCRIBED BY S. A. WHITE.

Fig. 11 gives a generalized section of the beds associated with the implement site at Fulham described by White (1919) and Howchin (1919). It is based partly on their notes, partly on information provided by bores drilled by members of the Anthropological Society of South Australia in 1933–1934, and also on the writer's

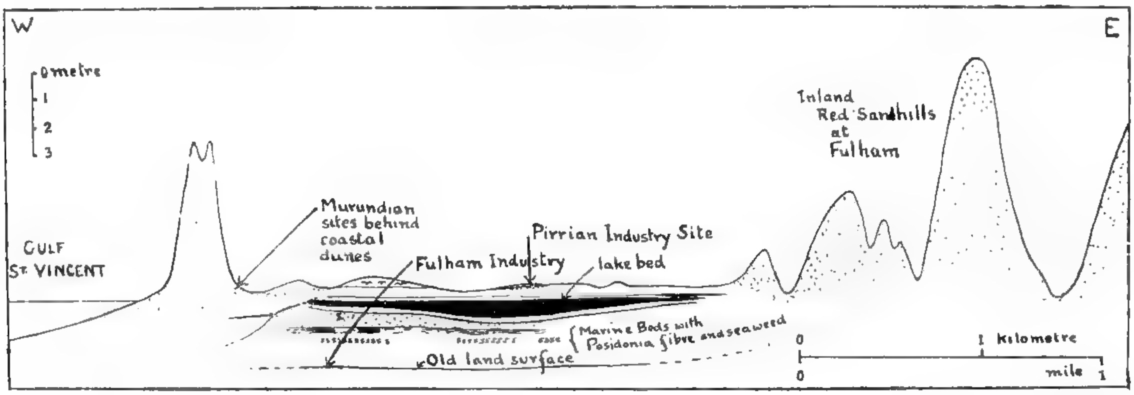


Fig. 11. Section at Fulham, South Australia, indicating in generalized form the succession of beds and relationships of implement sites.

own observations. It is not proposed to discuss in detail the history of the site as revealed by the bore sections, for the results obtained are sufficiently interesting to warrant separate description. Suffice to state that bores at "A", at 10 yards S. of "A", and at "B" seem to confirm the first two metres of White's section while deeper bores, at "Between B and C" and at "E", "F", "K" and "M", situated at distances of respectively 150, 375, 600, 1,075 and 1,300 yards in an easterly direction indicate the continuance of the blue-black clay of the estuarine lake-bed and also suggest the presence of an old land surface at the level indicated by White.

The implements ascribed to this old land surface comprise well worn hammer-stones of two types (fig. 12 and fig 13), made from quartzite pebbles and several core-like implements, also of two types. The latter are similar to the *karta* and the *horsehoof* cores of Kangaroo Island and are made of quartzites. Fig. 14 shows an example of the *karta* 6·8 cm. in diameter. In manufacture it has been broken off from a large block of quartzite, apparently as a random "flake", and bears evidence of much marginal secondary flaking. Fig. 15 shows an example of the larger "*horsehoof*" core type of implement. It is 9 cm. in greatest diameter and 6 cm. in height, and is made of a fine-grained quartzite.

One of the core implements has attached to it part of the consolidated matrix of "River Sand with calcareous concretions" in which it was once imbedded.

Portions of this matrix, when mounted and examined under the microscope, compare closely with samples from the same bed.

During the study of the Fulham site it was observed that a small surface area of campsite containing abundant *pirri* together with other implements of a rich

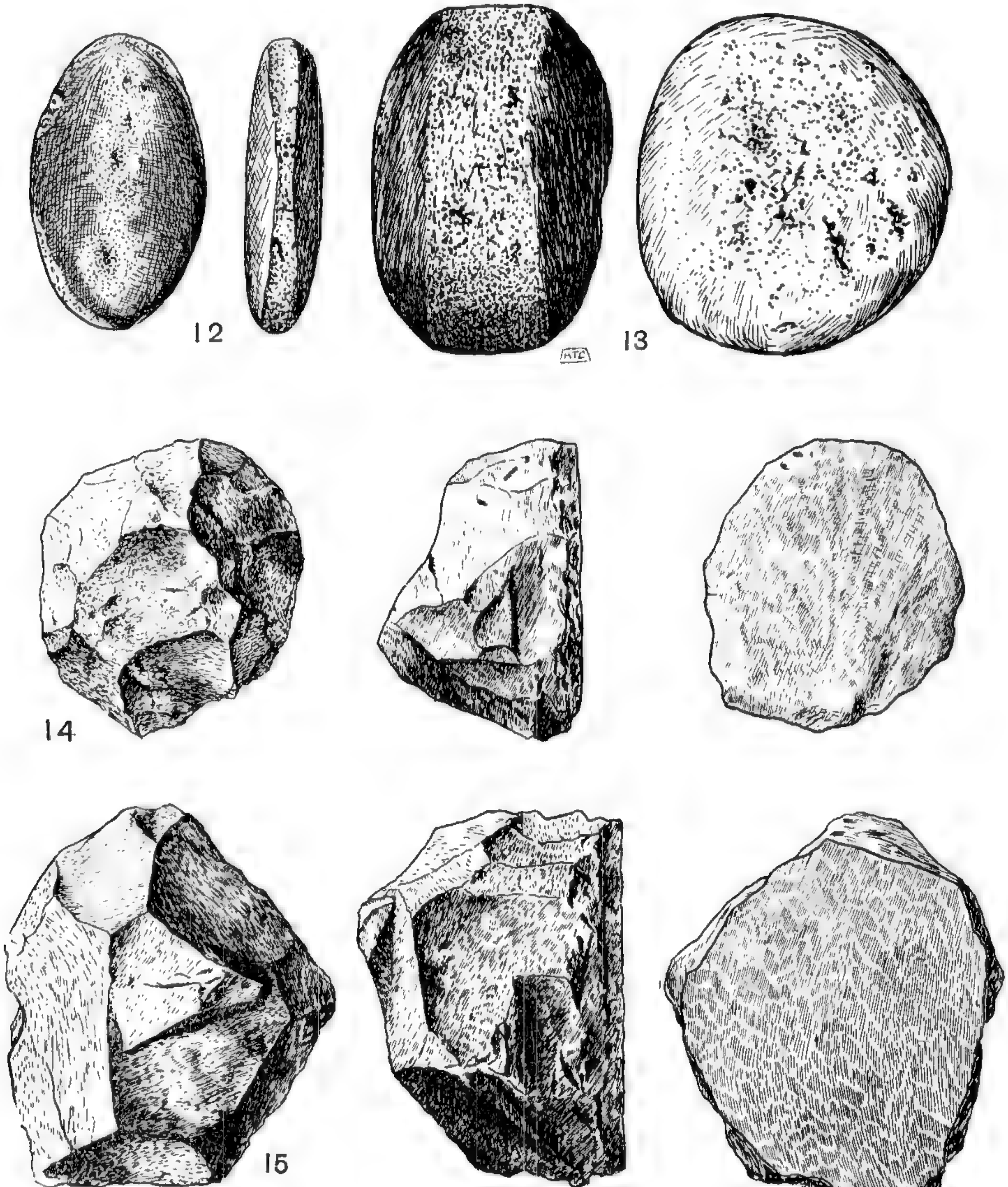


Fig. 12–15. Implements from buried land surface at Fulham, South Australia. 12–13, Hammerstones, showing marked marginal wear. 14. *Karta*-like implement. 15. Horsehoof core (× ½).

stone industry, lay beside the line of section indicated by the bores. It was possible to demonstrate that this campsite was formed on top of the blue-black clay of the estuarine lake. It is thus later in date than the Fulham industry. Careful collecting brought to light the following implements:

Pirri 24; small crescents 6; small chipped-back knives 3; discoidal adze stones, prepared from flakes struck from prepared platforms 6; irregular adze stones 14; large pirri-like flakes 3; large cores 1; hammerstone 1.

The position of this site is indicated by the words "Pirrian Industry Site" on the general section of the Fulham area (fig. 11).

IMPLEMENTS AT HALLETT COVE SIMILAR TO THOSE OF THE FULHAM INDUSTRY.

The Hallett Cove site is located on the western half of Section 562, Hundred of Noarlunga, and is situated a few hundred metres south-west of the Cove Railway Station, on a flat terrace forming the top of the cliffs. It is at a general height of sixty metres (200 feet) above sea level (Text fig. 16). Here an old soil of calcareous sandy nature is preserved over an area of some ten acres. Recent ploughing of the surface has revealed that large implements of the types present

Fig. 16. Plan and sketch section at Hallett Cove, to show an implement site of the Fulham industry overlain by a newer series.

at Fulham, namely *karta*-like implements, and "*horsehoof*" cores together with one or two doubtful sumatra implements and some hammerstones are present in the surface layer over the area where this special type of soil occurs. They are not associated with shells, or other signs of recent occupation.

Three small patches of black soil composed of ashes, abundant shell and other food remains and a poorly developed adze-stone industry are present on the southern side of this area and rest on the surface of this soil. The food remains of this upper stratum consist of:

Shells	*Turbo undulatus* (dominant).
	Monodonta odontis
	Nerita melanotragus
	Mactra pura
	Haliotus sp. fragments only.
Crab	*Ozius truncatus*
Bird	*Dromaeus novaehollandiae*, egg shells of emu.
Mammal	*Macropus* sp. fragments of bones.

These surface sites seem to be comparable with sites of recent occupation which are elsewhere in South Australia called Murundian.

DISCUSSION.

In the preceding pages some records of stone implement sites on Kangaroo Island, on the Australian mainland, and in Tasmania, have been set out, while several types of implements have been described and figured.

It is proposed now to speculate on the significance of these occurrences and to discuss some tentative correlations.

The systematic study of Australian implement cultures is only just beginning and it is certain that many of our conclusions will be modified in the light of new discoveries. Pressing desiderata are the systematic exploration of all rock shelter and other sites where it may be possible to find evidence of successions. In particular it seems highly desirable that preliminary conclusions here arrived at regarding the sequence in Tasmania should be tested by excavation of one of the rock-shelters present on the north coast of Tasmania.

At Tartanga and Devon Downs a sequence has been noted which has enabled tentative correlations to be made with surface sites in other parts of South Australia. In the accompanying table is set out in diagrammatic form the additional details brought out by a study of the Kangaroo Island Industry and the closely related Fulham Industry.

At Kangaroo Island we seem to have an old culture which has connections with the Upper Palaeolithic of Malaya and may thus represent the type of implement culture which the first visitors to Australia brought with them. These people may have been the ancestors of the Tasmanian aborigines; for like those people they did not succeed in carrying the dog with them to Kangaroo Island. The presence of similar implements in Tasmania and on some mainland sites lends colour to this suggestion.

TENTATIVE CORRELATION OF SOME IMPLEMENT SERIES IN AUSTRALIA AND TASMANIA.

<table>
<tr><th>MURRAY RIVER.</th><th>KANGAROO ISLAND.</th><th>FULHAM.</th><th>HALLETT COVE.</th><th>TASMANIA.</th></tr>
<tr><td>MURUNDIAN INDUSTRY.</td><td>NEWER TASMANIAN INDUSTRY c.A.D. 1819</td><td>MURUNDIAN-LIKE SITES (on present shore dunes).</td><td>MURUNDIAN-LIKE SITE.</td><td rowspan="3">NEWER TASMANIAN INDUSTRY (implements struck from specially prepared cores).</td></tr>
<tr><td>MUDUKIAN INDUSTRY.</td><td rowspan="2">Period of no occupation.</td><td rowspan="2">PIRRIAN INDUSTRY.</td><td rowspan="4"></td></tr>
<tr><td>PIRRIAN INDUSTRY</td></tr>
<tr><td rowspan="2">Higher river depositing series of silts over Tartangan beds; these below water level and mineralization taking place.</td><td rowspan="2">Kangaroo I. Industry at Rainy Creek apparently associated with a raised beach.</td><td>LACUSTRINE CONDITIONS.</td><td rowspan="2">OLDER TASMANIAN INDUSTRY (Flake industry; implements made from random flakes).</td></tr>
<tr><td>ESTUARINE and MARINE BEDS</td></tr>
<tr><td>TARTANGAN INDUSTRY associated with extinct species of Unio.</td><td>KANGAROO ISLAND INDUSTRY (sumatra, karta, and horse-hoof implements).</td><td>old land surface.
FULHAM INDUSTRY.
(karta and horse-hoof implements).</td><td>FULHAM INDUSTRY (karta and horse-hoof implements, some doubtful sumatra implements).</td><td>(surface finds of crude sumatra type implements, karta, and horse-hoof implements).</td></tr>
</table>

The almost unvarying uniformity of implement type in over fifty campsites on Kangaroo Island, suggests that this industry stagnated on the Island until the inhabitants became extinct; the *sumatra* apparently remained the dominant implement.

In the Fulham Industry, as known to us at Fulham and Hallett Cove, as well as from scattered sites in other parts of South Australia, the *sumatra* seems to have lost its dominant position and is rare or even absent; otherwise the implement types remain the same.

At Fulham the industry appears to be associated with an old land surface which was covered by marine, estuarine, and lacustrine beds. At Rainy Creek on Kangaroo Island there is also some evidence of physiographic changes associated with a recent raised beach, and it also seems significant that on the island implements are not found in the present day coastal sandhills although they are present relatively abundantly on many of the higher parts of the island. Tindale and Macgraith (1931) have already drawn attention to certain apparent changes in climate associated with the Hawks Nest site. The extinction of the Kangaroo Islanders may have taken place a relatively long time ago.

At Tartanga on the River Murray physiographic changes of a similar nature, involving a rise in river level, seem to be necessary to explain the building up of the series of Upper Silt Beds. These overlie the Tartangan beds, which contain human occupational debris associated with an extinct species of *Unio*. Mineralization of the bones preserved in the Tartangan beds apparently took place during this period of high river levels.

At Devon Downs Rock-shelter on the Murray River the Pirrian is the earliest recognizable industry in the type section described by Hale and Tindale (1930) and on several grounds it has been placed as later than the Tartangan.

At Fulham a Pirrian site occurs above a lake bed which covers the site of the Fulham Industry; it is therefore younger than the Fulham series.

Analysis of the implements present on the Pirrian site at Fulham shows that the *pirri* index $\left(\frac{\text{number of } pirri \times 100}{\text{number of other worked implements}}\right)$ is about 75. This is a surface site, and if some of the earlier implement collectors have visited it in past years it is likely that the percentage of *pirri* forms has been lowered by the gathering of some of these attractive little objects. Nevertheless the proportion of *pirri* is high. At Devon Downs the proportion was even higher as is indicated by a "*Pirri* Index" of 174. This index is based on the recovery of 36 *pirri* and 21 other implements from the block of Pirrian strata excavated.

At Section 1173 Hundred of Yankalilla the Rev. N. H. Louwyck has found an untouched Pirrian site on the southern bank of Bungala River where the ratio of *pirri* to other implements is in the neighbourhood of 100. Three kilometres away, near the present shore line at Haycock Point there is a campsite of Murundian facies, with abundant debris of recent occupation, where *pirri* implements do not occur.

The presence of *pirri* in such large proportions among the implements occurring in Pirrian sites suggests that they were of considerable importance in the culture and not likely to be of merely ceremonial importance, as suggested by one recent writer. In size and form they are closely similar to the pressure-flaked spear heads of North-Western Australia, which are made in great numbers, and are often used on hunting, as well as on fighting spears. There is one spear from the Great Western Desert in the South Australian Museum which bears a *pirri* as a spear point. In the absence of further examples it may be suggested that it is an archaeological *pirri* put to a new use, but it may indicate that formerly these implements were in general use as spear points.

The great abundance of *pirri* around some waterholes and also on some now apparently waterless sandhill sites around the arid Lake Eyre Basin and in the country south of the Musgrave Ranges indicates that the Pirrian culture once thrived there. A seemingly significant feature in the Lake Eyre Basin, as elsewhere, is the absence of *pirri* from some areas where other implements such as adze-stones are otherwise abundant. On the basis of the Devon Downs section it is possible to interpret this variation as one of the effects due to presence of a succession of industries rather than to any very local, and seemingly haphazard variations in the contemporary distribution of styles of implement making techniques

In 1934 one of the last survivors of the Dieri (Dintibana) informed the writer that "*pirri* were natural stones which always had that form. They were found on the ground and were on occasion picked up and used as drills." Like the Neolithic polished stone axes called "thunder stones" by the people of Iron Age Europe, their human origin was not readily appreciated.

In an earlier paper in this volume, the writer has discussed the relationship between an Older and a Newer Tasmanian implement series. His observations were based on the examination of the open face of an excavation in Rocky Cape Cave and a study of the collections made therein by Mr. A. L. Meston. In the present paper is noted the occasional presence in Tasmania of implements similar to those of the archaic Kangaroo Island Industry. This suggests the possibility that future work may lead to the recognition of at least two and perhaps three stages in the development of the Tasmanian implement culture.

The absence of any of the specialized implements of Tasmanian type on mainland sites has been an impressive argument for those who would derive the Tasmanians from an extra-Australian source by a sea route, especially if they overlook the fact that implements of Tasmanian type are not found either in New Guinea, in New Caledonia, or even in Patagonia whence they would like to derive them. If the Tasmanian implements have developed locally and if the prototypes are similar to those already recognized from the Australian mainland then one of the major bases for their argument lapses. A useful statement of recent opinion on the question of the origin of the Tasmanian culture is given by Davidson (1937) who also provides a bibliography of the subject. A general discussion on the problem of the origin of the Australians is given by Fürer-Haimendorf (1936) while Davidson has also considered the same problem.

SUMMARY.

Additional sites for implements of the extinct Kangaroo Island culture are described and several artefact types are defined. The relationship of one of the implements with the Sumatra-type ones of Palaeolithic sites in Malaya is discussed.

The original specimens found by White and indicative of the Fulham Industry are described and figured, and a new locality is recorded at Hallett Cove for similar objects.

Implements similar to those of the Kangaroo Island culture are described from Tasmania and from Wirrealpa in South Australia.

A tentative correlation of these industries with the succession already described from the Murray River is discussed and it is suggested that the Kangaroo Island Industry may be similar to that broaght to Australia from Malaya by the first native visitors, who may have been of Tasmanian type. The distinctive features of the Tasmanian implement culture are thought to have largely developed after their isolation on the island.

REFERENCES CITED.

Tindale, N. B. and Maegraith, B. G. (1931): Traces of an extinct aboriginal population on Kangaroo Island. *Records of the S. Aust. Museum*, iv (3), pp. 275–289; figs. 1–11, bibliography.

Tindale, N. B., Fenner, F. J. and Hall, F. J. (1935): Mammal bone beds of probable Pleistocene age, Rocky River, Kangaroo Island. *Trans. Roy. Soc. S. Aust.*, 59, pp. 103–106, figs. 1–3.

White, S. A. (1919): Notes on the occurrence of aboriginal remains below marine deposits at the Reedbeds, Fulham, near Adelaide. *Trans. Roy. Soc. S. Aust.*, 43, pp. 77–80, fig.

Howchin, W. (1919): Supplementary notes on the occurrence of aboriginal remains discovered by Captain S. A. White at Fulham (described in the preceding paper), with remarks on the geological section. *Trans. Roy. Soc. S. Aust.*, 43, pp. 81–84.

Howchin, W. (1934): Stone implements of the Adelaide tribe of aborigines now extinct. Adelaide, pp. 1–94, figs. 1–148.

Hale, H. M. and Tindale, N. B. (1930): Notes on some human remains in the Lower Murray Valley, South Australia. *Records of the S. Aust. Museum*, iv, (2), pp. 145–218, figs. 1–249.

Küpper, H. (1930) : Palaeolithische Werktuigen uit Atjah, N. Sumatra. *Tijdschr. van het kon. Nederl. Aardrijkskundige Genootschap,* xlvii, pp. 985–988.

Davidson, D. S. (1937) : The relationship of Tasmanian and Australian cultures. *Philadelphia Anthropological Society: twenty-fifth Anniversary Studies,* University of Pennsylvania Press, pp. 47–62.

Haimendorf, Christoph von Fürer (1936) : Zur Urgeschichte Australiens. *Anthropos,* xxxi, pp. 1–36, 433–455.

FURTHER NOTES ON THE CUMACEA OF SOUTH AUSTRALIAN REEFS

By Herbert M. Hale, Director, South Australian Museum

Summary

Since the publication of the last records of Cumacea from South Australia (Hale, 1936) collecting has been continued. As a result the following species are added to the forms known to occur in the littoral fauna of our State.

Cyclaspis cottoni sp. nov.
Paradiastylis tumida sp. nov.
Dic brevidactylum sp. nov.
Nannastacus nasutus var. **camelus** Zimmer.
Schizotrema depressum Calman.

FURTHER NOTES ON THE CUMACEA OF SOUTH AUSTRALIAN REEFS

By HERBERT M. HALE, Director, South Australian Museum.

Fig. 1–9.

Since the publication of the last records of Cumacea from South Australia (Hale, 1936) collecting has been continued. As a result the following species are added to the forms known to occur in the littoral fauna of our State.

Cyclaspis cottoni sp. nov.
Paradiastylis tumida sp. nov.
Dic brevidactylum sp. nov.
Nannastacus nasutus var. *camelus* Zimmer.
Schizotrema depressum Calman.

Twenty-one species have now been taken on the shore-line of Gulf St. Vincent and Spencer Gulf. The limestone reef at Port Willunga, three miles north of Sellick's reef, was worked systematically and, as would be expected, all the species recorded from the last-named were found at Port Willunga also.

The Cumacean fauna occurring on loose stones on our reefs is remarkably uniform. If short, filamentous algae are present to retain a film of sand even the smoothest rocks harbour Cumacea and other small Crustacea. For instance, in March of this year, Messrs. B. C. Cotton and K. Sheard spent a couple of hours on a tiny shingle patch in shallow water at Marino, a few miles from Adelaide. Here they immersed the larger smooth pebbles in weak formalin as previously described and obtained the following species:

Family BODOTRIIDAE

Cyclaspis pura Hale.

(A fully adult male has the hairs of the pleopods much longer than in the type.)

Picrocuma poecilota Hale.

Family DIASTYLIDAE

PACHYSTYLIS VIETUS Hale.

COLUROSTYLIS WAITEI (Hale).

(See Zimmer, 1930, p. 651.)

GYNODIASTYLIS SIMILIS Zimmer.

GYNODIASTYLIS TURGIDUS Hale.

Family NANNASTACIDAE

NANNASTACUS GIBBOSUS Calman.

CUMELLA LIMA Hale.

CUMELLA LAEVE Calman.

SCHIZOTREMA BIFRONS var. ACULEATA Hale.

Again I have to acknowledge my indebtedness to Mr. K. Sheard who spent many days painstakingly sorting out thousands of small crustaceans from fine debris.

Family BODOTRIIDAE

CYCLASPIS G. O. Sars.

CYCLASPIS COTTONI sp. nov.

Ovigerous female. Integument firm but easily broken; surface slightly glossy, squamose. Carapace with dorsal edge, when viewed from the side, slightly irregular, less than one-third total length of animal, its depth more than half its length and less than its greatest breadth. Pseudorostral lobes not quite reaching apex of eye-lobe. Most of the several ocular lenses, black. Antennal notch wide and deep, and tooth acute. Anterior half of carapace with a sharp dorsal keel, on each side of which is a shallow depression; there is a double pit at the middle of the length of the carapace and posterior to these indentations the keel bifurcates (the divergent portions being swollen and less elevated) forming a single keel again just before reaching the hinder margin. Most of the first pedigerous somite concealed; second to fifth somites with a low but distinct dorsal carina; third to fifth, each with a pair of dorso-lateral elevations.

Pleon somites all feebly keeled above and with small lateral articular processes on all but sixth; first to fourth and telsonic somite of approximately equal length; fifth distinctly longer.

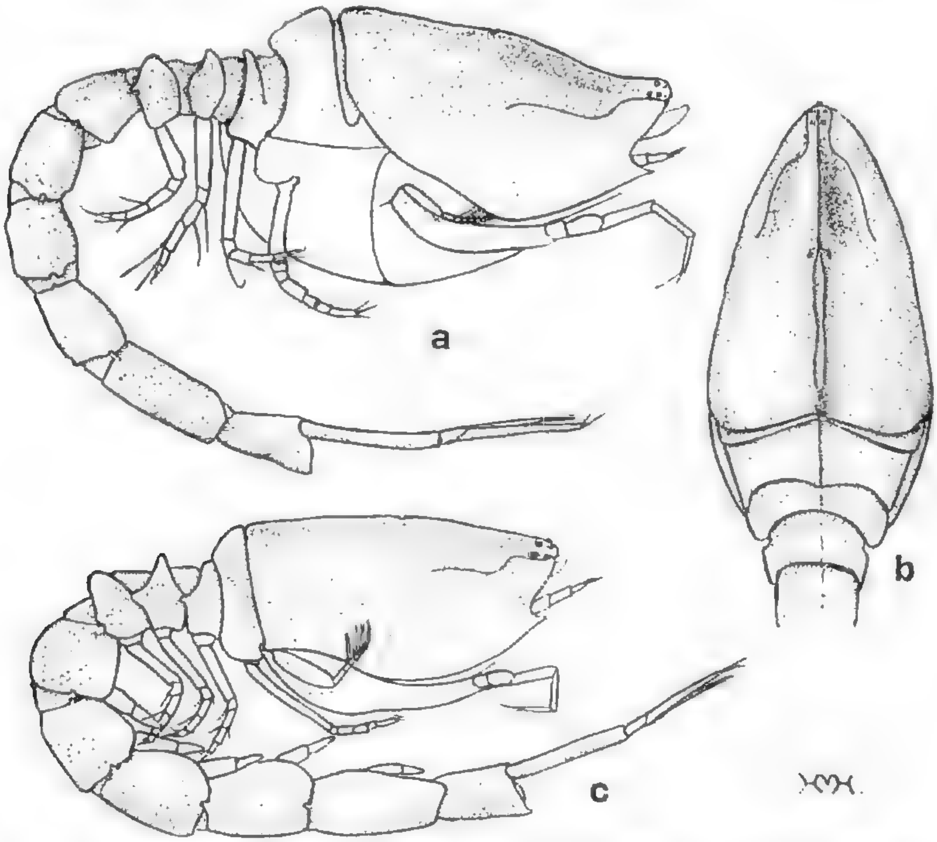


Fig. 1. *Cyclaspis cottoni.* Type female; a, lateral view; b, dorsal view of carapace. c, Lateral view of allotype male (all × 38).

First antennae with third segment longer than second and with first as long as second and third together; inner flagellum minute, elongate and apparently two-jointed; outer two-jointed, the first segment three times as long as second.

Basis of second maxillipeds a little longer than rest of appendage and with an apical plumose seta. Basis of third maxillipeds wide, strongly geniculate, distinctly longer than the "palp" and with outer apical portion expanded, and extending forwards beyond level of insertion of carpus; outer distal part of merus also expanded and reaching almost to level of apex of carpus, which is distally expanded on the inner side. First peraeopod with carpus reaching to apex of antennal angle; basis curved, subequal in length to remaining joints together, with inner (or ventral) distal portion produced into a sharp tooth and with a long plumose apical seta on opposite side; ischium and merus together as long as carpus which is a little longer than propodus (15 : 14); dactylus three-fourths as long as propodus, and with two unequal apical spines. Second peraeopods with basis as long as remaining joints together; ischium short and merus longer than carpus; dactylus a little shorter than carpus and propodus together and with three unequal spines at the oblique apex. The last three pairs of limbs offer no special features. Peduncle of uropods nearly half as long again as telsonic somite, slender, with inner edge feebly serrate; exopod four-fifths as long as peduncle, a little longer than endopod and narrowly truncate distally, with two unequal terminal spines; endopod slender, distally pointed and with inner edge serrated for portion of its length.

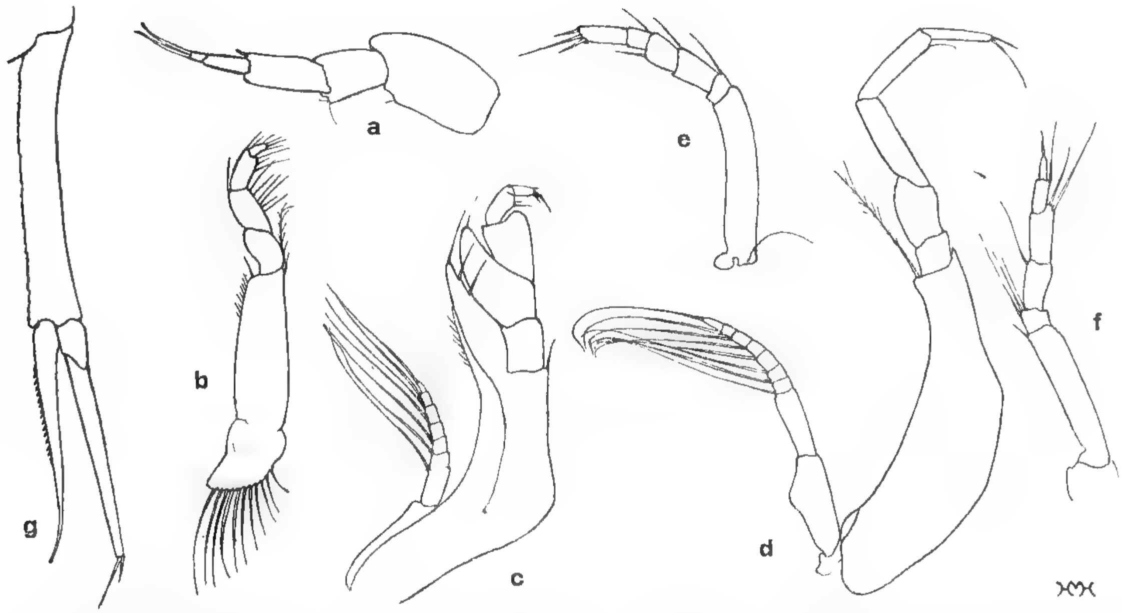


Fig. 2. *Cyclaspis cottoni.* Paratype ovigerous female; a, first antenna; b and c, second and third maxillipeds; d, e and f, first, second and fourth peraeopods; g, uropod (a, × 96; b–g, × 62).

Colour white with sooty markings and mottlings.

Length 3·3 mm.

Male. Differs from female in having carapace less deep, in the much larger ocular lenses, and in having the first pedigerous somite wholly concealed. The second pedigerous somite is shorter and its crest is less elevated. The infero-lateral portions of the first to fifth pleon somites are expanded downwards as usual in this sex.

Length 3·2 mm.

Loc. South Australia: Spencer Gulf, Port Germein, "burrowing in dirty sand between tide marks" (B. C. Cotton, Apl., 1937). Types in South Australian Museum, Reg. No. C. 2140–2141.

This is one of the several Cumacea new to South Australia which have been collected by Mr. Cotton, and I have pleasure in associating his name with it. It was secured by stirring sand in a bucket of sea water and straining out the disturbed Crustacea.

Although the carapace exhibits no bold sculpture, the impressions at the termination of the anterior, clear-cut part of the dorsal carina and the waviness of the more faintly marked, double posterior portion are responsible for slight but characteristic irregularity in the dorsal outline.

C. cottoni is very closely allied to *C. herdmani* Calman (1904, p. 171, pl. iii, fig 56–69, and pl. iv, fig. 60–66) and one would not hesitate to refer the South Australian specimens to that species were it not for the fact that they differ in having the exopod of the uropod distally truncate and with two distinctly articulated terminal spines. Calman in his fig. 65–66 illustrates the uropods of *C. herdmani* as he describes them—"Both rami are acutely pointed, without terminal spines."

LEPTOCUMA G. O. Sars.

LEPTOCUMA SHEARDI Hale.

Leptocuma sheardi Hale, 1936, p. 409, fig. 3–4.

The adult male is now available. The carapace in dorsal view is narrower than in the female. The ocular lobe is sooty, with four of the eye lenses clear, prominent and glittering. The pseudorostral lobes are produced in front of the eye-lobe, but do not come into contact. The exopod of the fourth peraeopods is rudimentary as in the female and young males.

In a male 5·65 mm. in length five pairs of pleopods are well developed and bear long setae, but in an example 4·35 mm. long the abdominal appendages are rudimentary.

The uropod of the adult male is much as in the female but is armed with longer and more numerous spines and setae.

The colour pattern is remarkably uniform and is as in the type (Hale, 1936, fig. 3).

Loc. South Australia: Gulf St. Vincent, Port Willunga, on stones, 1 fath. (Hale and Sheard, Feb., 1937).

FAMILY DIASTYLIDAE

GYNODIASTYLIS Calman.

GYNODIASTYLIS TRUNCATIFRONS Hale.

Gynodiastylis truncatifrons Hale, 1928, p. 43, fig. 13–14.

Several specimens of this distinctive species were secured at the southern end of Sellick's Reef. The type was taken five miles from shore.

Loc. South Australia: Gulf St. Vincent, Sellick's Reef, 1 fath. (Hale and Sheard, Jan., 1937).

PARADIASTYLIS Calman.

PARADIASTYLIS TUMIDA sp. nov.

Ovigerous female. Integument strongly indurated. Carapace one-third total length, much wider than deep; triangular in dorsal view, its greatest breadth occurring at posterior end, where it is almost as wide as long; a dorso-lateral fold or ridge on each side is marked off into three prominent tumidities; there is also a large rounded elevation at each side near the hinder margin, and from it curves forwards and downwards a swollen ridge, which does not reach to the anterior margin. Pseudorostral lobes rather narrow, meeting in front of eye lobe for a distance equal to more than one-fifth of length of carapace. Ocular lobe wide, with three unpigmented lenses. Antennal notch distinct; a distinct tooth below notch and above the rounded and serrate infero-lateral angle of carapace.

First pedigerous somite exposed, short; second and third somites short dorsally but with pleural portions lengthened and swollen above articulation of peraeopods; dorsal length of fourth somite about equal to that of first three somites together; fifth smaller than any of others.

Pleon somites one to four not markedly differing in length; fifth somite one-fourth as long again as fourth; telson three-fourths as long as fifth somite, and equal in length to sixth, with two upcurving rather prominent terminal spines and six pairs of smaller lateral spines.

First antennae with first joint barely longer than third and half as long again as second. Third maxillipeds without exopods; basis curved near proximal end, wide, and distally expanded, with a series of stout and very long plumose setae; length of basis equal to that of remaining segments together.

First peraeopods reaching but little beyond apex of pseudorostrum, basis only about two-thirds as long as rest of limb; ischium and merus each with a long plumose seta distally; carpus a little longer than propodus, half as long again as merus and three times as long as ischium; dactylus subequal in length to merus, tipped with several setae, of which one is conspicuously the stoutest; exopod short and slender. Second peraeopods widely separated from third pair; with basis very broad (two-thirds as wide as long) and having inner edge toothed; ischium suppressed; carpus barely longer than merus but nearly twice as long as propodus; dactylus shorter than propodus, with one of the terminal setae strong; exopod relatively longer and stouter than in first peraeopods. Last three pairs of peraeopods with basis shorter than remaining joints together (much shorter in fifth pair); carpus much shorter than merus in third and fourth peraeopods but as long as merus in fifth: carpus in each pair with an unusually stout and long distal seta and a slender bristle; dactylus terminating in a strong claw-like seta, and with one or two bristles near distal end.

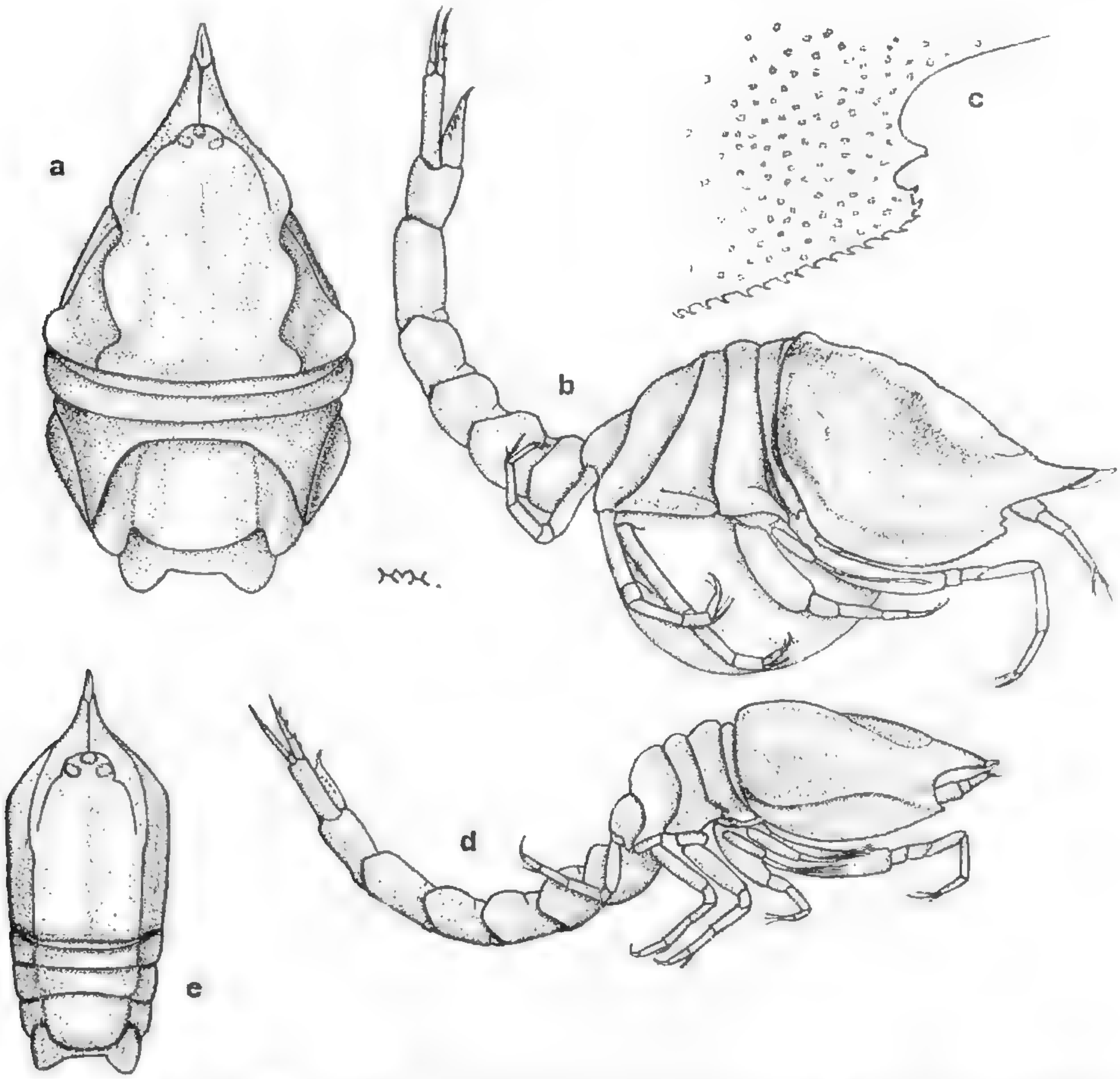


Fig. 3. *Paradiastylis tumida*. Type female; a, lateral view; b, dorsal view of cephalothorax; c, antero-lateral margin of carapace. Juvenile male; d, lateral view; e, dorsal view of cephalothorax (a–b, × 26; c, × 60; d–e, × 36).

Peduncle of uropods about half as long again as telson, wide (its greatest breadth nearly one-fourth the length) and armed with three spines on inner margin, two being placed near distal end; excluding the terminal spines the endopod is a little longer than exopod; including the spines the rami are subequal in length; endopod with first joint longer than second and the latter longer than third; four short spines on inner margin of endopod, one at middle of length and one at distal end of first joint, and one at distal ends of second and third joints.

Colour cream.

Length 3·75 mm.

Juvenile male. Carapace in dorsal view with sides parallel for posterior two-thirds, relatively much narrower and not so deep as in female; dorso-lateral and lateral ridges sharply defined and not swollen. Appendages as in female excepting that an exopod is present on the third maxilliped, the exopod of the first and second peraeopods is much stouter, and the bases of second and fourth pairs of legs are wider, with the inner margin serrate.

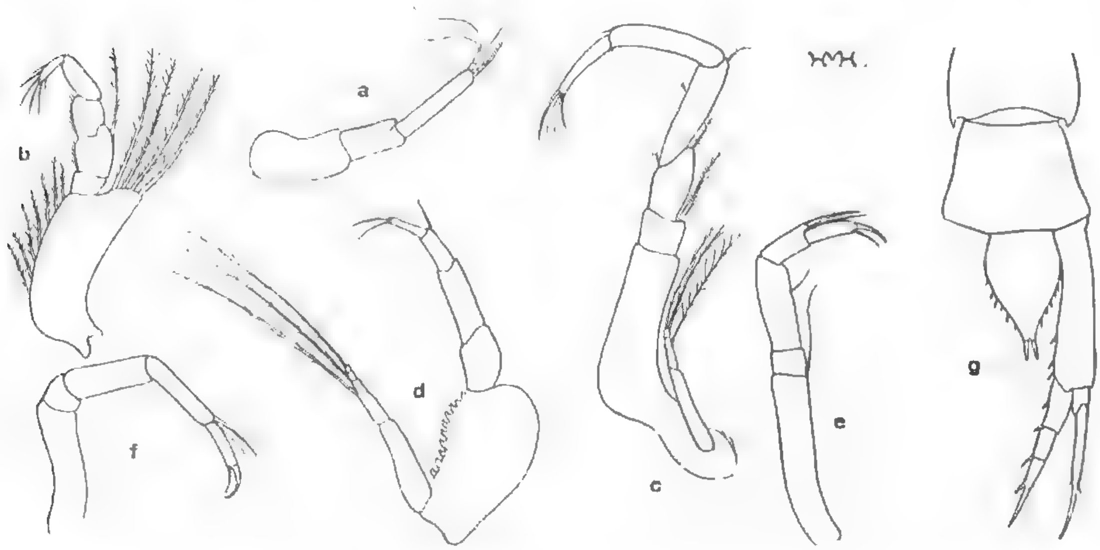


Fig. 4. *Paradiastylis tumida.* Paratype ovigerous female; a, first antenna; b, third maxilliped; c–f, first, second, third and fifth peraeopods; g, telson and uropods (× 52).

That the specimen is young is evidenced by the fact that exopods are absent on the third and fourth peraeopods, pleopods have not yet appeared and the second transverse suture of the endopod of the uropods is absent, although the spines are arranged as in the female; this two-jointed condition is without the slightest doubt due to immaturity.

Length 2 mm.

Loc. South Australia: Gulf St. Vincent, Port Willunga Reef, on stones, 1 fath., and Sellick's Reef, on stones, 1 fath. (H. M. Hale and K. Sheard, Jan. and Feb. 1937). New South Wales: Sydney Harbour, Vaucluse, on stones between tide marks (T. Harvey Johnston, Jan. 1937). Types in South Australian Museum, Reg. No. C. 2144–2147.

DIC Stebbing.

DIC LASIODACTYLUM Zimmer.

Dic lasiodactylum Zimmer, 1914, p. 193, fig. 17–18; Hale, 1936, p. 422, fig. 12–13.

In recording this species from South Australia, the writer described an immature male, larger than Zimmer's types and differing in having the carapace spiny and the telson and uropods relatively much longer and markedly spinose. The collecting of further material from Sellick's and Port Willunga Reefs, shows that, as adults, both "typical" and "spiny" forms cover the same range of size. Thus, one finds ovigerous females from 3 mm. down to 2·5 mm. in length having the long spiny telson and rough carapace. On the other hand a "typical" female nearly 3 mm. in length is like Zimmer's specimens in so far as telson and uropods are concerned, but has a pair of spinules on the ocular lobe and the inferior margin of the carapace spinose (fig. 5, a).

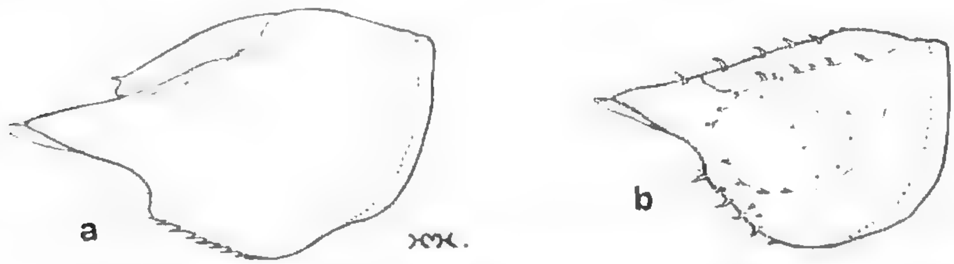


Fig. 5. a, Carapace of adult female of typical form of *Dic lasiodactylum*. b, Carapace of adult female of *Dic lasiodactylum* var. *spinicauda* (× 46).

As, however, the long, spiny telson consistently distinguishes the "spiny" form from "typical" specimens of the same size, the varietal name *spinicauda* is proposed for it. The carapace of var. *spinicauda* always bears a goodly number of spines arranged more or less as shown in fig. 5, b; in some examples the spines are more abundant and the dorso-lateral elevation on each side is much more marked.

DIC BREVIDACTYLUM sp. nov.

Ovigerous female. Integument rather thin. Carapace about as deep as wide, less than one-third total length; in dorsal view the lateral margins, to level of base of pseudorostrum, are subparallel; surface without sculpture save for a slight dorso-lateral bulge on each side. Pseudorostral lobes upturned, meeting in front of ocular lobe for a distance equal to more than one-fourth length of carapace. Ocular lobe very wide.

All pedigerous somites fully exposed; pleural parts of first and second produced forwards, of third to fifth backwardly produced.

Pleon a little longer than thorax; telson distinctly longer than sixth somite, without armature excepting a pair of rudimentary apical spinules.

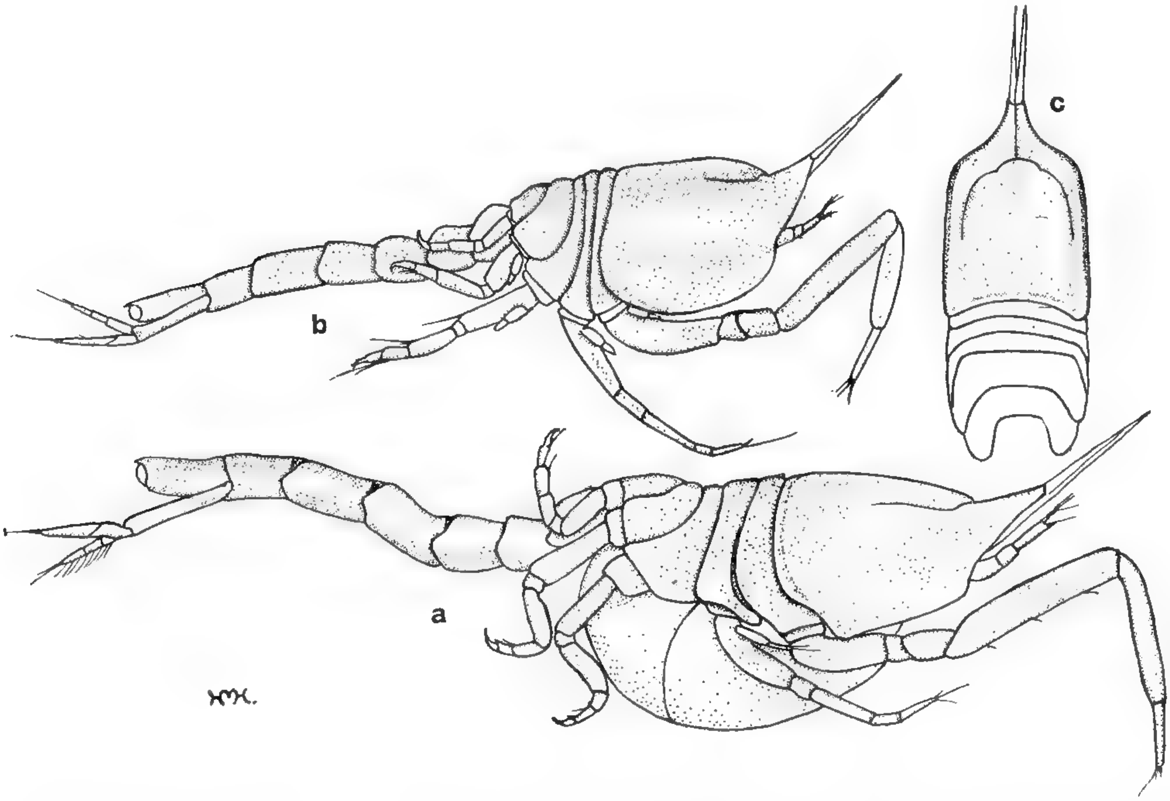


Fig. 6. *Dic brevidactylum.* a, Lateral view of ovigerous female. Juvenile male; b, lateral view; c, dorsal view of cephalothorax (× 32).

First peraeopods with small exopod, tipped with a few very short setae; basis one-fifth as long as remaining joints together; carpus stout, one-third as long again as propodus, which bears a long apical spine; dactylus less than half as long as propodus and with only three apical setae. Second peraeopods with small exopod bearing one or two hairs; ischium suppressed and carpus equal in length to propodus and dactylus together.

Peduncle of uropods nearly one-fourth as long again as telson, which is equal in length to exopod; endopod almost as long as exopod, with setae on inner edge, with a long terminal seta, and with third joint longer than second but shorter than first; exopod wtih two spines on outer margin and with three terminal setae.

Colour white.

Length 2·7 mm.

Immature male. Rudimentary exopods are present on the first four pairs of peraeopods, and the second antennae do not nearly reach to hinder margin of carapace. Appendages otherwise much as in female.

Length 2·1 mm.

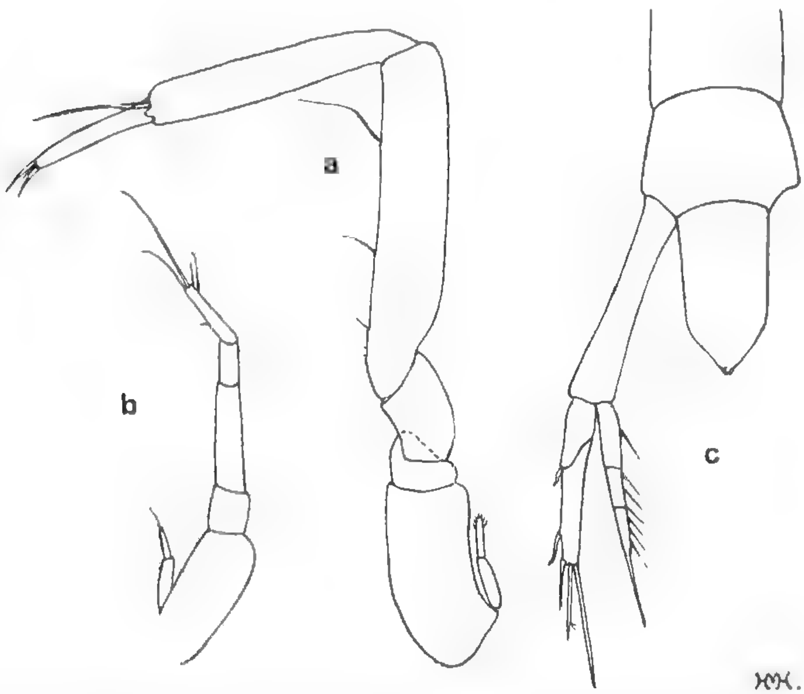


Fig. 7. *Dic brevidactylum.* Type female; a and b, first and second peraeopods; c, telson and uropod (× 70).

Loc. South Australia: Gulf St. Vincent, Sellick's Reef, on stones, 1 fath. (H. M. Hale and K. Sheard, Jan. and March 1937). Types in South Australian Museum, Reg. No. C. 2151–2152.

This species differs from *D. lasiodactylum* in the very different proportions of the segments of the first peraeopods and in the absence of long bristles on the dactylus of that limb, the subparallel (instead of convergent) sides of the carapace as seen in dorsal view and in the character of the uropods.

PACHYSTYLIS H. J. Hansen.

Anchicolurus of Stebbing seems to be a synonym of *Colurostylis* Calman (Hale, 1928, p. 47 and Zimmer, 1930, p. 651). The acquisition of a male of *Pachystylis victus* makes it increasingly difficult to separate *Colurostylis* from Hansen's genus.

PACHYSTYLIS VIETUS Hale.

Pachystylis vietus Hale, 1936, p. 424, fig. 14–15.

The species was previously known only from the adult female. A single young male differs as follows. The first four peraeopods bear well-developed exopods, the accessory flagellum of the first antennae is not much shorter than the main flagellum, there are pleopods on the first two pleon somites and the apical spines of the telson, although tiny, are longer; the branches of the pleopods are rudimentary and are not furnished with long setae. The apex of the telson has two short, slender setae, in addition to the small spines, just as in the female.

Loc. South Australia: Gulf St. Vincent, Sellick's Reef (H. M. Hale, Feb. 1937); Port Willunga (H. M. Hale and K. Sheard, Jan. and Feb. 1937); Marino (K. Sheard and B. C. Cotton, Mar. 1937).

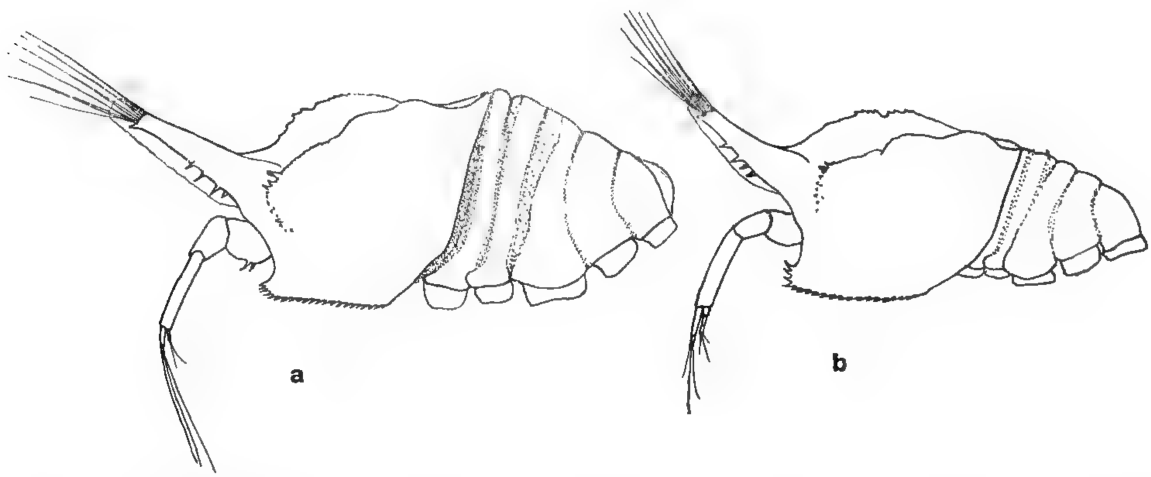


Fig. 8. *Allodiastylis cretatus.* a, Cephalothorax of adult female. b, Cephalothorax of male with form of female (× 34).

ALLODIASTYLIS Hale.

ALLODIASTYLIS CRETATUS Hale.

Allodiastylis cretatus Hale, 1936, p. 426, fig. 16–17.

This species was originally described from a single adult female and a single male. Further material now available reveals some curious facts.

The type female is abnormal in so far as the pseudorostrum and the anterior margin of the carapace are concerned; it has already been noted (Hale, *ut supra*, p. 428) that its first peraeopods do not form a symmetrical pair. In females now before me the pseudorostral lobes are upturned, are spinose inferiorly and have long setae radiating from the apex, while the antero-lateral angle of the carapace is prominent and, like the inferior margin, is spinose. In lateral view the serrated dorsal margin exhibits a deeper indentation at the middle of its length and the antero-lateral portions of each dorso-lateral ridge are spinous, one of the spines being fairly prominent (fig. 8, a). The appendages and telson are as in the type female (with the exception of the malformed first right peraeopod of the latter) and no exopods are apparent on any of the thoracic limbs.

One example from South Australia (fig. 8, b) resembles the females described above, but has exopods on the third maxillipeds and first to fourth peraeopods, although they are not fully developed; the appendages generally are as in the type male. The sculpture is exactly as in the females, while the integument is indurated and chalky white, the pseudorostrum is upturned and the telson terminates in a pair of very short blunt spines, instead of long spines as in the type male.

Using the "formalin method" of collecting on a reef in New South Wales, Prof. T. Harvey Johnston secured a number of females in company with an adult male; the latter agrees in every detail with the type male. Thus, this translucent male, with raised ocular lobe, downbent rostrum, strongly ridged carapace and long telsonic spines, has now been found associated with the very different white females in two widely separated Australian localities—evidence supporting the assumption that they are the sexes of the one species.

The variation exhibited by some other Cumacea indicates the desirability of examining large series whenever possible. One may cite, for example, the range of variability of *Diastylis glabra* Zimmer (see Zimmer, 1926, pp. 57 and 72), *Nannastacus nasutus* Zimmer, *N. gibbosus* Calman, *N. zimmeri* Calman, and *Dic lastodactylum* Zimmer.

Loc. South Australia: Gulf St. Vincent, Sellick's Reef, on stones, 1 fath. (H. M. Hale and K. Sheard, Jan. 1937). New South Wales: Sydney Harbour, Vaucluse, on stone between tide marks (T. Harvey Johnston, Jan. 1937).

FAMILY NANNASTACIDAE

NANNASTACUS Spence Bate.

NANNASTACUS NASUTUS var. CAMELUS Zimmer.

Nannastacus nasutus var. *camelus* Zimmer, 1914, p. 186, fig. 13.

A number of specimens taken on South Australian reefs conform to the above variety. The eye is pigmented in all. A female 2·5 mm. in length is figured.

Loc. South Australia: Gulf St. Vincent, Port Willunga Reef, on stone, 2 fath. at high tide, and Sellick's Reef, on stone, 1 fath. (H. M. Hale and K. Sheard, Jan.-Feb. 1937).

Hab. South-western and South Australia.

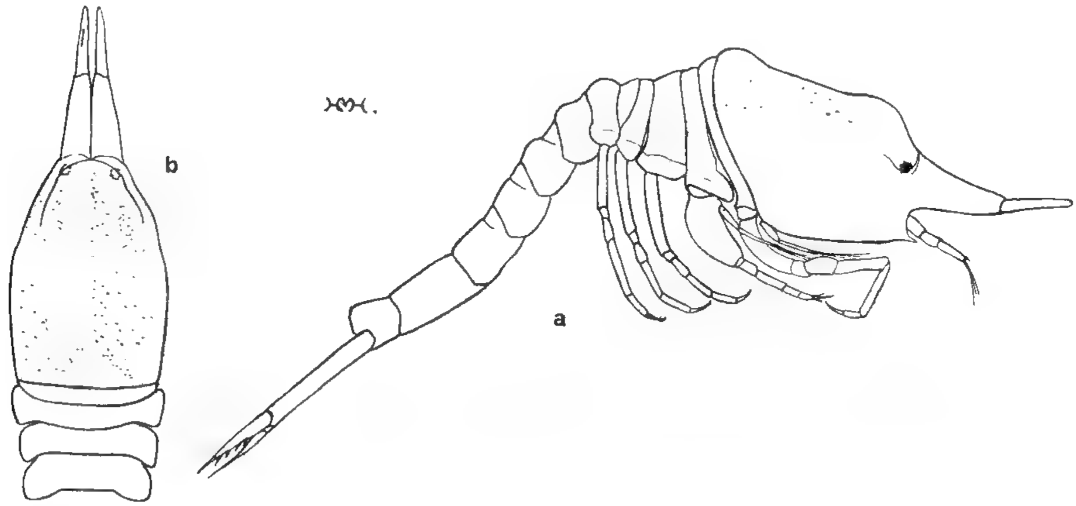


Fig. 9. *Nannastacus nasutus* var. *camelus.* Female; a, lateral view; b, dorsal view of cephalothorax (× 30).

SCHIZOTREMA Calman.

SCHIZOTREMA DEPRESSUM Calman.

Schizotrema depressum Calman, 1911, p. 361, pl. xxxiv, fig. 14–17.

Specimens of this species have now been taken in South Australian waters. Adult females attain a length of 2 mm. and have the carapace more rugose than that of smaller examples.

As noted by Calman the lateral setae of the cephalothorax and pleon are always encrusted—either with algae or mud—so that the bizarre appearance of the creature is increased.

Loc. South Australia: Gulf St. Vincent, Port Willunga Reef, on stones, 1 fath. (H. M. Hale and K. Sheard, Feb. 1937).

Hab. Gulf of Siam and South Australia.

REFERENCES.

Calman, W. T. (1904) : *Rep. Ceylon Pearl Fish.,* ii.
Calman, W. T. (1911) : *Trans. Zool. Soc.,* xviii.
Hale, H. M. (1928) : *Trans. Roy. Soc., S. Aust.,* lii.
Hale, H. M. (1936) : *Rec. S. Aust. Mus.,* v, No. 4.
Zimmer, C. (1914) : *Fauna Südwest Aust.,* v.
Zimmer, C. (1926) : *Kungl. Svenska Vet.-Akad. Hand.,* Band iii, No. 2.
Zimmer, C. (1930) : *Mitt. Zool. Mus., Berlin,* Band xvi, Heft. 4.

A REVISION OF THE AUSTRALIAN TROMBIDIIDAE (ACARINA)

BY H. WOMERSLEY, F.R.E.S., A.L.S., ENTOMOLOGIST, SOUTH AUSTRALIAN MUSEUM

Summary

Recently Dr. Sig Thor (Zool. Anz., 1935, ex, pp. 107-112) has divided the family Trombidiidae into ten subfamilies. In this paper therefore I propose to revise our knowledge of the Australian forms in the light of Sig Thor's studies.

Subfamily I, **Trombellinae** Sig Thor, 1935.

Body elongate, abdomen rectangular. Cuticle strong, tuberculate; hairs ciliated or simple, short and pointed; the two pseudostigmal hairs placed close together in the middle of the thorax on one or two prominences between the two pairs of stalked or sessile paired eyes. Fourth segment of palp with various spines or hairs; fifth segment long.

A REVISION OF THE AUSTRALIAN TROMBIDIIDAE (ACARINA)

By H. WOMERSLEY, F.R.E.S., A.L.S., Entomologist, South Australian Museum.

Fig. 1–3.

Recently Dr. Sig Thor (Zool. Anz., 1935, cx, pp. 107–112) has divided the family *Trombidiidae* into ten subfamilies. In this paper therefore I propose to revise our knowledge of the Australian forms in the light of Sig Thor's studies.

Subfamily 1, Trombellinae Sig Thor, 1935.

Body elongate, abdomen rectangular. Cuticle strong, tuberculate; hairs ciliated or simple, short and pointed; the two pseudostigmal hairs placed close together in the middle of the thorax on one or two prominences between the two pairs of stalked or sessile paired eyes. Fourth segment of palp with various spines or hairs; fifth segment long.

In this subfamily Sig Thor places only the typical genus *Trombella* Berl. 1887. In a subsequent paper (Zool. Anz. 1936, cxiv, pp. 29–32), however, he puts the genera *Chyzeria* Canest. 1897 and *Parachyzeria* Hirst 1926, both of which he omitted from the earlier paper, in the subfamily *Microtrombidiinae*. According to his subfamily diagnosis, both the above genera seem to me to be more closely related to *Trombella* and should, I believe, be grouped with that genus in the *Trombellinae*, rather than in the *Microtrombidiinae*. Such inclusion, however, does necessitate a slight alteration in the diagnosis of the *Trombellinae*. In both *Chyzeria* and *Parachyzeria* the crista is absent and the pseudostigmal hairs are placed close together on a single prominence, while the paired eyes are on long peduncles and not sessile. The above characteristics are included in the diagnosis of the subfamily as given above.

The three genera here included in the subfamily may be keyed as follows:

1. Pseudostigmal hairs on two slightly separated tubercles. Body hairs simple or very finely serrated. Eyes 2 + 2, sessile. Dorsal surface of abdomen often with glandular depressions .. .. Gen. *Trombella* Berl. 1887.

   Pseudostigmal hairs on a single tubercular prominence. Body with or without lateral processes; hairs ciliated and simple. Eyes 2 + 2, pedunculate .. 2.

2. Body with 4 lateral abdominal processes on each side. Dorsum posteriorly with simple sinuate hairs, overlying which are long ciliated hairs.
   Gen. *Chyzeria* Canestrini 1897.

   Body without above processes. Dorsum anteriorly with four brushes of very long ciliated hairs, underlying which posteriorly are the simple sinuate hairs as in *Chyzeria* .. .. Gen. *Parachyzeria* Hirst. 1926 (not Australian).

Genus TROMBELLA Berlese, 1887.

The only known Australian species is *Trombella warregensis* Hirst 1929, which is recorded from New South Wales and South Australia.

Genus CHYZERIA Canestrini, 1897.

This genus is widely distributed in Australia and also occurs in New Zealand. The following forms have been described and have been keyed in an earlier paper (Womersley 1934); *C. australiense* Hirst 1928; *C. australiense* v. *musgravei* Hirst 1929; *C. a.* var. *occidentalis* Hirst 1929; *C. a.* var. *hirsti* Wom. 1934; *C. insulana* Hirst 1929; *C. montana* Hirst 1929; *C. armigera* Hirst 1929.

Subfamily II, TANAUPODINAE Sig Thor, 1935.

Body moderately broad. Cuticle smooth or tuberculate; hairs pointed, short or long. Crista weak, without sensillary areas; the two pseudostigmal hairs placed near the crista in the middle of the thorax. The two pairs of sessile eyes sometimes absent. Palpi with few spines. Legs short, seldom long.

This subfamily is as yet unknown from Australia. It includes the following genera: *Tanaupodus* Haller 1882; *Eothrombium* Berlese 1910; *Rhinothrombium* Berlese 1910; *Typhlothrombium* Berlese 1910; *Neotanaupodes* Garman 1925.

Subfamily III, JOHNSTONIANINAE Sig Thor, 1935.

Abdomen cylindrical, with pointed simple hairs. Crista well developed, with two sensillary areas in the middle (or at ends) and 4 (2 pairs) of pseudostigmal hairs. With a distinct nasus. Eyes shortly stalked or sessile. Palpi with or without a few tibial spines. Legs moderately long.

Included here by Sir Thor are *Johnstoniana* George 1909 (= *Diplothrombium* Berlese 1910 = *Rohaultia* Oudemans 1911), *Centrotrombidium* Kramer 1896, *Notothrombium* Storkan 1934. To these should be added *Myrmicotrombium* Womersley 1934. The genus *Rohaultia* Oudemans was erected for a larval form. As the genus *Centrothrombidium* Kramer possesses only one pair of pseudostigmal hairs on a single sensillary area of the crista, the inclusion of it here does not seem natural. It would probably be better placed in the *Microtrombidiinae*. With the exception of this genus and of *Notothrombium*, the description of which is not available to me, the two Australian genera may be separated thus:

1. Eyes 2 + 2, sessile. Crista with either both or only one pair of pseudostigmal hairs situated medially; if only one, then the second pair is at the anterior end; both pairs on sensillary areas. .. Gen. *Johnstoniana* George 1909. (= *Diplothrombium* Berl. = *Rohaultia* Ouds.).
2. Eyes 1 + 1, sessile. Crista with two pairs of pseudostigmal hairs placed at opposite ends, on sensillary areas .. Gen. *Myrmicotrombium* Wom., 1934.

Genus JOHNSTONIANA George, 1909.

= *Diplothrombium* Berl. 1910, Hirst 1928, Womersley 1934.
= *Rohaultia* Ouds. 1911, Wom. 1934.

Only a single species *Johnstoniana australiense* (Hirst, 1928) is known from Australia. It was described by Hirst from Queensland and was later recorded by the present writer from South Australia.

Genus MYRMICOTROMBIUM Womersley, 1934.

This genus is only known from the type species *M. brevicristatum* Wom. described from specimens found in an ants' nest in South Australia.

Subfamily IV, EUTROMBIDIINAE Sig Thor, 1935.

Abdomen broad, triangular (except the narrow *Leptothrombium*), with short thickly ciliated hairs and with a few transverse furrows. Apex of abdomen with an oval shield-like area, seldom without. Thorax anteriorly with a distinct nasus. Crista well developed, with a medial small but solid sensillary area and two pseudostigmal hairs between the shortly pedunculate or sessile paired eyes. Palpi with strong accessory claw and many strong spines. Legs strong, of variable length. Larvae with 2 or 3 dorsal shields; lower lip forming a chitinous ring; tarsal claws of leg III strongly modified, the inner claw being stump-like and projecting backwards.

The genera placed here by Sig Thor are *Eutrombidium* Verdun 1909, *Leptothrombium* Berlese 1912, and *Cercothrombium* Methlagl 1927. The last is only known from the larval stage, *Eutrombidium* from both larva and adult, and *Leptothrombium* from the adult only. The last genus is regarded by Berlese as but a subgenus of *Eutrombidium*.

The following key will help in the separation of the genera.

1. Adults . .. . 2.
   Larvae . .. . 3.
2. Form broadly triangular; body hairs uniform.
   Gen. *Eutrombidium* Verdun, 1909.
   Form narrow and elongate; body hairs of two forms.
   Gen. *Leptothrombidium* Berlese, 1912.
3. Only two dorsal shields; coxal hairs short and stumpy and apically bifurcated.
   Gen. *Eutrombidium* Verdun, 1909.
   Three dorsal shields; coxal hairs long, pointed and ciliated.
   Gen. *Cercothrombium* Methlagl, 1927.

Genus EUTROMBIDIUM Verdun, 1909.

This is the only genus as yet known to occur in Australia. It is represented by *Eutrombidium trigonum* Herman, the larvae of which have been found attached to the Black-tipped Locust, *Chortoicetes terminifera* (Walker) at the Waite Institute, Glen Osmond, South Australia, by Mr. D. C. Swan in April, 1934.

Subfamily V, PODOTHROMBIINAE Sig Thor, 1935.

Abdomen moderately broad, cordate, with shoulders and with fine, very weakly or unciliated hairs. No nasus. In the middle of the thorax and between the two pairs of shortly pedunculate eyes is a well developed sensillary area with two pseudostigmal hairs; crista behind sensillary area shortened and in front rudimentary. Fourth segment of palpi with accessory claw and many spines or combs; fifth segment (tarsus) large. Legs long.

The genus *Podothrombium* Berlese 1910 is the only one included in this subfamily. It does not occur in Australia.

Subfamily VI, TROMBICULINAE Ewing, 1929.

(Itch- or Chigger-mites.)

Body form in adult with the shape of an 8, with a constriction behind the shoulders; abdomen rounded behind. Body hairs thick, soft, and finally ciliated. Thorax without nasus, sometimes with an anterior incision. Crista well developed, extending the whole length of thorax, posteriorly with a sensillary area and two pseudostigmal hairs. Eyes weakly developed, seldom one or two pairs near the sensillary area, often absent or rudimentary. Palpi long, fourth segment without comb or accessory claw, with few spines (more in *Blankaartia*). Legs short. Larvae with only one dorsal shield (two in *Blankaartia*).

In this group Sig Thor places the following genera: *Heterothrombidium* Verdun 1909, *Neothrombium* Bruyant 1909, *Doloisia* Oudemans 1910, *Leeuwenhoekia*

Oudemans 1911, *Hannemania* Oudemans 1911, *Gahrliepia* Oudemans 1912, *Schöngastia* Oudemans 1910, *Neoschöngastia* Ewing 1929, *Schöngastiella* Hirst 1915, *Odontacarus* Ewing 1929, *Walchia* Ewing 1932, *Endotrombicula* Ewing 1932, *Atomus* Latr. 1795 (= *Metathrombium* Oudemans 1909), *Trombicula* Berlese 1905 (= *Neotrombicula* Hirst 1925).

Very few of these genera are known from the adult forms, most of them being represented in collections by larvae. The larval stages are generally to be found as ectoparasites on warm-blooded animals (including man) but some appear to be restricted to amphibians.

The genus *Atomus* Latr. (= *Metathrombium* Ouds.) is here regarded as being more properly placed in the *Microtrombidiinae*.

The various genera may be separated with the help of the following key:

1. Adults; body 8-shaped. Eyes one or none on each side .. .. 2.
 Larvae .. .. 3.
2. Eyes placed at base of large sensillary area of crista, or absent. Sensillary area broad with two pseudostigmal hairs. Gen. *Trombicula* Berlese, 1903.
 Eyes placed on anterior margin of thorax; apex of thorax incised.
 Gen. *Blankaartia* Oudemans, 1911 (not Australian).
3. With two median dorsal shields. Eyes two on each side, posterior eye the smaller. Dorsum behind second shield with numerous small symmetrical shields. Lower lip not as a chitinous ring. Tarsi I and II with only 2 claws, III with three. Gen. *Blankaartia* Oudemans, 1911 (not Australian).
 With one or three median dorsal shields and only one eye on each side .. 4.
4. Anterior dorsal shield with 3 or more pairs of setae, in addition to the two pseudostigmal hairs .. .. 5.
 Dorsal shield with only 4 or 5 single setae besides the pseudostigmal hairs 9.
5. Dorsal shield with 5 pairs of setae besides the pseudostigmal hairs. Femur of leg I only divided; one pair of setae between coxae I and one pair between coxae III. Palpal claw bifurcate. Gen. *Gahrliepia* Oudemans, 1912.
 (= *Typhlothrombium* Oudemans, 1911) (not Australian).
 Dorsal shield with 3 pairs of setae .. .. 6.
6. Pseudostigmal hairs clavate.
 Gen. *Schöngastiella* Hirst, 1915 (not Australian).
 Pseudostigmal hairs not clavate .. .. 7.
7. Median dorsal shield longer than broad; maxillary coxal setae in front of palpi .. Gen. *Heterothrombium* Verdun, 1910 (not Australian).
 Dorsal shield broader than long .. .. 8.
8. Dorsal shield without any median anterior process but with a poorly developed crista .. Gen. *Hannemania* Oudemans, 1911 (not Australian).
 Dorsal shield with a short median anterior process; without crista.
 Gen. *Leeuwenhoekia* Oudemans, 1911.

9. Dorsal shield trapezoidal . .. . 10.
   Dorsal shield triangular. Palpal claw with 1–5 points.
   Gen. *Doloisia* Oudemans, 1912 (not Australian).

10. Dorsal shield with only two pairs of setae besides the pseudostigmal hairs; latter clavate. Eyes absent or rudimentary. Palpal claw trifurcate.
   Gen. *Walchia* Ewing, 1931 (not Australian).

   Dorsal shield with 5 setae in addition to the pseudostigmal hairs; latter clavate or not . .. . 11.

11. Pseudostigmal hairs clavate .. .. 12.
   Pseudostigmal hairs not clavate .. .. 13.

12. Chelicerae with a row of teeth dorsally; palpal claw usually bifurcate.
   Gen. *Schöngastia* Oudemans, 1910.
   Chelicerae without more than one dorsal tooth; palpal claw trifurcate. Eyes two .. .. Gen. *Neoschöngastia* Ewing, 1929 (not Australian).

13. Dorsal shield distinctly pentagonal, with the posterior sides forming a strong angle. Eyes two on each side or absent .. .. 14.
   Dorsal shield at most roughly 5-sided, without strong posterior angle .. 15.

14. Eyes two on each side. Gen. *Pentagonella* Sig Thor, 1936 (not Australian).
   Eyes absent .. Gen. *Reidlinea* Oudemans, 1916 (not Australian).

15. Dorsal shield poorly developed; all 5 setae placed near middle of shield; median anterior seta simple; pseudostigmal hairs short, simple, setiform. Chelicerae with 3 sharp recurved teeth on upper margin and a vestigial lateral tooth. Eyes 2 + 2, well developed.
   Gen. *Endotrombicula* Ewing, 1931 (not Australian).
   Dorsal shield well developed, the 5 setae marginal or submarginal .. 16.

16. Chelicerae with a row of teeth on upper margin.
   Gen. *Odontacarus* Ewing, 1929 (not Australian).
   Chelicerae with not more than one tooth on upper margin.
   Gen. *Trombicula* Berlese, 1905.
   (= *Neotrombicula* Hirst, 1925).

Of the above genera only *Trombicula* Berlese 1905, *Schöngastia* Oudemans 1910, and *Leeuwenhoekia* Oudemans 1911 are so far known to be represented in Australia.

Genus TROMBICULA Berlese, 1905.

The following five species of this genus are recorded from Australia, two as adults and three as larvae.

TROMBICULA SIGNATA Womersley, 1934.

Described from a solitary adult specimen from Western Australia. The type is in the South Australian Museum.

TROMBICULA TINDALEI Womersley, 1936.

Described from a specimen taken on Flinders Chase, Kangaroo Island, South Australia by Mr. N. B. Tindale. Type in the South Australian Museum.

TROMBICULA HIRSTI Sambon, 1927.

Only known from the larval form, this species is the "ti-tree itch mite" of Queensland and South Australia. Its real host is unknown but recently the writer has had a specimen from a blackbird where it was found walking over the beak after the death of the bird. This specimen was from Payneham, South Australia. June 30th, 1937.

TROMBICULA NOVAE-HOLLANDIAE Hirst, 1929.

Described from larvae found on *Rattus greyi* from Kangaroo Island, South Australia, it was later taken on *Potorous tridactylus* in Tasmania.

TROMBICULA MACROPUS Womersley, 1934.

This species was described from specimens of larvae found attached to the scrotum of a wallaby from Darwin, Northern Australia.

Genus SCHÖNGASTIA Oudemans, 1910.

Of this larval genus five species have been described from the Australian continent as follows:

SCHÖNGASTIA ANTIPODIANUM Hirst, 1929.

From *Rattus greyi* from Kangaroo Island, South Australia.

SCHÖNGASTIA COORONGENSIS Hirst, 1929.

From the ears of a rodent at Robe, South Australia.

SCHÖNGASTIA DASYCERCI Hirst, 1929.

From *Dasycercus cristicauda*, Ooldea, South Australia.

SCHÖNGASTIA WESTRALIENSE Womersley, 1934.

From the ears of a domestic cat, Greenbushes, Western Australia.

SCHÖNGASTIA PETROGALE Womersley, 1934.

From the scrotum of a wallaby, Musgrave Ranges, South Australia.

Genus LEEUWENHOEKIA Oudemans, 1911.

LEEUWENHOEKIA AUSTRALIENSE Hirst, 1925.

Originally described from specimens taken on a human being in New South Wales, it has also been found on the ears of a domestic cat at Glen Osmond, South Australia.

Subfamily VII, MICROTROMBIDIINAE Sig Thor, 1935.

Body small to moderately large. Abdomen cordate. Body hairs very variable, smooth, thin, weakly ciliated or thick (apparently unciliated), dagger-like, clavate or globular, frequently combed on inner side, septate or not. Eyes usually in two pairs or absent, sessile or shortly pedunculate. The sensillary area of crista behind the eyes, usually posterior or subposterior, occasionally submedial. Palpi on fourth segment with one or a few spines (besides accessory claw), on inner side with a longer or smaller comb of stiff hairs and sometimes some spine-like setae. Nasus absent (except *Neotrombidium*). Legs generally shorter than or as short as body. Larvae with 1, 2 or 5 large dorsal plates, sometimes these followed by rows of round or quadrate plates bearing setae. Eyes usually two on each side, occasionally only one. Hind tarsi with 2 or 3 claws, modified or not. Lower lip of mouth parts not ring-like.

Within this subfamily Sig Thor places the following:

Microtrombidium Haller 1882 (subg. *Enemothrombium* Berlese, 1910; *Campylothrombium* Krause, 1916); *Dromeothrombium* Berlese, 1912; *Ettmülleria* Oudemans, 1911 (larvae); *Atomus* Latr., 1795 (= *Metathrombium* Oudemans, 1911); *Polydiscia* Methlagl, 1927; *Neotrombidium* Leonardi, 1901; *Georgia* Hull, 1918; *Calothrombium* Berlese, 1918; *Haplothrombium* Ewing, 1925 (larvae); *Dendrothrombium* Sig Thor, 1936; *Platythrombidium* Sig Thor, 1936; *Camerothrombium* Sig Thor, 1936.

In 1935 (Zool. Anz. cix, 111) in defining his subfamily Sig Thor expressed the opinion that *Enemothrombidium* and *Campylothrombium* should be regarded as only subgenera of *Microtrombidium*. Later, however (Zool. Anz. 1936, cxiv, 30–31) he further split up the *Microtrombidium* complex and erected three additional new genera, *Dendrothrombium*, *Platythrombidium* and *Camerothrombium* on corresponding differences in hair structure. As restricted in the present paper both *Enemothrombidium* and *Campylothrombium* are regarded as of generic status in accordance with Sig Thor's later paper. The genus *Centrothrombium* Krause, for reasons stated earlier, is also included in this subfamily. Here also the following new genera are erected and defined: *Echinothrombium* (type *Ottonia spinosum* Canest.); *Laminothrombium* (type *M. myrmicum* Womersley, 1934); *Eutrichothrombium* (type *M.(E.) eutrichum* Berlese, 1905).

The larval genus *Ettmülleria*, although evidence is not conclusive, would appear to be the larval stage of *Echinothrombium* or *Camerothrombium*, more probably the latter (see Womersley 1936, J. Linn. Soc. London, xl. 114).

KEY TO THE GENERA OF MICROTROMBIDIINAE.

1. Larval forms .. .. 2.
   Adult forms .. .. 5.
2. With two large dorsal shields which are punctate. Inner claw of tarsus III strongly modified, short stump-like and directed backwards. Palpi with claws .. .. 3.
   One or five large dorsal shields; if one, then this followed by a series of rows of large dorsal shields. Inner claw of tarsus III not as above .. .. 4.
3. The dorsal setae behind the second shield placed on small round plates. Eyes 2 + 2, sessile. .. .. .. Gen. *Ettmülleria* Oudemans, 1911.
   No small plates behind second shield. Eyes 2 + 2, sessile.
   Gen. *Atomus* Latr., 1795.
   (= *Metathrombium* Oudemans, 1909 (not Australian).
4. With 5 large transverse dorsal shields. Eyes 1 + 1. Tarsus of leg III with only two claws, one long and one short, and a long stiff seta with long secondary hairlets .. Gen. *Hoplothrombium* Ewing, 1925 (not Australian).
   With one large dorsal plate, this hour-glass shaped and porous; the dorsum behind occupied by 16 large quadrate plates each bearing a seta. Eyes 2 + 2, sessile, on small plates. Claws on all tarsi unmodified.
   Gen. *Polydiscia* Methlagl, 1927 (not Australian).
5. With a distinct nasus. Dorsal body hairs uniform, trifurcate from base, with few or no serrations .. .. Gen. *Neotrombidium* Leonardi, 1911.
   Without a nasus . .. . 6.
6. Sensillary area of crista submedial. Palpi with strong accessory claw, three strong spines on inner side and 8–9 on outer side of tibia. Body hairs short but strong, frequently bifurcated from base, the arms sometimes expanded and forming an enclosure, with strong hairlets.
   Gen. *Calothrombium* Berlese, 1918.
   Sensillary area of crista posterior or subposterior .. .. .. 7.
7. Palpal tarsus clavate, apically with two strong long forwardly directed spines; tibia with long apical claw and small accessory claw. Pseudostigmal hairs clavate (Oudemans). Eyes 2 + 2.
   Gen. *Centrotrombidium* Krause, 1896 (not Australian).
   Not so . .. . 8.
8. Dorsal hairs uniformly of one type but sometimes of variable length .. 9.
   Dorsal hairs of two distinct types .. .. 17.
9. Dorsal hairs tapering, pointed, with long outstanding hairlets .. .. 10.
   Gen. *Microtrombidium* Haller, 1882.
   Dorsal hairs different .. .. 11.

10. Legs I and IV shorter than the body. Subg. *Microtrombidium* Haller, 1882.

Legs I and IV longer than body. Subg. *Dromeothrombium* Berlese, 1912.

11. Dorsal body hairs long and spine-like with few serrations. Palpal tibia with one large accessory claw and a few spine-like setae.
Gen. *Echinothrombium* nov. (part).
(type *O. spinosum* Canest., 1877).

Not so . .. . 12.

12. Dorsal body hairs tree-like with fine intermingling branches. Palpal tibia laterally with a strong forwardly directed spine. Tarsi I oval, broad, much longer than metatarsus.
Gen. *Dendrothrombium* Sig Thor, 1936 (not Australian).

Not so . .. . 13.

13. Dorsal body hairs not septate .. .. 14.

Dorsal body hairs septate, divided into chambers 16

14. Dorsal body hairs sessile, short, conical, pointed with numerous short ciliations. Palpal tibia laterally with at least one, often many, strong spines. Tarsus I generally elongate-oval, longer than metatarsus.
Gen. *Platythrombium* Sig Thor, 1936.

Not so . .. . 15.

15. Dorsal body hairs more or less sessile, arising from short conical tubercles, leaf-like with marginal ciliations. Palpal tibia with strong accessory claw and without strong dorsal spines. Tarsus I short and broad.
Gen. *Laminothrombium* nov.
(type *M. myrmicum* Wom., 1934).

Dorsal body hairs on short peduncles, claviform, apically acute or rounded, with short ciliations .. Gen. *Enemothrombium* Berlese, 1905 (part).

16. Dorsal body hairs short stalked or sessile, cup-like with short stiff ciliations.
Gen. *Camerothrombium* Sig Thor, 1936 (part).

Dorsal body hairs long, claviform and not cup-shaped, backwardly curved, with subapical septum and open apex.
Gen. *Campylothrombium* Krause, 1916 (part) (not Australian).

17. Many of the dorsal hairs with thick stems and long strong hairlets and multiramous apically, the rami being as thick as the stem; other hairs equally thick with long hairlets but not ramous Gen. *Georgia* Hull, 1918 (not Australian).

Not so . .. . 18.

18. Shorter hairs as in *Microtrombidium*; larger hairs stout, spine-like with few or no serrations .. .. Gen. *Echinothrombium* nov. (part).

Shorter hairs otherwise .. .. 19.

19. Longer hairs septate .. .. 20.

Longer hairs not septate .. .. 21.

20. Longer hairs elongate, claviform, open at apex.
Gen. *Campylothrombium* Krause, 1916 (part) (not Australian).

Longer hairs cup-like or globose, on short peduncles.
Gen. *Camerothrombium* Sig Thor, 1936 (part).

21. Shorter hairs sessile, short, conical, pointed, with numerous ciliations, as in *Platythrombidium*, or else without ciliations and with 4–5 short apical fungiform lobes; longer hairs claviform or rod-like with many ciliations.
Gen. *Enemothrombium* Berlese, 1905 (part).
Shorter hairs globose; without septa, closely packed but with longer fine setae interspersed .. .. Gen. *Eutrichothrombium* nov.
(type *M.*(*E.*) *eutrichum* Berlese, 1905) (not Australian).

Genus ETTMULLERIA Oudemans, 1911.

This larval genus is, so far, represented in Australia by the following two species.

ETTMULLERIA AUSTRALIS Womersley, 1936.

Reared from eggs which may have been those of a species of *Echinothrombium* or *Camerothrombium* from Flinders Chase, Kangaroo Island, South Australia.

ETTMULLERIA OBSCURA Womersley, 1936.

Only known from a single individual found in moss from Glen Osmond, South Australia.

Genus NEOTROMBIDIUM Leonardi, 1901.

Represented in Australia by a single species *N. barringunense* Hirst 1928, which is known from New South Wales and South Australia.

Genus CALOTHROMBIUM Berlese, 1918.

To this genus should be referred the following three species.

CALOTHROMBIUM RETENTUS (Banks, 1916).

= *Rhyncholophus retentus* Banks, 1916.
= *Microtrombidium retentus* Womersley, 1934.

The longer dorsal hairs often bifurcated with straight branches. Palpal tarsus with 3 inner spines. Tarsus I four times as long as high and only slightly longer than metatarsus.

This species is only known from the type material from Victoria.

CALOTHROMBIUM KOORDANUM (Hirst, 1928).

= *Microtrombidium koordanum* Hirst 1928, Womersley 1934.

The longer dorsal hairs bi- or trifurcate from base, the branches widened, leaf-like and forming more or less of an enclosure between the leaves. Palpi with clavate tarsus. Tarsi I twice as long as high and equal in length to metatarsus.

Only known from type material from Koorda, Western Australia.

CALOTHROMBIUM TUBBI sp. nov.

(Text fig. I a-d).

Description. Colour reddish. Length 1·923 mm., width 1·29 mm. Eyes 2 + 2 sessile, placed well forward on anterior margin of thorax. Crista 345μ long with posterior sensillary area and two pseudostigmal hairs. Palpi 430μ long, femur almost cylindrical and but little swollen, tibia with large blunt apical claw and smaller accessory claw behind which are two spines, tarsus long and cylindrical reaching tip of claw. Legs short; I 1345μ, tarsus elliptical 283μ by 170μ, metatarsus 173μ; II 865μ; III 770μ; IV 1070μ. Dorsal hairs uniform, bifurcated at base, one branch being fan- or leaf-like and convex, the other branch elongate and curved in towards the fan, both branches with long ciliae.

Locality. A single specimen collected by Mr. H. Tubb at Heathmont, Victoria, July 28th, 1934.

Genus MICROTROMBIDIUM Haller, 1882.

Subgenus DROMEOTHROMBIUM Berlese, 1912.

This is separated from the subgenus *Microtrombidium* s. str. by the great length of the first and fourth legs. The following Australian species should be placed here.

MICROTROMBIDIUM (DROMEOTHROMBIUM) ATTOLUS (Banks, 1916).

= *Rhyncholophus attolus* Banks, 1916.
= *Microtrombidium attolus* Womersley, 1934.

Only known from the type material from Sydney, New South Wales.

Subgenus MICROTROMBIDIUM Haller, 1882, s. str.

Nine Australian species can be referred to this subgenus in the restricted sense. They may be keyed as follows:

1. Eyes wanting. Front tarsus 4 times as long as high. Dorsal hairs long and slender, 26μ, tapering with long hairlets. Palpal tibia with 2 or 3 accessory claw-like spines .. .. *M.* (*M.*) *barringunense* Hirst, 1928.
   Eyes present, two on each side, sessile .. .. 2.
2. Front tarsus elongate, at least $2\frac{1}{2}$ times as long as high with straight sides which are parallel or converge perceptibly apically .. .. 3.
   Front tarsus elliptical with rounded sides, at most only slightly more than twice as long as high .. .. 4.

3. Tarsus I 204μ by 85μ, with sides converging towards apex, metatarsus 136μ. Hairs variable in length up to 65μ, with long outstanding hairlets. Palpal tibia with accessory claw and three strong spines on inner side, without lateral forwardly directed spine .. .. *M.(M.) westraliense* Womersley, 1934.

Front tarsus with parallel sides, 115μ by 135μ, metatarsus 235μ. Dorsal hairs variable in length up to 50μ, with long hairlets which on some of the longer hairs lie closer apically giving a clavate bushy appearance. Palpal tibia with strong accessory claw and laterally a strong forwardly directed spine.
M.(M.) myloriense sp. nov.

4. Front tarsus broadest basally, with a very distinct basal angle. Dorsal hairs 35μ. Palpal tibia with accessory claw .. .. 5.

Front tarsus broadest in the middle, without distinct basal angle . .. 6.

5. Smaller species, 1190μ, tarsus I twice as long as high, 272μ by 136μ, metatarsus 136μ. Dorsal setae 35μ long .. *M.(M.) karriense* Womersley, 1934.

Larger species 2040μ, tarsus I 450μ by 270μ, metatarsus longer than tarsus is high, 300μ. Dorsal setae 35μ long .. *M.(M.) tasmanicum* sp. nov.

6. Dorsal hairs 26μ, tapering, uniform in length, tarsus I 272μ by 136μ, sides strongly and evenly curved, widest in middle, metatarsus 270μ. Palpal tibia with accessory claw, without strong lateral spine. Length 1275μ.
M.(M.) aequalis (Banks, 1916).

Dorsal hairs 40μ or more long, uniform .. .. 7.

7. Dorsal hairs variable in length to 52μ, longer ones bushy at apex and appearing somewhat clavate. Tarsus I, 220μ by 90μ, broadest in middle. Palpal tarsus with accessory claw. Length 930μ .. .. *M.(M.) newmani* Wom., 1934.

Dorsal hairs 40μ long, uniform .. .. 8.

8. Tarsus I 187μ by 102μ, widest in middle, metatarsus 102μ long. Palpal tibia with accessory claw followed by a dorsal series of spines. Length 1000μ by 1100μ .. .. .. *M.(M.) adelaidicum* Wom., 1928.

Tarsus I 272μ by 136μ; widest medially, metatarsus nearly as long as tarsus, 238μ. Palpal tibia with accessory claw and series of spines. Length to 1200μ.
M.(M.) affine Hirst, 1928.

MICROTROMBIDIUM (M.) BARRINGUNENSE Hirst, 1928.

Only known from the type material from Barringun, New South Wales.

MICROTROMBIDIUM (M.) WESTRALIENSE Womersley, 1934.

Found associated with ants in Western Australia.

MICROTROMBIDIUM (M.) KARRIENSIS Womersley, 1934.

This species is widely distributed in South Australia, and I have records of it from Morialta Gorge, September 2nd, 1934; Mount Osmond, June 10th, 1934; Mylor, September 14th, 1935; Mount Compass, June 7th, 1935; National Park, Belair, May 6th, 1935, July 19th, 1936, July 4th, 1937; Adelaide, May 11th, 1936; Mount Lofty, May, 1937.

MICROTROMBIDIUM (M.) AEQUALIS (Banks, 1916).

As stated in my previous paper, the type of this species appears to have become lost, but a second record from Western Australia was given.

MICROTROMBIDIUM (M.) NEWMANI Womersley, 1934.

Only known from the type record of Bedford-dale, Western Australia.

MICROTROMBIDIUM (M.) AFFINE Hirst, 1928.

This species is fairly common in and around the Adelaide district of South Australia.

MICROTROMBIDIUM (M.) ADELAIDICUM Womersley, 1934.

Not uncommon around Adelaide, South Australia.

MICROTROMBIDIUM (M.) MYLORIENSE sp. nov.

(Text fig. 1, e-g).

Description. Length 1·91 mm., width 1·335 mm. Colour reddish. Abdomen ovate, with moderately rounded shoulders, thorax small 550μ wide; eyes 2 + 2, sessile, placed on lateral edge of thorax; crista short, 300μ long, sensillary area broad with two pseudostigmal hairs, anterior arm of crista two-thirds as wide as sensillary area. No nasus. Palpal tibia with strong apical claw and accessory claw, laterally a strong forwardly projecting spine and on outer side of tibia with a number of strong spines; tarsus slightly clavate, reaching tip of claw. Legs shorter than body, I 1600μ, tarsus I with almost parallel sides, 415μ by 135μ, metatarsus 235μ long. Body hairs slightly variable in length, 25–50μ, pointed with long hairlets but in some of the longer ones the apical hairlets tend to cling giving a brush-like appearance.

Locality. Two specimens from under a stone along Cox Creek, Mylor, South Australia, September 26, 1937.

MICROTROMBIDIUM (M.) TASMANICUM sp. nov.

(Text fig. 1, k-n).

Description. Length 2·0 mm. Colour reddish. Abdomen ovate without distinct shoulders, 1·2 mm. wide, thorax 600μ wide without nasus. Eyes 2 + 2, sessile, placed on anterior margins of thorax; crista 430μ long with posterior sensillary area and two pseudostigmal hairs. Palpal tibia with strong apical and accessory claws and on outer side with some strong setae, apparently without lateral forwardly directed spine; tarsus not clavate, reaching tip of claw. Legs shorter than body; tarsus 1 450μ by 270μ, elliptical, broadest before the middle, metatarsus 300μ long. Dorsal body hairs uniform, with strong lateral hairlets, but not forming a distinct apical taper; length of hairs 30–35μ.

Locality. Two specimens collected by Mr. J. W. Evans on Mount Wellington, Tasmania, October, 1935.

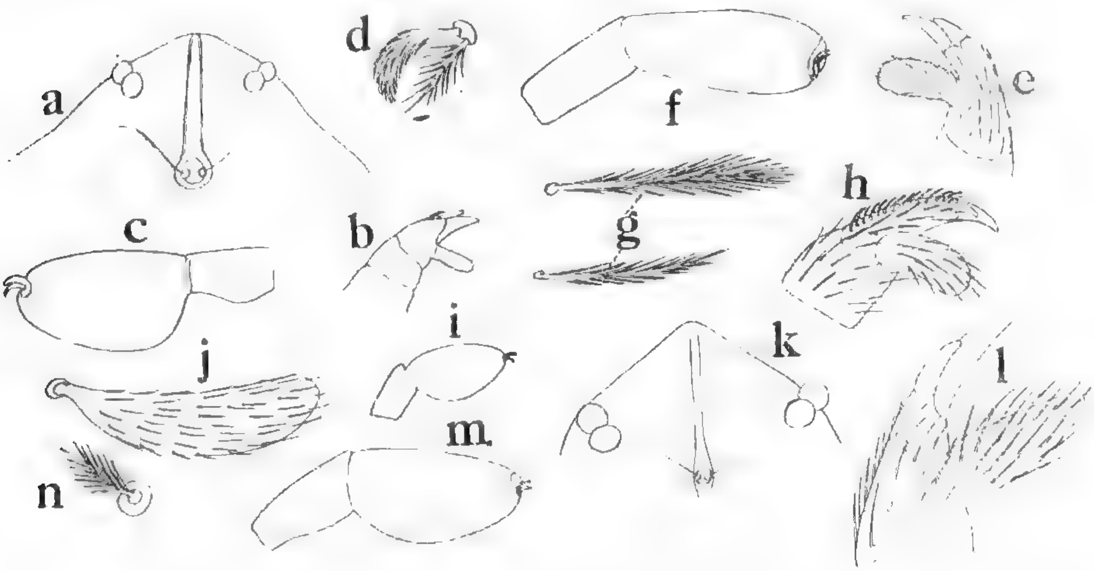


Fig. 1. a–d. *Calothrombium tubbi* sp. nov.; a, anterior end showing eyes and crista; b, tip of palp; c, front tarsus and metatarsus; d, dorsal seta. e–g, *Microtrombidium (M.) myloriense* sp. nov.; e, tip of palp; f, front tarsus and metatarsus; g, dorsal seta. h–j, *Enemothrombium evansi* sp. nov.; h, tip of palp; i, front tarsus and metatarsus; j, dorsal seta. k–n, *Microtrombidium (M.) tasmanicum* sp. nov.; k, anterior end showing eyes and crista; l, tip of palp; m, front tarsus and metatarsus; n, dorsal seta.

Genus ECHINOTHROMBIUM nov.

As in *Microtrombidium* s. str. but all or some of the body hairs long strong and spine-like with relatively few or no short serrations.

The type of the genus is *Ottonia spinosum* Canestrini 1877, and other species are *M. echidninum* Hirst, 1931 (= *M. victoriense* Womersley, 1934); *M. spinatum* Womersley, 1934; *O. hystricinum* Canestrini; *diversipile* Canestrini; *M. southcotti* Womersley, 1934; *M. willungae* Hirst, 1931.

Of these *spinatum, echidninum, southcotti* and *willungae* are Australian, *spinosum* is European while *hystricinum* and *diversipile* are known from New Guinea.

KEY TO THE AUSTRALIAN SPECIES OF ECHINOTHROMBIUM.

1. All the dorsal spines variable in length but uniform and spinelike with short serrations. Tarsus I 270μ by 135μ, elliptical, metatarsus 190μ long. Palpal tarsus clavate, tibia with terminal and accessory claw and two spines. *E. spinatum* (Wom., 1934).

   Dorsal spines interspersed with different setae, short, smaller, with long hairlets .. .. 2.

2. Dorsal spines sparsely and minutely serrated, tapering apically, 200–230μ long; smaller setae 25μ, pointed with comparatively long hairlets. Tarsus I $3\frac{1}{2}$ times as long as high, sides almost parallel. *E. echidninum* (Hirst, 1931). = *victoriense* (Wom., 1934).

   Dorsal spines not much more than 100μ long; shorter setae not so pointed, with relatively shorter hairlets. Front tarsus elliptical. Species smaller .. 3.

3. Front tarsus twice as long as high .. .. *E. southcotti* (Wom., 1934).

   Front tarsus three times as long as high .. *E. willungae* (Hirst, 1931).

ECHIDNINUM SPINATUM (Womersley, 1934).

The type of this species was collected at Glen Osmond, South Australia.

ECHINOTHROMBIUM ECHIDNINUM (Hirst, 1931).

= *M. echidninum* Hirst, 1931.
M. (*E.*) *victoriensis* Womersley, 1934.

This is one of the most abundant Trombid mites in South Australia. It is undoubtedly synonymous with my species *M.* (*E.*) *victoriensis*.

ECHINOTHROMBIUM SOUTHCOTTI (Womersley, 1934).

= *M.* (*E.*) *southcotti* Womersley, 1934.

Described from material from Belair, South Australia.

Genus PLATYTHROMBIDIUM Sig Thor, 1936.

To this genus belongs the single Australian species.

PLATYTHROMBIDIUM PARANUM (Hirst, 1928).

= *Microtrombidium paranum* Hirst 1928, Womersley 1934.

This species is only known from the type material from Gawler, South Australia.

Genus LAMINOTHROMBIUM nov.

Dorsal body hairs leaf-like with strong midrib and marginal ciliations. Front tarsi elliptical, width more than half the length. Palpal tibia with strong apical and accessory claws.

The type and only species of this genus is

LAMINOTHROMBIUM MYRMICUM (Womersley, 1934).

= *M. myrmicum* Womersley, 1934.

Described from material from the nest of ants in South Australia.

Genus ENEMOTHROMBIUM Berlese, 1905, s. str.

As restricted in the generic key this genus will include the two following species:

ENEMOTHROMBIUM CYGNUS Womersley, 1936.

= *M.(E.) cygnus* Womersley, 1936.

Described from a single specimen from Flinders Chase, Kangaroo Island, South Australia.

ENEMOTHROMBIUM EVANSI sp. nov.

(Text fig. 1 h-j).

Description. Length 1·1 mm., width 0·7 mm. Colour in life reddish. Eyes 2 + 2, sessile and placed on anterior margin of thorax. Crista 160μ long, well developed with posterior sensillary area and two pseudostigmal hairs. Palpal tibia with strong apical and subapical accessory claws, dorsally with a series of strong spines running right to base and laterally and inwardly with another shorter series. Legs shorter than body; tarsus I elliptical 176μ by 100μ, widest in middle, metatarsus 95μ long. Dorsal body hairs of approximately uniform length, sessile, cylindrical, with blunt apex and with longitudinal lines of fine serrations.

Locality. The type of this species was found by Mr. J. W. Evans in a rotten log on Mount Wellington, Tasmania, in May, 1935. A second specimen was from moss from Brisbane, Queensland, in October, 1934, and a third from Fern Tree Gully, Victoria, in January, 1937.

Genus CAMEROTHROMBIUM Sig Thor, 1936.

Sig Thor places in this genus the following Australian species: *E. simile* Hirst, *E. collinum* Hirst and *E. hirsti* Womersley. To them should be added *E. wyandrae* Hirst. These four species may be separated as follows:

1. Smaller dorsal hairs cup-shaped with minute denticles . .. .. 2.
   Smaller dorsal hairs otherwise .. .. 3.

2. Larger dorsal hairs with stem suddenly expanding to form cup. Tarsus I three and a half times as long as high .. *C. simile* (Hirst, 1928).

   Larger dorsal hairs with stem gradually expanding to form cup. Tarsus I less than 3 times as long as high .. .. *C. hirsti* (Wom., 1934).

3. Smaller dorsal hairs very irregular, with small lateral fungiform lobes. Tarsus I more than 4 times as long as high .. .. *C. wyandrae* (Hirst, 1928).

   Smaller dorsal hairs more regular, rod-like. Tarsus I more than 3 times as long as high .. .. *C. collinum* (Hirst, 1928).

CAMEROTHROMBIUM SIMILE (Hirst, 1928).

= *M.(E.) simile* Hirst, 1928.

= *M.(E.) simile* Womersley, 1934.

This species is fairly widely distributed in South Australia.

CAMEROTHROMBIUM HIRSTI (Womersley, 1934).

= *M.(E.) hirsti* Womersley, 1934.

As yet known from the type material only.

CAMEROTHROMBIUM WYANDRAE (Hirst, 1928).

= *M. wyandrae* Hirst, 1928.

Only known from the type material.

CAMEROTHROMBIUM COLLINUM (Hirst, 1928).

= *M. collinum* Hirst, 1928.

There are no further records beyond that of the type material.

Genus EUTRICHOTHROMBIUM nov.

Dorsal body hairs globular, on peduncles, without septa and interspersed with fine longer needle-like setae; globular hairs finely ciliated. Palpal tibia without true accessory claw but with a few dorsal setae and with a strong inner lateral forwardly directed spine. Tarsi elliptical.

This new genus is erected for the Javanese species *E. eutrichum* Berlese, 1903.

Subfamily VIII, TROMBIDIINAE Michael, 1883 (part), Sig Thor, 1936.

Body large or very large, triangular or cordate, thickly covered with elongate or clavate or ciliated or feathered hairs, generally reddish. No nasus. Eyes paired on long peduncles. Crista with sensillary area and two pseudostigmal hairs; sometimes the crista is tripartite, usually entire, always narrow. Palpi large; tarsus long and clavate, tibia simple with apical claw but no accessory claw or comb. Legs short and thick, tarsi without pulvilli.

Included here are the genera *Trombidium* Fab. 1775 (= *Sericothrombium* Berlese, 1910); *Dinothrombium* Oudemans, 1910 (= *Trombidium* Berlese, 1905); *Xenothrombium* Oudemans, 1927; *Caenothrombium* Oudemans, 1927; and *Austrothrombium* Womersley, 1934. They may be keyed thus:

1. Crista divided into three parts, with broad sensillary area, anterior arm ending in a broad rectangular plate in which the front margin is straight or only slightly concave. Gen. *Dinothrombium* Oudemans, 1910 (not Australian).
   Crista entire .. .. 2.
2. Crista with the sensillary area medial, anterior arm simple and not ending in a plate .. .. Gen. *Xenothrombium* Oudemans, 1927.
   Crista with the sensillary area anterior of middle .. .. .. 3.
3. Body hairs claviform or brush-like; apex of abdomen incised.
   Gen. *Trombidium* Fab., 1775.
   (Larvae with two dorsal plates, front plate with 3 pairs of setae and 2 pseudostigmal hairs. Claw of maxillary palp bifurcate. Median dorsal plate transverse; front plate folding below to venter. Mouth-parts not visible from above, lower lip ring-like. Leg III with deformed inner claw.)
   Not so; crista anteriorly with a broad transverse plate .. .. .. 4.
4. Anterior plate of crista very deeply cleft, so as to appear fork-like.
   Gen. *Austrothrombium* Womersley, 1934.
   Anterior plate of crista with straight or only slightly concave front margin.
   Gen. *Caenothrombium* Oudemans, 1927.

Genus XENOTHROMBIUM Oudemans, 1927.

Only represented in Australia by the following recently discovered species.

XENOTHROMBIUM HIRSUTUM sp. nov.

(Text fig. 2 e-j.)

Description. Length to 3·0 mm., width 1·5 mm., with a distinct constriction behind the shoulders. Colour bright red. Crista well developed with the sensillary area anterior of the middle, anterior arm simple and not ending in a transverse plate. Eyes 2 + 2, pedunculate. Palpi as figured, tarsus long, clavate, and reaching tip of claw. Legs shorter than body, strong; tarsus I 654μ by 211μ, more or less with parallel sides, metatarsus 480μ. Body thickly clothed with very long ciliated hairs, mostly up to 300μ long and red, but some up to 7–800μ and white (cf. fig. 2j).

Locality. This species has so far been found only at the National Park, Belair, South Australia, 1936 and since. It is moderately common under stones and fallen branches.

Genus CAENOTHROMBIUM Oudemans, 1927.

This seems to be the dominant genus in South Australia, no fewer than ten species having been described to date.

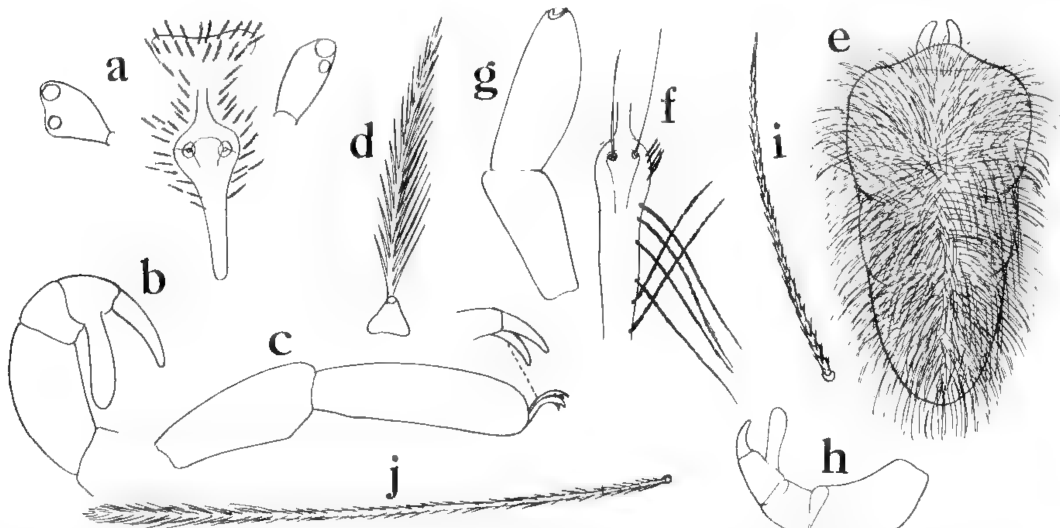


Fig. 2. a–d, *Caenothrombium furcatum* sp. nov.; a, crista and eyes; b, palp; c, front tarsus and metatarsus with claws enlarged; d, dorsal seta. e–j, *Xenothrombium hirsutum* sp. nov.; e, dorsal view; f, crista; g, front tarsus and metatarsus; h, palp; i, shorter dorsal seta; j, longer dorsal seta.

KEY TO THE SPECIES.

1. Anterior two pairs of legs with bifurcate, occasionally trifurcate, claws; posterior two pairs with simple claws. Tarsus I nearly 4 times as long as high, with parallel sides; metatarsus $\frac{3}{4}$ length of tarsus. Dorsal hairs 70μ long, pointed, with long hairlets . . . . *C. furcatum*, sp. nov.

   All tarsal claws simple . . . . 2.

2. Dorsal body hairs of two sizes. Front tarsus 3 times as long as high, 425μ long. *C. montivagum* (Hirst, 1928). = *rainbowi* (Hirst, 1929).

   Dorsal body hairs more uniform . . . . 3.

3. Front tarsus very elongate, about 7 times as long as high. Length of animal 2·4 mm. . . . . *C. augustae* (Hirst, 1928).

   Front tarsus much shorter, not exceeding $4\frac{1}{2}$ times as long as high . . 4.

4. Front and hind legs much longer than body. Front tarsus $4\frac{1}{2}$ times as long as high, 780μ by 175μ. A large well defined white patch on each shoulder and another at apex of abdomen . . . . *C. album* Womersley, 1934.

   Front and hind legs scarcely exceeding length of body . . . . . . 5.

5. Species not exceeding 4·0 mm. in length .. .. 6.
   Species more than 4·0 mm. long .. .. 7.
6. Front tarsus 4–4½ times as long as high. Dorsal body hairs 60–90μ long, slender, tapering with long hairlets .. *C. torridum* (Hirst, 1928).
   = *taylori* (Hirst, 1928).

   Front tarsus almost 4 times as long as high. Dorsal body hairs stout, blunt and strongly ciliated, 60μ long .. .. *C. miniatum* Womersley, 1934.

   Front tarsus 2½ times as long as high. Body hairs fairly stout and reaching 60μ in length .. .. *C. nynganense* (Hirst, 1928).
7. Posterior dorsal hairs short and stout, parallel sided, with short hairlets, often slightly swollen distally, 50–60μ long and slightly curved. Front tarsus 4½ times as long as high .. .. .. *C. sericatum* (Rainbow, 1906).
   = *splendidum* (Hirst, 1928).
   = *ventricosum* (Hirst, 1928).

   Posterior body hairs longer and straighter, 75μ long, more tapering and never swollen distally. Front tarsus 3 times as long as high.
   C. crassum (Hirst, 1928).

   Posterior body hairs longer still, 150μ, slightly curved, more tapering and delicate .. .. *C. nobile* (Hirst, 1928).

CAENOTHROMBIUM FURCATUM sp. nov.

(Text fig. 2a-d.)

Description. Length to 1·73 mm., width 1·0 mm. Colour light red with a tendency to white patches or bands behind the shoulders. Crista well developed with a broad sensillary area antero-medially and with two pseudostigmal hairs; anterior plate of crista with slightly concave front margin. Eyes 2 + 2, on long peduncles, posterior eye the smaller. Front tarsus 397μ by 110μ, metatarsus 318μ. Tarsi of legs I and II with bifurcated claws occasionally one or other claw trifurcate; claws of legs III and IV simple. Leg I 1·53 mm., II 1·21 mm., III 1·10 mm., IV 1·69 mm. Palpal tibia with long strong apical claw; tarsus long and clavate. Dorsal body hairs arising from short conical tubercles, 70μ long, tapering to a point and with long strong hairlets.

Locality. Three specimens from a small paddock at Wood's Point, South Australia, October 24th, 1935 (H.W.).

CAENOTHROMBIUM MONTIVAGUM (Hirst, 1928).

= *Microtrombidium montivagum* Hirst, 1928.
Dinothrombium montivagum Hirst, 1929.
Dinothrombium rainbowi Hirst, 1929.
Caenothrombium montivagum Womersley, 1934.

There are no fresh records for this species.

CAENOTHROMBIUM AUGUSTAE (Hirst, 1928).

= *Dinothrombium augustae* Hirst, 1928.
Caenothrombium augustae Womersley, 1934.

This species is fairly widely distributed in the southern parts of South Australia.

CAENOTHROMBIUM ALBUM Womersley, 1934.

Also a fairly widely distributed species.

CAENOTHROMBIUM TORRIDUM (Hirst, 1929).

= *Dinothrombium torridum* Hirst, 1929.
Dinothrombium taylori Hirst 1929.
Caenothrombium torridum Womersley, 1934.

This appears to be rather an uncommon species in the southern part of South Australia.

CAENOTHROMBIUM MINIATUM Womersley, 1934.

Not uncommon around the Adelaide district.

CAENOTHROMBIUM NYNGANENSE (Hirst, 1928).

= *Dinothrombium nynganense* Hirst, 1928.
Caenothrombium nynganense Womersley, 1934.

Common and widely distributed in South Australia; it also occurs in New South Wales.

CAENOTHROMBIUM CRASSUM (Hirst, 1928).

= *Dinothrombium crassum* Hirst, 1928.
Caenothrombium crassum Womersley, 1934.

Only known from previously published records.

CAENOTHROMBIUM SERICATUM (Rainbow, 1906).

= *Trombidium sericatum* Rainbow, 1906.
Dinothrombium splendidum Hirst, 1928.
Dinothrombium ventricosum Hirst, 1928.
Caenothrombium sericatum Womersley, 1934.

I have no further records of this species to add to those already published.

CAENOTHROMBIUM NOBILE (Hirst, 1928).

= *Dinothrombium nobile* Hirst, 1928.
Caenothrombium nobile Womersley, 1934.

No additional records.

Genus AUSTROTHROMBIUM Womersley, 1934.

Of this genus the three following species only are known from Australia:

AUSTROTHROMBIUM AUSTRALIENSE (Hirst, 1929).

= *Allothrombium* (*Mesothrombium*) *australiense* Hirst, 1929.
Austrothrombium australiense Womersley, 1934.

There are no further specimens to be recorded.

AUSTROTHROMBIUM INSIGNE (Hirst, 1928).

= *Allothrombium* (*Mesothrombium*) *insigne* Hirst, 1928.
Austrothrombium insigne Womersley, 1934.

I know of no further specimens of this species.

AUSTROTHROMBIUM KONDINIUM (Hirst, 1928).

= *Allothrombium* (*Mesothrombium*) *antipodianum* v. *kondinium* Hirst, 1928.
Allothrombium (*Mesothrombium*) *kondinium* Hirst, 1929.
Austrothrombium kondinium Womersley, 1934.

Only known from the previously published records.

Genus TROMBIDIUM Fab., 1775.

No adult species of this genus has yet been found in Australia, but the following larval form has recently been discovered by the writer.

TROMBIDIUM CLARKI sp. nov.

(Text fig. 3a-f.)

Description. Length 2·3 mm., width 1·5 mm. Colour red. Mouth parts not visible from above, lower lip forming a chitinous ring. Anterior dorsal plate only slighlty showing on the dorsal surface, mostly ventral, 175μ wide posteriorly and 112μ anteriorly, finely and longitudinally striate, with three pairs of hairs and one pair of long fine pseudostigmal hairs. Posterior plate wide and short, 142μ by 50μ, longitudinally striated with two hairs, 4 times its own length from the anterior plate. Eyes small, 2 + 2. Dorsal body hairs short, fine with few ciliations and sparse, in 5 rows of 2, 4, 4, 4, 2. Legs: anterior pairs of coxae adjacent, tarsi with three claws, front two pairs with the middle claw long and slender, lateral claws stouter, shorter and subapically trifurcate; inner claw on leg III modified, stump-like and directed backwards, outer claw spine-like with long hairlets, middle one short and sickle shaped. Venter with three pairs of hairs behind third legs.

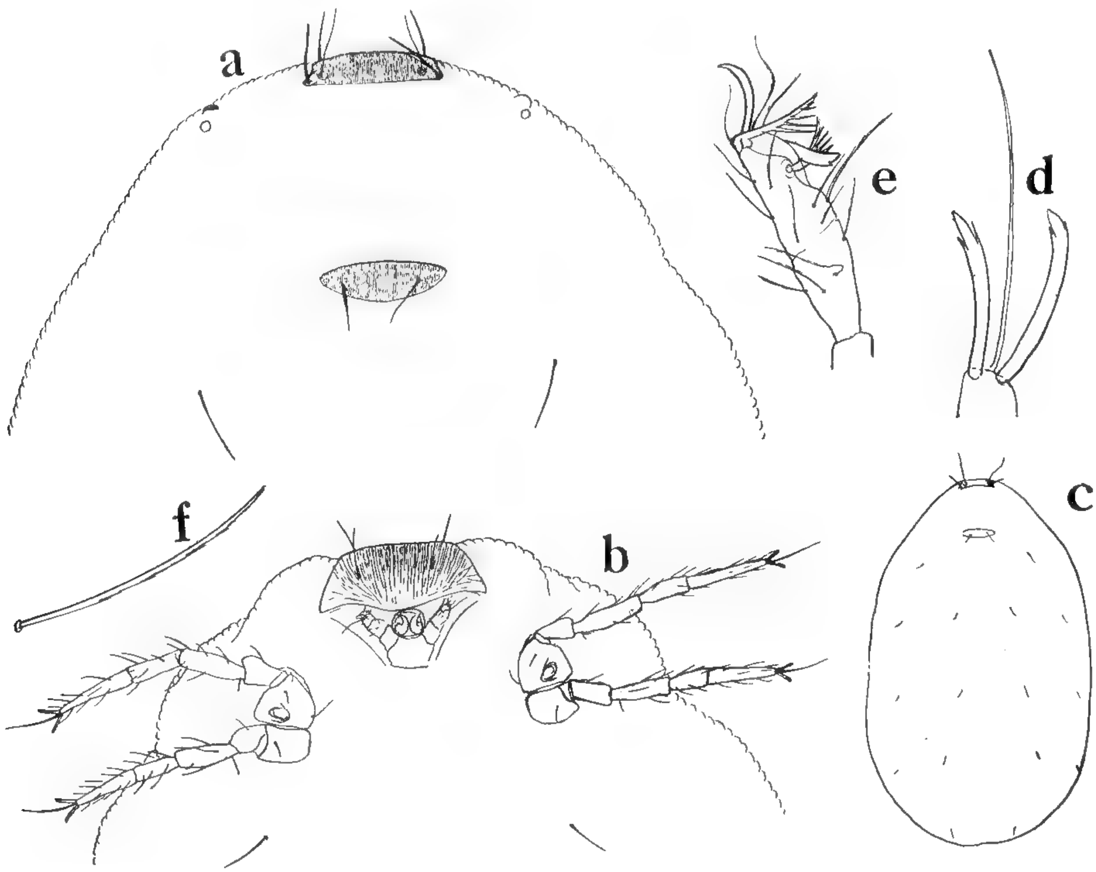


Fig. 3. a–f, *Trombidium clarki* sp. nov.; a, anterior half from above; b, same from below; c, entire dorsal view; d, front claws; e, posterior claws; f, dorsal seta.

Locality. Several specimens taken from an Anthomyid fly at Fern Tree Gully, Victoria, in January, 1937. It is named in honour of Mr. J. Clark, Entomologist to the National Museum, Melbourne.

Subfamily IX, ALLOTHROMBIINAE Sig Thor, 1936.

Body larger, with strong shoulders, rounded, with bristle-like feathered, seldom furcate hairs. Eyes 2 + 2 on long peduncles. Crista distinctly tripartite, with large broad, cross- or heart-shaped sensillary area which is placed on or in front of the middle; sensillary area with two pseudostigmal hairs. Palpi large, with large apical claw but without accessory claw or comb of spines. Legs short or moderately long, tarsi with characteristic pulvilli or on the outer side of each claw with a brush-like bristle (in *Coreothrothrombium*).

The two genera *Allothrombium* Berlese 1903 and *Coreothrothrombium* Oudemans 1928, are placed in this subfamily. Only the first of these is known from Australia.

KEY TO THE AUSTRALIAN SPECIES OF ALLOTHROMBIUM.

1. Up to 1·2 mm. in length, sparse haired; form rather elongate and much constricted behind shoulders. Body hairs uniform and with few long secondary hairlets .. .. .. *A. delicatulum* Womersley, 1934.
   Large species .. .. 2.
2. Dorsum with a distinct pattern of red and white. Some of the body hairs very much elongated .. .. .. *A. guttatum* Hirst, 1928.
   = *ornatum* Hirst, 1928.
   Colour entirely red .. .. 3.
3. Body hairs uniform, short, plumose. Front tarsus twice as long as high.
   A. wyandrae Hirst, 1928.
   Body hairs of two distinct types .. .. 4.
4. Longer body hairs more clavate apically, axial thread thicker; shorter hairs more tapering apically .. .. .. *A. antipodianum* Hirst, 1926.
   = v. *olorinum* Hirst, 1926.
   parvulum Hirst, 1929.
   ? *wasseli* Hirst, 1931.
   Longer body hairs less clavate apically, the hairlets longer near the base, stalk apparently shorter; short hairs not tapering apically.
   A. terrae-reginae Hirst, 1929.

ALLOTHROMBIUM DELICATULUM Womersley, 1934.

This small species is moderately abundant under loose stones, fallen branches and even on tree trunks in the National Park, Belair, South Australia.

ALLOTHROMBIUM GUTTATUM Hirst, 1928.

= *Allothrombium guttatum* Hirst, 1928.
Allothrombium ornatum Hirst, 1928.
Allothrombium guttatum Womersley, 1934.

I have no further records of this species since my earlier papers.

ALLOTHROMBIUM ANTIPODIANUM Hirst, 1926.

= *Allothrombium antipodianum* Hirst, 1926.
Allothrombium antipodianum v. *olorinum* Hirst, 1926.
Allothrombium parvulum Hirst, 1929.
Allothrombium ? wasseli Hirst, 1931.
Allothrombium antipodianum Womersley, 1934.

I have no further records of this species. The species *A. wasseli* described posthumously by Hirst appears to be identical with the above form as far as one can judge by the description, the accompanying drawings of which were lost after Hirst's death.

ALLOTHROMBIUM TERRAE-REGINAE Hirst, 1929.

There is nothing further to add to the previously published data on this species.

ALLOTHROMBIUM WYANDRAE Hirst, 1928.

Only known from the type material from Mount Kosciusko, N.S.W.

Subfamily X, STYGOTHROMBIINAE Sig Thor, 1936.

Body small, elongate, worm-like, swollen dorsally, with only small rudimentary hairs. Cuticle thin, striated, with low papillae. Crista similarly rudimentary, narrow, anteriorly with weak areola which, near the two sensory hairs, has 4 or 5 fine hairs. Rostrum outstanding, behind flask-like, in front spoon-like, with two bristles. Mandibles long and narrow with stylet-like claw. Palpal segments weakly differentiated, fourth segment can be distinguished with the reduced fifth attached; segment II has 2 thorns and 6 long hairs, III 3 thorns and some hairs, IV with a few hairs and a long thin end claw (no accessory claw). Legs with 3 claws, the lateral combed. Species living in water.

This subfamily is entirely unknown in Australia. It includes only the genus *Stygothrombium* Veitz, 1932, and its subgenus *Cerberothrombium* Veitz, 1934.

EGGS AND EGG CASES OF SOME SOUTHERN AUSTRALIAN MOLLUSCA

BY BERNARD C. COTTON, CONCHOLOGIST, SOUTH AUSTRALIAN MUSEUM

Summary

Melo Miltonis Gray.

The South Australian Museum is indebted to the Director of the Western Australian Museum (Mr. W. L. Glauert) for the opportunity of examining the egg capsule of the Southern Australian Baler Shell, Melo miltonis Gray, and a series of seven juvenile shells from Cottesloe, Western Australia.

The egg capsule is cylindrical, 165 mm. long, 75 mm. in diameter and contains 47 protoconchs. The protoconchs average 26 mm. in length and 16.5 mm. in greatest width; they consist of four whorls, axially crinkled and finely, obsoletely, spirally ribbed subsuturally. The last 3.5 mm. of the outer lip has the typical triangular white blotches on the light brown ground, while the rest of the protoconch is uniformly cream coloured. In an adult specimen, 10 mm. of the protoconch rises above the shell.

EGGS AND EGG CASES OF SOME SOUTHERN AUSTRALIAN MOLLUSCA

By BERNARD C. COTTON, Conchologist, South Australian Museum.

Plate iv.

Melo miltonis Gray.

The South Australian Museum is indebted to the Director of the Western Australian Museum (Mr. W. L. Glauert) for the opportunity of examining the egg capsule of the Southern Australian Baler Shell, *Melo miltonis* Gray, and a series of seven juvenile shells from Cottesloe, Western Australia.

The egg capsule is cylindrical, 165 mm. long, 75 mm. in diameter and contains 47 protoconchs. The protoconchs average 26 mm. in length and 16·5 mm. in greatest width; they consist of four whorls, axially crinkled and finely, obsoletely, spirally ribbed subsuturally. The last 3·5 mm. of the outer lip has the typical triangular white blotches on the light brown ground, while the rest of the protoconch is uniformly cream coloured. In an adult specimen, 10 mm. of the protoconch rises above the shell.

The protoconch of a common Queensland species, *Melo flammeum* Bolten, measures 19 mm. in length and 13 mm. in greatest width; an adult is half as big again as the fully grown *Melo miltonis*. There does not appear to be the subsutural crinkling in the protoconch of *Melo flammeum*.

Cominella adelaidensis Grosse.

The type locality of the species is "Port Adelaide". This species or variety is one of the *Cominella lineolata* group, very nearly allied, if not synonymous with *Cominella acutinodosa Reeve* (type locality, South Australia). At the Outer Harbour there is an isolated group of stones in the middle of a vast sand and mud flat where *Cominella adelaidensis* is found in plenty, being the dominant molluscan species.

The egg capsules are laid from the beginning to the end of September, and all appear to be hatched by the end of October. The egg capsules are acuminate blunt at the point, slightly expanded at the base and attached individually in irregular groups or lines folowing the depressions or cracks on the under surface of the stones. Height 8 mm., width 4 mm.

UBER CONICUM Lamarck.

The collar-like egg nidi of this species are found in great numbers in spring time after storms, and are flexible when wet and extremely brittle after drying. Levens Beach, Yorke Peninsula and Holdfast Bay are two places where these egg nidi are particularly common. Specimens usually range from 100–150 mm. in diameter; smaller specimens are sometimes found, probably incomplete, only 55 mm. in diameter or less.

HAPLOCHLOAENA MACULOSA Hoyle.

This small "Octopus" is frequently found in *Pinna dolabrata* Lamarck, and under rocky ledges at low tide in shallow water.

The eggs are attached individually by a delicate thin stalk to any convenient sheltered surface. Those figured are attached to the inner surface of a dead valve of the Port Lincoln Oyster (*Ostrea sinuata* Lamarck) collected at Dutton Bay by the Chief Inspector of Fisheries, Mr. F. W. Moorhouse, in April, 1937.

The eggs are club-shaped, smooth, shining, and are attached in clusters by their respective thin stalks. The cluster on the oyster contained about fifty eggs. Measurements are as follows: Length of flask, 17 mm.; width, 6 mm.; stalk length, 5 mm.; width, 0·5 mm.

The female of this species broods over the eggs apparently syringing them from the funnel.

During a collecting trip with Messrs. H. M. Hale, Leo Stach and K. Sheard, a small adult female was taken at the Port Willunga Reef in shallow water. Evidently disturbed in the act of brooding the specimen swam away dragging some of the ova with her, and these were retained after capture. Some of the eggs on the point of hatching were collected and placed in a bowl of sea water, others not secured hatched and the young were seen swimming in the rock pool.

Sixty-three young hatched out in the bowl; all consistently swam to the shaded side, as did also the parent who adopted the inverted brooding attitude, actually covering some of the young while clinging to the surface of the dish.

The funnel is proportionately larger in the juvenile, but the colour pattern is similar in scheme to that of the adult, consisting of bluish bands on a cream ground, the bands being regular and transverse on the arms, oblique and irregular on the body. The average measurements of the newly-hatched young are as follows: Total length, 11 mm.; length of body, 5 mm.; width of body 3·8 mm.; length of funnel, 2 mm.; length of arms, 6 mm.

It is surprising to learn that in Robson's Monograph of Recent Pelecypoda the eggs sizes of only nine Octopi are listed, probably the only available records.

Ova are best preserved in weak formalin as alcohol, even if diluted, shrinks them hopelessly.

AMPLISEPIA APAMA Gray.

Thirty eggs of this species were taken on the beach of St. Vincent Gulf, between Glenelg and Henley Beach, in October, 1932, after a storm. A few specimens placed in sea-water developed far enough to confirm the identification of the species. The specimen figured measures 60 mm. in total length, the flask being 32 mm. long and 21 mm. wide. Further specimens were taken at Brighton in November, 1933, so that October and November can be definitely cited as the breeding months.

SEPIOTEUTHIS AUSTRALIS Quoy and Gainard.

Bunches of egg nidi of this species were cast ashore in large numbers after the above-mentioned storm of October, 1932. They are particularly common on the beach during early spring.

EXPLANATION OF PLATE IV.

Fig. 1. *Cominella acutinodosa* Crosse, single egg capsule, lateral view ($\times$ 6).

Fig. 2. *Cominella acutinodosa* Crosse, single egg capsule, top view ($\times$ 6).

Fig. 3. *Cominella acutinodosa* Crosse, group of egg capsules ($\times$ 1·25).

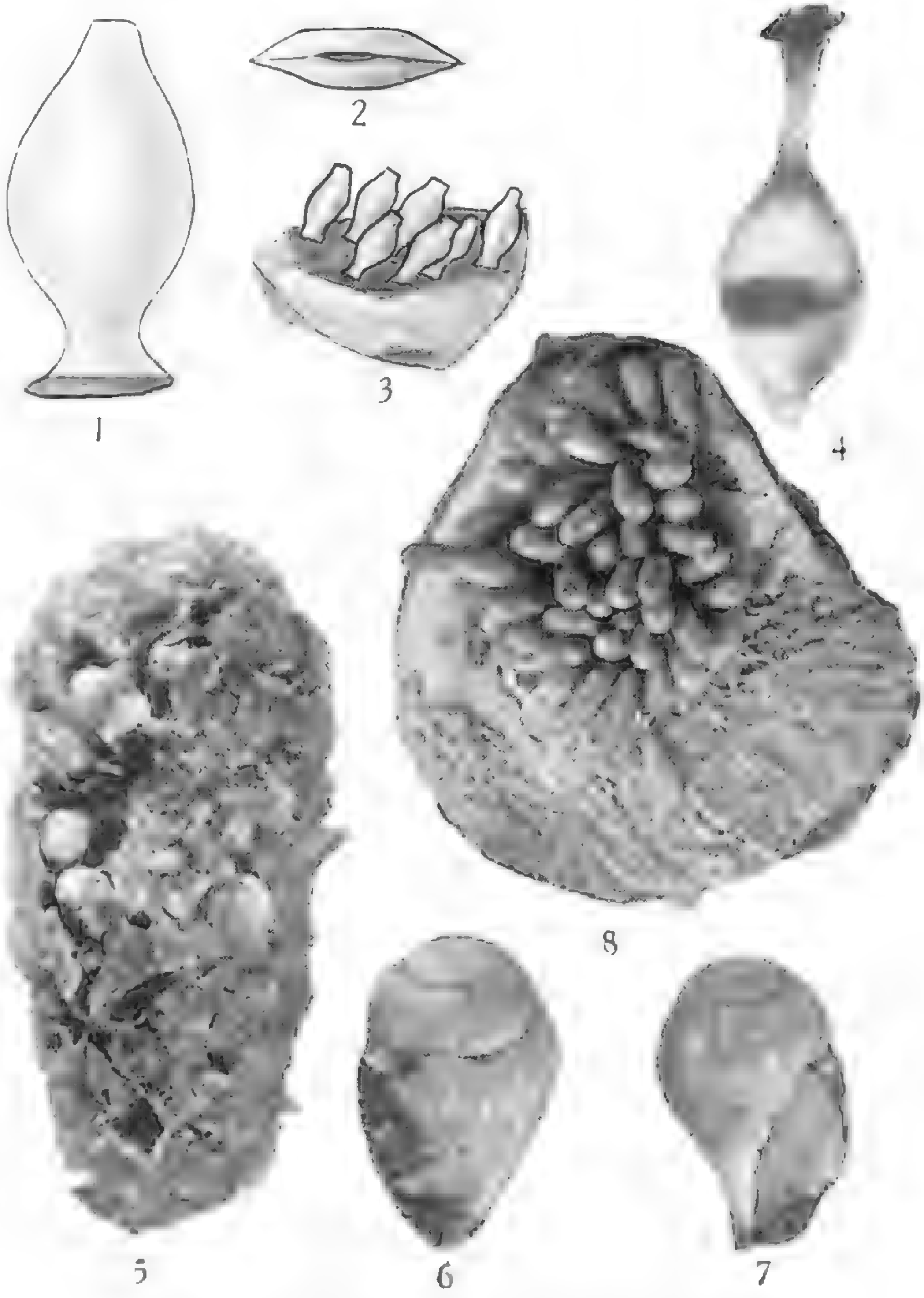
Fig. 4. *Amplisepia apama* Gray, single egg (nat. size).

Fig. 5. *Melo miltonis* Gray, egg capsule ($\times$ 0·6).

Fig. 6. *Melo miltonis* Gray, protoconch showing commencement of colourations ($\times$ 1·6).

Fig. 7. *Melo miltonis* Gray, protoconch showing aperture ($\times$ 1·6).

Fig. 8. *Haplochlaena maculosa* Hoyle, eggs attached to *Ostrea sinuata* Lamarck ($\times$ 0·6).



MOLLUSCAN EGGS AND EGG CAPSULES.

A NOTE ON THE OCCURRENCE OF RHABDOPLEURA ANNULATA IN SOUTH AUSTRALIAN WATERS

BY PROFESSOR T. HARVEY JOHNSTON, UNIVERSITY OF ADELAIDE

Summary

The only published reference to the presence of Rhabdopleura in Australian waters is that of Harmer (1904, p. 23) who found in South Australian material a fragment which he did not determine specifically. Norman (1921, p.98) described R. annulata from localities close to the Three Kings, a group of islands lying to the north of New Zealand. His material consisted of coenoecia found on stones and on a shell dredged from depth of 183 and 549 metres.

A NOTE ON THE OCCURRENCE OF *RHABDOPLEURA ANNULATA* IN SOUTH AUSTRALIAN WATERS

By Professor T. HARVEY JOHNSTON, University of Adelaide.

The only published reference to the presence of *Rhabdopleura* in Australian waters is that of Harmer (1904, p. 23) who found in South Australian material a fragment which he did not determine specifically. Norman (1921, p. 98) described *R. annulata* from localities close to the Three Kings, a group of islands lying to the north of New Zealand. His material consisted of coenoecia found on stones and on a shell dredged from depth of 183 and 549 metres.

In an account which has for some years been awaiting publication in the Reports of the Australasian Antarctic Expedition of 1911–1914, the present author has recorded the finding of fragments amongst the debris from a dredging in 65 fathoms off Maria Island on the east coast of Tasmania. Mention is also made in that report of the occurrence of the same species, identified as *R. annulata*, at two collecting stations (Nos. 113 and 115) of the British, Australian and New Zealand Antarctic Research Expedition of 1929–1931, both localities being off the eastern coast of Tasmania, viz.: (1) 42° 40′ S, 148° 27·5′ E, in 122 metres, as well as in 155 to 178 metres; and (2) 41° 03′ S, 148° 42′ E, in 128 metres. The latter locality is close to the entrance to Banks Strait.

In the report just mentioned, it was suggested that Harmer's material which was not definitely localized, might have been detected in dredgings taken from South Australian waters by the late Sir Joseph Verco who, we know, forwarded his collection of Polyzoa to that investigator for identification. The continental shelf in the vicinity of Kangaroo Island was suggested as a possible locality because of the depth. A mass of Polyzoa taken by Verco from various localities off our southern coast is at present in the collection of the South Australian Museum, and this was examined macroscopically in 1936 at my request by B. C. Cotton and by L. Stach, the latter being especially engaged in a study of the group. My own examination was only a cursory one. As a result of these searches, no trace of the characteristic peristomial tubes or pectocaulus was recognized.

In May of the present year, scrapings of the material adherent to the under surface of rocks at, or just below, low spring tide mark at Port Willunga Reef were examined for their content of lower invertebrate life and, quite unexpectedly, a fairly long, well preserved coenoecium of *R. annulata* was found. The specimen was probably not taken *in situ* and no doubt was washed up from deeper water in the vicinity as a result of storm action. The locality is open to the influence of south-westerly gales, so that it is possible that the tube may have been carried from the sea floor of Investigator Strait, whose depth varies from 60 to 70 fathoms between the end of Eyre's Peninsula and the western part of Kangaroo Island, but diminishes to 12 to 17 fathoms between the island and Yorke's Peninsula. The adjacent part of St. Vincent's Gulf varies from about 20 to 12 fathoms, shallowing rapidly close to the coast in the vicinity of Port Willunga.

As Harmer's article was published in 1904, his specimen must have been taken either in that year, or more probably earlier. Verco had been engaged in dredging prior to that date, but he stated (1935 Edit. Cotton) that, prior to January 1905, he had never dredged in depths greater than 35 fathoms.

The Port Willunga specimen, on which numerous minute filamentous algae were growing, is 2·53 mm. long and 0·265 mm. broad, the internal diameter of the tube being 0·19–0·192 mm. The maximum thickness of the wall at the projecting portion of each ring is 0·02–0·025 mm. The rings resemble closely those figured by Norman and are 0·042–0·045 mm. apart. The length of the fragment is much greater than in those illustrated by Norman who noted, however, that such was variable, and reminded one of those of *R. normani* Allman. The projecting rim and other features agree completely with Norman's figures. It is to be remarked that *R. normani* is a very widely distributed species, occurring off Greenland, the Shetland Islands, the coast of Norway, and in the South Atlantic off Tristan da Cunha where it was taken by the "Challenger". The known depths for that species range from 5 metres (according to Schepotieff) to 500 metres. Broch (1927, p. 468) recorded briefly the finding of fragments of *R. normani* by the "Gauss" in the Antarctic at 66° 02′ S, 89° 38′ E, in 350 metres, but since he considered that there was only one valid species (*R. normani*), and as he did not figure his specimen, its relation to *R. annulata* is not known. A specimen taken by the "Siboga" in the East Indies, south-westerly from Celebes, in 75 to 94 metres and described by Harmer (1905, 127, Text fig. 2) as *Rhabdopleura* sp., was assigned by Norman (1921, 101) to *R. annulata*.

The present note extends greatly the known range of the species, which now includes the seas off the northern part of New Zealand, the east coast of Tasmania from Maria Island to Banks Strait, and the region in the vicinity of the entrance to St. Vincent's Gulf in South Australia.

REFERENCES.

Broch, H. (1927) : Die Pterobranchier, Rhabdopleura. *Deutsche Südpolar Exped.*, 19 (Zool. 11), 468.

Harmer, S. F. (1904) : Hemichordata. *Cambr. Nat. Hist.*, 7, 21–32.

Harmer, S. F. (1905) : The Pterobranchia of the "Siboga" Expedition. *Siboga-Expeditie.* Monogr. 26 bis, 132, pp.

Johnston, T. H. (1911–1914) : Rhabdopleura. *Rep. Austr. Antarct. Exp.*, Ser. C, 3 (4), in press.

Norman, J. R. (1921) : Brit. Antarct. ("Terra Nova") Exp., *Nat. Hist. Rep. Zool.*, 4 (4), 95–102.

Verco, Sir J. (1935) : Combing the Southern Seas. (Edit. by B. C. Cotton), Adelaide.

PUBLIC LIBRARY, MUSEUM, AND ART GALLERY
OF SOUTH AUSTRALIA

RECORDS

OF THE

SOUTH AUSTRALIAN MUSEUM

Vol. VI, No. 2

Published by the Board of Governors, and edited by the Museum Director
(Herbert M. Hale)

Adelaide, December 24th, 1938.
PRINTED AT THE HASSELL PRESS, 104 CURRIE STREET

OBITUARY OF JOHN SUTTON

By Herbert M. Hale, Director and
H. Condon, Assistant in Zoology, South Australian Museum

Summary

Mr. John Sutton, who succeeded the late Dr. A. M. Morgan as Honorary Ornithologist at the South Australian Museum, died on November 22^{nd}, 1938, after a short illness. Mr. Sutton was a Victorian; he was born at Castlemaine on March 25^{th}, 1866, and his early years were spent at Bendigo. He was a banker by profession, at one time being acting Manager of the National Bank in Adelaide, and later Inspector at Melbourne. On his retirement from the bank in 1917, Mr. Sutton returned to this State and acted as lecturer in Banking at the University of Adelaide. He was a member of the Institute of Bankers.

OBITUARY OF JOHN SUTTON

By HERBERT M. HALE, Director, and

H. CONDON, Assistant in Zoology, South Australian Museum.

Mr. John Sutton, who succeeded the late Dr. A. M. Morgan as Honorary Ornithologist at the South Australian Museum, died on November 22nd, 1938, after a short illness. Mr. Sutton was a Victorian; he was born at Castlemaine on March 25th, 1866, and his early years were spent at Bendigo. He was a banker by profession, at one time being acting Manager of the National Bank in Adelaide, and later Inspector at Melbourne. On his retirement from the bank in 1917, Mr. Sutton returned to this State and acted as lecturer in Banking at the University of Adelaide. He was a member of the Institute of Bankers.

At the age of 53, Mr. Sutton began seriously to study our native birds. With characteristic thoroughness and enthusiasm, he set about observing and recording the habits, calls, and distribution of the South Australian avifauna, and whenever opportunity arose, extended his researches into other parts of the Commonwealth. Mr. Sutton was not a private collector of birds, but many specimens found by him are now in the Museum collection. Several trips were made to Queensland, New South Wales, and Victoria, and the habits of the birds observed there were recorded.

Mr. Sutton was also keenly interested in the historical side of South Australian ornithology, and discovered many new and interesting facts about early ornithologists and their activities in this State. He was the author of many papers and articles on birds as well as innumerable short notes and descriptions in the "Emu" and "South Australian Ornithologist". During his comparatively short career as an ornithologist, it can be said that he became one of the leading figures in South Australian ornithology, and his knowledge and opinions were valued greatly by all with whom he came into contact.

In 1923, following the death of Mr. F. R. Zeitz, Ornithologist at the Museum, Dr. A. M. Morgan was appointed Honorary Ornithologist, and during the same year, Mr. Sutton joined him as Assistant Honorary Ornithologist. For the next fifteen years, Mr. Sutton spent every afternoon at the Museum, and as a result of his organizing ability and thoroughness, about fifteen thousand specimens were registered, catalogued, and stored during this period. He was an expert penman, and all his records were kept with meticulous care.

Mr. Sutton joined the South Australian Ornithological Association in 1919, acted as Honorary Secretary for sixteen years, and was a member of the Editorial Committee of the "South Australian Ornithologist" for eleven years.

In October, 1934, on the death of Dr. Morgan, Mr. Sutton became Honorary Curator in Ornithology, which position he held until his death. He was a member of several learned and scientific societies, including the Royal Society of South Australia, the Royal Australasian Ornithologists' Union, the Royal Geographical Society, and the South Australian Ornithological Association.

CONTRAST IN DRAWINGS MADE BY AN AUSTRALIAN ABORIGINE BEFORE AND AFTER INITIATION

By C. P. Mountford, Acting Ethnologist, South Australian Museum

Summary

The remarkable change in the mental outlook of a partly detribalized aborigine, after he had passed through the ceremonies admitting him to full tribal membership, and the distinct alteration in the character of the crayon drawings, produced by him before and after initiation, form the subject of this paper.

When the 1935 Adelaide University Anthropological Expedition to the Warburton Ranges in Western Australia ([1]) left Laverton, two interpreters were employed; one, Pitawara, a fully initiated aborigine twenty-five years of age, the other, a youth named Nijau (pl. vii, Fig. 2), who, we understood at the time, had passed through all stages of initiation – that is to say, he had been circumcised and subincised.

CONTRAST IN DRAWINGS MADE BY AN AUSTRALIAN ABORIGINE BEFORE AND AFTER INITIATION

By C. P. MOUNTFORD, Acting Ethnologist, South Australian Museum.

Plates v–vii.

The remarkable change in the mental outlook of a partly detribalized aborigine, after he had passed through the ceremonies admitting him to full tribal membership, and the distinct alteration in the character of the crayon drawings produced by him before and after initiation, form the subject of this paper.

When the 1935 Adelaide University Anthropological Expedition to the Warburton Ranges in Western Australia (1) left Laverton, two interpreters were employed; one, Pitawara, a fully initiated aborigine twenty-five years of age, the other, a youth named Nijau (pl. vii, fig. 2), who, we understood at the time, had passed through all stages of initiation—that is to say, he had been circumcised and subincised.

After a journey of three hundred and fifty miles across uninhabited country, composed largely of mulga flats and spinifex-covered sandhills, we reached Warupuju, a small waterhole on the junction of the Elder and Warburton Creeks. Here we established our base camp and started work among a group of people of the Ngada tribe, who were practically untouched by civilization.

In order to gain some insight into the art of the aborigines, sheets of brown paper and red, yellow, black and white crayons were distributed amongst the natives.

For a while, when every-day objects formed the subjects of the drawings, the older men made no attempt to conceal them from our younger interpreter. But when confidence became established between the older men and myself and the drawings began to take on a more secret character, it became obvious that Nijau was not accepted by the tribal leaders. He was diffident and hestitating in their presence, and spent most of his time playing with boys many years his junior. Should Nijau pass near the place where the older men were making the drawings, these were at once turned face downwards.

Inquiries then revealed the fact that our younger interpreter, although he

(1) This was financed by funds made available by the Rockefeller Foundation and administered by the Australian National Research Council.

had been circumcised some years ago, had been persuaded by the mission authorities not to undergo the ritual subincision ceremonies, the participation in which would have granted him the rights and privileges of full tribal membership. He was therefore tribally a child, and as such would not be allowed to see drawings depicting legends known only to the initiated. Nijau was therefore useless as an interpreter.

During this period Nijau, in common with other aborigines, made a number of drawings; pl. v, figs. 1 and 2, are two examples of his work. The subjects are purely European, and are such as any white child in the upper classes of a primary school might have produced. In the first sheet (pl. v, fig. 1) the objects illustrated are easily recognizable, *i.e.* on the top of the sheet a policeman, then an aeroplane, railway train, axe, boot on the lower left, a revolver, and on the lower right a station hand, with his wide-brimmed sombrero and gay neckcloth, who had evidently caught the imagination of the aboriginal youth.

The drawings on the second sheet (pl. v, fig. 2) are, if anything, of a higher order. A, is a house on the Mount Margaret Mission; B, a ram (reminiscent of one of the famous paintings at the Altimira Caves in Spain); C, an echidna; and D, a cauliflower in blossom. The lower drawing is an excellent representation of the stockyards, windmill and troughs at the above mission station. Considerable detail is shown, even to the wheel of the stop valve E, that controls the flow of water to the trough. These sketches showed considerable skill, for, as Nijau could neither read nor write, it is almost certain that he had not received instruction in drawing.

During the latter part of our stay, Nijau, in company with two other younger boys, passed through the subincision operation and rituals.

This act wrought a major psychological change in the youth. He no longer played with the boys or approached the men with downcast eyes or diffident mien, but associated freely with the elders, noticeably proud of his new status and the head-dress that proclaimed it (pl. vii, fig. 1), while in his general conduct he displayed all the confidence and assurance of much older men.

No longer did the men turn their sheets of drawings face downward, but willingly explained, through Nijau, the meaning of the symbols on the sheets of drawings which illustrated the wanderings of their semi-human ancestors. The youth's pride and self-importance reached even greater heights when he was chosen as guardian to a boy selected for circumcision (pl. vii, fig. 1), and was, for the first time, allowed to sit in the circle of singers and chant the sacred songs of his tribe.

Thus Nijau reached full tribal membership. But it was in the crayon drawings that the remarkable psychological change was most clearly exhibited. After his initiation Nijau produced two sheets of drawings (pl. vi, fig. 1 and 2), and on these every object depicted is associated with the life of the uncivilized aborigine, and the symbols (with the exception of F, fig. 2) are the same as those used by the older men to illustrate their traditional stories.

A (pl. vi, fig. 2) are the tracks of parent emus as they travelled backwards and forwards to their nest at G. B is a line of wallaby tracks leading into a cave at C; a hill F overlooks this place. D pictures a distorted gum tree seen by the artist whilst on our outward journey; according to Nijau it had been blown over by the wind and had re-rooted itself. E indicates the roots of the tree. Except for A, a waterhole called Kapi Pilbit, and the associated creek (created by the ancestral Kangaroo) every object pictured would be known only to the fully initiated. B is a wanigi made by two ancestral beings, the Wati Kutjara, and left behind at Winduru Waterhole [2].

At C is shown another wanigi seen by the author and Nijau at a semi-secret ceremony enacted at the expedition camp. D is a *gnamma* hole [3], Kapi Matara; F, a somewhat Europeanized representation of an aborigine wearing the sacred wanigi supported from his head, his face painted with white pipeclay, and body decorated with lines of eagle-down, while E is the equally sacred bullroarer *pupinba* (equivalent to the Aranda tjurunga).

The cohesive power of the ceremonial life of the aborigines and the calamitous effect of any influences that tend to destroy that power will be evident from this short paper. If Nijau had not been subincised, he would have lived his life as an outcast from his tribe. At the same time, such nonconformity to native customs would not have rendered him more acceptable to the white community. For the happiness of the aborigine, the maintenance of his ceremonial life and social organization is vital.

REFERENCE.

Mountford, C. P. (1937) : *Rec. S. Aust. Mus.*, vi, pp. 5–28, fig. 1–27.

---

[2] Figured by Mountford, 1937, p. 19, in a suite of drawings describing the exploits of these ancestors. Winduru is a large water-hole some fifteen miles north-east of the base camp of the expedition (see W. Aus. plan IX/800).

[3] A water catchment of limited supply found in the arid parts of Western Australia.

EXPLANATION OF PLATES.

Plate v.

Fig. 1 and 2. Crayon drawings produced by Nijau before subincision ceremony.

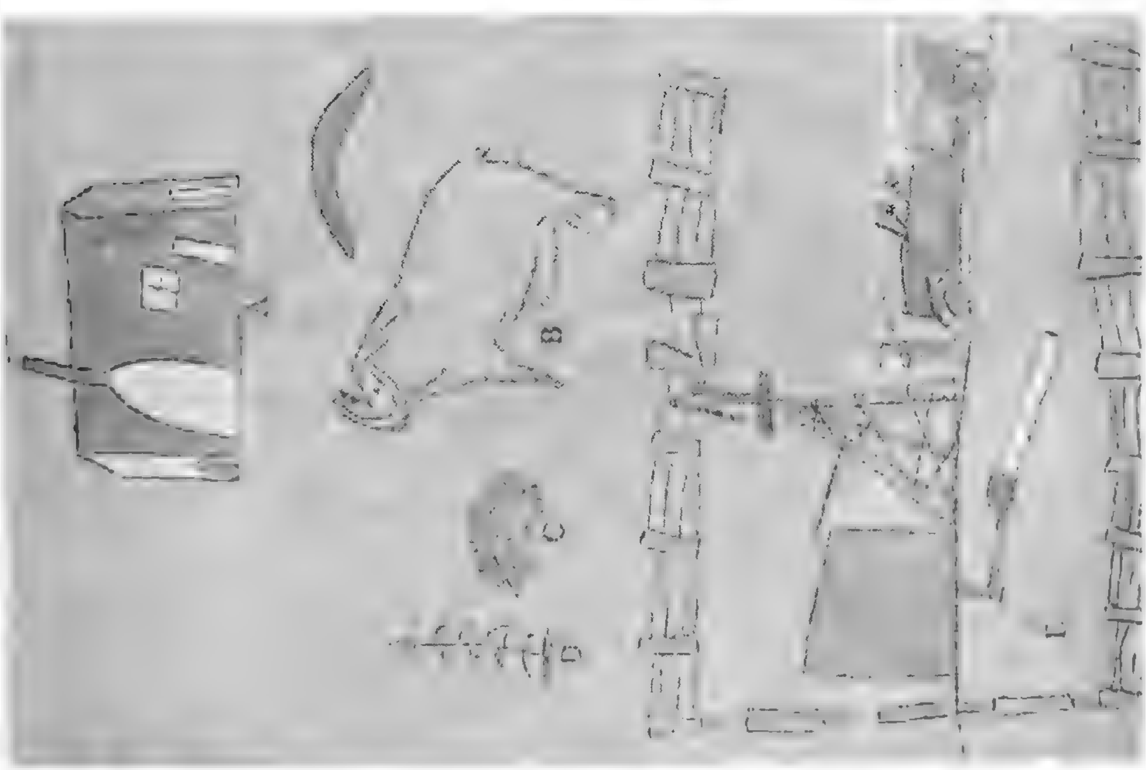
Plate vi.

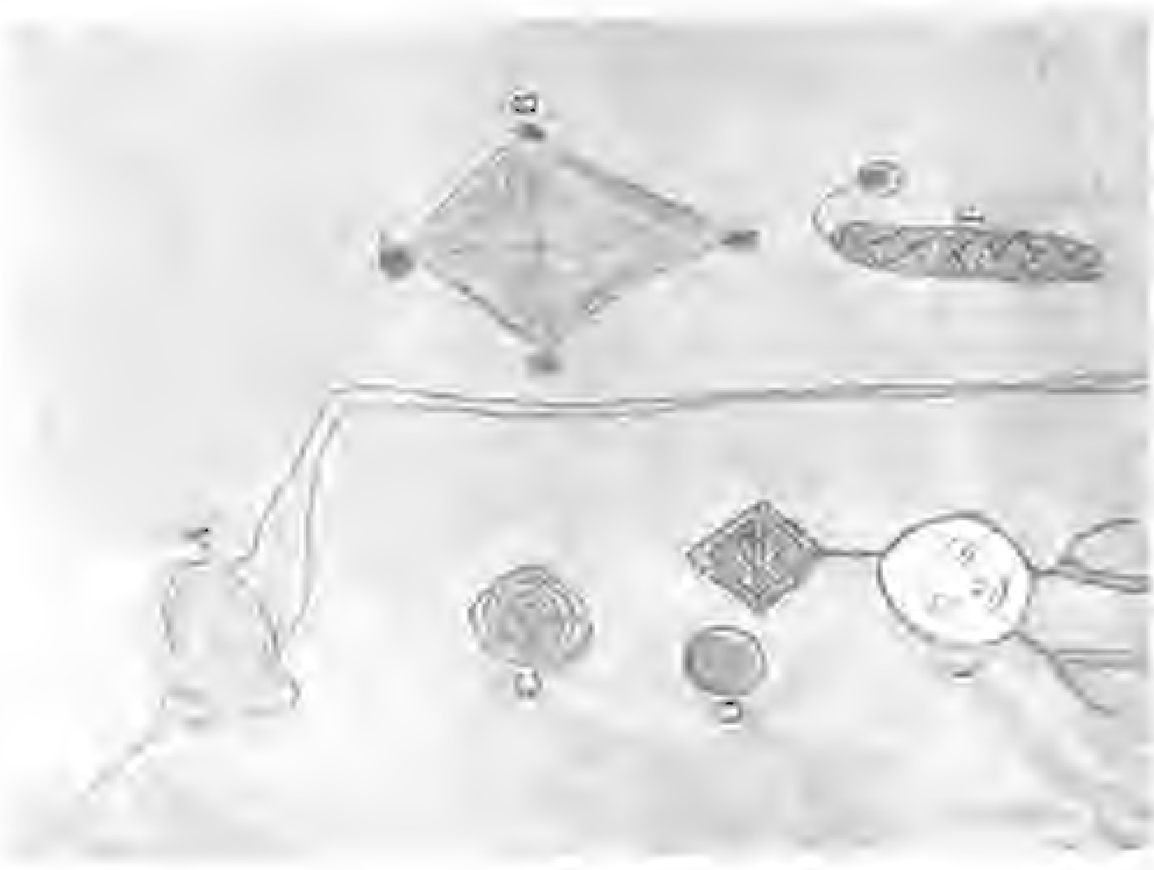
Fig. 1 and 2. Crayon drawings produced by Nijau after subincision ceremony.

Plate vii.

Fig. 1. Nijau guarding initiate in circumcision.

Fig. 2. Nijau.





A SURVEY OF AUSTRALIAN ABORIGINAL PEARL AND BALER SHELL ORNAMENTS

BY C. P. MOUNTFORD, ACTING ETHNOLOGIST, AND
ALISON HARVEY, HON. ASSISTANT IN ETHNOLOGY

Summary

The shell ornaments described in the following paper are used by the aboriginal population over wide areas in Australia. They may be divided into two general types, one made from the Baler shell (Melo diadema), the second from the shell of the Pearl Oyster (Meleagrina maxima), and from the smaller pearl shell (Meleagrina margaritifera).

The pearl shell ornaments are found almost exclusively in the western half of the continent, while with a few exceptions, the baler shell ornament is limited to Queensland, Western Central Australia and North-eastern South Australia.

A SURVEY OF AUSTRALIAN ABORIGINAL PEARL AND BALER SHELL ORNAMENTS

By C. P. MOUNTFORD, Acting Ethnologist, and ALISON HARVEY, Hon. Assistant in Ethnology.

Plates viii–ix, and Text fig. 1–7.

INTRODUCTION.

The shell ornaments described in the following paper are used by the aboriginal population over wide areas in Australia. They may be divided into two general types, one made from the Baler shell *(Melo diadema)*, the second from the shell of the Pearl Oyster *(Meleagrina maxima)*, and from the smaller pearl shell *(Meleagrina margaritifera)*.

The pearl shell ornaments are found almost exclusively in the western half of the continent, while with a few exceptions, the baler shell ornament is limited to Queensland, Western Central Australia and North-eastern South Australia.

PEARL SHELL ORNAMENTS.

Manufacture.

The pearl shell ornaments of the North-west Coast of Australia early attracted the attention of visitors and scientists. Martin and Panter in 1863, p. 86, noted that the method of manufacturing these objects consisted in grinding away about two-thirds of the marginal substance of the shell, and drilling a hole at one end of the smaller diameter for the hair-string. The patterns on the decorated ornaments were engraved to a depth of about half a millimetre, and the spaces filled in with a pigment of gum and charcoal.

Stirling, on a card in the South Australian Museum, substantiates the above description, and noted that the rough outer surface of the shell was covered with hot ashes and then removed by grinding with sand and water.

Usage.

Use of the pearl ornament lies in two fields, as a means of personal decoration and as an object of ceremonial importance. Love (1925, p. 27) points out that the men of the Worora tribe wear these shells as ornaments, and suspend them from their belts at the back and front; while both men and women hang several of them down their backs from a necklet made of human hair. Small pieces of oval pearl shell are sometimes used as forehead ornaments.

Martin and Panter (1863, p. 86) noticed the coastal north-western tribes wearing these ornaments suspended from a waist band. These writers consider them to be largely ornamental, although Campbell (1914, p. 86) saw them, at Sunday Island, being worn by youths who were passing through the final stages of initiation. On these occasions they wore richly ornamented shells (E and F, pl. viii). This evidence is supported by Mr. J. Heggie in connection with A and B, fig. 1. The dress of a fully initiated man consists of a plain shell.

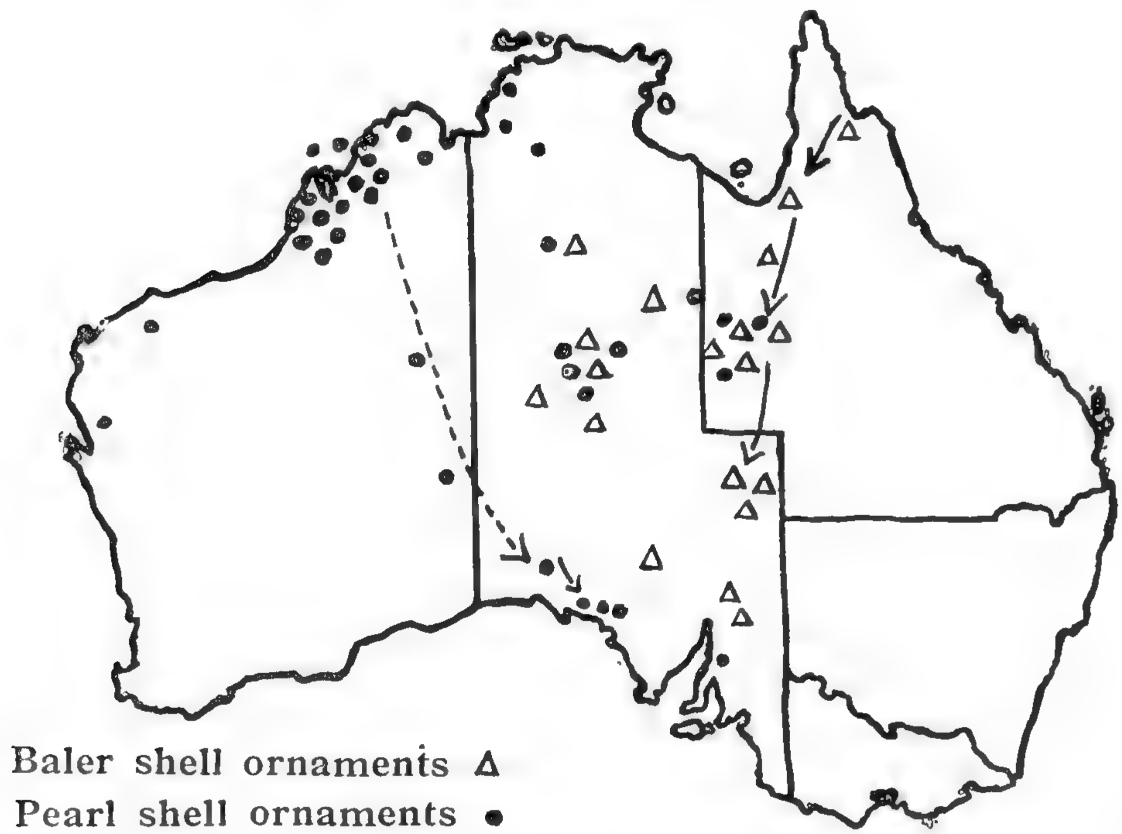


Fig. 1. Distribution of Pearl and Baler Shell ornaments.

The shell ornaments of South-Western Queensland have two uses, one as a pubic ornament for "corroborees and other public rejoicings", the other, in the hands of malignantly-disposed people, as an object of evil magic.

In Central Australia, such ornaments have an important magical value. Nevertheless they are still used as a form of decoration (Spencer and Gillen, 1899, p. 544).

According to Mr. N. B. Tindale, pearl shells at Ooldea (H, fig. 3) were used in the rain-making rituals, but a photograph by the late R. H. Pulleine, which pictures an aborigine wearing one as a neck pendant, suggests that on some occasions, the shells still perform the function of decoration.

In the Ngada tribe of the Warburton Range of Western Australia one of the authors observed that a pearl shell pendant was used by one of the older men as an article of dress in both the ordinary camp life and the initiation ceremonials.

In a recent interview a native called Waria, a member of the almost extinct Ngadjuri tribe of the middle north of South Australia, described how he wore pearl shell ornaments at the time of his circumcision. The shell ornaments, which he had not seen previously, were tied on the upper part of the leg (C, fig. 6) and according to Waria rattled and shone in the firelight as he ran round the ceremonial ground. The fact that Waria had not seen these ornaments before his initiation indicates their sacred character.

MAGIC.

As articles of magical worth, these ornaments are widely distributed in Australia.

In Central Australia they are found as such, and the chief aspects of their magic being their potence as charms for women and their healing properties. Describing their use in connection with the latter, Spencer and Gillen (1899, p. 544) write: "If a man desires to charm a particular woman, he takes a *Lonka-lonka,* as the ornament is called, to some retired spot, and charms it by singing over it, '*Ma quatcha purnto ma qillia purtno*', which conveys an invitation to the lightning to come and dwell in the *Lonka-lonka.* After the charming has taken place it is hung on a digging stick at the corroboree ground until night time, when a man removes it and ties it to his waist band. While he is dancing, the woman whom he wishes to attract, alone sees the lightning flashing in the *Lonka-lonka,* and all at once her internal organs shake with emotion. If possible, she will creep into his camp that night or take the earliest opportunity to run away with him."

From the description of the *Lonka-lonka* "flashing" in the firelight, it would appear that the object was made from pearl shell, as a baler shell (which is also in use in this area) would not "flash".

On the same page, in a footnote, Spencer and Gillen refer to the healing qualities of the *Lonka-lonka.* Used in sickness of any kind its magic has great curative properties. Roth (1897, p. 163) also refers to the use of the pearl plate as an antidote to sickness because of its magical powers.

At Ooldea, according to Mr. Tindale, scrapings of the shell are used in the rain-making ceremonies.

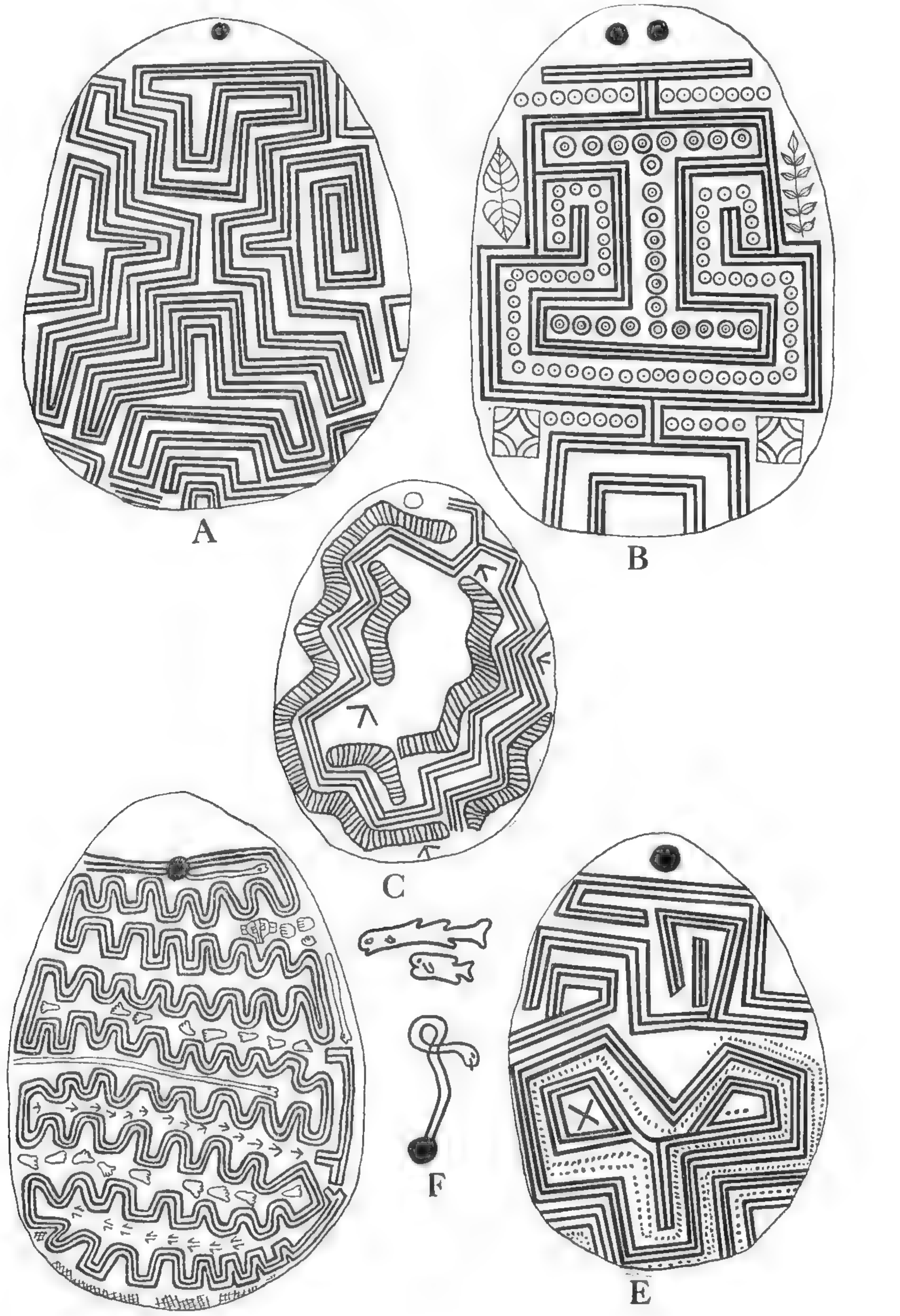

A B C D E F

Fig. 2. Decorated Pearl Shells. A, B, and D; Sunday Island, Western Australia. C; Cygnet Bay, Western Australia. E; Mount Casuarina, north-western Australia.

MYTHOLOGY.

Various myths are woven round the pearl shell. Professor A. P. Elkin, in a foreword of "Aboriginal Decorative Art" (McCarthy, 1938), writes that on the north-west coast a particular chant is sung when the design is being engraved on the pearl shell. The design cannot be made except by those who know the "song". This suggests that the patterns are traditional. This statement is supported by Mr. Heggie in connection with A, fig. 2.

According to Mr. N. B. Tindale, the natives at Ooldea believe that the shell comes from a place in the far north-west, where large lizards live in the water and attack the men who collect the shells (H, fig. 3).

DESCRIPTION.

The pearl shell ornaments are somewhat oval in shape, and vary from two to eight inches in length. Each shell has at one end either a hole or a mass of resin or wax to which a hair-string is attached. Pearl shells are of two types, plain and engraved. The pattern on the latter is usually carried out on the concave face, but sometimes on both.

Twenty-eight examples of pearl shell ornaments, from the eighty-five available for study, were chosen as being representative of the various forms. These are illustrated in fig. 2–6.

A, fig. 2, collected at Sunday Island by Mr. J. Heggie, is a striking example of a maze design. Commencing at the lower edge of the shell, three parallel lines can be followed without a break over most of the surface, finishing in the middle of the left-hand side. Basedow (1925, p. 355) figures a pearl shell from the same locality in which a definite anthropomorphic figure can be traced, and the fundamental design of the Sunday Island specimen is similar. According to Mr. Heggie, the youths of this locality, after they have passed through the four earlier stages of their initiation, wear engraved ornaments, while the insignia of the fully-initiated is a plain pearl shell.

The owner of the ornament (A, fig. 2) explained to Mr. Heggie that the pattern had been thought out by somebody a "long long time ago", and in that form had been handed down, generation by generation, to the aborigines of the present day. This statement suggests that the design is associated with the tribal mythology.

B, fig. 2, is also from Sunday Island. The engraved pattern is the key or meander type—a definitely aboriginal concept belonging to the north-western area (Davidson 1937, p. 130)—but the lines of circles, the leaf, and the conventional designs make one suspect European influence, while the regularity and accuracy

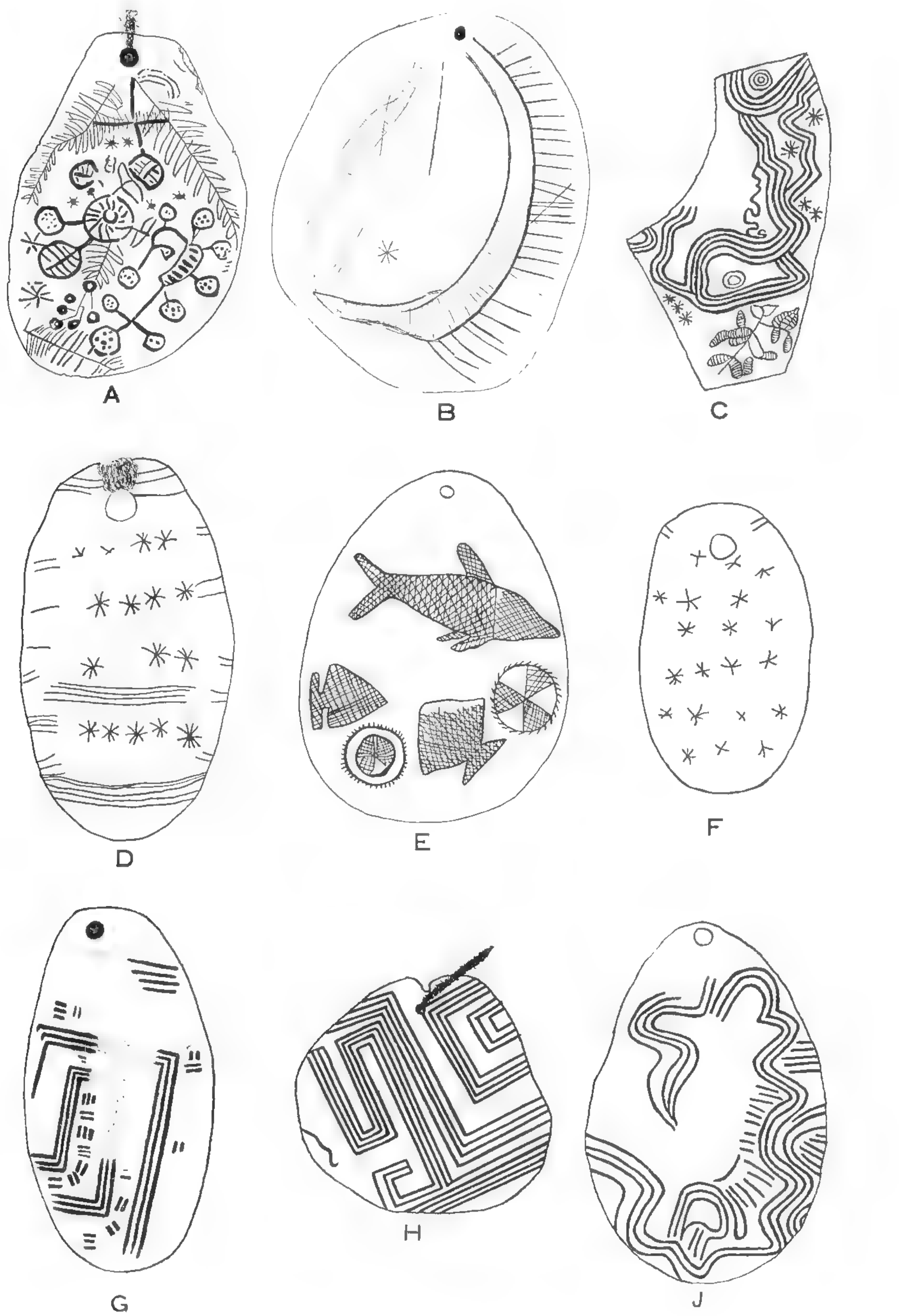


Fig. 3. Decorated Pearl and Baler Shells. A; Pearl Shell, Roebuck Bay. B; Pearl Shell, Katherine River, Northern Territory. C; Pearl Shell, Roeburn, Western Australia. D; Baler Shell, Daly Waters, Central Australia. E; Pearl Shell, north-western district, Western Australia. F; Baler Shell, Central Australia. G; Pearl Shell, between Barrow and Tennants Creek, Central Australia. H; Pearl Shell, Ooldea, South Australia. J; Pearl Shell, Sunday Island, Western Australia.

of the circles suggest the use of a steel tool. With one exception (C, fig. 3) this shell is the only example in the collection on which the concentric circle is engraved. This design is that most commonly employed in Central Australian decorative art (Mountford, 1937, p. 25).

The ladder-like, meandering design on C, fig. 2 (from Cygnet Bay) resembles the snake motif often found in the tjurunga designs of the Central tribes. Mountford, 1937, fig. 9, illustrates a crayon drawing that relates to a snake totemic centre, the meandering line of which resembles that on the left-hand of C, fig. 2. It is not unlikely that the design of the pearl shell refers to some mythical snake ancestor. The significance of the other figures is unknown, except those resembling arrow heads, which throughout Australia represent bird tracks.

D, fig. 2, was collected from the same locality as A, fig. 2. These are two of the most decorative examples in the collection. Three parallel lines meander backwards and forwards over the whole surface of the shell, making a modified maze. The spaces between are filled with engravings of tracks of human beings, kangaroo-like creatures and birds.

Snake designs have been engraved across the centre of the shell, on the upper right-hand edge, and emerging from the drilled hole at the top. This pattern is repeated on the reverse side (F, fig. 2) in greater detail. Above the snake is a remarkable group, the significance of which could hardly be misunderstood. The upper figure pictures one of the many sharks that infest the northern waters, while that immediately below is strongly suggestive of a Sucker-fish or Remora ([1]) ready to attach itself to its host.

E, fig. 2, was obtained at Mount Casuarina, which is the most northerly locality at which engraved pearl shell plaques have been collected. No meaning can be ascribed to the pattern.

A, fig. 3, from Roebuck Bay, is in the collection of the Hamburg Museum, and was photographed there by Mr. N. B. Tindale in 1937. The patterns, which do not appear to be as deeply engraved as those previously described, are almost entirely naturalistic. The two main figures, one on the lower right, the other slightly left of the centre, are similar to representations of yams seen on bark paintings from Arnhem Land, and in crayon drawings of the Granites district in the north-west of Central Australia. In such figures the circles indicate the yams, and the connecting lines the roots. The engravings on this pearl shell may have a similar meaning. Several star forms are also present.

B, fig. 3, was collected on the Katherine River, Northern Territory. A sharp-

---

([1]) The Sucker-fishes possess a large dorsal sucking disc and attach themselves to sharks, whales, or even the bottom of boats. When a meal is in sight the remora will leave its host, capture the prey, and return to its resting place.

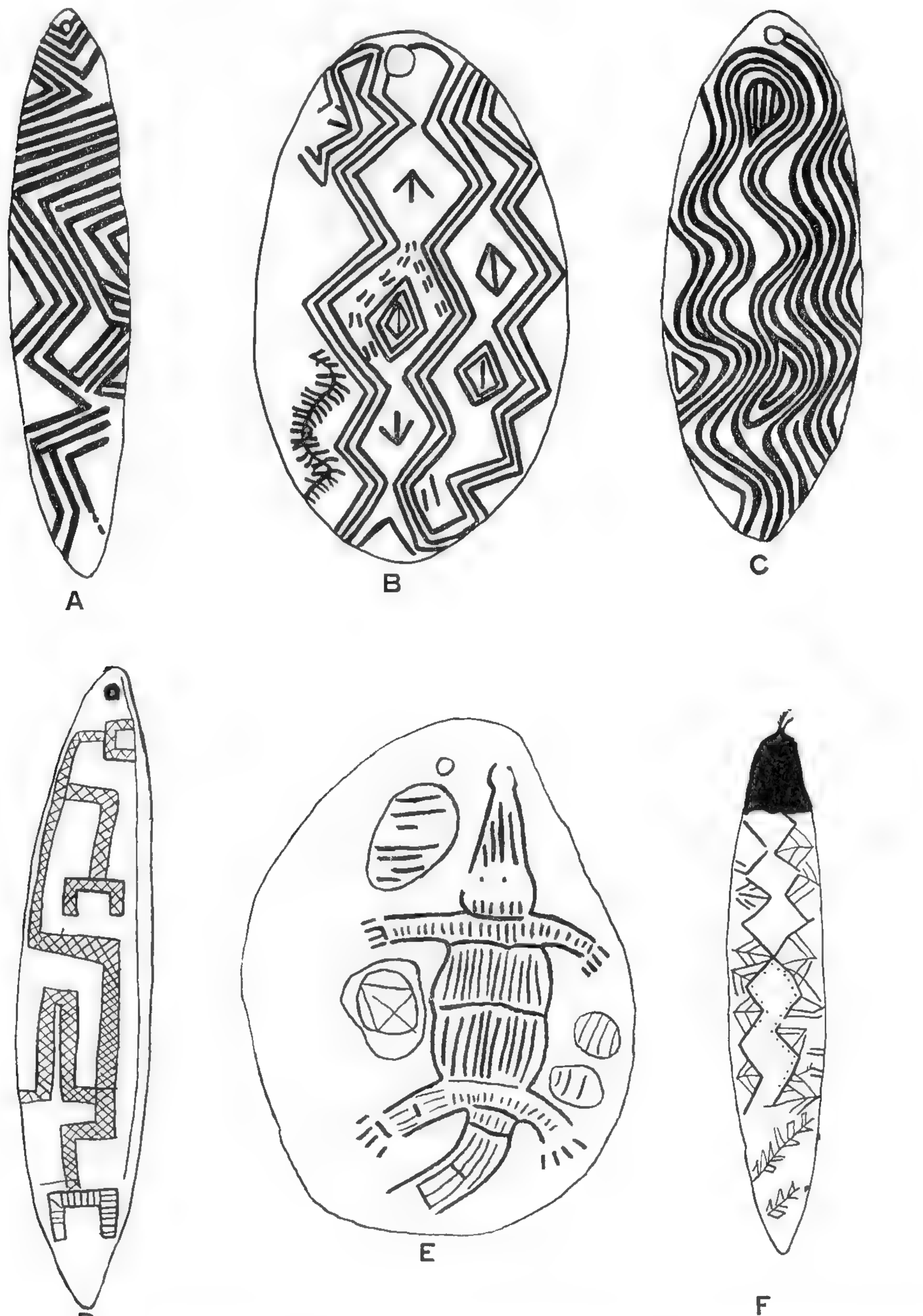


Fig. 4. Decorated Pearl Shell. A; Derby, Western Australia. B; Roebuck Bay, Western Australia. C; Cygnet Bay, Western Australia. D; Bernice Bay, Western Australia. E; Bernice Bay, Western Australia. F; Kimberley Coast, Western Australia.

edged tool had been used to cut the pattern, which is composed entirely of fine lines, some almost indistinguishable. With the exception of a single star, only ladder-like designs are present.

A fragment of what must have been a particularly decorative example is shown in C, fig. 3. The original is in the possession of Mr. W. B. Saunders, of Georgetown, who collected it at Roeburn. He kindly permitted a rubbing to be made, and from this the illustration was prepared. The plant-like figures on the lower edge are suggestive of those on A, fig. 3. Meandering lines, stars, and a single concentric circle form the remainder of the designs.

E, fig. 3, was collected from the north-western districts of Australia by Davidson (1937, fig. 44). The engraving on the lower right hand probably represents the silver bat fish *(Monodactylus argentius)*, and that on the centre left one of the coral fish. No meaning can be ascribed to the circular figures.

G, fig. 3, is a portion of a large pearl shell—collected between Barrow and Tennant's Creeks, Central Australia—on which the angular meander had been engraved. This design is strongly suggestive of the north-west coast, the home of this motif. The central portion of the pattern had been ground away, perhaps for the same reason as that recorded in connection with H, fig. 3 [2].

H, fig. 3, when sketched by Mr. N. B. Tindale at Ooldea, on the Trans-Australian Railway Line, was being used by the natives of those parts. Here again only a fragment of the original pearl shell remains, and consequently only portion of the engraved angular meander. According to Mr. Tindale the shell is called *kararba.* The natives claim that it comes from a place in the north-west, where large lizards live in the water and attack the men who collect the shell. Scrapings of the shell are used during rain-making ceremonies, which practice probably accounts for the small size of examples collected in South Australia (see also H, fig. 5; B, fig. 6; and as previously noted G, fig. 3).

By the courtesy of the Australian Museum, rubbings of J, fig. 3, as well as many others, were made available for study. This, in common with A, B, and D, fig. 2, was obtained from Sunday Island. The triple meandering lines, particularly on the upper right-hand side, resemble the almost obliterated design on H, fig. 5.

The long oval shell pictured on A, fig. 4, comes from Derby, north-west Australia, and had been cut from a shell already engraved with the angular meandĕr. This example was attached to several long strings of shells, and had been used as a neck pendant. Similar, but unengraved, plates, attached to shell necklets, are in the South Australian Museum.

---

[2] In Central Australia, similar unengraved ornaments, called *Lonka lonka,* are worn by men, especially during ceremonies (Spencer and Gillen, 1899, p. 544).

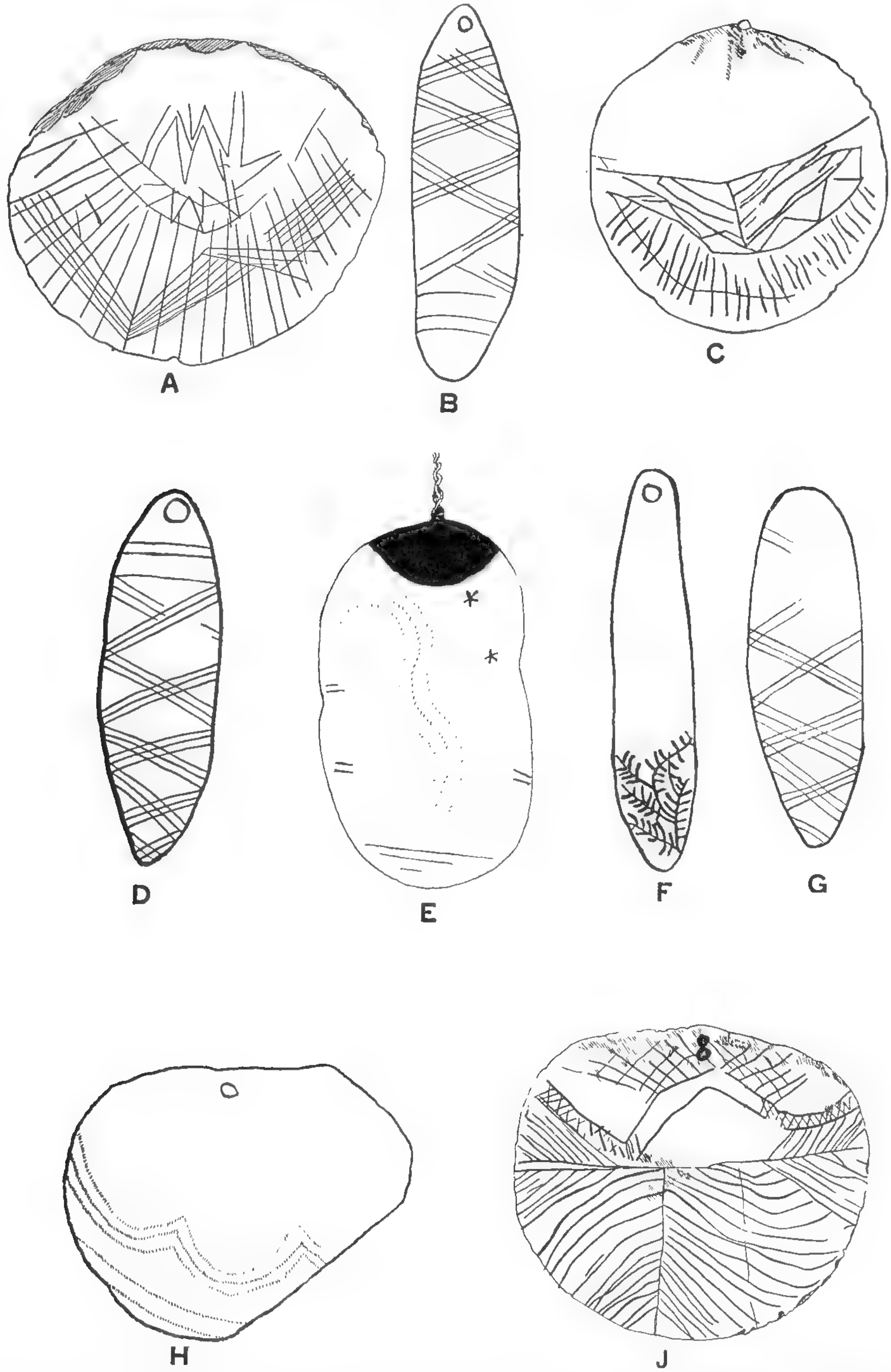


Fig. 5. Decorated Pearl Shell. A, C, and J; Maratuna Tribe, Western Australia. B and D; Lake White, Northern Territory. E; Central Australia. F and G; Timber Creek, Northern Territory. H; Koonibba, South Australia.

B, fig. 4, is from Roebuck Bay. The zig-zag lines predominate in the decoration of this shell; the concentric rhomboid is also present. This motif is unusual on this class of ornament, although common on other forms of aboriginal mobile art (Davidson, 1937, p. 119).

C, fig. 4, is a pendant from Cygnet Bay engraved with a meandering design, and like A, fig. 4, it was attached to a necklet of shells. E, fig. 5, from Central Australia, bears an identical but almost obliterated design.

D, E, and F, fig. 4, were collected by Dr. D. S. Davidson (1937, fig. 44) from Bernice Bay, and Kimberley Coast, respectively. These are figured on account of the unusual lattice pattern on D, the zig-zag and leaf-like forms of F, and the striking representation of a crocodile on E. The distortion of the crocodile to fit into the available space is a common feature of the bark drawings of Arnhem Land.

A, C, and J, fig. 5, were photographed at the Leiden Museum by Mr. N. B. Tindale. The pattern on all three examples is unlike any other in the series, with the possible exception of the faint lines on B, fig. 6. These ornaments were made from the smaller pearl shell *(M. margaritifera)*, by the Maratunia Tribe. The locality of the above tribe could not be traced, but the fact that neither the larger nor the smaller pearl shell occurs any further south than Hamelin Pool, on the West Coast of Australia, suggests that the tribe is north of this place.

B, D, F, and G, fig. 5, were collected by Dr. C. J. Hackett while on medical research in the Northern Territory. B and D (from Lake White), and G, from Timber Creek, are scratched with lattice patterns similar to those on D, fig. 4. A decorative fern leaf design occupies the lower edge of F (Timber Creek).

E, fig. 5, comes from Central Australia. From the point of design this specimen is of unusual interest. The parallel lines and star motif, which is confined to the centre of the continent (fig. 7) had been scratched on the surface of this pearl ornament. In addition, three faint meandering lines, reminiscent of those on C, fig. 4, from Cygnet Bay, proclaim, so to speak, the place of its birth. It would appear that this shell was engraved on the north-west coast, and, by the process of trade, found its way into Central Australia. Here it was again engraved, but this time with stars and parallel lines. Another such example is illustrated on D, pl. ix. A baler shell ornament bearing the same design is shown beside it for comparison.

H, fig. 5, is a fragment of the large pearl shell which, according to Mr. N. B. Tindale, had been traded to the natives of the Koonibba Station from Kalgoorlie. This shell has several scarcely discernible meandering lines on its inner surface, a remnant, no doubt, of the original engraving. This, as pointed out earlier, resembles the upper right-hand side of J, fig. 3.

B, fig. 6, a specimen from Penong, is also a fragment, chipped to its present size from a much larger shell. On this ornament a series of very fine lines forms a ladder-like pattern.

Pearl shell ornaments, called *Mukuli*, of which no specimens have been collected, were used by the Ngadjuri tribe of the middle-north of South Australia in their circumcision ceremonies. C, fig. 6, illustrates the method of wearing.

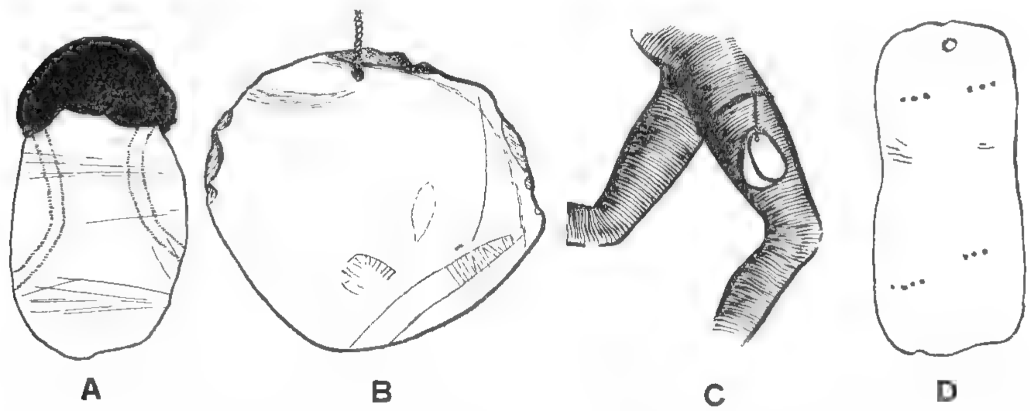


Fig. 6. Pearl and Baler Shell ornaments. A; Decorated Baler Shell, Coopers Creek, South Australia. B; Decorated Pearl Shell, Penong, South Australia. C; Method of carrying Pearl Shell ornaments by the Ngadjuri Tribe, South Australia. D; Decorated Baler Shell ornament, South Australia.

D, pl. viii, is the top of a fruit tin lid collected by the Canning Stock Route expedition. When obtained it was in use as a pubic ornament.

It is easy to imagine that the native, finding a lid when new, would see in it a striking resemblance to the shining pearl shell, and would wear it as such.

A, pl. viii, figures a plain pearl shell from Newcastle Waters, which illustrates the custom of repairing these shells, which have considerable value in this area.

B, pl. viii, is a shell bearing a modified maze design in which two bird tracks are incorporated. Both A and B, pl. viii, are attached to belts of hair string.

BALER SHELL ORNAMENTS.

MANUFACTURE.

The method of production of the baler-shell ornaments for spear-throwers at Princess Charlotte Bay is described by Hale and Tindale (1934, p. 99): "Two pieces of shell are roughly chipped to shape, and are then ground to an oval form on stones, sand and water assisting the operation; next the convex outer face is polished on a smooth rock, using finer sand as an abrasive, until it is pure white.

The shells are then placed, one on each side and with the concave or inside faces opposed, at the 'grip' end of the throwing-stick and fastened with beeswax, which fills the gap between them. A charm is frequently concealed within the adhesive between the two shells." G, pl. ix, pictures the haft of a spear-thrower from this area.

USAGE.

The use to which this ornament is put varies with the different localities; it may be used for ornamental or ceremonial purposes. Among the tribes of north-west-central Queensland it appears to be solely ornamental, being found as an article of personal adornment and as a decoration on the haft of spear-throwers. In the former case, Roth (1897, p. 112) states that as a chest ornament it is worn suspended on a hair string, and that it is occasionally but irregularly worn as a forehead ornament. He also gives the following description of its use as a spear-thrower (1897, p. 149): "This (spear-thrower) has a sort of haft to prevent the hand slipping off; this, projecting at an angle from the same edge as the peg, is composed of a flattened ovate piece of beef-wood gum, about three inches or more in its greater diameter; a white piece of shell . . . . with convex side outwards, is fixed to both sides of it."

Hale and Tindale (1934, p. 99), also found the baler shell used as a decoration for spear-throwers. Among the Dieri people of the far north-east of South Australia the shell ornament has a great magical value, and is closely connected with the circumcision ceremony in which it is worn by the initiate as a chest ornament.

Gason (1874, p. 18) refers to its use in the above ceremony, and states that, as soon as a boy shows signs of advancing manhood, the older men select a woman whose duty it is to suspend a "mussel" shell around the boy's neck, which she does at the appointed time, while engaging him in conversation.

Mr. T. Vogelsang, who spent many years among the Dieri people, related in a personal interview that the youths wear them immediately before, and just after, the circumcision ceremony. One of the tribal elders (the man who seized the youth chosen for initiation) also wore a plain baler shell around his neck, which gave him considerable authority and magical power.

Further south, the Urubunna and Wongkanguru tribes of the Peake district use this shell ornament in connection with initiation ceremonies in a way similar to the Dieri. In the manuscript notes by Mr. E. C. Kempe, on the Aborigines of the Peake District, the following reference is made to the initiation of a young man: "A certain rare shell is used in this ceremony. It is considered particularly precious by these blacks, and is handed down from operator to operator. When a young man is to be operated upon, he is, on a given signal, suddenly seized in camp by two blacks, his mouth covered to prevent outcry, and the shell ornament hung round his neck by a string.''

In the Anjamatana tribe in the Northern Flinders Range, these ornaments have the same ceremonial uses. A string of these shells, *makili,* is suspended round the neck of the youth during the initiation ceremonies after they have been handled by certain women relatives.

These shells are the objects of greatest value in the tribe, and are placed under the care of one of the old men, who informed one of us that if they had been lost or broken in the olden days he would have been killed for his carelessness (F, pl. ix).

Magic.

The only tribe known in which the Baler shells are used as objects of evil magic is the Dieri. Among the members of this tribe they serve the same purpose as the ''pointing bone'' of Central Australia, and have similar lethal qualities.

Mythology.

These ornaments are used by the Anjamatana tribe of the Northern Flinders, who, not knowing their source, suppose them to have a mythical origin. Two such legends are known to these people. One tells of a great ''whale'' *(Kukuri)* who lived in the springs, but is now in the sea; from the back of his neck come the shells that make up the necklace worn by a youth in the first initiation ceremonies. At one phase in the above ceremony, the youth, placing his hand under the shells, rattles them as he runs around the ground [3].

In a variant of the foregoing legend, baler shells were ''tick'' on the neck of snakes. An Anjamatana native told one of the authors that he had heard that a mythical snake died in John Creek, and, on searching the locality, found an undrilled baler shell in a swamp near Wertaloona. This shell is one of the string still used by that tribe.

Description.

The baler shell ornament has a fairly uniform appearance; it is an ovate piece of white *Melo* shell varying in length from two and a half to five inches, and has either a hole or a piece of resin gum to which the suspensory hair-string is attached. There are two types, one of which is plain, and the other engraved on the concave face (see E, pl. ix). In both, the inner face is smooth and white, and in most cases shows signs of having been coloured with red ochre, which makes the pattern stand

(3) This rattling of the shells was a feature in a similar ceremony of the more southerly tribe, the Ngadjuri (see C, fig. 6).

out clearly. In the plain forms, however, this colouring has almost disappeared, due no doubt to continual use.

Twenty-nine ornaments made from Baler shells *(Melo diadema)* are available for study, and of these seven are shown as text figures. They have been selected to illustrate types and designs. D, in fig. 3, collected at Daly Waters, exhibits the arrangement of stars anl parallel lines so characteristic of the Central Australian area (fig. 7). The lines of the design are about 0·5 mm. in width, engraved on the

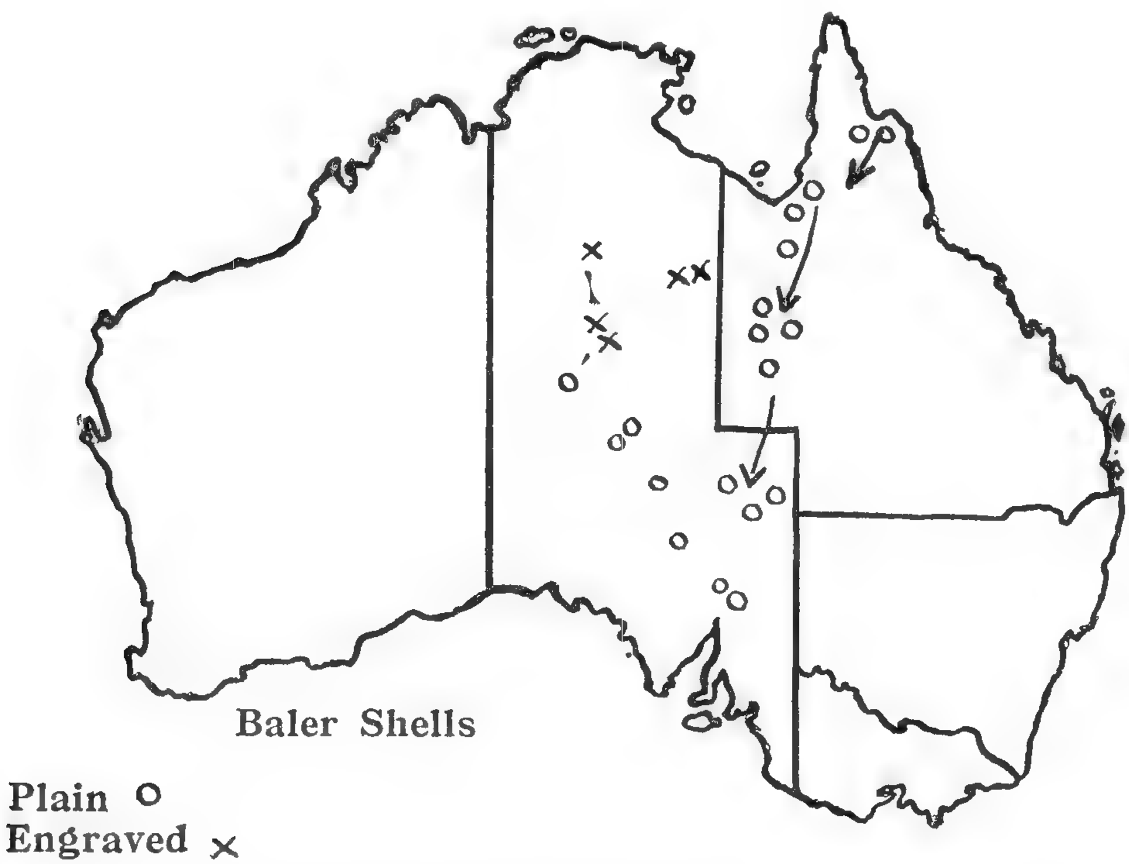


Fig. 7. Distribution of engraved and plain Baler Shell ornaments in Australia.

concave face, and coloured with red ochre rubbed into the cuts. The topmost portion of the shell, above the hole through which the string is threaded, has been broken, and later repaired with gum made from Porcupine Grass *(Triodia)* resin.

F, also in fig. 3, is a variation of the above motif in which engraved stars predominate. The shell is smooth and white, but red ochre has been rubbed into the design. This specimen, collected in Central Australia by F. J. Gillen, has not been fully localized.

A, fig. 6, is from Cooper's Creek. A large lump of gum has been attached to the top of the ornament, probably to fix the hair-string. Two parallel lines in a loop design have been lightly scratched at each side of the shell; this was the only specimen of baler shell which bore any sign of the meander motif so frequently found engraved on pearl shells, especially on those from the north-west coast. (See E and H, fig. 5, and C, fig. 2.)

D, in the same text figure, is an unlocalized baler shell collected by Mr. R. T. Maurice. This specimen is one of two varying from the usual ovate form; it bears an uncommon design composed of sets of dots and parallel lines. B, pl. ix, is a typical example of the plain baler shell. (The convex face has been photographed). The specimen—called *Kuripikiri* by the Mikari tribe—was collected at Minnie Downs, North-Eastern South Australia, by Mr. L. Reese. The smooth, white and glossy concave face was not engraved, but showed signs of having been coloured with red ochre, which remains as a faint trace in scratches on the face. Human hair string suspends the ornament through a hole in the top portion of the shell.

E, pl. ix, is a shell from Daly Waters bearing the characteristic line and star design on the concave face. Here again the engraved design was coloured with red ochre. A pearl shell (D, pl. ix) from Barrow Creek, three hundred and fifty miles south, is included for comparison on the same plate.

A, pl. ix, shows an unlocalized copy in bone of the plain baler shell ornament. Spencer and Gillen (1904, p. 446) in the legend of the two Oruntja men, tell of how one of them killed Induda, an opossum man, and from his shoulder-blade made a *Lonka-lonka,* which he wore as a forehead decoration.

C, pl. ix, shows the convex face of a "shell" ornament from Cooper's Creek, made from kaolin. This specimen was pale pink in colour, had acquired a surface gloss, and was made as a substitute for the true baler shell ornament. The latter is rare and of great value in this area.

F, pl. ix, is a photograph of a youth of the Anjamatana tribe of the northern Flinders wearing the baler shell ornament while undergoing initiation. This shell is called *makali* by these people ([4]).

DESIGN AND DISTRIBUTION.

The engraved patterns of the ornaments described in this paper can be classified into two main groups:

(1) Geometric.
(2) Naturalistic.

([4]) The name is similar to that given to the pearl shell ornament (see C, fig. 6) of the Ngulgura tribe who live in the area bounded by Wilpena Pound to the north, the western Flinders to the west, and Gawler in the south.

The former, which predominates, can again be subdivided into:

(a) The angular meander or maze designs.
(b) Meandering and zig-zag lines.
(c) Lattice and ladder designs.
(d) Parallel lines and stars.

(1) *Geometric.*

(a) The angular meander or maze design (see A, B, D, and E, fig. 2; G and H, fig. 3; and A, fig. 4), originates on the north-west coast of Western Australia, whence all but four of these examples were obtained. The remaining ornaments, *i.e.* those collected on the Canning Stock Route, Western Australia, at Barrow Creek, Central Australia, sketched by Mr. Tindale at Ooldea (C, pl. viii, and G and H, fig. 3) and that seen by one of the authors in the Warburton Range of Western Australia, undoubtedly reached their present position by various native trade routes.

(b) The meandering and zig-zag pattern is largely confined to the far north-west. Fourteen pearl shells and one baler shell bearing this pattern were examined, and on the only three collected outside of this area (E, fig. 5, from Central Australia, A, fig. 6, and H, fig. 5, from the Great Australian Bight), the designs were hardly distinguishable, due no doubt to age and attrition. When, however, one considers how long it must have taken for such an ornament to have been traded from its source to the Great Australian Bight, it is not surprising that the engravings were almost obliterated and the shell much reduced in size, particularly in view of the custom mentioned in connection with H, fig. 3.

(c) The lattice and ladder motifs (C, fig. 2; B, fig. 3; D, fig. 4; B, D, C, J, fig. 5; and B, fig. 6) are, without exception, cut into the surface of the shell with a sharp tool. In general, these designs originate on the north-west coast, although B, fig. 3, was collected on the Katherine River, Northern Territory, and B, fig. 6 from the Great Australian Bight. The lines on the latter are so fine that a magnifying glass was necessary to distinguish them. A, C, and J, fig. 5, were decorated with lightly-incised lines. The latter were unlocalized, and unlike any other examples in the series.

(d) Twelve of the shell ornaments were engraved with the stars and parallel lines motif. Three of these were made of pearl shell. One, D, pl. ix, is compared with a baler shell, E, pl. ix, both from Central Australia. This method of marking is confined entirely to the centre of the continent, and is more commonly seen on the baler shells of this area (see fig. 7).

(2) *Naturalistic.*

With the exception of the single example from south-western Northern Territory (F, fig. 5) all naturalistic designs originated in the north-west. Some are decidedly decorative, *i.e.* F, fig. 2; A, C, and E, fig. 3, and E and F, fig. 4.

A comparison of the patterns engraved on pearl-shell and those on tjurungas of Central Australia show few, if any, points of resemblance. In fact, except for the tracks on D, fig. 2, the concentric circles on B, fig. 2 and C, fig. 3, and the zig-zag lines and concentric rhomboids on B, fig. 4, none of the engravings on the shells of the north-west area appear on the tjurungas or the crayon drawings of the central tribes. The latter were collected by one of the authors.

It would seem that the art of the pearl-shell ornament is confined to the north-west, with the exception of the parallel lines and star motif, which is only found on both baler and pearl shells in the centre of the continent (fig. 7). It is noteworthy that the ornaments tend to become engraved with the typical design of the area in which they are used. Thus, a pearl shell from Barrow Creek (G, fig. 5), to which reference has already been made, has the typical design of the "centre" superimposed on an almost obliterated meander design of the north.

From the information already obtained, the southerly diffusion of these ornaments is a noteworthy feature. They originate in two well-defined areas, the pearl-shell in north-western Australia, with King's Sound as an approximate centre, and the baler shell in the Cape York area of Northern Queensland. Both types can be traced through Central Australia to South Australia (fig. 1).

Numerous references in literature support this evidence. Campbell, 1914, p. 86, noticed pearl shells in the Gascoyne districts similarly marked to those at Sunday Island. He concluded that they had been carried southward by barter, as the shells indigenous to the Gascoyne districts were much smaller and belong to a different species (probably *M. margaritifera*).

Roth, 1897, p. 163, when studying the aborigines of south-western Queensland, found that the pearl shell ornaments were traded to those districts from the north-west. Similarly, the same author, in p. 112, mentioned that the baler shell ornaments reached the same districts by the north or north-easterly trade routes, originating in the Gulf of Carpentaria. He traces these routes in considerable detail.

Hale and Tindale (1934, p. 99) when at Princess Charlotte Bay, ascertained the direction of their diffusion; they write: "The area over which these baler shell ornaments are made is limited to Cape York, but the shell discs are articles of trade to southern inland people.''

Mr. T. Vogelsang, in a personal communication, said that trade in these ornaments, as well as pituri and other articles, took place among the Dieri along the present Queensland stock route, which runs in a somewhat north-easterly direction.

An examination of the distribution and uses of these ornaments reveals an interesting fact. In places where the articles originate they have, in general, an utilitarian purpose, particularly in the case of the baler shell. As these are traded further from their source they assume the function of ornament, and in the most distant localities are associated only with the ceremonial aspect of the tribe. In other words, they tend to take on a more secret character as they travel further from their source. The two types meet in South Australia, the Anjamatana tribe, to the east, using the baler shell, and the Ngadjuri tribe, the adjacent tribe to the west, the pearl shell.

REPLACEMENT.

The high value placed upon these shell ornaments in the inland districts is illustrated by the fact that numerous replacements or substitutes of both types of shell ornaments have been found, and that such replacements have occurred where the shells have magical or ceremonial value. Thus the kaolin specimen (C, pl. ix), collected at Cooper's Creek, was made by tribes among whom, as before observed, the baler shell ornaments are of value both as magical objects and factors in initiation rituals.

The bone example (A, pl. ix) is unfortunately unlocalized, but the legend of the two Oruntja men, collected by Spencer and Gillen in Central Australia, in which a *Lonka-lonka* was made from a shoulder-blade, shows that bone replacements are known in Central Australia. Roth (1897, p. 112) records that at Roxburgh, in north-west Queensland, and south of that station (which is well within the area wherein the shells are used as ornaments at Boulia) the shell ornament is copied by grinding down pieces of broken chinaware.

Another interesting replacement is that collected on the Canning Stock route of Western Australia, where a fruit tin lid had been used in place of a pearl shell ornament (D, pl. viii). C, pl. viii, figured as a comparison, is a pearl shell pendant, also collected on the Canning Stock route.

USE BY WOMEN.

In general these shell ornaments are for male use only, and this is a fact to which many observers have drawn attention. It appears, however, that in certain circumstances women are associated, as is shown by Gason's description of the circumcision ceremony, to which reference has been made earlier in this paper (Gason, 1874, p. 18). Also in the Anjamatana tribe of the Northern Flinders certain female relatives handle the baler shell necklace before it is placed round the neck of the initiate. Sir Edward Stirling, in a note on shell ornaments in a case in the South Australian Museum, also mentions their use "in certain circumstances" by women. Hale and Tindale obtained specimens of baler shell ornaments at Princess Charlotte Bay from both men and women.

SUMMARY.

This paper describes the aboriginal shell ornaments of Australia. A selected number are figured and described, and their method of manufacture, use, magical value, mythology, design, and distribution are discussed.

ACKNOWLEDGMENTS.

The authors wish to acknowledge the help received from both the Australian Museum of Sydney and Miss D. Cowan of Western Australia.

LITERATURE.

Campbell, W. D. (1914) : *Trans. Roy. Soc., W. Aust.*, 1.
Davidson, D. S. (1937) : *Mem. Amer. Phil. Soc., IX.*
Elkin, A. P. in F. D. McCarthy (1938) : Australian Aboriginal Art.
Gason, Samuel (1874) : The Dieyerie tribe of South Australian Aborigines, 1874.
Hale and Tindale (1934) : *Rec. S. Aust. Mus.*
Love, J. R. B. (1915) : *Trans. Roy. Soc., S. Aust., XLI.*
Martin and Panter (1863) : Journals and reports of two voyages to the Glenelg River and North-Western Australia.
Mountford, C. P. (1937) : *Trans. Roy. Soc., S. Aust., LXI.*
Roth, Walter E. (1897) : Ethnological Studies among the North-Western Central Queensland Aborigines.
Spencer and Gillen (1899) : Native Tribes of Central Australia.
Spencer and Gillen (1904) : Northern Tribes of Central Australia.

EXPLANATION OF PLATES.

Plate viii.

A. Repaired plain Pearl Shell ornament, Central Australia.

B. Engraved Pearl Shell ornament, Western Australia.

C. Engraved Pearl Shell ornament, Canning Stock Route, Western Australia.

D. Fruit tin lid used in place of Pearl Shell ornament, Canning Stock Route, Western Australia.

E. and F. Method of wearing Pearl Shell ornaments, Sunday Island, north-western Australia.

Plate ix.

A. Plain bone ornament, locality unknown.

B. Plain Baler Shell ornament, Minnie Downs, South Australia.

C. Plain Kaolin ornament, Cooper's Creek, South Australia.

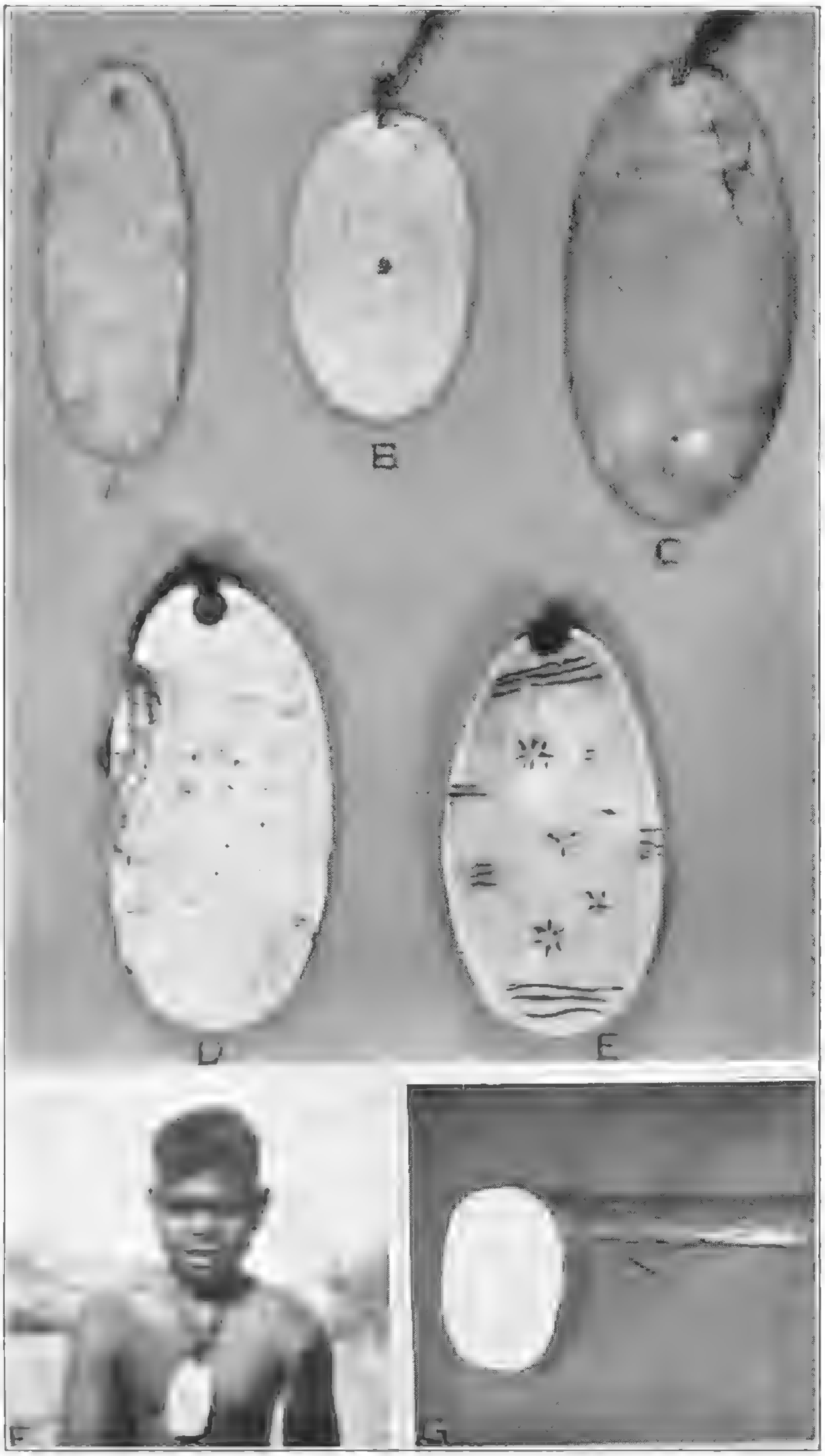
D. Decorated Pearl Shell ornament, Barrow Creek, Central Australia.

E. Decorated Baler Shell ornament, Daly Waters, Northern Territory.

F. Initiate wearing Baler Shell ornament, Anjamatana Tribe, South Australia.

G. Baler Shell on spear-thrower, Princess Charlotte Bay, Northern Queensland.


A
B
C
D
E
F


B
C
D
E
F
G

ILLUSTRATIONS OF STONE MONUMENTS OF THE WORORA

BY J. R. B. LOVE

Summary

Attention has been called to the presence in Australia of arranged stones, presumably evidence of a stone-cult of the aboriginals, but concerning which there has been little recorded at first-hand from aboriginal informants.

Professor F. Wood Jones (1925) has drawn attention to some interesting arrangements of stones in South Australia, and he also notes references by Brough Smyth (1978) to arranged stones in Victoria.

ILLUSTRATIONS OF STONE MONUMENTS OF THE WORORA

By J. R. B. LOVE.

Plates x–xiv.

Attention has been called to the presence in Australia of arranged stones, presumably evidence of a stone cult of the aboriginals, but concerning which there has been little recorded at first-hand from aboriginal informants.

Professor F. Wood Jones (1925) has drawn attention to some interesting arrangements of stones in South Australia, and he also notes references by Brough Smyth (1878) to arranged stones in Victoria.

The territory of the Worora tribe, which lies between the Glenelg and Prince Regent Rivers, in North-Western Australia, is plentifully besprinkled with stone monuments which still occupy an important place in the mythology, as also in the everyday talk, of the people.

The Worora stone monuments are of two different classes, *viz.* those which are natural rock formations and to which a mythological origin has been attributed by the Worora, and, secondly, those which are patently of human arranging. This second class is again to be divided into two groups, those to which the Worora attribute a supernatural origin, and those which are admittedly of human arrangement or erection.

Arranged stones, if heavy enough to withstand the levelling tendencies of rain and wind, remain as permanent memorials to the activities of the men who arranged them, even though, as must be the case in many parts of Australia, the people who knew their meaning have long been dead. But, whether arranged or natural formations, the stories associated with these rocks and stones can be obtained only from men to whom they have a meaning and value.

Fortunately, in the Worora tribe we have a surviving people who retain their traditional lore; this lore the elder men willingly impart to a trusted enquirer.

The Worora believe in a class of supernatural beings, named *Wondjuna.* Each local horde of the tribe has its own particular *Wondjuna,* with his own proper name. The *Wondjuna* have been elsewhere described by the writer (Love, 1929, p. 6–15) and by Professor A. P. Elkin of Sydney (1930, p. 256–269). Many of the natural features of the land, and also the arranged stones, represent in the Worora mythology, the scenes of exploits of one or many of the *Wondjuna.*

Animals, birds, and insects are also credited with human attributes in the times past, and many of the natural or arranged rocks and stones represent exploits of various of these creatures. The *Wondjuna*, and no less the lower creatures featured in Worora mythology, are represented in story as having travelled about the land, hunting for food and performing ceremonies in much the same way as the present generation of Worora people, and have left the land dotted with monuments to their experiences.

Most of these places, whether naturally or artificially marked, play an important part in the Worora theory of conception and birth. The Worora belief is that a man conceives the spirit of his child, either in a dream or by catching it in a lightning flash, at some spot where the spirits of children are present, waiting to be conceived by the father. When a child is born, the father thinks back to where he imagines he may have camped and conceived the spirit of the child. When the child can sit up, the father gives it the name of the place where he believes he conceived it. This place is called *wungguru*. A normal child, boy or girl, claims a certain spot as his or her *wungguru*, the place from which his spirit emerged, and where other spirits are waiting to be conceived by man and born as children.

Some of the rock monuments, natural or arranged, are just described as *wungguru*, without any special incident in the mythical past being allotted to them. There does not seem to be any difference in efficacy or fertility between those *wungguru* which have an incident attached to them and those which have none.

In the illustrations to this paper it will be seen that the monuments may be

(1) Remarkable natural features;
(2) Monoliths, not heavier than one or two men could erect;
(3) Groups of elongated or peculiar-looking stones;
(4) Elaborate arrangements of stones, such as circles, parallel lines, ovals, or more intricate designs;
(5) Cairns.

Among monuments which have no mythological story are single stones erected to commemorate some striking incident, such as the killing of a big kangaroo, the place where a man had a narrow escape (*e.g.* from snakebite or fall from a horse). Also, a stone placed in a prominent position to draw attention to a sacred place, or even to a spot where a hunter might hope to find a kangaroo resting behind a rock. On one occasion when the writer shot a "plain turkey" his aboriginal companion marked the place with a stone. Such spots could become legendary, and, with repeated exaggerations in the telling, even mythical in time.

In ascribing natural features to the activities of mythical ancestors, the objects represented are enormously magnified by their monuments. Thus a parcel of cooked fruit is represented by a rock more than one hundred feet long (A, pl. x); the digging of an edible root is shown by a cleft in the rock many feet wide and many yards long, and the head of a *Wondjuna* is two feet in diameter. Cairns have quite different meanings in different localities. Thus, in the illustrations given, a cairn represents the place where a *Wondjuna* lay down and died (so Sir George Grey was not so far out in his assumption that the cairns he saw near the Prince Regent River were tombs); again, a big stone on a cairn represents a mass of cooked food (D, pl. xiv); and a group of cairns are "sneezing places" (C, pl. x).

It may be remarked that, with the one exception of the stone that represents a subincision (B, pl. xiv), none of the long or cylindrical stones has any phallic significance.

A further type of stone arrangement is that left after death and burial ceremonies. On the first night after the death of a man the body, with thumbs tied together and big toes tied together, is doubled up, laid on its side on the ground, and surrounded by an oval of stones set in the earth. Next day the body is placed on a platform of branches, to await the drying and bleaching of the bones. The oval of stones remains, and is often to be found where the name of the man who died has long been forgotten. This oval looks like a grave, but no body remains are there (C, pl. xiii). The burial platform is laid across poles supported by four corner posts, which are in turn supported by small piles of stones. When the platform has decayed, or been burnt by a bush fire, these corner supports remain, as four little heaps of stones. When the body is placed on the platform the custom is, or was, to put a long line, or else a circle, of large stones near, or surrounding, the body on the platform. Each stone represented a man. After a day or two, the elder men, particularly the *banmandja*, or wizard, examined this line or circle of stones. Should one of them be marked by a splash of the fluid dripping from the decomposing corpse on the platform it was taken as proof that the man represented by that stone was the guilty one, responsible for the death, and the suspected individual was speared by men detailed for the purpose. This line or circle of stones remains when the bones have been removed for placing in the appropriate cave.

LITERATURE.

Brough Smyth, R. (1878): Aborigines of Victoria.
Elkin, A. P. (1930): Oceania, i, No. 3, pp. 258–269.
Love, J. R. B. (1929): *Trans. Roy. Soc., W. Aust.*, xvi, pp. 15–16.
Mountford, C. P. (1938): *Trans. Roy. Soc., S. Aust.*, lxii.
Wood Jones, F. (1925): *Journ. Roy. Anthro. Inst.*, lv.

EXPLANATION OF PLATES.

Plate x.

A. Sandstone rock on the sea coast. The larger rock above the cliff represents a wallet of paper-bark, such as is used for carrying food. The smaller rock on top is a mass of cooked "*mandjawora*", a small black berry that is roasted, pounded into a mass, and then carried to the main camp to be shared. These masses may weigh five pounds. The rock is named "*Tjimbaleri*", which means the bark dish (1).

B. The *wungguru* of the "white-fish", a hollow circle of stones. This is the reproductive centre for this species of fish.

C. *Dindjin kari,* meaning "Sneezing-things". Cairns of stones near Sale River. Seven cairns can be seen in the picture. The explanation is that a man who might pass that way on his hunting must deposit a spear or a stick on one of these heaps. Should he fail to do this, he would be troubled by sneezing for the rest of the day.

D. *Wiarinja*, a stingray. This is a rock that has fallen across a stream, several miles from the sea shore. It represents a stingray that swam from the sea to this place, but could go no further.

Plate xi.

A. *Kulorubada.* The large round stone projecting from the earth represents the head of *Kulorubada.* It is a red stone. The name *Kulorubada* means "He-having-the-tranquil-dove". The white stone set on the head represents the dove *(Geopelia tranquilla),* named *kulorugu.* The dove is sitting on the head of *Kulorubada.* The little stones round the head are chicks of the dove.

B. *Kunggurum*, the *wungguru* of the *kunggurum*, a palm with an edible fruit.

C. *Ilaidja,* a yellow, cylindrical stone, set in a cave that contains the pictures of the *Wondjuna* named *Kulorubada. Ilaidja* is the edible root of a lily. The root is cooked in ashes, then pounded and rolled into a more or less cylindrical shape, really very like this stone in shape and colour. Beside the *ilaidja* stone is part of a human thigh bone, from a long-forgotten cave burial.

D. Stone set to mark the proximity of a store-house of sacra ("bull-roarers").

---

(1) Mountford, 1938, fig. 12, p. 252, figures an aboriginal crayon drawing from the Warburton Ranges of Western Australia that illustrates the wooden dish, resting on the lower grinding stone, which was left behind by the mythical Kunkarunkara women. These are now a large hill near Meitika water hole.

Plate xii.

A. Ranggudj inggunung, meaning, "Where-the-heart-is". This is a heart-shaped stone, representing the heart of a kangaroo killed here by a group of *Wondjuna*.

B. Buroi kenga, meaning "He-wrestled". This is the scene of a great wrestling that took place among kangaroo ancestors. The stones set upright represent kangaroos that wrestled; stones lying on the ground those thrown down in the struggle.

C. Ranggudj-inggunung. The heap of stones on a boulder is the spot where the *Wondjuna* cooked the kangaroo, whose heart they put on another stone.

D. Kanawci, a great man of the Worora, once lay asleep near a tree. He was awakened, or said that he was awakened, by a black snake passing over his thighs. He rose and set up this stone to mark the place, and is here seen with his hand resting on his *kauanja* (black snake) stone.

Plate xiii.

A. Kulorubada, a cairn at the foot of a "bottle tree" *(Adansonia gregorii)*. This marks the spot where the *Wondjuna* named *Kulorubada* lay down and died.

B. Ngo:-go. This group of stones is on the brow of a hill overlooking an arm of the sea. According to the story the sea once threatened to overflow the earth. As the tide rose in the valley below, a boobook owl, seeing the danger, flew to the brow of the hill. He seated himself on this spot, looked down on the sea, and uttered his awe-inspiring cry, "*Ngo:k-ngo:k! Ngo:k-ongo:k!*" Seeing the big eyes of the owl, and hearing his terrifying voice, the sea receded. These stones arose spontaneously to mark the place where *mununggoia*, the boobook owl, saved the land from being overwhelmed by the sea.

C. Stones at the scene of a burial platform. The remnants of the bleaching platform can be seen, four poles supported by stones. The line of big stones passing across the picture is the row of "inquest" stones. At the right can be seen the oval of stones where the corpse lay for the first night, before being placed upon the platform.

D. Men at the store of sacra. One man stooping to remove a "Bull-roarer" from the cleft where they are stored.

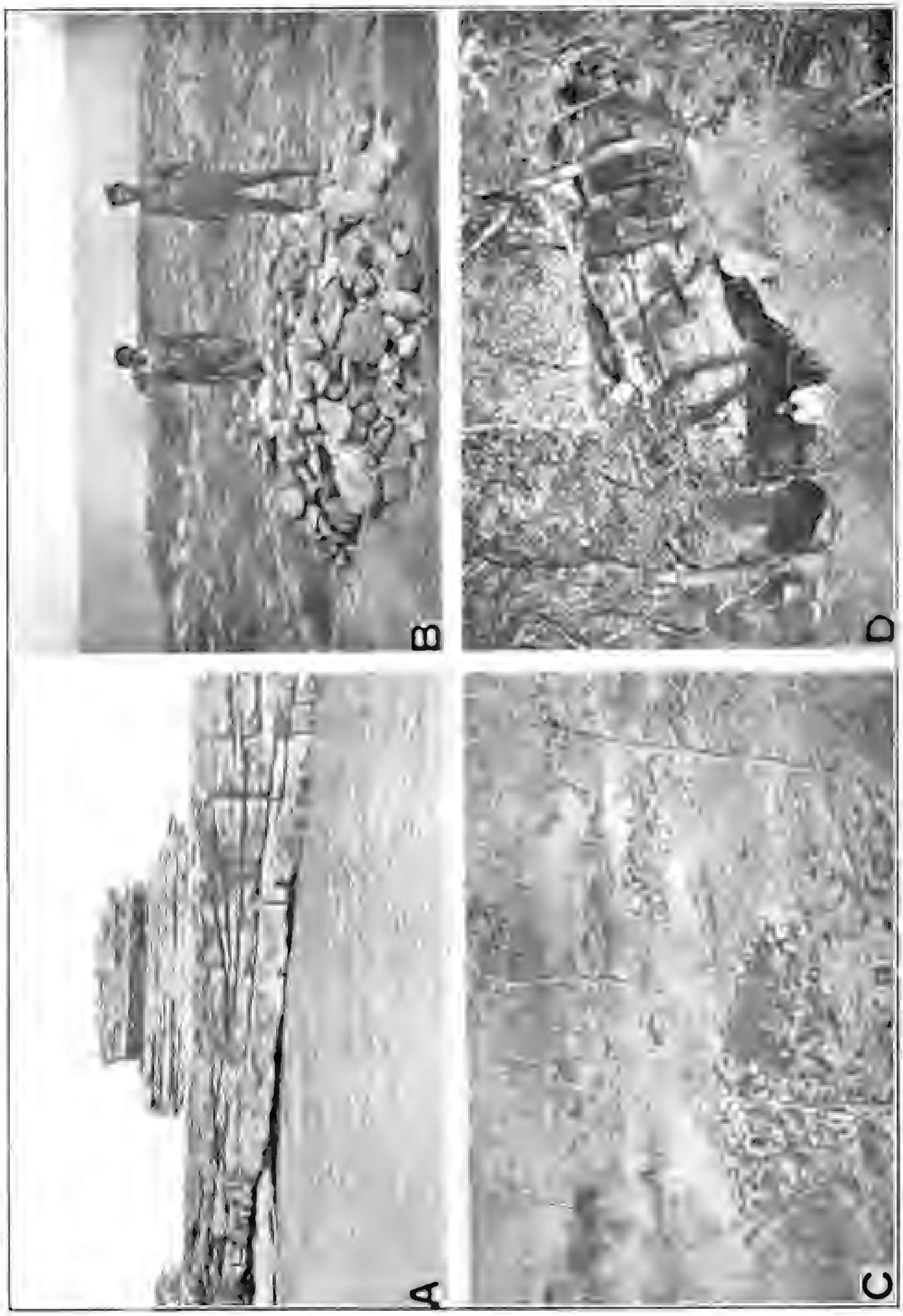
Plate xiv.

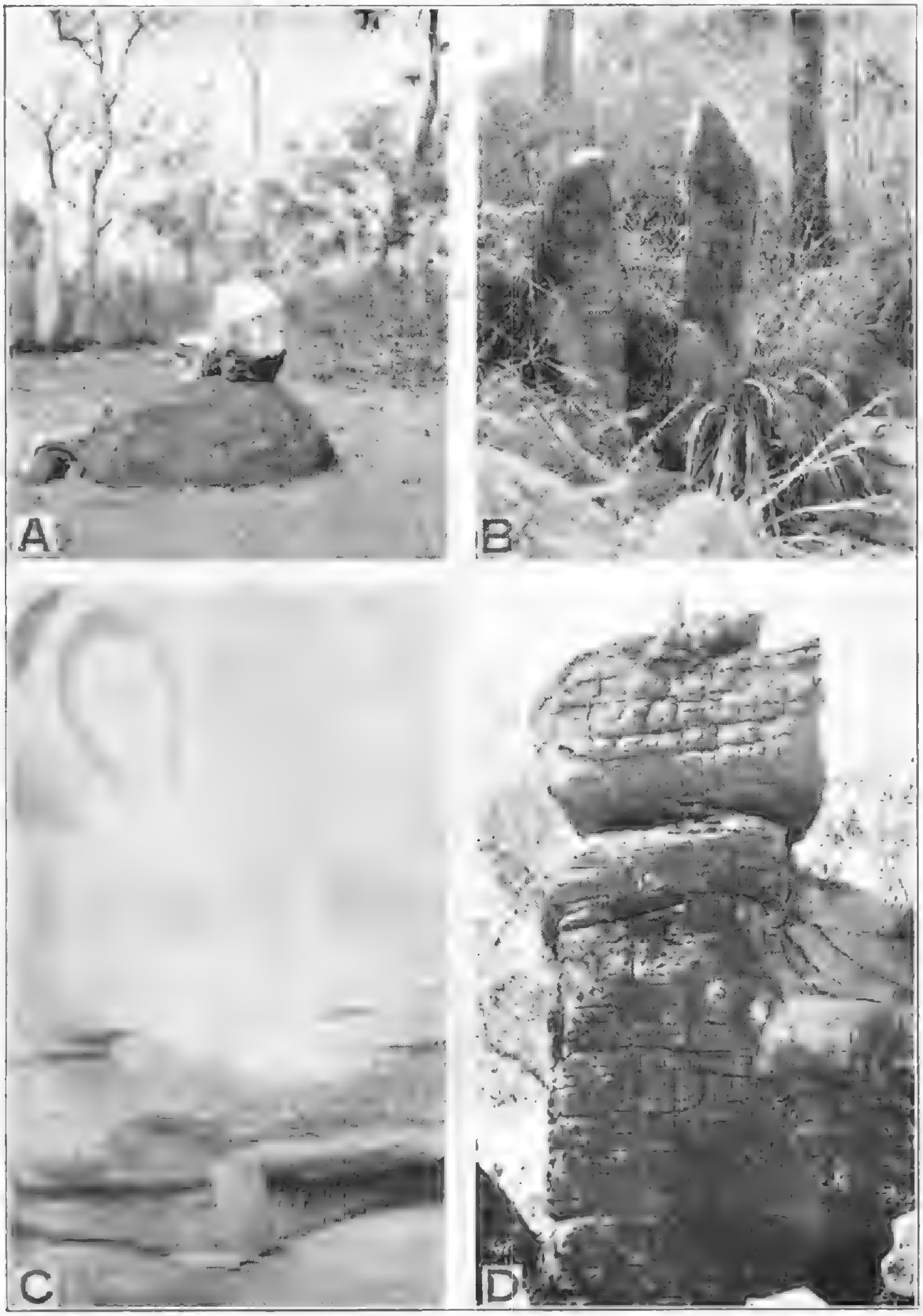
A. Tjakarara-tjari-kadjirim, a double row of stones that represents the root of a wild grape extending under the surface. In the centre foreground, at the end of the double row, is a stone with a hole in it. This represents the *kuworu,* or butt-of-the-stem, the part where the stem of the grape vine emerges from the soil.

B. Njanggaltja, subincision. This stone resembles a subincised penis, and has been set up because of its resemblance.

C. Tjakarara-tjari-kadjirim, which means "Where-they-dug-tjakarara", the root of the wild grape. This is an inlet of the sea, which is said to have been made by some *Wondjuna* digging out roots of the wild grape.

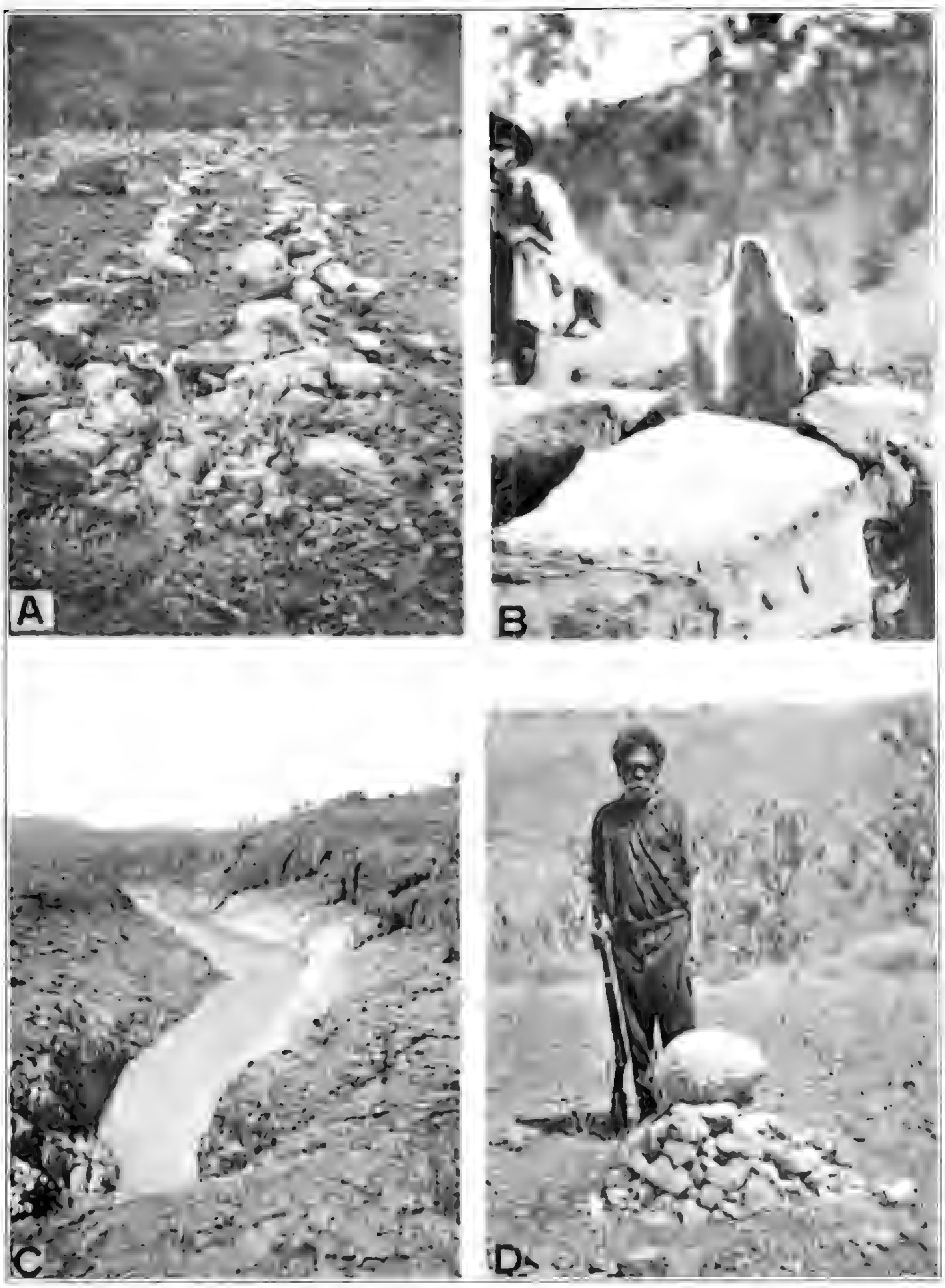
D. Tjakarara-tjari-kadjirim. The large stone set on the cairn represents the mass of cooked and pounded grape vine root. This cooked mass is called *nuguwa.*


A
B
C
D




A
B
C
D


A
B
C
D


A
B
C
D

SOME AUSTRALIAN ABORIGINAL SCAPHOCEPHALIC SKULLS

By Frank J. Fenner, Honorary Craniologist, South Australian Museum

Summary

The term scaphocephaly has been used in two ways in anthropological literature. Firstly, to describe long narrow normal skulls, like those of the Australian and the Eskimo, which are distinguished by a flattening of the paramedian parts of the frontal and parietal bones, and by the development of a sagittal crest of the parietal and sometimes also of the frontal bone.

Secondly, the term is used in connection with a very long narrow type of skull in which there is invariably a premature, probably foetal, synostosis of the sagittal suture. These skulls are rare, and occur in many races of man, European, Egyptians, Negroes, Australians, etc. In this paper, in accordance with Poirier (1931) the term scaphocephaly is used to describe the second type of skull, i.e. the pathological type.

Some AUSTRALIAN ABORIGINAL SCAPHOCEPHALIC SKULLS

By FRANK J. FENNER, Honorary Craniologist, South Australian Museum.

Plate xv and Text-fig. 1–8.

INTRODUCTION.

The term scaphocephaly has been used in two ways in anthropological literature. Firstly, to describe long narrow normal skulls, like those of the Australian and the Eskimo, which are distinguished by a flattening of the paramedian parts of the frontal and parietal bones, and by the development of a sagittal crest of the parietal and sometimes also of the frontal bone.

Secondly, the term is used in connection with a very long narrow type of skull in which there is invariably a premature, probably foetal, synostosis of the sagittal suture. These skulls are rare, and occur in many races of man, Europeans, Egyptians, Negroes, Australians, etc. In this paper, in accordance with Poirier (1931) the term scaphocephaly is used to describe the second type of skull, *i.e.* the pathological type.

It may be noted here that premature closure of the sagittal suture may occur without any trace of scaphocephaly, *e.g.* skull A999 (South Australian Muesum, Adelaide), that of a youth of 14 years, shows complete synostosis of the posterior half of the sagittal suture without any deformation of the skull. Davis (1867) describes a similar skull, that of an Australian female about 17 years old with premature obliteration of the sagittal suture, but no scaphocephaly. Hamy (1874) also describes skulls with premature sagittal synostosis but no scaphocephaly, and suggests that in these the fusion begins at some later (postnatal) period, when the ossification of the parietals is well advanced. In scaphocephalic skulls the synostosis commences during intranterine life.

PREVIOUS LITERATURE.

The only references which I can find to scaphocephaly in the Australian aboriginal are those of Davis (1867). He describes scaphocephalic skulls from McLeay River, New South Wales, and Victoria Tribe, Australia.

N. de Miklouko-Maclay (1883) published a short description of skull B1, described later in this paper, but did not recognize it as being scaphocephalic.

SOURCE OF MATERIAL.

During an examination of over 2,000 Australian aboriginal skulls in the museums of Adelaide, Melbourne, Sydney, and Canberra, five scaphocephalic skulls were seen. Particulars of these skulls may be given:

REFERENCE No.	LOCALITY.	AGE.	SEX.	MUSEUM.
A.248	Wellington, R. Murray, South Australia	c. 6 yrs.	—	S.A. Museum, Adelaide.
A.16520	Teatree Gully, South Australia	Adult	♂	S.A. Museum, Adelaide.
B.1	Rockhampton, Queensland	Adult	♂	Australian Museum, Sydney.
31837	Riverina District, N.S.W.	Adult	♂	National Museum, Melbourne.
38586	Riverina District, N.S.W.	c. 4–5 yrs.	—	National Museum, Melbourne.

OBSERVATIONS MADE.

All five scaphocephalic skulls were measured and examined. Circumstances prevented a fuller examination of the two specimens from the National Museum, Melbourne. A search for a comprehensive series of measurements with which to compare those of the abnormal skulls proved fruitless, and the figures given in Table 1 are from several sources. The reference numbers of the measurements correspond with those in Martin (1928), whose technique has been followed in all cases.

(a) Measurements 1, 2, 3, 8, 9, 10, 13, 20, 22a, 25, 26, 27, 28(1), 29, 30, 31(1), 32(1), 32(5), 33(1), 33(4), 38, 43, 44, 45, 46, 48, 50, 51, 52, 54, 55, 72, 73, 74, 75, and 75(1) were made from the reconstructed normae of Wood Jones (1929).

(b) Measurements 5, 17, 28, 31, 40 are the averages of the measurements of the first 50 skulls of Berry and Robertson's series (1914), from which Wood Jones's normae were constructed.

(c) Measurements 7, 11, 12, 23, 24, 57, 57(1) were made on a series of fifty adult crania (unsexed) from Swanport, S.A., which are housed in the South Australian Museum.

(d) Measurements 62, 63 are from Campbell (1925).

No measurements of juvenile Australian aboriginal crania were available for comparison. For this reason five normal aboriginal children's skulls of about six years of age were measured. The skulls are from the collection in the South Australian Museum.

The measurements are set out in Table 1, and the indices derived therefrom in Table 2. Where a figure is preceded by a question mark, the measurement is approximate owing to indefinite measuring points.

TABLE I.

Measurement.	Reference Number.*	Normal Juvenile Skulls.					Normal Adult Skull. Average figures.	Scaphocephalic Skulls. Juvenile.		Scaphocephalic Skulls. Adult.		
		A20626	A13179	A111	A128	A56		A248	38586	31837	B1	A16250
Greatest skull length	1	171	173	180	167	175	185	197	196	213	203	200
Glabella-Inion length	2	131	159	164	155	162	179	177	156	204	202	189
Glabella-Lambda length	3	163	161	172	164	167	180	187	?195	?208	197	189
Skull base length	5	88	89	87	85	87	98	86	84	114	101	—
Length and width of	7	?33	35	36	37	38	36	31	31	36	?37	—
foramen magnum		30	27	28	32	31	31	30	26	30	32	—
Greatest skull breadth	8	131	121	129	126	125	130	122	134	123†	121	113
Smallest frontal breadth	9	90	89	90	91	89	94	93	95	101	90	88
Greatest frontal breadth	10	103	103	109	105	103	107	104	122	104	104	98
Biauricular breadth	11	105	99	105	104	106	119	100	93	115	108	—
Greatest occipital breadth	12	100	99	91	105	98	111	100	106	?108	106	102
Mastoid breadth	13	85	89	107	90	91	99	85	74	103	100	—
Basion-Bregma height	17	?114	119	119	119	116	130	112	?137	149	134	—
Ear-Bregma height	20	107	104	114	108	107	110	108	?131	128	118	110
Highest point of skull from Glabello-Inion line	22a	95	90	95	98	93	94	101	130	116	101	98
Horizontal circumference on Glabello-Opisthion line	23	480	471	495	471	478	535	505	536	560	545	527
Transverse arc from porion to porion	24	267	265	284	276	270	293	267	?345	310	262	?260
Median sagittal arc	25	341	342	357	343	345	360	392	458	420	408	—
Median sagittal frontal arc	26	113	120	117	115	120	120	142	?188	138	136	?136
Median sagittal parietal arc	27	115	108	127	118	128	128	137	?140	?160	152	?127
Median sagittal occipital arc	28	113	114	110	109	109	112	113	?130	?122	?120	—
Median sagittal supra-occipital arc	28(1)	75	75	67	69	69	56	75	?95	65	50	72
Median sagittal frontal chord	29	97	102	103	99	102	111	110	?137	121	103	?114
Median sagittal parietal chord	30	105	101	114	105	107	115	126	?134	150	135	?121
Median sagittal occipital chord	31	92	91	88	94	87	93	82	?102	?98	96	—
Median sagittal supra-occipital chord	31(1)	65	65	57	64	61	52	65	?85	?59	48	64
Frontal angle (Bregma-Nasion-Inion)	32(1)	63°	62°	63°	63°	60°	57°	66°	70°	66°	57°	59°
Angle of frontal convexity	32(5)	127°	125°	127°	128°	120°	133°	108°	111°	130°	126°	129°
Angle of Lambda-Inion line with Frankfurt Horizontal	33(1)	157°	103°	—	—	104°	94°	114°	118°	104°	92°	?97°

TABLE I (continued).

Measurement.	Reference Number.*	Normal Juvenile Skulls. A20626	A13179	A111	A128	A56	Normal Adult Skull. Average figures.	Scaphocephalic Skulls. Juvenile. A248	38586	Scaphocephalic Skulls. Adult. 31837	B1	A16250
Occipital angle (Lambda-Inion-Opisthion)	33(4)	129°	122°	122°	129°	120°	121°	104°	110°	115°	116°	?98°
Cubic capacity of skull (in c.cs.)	38	1,090	1,040	1,230	1,140	1,070	1,290	1,160	—	1,400	1,270	—
Face length	40	?84	92	92	85	86	99	?87	83	105	—	—
Upper facial breadth	43	92	93	96	96	92	109	92	?97	119	—	—
Biorbital breadth	44	86	85	88	88	86	99	85	—	106	—	—
Bizygomatic breadth	45	?97	105	116	?107	110	128	99	—	144	—	—
Middle facial breadth	46	77	79	87	77	76	93	80	—	?99	—	—
Upper facial height	48	53	58	59	52	54	65	?50	44	68	—	—
Anterior interorbital breadth	50	17	20	23	20	18	21	20	—	25	24	—
Orbital breadth from maxillo-frontal suture	51	R. 36 L. 36	R. 34 L. 34	R. 33 L. 34	R. 36 L. 36	R. 35 L. 34	39	R. 34 L. 34	R. — L. 34	R. 44 L. 44	R. 42 L. —	— —
Orbital height	52	R. 28 L. 28	R. 33 L. 31	R. 32 L. 32	R. 30 L. 29	R. 32 L. 32	34	R. 31 L. 31	R. — L. 28	R. 33 L. 31	R. 32 L. —	— —
Nasal breadth	54	20	20	21	20	21	26	21	—	30	—	—
Nasal height	55	36	45	43	40	40	47	?36	—	53	—	—
Smallest breadth of nasal bone	57	5	8	11	8	5	10	8	—	13	—	—
Greatest breadth of nasal bone	57(1)	12	16	16	14	14	17	14	—	?21	—	—
Palatal length	62	36	46	44	43	40	51·5	40	—	54	—	—
Palatal breadth	63	29	28	27	25	30	39	31	—	35	—	—
Profile angle	72	84°	76°	78°	83°	80°	89°	?91°	85°	87°	—	—
Nasal profile angle	73	87°	79°	83°	86°	84°	92°	?99°	87°	92°	—	—
Alveolar profile angle	74	78°	68°	62°	64°	68°	73°	—	81°	66°	—	—
Profile angle of nasal roof	75	82°	69°	67°	76°	76°	66°	99°	—	76°	—	—
Angle of nasal roof with profile line	75(1)	2°	7°	11°	7°	4°	13°	—8°	—	11°	—	—

* These refer to the definitions given by Martin (1928). † 130 between supra = meatal crests.

DESCRIPTION OF SKULLS.

(1) A 248, child of approximately six years, Wellington, South Australia.

The accompanying figures (fig. 1, 4, and 5) show the remarkable shape of this skull. There is no trace whatever of a sagittal suture. The posterior third of the right and the posterior two-thirds of the left squamous sutures are also completely fused. All other sutures are normal for the age.

Accompanying this synostosis is a great forward bulging of the frontal bone, with a strongly orthognathic face, an elongation of the parietal bone, and downward projection of the occipital bone behind. There is a well-developed keel along the median sagittal plane of the frontal bone extending from glabella to just behind bregma, where it is replaced by the flattening of a post-coronal depression. The parietals themselves are very slightly keeled about half-way back. From here the bone slopes away rapidly to the occipital bone. There is no sign of a parietal tuberosity on either side.

TABLE II.

Index.	Normal Juvenile Skulls.					Normal Adult Skull Average Figures.	Scaphocephalic Skulls. Juvenile.		Scaphocephalic Skulls. Adult.		
	A20626	A13179	A111	A128	A56		A248	38586	31837	B1	A16250
Length—Breadth	76·6	70·0	70·2	75·4	71·4	70·3	61·9	68·4	57·7	59·6	56·5
Length—Height	66·7	68·8	66·1	71·2	66·0	70·3	56·8	69·4	70·0	66·0	—
Breadth—Height	87·0	98·3	92·4	94·4	92·8	100·0	91·8	102·2	121·1	117·4	—
Length—Auricular height	62·6	60·1	63·3	64·7	61·1	59·5	54·8	66·8	60·1	58·1	—
Skull Height	72·5	56·7	57·9	63·2	51·2	52·5	57·1	83·3	56·8	50·0	—
Transverse Frontal	87·3	86·6	82·6	86·7	86·4	90·4	89·4	77·8	96·1	86·5	89·8
Transverse Fronto-parietal	68·7	73·6	69·8	72·2	71·2	72·3	76·2	70·9	82·1	74·4	77·9
Sagittal Fronto-parietal	101·8	90·0	108·5	100·3	93·8	106·7	96·5	74·5	116·0	108·8	93·4
Sagittal Frontal	85·8	85·0	88·3	86·1	85·0	92·5	77·5	72·8	87·7	75·7	83·8
Sagittal Parietal	91·3	93·5	89·7	89·0	84·4	89·8	93·0	95·7	93·8	88·8	95·3
Sagittal Occipital	81·4	80·0	80·0	86·2	79·8	83·0	72·6	78·5	80·0	80·0	—
Convexity Index of Supra-occipital	86·7	86·7	85·8	92·7	88·4	93·0	86·7	89·5	90·8	96·0	88·9
Upper Face	54·6	55·2	50·9	48·6	49·1	50·8	55·6	—	64·8	—	—
Orbital	77·8	97·1	97·0	83·3	91·4	87·2	91·1	82·3	R. 75·0 L. 70·5	76·2	—
Interorbital	19·8	23·5	26·1	22·7	29·3	21·2	23·5	—	23·5	—	—
Nasal	55·6	44·4	48·8	50·0	50·3	55·3	58·3	—	56·6	—	—
Palatal	80·6	60·9	61·4	78·2	75·0	76·0	77·5	—	64·8	—	—
Transverse Cranio-facial	74·0	86·8	89·9	84·9	88·0	98·5	81·2	—	117·0	—	—
Fronto-biorbital	97·8	95·7	93·7	94·8	96·7	90·4	101·0	98·0	84·9	—	—
Jugo-frontal	92·8	84·8	77·6	85·1	80·9	73·4	94·0	—	70·0	—	—
Transverse Nasal Bone	41·7	50·0	68·8	57·1	35·7	58·8	57·1	—	62·0	—	—

A study of the measurements shows that the frontal and parietal bones have been considerably lengthened in a sagittal direction. The occipital bone has undergone no lengthening, but it bulges down because of the lower position of lambda.

In spite of the great longitudinal extension of the bones of the vault, the breadth measurements of the skull are only slightly reduced. This is due, in the case of the greatest width measurement, to a lateral bulging of the squamous temporal bone, a condition probably associated with the partial fusion of the squamous sutures. In spite of the great length and normal width of the skull, the cranial contents are approximately normal. This is due to the pronounced lateral flattening of the parietal bones.

As the photograph (pl. xv, fig. 1) shows, there is a greater degree of local bulging in this skull than is usually seen. There are bulges in front of the spheno-parietal grooves, and the occipital bone consists of a large supraoccipital protuberance and two smaller symmetrical bulges on the nuchal plane of the bone.

The basis cranii is of normal dimensions, though somewhat curved with its concavity downwards.

The face shows strong orthognathism, probably caused by the great bulging of the frontal bone, and accentuated by the flatness of the nasal bones.

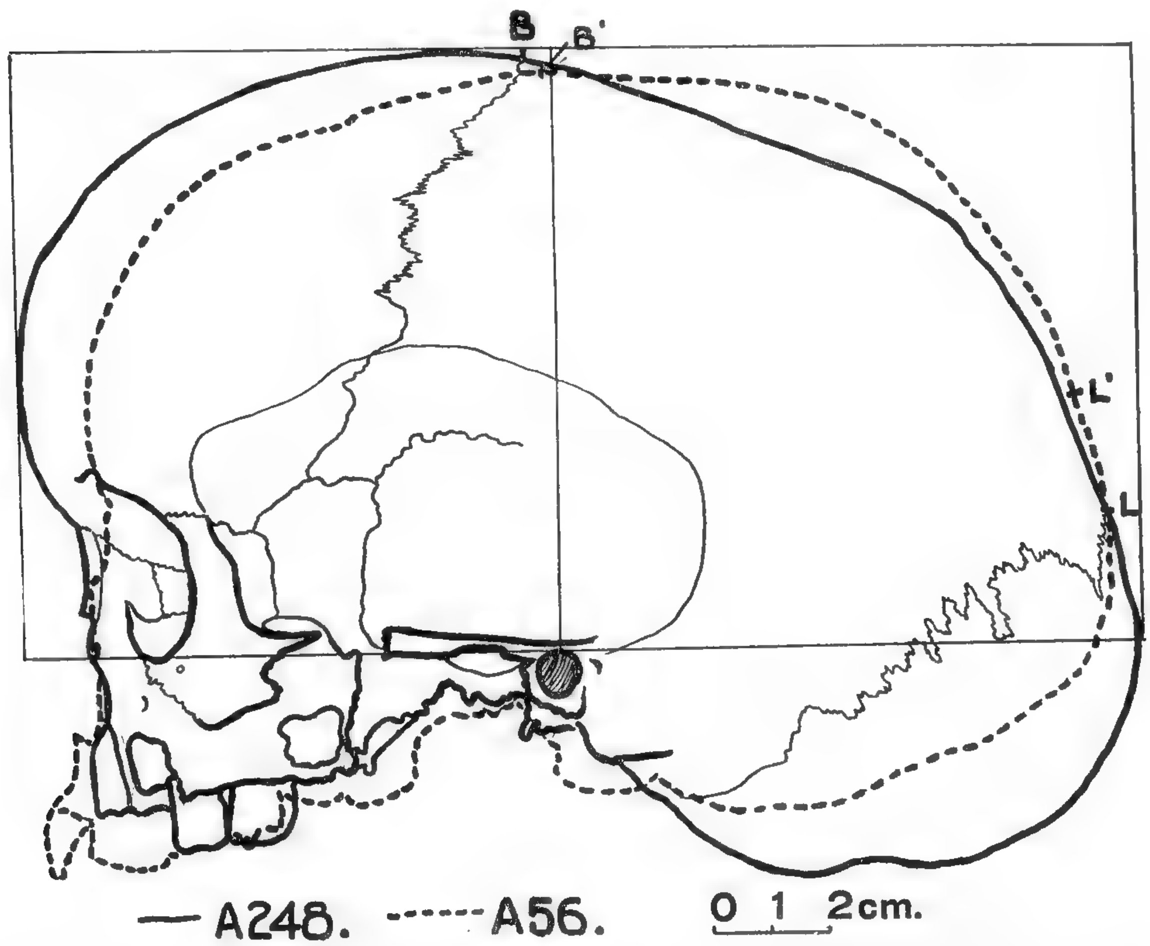


Fig. 1. Diopterographic tracings of norma lateralis of the scaphocephalic skull A248 (Wellington, S.A.), compared with a normal aboriginal skull of a child about the same age (A56). (B = bregma, L = lambda of A248) (B′ = bregma, L′ = lambda of A56).

There is no trace of the sagittal beak of Turner. The bone of the whole of the vault is considerably thinner than normal, and the juga cerebralia are particularly well marked. A skiagram of this skull (pl. xv, fig. 2) shows the "beaten-silver" effect in the bones of the vault.

The surface of the parietals shows no trace of the radiations and etching of the bone on which Hamy comments, but this condition is evident on the frontal bone just above glabella. The outer table of the parietal bone is beset with many tiny vascular pores, some of which can be seen in figure. There are no parietal foramina present, but in a series of 1,154 adult Australian skulls recently examined (Fenner, 1938) absence of these foramina bilaterally was recorded in 36 per cent.

(2) A.16520, adult male, Teatree Gully, South Australia.

This skull, of which the face and basis cranii have been destroyed, was found associated with a few other bones which are normal save for an exaggerated forward bowing of the upper third of both femora.

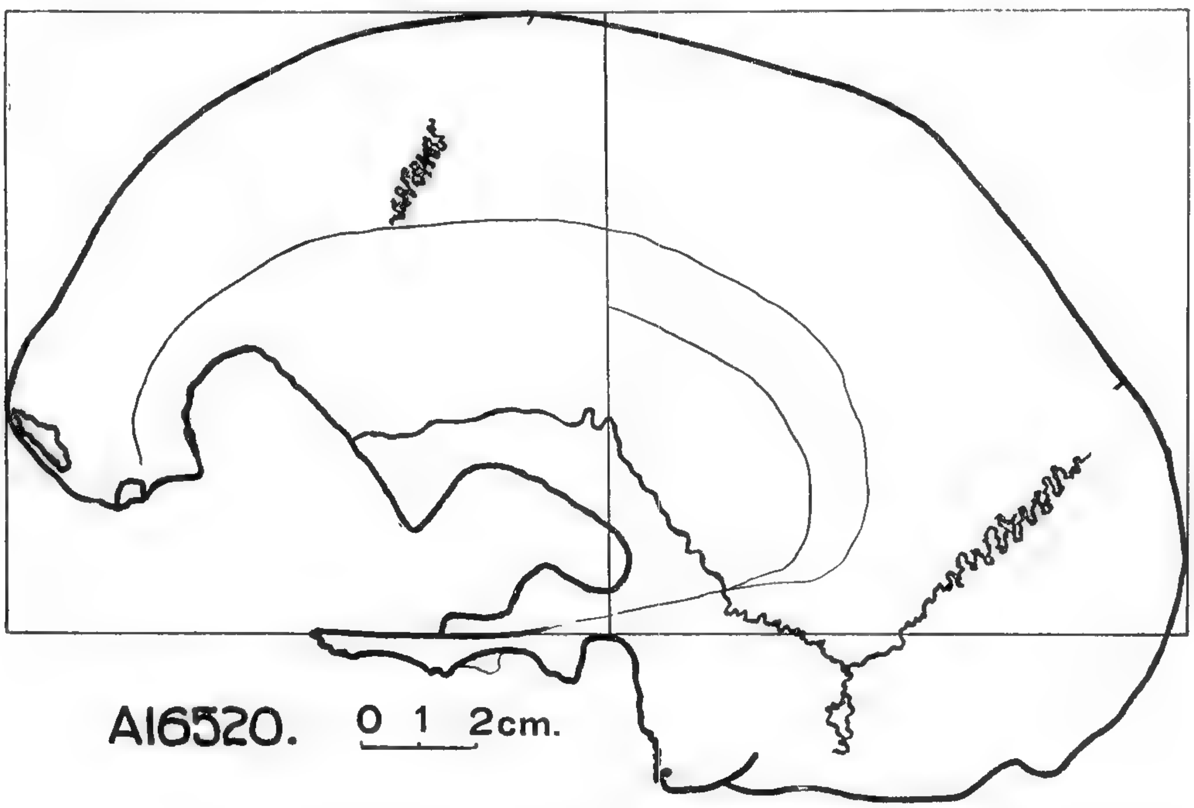


Fig. 2. Diopteragraphic tracing of norma lateralis of the scaphocephalic skull A16520 (Teatree Gully, S.A.).

There is no trace of a sagittal suture. The skull is that of an old man, and the coronal suture is obliterated save for pars complicata. The pars lambdoidea of the lamboid suture is completely fused. The other sutures are open.

The general shape of the skull can be seen in the diagrams (fig. 2, 4, and 5). There are no parietal tuberosities present, and there is a moderately well-developed sagittal keel of the frontal and anterior half of the parietal bones. It has an exceptionally long, narrow skull, and there is no bulging of the temporal bone as was noted in A.248.

The bone of the vault is very much thinner and lighter than in a normal adult aboriginal skull. The surface of the bone has been somewhat injured by exposure, but there are many tiny vascular pores over the parietal bones, especially near the midline. There is a parietal foramen on the right side in its ordinary position, and another small emissary foramen just above and to the right of lambda.

(3) B 1, adult male, Rockhampton, Queensland.

This skull is imperfectly preserved, and most of the face is missing. There is no trace of a sagittal suture. All other sutures are normal and not synostosed at all. Fig. 3, 4, and 5 show the shape of this specimen.

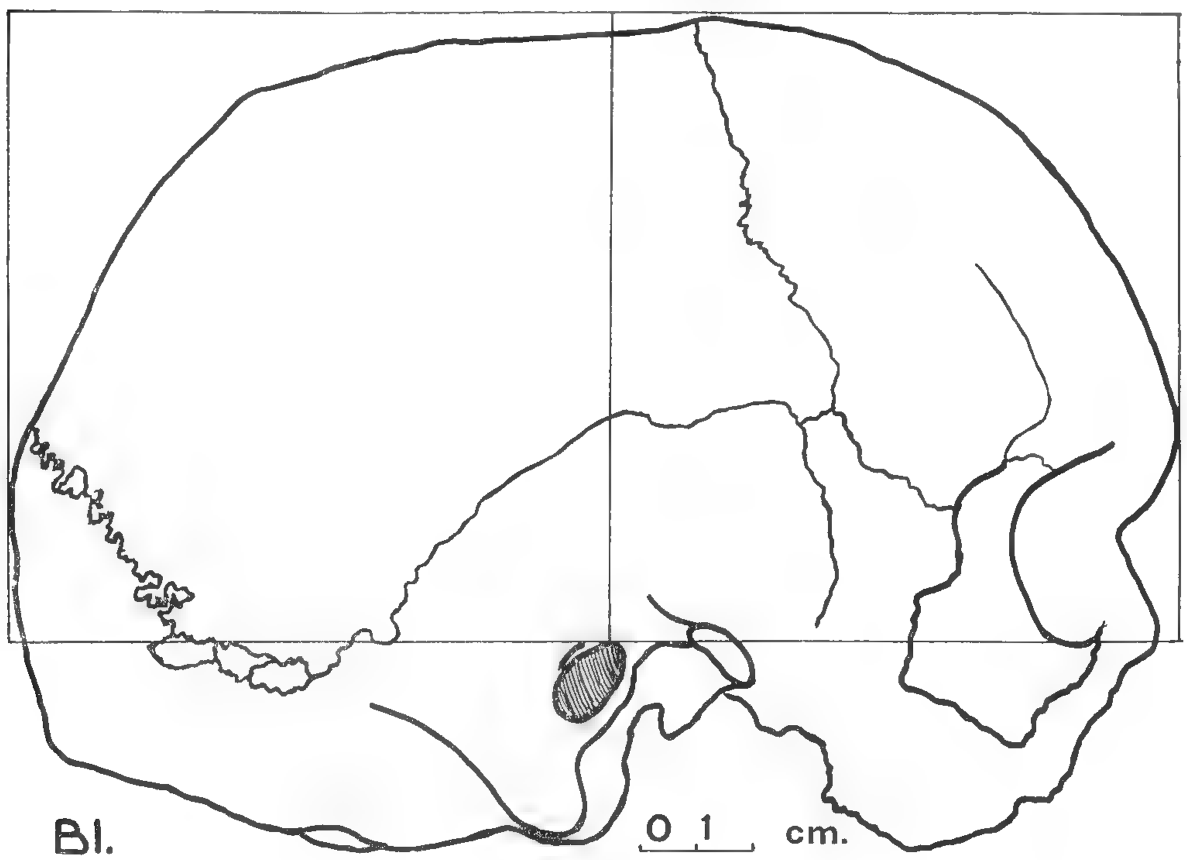


Fig. 3. Diopterographic tracing of norma lateralis of the scaphocephalic skull B1 (Rockhampton, Q.).

The features in which this skull differs from A.16520 are in part those in which distinct differences are found between Queensland and South Australian skulls (Fenner, 1938), *i.e.* it is broader and higher, the temporal fossae are better filled, and the occiput is somewhat more steeply planed than A.16520.

The sagittal keel is well developed, and extends along the whole of the frontal and the anterior half of the parietal bones. The parietal tuberosities are better developed than in the other scaphocephalic skulls, but would be classed as small. The surface of the parietal bones between the parietal tuberosities and the sagittal crest is quite flat. The transverse occipital torus and the mastoid processes are well developed, and the glenoid fossae deep. The basis cranii is of the usual aboriginal type. Beyond the fact that the bone of the vault is not excessively thinned, it is not possible to state whether there is any evidence of past disease of the bones.

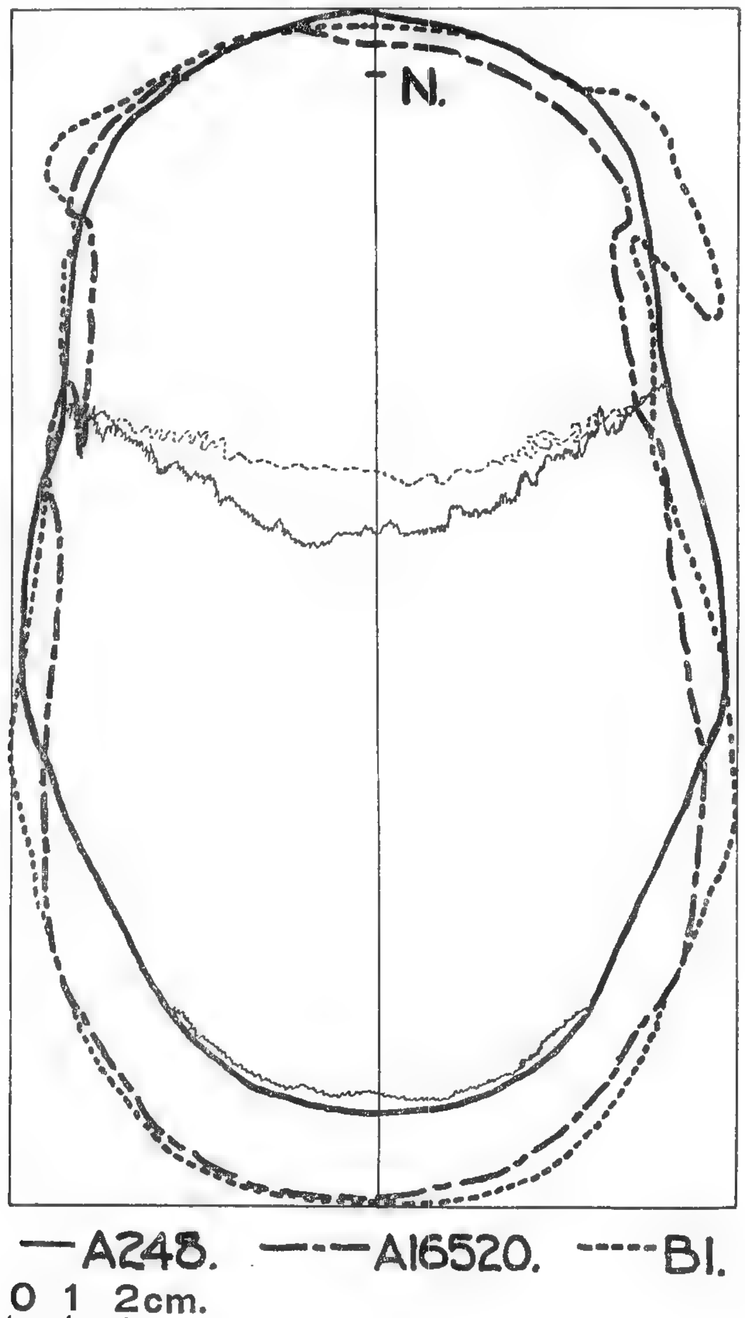


Fig. 4. Diopterographic tracings of norma verticalis of the three scaphocephalic skulls A248, A16520 and B1. (Oriented about a common point N = nasion).

(4) 31837, adult male, Parish of Nyang, Southern Riverina, New South Wales.

This is a well preserved skull, rather highly impregnated with lime. There is no trace of a sagittal suture. The coronal suture is almost completely fused, whilst the pars asterica of the lambdoid is the only part of that suture not fused. The internasal suture is fused in the greater part of its extent.

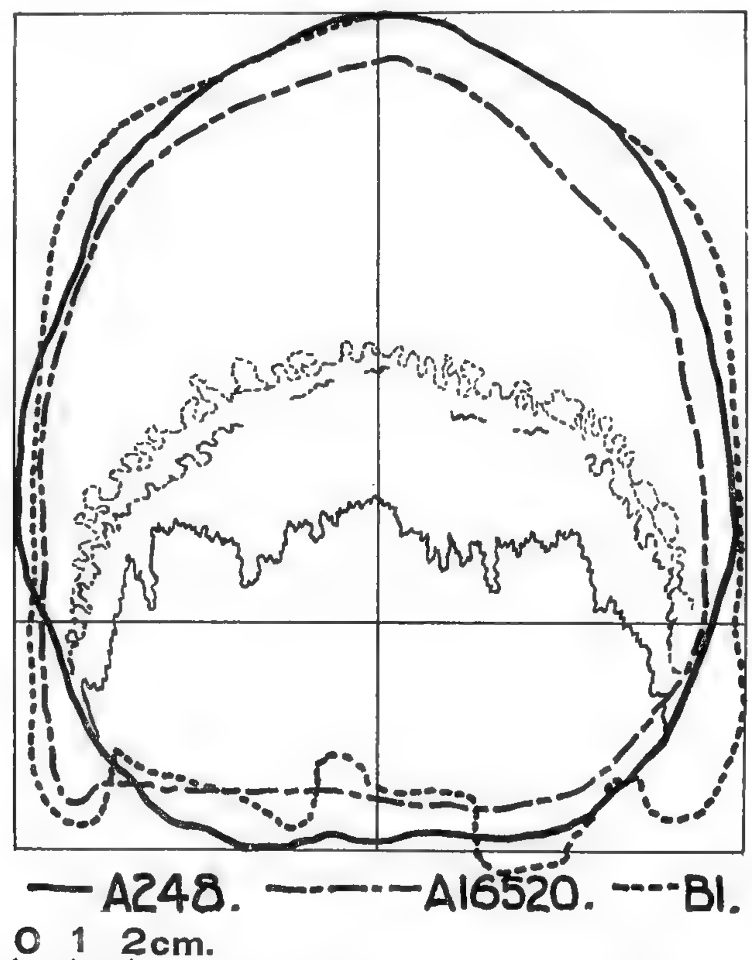


Fig. 5. Diopterographic tracings of norma occipitalis of the three scaphocephalic skulls A248, A16520 and B1. (Oriented about a common Frankfurt horizontal).

It corresponds rather closely with the other adult Australian scaphocephalic skulls (see fig. 6 and 7). It is greatly elongated, narrow, and high, and the frontal bone is more bulging than usual. There is no sign of a parietal tuberosity on either side; the sagittal crest of the parietal bones is fairly well developed, and the bregmatic eminence of Klaatsch (1908) is strongly developed.

In its other features this skull is typical of the adult male Australian, with a pronounced transverse occipital torus, well developed superorbital ridges and supramastoid crests, deep nasion, wide nasal aperture, subnasal prognathism, shallow guttered nasal margins, etc. There are no parietal foramina. The temporal lines are very high and well marked.

The glenoid fossae show advanced arthritic changes. The suture between the squamous temporal bone and the great wing of the sphenoid is raised up on a prominent crest, and in front of this there is a well marked spheno-parietal groove.

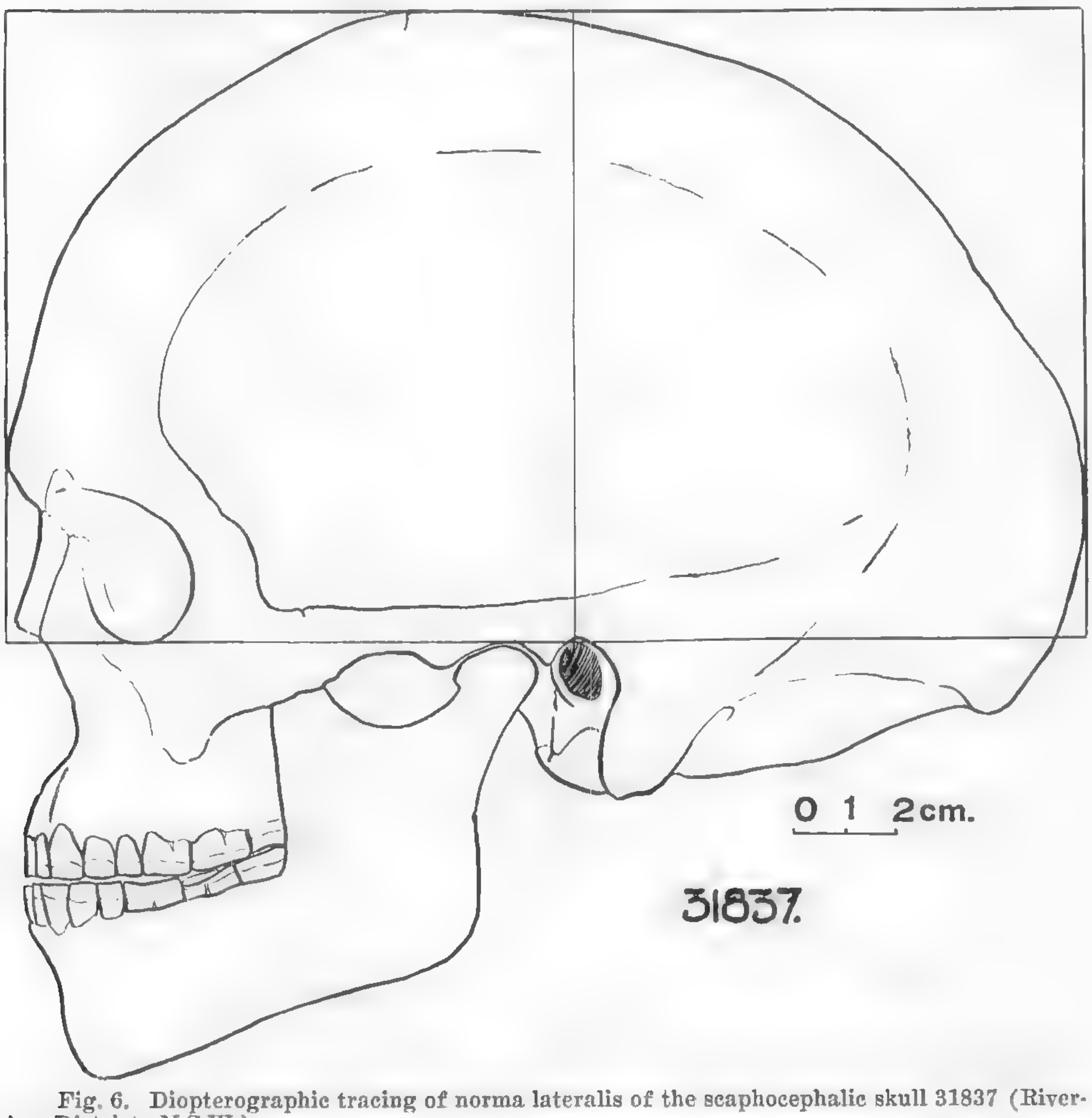


Fig. 6. Diopterographic tracing of norma lateralis of the scaphocephalic skull 31837 (Riverina District, N.S.W.).

(5) 38586, child c. 4–5 years old, near Moulamein, Southern Riverina, New South Wales.

Although included here as a scaphocephalic skull, early closure of the sagittal suture probably played only a part in the development of its remarkable shape. It is fairly heavily mineralized and encrusted with carbonate of lime. The bones constituting the right side of the face are missing.

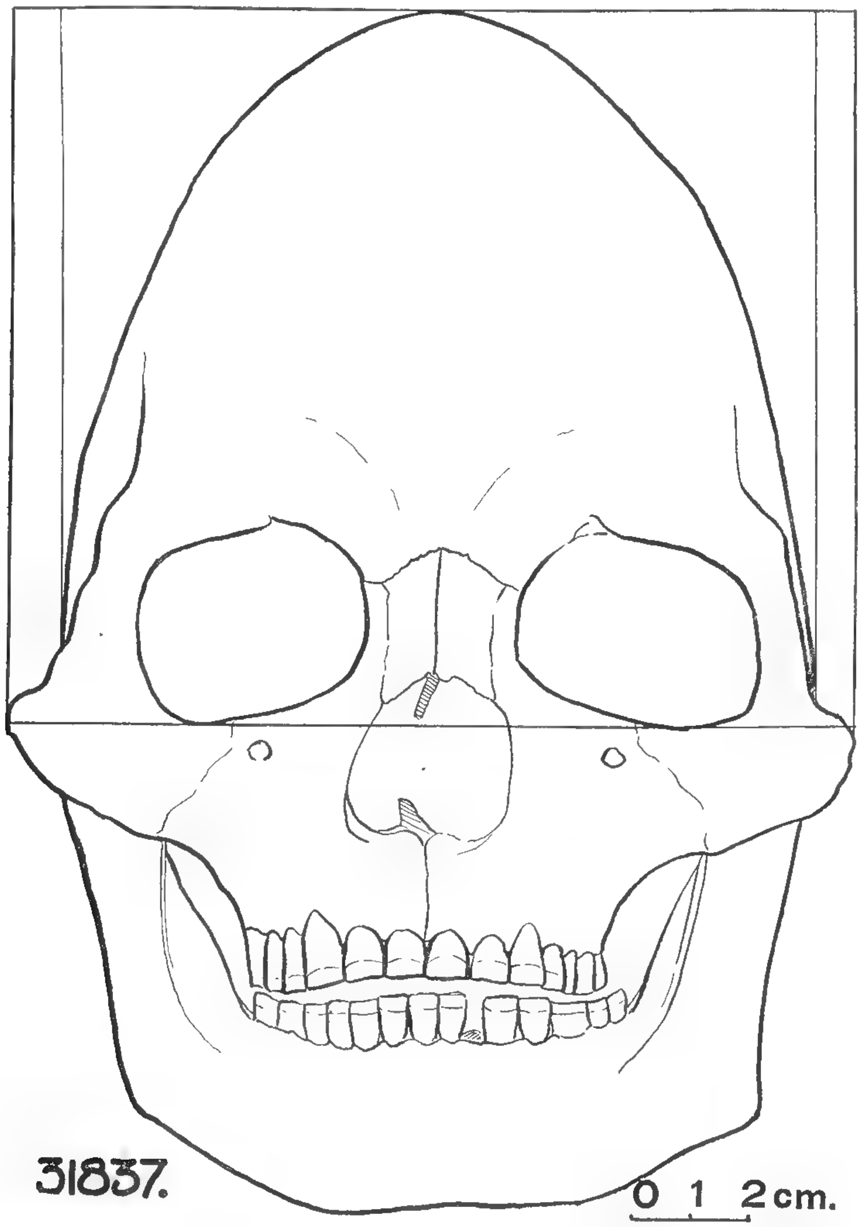


Fig. 7. Diopterographic tracing of norma facialis of the scaphocephalic skull 31837 (Riverina District, N.S.W.).

The sagittal, coronal, lambdoid, and greater part of both squamous sutures appear to be fused. In general contour it resembles A.248 somewhat, with a very protruberant forehead; flattened, backwardly projecting parietal bones with no definite parietal tuberosities and no parietal foramina; and a rather bulbous occipital bone.

It has several features which distinguish it from the South Australian skull. Firstly, the extensive and general obliteration of sutures. Secondly, the large knob-like bulge of the sagittal part of the bones of the vault, in the neighbourhood of bregma. Also it is very heavy, and its great weight is due to the enormous thickness of the bone. The greater part of the vault of this skull appears to be up to 10 mm. in thickness, and the specimen weighs more than $3\frac{1}{2}$ lb.

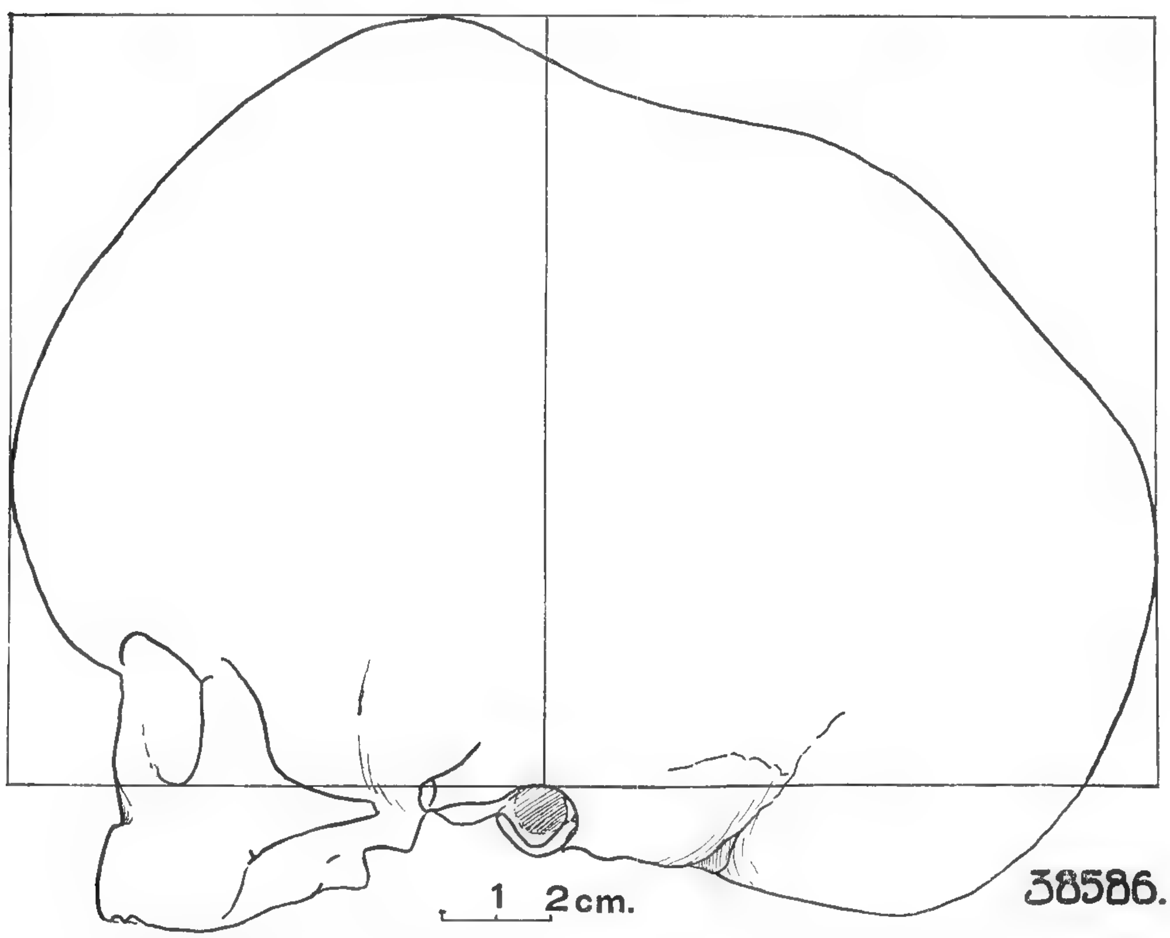


Fig. 8. Diopterographic tracing of norma lateralis of the scaphocephalic skull 38586 (Riverina District, N.S.W.).

There is a deep erosion just to the right of where lambda would probably lie. It has irregular edges and does not penetrate the bone completely. The surface of the bone has a curious pitted appearance over the greater part of the vault.

This skull merits a detailed study, and this short description is intended to do no more than bring the skull under scientific notice.

DISCUSSION.

Hamy (1874), in his review of the subject, comes to the conclusion that scaphocephaly is the result of the synostosis of the two parietal bones, that this synostosis is the result of a pathological process, probably inflammatory, and that the deformation occurs only when the fusion begins during intranterine life at a time close to the commencement of ossification of the cranial vault.

The evidence provided by these skulls supports this hypothesis. In two of these skulls and in the McLeay River specimen described by Davis (1867) the surface of the bone was covered with fine vascular pores—evidence of the pathological condition of the bone. The other three skulls are not sufficiently well preserved to determine the condition of their bone.

Hamy describes a scaphocephalic skull in which the posterior third of the squamous suture is synostosed, and mentions that he considers this synostosis to be of quite a different origin from the sagittal fusion, namely secondary to growth changes in the underlying brain.

In skull A.248 of this series there is a synostosis of the posterior parts of the squamous suture bilaterally; skull 38586 shows but a trace of the squamous suture, and Davis's McLeay River specimen had a completely obliterated right squamous suture. Only three out of 1,200 normal aboriginal skulls recently examined showed fusion of the squamous sutures, and these were all the skulls of aged individuals. Thus it seems likely that the squamous synostosis in the skulls we are considering is definitely related to the sagittal synostosis, and there is no reason to doubt that it is a further result of the same underlying pathological process which was responsible for the early fusion of the sagittal suture. What this pathological process was, other than that it was probably inflammatory, is not known.

Hauschild (1921) said that scaphocephalic skulls showed a heavy layer of osseous tissue on the tabula interna beneath the obliterated sagittal suture. The vault of the skulls described here was not cut open, but there did not appear to be any great thickening of bone beneath the obliterated sagittal suture as far as could be ascertained.

SUMMARY.

Five scaphocephalic Australian aboriginal skulls have been measured and described, and their measurements compared with those of series of normal aboriginal skulls.

ACKNOWLEDGMENTS.

I am indebted to Professor F. Wood Jones for the diopterographic tracings of skulls 31837 and 38586, and for his help in the preparation of the paper. I have to thank Mr. D. J. Mahony, Director of the National Museum, Melbourne; Dr. C. Anderson, Director of the Australian Museum, Sydney; and the Director, Mr. H. M. Hale, and Board of Governors of the South Australian Museum, Adelaide, for their kindness in allowing me to examine the skulls in their care. Mr. C. H. Marshall, of the Adelaide Hospital, kindly prepared the skiagram reproduced in pl. xv, fig. 2.

REFERENCES.

Berry, R. J. A. and Robertson, A. W. D. (1914): Diopterographic Tracings in Three Normae of Ninety Australian Aboriginal Crania. *Trans. Roy. Soc., Vict.*, vi.

Campbell, T. D. (1925): "The Dentition and Palate of the Australian Aborigine." *University of Adelaide Pub.*, No. 1.

Davis, J. Barnard (1867): Thesaurus Craniorum, London.

Fenner, F. J. (1938): The Australian Aboriginal Skull: Its non-metrical morphological characters (in manuscript).

Hamy, E. T. (1874): Sur la genèse de la scaphocephalie. *Bull. Soc. d'Anthrop. de Paris*, Ser. 2, ix, p. 836.

Hauschild, M. W. (1921): *Verh. d. anatom. Ges., Ergzh, Anatom. Anz.*, liv., p. 85 (Abstr. in *Am. J. Phys. Anthrop.*, v, p. 91).

Klaatsch, H. (1908): "The Skull of the Australian Aboriginal." *Reports from the Pathological Laboratory of the Lunacy Department, N.S. Wales*, i, Part 3, p. 45.

Martin, R. (1928): "Lehrbuch der Anthropologie", Bd. II, Jena.

Miklouko-Maclay, N. de (1883): "On a very dolichocephalic skull of an Australian Aboriginal." *Proc. Linn. Soc., N.S. Wales*, viii, p. 401.

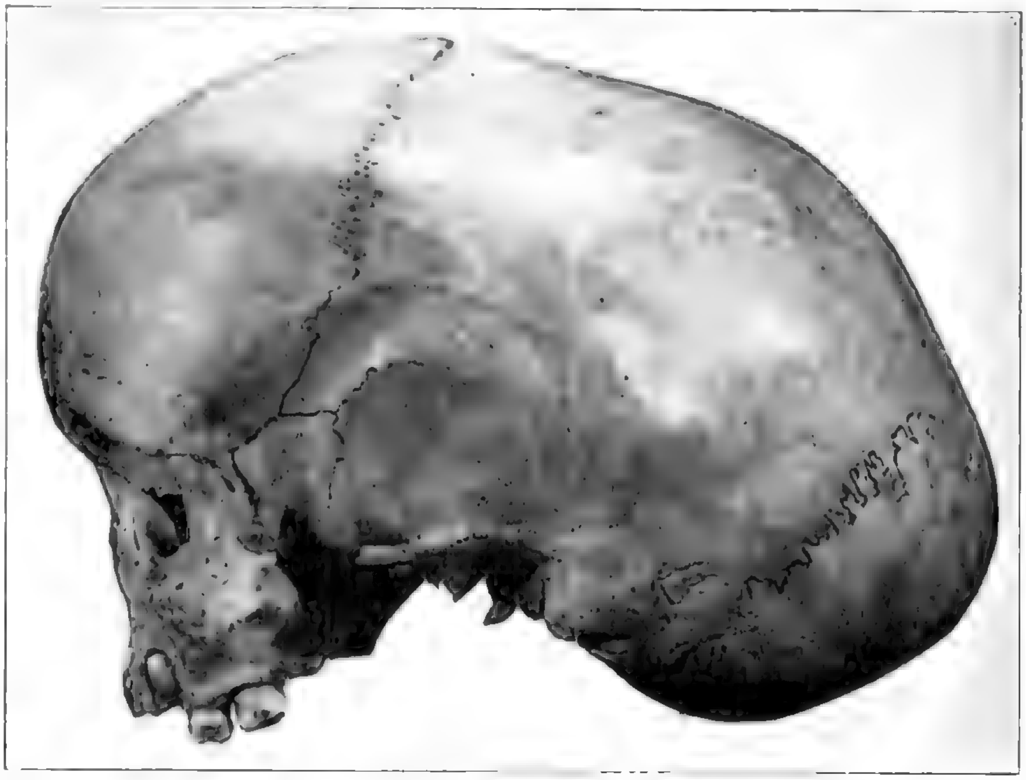
Poirire, P., Charpy, A., et Nicolas, A. (1931): Traité d'anatomie Humaine, 4th Ed., Tome 1, Fasc. 1, Paris.

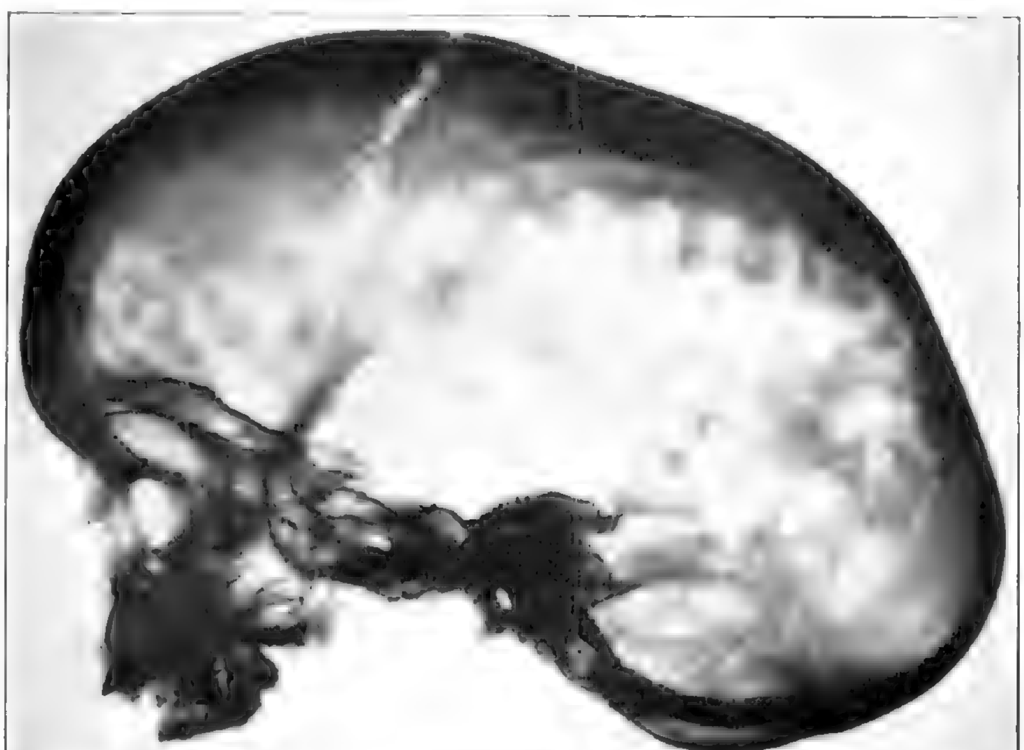
Wood Jones, F. (1929): *Journal of Anatomy*, lxiii, p. 352.

EXPLANATION OF PLATE xv.

Fig. 1. Photograph from norma lateralis of scaphocephalic skull A.248 (S.A.M., Adelaide). Note the small vascular foramina on the parietal bone and the fusion of the posterior part of the temporoparietal suture. (Photo: K. Sheard.)

Fig. 2. Skiagram from norma lateralis of scaphocephalic skull A.248. Note the thinning of the lateral parts of the vault due to the pressure of the growing brain. Photo: C. H. Marshall.)





A NEW STROMATEIFORM FISH FROM SOUTH AUSTRALIA

BY GILBERT P. WHITLEY, F.R.Z.S., ICHTHYOLOGIST,
THE AUSTRALIAN MUSEUM, SYDNEY

(Contribution from The Australian Museum,)

Summary

A most interesting fish has been submitted to me for identification by the Director of the South Australian Museum. It belongs to the Series Stromateiformes, family Nomeidae, and represents a new genus and species, quite unlike any hitherto described.
It is hoped that efforts will be made to obtain further specimens of this fish, since the study of its oesophagus, to ascertain whether teeth are present there, its branchiostegals, gill-arches, and vertebrae is very desirable, and cannot be carried out on the unique type-specimen.

A NEW STROMATEIFORM FISH FROM SOUTH AUSTRALIA

By GILBERT P. WHITLEY, F.R.Z.S., Ichthyologist, The Australian Museum, Sydney.

(Contribution from The Australian Museum.)

Plate xvi.

A most interesting fish has been submitted to me for identification by the Director of the South Australian Museum. It belongs to the Series Stromateiformes, family Nomeidae, and represents a new genus and species, quite unlike any hitherto described.

It is hoped that efforts will be made to obtain further specimens of this fish, since the study of its oesophagus, to ascertain whether teeth are present there, its branchiostegals, gill-arches, and vertebrae is very desirable, and cannot be carried out on the unique type-specimen.

Family NOMEIDAE

Genus Cridorsa gen. nov.

Orthotype Cridorsa moonta sp. nov.

A genus of small Stromateiform fishes with the body deep, form not elongate, flesh firm. Eye large, without adipose lids. Jaws with cusped incisors in front and small canines at the side. First dorsal fin well developed, with twelve spines. Soft dorsal and anal fins with about twelve rays. Pectoral fins small. Ventral fins well developed. Scales ctenoid. Coloration patterned.

In some respects this genus may represent a form ancestral to the more highly specialized Stromateiformes.

Cridorsa moonta sp. nov.

D. xi/12; A. iii/12; P. 18; V. 1/5; C. 17.
L.lat.53. L.tr.8/1/20 from first dorsal spine, to 5/1/5 on caudal peduncle.

Head (15 mm.) 3, depth of body (21 mm.) 2·1 in standard length (45 mm.). Eye (5 mm.) 3, interorbital (6 mm.), 2·5 in head. General facies as shown in pl. xvi. Head very scaly, except anteriorly, where there are many large pores, the latter mingling with scales on the broad, weakly convex interorbital. Two large nostrils on each side. Eyes large, with supraorbital ciliary processes. Jaws equal anteriorly, deflected downwards laterally. Premaxillary well developed, reaching back under the scaly maxillary.

A single outer row of erect incisor teeth in each jaw, each one compressed and with several cusps. Behind these is a series of inconspicuous villiform teeth, and there are small spaced canines at sides of jaws. Apparently there are no teeth on vomer or palatines.

Tongue free, tip broadly rounded. Velum maxillare present. Margins of preorbital and of upper limb of preoperculum serrated. Lower limb of preoperculum weakly serrated. The interoperculum, suboperculum, and branchiostegals are covered by strong ctenoid scales. Opercular margin free, entire. A small opercular spine. Gill openings wide, the membranes slightly overlapping across the narrow isthmus.

Risk of damaging the unique specimen prevents me from examining the branchiostegals, gill-arches and oesophagus. Chin and breast scaly. The broadest part of the fish is just behind the eyes. Body compressed, deep oval, and entirely covered with imbricate, thin but strong, markedly ctenoid scales, which extend over the bases of the fins.

About forty predorsal scales.

Lateral line complete, not very conspicuous, subparallel to the dorsal outline, each scale with a short tube.

Vent small, with a papilla, a little in advance of anal fin.

Caudal peduncle constricted.

First dorsal fin well developed, of eleven spines of which the middle ones are longest. Soft dorsal base shorter than that of spinous dorsal, and invested with scales. Anal fin commencing below notch between dorsal fins. It has three stout spines (middle one longest), and the soft fin terminates before the end of the soft dorsal. Twelve dorsal and anal rays, the last ones divided to their bases. Pectorals small, rounded, upper rays longest. Ventrals well developed, not reaching anal when adpressed, but only as far as vent. Caudal damaged in this specimen but probably originally emarginate.

Colour. A water-colour painting of the fresh fish shows the ground-colour as dull brownish on the back, becoming red to orange on the flanks, and dirty yellowish on the belly.

The sides of the head, body, and caudal peduncle are well-endowed with about sixty large white oval spots which break the ground-colour into a network. There is a subhorizontal white stripe below the eye.

The pupil of the eye is blackish, the iris is reddish to white, and the orbital margin grey. The fins are similar in ground-colour to the adjacent parts of the body.. There is a good deal of white on the proximal half of the spinous dorsal, towards the rear of the soft dorsal, and over the caudal fin. The rays of the fins are largely greyish.

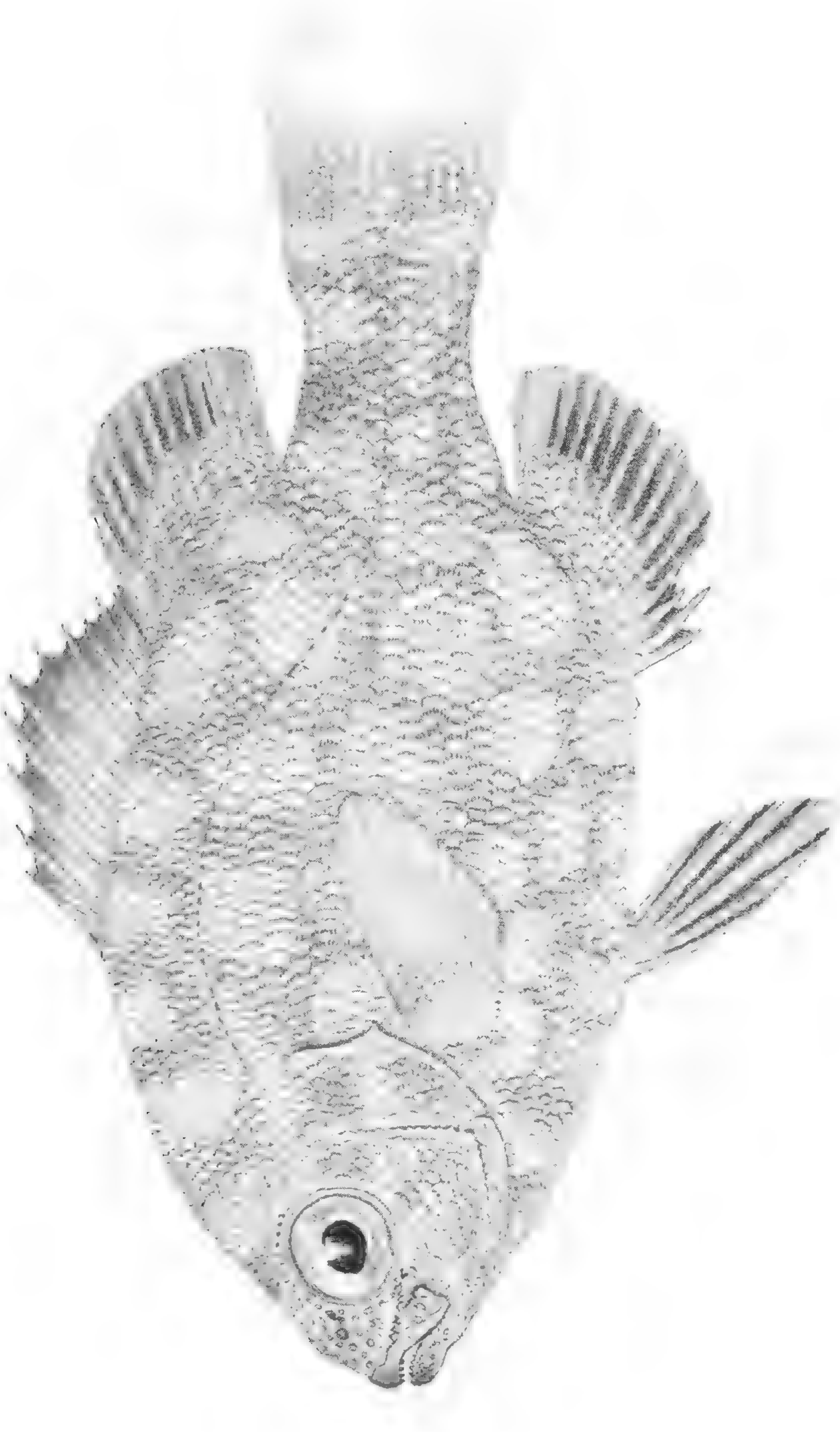
In spirit, the specimen is brownish-grey with the white spots now much duller. The fins are largely infuscated and the eye is blue. On the nape and belly the spots tend to fuse with their fellows of the other side to form cross-bars.

Described and figured from the unique holotype of the species, a specimen 45 mm. in standard length or about 2⅕ inches overall.

Loc. South Australia: Spencer Gulf, Moonta Bay (H. Kemp, Mar. 1938). Type in South Australian Museum, Reg. No. F. 2023.

EXPLANATION OF PLATE xvi.

Cridorsa moonta sp. nov. (× 4).



IDOTASIA OF FIJI (COLEOPTERA, CURCULIONIDAE)

BY ELWOOD G. ZIMMERMAN, BERNICE P. BISHOP MUSEUM, HONOLULU, T.H.

Summary

Heretofore five species and two varieties of Idotasia have been recorded from Fiji. In this paper I add three new species. In using the name Idotasia Pascoe in place of Trigonopterus Fauvel, I follow Hustache (Coleopterorum Catalogus, part 151, p. 264, 1937).

Through the kindness of the South Australian Museum I have been able to examine the types of Lea's Fijian species and varieties (Trans. Roy. Sco. S. Aust., lii, 1928, pp. 156-157). I have not seen specimens of Fairmaire's three species described as Trigonopterus anthrax, T. semicribosus, and T. merophysioides (Ann. Ent. Soc. France, 1881, pp. 314-316). Dr. P. Lesne, of the National Museum at Paris, kindly compared several of our specimens with the types of T. anthrax and T. semicribosus, and found that none of them was the same. The type of T. merophysioides could not be located. I have been unable to glean enough information from Fairmaire's original descriptions to feel safe in placing them in the key.

IDOTASIA OF FIJI *(COLEOPTERA, CURCULIONIDAE)*

BY ELWOOD G. ZIMMERMAN, BERNICE P. BISHOP MUSEUM, HONOLULU, T.H.

Fig. 1.

HERETOFORE five species and two varieties of *Idotasia* have been recorded from Fiji. In this paper I add three new species. In using the name *Idotasia* Pascoe in place of *Trigonopterus* Fauvel, I follow Hustache (Coleopterorum Catalogus, part 151, p. 264, 1937).

Through the kindness of The South Australian Museum I have been able to examine the types of Lea's Fijian species and varieties (Trans. Roy. Soc., S. Aust., lii, 1928, pp. 156–157). I have not seen specimens of Fairmaire's three species described as *Trigonopterus anthrax*, *T. semicribosus*, and *T. merophysioides* (Ann. Ent. Soc. France, 1881, pp. 314–316). Dr. P. Lesne, of the National Museum at Paris, kindly compared several of our specimens with the types of *T. anthrax* and *T. semicribosus*, and found that none of them was the same. The type of *T. merophysioides* could not be located. I have been unable to glean enough information from Fairmaire's original descriptions to feel safe in placing them in the key.

CHECK LIST.

1. *Idotasia humeralis* Lea. Viti Levu.
1–a. *Idotasia humeralis* var. *posthumeralis* Lea. Viti Levu.
1–b. *Idotasia humeralis* var. *immaculata* Lea. Viti Levu.
2. *Idotasia cribricollis* Lea. Viti Levu (Colo-i-Suva).
3. *Idotasia obsoleta*, new species. Viti Levu (Colo-i-Suva).
4. *Idotasia grandicollis*, new species. Yuvutha and Ongea, Lau.
5. *Idotasia dehiscens*, new species. Ovalau.
6. *Idotasia semicribosus* (Fairmaire). Ovalau.
7. *Idotasia anthrax* (Fairmaire). "Fiji."
8. *Idotasia merophysioides* (Fairmaire). "Fiji."

KEY TO THE SPECIES.

(*I. anthrax*, *I. semicribosus* and *I. merophysioides omitted.*)

1. Punctures on the pronotum comparatively small and round, separated by distances at least equal to, and often greater than their diameters, never close and coarse .. .. 2.

Pronotal punctures coarse and close, often subhexagonal, separated by distances equal to or less than their diameters, often subconfluent .. 4.

2(1). Form stout (fig. 1, b), prothorax broader than long, longitudinally convex; longitudinal dorsal outline of prothorax and elytra discontinuous, the elytra rising above the pronotum (fig. 1, e); ninth elytral stria with three abnormally large, coarse punctures at the base; fore femora with a blunt tooth on the outer side below .. .. *obsoleta*.

Form elongate (fig. 1, a), prothorax as long as broad, or but slightly broader than long, the disk slightly or distinctly flattened; dorsal outline of prothorax and elytra subcontinuous, the elytra not rising above the pronotum (fig. 1, f); ninth elytral stria without much larger punctures at the base; femora edentate .. .. 3.

3(2). Elytra with a large black area in the basal fourth touching at the base and lateral margin .. .. *humeralis*.

Elytra with a large black spot before the middle that is isolated from the base, suture and lateral margin .. .. *humeralis* var. *posthumeralis*.

Elytra without a humeral black spot .. *humeralis* var. *immaculatus*.

4(3). Elytra dehiscent, separately, subtubularly produced at the apex (fig. 1, d) *dehiscens*.

Elytra either jointly and broadly rounded at the apex or slightly emarginate, not dehiscent nor separately produced (fig. 1, c) .. .. 5.

5(4). Pronotum so strongly convex at the base that the dorsal outline of pronotum and elytra form a conspicuous notch; prothorax large, strongly rounded on the sides, punctures very deep and coarse, the interstices narrow and subcarinate .. .. *grandicollis*.

Prothorax subparallel-sided in the basal half, the dorsal outline subcontinuous with that of the elytra, punctures moderately coarse, their interstices flat and not appearing like carinae .. .. *cribricollis*.

IDOTASIA OBSOLETA sp. nov. (fig. 1, b, e).

Male. Derm reddish, thorax piceous, reddish to piceous below, variable; with a small elongate patch of white scales near the apex of each elytron between stria four and six and along the dorsal edge of the hind femora.

Head finely reticulate and almost impunctate, with a small interocular puncture at the base of the median rostral carina. *Rostrum* with three polished dorsal carinae that terminate at about half-way between the antennae and apex; with fine, erect, or slanting setae in the striae; punctuation fine and inconspicuous. *Prothorax* broader than long (3·2 : 2·7), and almost as broad as the elytra in the male, broadest at about the middle, rounded on the sides and without a subapical constriction, apex gently arcuate and about half as broad as the base; the longitudinal dorsal outline evenly convex, slightly, but distinctly discontinuous with that of the elytra; the dorsal punctures round, medium-sized, separated by distances equal to or greater than their diameters; with a row of impressed punctures at the base; the punctures normally bearing short, fine setae. *Elytra* subcuniform, broadest near the base, thence rapidly narrowing to the broadly rounded apex; striae obsolete, marked by series of small, shallow, inconspicuous oval punctures; with three large punctures at the base of row nine; intervals plain. *Legs* with the fore femora with a blunt tooth on the anterior ventral margin slightly beyond the middle that marks the termination of the outer ventral flange, the other femora

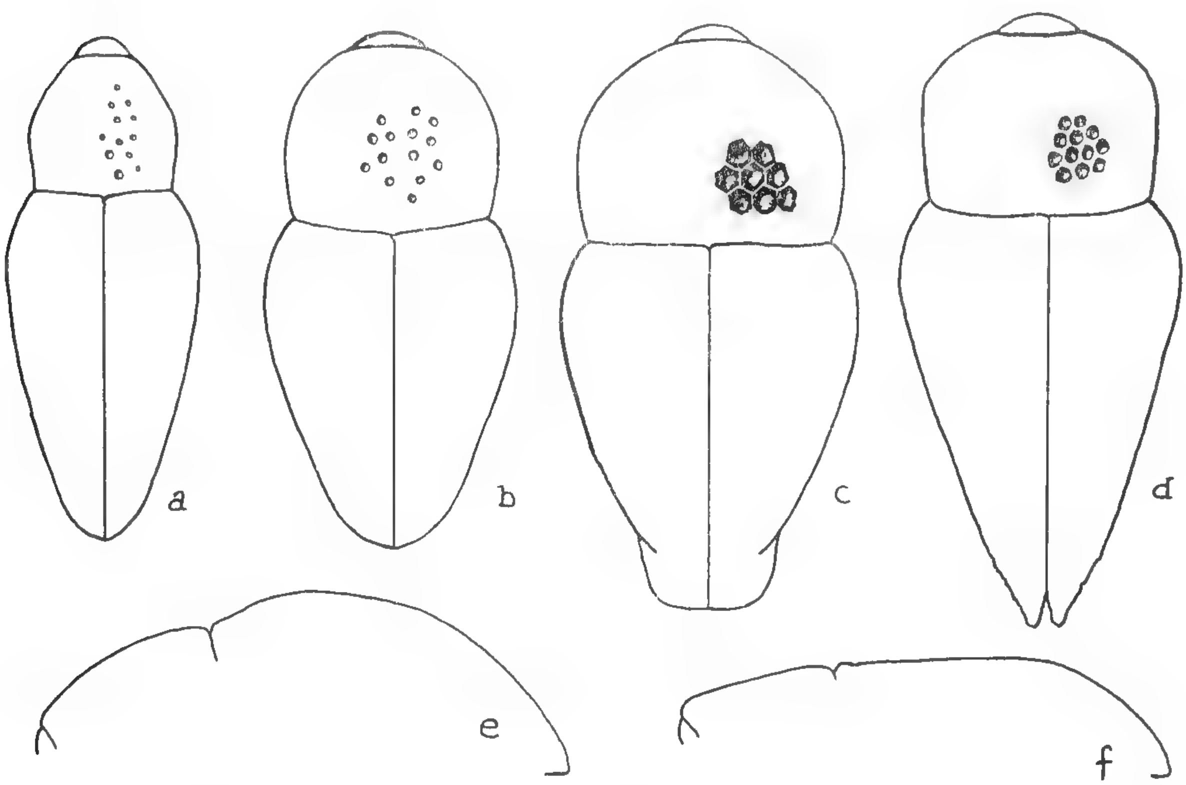


Fig. 1. Outlines of Fijian *Idotasia:* a, *Idotasia humeralis*; b, *I. obsoleta*; c, *I. grandicollis*; e, *I. dehiscens*; e and f, dorsal outlines of *I. obsoleta* and *I. humeralis.*

edentate, with a punctate groove along the outer lower margin, and several irregular rows of punctures in the distal half; the tibiae without a median carina on the outer side, with an almost obsolete, hardly discernible tooth at the base of the uncus on the hind pair. *Sternum* with the mesosternal receptacle impressed on each side of the median line at the base only, with large round punctures; metasternum concave, with coarse punctures on the sides and apex. *Venter* with the first two ventrites rather deeply and narrowly caniculate down the middle, with coarse punctures bearing rather long, fine, erect setae on the sides, but impunctate in the middle; ventrites three and four with two or three setiferous punctures on each side; ventrite five concave, densely set with small setiferous punctures. Length, 3 mm.; breadth, 1·4 mm.

Fiji, Viti Levu. Holotype male in Bernice P. Bishop Museum, collected by Mr. E. H. Bryan, Jr., at Colo-i-Suva, 29th June, 1924.

This species is closely allied to *I. cribricollis* Lea, but the prothorax is less coarsely and densely punctate, and the fore femora are not edentate as in that species.

IDOTASIA GRANDICOLLIS sp. nov. (fig. 1, c).

Derm shiny, thorax, usually the head, rostrum and venter black, antennae and legs reddish, elytra reddish, black at the apex; with an elongate patch of white scales at the apex of each elytron between the third and sixth striae and white scaling along the dorsal edges of the hind femora.

Head almost impunctate on the crown, the front flattened and very coarsely and confluently punctate; with numerous fine, recumbent setae. *Rostrum* coarsely tricarinate to the apical fourth or near the apex in the male, less coarsely so and only in the basal half in the female; coarsely punctate throughout. *Prothorax* about as broad as the elytra in the female and slightly broader in the male, somewhat broader than long in the female (3·8 : 2·8), and distinctly broader than long in the male (3·8 : 3·2); rather straightly and slightly expanded on the sides from the base to the apical third, and thence rapidly narrowing to the apex; base subtruncate; dorsum strongly convex, very coarsely and densely punctate throughout; the punctures large and subhexagonal, the interspaces very narrow. *Elytra* two-fifths longer than the prothorax, broadest near the base, thence rather rapidly narrowing to before the apex which is somewhat produced and rounded; striae impressed only at the base and apex, otherwise marked by small, well separated, elongate-oval punctures, the outer stria deeply impressed, its punctures very coarse in the basal third; intervals flat, the outer one raised in the basal third; apex coarsely punctate, with a dense, elongate patch of white scales in an impression between the second and sixth stria, inflexed at the sides. *Legs* with the femora edentate, the anterior pair serrate on the outer ventral edge in the basal two-thirds; rather densely, longitudinally punctate, with a sulcus along the outer ventral margin, the posterior pair with a dense dorsal patch of white scales in the distal half, otherwise with erect or prostrate scales or setae; tibiae with a dorsal, median and ventral carina on the outer surface, with a small, obtuse tooth at the outer side above the base of the uncus on the hind pair. *Sternum* with the mesosternal receptacle slanting forward from the middle of the mid coxae to the posterior edge of the fore coxae, impressed on either side of the raised median line; metasternum set with coarse, setiferous punctures. *Venter* with the first two ventrites deeply and broadly concave in the male, shallowly concave in the female, rather closely and evenly set with large, coarse setiferous punctures; third and fourth ventrites impunctate; fifth ventrite somewhat concave, with numerous punctures bearing sharp erect setae; the intercoxal process forming a broad angle. Length, 2·6–3·2 mm.; breadth, 1·2–1·5 mm.

Fiji. Holotype male, allotype female, in Bernice B. Bishop Museum, and six paratypes from Yuvutha, Lau, August 11, 1924, from "Yangasa Cluster", and one paratype from Ongea, Lau, July 30, 1924, all collected by Mr. E. H. Bryan, Jr.

This species is allied to *I. cribricollis* Lea, but the thorax is broader and much more densely and coarsely punctured, and with the dorsal contour of the prothorax and elytra strongly discontinuous. The squamose area at the apex of the elytra is distinctly impressed, and the intervals at the sides of the squamose area form a round subcostaform area which overhangs the side margin of the elytra.

IDOTASIA DEHISCENS sp. nov. (fig. 1, d).

Male. Derm variable in colour, dark reddish to piceous; with but a few white squamiform setae near the apex of each elytron, and without a dense white patch; with dense white scaling on the dorsal edge of the hind femora.

Head with the front flattened and coarsely, closely, and irregularly punctate; finely punctate above. *Rostrum* somewhat dilated near the base, and there with five dorsal carinae, the lateral one on each side fine, the three median carinae rather irregular and continued nearly to the apex; striae between the carinae coarse and with fine erect setae. *Prothorax* somewhat subquadrate, slightly narrower than the elytra, distinctly broader than long (3·3: 2·8), almost straight on the sides in the basal two-thirds, and thence abruptly narrowed to the truncate apex, which is half as broad as the base; the longitudinal dorsal outline gently convex, almost continuous with that of the elytra; coarsely and densely punctate throughout, the punctures separated by distances equal to about one-half of their diameters, each puncture bearing a fine recumbent seta. *Elytra* subcuniform, base slightly sinuous; broadest behind the base and thence sharply and almost straightly narrowed to near the apex which is produced, and the elytra separated, each elytron produced into a subconical process; strial grooves wanting on the disk, but the punctures elongate, close and conspicuous throughout, the ninth stria very coarsely punctate to above the hind coxa, and the seventh and eighth striae with large punctures near the base; punctures large and coarse at the apex, and bearing fine recumbent setae, those near the apex of stria three bearing a few white, squamiform setae; the first interval with a complete row of small punctures. *Legs* with the femora edentate, the fore pair minutely serrate in the basal half of the anterior ventral edge; with numerous setigerous punctures, coarser and more abundant on the fore pair; fore tibiae with two fine carinae between the dorsal and ventral carinae on the outer face, mid and hind tibiae with one median carina, that of the hind tibiae nearer the ventral than the dorsal carina; hind tibiae with a small but distinct sharp tooth on the outer edge at the base of the uncus; all the tibiae with rows of fine, erect, or slanting setae between the carinae. *Sternum* with a large, foveaform impression on either side of the middle of the base of the mesosternal receptacle; metasternum transversally impressed near the base. *Venter* with the first two ventrites broadly and shallowly concave, with rather small punctures separated by distances about equal to twice their diameters; the second ventrite with a narrow vertical face behind; ventrites three and four impunctate; ventrite five concave, densely set at the edges and apex with small setiferous punctures. Length, 3·5 mm.; breadth, 1·4 mm.

Fiji, Ovalau. Holotype male, collected by Mr. M. Greenwood, June 4, 1922, to be deposited in the British Museum from whence it was sent by Sir Guy A. K. Marshall for study.

This species may be easily distinguished from all of the other known Fijian species by its dehiscent and conically produced elytral apices.

THE AMPHIPOD GENERA EUONYX, SYNDEXAMINE AND PARADEXAMINE

BY KEITH SHEARD, HONORARY ASSISTANT IN ZOOLOGY, SOUTH AUSTRALIAN MUSEUM

Summary

The specimens treated below have been selected in order to revise the genera concerned. They were taken from tow nettings and dredgings made on the patrol boat of the Department of Fisheries and Game, during March, 1938, in Spencer Gulf, South Australia; these collections were made possible by the co-operation of the Chief Inspector of Fisheries and Game (Mr. F. W. Moorhouse).
Acknowledgements are due to the Council for Scientific and Industrial Research and to the Board of Governors of the Public Library, Museum, and Art Gallery of South Australia for their assistance; to Professor E. Percival, of the Canterbury University College, New Zealand, for the loan of New Zealand type material for comparison and revision; to Professor G. E. Nicholls, of the University of Western Australia, for literature; and to Dr. R. C. Bassett, of Adelaide, for the use of his apparatus in the preparation of the drawings.

THE AMPHIPOD GENERA *EUONYX*, *SYNDEXAMINE* AND *PARADEXAMINE*

By KEITH SHEARD, HONORARY ASSISTANT IN ZOOLOGY, SOUTH AUSTRALIAN MUSEUM.

Fig. 1–9.

THE specimens treated below have been selected in order to revise the genera concerned. They were taken from tow nettings and dredgings made on the patrol boat of the Department of Fisheries and Game, during March, 1938, in Spencer Gulf, South Australia; these collections were made possible by the co-operation of the Chief Inspector of Fisheries and Game (Mr. F. W. Moorhouse).

Acknowledgments are due to the Council for Scientific and Industrial Research and to the Board of Governors of the Public Library, Museum, and Art Gallery of South Australia for their assistance; to Professor E. Percival, of the Canterbury University College, New Zealand, for the loan of New Zealand type material for comparison and revision; to Professor G. E. Nicholls, of the University of Western Australia, for literature; and to Dr. R. C. Bassett, of Adelaide, for the use of his apparatus in the preparation of the drawings.

The species dealt with in this paper are only a fraction of those obtained. The remainder cannot be described until the revision of Haswell's types of Australian Gammaridea, now in progress, has been completed.

A curious feature of the material collected was the very great predominance of Gammaridea in both tow-nettings (using Marine Biological Association standard nets) and dredgings. Copepoda, Euphausiacea and Mysidae were very scarce, Hyperiidea were absent, while fish eggs were only present in one tow-netting—and then in very small numbers. *Nebalia* and *Sagittae* as yet undetermined were moderately plentiful. This balance was constant from near the head waters of the Gulf up to and including the open sea near Kangaroo Island.

There would appear to be some connection between the abundance of destructive forms and the relative scarcity of fish and oysters, but since this is the first time tow-nettings have been made in these waters, any conclusions are premature.

FAMILY LYSIANASSIDAE

EUONYX Norman, 1867.

Stebbing, 1906, p. 19 (key); Chevreux, 1908, p. 1 (fig.), and 1919, p. 576; Barnard, 1916, p. 110; Chilton, 1921, p. 52 (fig.); Stephensen, 1923, p. 41; Schellenberg, 1926, p. 200; Pirlot, 1933, p. 120 (fig. and key); Sheard, 1937, p. 19.

EUONYX PIRLOTI sp. nov.

Euonyx normani (*nec* Stebbing); Chilton, 1921, p. 52; Pirlot, 1933, p. 120; Sheard, 1937, p. 19.

Chilton ascribed his specimen (♂) to *Euonyx normani* Stebbing (1888, p. 669, pl. xix), and from manuscript notes in my possession, was considerably in-

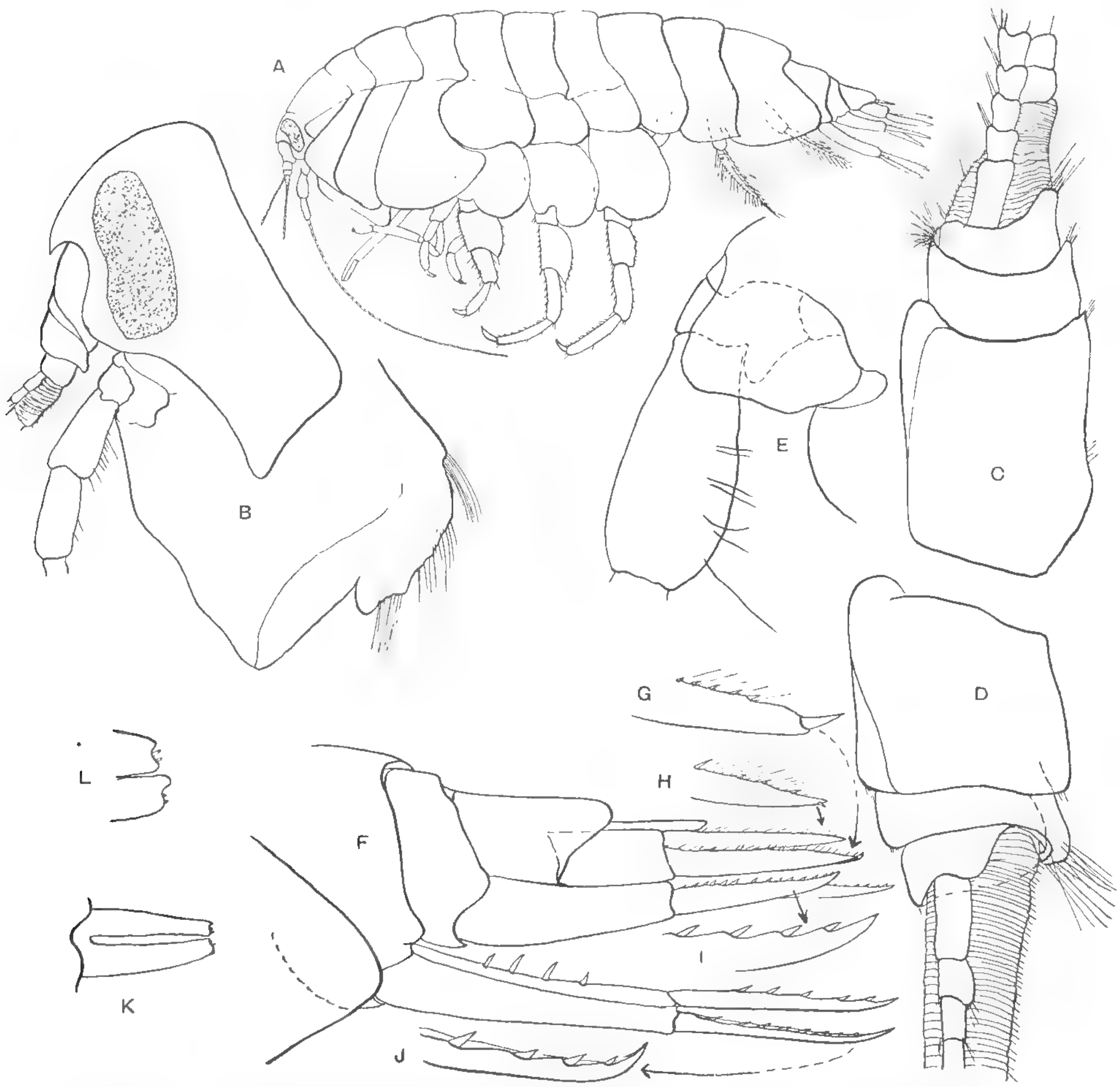


Fig. 1. *Euonyx pirloti:* A, lateral view (♀); B, detail of head and epistome; C, peduncle first antenna (♀); D, peduncle first antenna (Chilton's ♂), refigured; E, attachment of antenna (♀); F–I, details of urosome and uropoda (♀); L–K, telson (♀). (K.S. *del.*)

fluenced in this by the fact that Stebbing's species was a (♀) with the (♂) yet to be discovered. Pirlot (loc cit. p. 120) in his key separates the two, while Sheard (*loc. cit.*, p. 19) states that Chilton's specimen is probably not the (♂) of Stebbing's species.

Specimens obtained by Mr. F. W. Moorhouse off Kangaroo Island led me to search carefully through the unnamed material in the Museum collection, with the result that a long series has been found (♀ ♀ , ♂ ♂) which, on examination, proved to be cospecific with Chilton's specimen. The new species has been named in recognition of the credit due to Professor J. Pirlot for his original separation.

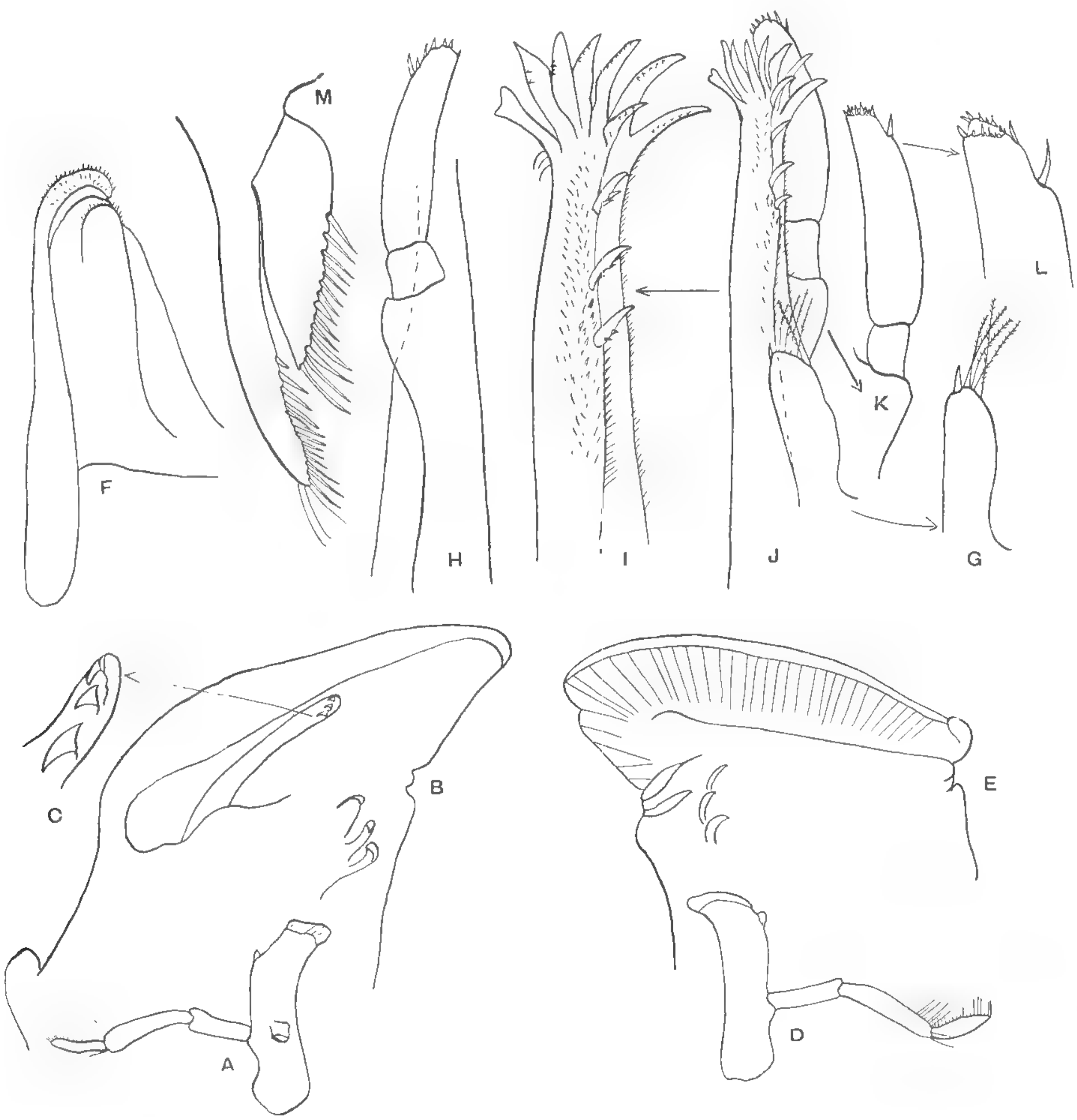


Fig. 2. *Euonyx pirloti* (♀): A–E, details of mandibles; F, half of lower lip; G–L, details of first maxilla; M, second maxilla. (K.S. *del.*)

In a recent letter from Professor G. E. Nicholls, he remarks: "With reference to your remarks about *Euonyx normani* as identified by Chilton, I should tell you that I too have amongst the "Discovery" material a specimen (ovigerous ♀ only), which I regard as new, and probably belonging to the same species as that referred by Chilton to *E. normani* Stebbing. If you are publishing shortly, would you let me see the typescript, so that I may refer my species to your manuscript name if that is necessary. If, however, you are not proposing to publish immediately, I should still be glad if you would allow me to quote you as having made that same discovery from South Australian material.''

Tracings of the South Australian specimen have been forwarded to Professor Nicholls. and thanks are due to him for his courtesy.

So far specimens have been obtained in dredgings close to land and in washings from reefs. The species is a moderately common element in the faunule, at a cursory glance quite like *Waldeckia,* but distinguishable therefrom by its chelate first gnathopod.

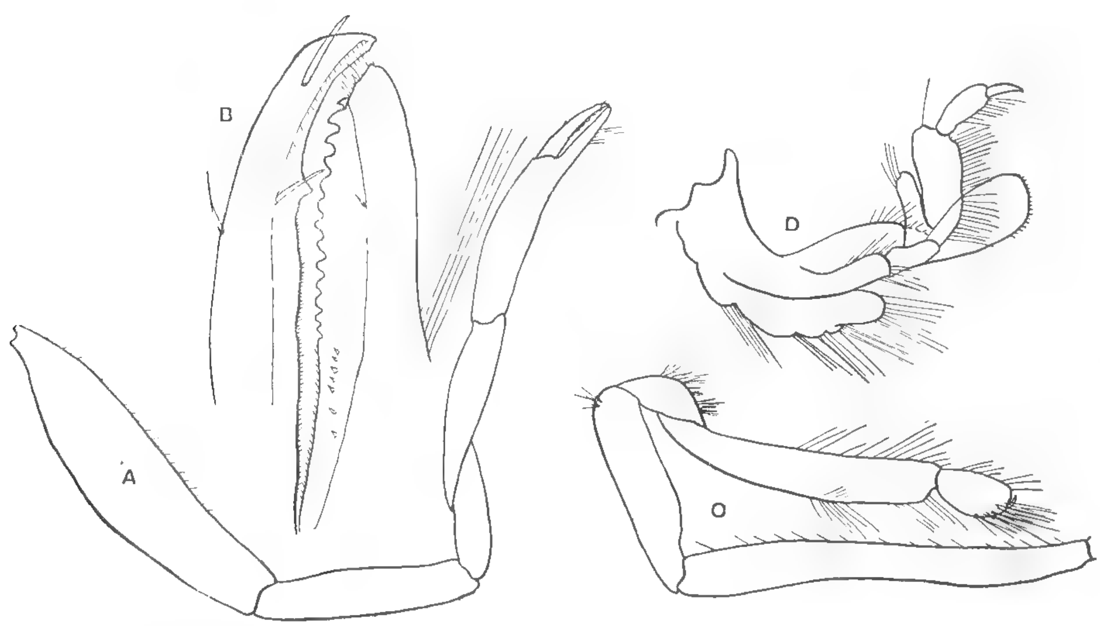


Fig. 3. *Euonyx pirloti* (♀): A, first gnathopod; B, detail of chela; C, second gnathopod; D, lateral view, maxilliped. (K.S. *del.*)

The specimen figured (♀), Kangaroo Island, is representative of the series, although those specimens collected in St. Vincent Gulf are slightly less robust, with gnathopods 1 and 2 slightly more slender. The specimen is fully figured so that only the main differences from *Euonyx normani* Stebbing are given here.

Mandible; palp with first segment equal to third, and three-quarters length of the second. (*E. normani,* one-third length of second.)

Maxilliped; the second segment of the palp appears to be relatively longer and more expanded.

Gnathopod 1; giving the basis (segment two) the value of one hundred, the proportions of the segments are as follows:

E. pirloti	100	90	39	55·2	69·7	25
Segment	2	3	4	5	6	7
E. normani	100	50	41·8	36·2	87·5	21

Gnathopod 2; giving the length of the basis the value of one hundred, the proportions of the segments are as follows:

Segment	2	3	4	5	6	7
E. normani	100	43·7	37	56	31	3·1
E. pirloti	100	50	23·3	68·8	20	3·3

Pleon segment 3; side plate not pointed behind.

Peraeopod 5; segment 5 is slightly longer than segment 4, not shorter as in *E. normani* Stebbing.

The rami of the uropods are approximately equal in length. (The outer ramus of uropod 2 is slightly foreshortened in fig. 1 (f).) No small teeth could be seen on the dorsal surface of the telson (c.f. Stebbing, 1888, pl. xix).

The relatively much longer gnathopod 1 of *E. pirloti,* due to a longer segment five, and its attachment nearer to the anterior end of segment four than in *E. normani,* readily distinguishes between them.

In passing, it may be noted that Chilton (loc cit. p. 52, fig. 5a) omitted a shallow groove on the anterior dorso-lateral surface of his figure of segment one of antenna 1. This groove gives a slightly keeled effect to this segment.

Loc. Nepean Bay, Kangaroo Island (F. W. Moorhouse, May, 1938); Brighton, St. Vincent Gulf (K. Sheard and B. C. Cotton, Mar., 1937); Sellick's Beach, St. Vincent Gulf (H. M. Hale, Apr., 1936); off Semaphore, St. Vincent Gulf (H. M. Hale, Mar., 1924); Spencer Gulf (A. Zeitz, 1887); Ardrossan (Dr. J. C. Verco, Jan., 1903); Western Shoal, Spencer Gulf (K. Sheard and F. Moorhouse, Mar., 1938).

FAMILY DEXAMINIDAE

Dexaminidae; Stebbing, 1906, p. 514 (*lit.* and *syn.*), and 1910, p. 602; Chilton, 1914, p. 332; Spandl, 1924, p. 56; Schellenberg, 1928, p. 655, and 1931, p. 209; Barnard, 1932, p. 217.

The following key is adapted from Stebbing (1906, p. 514) to include recent genera:

a. Maxillipeds, palp with 3 segments.
  b. Lower lip, with inner lobes well developed. .. .. *Dexaminella*
  bb. Lower lip, with inner lobes rudimentary.
    c. Peraeopods 1–5, 4th segment shorter than 5th and 6th combined .. .. *Dexamine*
    cc. Peraeopods 1–5, 4th segment longer than 5th and 6th combined .. .. *Tritaeta*

aa. Maxillipeds, palp with four segments.
- d. Maxilla 1, palp with one segment.
  - e. Maxillipeds, inner plates short and bud-like .. *Dexaminoides*
  - ee. Maxillipeds, inner plates of moderate size.
    - f. Lower lip, mandibular process absent .. .. *Syndexamine*
    - ff. Lower lip, mandibular process present .. .. *Paradexamine*
- dd. Maxilla 1 palp with two segments.
  - g. Maxilla 1, second segment of palp large, maxillipeds, inner plates well developed .. .. .. *Polycheria*
  - gg. Maxilla 1, second segment of palp small, maxillipeds, inner plate rudimentary .. .. *Guernea*

The genera discussed here are *Syndexamine* and *Paradexamine.*

Professor E. Percival, to whom I wrote for types, states:

"There are no types of *Paradexamine pacifica* (Thomson), merely tubes of material labelled with the country of origin. You will need, I suppose, to select suitable specimens for description therefrom. *Syndexamine carinata* Chilton is represented only by two co-types."

Accordingly, specimens have been selected and figured as lectotypes.

In passing it is worth recording that the examination of some of Chilton's Amphipod material and its comparison with more modern work has convinced me that he tended to simplify the issue a little too much. While it is quite true that growth changes occur in the chitinous cuticle with age, that secondary sexual characters emerge and develop, and that every specimen varies in some slight particulars from every other specimen; it is also true that growth changes tend to follow a certain course within the species, that secondary sexual characters develop in a definite manner, while the intra-specific variation bears a high degree of relationship to the species itself. Consequently it is the business of the systematist to record outstanding differences and divergencies from the already known ranges of variation and not to seek to integrate the pattern until significant data, widely spaced along the curve of variation, is accumulated.

Full illustration of all differences is essential, an ideal often difficult of attainment.

SYNDEXAMINE Chilton.

Syndexamine Chilton, 1914, p. 332 (fig.).

SYNDEXAMINE CARINATA Chilton.

Chilton's generic description must be slightly emended as a large well-defined molar area is present.

Lectotype (♂). As described and figured by Chilton except in the following particulars:

A definite, large molar area is present.

An accessory plate (see fig. 4, A, B, C, D) is present.

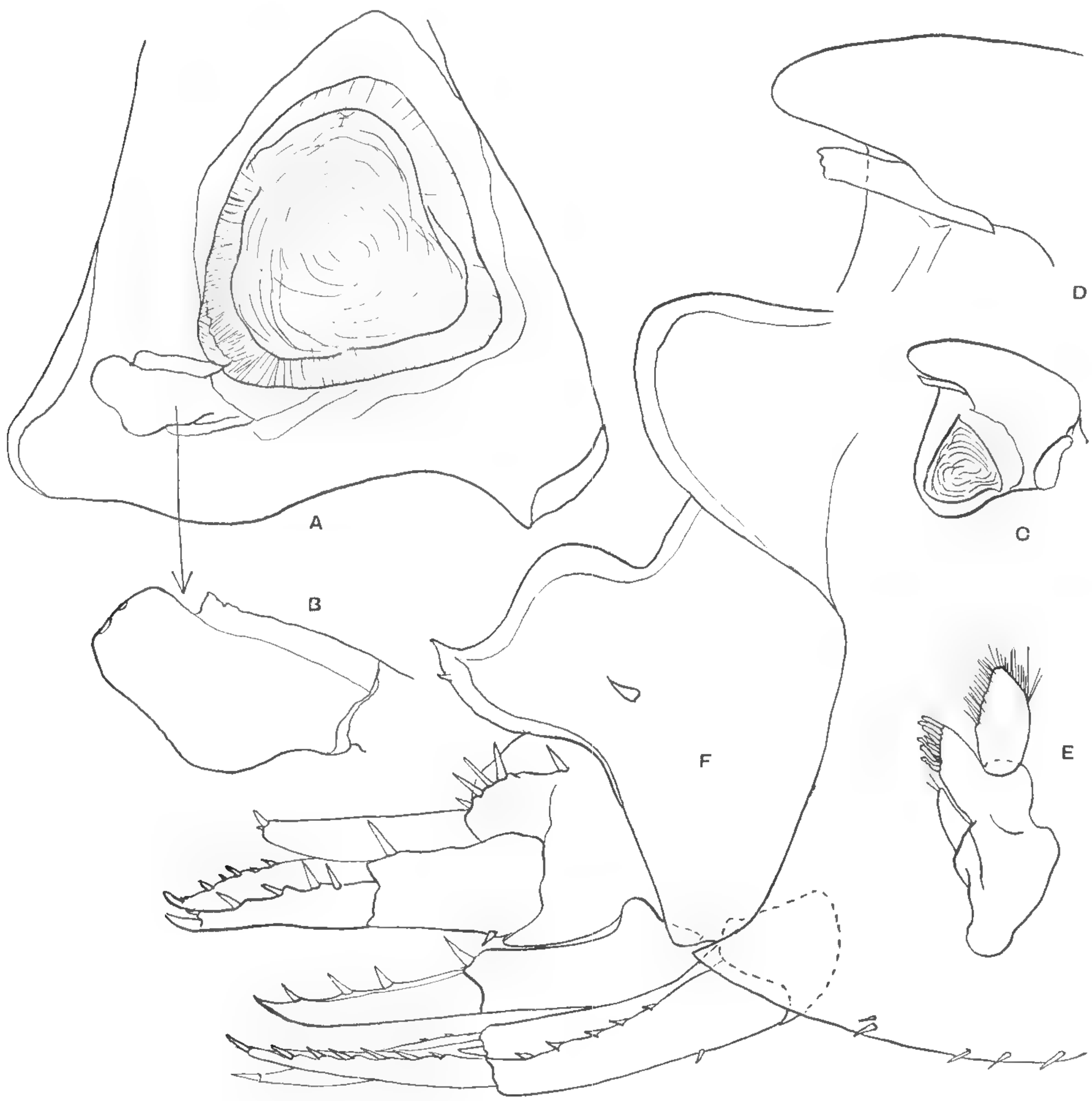


Fig. 4. *Syndexamine carinata* (lectotype): A–D, mandibles; E, first maxilla; F, urosome. (K.S. *del.*)

The palp of Maxilla 1 appears to be broader than in Chilton's figure.

The small rounded protuberance in the mandibles mentioned by Chilton (loc. cit. p. 334) appears to be the newly-developing mandibular cutting edge, previous to moulting.

The eye is slightly oval, and is situated between the two antennae at the base of the inter-antennal angle.

PARADEXAMINE Stebbing.

Paradexamine Stebbing, 1906, p. 518 (*lit.* and *syn.*), and 1914, p. 366; Chevreux, 1906, p. 88 and 1913, p. 181; Chilton, 1909, p. 632, 1912, p. 501 and 1925, p. 179; Stephensen, 1927, p. 347; Barnard, 1930, p. 389, and 1932, p. 217; Sheard, 1937, p. 25.

As it is difficult to find a reliable character which has been positively described by authors for each of the seven species of this genus, the following key which I have drawn up for their separation is even more suspect than most. It is accurate within its limits, but must be used in conjunction with the specific description.

a. Apex of telson with many small teeth on each lobe, inter-antennal angle pointed.
  b. Gnathopod 2, joint 5 subequal to joint 6 .. .. *P. pacifica*
  bb. Gnathopod 2, joint 5 more than $1\frac{1}{2}$ times joint 6.
    c. Lower lip, with no teeth on apex of each lobe .. *P. moorhousei*
    cc. Lower lip, with one tooth on apex of each lobe .. *P. barnardi*
aa. Apex of telson with several small teeth together on each lobe, then an outer spine. Inter-antennal angle convex.
  d. Gnathopod 2, joint 6 longer than joint 5; antenna 1, first joint of peduncle longer than second; antenna 2, peduncle stout, subequal to peduncle of antenna 1 .. *P. flindersi*
  dd. Gnathopod 2, joint 6 shorter than joint 5; antenna 1, first joint of peduncle shorter than second; antenna 2, peduncle long and slender, longer than peduncle of antenna 1 .. .. *P. frinsdorfi*
aaa. Apex of telson with two teeth separated by a strong spine, antennal angle rounded (? *P. nana*).
  e. Maxilla 11, setae on distal third of inner edge of inner plate .. .. .. *P. sexdentata*
  ee. Maxilla 11, setae confined to end of inner plate .. .. *P. nana*
aaaa. Apex of telson without teeth, antennal angle rounded; lower lip, a tooth on inner margin of outer lobes; maxilla 11, seta on inner edge of inner plate .. .. *P. fissicauda*

PARADEXAMINE PACIFICA (Thomson).

Stebbing, 1906, p. 518 (*lit.* and *syn.*); Chilton, 1909, p. 632; Stephensen, 1927, p. 347 (fig.) and 1938, p. 246; Schellenberg, 1931, p. 209; *nec* Barnard, 1930, p. 389, fig.

The specimens sent to me from the Chilton collection include some originally collected and named by Thomson, but the only locality given is New Zealand. As might be expected, there is a slight variation existing between the specimens in minor characters, but the complex is itself so clearly marked off from any other

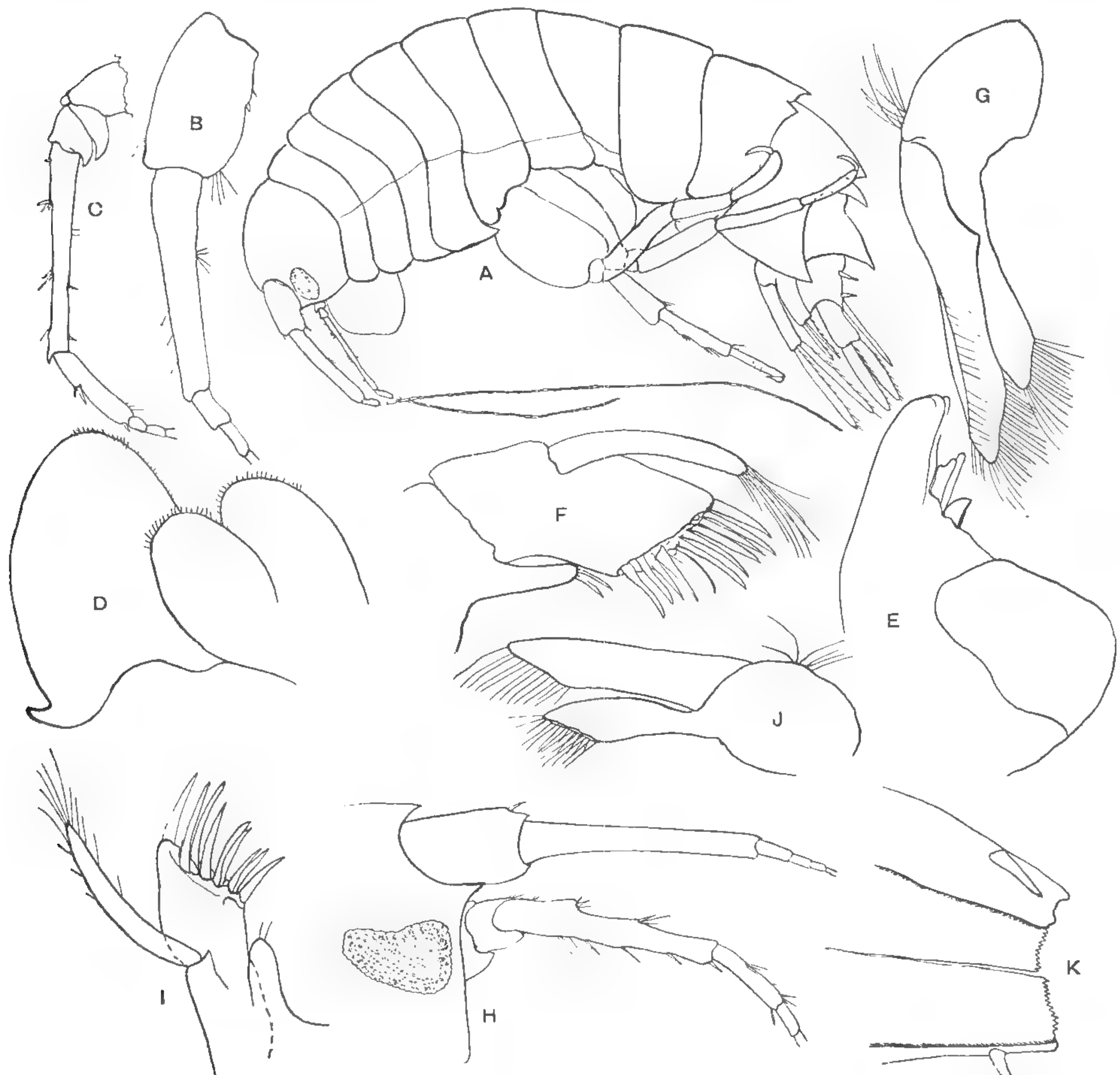


Fig. 5. *Paradexamine pacifica* (lectotype ♂, ♀): A, lateral view (♂); B, peduncle first antenna (♂); C, peduncle second antenna (♂); D, portion of lower lip (♂); E, mandible (♂); F, first maxilla (♂); G, second maxilla (♂); H, head (♀); I, first maxilla (♀); J, second maxilla (♀); K, tip of telson (♀). (K.S. *del.*).

species of the genus that there would be nothing gained by making further new species or subspecies. When material is to hand with the localities definitely marked, splitting is to some extent justified. The characters which present some degree of variation are as follows:

1. The armature of the peraeopods.

2. The presence in varying numbers of setae on the margins of the palp of maxilla 1.

3. The presence in varying numbers of scattered setae on the outer edge of the outer plate of maxilla 2.

4. The finger of the palp of the maxilliped varying from slightly swollen and blunt (type) to slender. In no case is it at all large.

5. The eye colour (spirit specimens) varies from very faded to very bright red.

Among the constant characters connecting all the specimens are the following:

1. The pointed inter-antennal angle of the head.

2. The slightly swollen first joint of antenna 1.

3. The relative proportions of the joints of the gnathopods and peraeopods.

4. The slightly greater length of peraeopod 4 as compared with peraeopods 3 and 5.

5. The presence of two spines on each side of the dorsal surface of the last urosome segment.

The last part of Thomson's statement, "Peraeopoda slender, thickly setose, all having the dactylos directed posteriorly, except the last pair, which are also much the longest" (Trans. N.Z. Inst., XI, 1878, p. 238), is incorrect in one particular. On account of the way in which the peraeopoda are carried it is very easy to consider the longest to be peraeopod 5; actually it is peraeopod 4.

Two specimens (♂ and ♀) have been erected as lectotypes. Their salient points have been figured. For the rest, while I am not quite satisfied that Stephensen (loc. cit. p. 345) was dealing with the same species, I can see no difference in the appendages named below, and since Thomson's specimens are somewhat damaged by long storage, while Stephensen's figures of the peraeopods and uropods are taken from comparatively fresh material, I see no necessity for duplicating his work. In the type selected the pleon side plates are slightly damaged. In other specimens they are as drawn by Stephensen (loc. cit. p. 345).

Distribution: New Zealand; East Coast of Australia (?).

PARADEXAMINE BARNARDI sp. nov.

PARADEXAMINE PACIFICA (*nec* Stebbing) Barnard, 1930, p. 389, fig.

At the request of Dr. H. K. Barnard, of the South African Museum, some specimens of this "Terra Nova" species were sent to me by Dr. Isabella Gordon, of the British Museum.

As is usually the case with such expeditions, the specimens had obviously

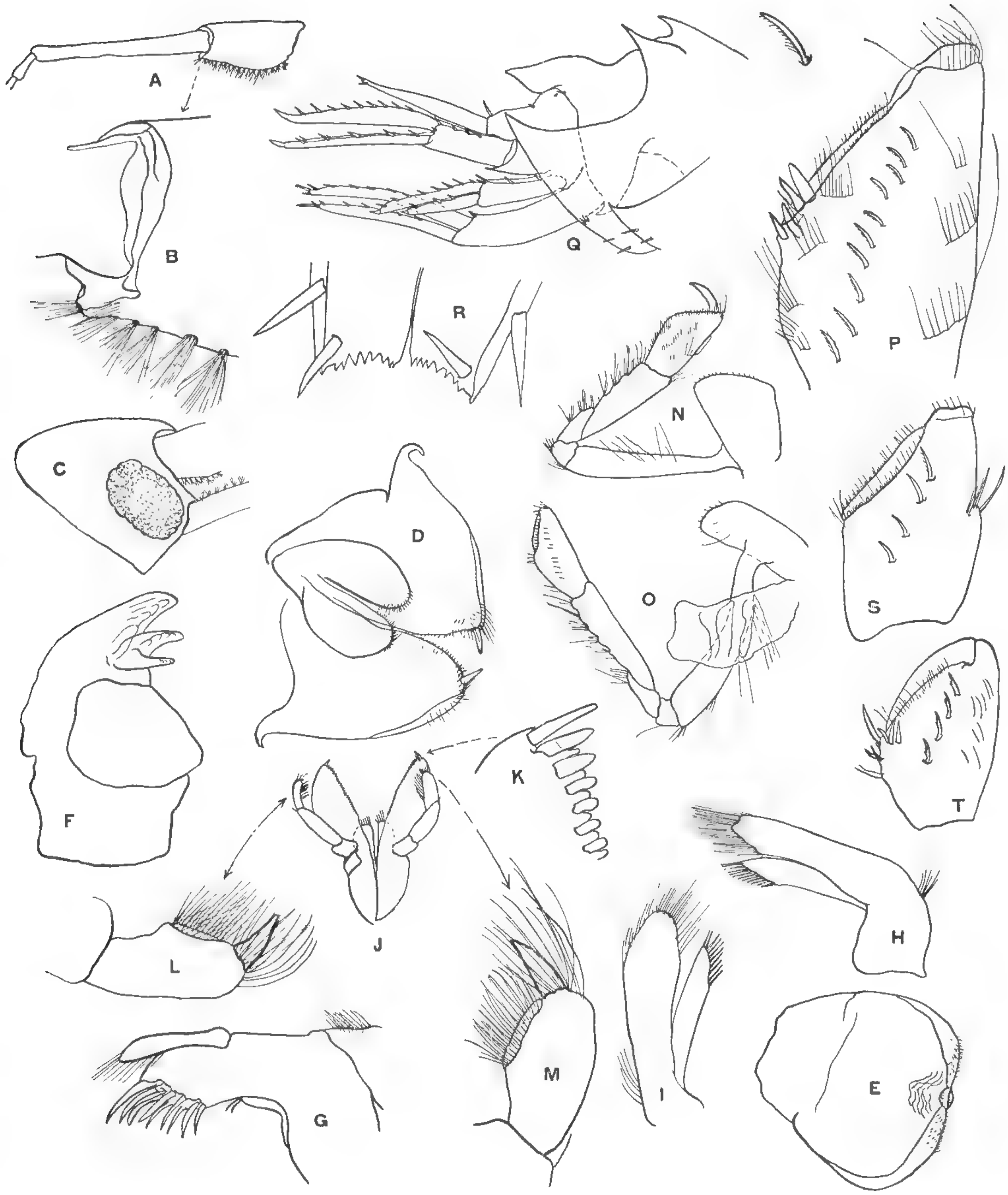


Fig. 6. *A–R, Paradexamine barnardi* (type ♂): A, peduncle, first antenna; B, sensory setae; C, cephalon; D, lower lip; E, upper lip; F, mandible; G, first maxilla; H–I, second maxilla; J–M, details of maxilliped; N first gnathopod; O, second gnathopod; P, hand, first gnathopod; Q, urosome; R, apex, telson; S, *Paradexamine moorehousei:* hand, first gnathopod; T, *Paradexamine frinsdorfi:* hand, first gnathopod. (K.S. *del.*).

been for a considerable time in formalin before their transfer to spirit. This has had the usual effect of making the chitin very brittle, resulting in reticulations of the surface and false joints, very difficult to distinguish from true ones in the antennae, unless the underlying muscle fibres are made visible by appropriate staining.

Direct comparison with type specimens of *P. pacifica* (Thomson) and with other *Paradexamine* species shows that the "Terra Nova" specimens are distinct from, but fairly closely allied to, *P. pacifica,* and I regret that the time of going to press of this paper will not permit me to follow the course of returning them to their original author for fuller description.

The general facies, with the exceptions noted by Barnard, show a close resemblance to the *P. pacifica* group. The lower lip with its toothed apex resembles *P. fissicauda,* while the large outer plate of the maxilliped is somewhat like *P. flindersi.*

However, unless the species concept is enlarged beyond the point when it will be of use in taxonomy, these are all distinct species.

The species is as described by Barnard (*loc cit.,* p. 389) with the exception of the second joint of the peduncle of antenna 2 (fig. 9, A) and the addition of the following details.

Upper lip; slightly lobed on its upper marign.

Lower lip; with a tooth on the inner margin of the apex of each outer lobe.

Maxilla; with two hairs on the inner plate.

Maxilliped; outer plate slightly longer than palp. Finger of palp very small.

Gnathopod 1; long and slender, joint five longer than joint six.

Gnathopod 2; long and slender, joint five about one-and-a-half times joint six.

The row of transverse fringed spines on the hands of the gnathopods vary much as in *P. pacifica*; in *P. moorhousei* and *P. frinsdorfi* the number is less, but there is a slight variation.

Pleopods; long and slender.

There appears to be only one long spine on each side of the dorsal surface of the last urosome segment near the telson.

Branchiae; pleated.

The fascicules of setae on the peduncle of the antennae are distinctive.

Loc. Off Three Kings Island, north of New Zealand.

PARADEXAMINE MOORHOUSEI sp. nov.

Very like *Paradexamine pacifica* (Thomson) but smaller and much more lightly spined.

The resemblances lie mainly in the pointed inter-antennal angle, the lower lip, the proportions of the peraeopods (peraeopod 5 excepted) the type of carination, the dentation of the apex of the telson, and in the general facies.

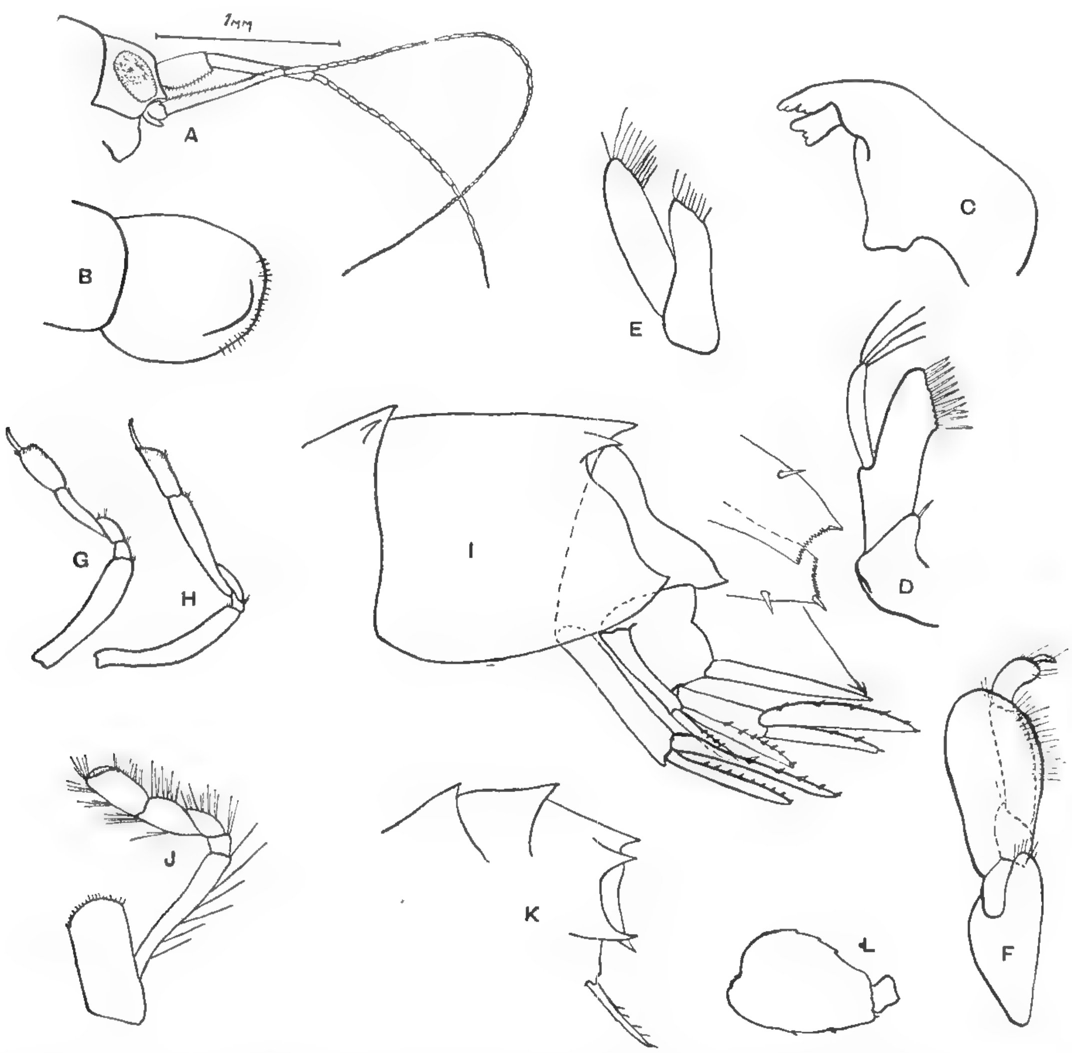


Fig. 7. A–L, *Paradexamine moorhousei* (type ♀): A, head and antennae; B, upper lip; C, mandible; D, first maxilla; E, second maxilla; F, half of maxilliped; G, first gnathopod; H, second gnathopod; I, urosome; L, basis peraeopod 5. (K.S. *del.*). J–K, *Paradexamine sexdentata* (after Schellenberg): J, first gnathopod; K, dorsal outline of pleon.

The main differences are:

Antenna 1; no tooth on the lower margin of the first joint of the peduncle, but instead rows of single setae.

Antenna 2; instead of spines the fourth joint of the peduncle bears a fringe of single setae.

Eyes; relatively larger, filling most of the side of the head and present as prominent black spots in spirit material.

Maxilla 1; relatively feeble, a single spine on the inner plate, four long hairs on the apex of the single-pointed palp; the eleven spine teeth on the outer plate are weak.

Maxilla 2; feeble, and with sparse hairs present on the apices of the plates only.

Maxilliped; the teeth on the outer plate are small, and the plate itself does not reach much above the second joint of the palp, of which the finger is slender and weak.

Gnathopod 1; much less setose than *P. pacifica*, and its greater slenderness is due to the more elongate and slender joint five.

Gnathopod 2; very little setose with joint five twice as long as joint six.

Peraeopod 5; the basis (fig. 6, 1) is more rounded than in *P. pacifica*, and is only lightly spined.

The last urosome segment bears no spines.

The side plates are of moderate size, the first, second, third, and fourth with the margins very finely serrate.

This species was present in countless numbers in the waters of Spencer Gulf. The specimens collected varied in size between 3 and 5 mm. In life they are nearly transparent with prominent black eye-spots. Associated with them are many *Nototropis homochir* Haswell with the smaller specimens of which they are easily confused in the collecting dish.

Loc. Spencer Gulf, South Australia (K. Sheard and F. Moorhouse, March, 1938).

The species is named in recognition of the indispensable assistance given by Mr. F. W. Moorhouse (Chief Inspector of Fisheries and Game), particularly in the securing of tow-net material.

PARADEXAMINE FRINSDORFI sp. nov.

Head; rostrum acute, inter-antennal angle convex. Antenna 1; peduncle shorter than that of antenna 2; first joint shorter than second, third very slender and shore; antenna 2, peduncle slender, joints 4 and 5 long and slender. Flagella in each case moderately long.

Carination of body; commencing from second last peraeon segment, accessory dentation from the last peraeon segment.

Lower lip; inner lobes long and slender, outer lobes with no tooth on inner margins, mandibular processes only slightly upturned.

Mandible; cutting edge complexly dentate, accessory cutting edge dentate, two spines on spine row, molar fairly prominent, the space between the spine row and the molar is occupied by a ridge with rounded teeth.

Maxilla 1; inner lobe with no end bristles, outer plate with 10–11 toothed spines, single-jointed palp with six long hairs.

Maxilla 2; inner plate with strong setae, 3 to 5 on outer edge, 6 to 8 on apex, outer plate with the distal half fringed with scattered setae.

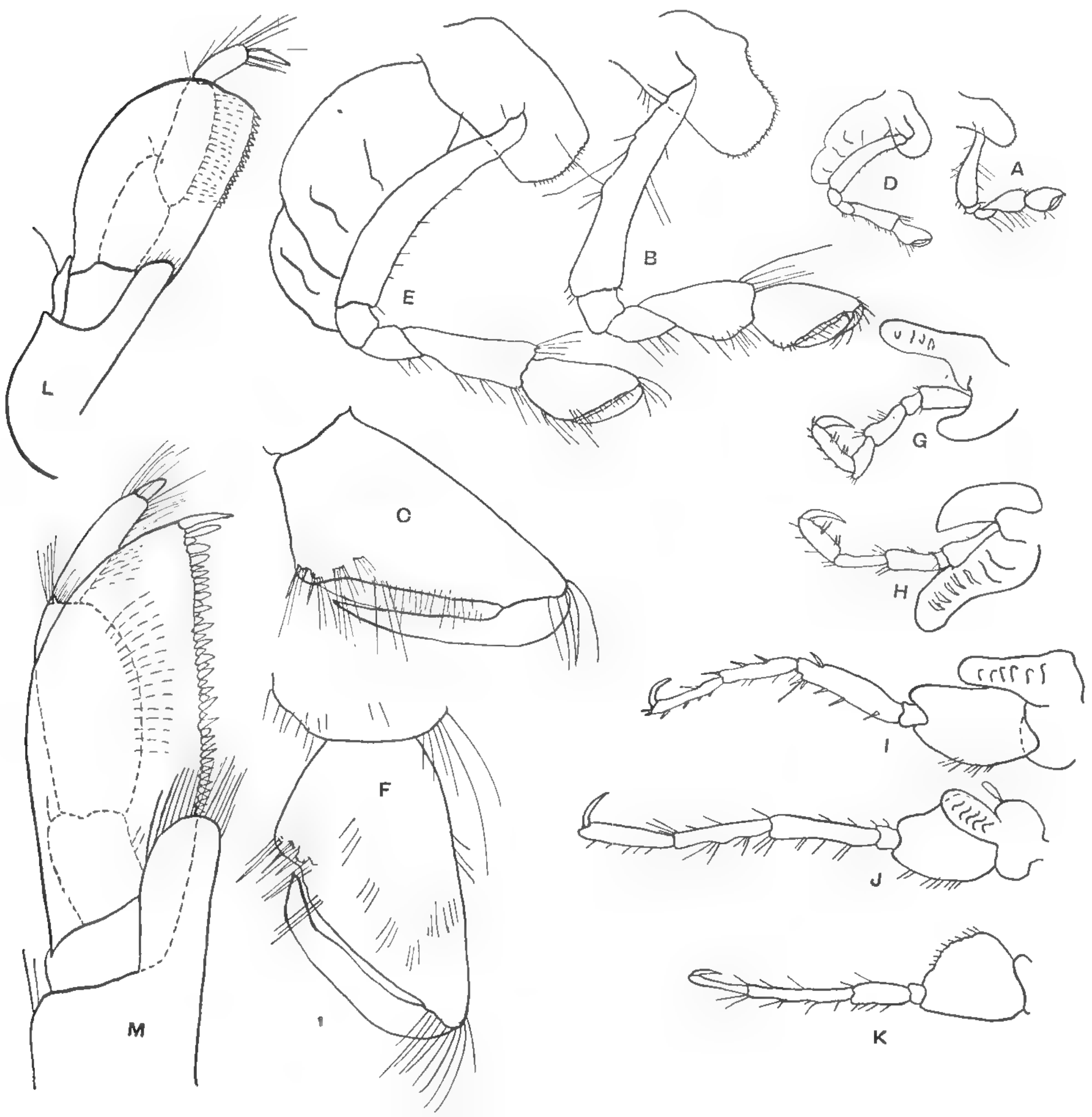


Fig. 8. A–L, *Paradexamine frinsdorfi* (type ♂): A–C, first gnathopod; D–F, second gnathopod; G–K, peraeopods; L, half maxilliped; M, *Paradexamine pacifica* (lectotype ♂) half of maxilliped. (K.S. *del.*)

Maxilliped; inner plate small, outer plate not reaching much above second joint of palp, teeth small, finger of palp moderately strong.

Gnathopod 1; joint five slightly longer than six.

Gnathopod 2; joint five longer than joint six. Side plates of both, minutely dentate with short hairs growing between the teeth.

Peraeopods 1 to 5, comparable with *P. flindersi*.

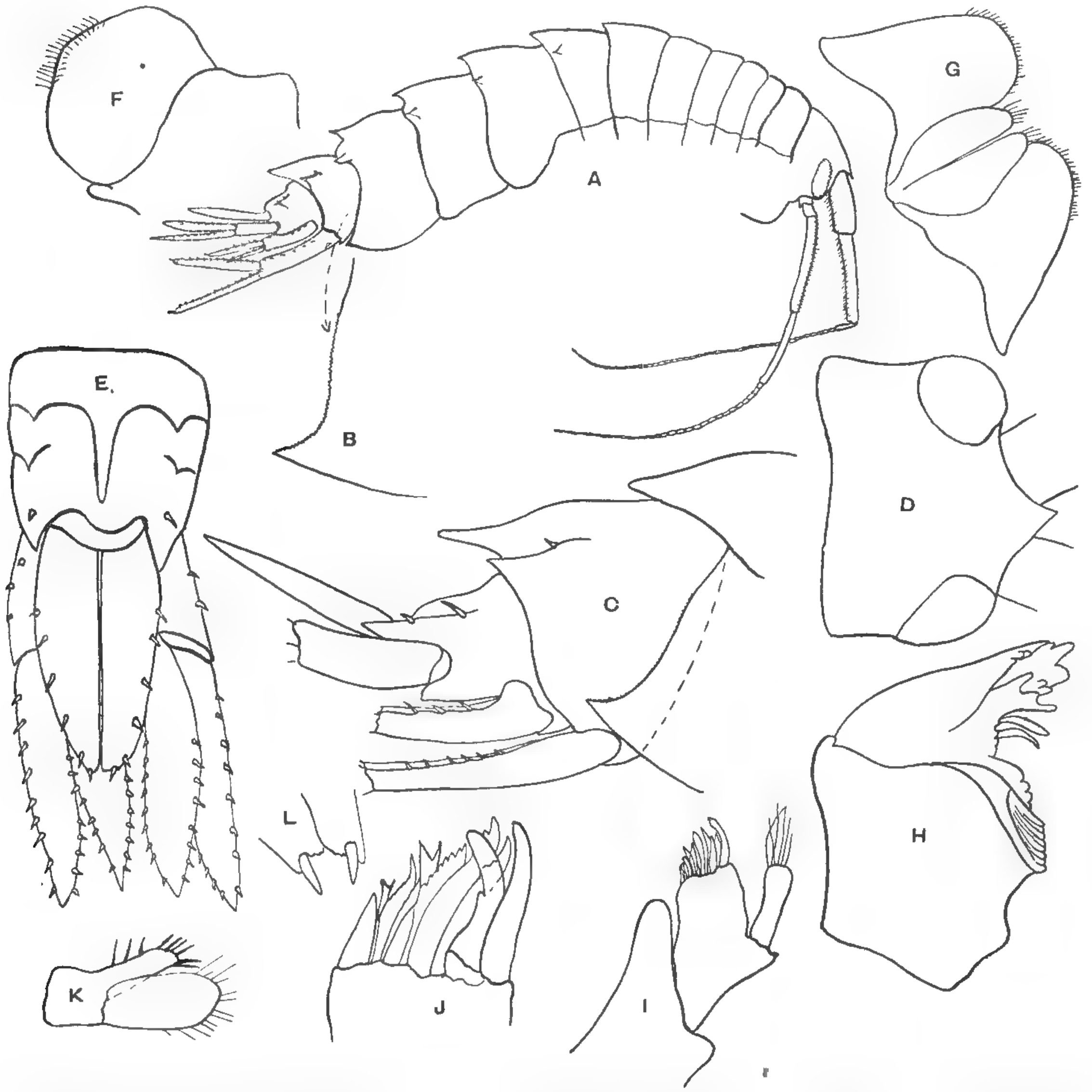


Fig. 9. *Paradexamine frinsdorfi* (type ♂): A, outline of body; B, margin of pleon side plate three; C, urosome; D, plan of head; E, plan of urosome; F, upper lip; G, lower lip; H, mandible; I–J, first maxilla; K, second maxilla; L, apex of telson. (K.S. *del.*)

Pleopods; strong.

Uropods; comparable with *P. fissicauda*.

Telson; cleft to base, each lobe bearing six teeth on its outer margin, the apex of each lobe is produced to a small point at the outer side, then follows a strong spine, then several very small teeth with no intermediary setule.

Branchiae; pleated.

Eyes; large, oval and prominent (see fig. 7, d). Their colour varies from faded red to dark red in spirit.

Length; 6–8 mm.

Although not nearly as numerous as *P. moorhousei,* the species is quite common, and together with the first named, provided the bulk of the free Amphipodan fauna of the Gulf waters at the date of the collections.

In life, with its predominating colour of scarlet, eyes of reddish sapphire, and with prominent sapphire colour-spots on the side plates, it is at once recognizable in a collecting dish. In the darkness it is faintly phosphorescent.

Although the specimen described is probably an intersex (see rudimentary marsupial plate, fig. 7, J), it is characteristic of the species and neither (♂) nor (♀) appear to exhibit any marked variation from this form.

The species was named after Mr. A. Frinsdorf (Senior Inspector of Fisheries) to whose knowledge of the Gulf waters and conditions our useful collections were largely due.

Loc. Off St. Francis Island, Great Australian Bight (Dr. J. C. Verco, 1907); Spencer Gulf (K. Sheard and F. W. Moorhouse, March, 1938).

The literature and synonomy of the other species admitted in the Genus (of which *P. pacifica* is the genotype) are as follows:

PARADEXAMINE FISSICAUDA Chevreux.

Paradexamine fissicauda Chevreux, 1906, p. 88 (fig.) and 1913, p. 181; ? Chilton, 1912, p. 501 and ? 1925, p. 178; Schellenberg, 1931, p. 210; Barnard, 1932, p. 217; Stephensen, 1938, p. 240.

PARADEXAMINE FLINDERSI (Stebbing).

Dexamine flindersi Stebbing, 1888, p. 146.
Guernea flindersi Stebbing, 1906, p. 522.
Paradexamine flindersi Stebbing, 1910, p. 103, plate lii.

PARADEXAMINE NANA Stebbing.

Paradexamine nana Stebbing, 1914, p. 366; Schellenberg, 1931, p. 210.

PARADEXAMINE SEXDENTATA Schellenberg.

Paradexamine sexdentata Schellenberg, 1931, p. 211, fig. 106.

LITERATURE.

Barnard, K. H. (1916) : *Ann. S. Afr. Mus.*, xv, part 3.
Barnard, K. H. (1930) : *Brit. Ant. ("Terra Nova") Exped.*, 1910, Zool. viii, No. 4.
Barnard, K. H. (1932) : *Discovery Reports*, v.
Chevreux, E. (1906) : *Exped. Ant. Franc.* (1903–05), "Amphipodes".
Chevreux, E. (1913) : *Deux. Exped. Franc.* (1908–10), "Amphipodes".
Chevreux, E. (1919) : *Bull. Mus. Franc.*, xxv.
Chilton, C. (1909) : *Sub. Ant. Is. N.Z.*, Article xxvi.
Chilton, C. (1912) : *Trans. Roy. Soc., Edinburgh*, xlviii, part 2.
Chilton, C. (1921) : *Biol. Res. "Endeavour", Sydney*, v, part 2.
Chilton, C. (1925) : *Com. Mus. Nac. Hist. Nat. Buenos Aires*, ii.
Pirlot, J. (1933) : *Siboga Exped.*, Mono. cxxxiii, livr. cxx.
Schellenberg, A. (1926) : *Deutsche Südpolar-Exped.* (1901–03), xviii, zool., x.
Schellenberg, A. (1928) : *Trans. Zool. Soc.*, xxii, part 35.
Schellenberg (1931) : *Swed. Ant. Exped., Further Zool. Res.*, xi, No. 6.
Sheard, K. (1937) : *Trans. Roy. Soc., S. Aust.*, lxi.
Stebbing, T. R. R. (1888) : *Challenger Reports, Zool.*, xxix.
Stebbing, T. R. R. (1906) : *Das Tierreich*, xxi.
Stebbing, T. R. R. (1910) : *Mem. Aust. Mus.*, iv, part 2.
Stebbing, T. R. R. (1914) : *Proc. Zool. Soc., Lond.*
Stephensen, K. (1923) : *Danish Ingolf-Exped.*, iii, part 8 (Amphipoda 1).
Stephensen, K. (1927) : *Medd. fra. Dansk. foren.*, lxxxiii.
Stephensen, K. (1938) : *Sond. Senckenbergiana*, Bd. 20, No. 3/4.

SOME NEMATODES FROM AUSTRALIAN MARSUPIALS

BY T. HARVEY JOHNSTON AND P. M. MAWSON

Summary

The present paper is the third of the series relating to nematode parasites of our marsupials. The first (1938a) dealt with Filariidae, and the second (1938b) with Strongylidae (Trichoneminae), chiefly from Central Australian kangaroos and wallabies. We now give an account of a number of nematodes from various Queensland localities extending from the Gulf of Carpentaria to the coastal region adjacent to the New South Wales border. The species are distributed amongst the Filariidae, Spiruridae, Oxyuridae, and Trichostrongylidae.

Some NEMATODES from AUSTRALIAN MARSUPIALS

By T. HARVEY JOHNSTON and P. M. MAWSON.

The present paper is the third of the series relating to nematode parasites of our marsupials. The first (1938a) dealt with Filariidae, and the second (1938b) with Strongylidae (Trichoneminae), chiefly from Central Australian kangaroos and wallabies. We now give an account of a number of nematodes from various Queensland localities extending from the Gulf of Carpentaria to the coastal region adjacent to the New South Wales border. The species are distributed amongst the Filariidae, Spiruridae, Oxyuridae, and Trichostrongylidae.

This series of studies has been made possible by a Commonwealth grant to the University of Adelaide.

Oxyurids had not been recorded as occurring in Australian marsupials, but no less than four species, probably belonging to as many distinct genera, are described in this paper. Three of these were found in the preserved viscera (ileum and caecum) of a flying opossum, *Petauroides volans* var. *minor* collected by H. H. Finlayson on the Fitzroy River, Central Queensland, and forwarded to the South Australian Museum. Unfortunately this interesting assemblage of parasites is in a poor state of preservation. One of the forms has been assigned to a new genus, *Austroxyuris*. The fourth species was found in the common opossum, *Trichosurus vulpecula,* from South-eastern Queensland.

Only the female of the Spirurid, *Protospirura marsupialis,* was known previously. One of the two species of Filariids from the Gulf of Carpentaria is regarded as new, while the other, which was represented by immature females, is probably the female of one of our recently described species. The two Trichostrongylids belong to genera previously known from Australian marsupials, a second species being added to *Austrostrongylus* and *Filarinema,* which were monotypic, and described from material collected in zoological gardens in the United States and Pretoria respectively.

We are indebted for material to H. H. Finlayson, Honorary Curator of Mammals, South Australian Museum; Dr. F. H. S. Roberts, Parasitologist, Department of Stock, Brisbane; the late Dr. T. L. Bancroft and his daughter, Dr. J. M. Mackerras, formerly of Eidsvold, Burnett River. The types of the new species have been deposited in the South Australian Museum, Adelaide.

HOSTS AND PARASITES REFERRED TO IN THIS REPORT.

Macropus robustus Gould	*Dipetalonema robertsi* sp. nov.
Macropus sp.	*Dipetalonema annulipapillatum* Johnston and Mawson
Macropus dorsalis Gray	*Austrostrongylus minutus* sp. nov.
Trichosurus vulpecula (Kerr)	*Protospirura marsupialis* Baylis
	Syphacia trichosuri sp. nov.
Petauroides volans (Kerr) var. *minor* Collett	*Austroxyuris finlaysoni* gen. et. sp. nov.
	Passalurus parvus sp. nov.
	Oxyuris (s.l.) *acuticaudata* sp. nov.
Isoodon obesulus (Shaw)	*Filarinema peramelis* sp. nov.

FAMILY FILARIIDAE

DIPETALONEMA ROBERTSI sp. nov.

(Fig. 1–5.)

From the body cavity of *Macropus robustus*, from Normanton, North Queensland.

Male. 6·5 cm. long, 0·23 mm. in maximum breadth; female, represented by fragments of two specimens, one fragment being 11 cm. long with a maximum width 0·45 mm. Anterior end dome-shaped with papillae arranged in two rows, each with four large and two small (probably lateral) papillae. The cuticle possesses fine transverse striations which are not obvious except in the lateral lines, since they are masked elsewhere by deeper longitudinal markings. The lateral regions have each two irregular rows of "gland cells" or "pores". Mouth small, leading into a short vestibule, 6μ long, with its base supported by a chitinous ring. Oesophagus about 2 mm. long in both sexes; with narrower anterior portion, 0·55 mm. in female. Nerve ring at about 0·28 mm. from anterior end.

Male. Testis tube extends as far forwards as the posterior end of the oesophagus. Tail 0·48 mm. long, with rounded tip which is apparently without papillae. Larger spicule 0·24 mm. long, cylindrical proximally but tapering to a fine point; shorter spicule 0·12 mm. long, broad, ending in a rounded tip. Three pairs of preanal papillae, somewhat irregularly arranged, one pair immediately postanal, and another pair some distance behind the latter and not quite symmetrically placed.

Female. Tail 0·4 mm. long, with two very small subterminal papillae. Uterine tubes extend posteriorly to within 1·7 mm. from the anus; the two tubes unite just behind the vulvar region, the single uterus passing forward to within 1 mm. from the oesophagus before turning posteriorly as the vagina the latter forming a loop before entering a small muscular pyriform bulb at the vulva which lies at 6·5 mm. from the anterior end of the worm.

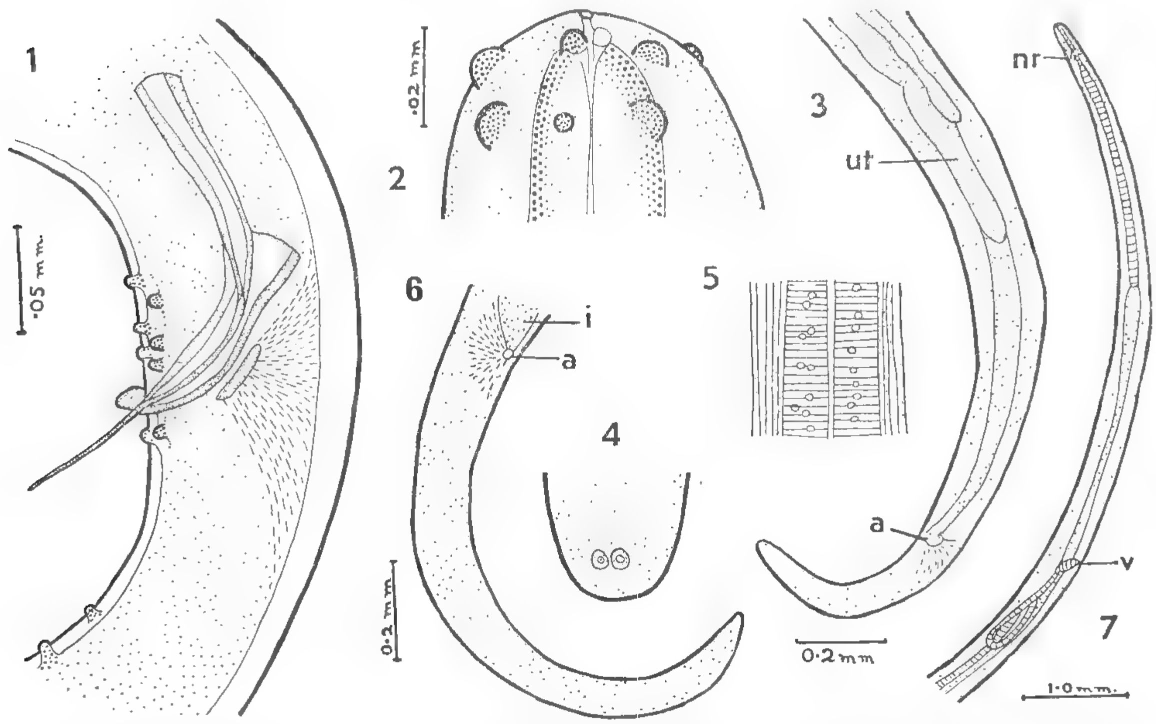


Fig. 1–5. *Dipetalonema robertsi.* 1. Cloacal region of male, lateral view; 2. head; 3. posterior end of female; 4. tip of female tail, ventral; 5. cuticle at lateral line. Fig. 6–7. *D. annulipapillatum.* 6. posterior end of female; 7. anterior end of female. Fig. 1 and 4 to same scale; 5 and 6 to same scale.

Explanation of lettering: a. anus; dr. dorsal ray; dt. dorsal tooth; edr. externo-dorsal ray; elr. externo-lateral ray; ep. excretory pore; g. gubernaculum; i. intestine; ic. inflated cuticle; nr. nerve ring; plr. postero-lateral ray; s. spicule; ut. uterus; v. vulva; vd. vas deferens.

D. robertsi differs from other species of the genus in the number and arrangement of the head papillae. The female system resembles that of *D. tenue* Johnston and Mawson 1938. The specific name is given in recognition of the excellent work now being carried out by its collector, Dr. F. H. S. Roberts. Parasitologist, Department of Stock, Queensland.

DIPETALONEMA ANNULIPAPILLATUM Johnston and Mawson 1938.

(Fig. 6–7.)

The material consists of two female specimens, both immature, taken from the dorsal aorta of *Macropus* sp., at Inverleigh, near the Flinders River, Gulf of

Carpentaria, North Queensland, by Dr. F. S. Roberts. The larger is 9·5 cm. long, 0·07 mm. wide at the head, 0·4 mm. in maximum breadth, and 0·12 mm. broad at the anus. The anterior portion of the head of each worm is damaged, but one can distinguish a chitinous ring around the mouth, and there appears to be outgrowths of the hypodermis into the cuticle resembling those occurring in *D. annulipapillatum,* of which species only the male has been described. The oesophagus is 2·6 mm. long, with an anterior narrower portion 0·6 mm. in length, and a wider posterior part. The nerve cord is situated at 0·3 mm. from the anterior end. The anus lies at 1·18 mm. from the tip of the tail. The uteri are not readily distinguishable because of immaturity. They pass forward to enter a muscular vagina a short distance behind the vulva, the vagina coiling on itself once before entering a pyriform muscular structure leading into the small vulva. The latter lies at 5·3 mm. from the anterior end. The long tail has a rounded tip on which papillae were not detected.

The characters present suggest that the specimens may be females of *D. annulipapillatum,* recently described by us (1938) from three species of wallabies, two of them from the Burnett River, Central Queensland, and one from coastal New South Wales. The main differences are the presence of a chitinous ring around the buccal region, and the differentiation of the oesophagus into a narrower and a wider region.

FAMILY SPIRURIDAE

PROTOSPIRURA MARSUPIALIS Baylis.

(Fig. 8.)

Baylis (1927) described only the female. Since our material contained both sexes, an account of the male can now be given. The host was the opossum, *Trichosurus vulpecula,* from Eidsvold, Burnett River, Central Queensland (collected by the late Dr. T. L. Bancroft and Dr. M. J. Mackerras) and from Brisbane.

The head and general features of the body have already been described by Baylis.

Male. About 3·5 cm. long, shorter and thinner than the female, and with two or three close coils at the posterior end. The distance from the anterior end of the head to the posterior end of the oesophagus is 4·05 mm. The thick-walled vestibule is 0·25 mm. long, with an internal diameter 0·07 mm. The nerve cord lies at 0·34–0·35 mm. from the anterior end, and just in front of the excretory pore. The tail has long alae, 0·22 mm. wide, narrowing near the tip, slightly beyond the end of which they project. The spicules are subequal in length, but the left is thinner than the right, to which the vas deferens is attached. In one specimen the right spicule measured 1·15 mm. and the left 1·2 mm.; in another they were 1·3 and 1·1 respectively. A gubernaculum is present. The cloaca is slit-like, slightly elongated transversely, and lies at 0·7 mm. from tail end. There are four pairs of pedunculate preanal papillae, and a similar pair about mid-way between the cloaca and the tip of the tail. There is a pair immediately postanal, as well as two or three pairs of very small papillae close to the end of the tail. The alae are ornamented with longitudinal striations, and similar markings form a very narrow zone across the ventral surface of the body in the immediate vicinity of the cloaca.

FAMILY OXYURIDAE

AUSTROXYURIS FINLAYSONI gen. et sp. nov.

(Fig. 9–12.)

This tiny species was present in great numbers in the caecum and intestine of *Petauroides volans* var. *minor*, obtained by H. H. Finlayson in the Fitzroy River District, Central Queensland. The viscera in which the parasites were found were forwarded by the South Australian Museum. The state of preservation was poor.

Worms short, straight; male 1·7–1·8 mm. long; female about 2 mm. Cuticle with fine transverse striations. Maximum diameter of male 0·11 mm. of female 0·15 mm., occurring at the level of the posterior end of the oesophagus, the body then tapering to the tail.

Head end rounded, with cuticle not regularly inflated. Mouth circular, directed forwards, with its margin supported by a continuation of the chitinous wall of the buccal capsule. One pair of lateral papillae. Buccal capsule 0·01 mm. in diameter and 5μ long in the female, with a projection outwardly from the middle of its wall. Oesophagus 0·3–0·4 mm. long in the male (1:4·5–5·6 of body length); narrow, slightly constricted in front of the rounded bulb, the latter 0·035 mm. in diameter, and provided with valves. Anterior end of intestine swollen. Nerve ring at the end of the first third of the tubular portion of the oesophagus, and about 0·12 mm. from the head end. Excretory pore just behind the oesophageal bulb.

Male. A pair of symmetrical caudal alae with maximum width (each 0·01 mm.) at cloacal level, length 0·2 mm. Body narrowed suddenly just in front of the posterior end of the alae, continuing as a very thin tail 0·06 mm. long. A pair of adanal papillae; a median papilla immediately postanal; three lateral papillae just behind the anal region, arising close together, supported by long peduncles, one pair of these papillae being located at the widest part of the alae, the others arising more ventrally. No papillae could be detected at the posterior end of the alae. Spicule single, short, cylindrical, 0·05–0·08 mm. long, not strongly chitinized except at its proximal end, where it joins the vas deferens and has a well-chitinized ring. Gubernaculum absent.

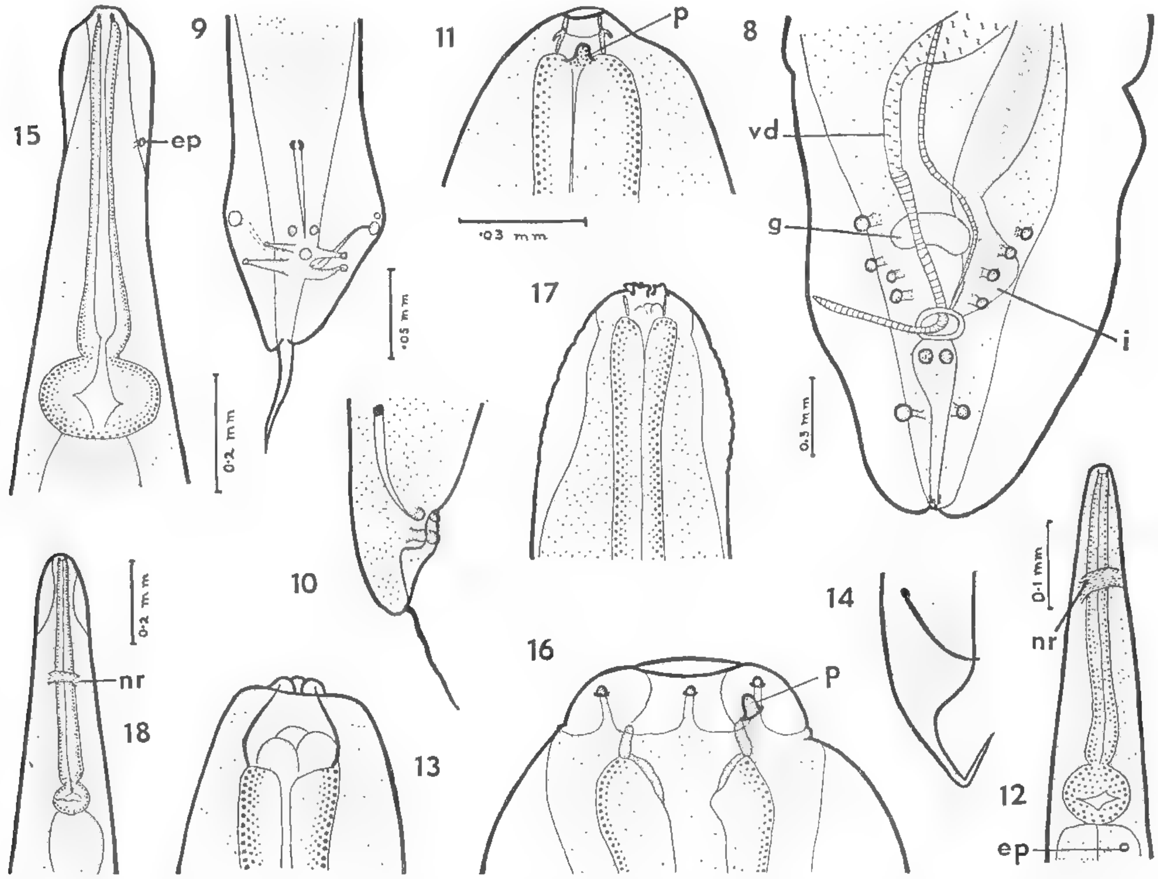


Fig. 8. *Protospirura marsupialis.* Posterior end of male. Fig. 9–12. *Austroxyuris finlaysoni.* 9. posterior end of male; 10. ditto, lateral view; 11. head, lateral; 12. oesophageal region, lateral. Fig. 13–14. *Passalurus parvus.* 13. head; 14. posterior end of male, lateral. Fig. 15–16. *Oxyuris acuticaudata.* 15. oesophageal region; 16. head. Fig. 17–18. *Syphacia trichosuri.* 17. head; 18. oesophageal region. Fig. 9, 10, 14 and 17 to same scale; 11, 13 and 16 to same scale.

Female. Tail very long, 0·29 mm. in length, tapering to a fine point. Vulva large, round, dividing the body antero-posteriorly in the ratio 1 : 1·8. Uteri very indifferently preserved, but appear to be divergent. Eggs not observed.

The species belongs obviously to Oxyurinae, near *Passalurus,* from which it differs chiefly in the characters of the vestibule, in the absence of a prebulbar swelling on the oesophagus, and in the absence of narrow cuticular flanges at the anterior end. Some of the features suggest those of *Protozoophaga.* A new genus *Austroxyuris* is proposed for it, and is diagnosed as follows:

Oxyurinae. Mouth simple with two papillae; cuticle without cephalic expansions; vestibule short, without teeth. Oesophagus with distinct bulb but without marked prebulbar swelling; excretory pore behind bulb. Male with alae, a pair of sessile adanal papillae, a median postanal, and three pairs of pedunculate postanal papillae; spicule, single, weakly chitinized, short; gubernaculum absent; tail short, resembling a spike. Female with very long tail, tapering to a fine point; vulva in anterior third. Type *A. finlaysoni.*

The species is dedicated to H. H. Finlayson, Honorary Curator of Mammals, South Australian Museum. In company with it were found the two Oxyurids, whose descriptions follow this account.

PASSALURUS PARVUS sp. nov.

(Fig. 13–14.)

Found in company with other oxyurids in *Petauroides volans* var. *minor,* Fitzroy River, Central Queensland.

Short worms, females 3–3·5 mm. long; single male found, 1·12 mm. long. Cuticle deeply annulate, finely striated longitudinally. Anterior end rounded. Mouth small, terminal, with three lips supported by chitinous prolongation from the buccal capsule. Two (perhaps four) small papillae at anterior end. Buccal capsule very large, 0·02 mm. long, 0·023 mm. wide at its base, with thin outwardly concave walls; three semi-circular teeth, 7μ long, arising from the anterior end of the oesophagus. Oesophagus 0·52 mm. long in male, 0·63 mm. in female; with a constriction between the tubular portion and the spherical bulb. Nerve cord and excretory pore not observed.

The posterior end of the only male available is in an unsatisfactory state. The single spicule is 0·06 mm. long, more strongly chitinized at its proximal end. There is a short spine-like tail. The papillary arrangement was not recognizable.

The female has a narrow tapering posterior end, the tail being 0·42 mm. long and markedly ringed. Position of vulva not determined. Eggs thick-shelled, 0·03 by 0·01 mm., mostly with a thickening of the shell at one pole; embryos present.

The species belongs to a genus closely related to *Passalurus.* In view of the indifferent condition of the specimens, a satisfactory examination could not be made, and it has been considered advisable to place the species provisionally under that genus.

OXYURIS (s.1) ACUTICAUDATA sp. nov.

(Fig. 15–16.)

From caecum and intestine of *Petauroides volans* var. *minor*, Fitzroy River, Central Queensland. Only females were found. They were 6–8 mm. long, tapering gradually towards posterior end, with very finely-pointed tail, 1·4 mm. long. Cephalic cuticle inflated; body narrowed suddenly in the anterior 0·25 mm.; cuticle at extreme anterior end forming a collar 0·015 mm. in depth, surrounding oral aperture. Six minute papillae pass up through the collar and project about 1·5μ, a pair of larger papillae behind these. Buccal capsule wide, shallow, 0·016 by 0·007 mm. Oesophagus 0·7 mm. long, with wide lumen which narrows at the end of the anterior tubular portion, expanding again in the bulb; the latter wider than long. Nerve ring just in front of mid-oesophagus. Excretory pore in the vicinity of junction of first and second thirds of tubular part of oesophagus. Vulva strongly chitinized, lying at end of first quarter of the body length. Eggs 0·034 by 0·017 mm.

On account of the absence of males we prefer to assign the species to *Oxyuris* (s.1). It is certainly not a member of *Oxyuris* (s.str.).

SYPHACIA TRICHOSURI sp. nov.

(Fig. 17–18.)

From the intestine of *Trichosurus vulpecula*, West Burleigh, South-eastern Queensland. Only females present; 5 mm. long; with cervical cuticle inflated for 0·12 mm. from the anterior end, the body being narrowed in this region. Tail long, 0·8 mm. in length, tapering to a point. Vestibule small, 0·015 mm. long, 0·02 mm. wide, chitinized, with three small rounded teeth at its base. Oesophagus 0·6 mm. long, with a constriction between the tubular portion and the spherical bulb which is about 0·1 mm. in diameter. Nerve ring at 0·3 mm. from the anterior end and at about mid-length of the tubular portion of the oesophagus. Vulva at about midlength; vagina muscular; uterus long, single. Two ovaries. Eggs 0·05 by 0·025 mm., with very thick shells.

In most features the species agrees with those of *Syphacia*, but differs in possessing a definite vestibule and in having the vagina at mid-body. On account of the absence of males it is considered preferable to assign the parasite to *Syphacia*, all of whose previously described species occur in rodents.

FAMILY TRICHOSTRONGYLIDAE

AUSTROSTRONGYLUS MINUTUS sp. nov.

(Fig. 19–21.)

From the intestine of *Macropus dorsalis*, Eidsvold, Burnett River, Queensland. Male 2·9–3·1 mm., female 3·2 mm., all specimens probably immature; reddish when collected. These small thin worms were coiled in alcohol. There are six longitudinal ridges on the body, a ventral and a dorsal pair, in addition to a very wide lateral pair. Each of the latter is about 0·035 mm. wide, and the others each about 0·012 mm. They extend from the region just behind the inflated area almost to the end of the body, and in the case of the female reach to the anus. The lateral lines are longest. The transverse striae are about 1·6μ apart. Cuticle at head end inflated, but not striated, for a distance of 0·46 mm. Mouth small, circular. Buccal capsule dome-shaped anteriorly and funnel-like at its base, its chitinous walls being continued back into the oesophagus. Projecting into the base of the capsule is a relatively large dorsal tooth 8μ long in the male, 10μ in the female. There are also a smaller ventral and two small lateral teeth. The capsule is 7–8μ long and 13–14μ wide in the male, 10μ long and 18μ wide in the female. The oesophagus is 0·20 mm. long in the male (about one-sixteenth of body length) and 0·25 mm. in the female (one-thirteenth of body length), widening posteriorly. The excretory pore lies at about 0·16 mm. from the head end, and in the vicinity of the junction of the third and fourth quarters of the oesophagus.

Male. Bursa expanded laterally and nearly symmetrical; ventral lobes slightly separated from the laterals; small dorsal lobe. Ventral rays widely separated and subequal, the ventro-ventral curving antero-ventrally, the latero-ventral extending directly laterally. Externo- and medio-lateral rays stout, close to each other and parallel; postero-lateral ray much narrower than the other laterals. All ventral and lateral rays reach almost to the bursal edge, as also does each long narrow externo-dorsal which arises separately. Dorsal ray rather short, giving off two narrow curved branches at about half its length and then continuing a short distance before bifurcating into the short terminations. Spicules equal, 0·35–0·4 mm. long, about one-eighth of body length, narrow, cylindrical, curved at the distal end to meet each other at a blunt point. A long narrow chitinization of the dorsal wall of the spicule sheath probably represents a gubernaculum.

Female. The tail ends in long spine-like portion. Anus at 0·09 mm. from the posterior end. Vagina very short; ovejectors stout, relatively long; eggs not present; vulva at 0·31–0·35 mm. from tip of the tail, the distance being about one-ninth of body length.

A. minutus differs from the other known species, *A. macropodis* Chandler 1924, in the following features: smaller size, presence of lateral teeth in the buccal capsule, smaller dorsal tooth, rather shorter oesophagus, more posteriorly situated vulva, longer spicules, bursa much less markedly asymmetrical and of different shape, most of the bursal rays relatively stouter, and the different arrangement of the branches of the dorsal ray.

FILARINEMA PERAMELIS sp. nov.

(Fig. 22–25.)

From the intestine of a bandicoot, *Isoodon obesulus,* from West Burleigh, South-eastern Queensland. Male, 4·6–4·9 mm. long with a maximum diameter of 0·07 mm.; female, 5·8–6 mm. Head very small, and its parts are difficult to determine accurately. Head end with a very narrow cuticular inflation extending back for about 0·05–0·06 mm., the underlying region being somewhat narrower than the succeeding portion. There appear to be six minute lips. Longitudinal cuticular striations are present. There is no buccal cavity, the oesophagus reaching the anterior end. A tooth could not be recognized, though in a few specimens a tooth-like structure seemed to be protruding from the end of the oesophagus through the mouth. Oesophagus 0·35–0·38 mm. long, thin, widening slightly towards its base. Intestine narrow. Nerve cord and cervical papillae not observed. Excretory pore quite distinct and lying in the vicinity of the mid-oesophagus, about 0·22 mm. from the head end.

Male. Bursa large, consisting of two large lateral lobes and a dorsal lobe, laterals with lower edges inturned. Ventral and lateral rays more or less equal in length and thickness, and all extending practically to the bursal edge; all of them arise together from a common stem, diverging in their distal third. Ventrals separate; ventro-laterals curved ventrally; postero-laterals slightly curved; externo-laterals nearly straight; medio- and postero-laterals bending rather dorsally. Dorsal ray stout and long, the externo-dorsals arising as stout curved rays from the end of its proximal third; the main stem continues a short distance and then gives off two short thin lateral branches, the main portion proceeding backwards to divide ultimately into two small bidigitate rays almost reaching the bursal edge. Spicules 0·14–0·15 mm. long; anterior part cylindrical, 0·015 mm. in diameter; widest near middle; eventually subdividing to form three pointed processes, two shorter laterals, and a longer median. The lateral structures are comparable with the whip-like processes described by Mönnig for *Filarinema flagrifer.* The gubernaculum is spindle-shaped. There are two minute prebursal papillae.

Female. Tail 0·08–0·09 mm. long, tapering to terminate in a median ventral and two latero-dorsal conical processes, the ventral cone bearing on its dorsal surface a spine-like process 0·012 mm. long. Vulva 1·13 mm. from the posterior end and protected by a thin flap arising in front of it. Vagina short; ovejectors muscular; uteri divergent.

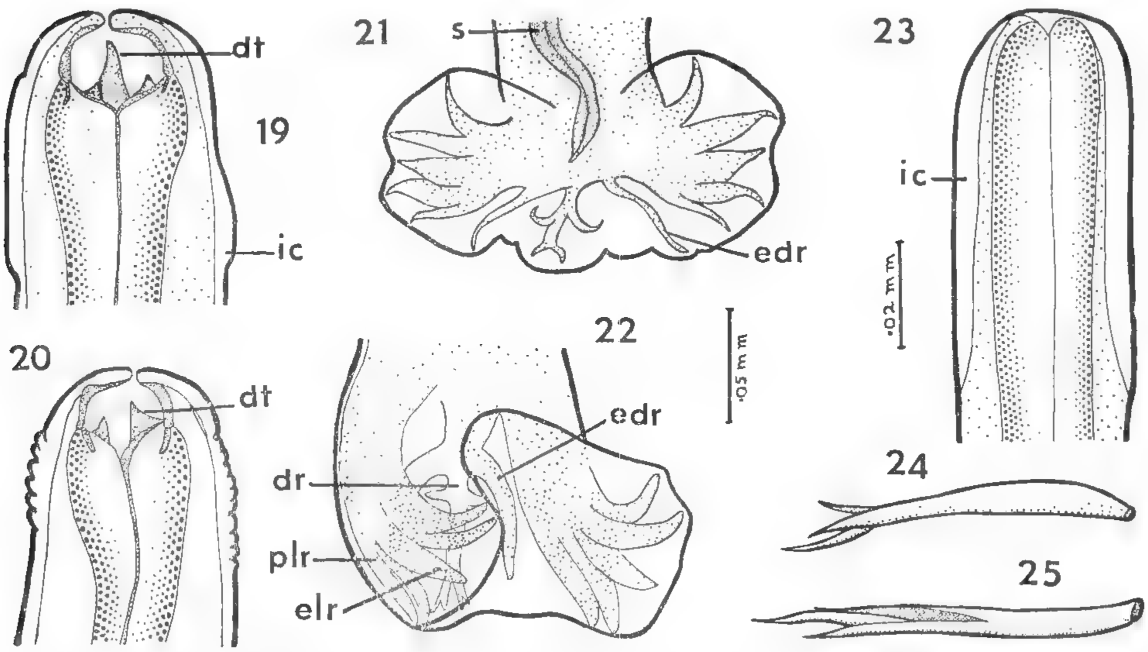


Fig. 19–21. *Austrostrongylus minutus.* 19. head, ventral; 20. head, lateral; 21. bursa, dorsal. Fig. 22–25. *Filarinema peramelis.* 22. bursa, ventral; 23. head end; 24. spicule, lateral; 25. spicule, subventral.

Fig. 19, 20, and 23 are drawn to scale adjacent to fig. 23; 21, 22, 24, and 25, to scale beside fig. 22.

The specific name is derived from *Perameles,* the generic name under which most Australian bandicoots were formerly placed. *F. peramelis* approaches most closely to *F. flagrifer* Mönnig 1929, from *Macropus rufus,* but differs in size; the presence of cuticular cephalic inflations and longitudinal striations; the form of the spicules; and the characters of the dorsal ray. The difference regarding the branching of the dorsal ray may be of generic value, but we prefer to place the species under Mönnig's genus because of the similarity of most of the other characters.

LITERATURE.

Baylis, H. A. (1927) : Some new parasite nematodes from Australia. *Ann. Mag. Nat. Hist.* (9), 20, 1927, 214–225.

Chandler, A. C. (1924) : A new genus of Trichostrongylid worms from the kangaroo. Parasitol, 16, 1924, 160–163.

Johnston, T. H. and Mawson, P. M. (1938) : An account of some filarial parasites of Australian marsupials, *Trans. Roy. Soc. S. Aust.* 62 (1), 1938, 107–121.

Johnston, T. H. (1938) and Mawson, P. M.: Strongyle nematodes from Central Australian kangaroos and wallabies. *Trans. Roy. Soc. S. Aust.* 62 (2), 1938, 263–286.

Mönnig, H. O. (1929) : Filarinema flagrifer n.gen. n.sp., a Trichostrongylid parasite of the kangaroo. *Rep. Dir. Vet. Serv. Pretoria,* 15, 1929, 311–316.

NEW SPECIES OF SOUTH AUSTRALIAN GASTROPODA

BY BERNARD C. COTTON, CONCHOLOGIST AND
FRANK K. GODFREY, HON. ASSISTANT CONCHOLOGIST,
SOUTH AUSTRALIAN MUSEUM

Summary

In preparing a list of South Australian Gastropoda we found that some new species awaited description, and that a few names required emendation. The more obvious are here dealt with. Holotypes are in the South Australian Museum, and their registration numbers are quoted herein.

Scissurella Cyprina sp. nov.

Scissurella ornata Cotton and Godfrey (nec May), S. Aust. Nat., Xv, Nov. 30, 1938, p. 21, p1. i. Fig. 8.

NEW SPECIES OF SOUTH AUSTRALIAN GASTROPODA

By BERNARD C. COTTON, Conchologist, and

FRANK K. GODFREY, Hon. Assistant Conchologist, South Australian Museum.

Plate xvii.

In preparing a list of South Australian Gastropoda we found that some new species awaited description, and that a few names required emendation. The more obvious are here dealt with. Holotypes are in the South Australian Museum, and their registration numbers are quoted herein.

Scissurella cyprina sp. nov.

Scissurella ornata Cotton and Godfrey (*nec* May), *S. Aust. Nat.*, XV, Nov. 30, 1938, p. 21, pl. i, fig. 8.

Minute, discoidal, somewhat oblique; colour yellowish-white; protoconch of one-and-a-half turns, squared by a beaded ridge, and sunken below the level of the two rounded adult whorls, which are somewhat angled by the canal; canal, a deep furrow, about mid-way between the suture and the periphery, has sharp, raised edges, and the whole is surmounted on a distinct ridge surrounding the shell; radial ribs, sixteen, raised, curved, interrupted by the furrow, extend from the suture to the small, deep umbilicus; numerous spirals, smaller than the ribs, do not pass over those ribs which are between the canal and the suture, but pass over the lower ribs and develop a crested appearance; aperture defined by a continuous narrow margin; slit open, deep, moderately wide. Holotype, height 1·5 mm., diameter 2 mm., Venus Bay, S. Aust. (Reg. No. D 9674). Distribution: Cape Borda, S. Aust., Venus Bay, beach.

From *Scissurella ornata* May, the species is larger, the spirals stronger and radials weaker. South Australian examples have been formerly labelled *ornata* in error.

Zeidora legrandi Tate, 1894.

Zeidora tasmanica Cotton and Godfrey (*nec* Beddome), *S. Aust. Nat.*, XV, March 27, 1934, p. 53, pl. i, fig. 12.

This is separable from *Zeidora tasmanica* Beddome in the position of the protoconch, which does not quite reach to the posterior margin, whereas in the Tasmanian species it sometimes overhangs. Furthermore the South Australian shell is twice as large as the Tasmanian. Holotype, length 9·5 mm., breadth 6 mm., height 2 mm., depth of cleft 2 mm., Corny Point, S. Aust. (D 13371). Distribution: Corny Point; Venus Bay; also dredged St. Francis Island, 35 fathoms; Backstairs Passage, 7–20 fathoms.

CALLIOSTOMA (SALSIPOTENS) CALLIOPE sp. nov.

Calliostoma (Salsipotens) ciliare Cotton and Godfrey (*nec* Menke), *S. Aust. Nat.*, XVI, April 10, 1935, p. 19, pl. i, fig. 9.

Pyramidal, broadly depressed, thin, imperforate; colour yellowish, red-spotted along the suture; sometimes the adult whorls have a spiral line articulated brown and white like a twisted cord, below which are crescents of brown, open forwards, also with axial flames of brown growing wider as they descend to the periphery, beyond which they extend for a short distance across the base; sculpture obsolete, transversely striate, and decussated by very fine axial striae; whorls six, flat, margined below; suture linear; base flat; aperture obliquely ovate, outer lip margin callous within. Holotype, height 23 mm., diameter, 30 mm., Gulf St. Vincent, S. Aust., 13–17 fathoms (D 13611). Distribution: Gulf St. Vincent; Investigator Straits; Backstairs Passage; 13–17 fathoms; also W. Aust., Swan River; Esperance Bay; on beach. Formerly misidentified as *Calliostoma ciliare* Menke, from North-west Australia, which is different in shape, sculpture, and colour.

ETHMINOLIA ELVERI sp. nov.

Trochoid, depressed, widely umbilicate, thin; whorls medially angulate, and subangulate above; colour extremely variable; base colour white or rose, axially flecked and blotched; protoconch minute, depressed, white, smooth, of one-and-a-half whorls; sculpture of regular microscopic spiral lirae cut by fine, regular, accremental striae; umbilicus profound and narrow, spirally obsoletely ribbed; aperture subquadrate, outer lip thin; columella simple, very slightly convex at the lower half. Holotype, height 7 mm., diameter 10 mm., Gulf St. Vincent, S. Aust., 7 fathoms (D. 13388). Distribution: Beach, not common, Hardwicke Bay, Spencer Gulf; dredged, Gulf St. Vincent; Investigator Straits; Backstairs Passage; Cape Jaffa; 7–130 fathoms. Also King George Sound, W. Aust., on beach and dredged to 28 fathoms. South Australian Museum specimens have been labelled *angulata* Adams, *prodictus* Fischer, and later *probabilis* Iredale. The species is larger, higher, less shouldered, and less acutely angulate than the Peronian *probabilis* Iredale.

ETHMINOLIA CINCTA sp. nov.

Conical, elevated, umbilicate, spirally ribbed; colour, creamy-white with dull red interrupted zig-zags, except the first three whorls which are yellow; spiral striae, very fine, crowded, present on the base and in the umbilicus; well marked axial wrinkles in the infrasutural excavation; spire rather high, scalar; protoconch small, blunt; adult whorls about five-and-a-half, convex medially, with a noduled shelf below the suture, angulated, and ribbed at about one-fifth of their breadth, and flatly rounded from the angulation to the suture; last whorl bluntly angulated at the edge of the rounded base; suture well defined; aperture slightly oblique, round; outer lip thin, sharp; inner lip thin, sharp, slightly spreading on the columella; interior iridescent; umbilicus wide, deep, much impressed at the suture, which is spirally continuous to the apex. Holotype, height 4·5 mm., major diameter 6·5 mm., minor diameter 5·5 mm., Leven's Beach, Spencer Gulf, S. Aust., shallow water (Cotton) (D. 3389). Distribution: Beachport, to Hardwicke Bay, Spencer Gulf, to 200 fathoms.

Related to the Peronian shell, *Ethminolia pulcherrima* Angas *(Minolia)*, but our shell has the sculpture more valid, though the base is almost smooth; the coloration is different from the bright dotting of the N.S. Wales shell. The deeper water form from 200 fathoms off Beachport is less validly sculptured, with whorls more rounded and smaller, with higher spire, recalling *Ethminolia pulcherrima emendata* Iredale, the Peronian deep-water form.

SPECTAMEN MARSUS sp. nov.

Conoidal, umbilicate, thin; colour, protoconch white, consisting of one-and-a-half whorls, then five adult whorls of saffron yellow, gradually fading out into very light yellow or dull grey; adult whorls and base have rather broad, equidistant, radiating, somewhat flexuous, rosy streaks which are disconnected at the periphery; spiral striae very crowded; spire elevated; whorls six, convex, depressed—canaliculate below the suture, gradate; last whorl carinate; aperture subquadrate; outer lip thin; columella scarcely arcuate, narrow, forming an angle with the basal margin; umbilicus funnel-shaped with two spiral carinae within, which are granulate; the angulate margin has about twenty tubercules, due to axial wrinkles in the umbilicus, which end just outside the border. Holotype, height 5·2 mm., major diameter 7 mm., minor diameter 6·5 mm., Beachport, S. Aust., 40 fathoms (D. 13390). Distribution: Dredged, Beachport to 120 miles west of Eucla, Great Australian Bight, 40–300 fathoms.

Differs from *Spectamen philippensis* Watson, in being smaller, thinner, and less elate; it is somewhat less canaliculate at the suture, and the spiral lineations are more crowded; it is yellowish instead of white; the rosy axial colour markings are fewer, and are present on the base; also there are two or three spirals in the umbilicus. In all these characters, except the colour, our shells show some variation, a few having been misidentified as *Spectamen bellulus* Angas, but they are not that species, and are merely variants of *Spectamen marsus*.

BASILISSA BOMBAX sp. nov.

Basilissa radialis var. *bilix* Verco (*nec* Hedley), *Trans. Roy. Soc., S. Aust.*, XXX, 1906, p. 218, pl. x, fig. 1, 2, 3.

Depressedly conical, umbilicate; protoconch homostrophe, smooth, of one-and-a-quarter whorls; adult whorls six; spire somewhat gradate; one marked spiral rib in the first whorl and two in the others, becoming gradually more valid and distant; a secondary threadlet appears between the two ribs in the third whorl; another threadlet arises in the fourth, two in the fifth, and still another spiral rib in the body-whorl; the last rib forms the periphery and the suture, and, separated from its fellow by a furrow, gives an apparent canaliculate suture; sutures well marked; base flatly rounded with eight, equidistant, nearly equal, concentric rounded spiral lirae, as wide as their interspaces; shell surface cancellated by crowded narrow erect lamellae, crossing the spirals, and sinuous, but not following exactly the outline of the labrum, and ending at the outer basal lira; crowded radial striae cancellate and granulate the base; aperture obliquely quadrate, with a large posterior sinus in the outer lip, rather deeper than wide ;a second sinus at the baso-labral junction, about as deep and rather wider, and a third shallow and wide at the baso-columellar angle; columella oblique, concave, expanded towards the umbilicus, truncate anteriorly; inner lip thin, smooth; interior of aperture smooth; umbilicus deep, small, margined with oblique plicate tubercles. Holotype, height 3·6 mm.; diameter 3·4 mm., Cape Jaffa, S. Aust., 130 fathoms (D. 13397). Also dredged from 300 fathoms off Cape Jaffa.

Formerly recorded as *Basilissa radialis* var. *bilix* Hedley, a Peronian shell, noticeably different in the validity of sculpture and the shape of the whorls. The species is well figured by Verco *loc. cit.*

PELLAX GABINIANA sp. nov.

Subglobose, thin, imperforate, smooth; ground colour whitish, beautifully closely lined or speckled with rose—which colour predominates; protoconch white; columella white; spire depressed, of three whorls; subangled at the lower portion of the body-whorl, where there is a white maculated band; aperture oval, simple. Holotype, height 6 mm., diameter 4·5 mm., Royston Head, Yorke Peninsula, S. Aust. (D. 13414). Distribution: Corny Point, and generally along the west coast of Yorke Peninsula, to Albany, W. Aust. This distinctive species has been incorrectly listed as *Phasianella kochi* Philippi.

SCALA (MAZESCALA) BEACHPORTENSIS sp. nov.

Squat, imperforate; sculpture of thin, erect lamellae, forming a right-angled shoulder on the upper portion of each whorl; lamellae numbering seventeen on the body-whorl; interstices crossed by obscure spiral incisions; protoconch of four whorls, smooth, polished, sharp; aperture oval, free. Holotype, height 9 mm., diameter 4 mm., Beachport, S. Aust., 110 fathoms (D. 13302). The holotype is unique.

From *Scala heloris* Iredale, the species differs in being smaller, more numerously but less prominently variced, and in lacking the basal rib. From *Scala bellicosa* Hedley, it differs in being spirally sculptured and stouter.

SCALA (NARVALISCALA) FLINDERSI sp. nov.

Elongate, acuminate, imperforate, variced at about every one-and-a-quarter whorls; sculpture of longitudinal rounded ribs, about twenty-five on the body-whorl, crossed by about six spiral threadlets; protoconch smooth, sharp, inconspicuous; adult whorls, fourteen, rounded; suture impressed; base smooth, defined by a fine basal rib; aperture circular. Holotype, height 24 mm., diameter 7 mm., 120 miles west of Eucla, Great Australian Bight, 300 fathoms (D. 13303). The holotype has the varices mostly on the dorsum, therefore only those at the upper quarter and the last one on the body-whorl, are seen in the figure.

Compared with *Scala dorysa* Iredale, the present species is separable by the greater height of the individual whorls, and their roundness. The last three whorls of *Scala flindersi* together, form more than half the length of the shell, whereas in *Scala dorysa* they form less than half.

SCALA (NODISCALA) SUBCRASSA sp. nov.

Narrow, thick, imperforate; longitudinally sculptured with thick, low ribs, angled at the upper third, and obsolete at the rather deep suture, crossed by spiral threads; protoconch, fairly blunt, of two smooth whorls; adult whorls nine, flattened; basal keel indistinct; aperture oval, not separate from the body-whorl, a thick varix forming the outer lip; a further thick varix is situated in the middle back of the penultimate whorl. Holotype, height 13 mm. diameter 4 mm., Gulf St. Vincent, S. Aust., 22 fathoms (D. 13301). Allied to *Scala apostolorum* Iredale, but is larger, and also differs in that the basal rib is obsolete; the general appearance too is different.

The present species was formerly classed in error as *Scala crassilabrum* Sowerby, from the Philippines and Central America.

RETICUNASSA FLINDERSI sp. nov.

Thin, white, sculptured with twenty obsolete, axial riblets, crossed by about eight spiral riblets, producing rather depressed tubercles at the intersections; base with five sharp, spiral riblets; protoconch of four depressed whorls, smooth, polished, horn coloured, with microscopic axial accremental striae only; adult whorls four, a little convex, sharply shelved at the suture. There is no abrupt cessation of sculpture at the commencement of the adult shell as in *Reticunassa dipsacoides* Hedley, but a very gradual formation of sculpture, leaving no definite axial indication as to the finish of the protoconch and the start of the adult shell; the basal keel of the protoconch is only just discernible at the junction. Holotype, height 9 mm., diameter 5 mm., Cape Jaffa, S. Aust., 300 fathoms (D. 13298).

Distinguished from *Reticunassa dipsacoides* Hedley, by the less developed sculpture, the different basal sculpture, the protoconch features, and the relative height and diameter.

SEGNITILA gen. nov.

Shell dextral, discoid, keeled, somewhat flattened beneath, last whorl comparatively rather large, spire small and sunken, umbilicus narrow, aperture acutely angled, no internal laminae. Genotype, *Segmentina victoriae* E. A. Smith, 1881.

This genus is introduced for that species, in describing which Smith stated: "It appears inconsistent to place a shell in Segmentina, lacking the essential characters of internal laminae."

ATAXOCERITHIUM BEASLEYI sp. nov.

Protoconch, blunt, of three convex whorls, the first smooth, the second and third with distant, valid, axial, sigmoid, round cords. Spire whorls with close spirals, rounded, wider than the interspaces, five in the penultimate whorl, the lowest two more prominent throughout, the upper three diminishing in number towards the apex where there is but one; periphery roundly angular; base nearly flat with six spirals; axial, obsolete, round costae, nearly as wide as the interspaces, fourteen in the penultimate whorl; mouth roundly rhomboid; outer lip slightly expanded, sharp, crenulated; inner lip erect and free; canal short, nearly closed at front of point of contact of inner and outer lip, reflected; collumella curved and forming an obtuse angle at the canal. Shell colour of holotype white. Holotype height 8 mm., diameter 2·9 mm., Cape Borda, S. Aust., 55 fathoms (D. 13435). Distribution: 81 miles west of Eucla, 4 fathoms; Gulf St. Vincent, ? depth, seven specimens larger and more solid than the type, four are uniformly brown, another has the protoconch white and the rest of the shell brown, two are nearly white; 45

fathoms east of north of the Neptune Islands; Beachport, 100–150 fathoms, one specimen brown; Gulf St. Vincent, 10 fathoms; 50 miles west of Eucla, W. Aust., 80 fathoms.

This species differs from *A. serotinum* in having valid spirals of obsolete axials. In *A. serotinum* the axials are more prominent than the spirals.

EPIDEIRA FLINDERSI sp. nov.

Fairly solid, acuminate, last whorl longer than the spire; colour, cream, blotched with light brown just below the sutures; sculpture of spiral lirae crossed by numerous, fine, axial plicae, which have each two small nodules arranged vertically, one at and one just below the suture; below the lower nodule is a narrow area in which the axial plicae are obsolete, there another nodule tops the longer plica of the whorls; plicae are somewhat cut by the axials but not sufficient to form distinct tuberculose sculpture; protoconch bulbous, of two smooth, turbinate whorls, set obliquely on the adult shell; adult whorls seven. Holotype, height 21 mm., diameter 8 mm., 80 miles west of Eucla, Great Australian Bight, 75 fathoms (D. 13645).

The species is readily distinguished from others of the genus, the only one bearing the remotest resemblance is *Epideira striata* Gray, from New South Wales, which, however, has a coarser sculpture of a very different pattern.

EPIDEIRA BEACHPORTENSIS sp. nov.

Very solid, acuminate, last whorl longer than the spire; colour cream, with distant lines of elongate, small, brown spots; sculpture of fine, regular, spiral riblets, with slightly wider interspaces, the whole crossed by weak, irregular axials; protoconch bulbous, of two smooth, turbinate whorls, set obliquely on the adult shell; adult whorls six; columella bearing a heavy callus; notch broad and shallow; outer lip not inflected; canal very short. Holotype, height 31 mm., diameter 11 mm., Beachport, S. Aust., 150 fathoms (D. 13644).

This species appears quite distinct from all its congeners.

ONUSTUS FLINDERSI sp. nov.

Onustus peronianus Cotton and Godfrey, *nec* Iredale, *S.A. Nat.*, XIII, 1932, p. 38, pl. i., fig. 4.

Trochiform, medium size; white or yellowish, the basal ridges yellowish-brown; growth lines strong, irregular, oblique, crossed by flexuous, curved, oblique striae; base with numerous, sharp-ridged, curved, granose ribs, with fine thread lines between, crossed by distinct spiral ribs; spire conical, slightly convex;

protoconch conic, whorls few, convex, smooth, polished, white, with marks where very small fragments have formerly adhered; adult whorls nine, the last keeled; base flat; aperture low, broad, interior porcellanous; outer lip produced above; inner lip reflexed, forming a thick, white, shining callus; juveniles narrowly umbilicate, adult shells without umbilicus; operculum squarish. Holotype, height 9 mm., diameter 18 mm., Petrel Bay, St. Francis Island, S. Aust., 15–20 fathoms (D. 13615).

The upper surface is almost or quite hidden by the agglutinated shells. Compared with *Onustus peronianus* Iredale, the species is smaller and differently sculptured, and has the usual South Australian molluscan shells attached.

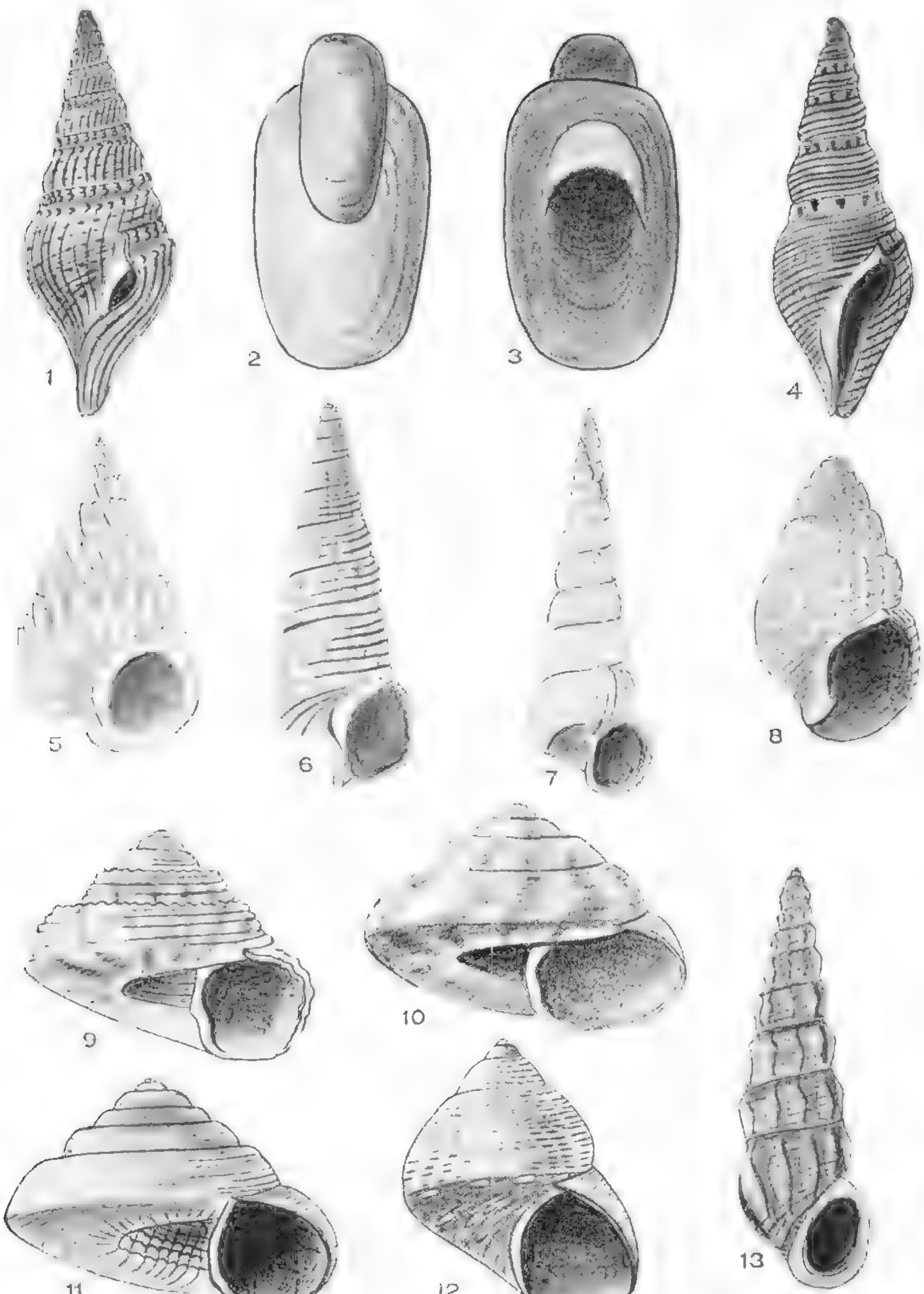
GUNDLACHIA EREMIA sp. nov.

Limpet-like, subpellucid, thin, oval, obliquely conical, in two distinct tiers; the juvenile portion above, long and narrow, one-third overlapping the margin of the adult; viewed laterally the juvenile is set obliquely on the adult, but follows the median line when viewed dorsally; internal shelf well produced. Holotype, total length 3·5 mm., breadth 1·8 mm., juvenile, length 2 mm., breadth 0·9 mm., Mount Lofty, S. Aust., in creek (D. 13613). Distribution: Mount Lofty; Aldgate; Reed Beds, River Torrens, near Henley Beach.

From *Gundlachia petterdi* Johnston, the species is smaller, thinner, smoother, and has the juvenile portion set along the median line and not obliquely to it, also the internal shelf almost reaches to the middle of the adult shell. It is comparatively rare in South Australia.

EXPLANATION OF PLATE xvii.

Fig. 1. *Epideira flindersi* sp. nov. (× 2·4).
Fig. 2. *Gundlachia cremia* sp. nov., dorsal view (× 12).
Fig. 3. *Gundlachia eremia* sp. nov., ventral view (× 12).
Fig. 4. *Epideira beachportensis* sp. nov. (× 1·6).
Fig. 5. *Scala (Mazescala) beachportensis* sp. nov. (× 7·6).
Fig. 6. *Ataxocerithium beasleyi* sp. nov. (× 6).
Fig. 7. *Scala (Narvaliscala) flindersi* sp. nov. (× 1·8).
Fig. 8. *Reticunassa flindersi* sp. nov. (× 4).
Fig. 9. *Ethminolia cincta* sp. nov. (× 5·6).
Fig. 10. *Ethminolia elveri* sp. nov. (× 4).
Fig. 11. *Spectamen marsus* sp. nov. (× 6).
Fig. 12. *Pellax gabiniana* sp. nov. (× 6).
Fig. 13. *Scala (Nodiscala) subcrassa* sp. nov. (× 4).


1
2
3
4
5
6
7
8
9
10
11
12
13
B.C.C.

PUBLIC LIBRARY, MUSEUM, AND ART GALLERY
OF SOUTH AUSTRALIA

RECORDS

OF THE

SOUTH AUSTRALIAN MUSEUM

Vol. VI, No. 3

Published by the Board of Governors, and edited by the Museum Director
(Herbert M. Hale)

ADELAIDE, DECEMBER 16TH, 1939.
PRINTED AT THE HASSELL PRESS, 104 CURRIE STREET

A NEW ASTROCONUS FROM SOUTH AUSTRALIA

By H. Lyman Clark, Museum of Comparative Zoölogy, Cambridge, Mass., U.S.A.

Summary

Thanks to the kindness of the Director of the South Australian Museum, I have had the privilege of studying a very remarkable "basket star" (Gorgonocephalid) of the genus Astroconus. The specimen is exceptionally well preserved and very handsomely coloured, and hence quite different in appearance from any other specimen of the genus I have ever seen.

Astroconus Pulcher sp. nov.

Disk 35mm. in diamter, with five arms, exceeding 125 mm. in length, forking at least seven or eight times; width of arms at base 10 mm., height 6 mm., disk distorted by drying; in life it was undoubtedly more or less swollen with the radial and interradial areas about equal ; in its dry condition the radial ridges are elevated, the interradial areas much sunken; radial shields distally widely separated from each other, space between considerably depressed.

A NEW ASTROCONUS FROM SOUTH AUSTRALIA

By H. LYMAN CLARK, Museum of Comparative Zoology, Cambridge, Mass., U.S.A.

Plate xviii.

Thanks to the kindness of the Director of the South Australian Museum, I have had the privilege of studying a very remarkable "basket star" (Gorgonocephalid) of the genus *Astroconus*. The specimen is exceptionally well preserved and very handsomely coloured, and hence quite different in appearance from any other specimen of the genus I have ever seen.

Astroconus pulcher sp. nov.

Disk 35 mm. in diameter, with five arms, exceeding 125 mm. in length, forking at least seven or eight times; width of arms at base 10 mm., height 6 mm.; disk distorted by drying; in life it was undoubtedly more or less swollen with the radial and interradial areas about equal; in its dry condition the radial ridges are elevated, the interradial areas much sunken; radial shields distally widely separated from each other, space between considerably depressed. The shrinkage of the disk causes the inner ends of the radial ridges to overlap in an irregular manner laterally, making it impossible to see the actual centre of the disk. Relatively large wrinkled, conical tubercles, 1 to 2 mm. high and nearly as thick at base, are scattered sparsely over the disk, chiefly at the distal ends of the radial shields. The covering of the disk is made up of crowded granules and plates as in typical *Astroconus.* Beginning at the very base, the arms are covered by tubercled transverse ridges all the way from the radial shields to the tips, the ridges separated from each other by slightly depressed areas without tubercles; if it were not for their distinctive colouration they would be much less defined and difficult to make out. Covering of arms, ridges, and valleys similar, made up of granules and small smooth plates as on disk. Each ridge to the third or fourth fork of the arm carries blunt, conical tubercles like those on the disk but distinctly smaller; occasionally there may be only one on a ridge, or very rarely none, usually two, three, or four, very rarely five. On the outer branches of the arms tubercles are wanting.

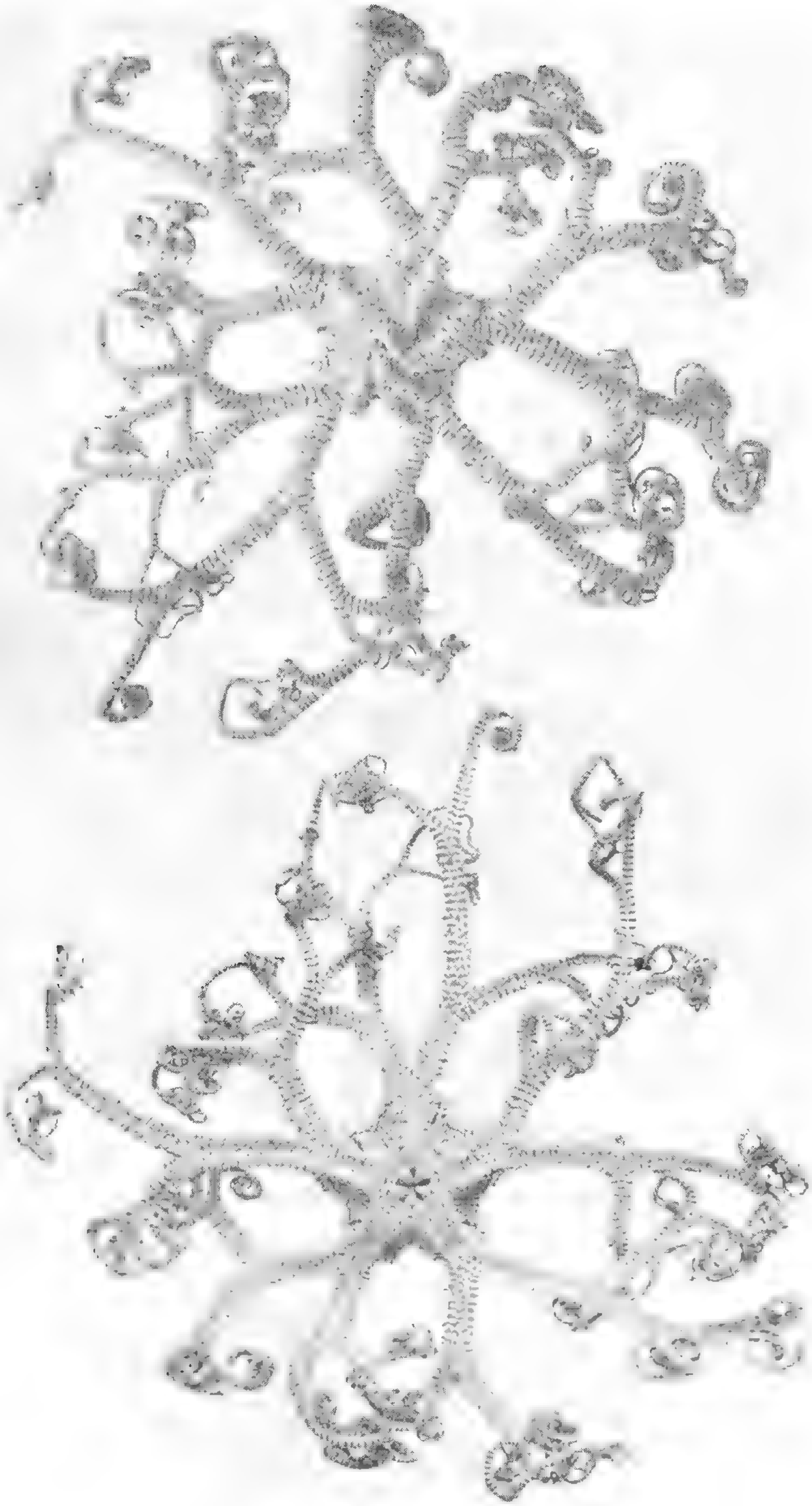
Entire lower surface covered by a fine granular coat, coarsest in the interradial areas. Tentacle spores small, but the first pair well within the disk and lacking any tentacle scale, appear to open at the tip of a more or less calcified papilla which has shrunken on drying into a minute shapeless heap. Each succeeding spore more or less concealed by a slight ridge on the adoral side, which carries three, four, five, or even six short, thick, slightly flattened spines, terminating in a cluster of 3–5 short but sharp glassy thorns; the ridges themselves merge into the tubercled ridges of the sides and upper surfaces of the arms. Each mouth angle carries a large number of teeth and oral papillae of diverse sizes, arranged irregularly on the sides and angle of the jaw. Genital slits conspicuous, 5 mm. long, placed near the arm but distinctly separated from it. Madreporic plate single, well defined, close to the mouth frame in one interradial area.

Colour: above, a light ashy-grey with a purplish tinge; disk with numerous spots and irregular slender brownish-black lines; arms with the ridges light ashy-grey, the depressed areas between brownish-black in sharp contrast; the large tubercles are ashy, but many have the tips more or less dusky. The annulation of the small branches of the arms is very handsome. Lower surface pale-buff or cream colour; on the interradial areas are numerous irregular lines and spots of brownish-black; the mouth-frame and the lower surface of the arms is prettily marked with numerous spots and small blotches of brownish-black. Arm spines lemon-yellow in marked contrast. Oral papillae and teeth pale orange.

Holotype. South Australian Museum Coll. No. K.561.

This very handsome, and at present unique, specimen was taken in a crayfish pot, in 20 fathoms of water, at Cape Dutton, South Australia, by Mr. K. Mattson. Aside from its colouration there is little to distinguish it from *australis*, but the regular "ringing" of the arms is unlike any specimen of that species which I have seen (71 in all). It is hard to say, however, how much the validity of this character is affected by its close association with colour in the new species. Only observation of a good series of living or well-preserved specimens can determine the true status of *pulcher*. Comparison with specimens of *australis*, of which no two specimens seem to be exactly alike, showed that it was very close to some specimens of that species. It is distinguished at once from *occidentalis*, the only other *Astroconus* as yet described, by the fact that the well marked transverse ridges which encircle the upper surface and sides of the arms carry but few tubercles (2–5), and these are relatively large and irregularly arranged.

As regards its relationship to *australis*, it may be only a colour form or extreme variety, but after considerable study it seems best to treat it as a distinct species, and I therefore have ventured to describe it as such, giving it the name of *pulcher*, because of its beauty.



NEW FOSSIL CHITONS FROM THE MIOCENE AND PLIOCENE OF VICTORIA

BY EDWIN ASHBY AND BERNARD C. COTTON, SOUTH AUSTRALIAN MUSEUM

Summary

At the request of Dr. Sule, of Prague, Czechoslovakia, Edwin Ashby made arrangements with Walter Greed, of Hamilton, Victoria, to collect fossiliferous earth from three exposures in Victoria.

By a special process, and by using millimetre and half-millimetre sieves, Dr. Sule washed out from four four-gallon tins of this material, no fewer than fifty species, of which 44 are new species of fossil chitons. As hitherto the number of authentic fossil chitons known from Australia was under twenty, the present additions more than treble the known fauna.

NEW FOSSIL CHITONS FROM THE MIOCENE AND PLIOCENE OF VICTORIA

By EDWIN ASHBY AND BERNARD C. COTTON, SOUTH AUSTRALIAN MUSEUM.

Plates xix–xxi.

At the request of Dr. Sule, of Prague, Czechoslovakia, Edwin Ashby made arrangements with Walter Greed, of Hamilton, Victoria, to collect fossiliferous earth from three exposures in Victoria.

By a special process, and by using millimetre and half-millimetre sieves, Dr. Sule washed out from four four-gallon tins of this material, no fewer than fifty species, of which 44 are new species of fossil chitons. As hitherto the number of authentic fossil chitons known from Australia was under twenty, the present additions more than treble the known fauna.

Still another species, which is represented by a unique specimen found in soil belonging to the United States National Museum and from the same exposures, is described. This unique specimen has been presented to the South Australian Museum.

The great increase in our knowledge of the Australian Fossil Chitons, due to the success of Dr. Sule's method, should stimulate interest in the Polyplacophora (Loricata), and seems to indicate that our ideas of the class may need considerable revision.

The beautiful figures here reproduced were prepared by Miss Varena Nottage, and, as an aid to the identification and understanding of the species, the missing parts of the valves have been reconstructed, the original portion being demarcated by a dark line.

PROTOCHITON Ashby, 1901.

PROTOCHITON GRANULOSUS Ashby and Torr, 1901.

The taxonomic importance of the above species cannot be too strongly stressed. Pilsbry (4) wrote: "It is commonly known that the earlier (Palaeozoic) Chitons are without insertion plates, and belong therefore to the family *Lepidopleuridae.*" In 1900 (5) he proposed his sub-order *Eoplacophora* for the reception of all Palaeozoic genera, and adds: "None of the Palaeozoic genera are known to continue into the Mezozoic, but are replaced by types more related to modern Chitons."

While the genus *Lepidopleurus* (still extant) has no insertion plates, it is recognized by most students as being the progenitor of all living forms, and that the development of the insertion plate commenced with the end valves. Ashby (3) has shown that the genus *Protochiton* has no insertion plate in either of the end valves, but has begun to form one, still incomplete, in the median valves. It seems certain therefore that the genus *Protochiton* cannot have been derived through any member of the family *Lepidopleuridae*; it is undoubtedly the progenitor of the large family *Acanthochitonidae*. It would seem that the Acanthochitonids have been derived from primitive (Palaeozoic) stock along a separate and parallel line to that which produced the *Lepidopleuridae*. Further, the tail valve of "*Chiton gemmatus* de Koninck" from the Carboniferous beds of Dunfermline, Scotland, in the peculiar character of the outward extension of the tegmentum, absence of insertion plate, and general shape, is seemingly the prototype of the tail valve of *Protochiton granulosus* Ashby and Torr. The grains in the sculpture of *P. granulosus* are hollow, with a black dot on each grain, probably a sense organ, in which case the hollow grain may have been filled with "nerve fibre", a feature we do not remember to have seen in any living Chiton. We conclude that the strange extension to the tegmentum, common to both *Chiton gemmatus* de Koninck and *Protochiton granulosus* Ashby and Torr, is a primitive survival factor, giving increased surface for the girdle attachment which was later discarded in favour of an extension of the articulamentum to form the insertion plate and eaves. From the single tin (four gallons) of material from Clifton Bank (Lower Miocene) nine valves or fragments of valves of this species were obtained; one being a fairly perfect tail valve, the others median valves.

? PROTOCHITON sp.

From the same exposure also, comes a single median valve which is Acanthochitonoid in character, but with hollow grains which are widely different from those of the above species. As this is too imperfect to make a holotype, its description is deferred in the hope that future work will produce a better preserved example of what must be a very interesting species.

AFOSSOCHITON Ashby, 1925.

AFOSSOCHITON SULCI sp. nov.

Plate xx, fig. 21.

Head valve only, length 1·0 m.m., width 1·25 mm. Straw coloured. Raised, anterior slope convex and steep. Entire surface, under X30 Zeiss binocular, evenly covered with circular, flat-topped polished, minute grains, which, although crowded, appear not to touch. Five ray ribs, three central ones strongly raised, outer ones little more than mere folds.

Articulamentum. Insertion plate extending well forward beyond tegmentum for one-fifth of width of latter; colour white, three central ray ribs continued right across insertion plate, which is folded up, the fold standing out beyond the margin of the insertion plate; no trace of a slit.

Tegmentum inside without sculpture, turned over to an unusual degree; three dark-coloured apertures in three depressions corresponding with the three ray ribs of the tegmentum, and each almost corresponding with the edge of tegmentum above.

Holotype, McDonald's, Muddy Creek, Pliocene (Kalimnan). P. 4340, S.A.M. Beautifully preserved.

We have great pleasure in naming this important discovery after Dr. Sule, to whose labours we are indebted for its discovery. Because of its excellent state of preservation, this specimen amply justifies Ashby's primitive genus, *Afossochiton*, which has all the characters of *Acanthochiton* except that of slits, and can be regarded as a direct progenitor of *Acanthochiton*. The three dark-coloured apertures suggest large nerve channels connecting with the girdle at its junction with the tegmentum; exactly similar features do not occur in living Chitons.

AFOSSOCHITON CUDMOREI Ashby, 1925.

Plate xx, fig. 22.

One median valve from McDonald's, Miocene (Kalimnan).

TELOCHITON subg. nov.

Sculpture conforming to that of *Afossochiton*, but ray ribs of anterior and other valves continued right across insertion plate in narrow raised ribs, which (in some cases) do not seem to be a prolongation of the tegmentum, but are built up out of the articulamentum. Genotype, *Afossochiton (Telochiton) dendus* sp. nov.

AFOSSOCHITON (TELOCHITON) DENDUS sp. nov.

Plate xx, fig. 24.

Incomplete head valve only; length of piece 3 mm., width 3 mm. Tegmentum occupies about one-third of valve, insertion plate very wide; sculpture of crowded elliptical small grains with no definite arrangement, those grains surmounting the ray ribs sometimes larger, some several times as large, in one place apparently fused, larger near the posterior margin; five strongly raised ray ribs, the space concave between the two posterior and the one next to them; an unusual feature is that each rib in the tegmentum is continued right across the broad insertion plate in a narrow sharply-raised rib, apparently built of the lower layer of the articulamentum; this appearance is not due to attrition of the tegmentum, for, in places, the anterior edge of the tegmentum has sculpture of small grains.

Articulamentum. White; tegmentum folded over at apex of valve, continuation of ray ribs across the insertion plate not by a prolongation of tegmentum but by a building-up of the articulamentum. No slits, but insertion plate edge considerably damaged.

Holotype: Clifton Bank, Grange Burn, Hamilton, Victoria. Lower Miocene. P. 4342.

AFOSSOCHITON (TELOCHITON) ISCUS sp. nov.

Plate xix, fig. 20.

Tail valve only, length 2 mm., width 3 mm., much elevated and arched, mucro at posterior third, tegmentum behind mucro vertical, reduced to one-third only of area of shell; dorsal area very narrow, sides parallel, not wedge-shaped, with a narrow short groove on either side, the posterior portion of this area worn, though a perfect specimen may have a short second groove making this area narrowly and partially pinnatifid; area behind mucro, small, evenly covered with closely-packed small, rounded, ball-like grains, posterior margin with two very large grains and a third smaller one suggesting the beginning of a very coarse broken rib; a most unusual feature typical of this subgenus, and situated next to the girdle at the posterior portion of the insertion plate, are three ribs traversing the insertion plate, one in line with the dorsal area, and one on either side diverging. (Since writing this description, one rib has flaked off.) These do not appear to be narrow ridges of the tegmentum, but are rather narrow thickenings of the articulamentum. No slits. Area anterior to mucro decorated on either side with four horizontal rows of globular to subelliptical grains; the pattern is so regular that transverse rows of grains are formed.

Articulamentum. White; hollow under mucro unusually deep, either the sutural laminae were weak or the larger portion is missing.

Holotype: Clifton Bank, Grange Burn, Hamilton, Victoria, Lower Miocene. P. 4339, S.A.M.

AFOSSOCHITON (TELOCHITON) MAGNICOSTATUS sp. nov.

Plate xx, fig. 23.

One median valve only, length 5 mm., width 6·5 mm., angle of divergence 90°. Carinated, beaked, dorsal ridge longitudinally convex, side slope steep; dorsal area flaked off, evidently longitudinally curved; pleural area diagonally concave, decorated with rather large elliptical grains arranged diagonally in longitudinal rows in some places; many of grains rectangular on the upper end, obtusely rounded at the lower; most striking feature is an exceptionally narrow and high diagonal rib starting from the prominent beak and reaching the girdle not far posterior of the middle of the valve; pleural area bends upwards at the diagonal rib, making pleural area concave; top of rib as wide as a single large elliptical grain; pleural area slope to top of diagonal rib gradual, but on the other side, that of the lateral area, the slope is vertical; consequently lateral area is depressed, and at a considerably lower level than the pleural area; sculpture of depressed lateral area similar to that of pleural, but grains there a little more spaced.

Holotype: McDonald's, Muddy Creek, Pliocene (Kalimnan). P. 4343, S.A.M.

The narrow, much raised diagonal rib and depressed lateral area easily distinguish this *Afossochiton.* What appears to be an extension of the sutural laminae is on one side crossed by an extension of the diagonal rib. This feature is the sole justification for placing the species under *Telochiton.* That a fragile fragment of the tegmentum does, at the diagonal rib, extend across the articulamentum, is quite certain. Any but very cautious handling of the valve will break this. There still remains a possibility that the whole of the articulamentum showing has been produced by the flaking off of the tegmentum, for in places pieces of grain appear to have been removed and then to have adhered to the articulamentum, or this appearance may be due to scars; additional examples are required for exact determination of this point.

ACANTHOCHITON Gray, 1821.

ACANTHOCHITON FORSYTHENSIS sp. nov.

Plate xx, fig. 26.

Two median valves. One, length 1·25 mm., width 2 mm. (holotype), and the other, length 3 mm., width 3·8 mm. (paratype).

Carinated, dorsal area broadly wedge-shaped and pinnatifid, beaked, surface smooth, lateral-pleural area decorated by longitudinal rows of triangular, spaced, flattish grains of four complete and one half-rows; grains regularly placed, forming rows either way; apex of triangular grains point downwards and forwards.

Articulamentum. White; insertion plates and sutural laminae broken off, tegumentum folded back at the beak, in centre of the valve articulamentum much thickened from one side to the other.

Holotype: Forsyth's Grange Burn, near Hamilton, Victoria, Pliocene (Kalimnan). P. 4345.

Paratype: Same locality, median valve.

A further specimen from Clifton Bank, median valve, length 1·5 mm., width 2 mm.

This species differs from *Afossochiton cudmorei* Ashby in that the triangular grains are arranged regularly, while in *cudmorei* they are very irregular, dorsal areas not pinnatifid, and the carination less sharp.

ACANTHOCHITON FORSYTHENSIS RELATUS sub.sp. nov.

One median valve. Differs from *forsythensis* in lateral area being indicated by a shallow fold, grains arranged diagonally, but dorsal area and grains similar.

Holotype: Clifton Bank, Grange Burn, Hamilton, Victoria, Lower Miocene.

ACANTHOCHITON DRUNUS sp. nov.

Plate xx, fig. 29.

One median valve, length 1·5 mm., width 2 mm. Dorsal area worn, narrower than in *forsythensis,* not pinnatifid, but suggests longitudinal striation; ridge straight, not arched; pleural-lateral area decorated with straight longitudinal rows of grains arranged on the diagonal and almost, sometimes actually, touching; grains elliptical, slightly rounded at apex, flattish but not actually flat; five rows of grains, one next to girdle has three grains and one next to dorsal has worn grains.

Articulamentum. Sutural laminae present but worn, broad, shallow anteriorly, sinus between wide; insertion plates have no indication of slit, though absence may be due to wearing.

Holotype: McDonald's, Muddy Creek, Pliocene (Kalimnan). P. 4348, S.A.M.

ACANTHOCHITON CASUS sp. nov.

Plate xx, fig. 30.

One median valve only; length 1·5 mm., width 2 mm. Side slope steep; dorsal area, ridged, curved, and arched, less broad than in *Acanthochiton forsythensis* due to smaller angle of divergence, subpinnatifid, three grooves narrower than in *forsythensis,* lateral area not defined; pleural-lateral area slightly concave, outer edge becoming less steep; this area decorated with six and a partial seventh row of grains placed longitudinally; grains small, triangular, placed in rows at an acute angle, pointing forward; viewed transversely, rows are curved, not at right angles as in *forsythensis*; difference of pattern largely due to concavity of shell.

Articulamentum. Dirty-white; sutural laminae and insertion plates broken off.

Holotype: Clifton Bank, Grange Burn, Lower Miocene. P. 4349, S.A.M.

This species may be the progenitor of *Acanthochiton forsythensis*, for, in several respects, they resemble one another.

ACANTHOCHITON SABRATUS sp. nov.

Plate xx, fig. 25.

One median valve, length 1·75 mm., width 2·25 mm. Arched, not carinated, side slope convex and dorsal ridge beaked; dorsal area has sculpture worn away (if any was present), narrowly wedge-shaped as shown by the sculpture of pleural area at the anterior end; pleural area separated from lateral by narrow rib, but except for this rib, lateral area is at same level as pleural area; sculpture of both areas and of the rib itself identical; sculpture of small grains irregularly arranged and crowded, minute crowded round grains near the beak, across the pleural area grains are double the size, and for a short distance are in a semi-longitudinal arrangement, become a little longer in shape, then another change takes place, and a few grains along anterior margin are almost circular with flattish tops; briefly, grains are unusually small, with little pattern, and vary in shape.

Articulamentum. Dirty white; only a small fragment of sutural lamina present; we judge this to have been well developed, and sinus between fairly broad; all insertion plates missing; tegmentum folded over at beak.

Holotype: Clifton Bank, Grange Burn, Hamilton, Victoria, Lower Miocene. P. 4344, S.A.M.

LIRACHITON subg. nov.

Pleural area decorated with narrow, widely-spaced ribs, instead of granular ornamentation. In the genotype, *Acanthochiton (Lirachiton) inexpectus* sp. nov., the sculpture behind mucro and in area corresponding with lateral area in median valve is formed of triangular flat grains; near the apex of each is an ocellus or sense organ. While we have provisionally placed the subgenus *Lirachiton* under *Acanthochiton*, it could be placed under *Afossochiton* with as much justification; the evidence of more material is needed to settle the point.

ACANTHOCHITON (LIRACHITON) INEXPECTUS sp. nov.

Plate xx, fig. 31.

One tail valve only; length 2 mm., width 2·5 mm. Shell arched, not carinated, side slope almost straight; in most of dorsal area tegmentum has broken off, but there is a little left at the anterior edge where it is smooth; mucro a little posterior of central, slope behind mucro steep and decorated with flat triangular grains, most of which have been partially worn off, revealing that they are apparently hollow; at the sides, an area corresponding with lateral area in median valves where the triangular flat grains are well preserved and larger than the posterior ones; apertures situated near but not at the apex of each triangular grain, may be sense organs, but larger than those in hollow grains of *Protochiton granulosus*, corresponding with the ocelli common in several living genera; rest of portion anterior to mucro and corresponding with pleural area, traversed longitudinally by three much raised, rounded ribs, the trough between these ribs broad, and the ribs themselves overhanging.

Articulamentum. White; hollow under mucro wide and deep, nerve apertures exceptionally developed and numerous; slits not discernable, but two or three very shallow grooves may be connected with slits.

Holotype: McDonald's Muddy Creek, Pliocene (Kalimnan). P. 4350, S.A.M.

The nearest allied living species is, we think, *Pseudotonicia cunata* Suter, from New Zealand.

ACANTHOCHITON PILSBRYOIDES sp. nov.

Plate xx, fig. 27.

One median valve only, length 2·25 mm., width 3 mm. Subcarinate, angle of divergence 110°. Dorsal area and small adjoining portion of pleural area eroded on one side, and whole of sculpture eroded on the other; major portion of sculpture on pleural-lateral area on the one side so well preserved and ornamentations so distinctive, that we describe it as new; sculpture of horizontal rows of grains, the larger portion in shape of rectangular ellipse, set in rows diagonally (similar to sculpture of the recent *Acanthochiton pilsbryi* Sykes), but near the dorsal area some grains are rhomboided and one or two fusiform.

Articulamentum. Insertion plate broad, no slits visible, but this may be due to erosion, which also accounts for bases only of the sutural laminae being left.

Holotype: Clifton Bank, Grange Burn, Hamilton, Victoria, Lower Miocene. P. 4346, S.A.M.

The specific name is suggested by the similarity of sculpture with that of the Australian recent species, *Acanthochiton pilsbryi* Sykes, but in the shape of the valves and absence of bridging in the sculpture, it is quite dissimilar.

ACANTHOCHITON TRIANGULOIDES sp. nov.

Plate xx, fig. 28.

One median valve, length 2 mm., width 2·25 mm. Rather flat, arched, and beaked, dorsal area narrow and wedge-shaped, anterior half granulosely sculptured; much sculpture flaked off, but what remains shows rather long ovate-elliptical shallow grains, changing before the centre of area is reached to three shallow rows of small, indistinct grains; posterior half of this area smooth and polished; beak protrudes well beyond posterior margin of valve; pleural-lateral area decorated with eight or nine longitudinal rows of small, spaced, slightly-raised (obtuse-triangular) flat-topped grains; direction of rows not parallel, and in one place a short row is intercalated; arrangement of rows a little indistinct, some angles of lighting suggest more diagonal than longitudinal arrangement; grains evenly spaced throughout in the rows, and exceptionally even in size; no diagonal rib or fold, lateral area differing in that in the two outer rows at the posterior corner the grains, eight in all, are half as large again as the rest of the area.

Articulamentum. White; insertion plate and sutural laminae are missing.

Holotype: Forsyth's Grange Burn, Hamilton, Victoria, Pliocene (Kalimnan). P. 4347, S.A.M.

The sharply-cut, small, even in size, and subtriangular grains make this quite a distinctive species. If, when a perfect specimen should be found, the insertion plates are unslit, the species will then have to be removed to *Afossochiton* Ashby.

The description was made while viewing the specimen under X30 Zeiss binocular.

CRYPTOPLAX Blainville, 1818.

CRYPTOPLAX PRITCHARDI Hall, 1904.

Plate xix, fig. 20.

Cryptoplax gatliffi Hall (6) is a synonym of the above species. Ashby (3) states: "The holotype of *C. gatliffi* differs in one respect only from the majority of specimens described as *C. pritchardi* Hall, in that it possesses a lobe-shaped plate on the inside, just under the apex." We now find that the "lobe-shaped plate" is common to all valves, although more marked in the three anterior valves. We find that Hall was incorrect in believing that any of the fossil examples he had seen showed the tegmentum, and we are confident that the only difference is that *pritchardi* is the remains of an ordinary median valve, and *gatliffi* was one of the three anterior valves of the same species. Ashby (3) also expressed the opinion that these worn "valves" may be of "non-Chitonoid origin". Now, thanks to Dr. Sule's washings, we have hundreds of these *Cryptoplax* valves, very few showing sculpture.

We now express the following opinions:

1. Holotypes of *pritchardi* and *gatliffi* and all previously recorded examples have no visible tegmentum, and all sculpture has been worn off.

2. Hundreds of these worn examples might reasonably be considered one species, because in living forms there is an equal discrepancy in the valves of a single specimen, the first two and often the first three valves are broad, and the rest narrow, subject to variations in the tail valve.

3. The present shape of these worn valves is often not at all the original form, but that as they have been ground out of all recognition by ceaseless rolling of the waves, a valve has often been shortened by nearly one-third.

4. Not one per cent. of the valves shows any sculpture. We offer the explanation that the shape is that of an elongate roller, which lends itself to rolling over and over with the slightest ripple, as well as in the more violent surf.

Pleisiotype. Out of the first examples of fossil *Cryptoplax* to show sufficient data for specific description, we select one as pleisiotype of the late Prof. Hall's *Cryptoplax pritchardi,* and we also place his *Cryptoplax gatliffi* as a synonym.

We also describe and name two distinct new species of *Cryptoplax* in the following pages.

Re-description from pleisiotype.

Median valve, length 6 mm., width 2 mm. Sharply raised, side slope convex, dorsal area very narrow, straight sides, raised, a little flattish top, beak slightly worn; sculpture forms one area at the beak consisting of spaced, circular or spherical small grains (truly Acanthochitonoid in character), from there the two upper ribs granulose for a third the length of valve; upper rib next the dorsal area continued parallel with the dorsal area almost to the anterior edge of the valve, and for the last two-thirds of its length is a strong irregular rib very coarsely toothed at its base on the upper side, the effect of the coarse teeth is to suggest a series of pits; on one side there are two outer ribs sculptured in the same manner one over half the length of valve, the other a little less than half, these two granulose for half their length, then change to the coarse-toothed sculpture; on the other side, while the two upper ribs correspond with the above description, there are also two outer short ribs (probably the outer one on the other side has been broken off); these two immediately beyond the granulose base near the beak become a series of confused, irregular, highly-polished grains.

Articulamentum. Creamy-white; sutural laminae worn, insertion plate worn; tegmentum bent over at posterior forming a pocket, the internal plate only showing as a hollow rise.

Paratype 1. Same locality, length 4·5 mm.; worn, whole of tegmentum present and in proportion to size, the granulose sculpture is a little more extensive.

Paratype 2. Length 4 mm., worn. Both 1 and 2 have well defined, raised dorsal area.

Pleisiotype and Paratypes: McDonald's Muddy Creek, Pliocene (Kalimnan).

CRYPTOPLAX SICUS sp. nov.

Plate xix, fig. 17.

Large median valve (holotype), length 6 mm., long, narrow, steeply raised, beaked; dorsal area colour "tawny" (Ridgeway) narrow, straight-sided, strongly raised, rounded; sculpture, except at beak, composed of five dagger-like ribs on either side, ivory-like in appearance, commencing near the beak, narrow and slender, becoming swollen within a third of their length from the end, and then tapering to a sharp point, longest rib next to dorsal area, ending one-fifth short of the anterior edge of the valve; close to beak ribs show slight granulation at their sides, and so for a very short distance, but the beak itself is partly broken away, and there might have been a small amount of granulation had there been no breaking away.

Articulamentum. White; the damage to the valve has still left the little internal "plate" in perfect preservation.

Holotype: McDonald's, Muddy Creek, Pliocene (Kalimnan). P. 4336, S.A.M.

Paratype: One median valve, width 3 mm., worn, but showing most of the sculpture. Same locality as holotype.

Hypotype: Of head valve, only specimen; badly worn, but showing some sculpture, although not sufficient to make it holotype head valve. Same locality as holotype.

The name (from "*sica*", a dagger) is suggested by the dagger shape of the ribs.

CRYPTOPLAX NUMICUS sp. nov.

Plate xix, fig. 18.

One median valve only, length 3 mm., width 1·5 mm., in perfect state of preservation; wider than most species, arched, side slope less steep than usual; not beaked, but dorsal area slopes down to shell margin posteriorly; dorsal area has no raised, narrow dorsal ridge as in *C. pritchardi* and *C. sicus*, but presents a broader convex surface than either; it is possible that this area received a good deal of erosion, but the exceptionally well preserved sculpture on other portions of valve seem to contradict this idea; sculpture entirely granulose throughout, consisting of fine granulose longitudinal ribs, the outer one very short, little more than the granulose thickening of the posterior edge of the tegmentum; upper rib close to edge of dorsal area, indistinct in places, possibly due to wearing, grains small, spherical, and mostly narrowly spaced.

Articulamentum. Creamy-white; insertion plate in good state of preservation, sutural laminae well defined, but shallow, tegmentum folded over at posterior end, making that end slipper-heel shaped, a feature characteristic of *Cryptoplax*.

Holotype: McDonald's, Muddy Creek, Pliocene (Kalimnan). P. 4337, S.A.M.

MOLACHITON gen. nov.

Dorsal area (worn in genotype) broad, smooth except for faint growth grooves; pleural area unique, crossed longitudinally with broad irregular ribs, composed of large grains shaped on upper side like a large molar tooth, whole series of grains in rib fused together, centre of each grain with a funnel-like depression, and in centre of funnel a black dot or nerve aperture; ribs near dorsal area short, several run forward into dorsal area, but too worn to show "ocelli", if present; twelve ribs showing between dorsal area and girdle; lateral area sharply up-folded at the posterior margin; both raised portion, trough below, and a small part of the adjoining outer edge of pleural area decorated with imbricating, sub-triangular sub-convex grains.

Genotype (monotype): *Molachiton naxus* sp. nov.

The unusual sculpture of the pleural areas with the sensory organ in the centre of each molar-shaped fused grain, and the absence of insertion plate or sutural lamina, precludes determination of the true position of the genus in the natural taxis, so provisionally we place it in the family *Lepidopleuridae.*

MOLACHITON NAXUS sp. nov.

Plate xx, fig. 32.

One half median valve only, length 4 mm., width 4 mm. Strongly beaked, dorsal area a good deal worn, broad, smooth except for faint growth grooves; pleural area unique, crossed longitudinally by broad irregular ribs composed of large grains in the shape of a large molar tooth; whole series in rib fused together; a funnel-shaped depression in centre of each grain, and in its centre a black dot or nerve aperture (ocellus), ribs near dorsal area short, and several run forward into that area; these are too worn to show ocelli even if present; twelve ribs showing in pleural area; lateral area sharply up-folded at posterior margin; both raised portion, the trough (hollow below) and small part of adjoining outer edge of pleural area decorated with imbricating, subtriangular, sub-convex grains.

Articulamentum. Cream; insertion plate and sutural laminae missing.

Holotype: McDonald's, Muddy Creek, Pliocene (Kalimnan). P. 4251, S.A.M.

BELCHITON gen. nov.

Sculpture of pleural area consists of slender longitudinal ridges surmounted with minute spherical glossy or porcelain grains; the interspaces twice the width of the granular ridges and shallowly bridged below each grain; lateral area covered with closely-packed radial rows of grains similar to those of the pleural area, the rows in places intercalated with shorter rows; lateral area not raised as a whole, but near dorsal area and girdle are two shallow upward folds; sutural lamina in genotype appears perfect, weak and shallow, quite characteristic of palaeozoic forms; in common with *Protochiton granulosus* Ashby and Torr, each granule has a black dot or "sense aperture" at the summit. We place this genus in the family *Lepidopleuridae*.

Genotype (monotype): *Belchiton pulcherrinus* sp. nov.

The sculpture is so different from any other genus of *Lepidopleuridae* that we propose the above new genus.

BELCHITON PULCHERRIMUS sp. nov.

Plate xix, fig. 10.

Two fragments median valves, good condition; larger (holotype) 3 mm. wide, smaller 2 mm. wide. Fragments almost square (reconstructed in figure); pleural area crossed longitudinally by numerous extremely slender riblets, each carrying at the top, tiny spherical glossy or porcelain-like grains; near the dorsal area, riblets are crowded, several short ones intercalated, where this occurs almost touching; from there until girdle is reached, riblets are in proportion to their width, widely separated, each turning upward on reaching lateral area; an important feature of sculpture in the pleural area is the bridging, the transverse sculpture, very slender and shallow, crosses from grain to grain; lateral area closely covered with radial rows of grains of same character as those in pleural area, which do not seem to surmount a ridge, but lie on the surface; shorter rows intercalate in places; lateral area not raised as a whole, but near both dorsal area and girdle a shallow upward fold; grains in both areas with a black dot or aperture in their apices, no doubt associated with sensory organs, a primitive feature found in the genus *Protochiton* Ashby.

Articulamentum. White; sutural lamina very small both ways (quite primitive in character), and placed towards outer margin; tegmentum turned over full length of posterior margin.

Holotype: McDonald's, Hamilton, Victoria, Lower Pliocene (Kalimnan). P. 4329, S.A.M.

The beauty of the sculpture suggests the name. A Zeiss X30 binocular and pocket lens X20 were used for examination.

LEPIDOPLEURUS Risso, 1826.

LEPIDOPLEURUS NIVARUS sp. nov.

Plate xix, fig. 5.

One median valve, holotype, length 2 mm., width 4·9 mm. Valve arched, not carinated, angle of divergence 105°, side slope slightly convex, dorsal area eroded, shell bowed forward at beak; pleural area well preserved, crossed longitudinally by narrow granulose ribs, a few bifid, many wavy; interspaces two to three times the width of ribs; lateral area sharply raised and closely decorated with five ray rows which almost touch; grains small, circular, and rounded.

Articulamentum. Probably originally white, now stained; thickened across middle, no insertion plate.

Holotype: Clifton Bank, Grange Burn, Hamilton, Victoria, Lower Miocene. P. 4324, S.A.M.

Paratypes: Two fragments median valves, same locality.

LEPIDOPLEURUS PAMPHILIUS sp. nov.

Plate xix, fig. 2.

One median valve only, length 1·9 mm., width 3 mm., angle of divergence 90°. Side slope straight, arched, not carinated, dorsal area beaked, broadly wedge-shaped, striate with slender, closely packed, minutely granulose riblets; division between dorsal area and pleural area ill-defined because similar slender riblets to those of dorsal area are continued for at least one-third of the pleural area, and from there until lateral area is reached, grains and riblets, of which they are part, increase till two or three times their size; lateral area raised, narrow, ornamented with closely-packed granules, which commence quite minute at the dorsal area, increasing in size towards the girdle, but even these are not as large as the adjoining portion of pleural area.

Articulamentum. White; the lamina on one side perfect except for small notch, demonstrating that laminae of this genus are weak and produced very far apart, a feature this genus has in common with all known forms of palaeozoic chitons from the Primary Carboniferous Beds of Europe; no insertion plate.

Holotype: Clifton Bank, Grange Burn, Hamilton, Victoria, Lower Miocene. P. 4321, S.A.M.

LEPIDOPLEURUS BADIOIDES sp. nov.

Plate xix, fig. 4; xxi, 47.

Tail valve, length 1·75 mm., width 2·25 mm. Mucro at anterior third, immediately behind mucro shell is vertical, from there posterior area is at a steep angle, flattening out a little near posterior margin; whole of this area posterior to mucro and including both sides of mucro clothed with closely-packed radiating minutely granulose riblets; small area anterior to mucro evenly decorated with proportionately widely-spaced granular riblets, while coarser than those of posterior portion, still slender; this sculpture present not only at sides of the valve but continued over anterior half of dorsal area, which seems unsculptured at mucro itself.

Articulamentum. No insertion plate, sutural laminae much reduced and far apart.

Holotype: Clifton Bank, Grange Burn, Hamilton, Victoria, Lower Miocene. P. 4323, S.A.M. Fig. 4.

Hypotype of median valve. One well preserved, length 1·5 mm., width 3·25 mm., from Forsyth's, Pliocene (Kalimnan), subcarinated, side slope convex; sculpture similar to that of area anterior to mucro in holotype, but direction of slender riblets in lateral area radial.

Articulamentum. Cream; no insertion plate, sutural laminae missing, tegumentum folded over under beak. Fig. 47. P. 4358, S.A.M.

Paratype 1: Tail valve, broken, length 1·25 mm., width 2 mm., posterior and sides of mucro clothed with closely-packed radiating minutely granulose riblets, a good deal obscured owing to wear. Same locality.

Paratype 2: Fragment of median valve—same locality as paratype 1.

The name *badioides* is suggested by the similarity to the recent *badius* Hedly and Hull.

? LEPIDOPLEURUS UXELLUS sp. nov.

Plate xix, fig. 13.

A portion of tail valve, length 1·25 mm., width 2·25 mm. Mucro well defined, central, almost vertical immediately behind the mucro; from there to posterior margin shell is very flat, decorated with closely-packed radiating subgranulose riblets; width and crowding of riblets almost identical with the similar riblets in *Lepidopleurus badioides* Ashby and Cotton, but in *uxellus*, granulation is only partial; posterior area ends abruptly at the mucro, not carried forward along the sides as in *L. badioides*; area anterior to mucro much raised and decorated by numerous, strong, longitudinal, pectinated ribs (not granulose), the interspaces deep and about half the width of ribs; this sculpture carried right across dorsal area, which is striate for its full length, the whole of the tegmentum is slate-grey.

Articulamentum. Greyish-blue; no evidence of insertion plate; a steep narrow ridge commencing V-shaped under mucro and reaching outer anterior margin on either side; one side incomplete (due to breaking away), but on the other side, ridge is perfect, and shows a deep groove commencing at girdle and ending near centre of valve; we do not recall a similar ridge in any other chiton.

Holotype: Forsyth's, Grange Burn, Pliocene (Kalimnan). P. 4332, S.A.M.

Although we have placed this species under the genus *Lepidopleurus* failing further data, the flatness of the area behind the mucro, the colour of articulamentum, and to some extent the sculpture of the area anterior to the mucro, are not characteristic of the genus *Lepidopleurus*.

Lepidopleurus magnogranifer Ashby, 1925.

Plate xix, fig. 3.

Four portions of median valves from Clifton Bank. The holotype described by Ashby (3) was picked from among fossils collected by Dennant and Tate from the general locality "Muddy Creek", some of which were also described by Ashby and Torr (1).

We now designate the holotype locality as Clifton Bank, Grange Burn, Lower Miocene. Specimen figured Pleisiotype, P. 4322, S.A.M., has better preserved sculpture than that of the holotype.

Lepidopleurus relatus sp. nov.

Plate xix, fig. 12.

One incomplete median valve, length 2·25 mm., width 4·5 mm., angle of divergence 90°, valve arched, side slope convex, dorsal area with some inconspicuous slender network sculpture, much confused; pleural area near to dorsal area crossed by crowded longitudinal ribs; from there they become widely spaced, still parallel to each other, but becoming more and more bent upwards near the lateral area; ribs themselves very narrow, forming narrow, rather high ridges with minute granulation near their bases, those near the girdle become nearer together with granulation on top of ridges; lateral area much raised and closely covered with irregular pebble-like grains, pattern conspicuously in transverse rows, grains in each row about the same size, but a row with coarse grains may be next to one with small grains, posterior edge of this area consists entirely of large, pebble-like grains, three and a partial fourth radial grooves.

Articulamentum. White; centre much thicker, thickening diverging on either side, but rapidly terminating in a point; no insertion plate, and sutural laminae broken off.

Holotype: Clifton Bank, Grange Burn, Hamilton, Victoria, Lower Miocene. P. 4331, S.A.M.

Paratypes: Two fragments of median valves.

Although resembling *Lepidopleurus magnogranifer* Ashby, *L. relatus* can be easily distinguished by the narrow longitudinal ribs and minute granulation.

LEPIDOPLEURUS SEPHUS sp. nov.

Plate xix, fig. 11.

One median valve, half one side missing, complete side, length 2 mm., width from dorsal ridge to girdle 4 mm., valve arched, side slope convex, angle of divergence 80°, dorsal area tegmentum absent, pleural area crossed longitudinally by rather strong parallel ribs; ribs definitely straight and parallel right to girdle, subgranulose; most important feature is that they are numerously and strongly bridged across, giving the sculpture a semi-honeycomb appearance; bridging does not reach top of ribs or the honeycombing would be more marked; lateral area raised and decorated with radial ribbing; furcate in some cases; ribs coarsely subgranulose, but most regular and almost smooth; total number of ribs and half-ribs, seven.

Articulamentum. Cream coloured; no insertion plate; remains of sutural lamina on one side only; lamina weak and shallow, tegmentum folded over along most of posterior margin.

Holotype: Forsyth's, Grange Burn, Hamilton, Victoria, Pliocene (Kalimnan). P. 4330, S.A.M.

This species differs from both *magnogranifer* Ashby and *relatus* Ashby and Cotton in the marked bridging of the pleural area, and in the smooth, subgranulose ribs of the lateral area.

LEPIDOPLEURUS SINERVUS sp. nov.

Plate xix, fig. 7.

One almost complete head valve, length 1·9 mm., width 3·75 mm., sculpture of narrow riblets, closely-packed and smooth of surface, interspaces appearing under X20 magnifications as mere grooves, but at the bottom of groove in places pectinated; under X30 magnifications, the bottoms of grooves seem to be series of minute perforations; at one side, a few riblets surmounted with minute granules suggest that when newly-formed they may be minutely granular, a feature that is quickly lost; riblets consistently twenty-three to twenty-four to the millimetre.

Articulamentum. Cream; much thickened in centre, no insertion plate or sutural laminae.

Holotype: Forsyth's, Grange Burn, Hamilton, Victoria, Pliocene (Kalimnan). P. 4326, S.A.M.

Paratype: Large fragment, possibly of a large head valve, same location.

LEPIDOPLEURUS SINGUS sp. nov.

Plate xix, fig. 8.

One tail valve only, length 2 mm., width 3·1 mm.; mucro not defined, shell strongly raised, sloping sharply from the anterior edge to middle of valve, and from there vertical to the girdle; whole shell decorated with longitudinal, mostly parallel, riblets, those in centre more slender and more closely packed than elsewhere on the valve; interspaces vary a good deal; where interspaces are wide, ridges are bridged across; where closer together this feature is reduced to a mere hole; thirteen riblets to the millimetre, but this count includes the central crowded narrower riblets, so we estimate that the riblets in this species are only half the number shown in the preceding species, *L. sinervus* Ashby and Cotton.

Articulamentum. Colour buff, sutural laminae seemingly complete, very small and laterally narrow; altogether they are unusually small for even this primitive genus.

Holotype: McDonald's, Muddy Creek, Pliocene (Kalimnan). P. 4327, S.A.M.

LEPIDOPLEURUS BABIDUS sp. nov.

Plate xix, fig. 6.

One half median valve, length 1·9 mm., width 3 mm.; pleural area sculptured with longitudinal granulose widely-spaced ribs, but close together near dorsal area; interspaces twice, sometimes thrice, the width of rib; ribs parallel until near girdle, where they become irregular and weak; interspaces in pleural area shallowly bridged across; transverse shallow ridges correspond with grains which surmount the ribs; ribs turn upwards at the lateral area; lateral area much and irregularly raised, eight growth grooves, two outer ones at a much lower level than those above; sculpture of lateral area composed of numerous radiating subgranulose riblets touching one another; while these are much broken by the growth grooves, the general radial pattern is maintained.

Articulamentum. White; no insertion plate, sutural laminae absent.

Holotype: McDonald's, Muddy Creek, Pliocene (Kalimnan). P. 4325, S.A.M.

Paratype: Two worn fragments median valves, same locality.

This species is easily separated from any other species herein described by the deep growth grooving in the lateral area, and from some others in the character of the bridging.

LEPIDOPLEURUS DIVERSIGRANOSUS sp. nov.

Plate xix, figs. 1 and 9.

One tail valve, length 2 mm., width 3 mm., mucro at anterior third, area behind mucro steep for two-thirds of area, and from there to outer margin almost flat, steep portion sculptured with minute grains forming under X20 a decussate pattern; outer portion of this area exhibits the start of about thirty granulose, radiating, shallow ribs, grains occupying about same area as four of the minute grains referred to above; area anterior to mucro narrow and longitudinally crossed by numerous, shallow, narrow, subpectinated riblets, interspaces vary from same width as riblets to twice that width; dorsal area wedge-shaped, small, similarly minutely decussate as in area immediately posterior to mucro.

Articulamentum. Cream; saucer-shape, no insertion plate (Fig. 9).

Holotype: Clifton Bank, Lower Miocene. P. 4328, S.A.M.

Hypotype of median valve, from same locality, width 2·75 mm., rather flat, side slope straight; part of dorsal area flaked off, what remains minutely granulose; pleural area decorated with slender, rather irregular, minutely pectinated or subgranulose riblets; lateral area separated from pleural by a rather coarsely granulose rib, much of this area minutely granulose, granules double the size of those of dorsal area, and no regular pattern; grains near girdle much larger and very irregular. The hypotype valve only. Fig. 1. P. 4320, S.A.M.

CALLOCHITON Gray, 1847.

CALLOCHITON MACDONALDI sp. nov.

Plate xxi, fig. 46.

One median valve, length 1·5 mm., width 3·5 mm., shell is arched rather than carinated, side slope straight, tegmentum of dorsal area largely missing, but was evidently smooth and ill-defined; pleural area smooth, without sculpture except for four or five shallow growth grooves distinguished only by lateral lighting; lateral area raised and smooth, crossed by three broad and deep growth grooves; colour pinkish-cinnamon (Ridgeway).

Articulamentum. White; sutural laminae weak and shallow, sinus between 1 mm. wide, broad in proportion to size of valve; articulamentum not joined across sinus, but edge of tegmentum slightly overhangs; a strong raised rib runs from dorsal hollow almost to margin on either side. Shell arched rather than carinated, side slope straight, angle of divergence 100°.

Holotype: Muddy Creek, McDonald's, Hamilton, Victoria, Lower Pliocene

(Kalimnan). P. 4368, S.A.M. Unique example presented by the National Museum, Washington, U.S.A., to the Ashby collection in the South Australian Museum. The valve was unfortunately broken in the washing, and was mended by Dr. Sule before being sent to us. Although we have placed the species in *Callochiton*, the shape resembles that of *Loricella*, but the weak sutural laminae and complete absence of forward extension of the articulamentum in the sutural sinus absolutely removes it from *Loricella*. The tegmentum surface in *Callochiton* seen under X30 magnification is minutely decussate, a feature absent from *macdonaldi*; there is no insertion plate, but we assume this has broken off. We provisionally place the species in *Callochiton*.

ISCHNOCHITON Gray, 1847.

In the material before us there are several fragments of median valve of two allied members of this genus; the sculpture of the pleural areas in these fragments may be broadly described as vermiform, wavy, or V-shaped. While these forms of sculpture exist in living species, it is probable that had we a complete set of valves of these fossil species, the combination of sculpture would more nearly conform to the regular recent *Ischnochiton* pattern than it appears to do in the fragmentary valves.

ISCHNOCHITON VINAZUS sp. nov.

Plate xx, fig. 36.

One half median valve, width 3 mm., pleural area decussate near dorsal area, but in outer half riblets become vermiform, wavy, and increase in size towards the girdle; two outer ribs stouter; lateral area raised, on anterior edge next to pleural area a row of eight very coarse grains, third grain from girdle part of one of the extra stout ribs before-mentioned, continued right across lateral area; three further coarse transverse bars or elongate coarse grains; interspaces or true surface of this area covered with small, inconspicuous grains.

Articulamentum. White; most of insertion plate and whole of sutural lamina broken away.

Holotype: McDonald's, Muddy Creek, Pliocene (Kalimnan). P. 4335, S.A.M.

Paratypes: Two fragments of median valves; lateral area with isolated pustules rather than bars. Same locality.

ISCHNOCHITON TISURUS sp. nov.

Plate xix, fig. 15; xx, 35.

One half median valve 3 mm. wide. Pleural area with narrow crowded riblets without pattern near the dorsal area, become small crowded riblets with a partial diagonal direction, but in outer half of area they form an irregular V-shaped pattern; lateral area raised at anterior edge, and here rather worn; rest of area crossed by six or more bars, of which three are composed of angular shallow grains; other bars badly worn.

Articulamentum. White; insertion plate and sutural laminae missing.

Holotype: McDonald's, Muddy Creek, Pliocene (Kalimnan). P. 4334, S.A.M. Fig. 15.

Paratype 1: Fragment of median valve, same locality.

Paratype 2: Half median valve from Forsyth's, Pliocene (Kalimnan).

Hypotype—of tail valve, length 2 mm., width 3 mm. Forsyth's Pliocene (Kalimnan), mucro central, but broken; slope behind mucro somewhat steep at first, then becoming very flat, only a small part of sculpture present formed of concentric rows of less coarse pustules than those of lateral area of holotype; sculpture of anterior portion of this valve corresponds exactly with V-shaped pattern of pleural area of median valve. This solitary specimen is associated with *Ischnochiton tisurus*. Fig. 35, P. 4354, S.A.M.

ISCHNOCHITON COSSYRUS sp. nov.

Plate xx, fig. 37.

One tail valve only, length 3·75 mm., width 5 mm. Flattish, mucro central, area behind mucro nearly vertical for a short distance, then sloping at 45° to the girdle; very little sculpture left, but what remains shows that this area was radially ribbed with shallow ribs irregularly surmounted with rather shallow pustule-like grains and elongate grains; whole surface of shell was minutely granulose with decussate pattern; area anterior to mucro was decorated with rather coarse, more or less disjointed vermiform or wavy riblets; dorsal area flaked away.

Articulamentum. Large V-shaped area with its base bounded by two sutural laminae, and apex under mucro with bifurcating branchlets on either side pure white; rest of inside cream; insertion plate much worn away, but evidences of slitting exist; sutural laminae weak (probably reduced by attrition); sutural sinus wide.

Holotype: McDonald's, Muddy Creek, Pliocene (Kalimnan). P. 4356, S.A.M.

ISCHNOCHITON NUMANTIUS sp. nov.

Plate xix, fig. 16.

One almost complete and well preserved tail valve, length 3 mm., width 3·75 mm.; mucro slightly anterior of central, dorsal area broken away; area behind mucro steep at first, then to outer edge concave; whole of this area decorated with closely-packed subgranulose ribs, thirty-five in all; many intercalated and not full length; granulation most even throughout with exception of anterior rib, where it is coarser; a small area immediately behind the mucro smooth except for minute granulation; area anterior to mucro minutely decussate, a pattern formed by minute subgranulose strings crossing one another at right angles.

Articulamentum. The central V-shaped portion slightly raised; cream, with about five short wavy branches on either side; rest of valve white; insertion plate broken off, but slight evidences of slitting remain; only bases of sutural laminae remain.

Holotype: Forsyth's, Grange Burn, Hamilton, Victoria, Pliocene (Kalimnan). P. 4335, S.A.M.

ISCHNOCHITON DURIUS sp. nov.

Plate xx, fig. 33.

One juvenile tail valve, length 1·25 mm., width 2·25 mm., in excellent state of preservation; unusually flat, mucro at anterior third; area immediately behind mucro at first almost vertical, and then continued at an angle of 47° until half-way across area, and from there to margin almost flat; mucro and a patch equal to one-third width of whole valve and dorsal area, smooth, without any signs of sculpture; rest of posterior area consisting of a narrow region between the unsculptured patch and the posterior margin of shell, and two large patches on either side evenly and regularly sculptured with three concentric rows of spaced, rather large grains; on either side are several short rows arranged in the same way as the three outer ones; area anterior to mucro narrow and small, what sculpture present is minutely granular, and under X30 magnification a few parallel transverse scratches are visible; the apparent unsculptured character of the anterior area (which corresponds with the pleural area in median valves) may take an additional pattern in the adult form, but the sculpture of the posterior area is likely to be maintained.

Articulamentum. Bluish-white; nine very clearly marked scratches radiating from beneath the mucro to outer edge at girdle; these probably correspond with nine slits which, owing to damage of insertion plate, cannot be seen; "scratches" may be really nerve channels, the specimen presenting one of the best examples of this feature seen; insertion plate broken away; sutural laminae were certainly weak and far apart, only the bases remaining.

Holotype: McDonald's, Muddy Creek, Pliocene (Kalimnan). P. 4352, S.A.M.

ISCHNOCHITON NEGLECTUS sp. nov.

Plate xx, fig. 34.

Half median valve, width 3 mm., dorsal area missing; pleural area sculptured with eleven longitudinal ribs, well preserved, but several towards girdle badly worn; ribs high and narrow, and each rib has at the summit a complete row of minute, polished, spherical grains, quite even in size, a little smaller than width of rib, and all spaced fully the width of a single grain apart; lateral area raised and sculptured with seven spaced radial rows of large grains twenty times the size of minute grains referred to in pleural area; most of these grains spherical, but row adjoining pleural area larger and variable in shape; near the girdle grains smaller and less raised.

Articulamentum. White; base of insertion plate possibly showing, sutural laminae absent, tegmentum folded over at posterior margin.

Holotype: Forsyth's, Grange Burn, Hamilton, Victoria, Pliocene (Kalimnan). P. 4353, S.A.M.

Paratypes: Several fragments of median valves, one possibly has insertion plate showing as in holotype, but the rest have no sign of it.

There are no complete valves, so the data available is not sufficient to determine accurately the generic position. We have decided to describe it under the genus *Ischnochiton.*

RADSIELLA Pilsbry, 1892.

ISCHNOCHITON (RADSIELLA) CLIFTONENSIS sp. nov.

Plate xix, fig. 14.

One median valve, length 4 mm., width 7·3 mm., angle of divergence 110°, valve well worn, subcarinated, side slope slightly concave; sculpture of dorsal area and small portion of pleural entirely eroded; sculpture of remainder consists of a series of strong longitudinal ribs which furcate or sometimes fuse; ribs flattened out in places to double their normal width, and then a short distance away narrow rapidly to normal width; lateral area not in any way defined; whole surface of valve with same sculpture except where worn away; longitudinal ribs inter-connected by narrow diagonal ribs of the same height; with lateral lighting this "bridging" gives a "honeycomb" effect, but with vertical lighting surface appears as if studded with deep pits somewhat cuneiform in character.

Articulamentum. Cream; much thickened from the hollow under beak out towards girdle; insertion plate and sutural laminae worn off, so there is doubt as to generic character.

Holoytpe: Clifton Bank, Grange Burn, Hamilton, Victoria, Lower Miocene. P. 4333, S.A.M.

Sculpture suggests affinity with Pilsbry's subgenus of *Ischnochiton, Radsiella,* of which South Africa has two representatives, but hitherto neither recent nor fossil representatives have been discovered in Australia.

Genus Callistochiton Dall, 1881.

Relatively much more time has been expended in the examination of numerous fragments (mostly median valves) of this genus, than on valves of other genera.

This is principally due to the following features:

1. The great variety of sculpture in a single individual.
2. The wide changes in sculpture from that of the juvenile to adult.
3. The depth of sculpture in this genus frequently makes a half-worn individual look entirely different from a perfect specimen.

Callistochiton greedi sp. nov.

Plate xxi, fig. 41.

Median valve, width 2·5 mm.; dorsal area missing; pleural area with only seven complete longitudinal ribs remaining; ribs strong, almost straight and parallel, ridges high and many interspaces double width of ribs; ribs bridged from bases; ribs do not turn upwards on reaching lateral area; lateral area composed of two strong nodulose, radiating ribs with a deep groove between, occupying the whole of this area; at bottom of groove ribs are bridged across forming a series of small pits; arrangement of nodules suggests a number of funnels or cones fitted one into the other; eleven nodules, some broken.

Articulamentum. White; sutural lamina weak.

Holotype: Forsyth's, Grange Burn, Hamilton, Victoria, Pliocene (Kalimnan). P. 4369, S.A.M.

Coarseness and regularity of ribs in pleural area distinguish the species. Named after Mr. Walter Greed, of Hamilton, Victoria, to whom we are indebted for packing the material sent to Dr. Sulc for washing.

Paratypes: There are four other fragments of median valves belonging to this species, same locality.

CALLISTOCHITON RETICULATUS sp. nov.

Plate xxi, figs. 44, 45.

One complete median valve, length 1·25 mm., width 3 mm.; valve arched, side slope convex, a longitudinal ridge corresponds with cap and suggests subcarination; dorsal area not defined, but decorated with slender network sculpture continued well into the pleural area; beak broken away, slender network sculpture occupying a third of anterior portion of valve, in longitudinal rows fairly parallel to one another; network sculpture replaced at the posterior margin by widely-spaced longitudinal slender ribs; these ribs turn up acutely at the girdle, making the ribs falcate rather than longitudinal; falcate ribs four, widest interspace four times width of rib; all interspaces between ribs narrowly and closely crossed by slender threads of sculpture; lateral area composed of two highly raised, nodulose, narrow radial ribs; five nodules and next to dorsal area three elongate grains, sulcus between the two ribs deep, and does not appear to have any bridging.

Articulamentum. Pale bluish-grey; sutural lamina and insertion plate missing; tegmentum folded right across from side to side.

Holotype: McDonald's, Muddy Creek, Pliocene (Kalimnan). P. 4370, S.A.M. Fig. 44.

The nearest living species is *Callistochiton generos* Iredale and Hull, from which the species under review is easily separated; amongst other differences, *C. generos* has a granular dorsal area and sharply-sloping posterior portion of tail valve, whereas in *C. reticulatus* the former has network and the latter is flat. Fig. 45, P. 4383, S.A.M.

Hypotype: Tail valve taken as type of that valve. Fragment three-quarters of whole, width 2·5 mm., mucro central, area behind mucro flat, decorated with ten nodulose ray ribs; dorsal area anterior to mucro, broad; all network sculpture like holotype, rest of anterior area with nine longitudinal ribs as in pleural area of holotype, except that, owing to flat posterior portion, these ribs are barely falcate. Locality same as holotype.

Paratype: One median valve, length 2 mm., width 5·5 mm., flatly arched, side slope unusually convex, angle of divergence 100°, dorsal area beaked, sculpture a good deal flaked and worn. Clifton Bank, Lower Miocene, one specimen.

In addition, there are two half-median valves, and two partly damaged tail valves from Forsyth's.

CALLISTOCHITON INEXPECTUS sp. nov.

Plate xxi, figs. 41, 42.

Median valve, juvenile, length 1·75 mm., width 4 mm., subcarinated side slope very slightly convex, rather flat, angle of divergence 110°; dorsal and pleural areas indistinguishable; a form of decussate sculpture minute near the posterior of dorsal ridge and increasing in size, anteriorly and laterally; sculpture of this portion in less worn examples strictly of network form, in which the strands are coarser and apertures of mesh much smaller than in *C. reticulatus*; three short diagonal ribs show close to girdle (an adult would no doubt have this feature far more developed); lateral areas formed by two coarse radial ribs, of which the nodules numbering five to six better resemble the flange of a wheel, and continue down into the sulcus between the two ribs, causing the ribs to be coarsely bridged across.

Articulamentum. Pale-grey; insertion plate and sutural laminae missing, tegmentum folded over for the full length of the posterior margin of this valve.

Holotype: McDonald's, Muddy Creek, Pliocene (Kalimnan). P. 4372, S.A.M. Fig. 42.

Hypotype: Type of tail valve, length 1·5 mm., width 3 mm., mucro slightly anterior to centre, raised, at first very steep, and from there to posterior margin slightly sloping only; posterior area at first smooth behind the mucro, rest of this area decorated with eight nodulose ribs; nodules of ribs correspond with two broken concentric ribs; area anterior to mucro small and without sculpture; surface and interspaces of both areas show signs of minute granulation. Same locality as holotype. Fig. 41.

In addition, there is one more tail valve and one more median valve of this species from the same locality.

The nearest recent species is *Callistochiton meridionalis* Ashby (3), from which *inexpectus* differs in the stouter nodules of the lateral areas, the flatter posterior portion of the tail valve, and the entire absence of surface granulation.

ANTHOCHITON Thiele, 1893.

Thiele, in "Das Gebiss der Schnecken, 1893", proposed three subgenera under the genus *Chiton*, namely *Clathropleura*, *Rhyssoplax*, and *Anthochiton*, but only the last-named can date from 1893, because the genotype species of the other two were not published until 1909. Therefore those two subgenera date from 1909. We use *Anthochiton* Thiele, 1893, as a full genus.

ANTHOCHITON MACDONALDENSIS sp. nov.

Plate xxi, fig. 39.

Tail valve, length 2·5 mm., width 3·75 mm., mucro at anterior third, tegmentum worn off mucro, posterior slope from mucro straight at an angle of 43°; polished, straw colour, surface minutely decussate, a few shallow growth grooves, but no sculpture in the area posterior to mucro; area anterior to mucro small, separated from posterior area by a shallow fold, upper half smooth and polished like the posterior area, but lower or outer half possesses three fairly strong polished ribs; ribs short owing to narrowness of this area; ribs begin at the "fold" and terminate at anterior edge of valve; anterior edge minutely granulose by lateral lighting.

Articulamentum. Creamy-white; insertion plate worn away, but evidences of numerous slitting; sutural laminae absent.

Holotype: McDonald's, Muddy Creek, Pliocene (Kalimnan). P. 4359, S.A.M.

ANTHOCHITON DUODENI sp. nov.

Plate xx, fig. 38.

One small fragment of median valve; very small, but portion of pleural area decorated with twelve narrow, strongly-raised ribs, each of which bends upwards at the lateral area, interspaces double width of ribs; lateral area smooth, but with several well-marked growth lines; this area strongly raised, slightly overhanging pleural area.

Holotype: McDonald's, Muddy Creek, Pliocene (Kalimnan). P. 4357, S.A.M. Name suggested by the twelve ribs.

ANTHOCHITON OCTOCOSTATUS sp. nov.

Plate xxi, fig. 40.

Three-quarters of median valve; single side 3 mm. wide; carinated, side slope straight, angle of divergence 100°; tegmentum flaked off dorsal area, surface of valve minutely decussate, only definite sculpture eight longitudinal widely-spaced ribs, interspaces three to four times width of ribs themselves.

Articulamentum. White.

Holotype: McDonald's, Muddy Creek, Pliocene (Kalimnan). P. 4360, S.A.M. Name suggested by the eight ribs.

LORICELLA Pilsbry, 1893.

LORICELLA MAGNOPUSTULOSA sp. nov.

Plate xxi, figs. 50, 53.

Head valve, length 4 mm., width 7 mm., posterior edge imperfect, insertion plate missing; apex steep and worn, lower half of shell rather flat; eight and portion of ninth ray ribs surmounted with two to three large, widely-spaced pustules; surface of shell smooth, exhibits evidence of wearing.

Articulamentum. Buffish-white, shows signs of wearing, nerve perforations correspond with ray ribs in tegmentum.

Holotype: McDonald's, Muddy Creek, Lower Pliocene (Kalimnan). P. 4365, S.A.M., Fig. 53.

Hypotype: Half median valve, broken, taken as type of median valve; length 3 mm., width of half-valve 10 mm.; insertion plate and sutural laminae missing; dorsal area and pleural areas inseparable except for two broad growth grooves, and towards girdle several minor growth grooves, but at junction of pleural area and lateral area fifteen short ridges, interspaces appearing like fourteen deep pits; lateral area defined by a very much raised diagnoal rib surmounted by three larger widely-spaced pustules; most likely there were two more of these pustules nearer the dorsal area, as shell here shows signs of wearing; colour pinkish-cinnamon (Ridgeway), inside white. Same locality and horizon as holotype. P. 4364, S.A.M., Fig. 50.

Paratypes: Two head valves, much worn, appear to belong to this species, as they show faint signs of large pustules; same locality and horizon.

LORICELLA PAUCIPUSTULOSA Ashby and Torr, 1901.

Plate xxi, figs. 52, 54.

One tail valve, length 2·25, width 6 mm., no sculpture showing, though it may be worn off; as median valves only possess two inconspicuous shallow diagonal ribs carrying small, spaced pustules, it is possible that the tail valve never possessed any ribs; whole of upper surface of valve convex; anterior and posterior margin much thickened, and anal portion broadly upturned.

Hypotype: McDonald's, Muddy Creek, Pliocene (Kalimnan). We present this specimen as the Hypotype tail valve of the species *Loricella paucipustulosa* Ashby and Torr (1).

LORICELLA CONCAVA sp. nov.

Plate xxi, fig. 51.

Tail valve, length 1·5 mm., width 3·25 mm., very flat, dorsal area much raised, straight-sided, pleural area and lateral areas consist of one depressed smooth surface; posterior edge much thickened and raised, so that the pleural-lateral areas are concave; tail upturned, posterior edge bending inwards at the upturned portion; only sculpture in pleural lateral area consists of four growth grooves at anterior portion and two at the anal; the grooves traverse the areas, and continue up the posterior ridge.

Articulamentum. Insertion plates broken away, but sufficient of sutural laminae remain to indicate that they are broad and well developed, sutural laminae joined across the sinus, articulamentum extending beyond anterior edge of tegmentum; articulamentum much thickened and notched in centre, posterior end hollowed out under upturned tail, evidently associated with some body organ such as a syphon; from there to anterior edge of valve on either side articulamentum much thickened.

Holotype: McDonald's, Muddy Creek, Pliocene (Kalimnan). P. 4367, S.A.M.

This remarkable little valve is definitely a *Loricella*. The tegmentum is in excellent state of preservation, and sufficient of the articulamentum is preserved to definitely state that in the thickening of the articulamentum, both in the centre and at the outer edge, it presents features hitherto unknown. The name *concava* is suggested by the concave tail valve.

LORICA H. & A. Adams, 1852.

We naturally expected that one of the three valves in this material of juvenile *Lorica* would represent *L. compressa* Ashby and Torr. In neither *L. oculea* nor in *L. varena* is there any sign of the scattered large pustules (grains) in the lateral area that were mentioned in Ashby and Torr's description of *Lorica affinis*. This Ashby (3) considered a mere variety of *L. compressa*. We have now, through the kindness of F. A. Cudmore, examined a series taken at Table Cape, Tasmania, and we are satisfied that they are conspecific, the type of *L. compressa* being a badly worn example, and that of *L. affinis* a better preserved specimen of the same species. While it is quite possible that *L. compressa* may not always show this sculpture in the very juvenile stage, in the best example of the adult we have seen the coarse grains make their appearance at a very early stage of growth.

We believe that the three juvenile *Lorica* valves here described represent two different species, chiefly marked by the great difference in the angle of divergence, and both differ from *L. compressa* in the entire absence of coarse pustules in the lateral areas.

LORICA COMPRESSA Ashby and Torr, 1901.

There is one incomplete median valve that certainly belongs to the above species, and a tail valve which has lost all sculpture on the upper side, but is better preserved on the underside. The tail valve of *L. compressa* Ashby (1), (3) has not been figured or described, and the present specimen is too poorly preserved to form a hypotype. From Clifton Bank, Grange Burn, Lower Miocene.

LORICA OCULEA sp. nov.

Plate xxi, fig. 48.

Median valve, well preserved, but a small fragment missing; width 2 mm., angle of divergence 110°. Valve carinated, side slope straight, dorsal area ill-defined, smooth except for two short and slender longitudinal ribs on either side; pleural area crossed by four subgranulose narrow high ribs, the interspaces three times width of ribs, each rib where it joins the lateral area with funnel-shaped pit, at the bottom of which is a black dot or aperture; in some lights this pit shows a shining spot, and it is certain these apertures lead to sense organs, which we assume are ocelli; lateral area much raised and minutely granulose; four transverse or growth ridges composed of larger granules than rest of lateral area; ridges under X30 Zeiss appear due to growth grooves which vary much in width, and the apparent large size of the grains on the ridges is an illusion caused by these grains catching more light.

Articulamentum. Cream; no definite slit can be seen, sutural laminae shallow but laterally wide, the sinus between wide, but a feature typical of both *Lorica* and *Loricella* is the joining across the sutural sinus of the two sutural laminae, by a forward extension of the articulamentum; this a marked feature of the holotype.

Holotype: Clifton Bank Grange Burn, Hamilton, Victoria, Lower Miocene. P. 4362, S.A.M.

Paratype: Median valve, small fragment missing, width 2 mm., same locality. The black dot occurring in each valve is situated at the third of the lateral area from the girdle and a little posterior from the centre of the valve. It is circled by a ring of normal grains on this area; there is a rather large funnel-shaped aperture through the tegmentum and the articulamentum with what, at the bottom in ordinary light, appears to be a black dot. When the electric globe was almost directly above, the light was brilliantly reflected in the corner at the bottom of the deep funnel; again in good daylight the light from the window was squarely reflected. Hitherto, no oculae have been seen in this genus other than those at the junction of the ribs on the pleural area with the lateral area, so this discovery is the first record of the existence of "eyes" on the surface of the lateral areas (in fossil *Lorica*), and the first discovery of the preservation of the cornea in fossil forms. As in the adult fossil examples, the apertures at the junction of the ribs with the lateral area are much larger than in any known recent chitons; the nature of the sense organs has always been doubtful. This discovery seems to confirm the belief that they are true ocelli, and, owing to the position of the cornea at the bottom of a deep funnel preventing lateral sighting, it seems that they could only serve to distinguish daylight from dark because their deep setting prevents any lateral sighting.

LORICA VARENA sp. nov.

Plate xxi, fig. 49.

One complete juvenile median valve, width from dorsal ridge to girdle 1·5 mm., but, owing to steepness of carination, valve is only 2 mm. right across; angle of divergence 80° (compared with 110° in *oculca*); compared to *oculca*, ribs in pleural area more granular, interspaces wider; lateral area has one very deep and wide growth groove (*oculca* has several), granulate, less crowded and grains less raised and more irregular, the ocelli similar in position and size; otherwise generally like *oculca*, except is one-third smaller.

Holotype: Clifton Bank, Grange Burn, Hamilton, Victoria, Lower Miocene. P. 4361, S.A.M.

OOCHITON Ashby, 1934.

OOCHITON HALLI Ashby, 1934.

Plate xxi, fig. 55.

From one ten-gallon tin of fossiliferous soil from Clifton Bank, Hamilton, Victoria, Lower Miocene, twelve median valves or fragments, four head valves, and one tail valve of the above species.

The original holotype of the head valve of this species was destroyed when Mr. Edwin Ashby's house was burnt in a bushfire on March 9, 1934. We now describe a Neotype:

Head valve, length 2 mm., width 3 mm., height 2 mm., angle of divergence acute; highly elevated, apex slightly recurved, anterior slope very steep and concave (due to recurved apex); sculpture of strings of egg-like pustules similar to those in the other valves; arrangement generally speaking longitudinal, the strings commencing at the posterior margin and continuing to the insertion plate with considerable irregularity, several strings bifurcate, and in some places there are short intermediate rows; the strings or rows of pustules apparently have no relationship with the slits in insertion plate.

Articulamentum. Creamy white; highly polished, smooth, without any grooves; tegmentum unfolded at the apex, this unfolded portion thickly studded with egg-like pustules; insertion plate well produced, perfect except for a few minute chips; slits high, broad and short, spacing irregular; upper side of insertion plate numerously grooved, plate broad and proportionately thick, but upper edge bevelled off so that the actual edge is sharp, the grooves not continuing to the inner edge.

Neotype: Clifton Brank, Grange Burn, Hamilton, Victoria, Lower Miocene.

The sculpture of this *Oochiton* is quite unique, the angle of divergence unusually small, resulting in the carination of the median valves being very steep; the shape of the tail valve has no parallel in any living forms. The nearest to it is to be found in the upturned extremity of the same valve in the genus *Lorica*, and in both there would be body modifications to correspond.

We think that the two genera *Loricella* and *Lorica* seem to have little affinity with any other living forms, and may, together with *Oochiton,* have come down from Palaeozoic times along separate parallel channels to that of the *Lepidopleuridae,* as is certainly the case in the Acanthochitonoid group.

BIBLIOGRAPHY.

1. Ashby and Torr (1901) : Fossil Polyplacophora from Muddy Creek, Mornington, Victoria. *Trans. Roy. Soc. S. Aust.,* 25 (2), 136–144.
2. Chapman (1907) : New and Little known Victorian Fossils in the National Museum. *Proc. Roy. Soc. Vic.,* 20 (2), 218–220.
3. Ashby (1925) : Monograph on Australian Fossil Polyplacophora. *Proc. Roy. Soc. Vic.,* 37 (2), 170–205.
4. Pilsbry (1892) : Manual of Conchology, 14, 23.
5. Pilsbry : In Zittel (English Translation by Eastman), 1, 433–444.
6. Hall (1905) : On the occurrence of two species of *Cryptoplax* in the Tertiary Rocks of Victoria. *Proc. Roy. Soc. Vic.,* 17.
7. Hull (1910) : *Proc. Linn. Soc. N.S.W.,* 35, 654, and 39, 1915. (All Hull's types figured in Ashby's Monograph.)
8. Ashby (1929) : Notes on and Additions to Australian Fossil Polyplacophora. *Proc. Roy. Soc. Vic.,* 41 (2), 220–230.

EXPLANATION OF PLATES.

Plate xix.

Fig. 1. *Lepidopleurus diversigranosus* sp. nov., Hypotype.
Fig. 2. *Lepidopleurus pamphilius* sp. nov., Holotype.
Fig. 3. *Lepidopleurus magnogranifer* Ashby, Holotype.
Fig. 4. *Lepidopleurus badioides* sp. nov., Holotype.
Fig. 5. *Lepidopleurus nivarus* sp. nov., Holotype.
Fig. 6. *Lepidopleurus babidus* sp. nov., Holotype.
Fig. 7. *Lepidopleurus sinervus* sp. nov., Holotype.
Fig. 8. *Lepidopleurus singus* sp. nov., Holotype.
Fig. 9. *Lepidopleurus diversigranus* sp. nov., Holotype.
Fig. 10. *Belchiton pulcherrimus* sp. nov., Holotype.
Fig. 11. *Lepidopleurus sephus* sp. nov., Holotype.
Fig. 12. *Lepidopleurus relatus* sp. nov., Holotype.
Fig. 13. *Lepidopleurus uxellus* sp. nov., Holotype.
Fig. 14. *Ischnochiton (Radsiella) cliftonensis* sp. nov., Holotype.
Fig. 15. *Ischnochiton tisurus* sp. nov., Holotype.
Fig. 16. *Ischnochiton numantius* sp. nov., Holotype.
Fig. 17. *Cryptoplax sicus* sp. nov., Holotype.
Fig. 18. *Cryptoplax numicus* sp. nov., Holotype.
Fig. 19. *Cryptoplax pritchardi* Hall, Hypotype.
Fig. 20. *Afossochiton (Telochiton) iscus* sp. nov., Holotype.

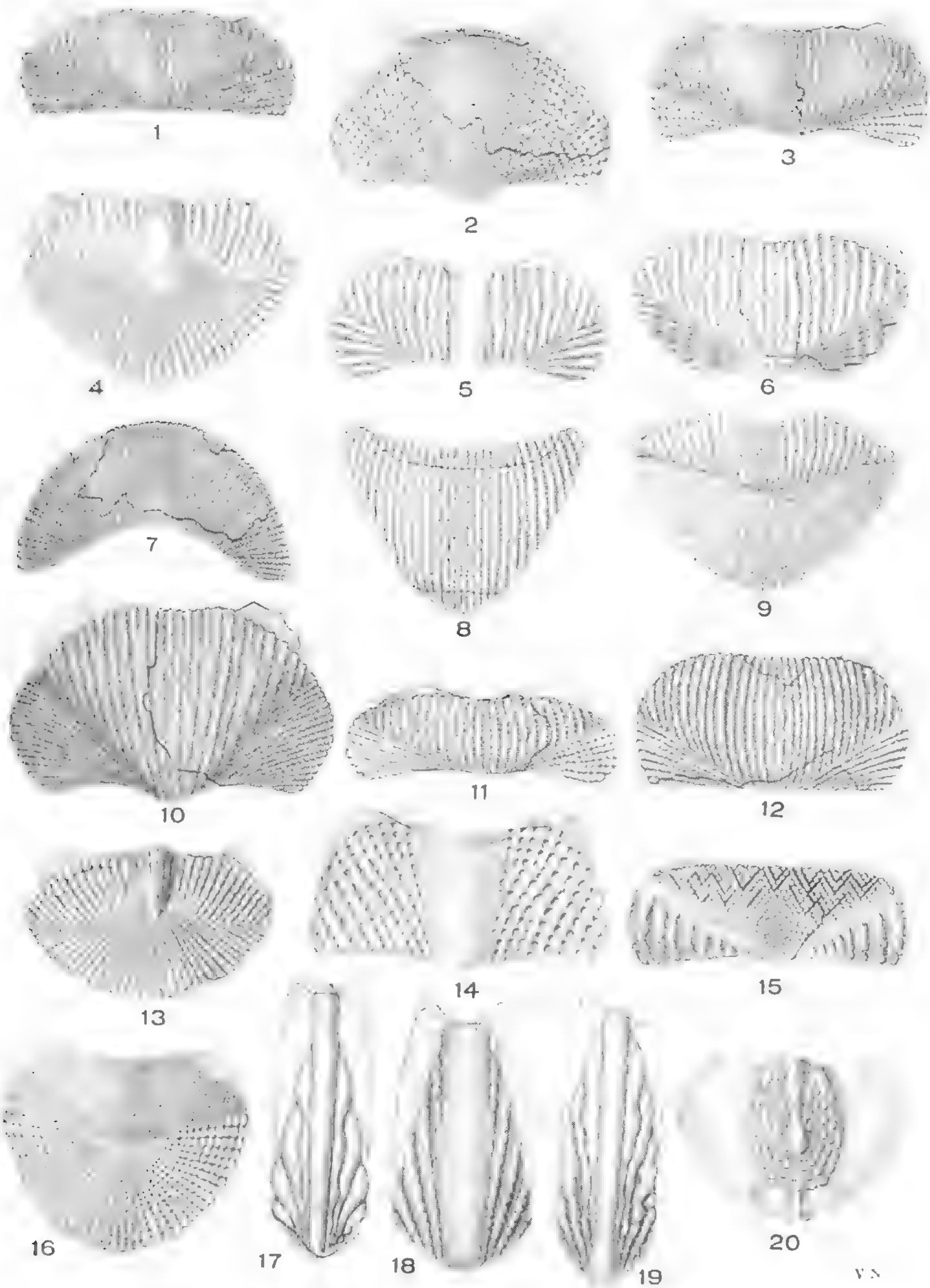
Plate xx.

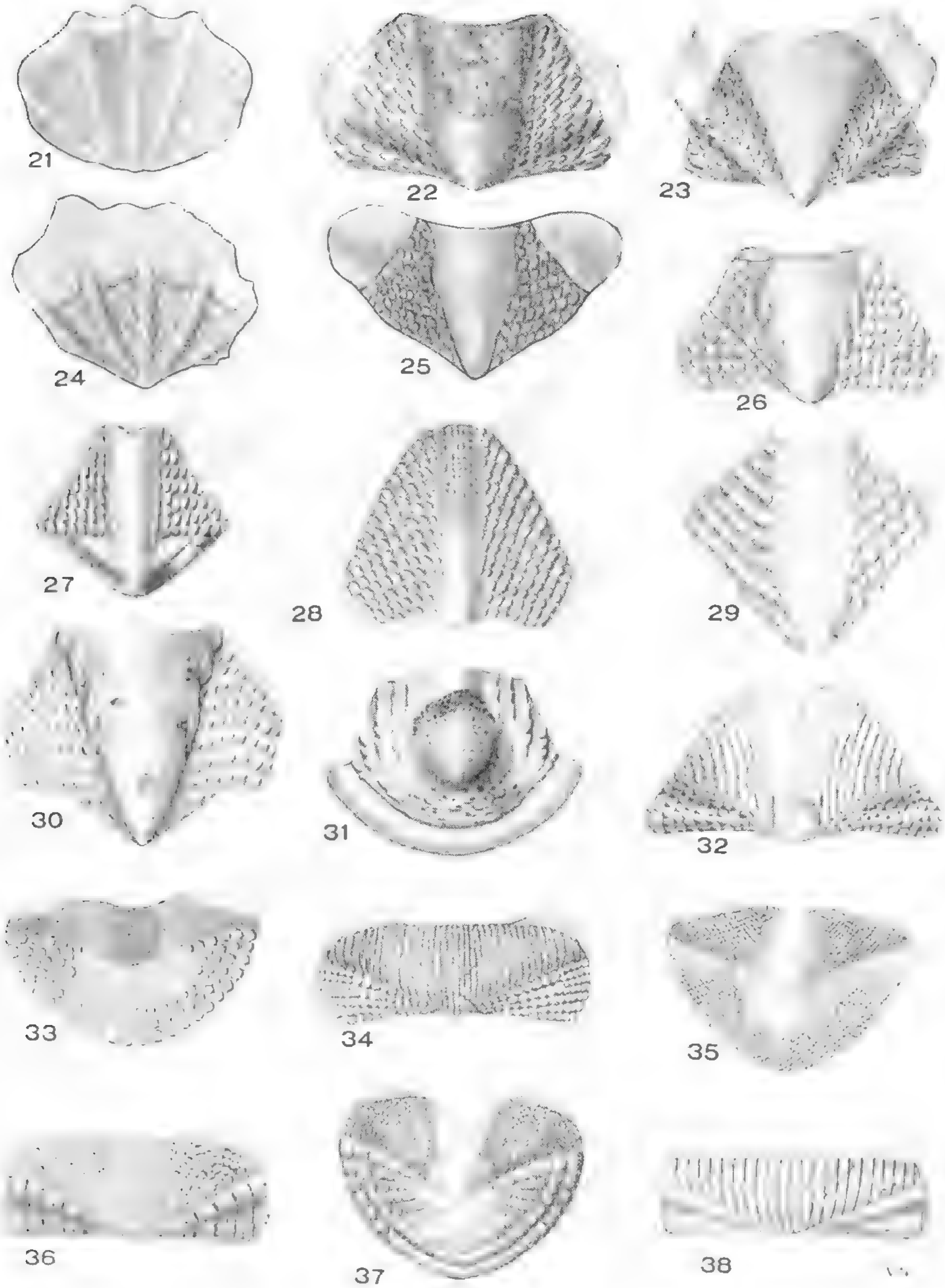
Fig. 21. *Afossochiton sulci* sp. nov., Holotype.
Fig. 22. *Afossochiton cudmorei* Ashby, Holotype.
Fig. 23. *Afossochiton (Telochiton) magnicostatus* sp. nov., Holotype.
Fig. 24. *Afossochiton (Telochiton) dendus* sp. nov., Holotype.
Fig. 25. *Acanthochiton sabratus* sp. nov., Holoytpe.
Fig. 26. *Acanthochiton forsythensis* sp. nov., Holotype.
Fig. 27. *Acanthochiton pilsbryoides* sp. nov., Holotype.
Fig. 28. *Acanthochiton trianguloides* sp. nov., Holotype.
Fig. 29. *Acanthochiton drunus* sp. nov., Holotype.
Fig. 30. *Acanthochiton casus* sp. nov., Holotype.
Fig. 31. *Acanthochiton (Lirachiton) inexpectus* sp. nov., Holoytpe.
Fig. 32. *Molachiton naxus* sp. nov., Holotype.

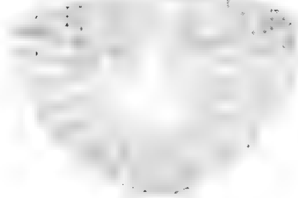
Fig. 33. *Ischnochiton durius* sp. nov., Holotype.
Fig. 34. *Ischnochiton neglectus* sp. nov., Holotype.
Fig. 35. *Ischnochiton tisurus* sp. nov., Hypotype.
Fig. 36. *Ischnochiton vinazus* sp. nov., Holotype.
Fig. 37. *Ischnochiton cossyrus* sp. nov., Holotype.
Fig. 38. *Anthochiton duodeni* sp. nov., Holotype.

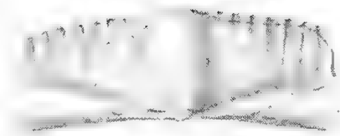
Plate xxi.

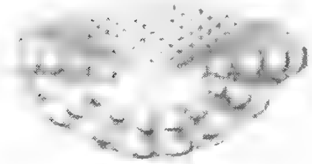
Fig. 39. *Anthochiton macdonaldensis* sp. nov., Holotype.
Fig. 40. *Anthochiton octocostus* sp. nov., Holotype.
Fig. 41. *Callistochiton inexpectus* sp. nov., Hypotype.
Fig. 42. *Callistochiton inexpectus* sp. nov., Holotype.
Fig. 43. *Callistochiton greedi* sp. nov., Holotype.
Fig. 44. *Callistochiton reticulatus* sp. nov., Holotype.
Fig. 45. *Callistochiton reticulatus* sp. nov., Hypotype.
Fig. 46. *Callochiton macdonaldi* sp. nov., Holotype.
Fig. 47. *Lepidopleurus badioides* sp. nov., Hypotype.
Fig. 48. *Lorica oculea* sp. nov., Holotype.
Fig. 49. *Lorica varena* sp. nov., Holotype.
Fig. 50. *Loricella magnopustulosa* sp. nov., Hypotype.
Fig. 51. *Loricella concava* sp. nov., Holotype.
Fig. 52. *Loricella paucipustulosa* Ashby and Torr, Hypotype.
Fig. 53. *Loricella magnopustulosa* sp. nov., Holotype.
Fig. 54. *Loricella paucipustulosa* Ashby and Torr, Paratype.
Fig. 55. *Oochiton halli* Ashby, Pleisiotype.

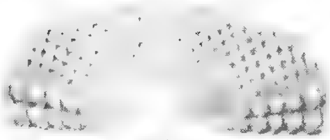

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

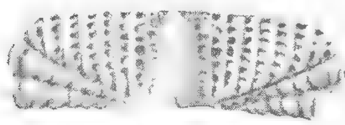

21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38

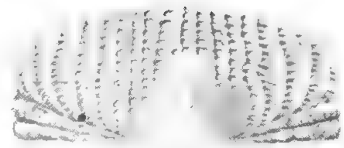

39

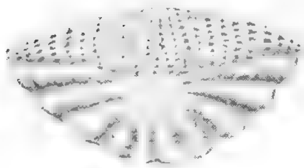

40


41


42

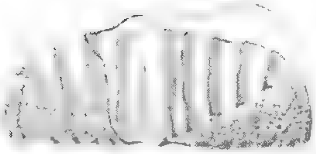

43

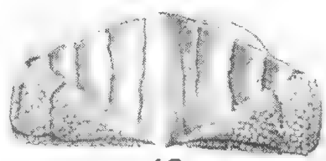

44

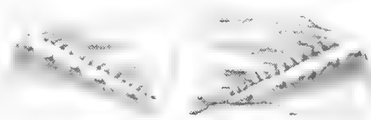

45

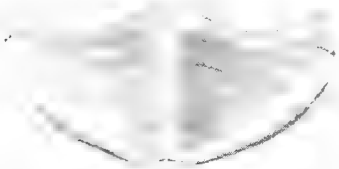

46

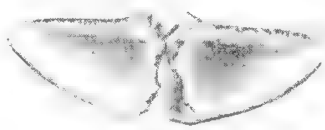

47

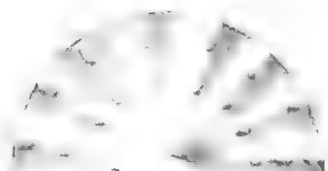

48


49

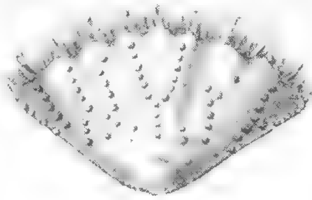

50


51


52


53


54


55

EAGLE AND CROW MYTHS OF THE MARAURA TRIBE, LOWER DARLING RIVER, NEW SOUTH WALES

BY NORMAN B. TINDALE, B.SC., ETHNOLOGIST, SOUTH AUSTRALIAN MUSEUM

Summary

The literature relating to myths of the "Eaglehawk and Crow" series in South-Eastern Australia is growing, and a detailed study should be made of their distribution.
During a recent visit to South-Western Australia, it was noticed that there were kindred myths among the [ˊNona:] peoples, especially amongst the "-ap" ([1]) tribes, who live in the extreme South-West and extend eastward along the Southern Coast to Cape Paisley.

EAGLE AND CROW MYTHS OF THE MARAURA TRIBE, LOWER DARLING RIVER, NEW SOUTH WALES

By NORMAN B. TINDALE, B.Sc., Ethnologist, South Australian Museum.

Text-fig. 1–6.

The literature relating to myths of the "Eaglehawk and Crow" series in South-Eastern Australia is growing, and a detailed study should be made of their distribution.

During a recent visit to South-Western Australia, it was noticed that there were kindred myths among the [ˈNoŋa:] peoples, especially amongst the "-ap"[1] tribes, who live in the extreme South-West and extend eastward along the Southern Coast to Cape Paisley.

Hassell (1934) has records of a Crow and Eagle story among the "Wheelman" people who live within this area, while evidences of these stories and their influences on social organizational patterns are also to be met with among tribes such as the [ˈWakaman], [ˈAwamin], and [ˈBa:baram], thus extending their range into the country on the western side of the Great Dividing Range in North Queensland. In general, it may be noted that these stories can be found over a wide southern and eastern peripheral belt in Australia, from Bunbury in the South-West, to Chillagoe in North Queensland. Texts have also been obtained in the [Taŋane] and [ˈJarilde'kald] languages. They tell of the activities of the Crow-man along the lower reaches of the Murray and down the Coorong as far as Mount Gambier, where his activities were associated with what are believed to have been volcanic eruptions.

The present contribution is intended to place on record only the form of the story belonging to the [ˈMaraura] people.

The principal Maraura text takes the form of a recital or monologue, in what may be regarded for convenience, as two acts. In this form it is told at evening gatherings, of both sexes, around the camp fire. Explanations and asides have been added to render the sequences clear to those not familiar with particulars of the story, for it must be remembered that many, if not all, the details of these tales were well known to the audiences for which they were recited. The mere recountal of the dialogue and the dramatization introduced by change of voice and tone was sufficient to vividly recall to the listeners the actions of the heroes.

[1] The terms [-ap] and [-iŋ], the terminations of place names in separate areas of South-Western Australia, have been used to divide the tribes of South-Western Australia into two series which differ in language, social organization, and other characteristics.

The informant was a seventy-four-year-old man of the Maraura tribe, who is remotely related, through his father, with the Ba:kindji people. The action of the first story takes place near the north-eastern boundary of the latter tribe, but the wanderings of the Crow also extend down the Darling and Murray Rivers to South Australia.

The range of the Maraura tribe, at the beginning of white contact, was from Avoca and Tapio on the Darling River, downstream to Wentworth and Moorna. They lived also on the western anabranch of the Darling as far north as Popilta, but were excluded from Milkengay Lake, which traditionally belonged to the ['Ba:kindji]. On occasion, they wandered in the dry country to the north-west of this area. All this area was their ['keiða], or country, upon which they lived and hunted. The Maraura are the "Waimbio tribe" of Fison and Howitt (1880, p. 288).

The Ba:kindji lived as next-door neighbours on both sides of the Darling River, from about Avoca northwards to Wilcannia. If Maraura wished to visit or hunt on the ['keiða] of their neighbours, they had first to receive permission.

Although both tribes possessed matrilineal social organizations of the Dual type (with Makwora and Ki:lpara as moiety terms), neither of them practised circumcision in their initiations. Their ceremonies were indeed allied more with those of the Jarildakald near the mouth of the Murray River. Elevation of the youth to manhood was marked by a series of rites, including hair-plucking and singeing, painting with red ochre, restrictions on the touching of water, and avoidance of women.

The native text has been supplied with an interlinear translation with as close a rendering of the meanings as is possible at present; where the phrase is given in inverted commas, only the general sense of the native version has been ascertained. In such cases the rendering follows closely that of the informant, who speaks English rather well, although he is unable to either read or write it. The other stories also follow his diction as closely as consistent with clarity and brevity. Critical passages are quoted *verbatim* in inverted commas within brackets. Opinions and discussion of the statements detailed are placed in a concluding section of the paper.

The system of transcription follows that set out in previous papers by Tindale (1935, p. 264; 1937, p. 107). As in these papers, italics and black letters have been used to differentiate those vowel and consonantal sounds of which a close rendering is of principal interest to the student of phonetics.

A song series is stated to be associated with the Eaglehawk and Crow story of the Maraura. There were many verses which were sung to describe incidents in the lives of the ancestral beings. The present story still belongs to four men, and although there is no objection to the telling of the tale, the songs may not be sung without the permission of all four of them. They were only sung when the owners met for initiation rites.

In relating the story of [ˈWa:ku] and his endeavours to marry the two sisters, the informant on several occasions made sketches on the ground with a stick. These are reproduced in figs. 1-5. Their general resemblance to scratchings in rock shelters along the Murray River is worthy of note.

AN INTRODUCTION TO THE STORY OF WA:KU AND KA:NAU.

[ˈWa:ku], or Crow, a man of the [ˈKi:lpara] moiety, formerly lived at one end of Manara Range, and [ˈKa:nau], or Eagle, a man of the [ˈMakwora] moiety, lived at the other. They were both [ˈnu:rili] ancestral beings, and in their time Makwora men were short, stout, and dark-haired; while Ki:lpara were tall and light-haired. Manara Range is situated in western New South Wales (143° 45′ East Longitude x 32° 25′ South Latitude).

The homes of the two men stood up like hills, one at each end of the range, and the camps are identified to-day with two peaks, believed to have been formed by the turning to stone of the ancestral huts. In between the two camps lived two sisters [ˈwituliŋ]. [ˈWituliŋ] is a special term applied to a pair of sisters.

The [ˈwituliŋ] were unmarried girls of the Makwora moiety, and were [ˈtambar] (i.e. set apart, forbidden, almost sacred), for no one was permitted either to approach, or touch, or even to have conversation with them. Ka:nau, as a leading man of the [ˈBarindji] people (literally the "people of the trees", in contrast to [ˈBa:kindji], the people of the [ˈBa:ka] or Darling River), had the two girls under his care. He called them by the relationship term [ˈŋam:aˈga], mother, of which the reciprocal is [ˈwi:mba:lu]. Wa:ku called them [ˈmeititja] (sister's husband's mother, mother-in-law). The Barindji folk had lived on the Manara Range, away from the Darling River, for a long time. They were friendly with the River folk.

The Ba:kindji, at that time, wandered chiefly in the country on the eastern side of the Darling, and were related to the two women as [ˈŋulti:li], mother's brother's sons [ˈwakatja], mother's brothers, and [ˈtanguwa] (not translated). All these men were prepared to fight for the two sisters if they should be molested.

Daily the two young women went hunting, searching on the flats for [ˈŋardu] (seedspores of *Marsilia Drummondii*) and other vegetable foods, and hunting for opossums. In the intervals of food-gathering, they ground their [ˈŋardu] between stone mills, making flour for [ˈŋardu] cakes. Ka:nau made a practice of killing wallabies and kangaroos, and of leaving them secretly at the girls' camp in their absence. The girls suspected that their [ˈwi:mbalu] was the food-bringer, but never saw him.

Ka:nau had as wife the sister of Wa:ku (and therefore also a Ki:lpara moiety woman). Ka:nau, who was a "good man", had no sister, and had been unable to give a sister to Wa:ku in exchange for the wife he had received.

ACT I.

W. to K.: ′Ondadja ′noŋgomal′kai ′janta′ŋeŋginba ′noŋgadlui.
Brother-in-law woman-you've-got I-have-not "wife-of-my-own".

′Oŋka:′nel noŋgo ′ba:leire ŋeŋgali. ′Ju:′na
Give-me woman it-will-be-good "to-sit-down-with-a-glad-heart". If-you

ila ′ŋokandai ′noŋgo nan ′ŋanbar′du:ma. ′U:ra
don't allow-me-to-have woman "I-will-catch-you-with-a-bone". "I-am
(ŋanba = magic bone)

′watutu ′geinou ′noŋgo ŋodlo ′kaŋgarein′garn
going-to-take" women two who-sit-down-together (i.e. the two sisters).

K. to W.: ′Paltjar′til ′ŋeiŋga ′ondadja. ′Ka:rujukul ′narn
A-few-days wait brother-in-law. Some-other-day (in two or

′jawundu ′ŋakun′deimbar. ′Keiŋgudjarm ′na:ro
three days) return and-see. Your-sister's-son is

′aŋga′neingarn ba:roleilna:ro. ′Keiŋgudjarm ′ba:raleiŋgarn kaŋgara
with-us is-listening. Your-sister's-son may-listen forbidden

′itun′a:ru ′mondama′tindjal.
must-be this-secret-affair-of-ours.

(Wa:ku goes away. A few days later he returns, and Ka:nau sees him approaching. He says to his son):

K. to boy: **E**! **E**! Itil ′wakatjarm ′jowoporan′du. ′Wuril bari
See your-mother's-brother appears. You-go-away

′kudi:r ′ŋali ′ŋulpil wakatjarm du:lali ′mondabalkul.
play we talk-now your-mother's-brother the-two-of-us secret-things.

ŋempa kudi:r buru:rna ′monda. ′Ilinba ′bararba
You play far-off from-the-secret. Forbidden to-listen

′geinun ′balkur.
to-our-words.

(The boy goes away, and the men talk together.)

K. to W.: Ila′naŋunj ′ŋokaðum ′noŋgo ′na:tau ′wari
I-cannot-see-the-way to-give-to-you woman "no-such"

′noŋgo ′ŋeŋga:pa.
woman sits-down-here (i.e. is here).

W. to K.: ′ŋarnba ′ondadja ila′naŋunj ′ŋokalmilali.
The-bone brother-in-law "for-I-cannot-see-my-way to-yield-to-you".

(*K.* makes many excuses to *W.*—They are difficult to translate.)

K. to W.: ′Tom:a′ŋeiŋa: ′pa′jarta ′ŋap:abarinj ′pamil. ′Kitarn′bal
Have-patience a-little-while about-it I-will-see. Obtain
(kitarnda = to obtain)

′artinj ′wat:ulpi noŋgom tjun:a ′ŋain′balat′pa. ′Eina:
I might by-asking woman by tormenting-the-people. Then-again

′nalpi ′wata tum:ari ′tjun:a ′ji:na ′ŋainba′latpa ′go:ta
perhaps get-by-asking by torment-the-people.

′wi:mbi ′narndu. ′Eina:′na:tiŋ ′waijuti ′nalin ′git:i wi:mbi.
Soon "they-might-pity-us" those people.

′Einana:tiŋil ′ba:ralelei ′badeil balku:l. ′Eina:′nil ŋok:atum
Then-I-will listen "for-good news". Then-you will-be-given

′baleir ′balku:r. ′Ju:na il:a ŋo:kaduma ′baleir ′balkur i:man
good news. However if-not giving good news then

′ju:ri′la:li Tum:a ′ŋeŋgali ba:ral ′gitinka wimbiu naŋgun
we-will-consider-it. After-a-while-we-listen those-fellows men will-show-us
A-while-sit

′kulpi:lati ′juŋgi ′balku:nkari. Nadliu tum:a ′ŋeŋgali ′ba:ral
how-they-are making their-own-news. You-and-I a-while sit listen

′gitinkadi wimbiuti naŋunj ′kulpi:lati. ′Ju:na
those-fellow people see "how-they-are-treating-the-matter". However

baleir balkur ŋeŋgali ′wora ′kulpilati ŋaji dani.
good news sit-and-wait how-are-they will-be-told-to-me.

′Ju:na il:a ′baleir ′balkur ′kulpati′jarn ′wora
However if-not good news "if-they-don't-tell-me-true"

′naŋonjarti. ŋeli ŋeŋgali ′tum:a ′jin:atil ′ŋeŋgali.
leave-it-to-them. We-two sit-down a-while at-that "we-will-sit-and-wait".

(Ka:nau is helpless and is unable to assist Wa:ku. The two watch each other for signs of treachery. Each fears the other.)

W. to K.: ′Ondadja ′teka:latpil ′jap:arai. ′Kanim:arn
Brother-in-law I-return-home to-my-camp. Some-day

′pam:itum.
I-come-again-to-see-you.

(They part. Several years elapse. Wa:ku broods over his trouble. He has other adventures. [See later part of this paper.] By magic, he secretly assaults the women, and when they run away he unsuccessfully chases them down the Darling as far as Swan Reach. Embittered, he returns to the Manara Range. He decides to injure his brother-in-law for his part in the many troubles that have come over him. He thinks, "I'll kill my sister's child", the son of Ka:nau.)

ACT II.

W. to self: E! E! ′Purabarit′pili ′balkatu ′keiŋkutjai.
"I-am-going-over" to-kill sister's son (of mine).

(Wa:ku journeys to the camp of Ka:nau at the other end of the Range.)

W. to K.: A! ′Ondadja ′naŋon jeŋ′geimbar. ′Balkandarlnari
Brother-in-law "how-are-you". "You-go-and-hunt"

′wanga ′teinai ′kaldaran ′ŋalei ŋeiŋgal. ′Keinkudjalni
meat foot (mine) aching we-two will-camp (sit-down). My-sister's-son

′wandal ′kuni ′wora ′ŋoŋgali ′keina ′marinji ′ŋoŋgitu.
is-making fire "we-will-share" wallaby when-it-is-cooked.

′narneil ′tailali. ′Mot:a ′ip:atu ′ŋomba mani
"Some we-will-eat-now." A-piece "we-will-leave" for-you

′ŋoŋgi ′wanga. ′Jawu ′tekar ′leinbar ora ′ŋarŋgal ora
of-cooked meat. When you-return "we" sit-down "we"

tail ′ŋindu ′ŋarndin ′kininka ′matjul ′wanga ′kininka ′ka:raminki
eat you raw meat to-morrow

ora ′ŋo:wali. ′ŋali ′kana′tar ′im:ali ′kaŋarn ′doŋkarn.
"we" cook-it. We stay-here asleep this night.

(Ka:nau goes hunting, leaving W. and the boy at the camp. W. is supposed to be caring for the boy. The two have a large meal of wallaby flesh. The boy sits on one side of the fire, and Wa:ku on the other. The boy is gorged with eating.)

Boy to W.: ′Wakatja! ′kuruntoi ′kadlara:nil ′ku:ntoi ′matjira: ′pili.
Uncle belly paining-me belly is-full now.

(Wa:ku decides the boy has not gorged sufficiently for his purpose.)

W. to boy: 'Paljarti, 'paljarti, 'katjilju 'nok:atombari 'ŋitjuru'ŋi.
Wait wait a-while I-cut-you one-more-piece.

Boy to W.: 'ŋa:ta'tau 'kuruntoi 'bo:'bomaranil 'jaruka:pil 'bilkara:pil
Impossible belly full-now I-am-thirsty I-will-fetch

'ŋok:o 'wi:tjalu.
water to-drink.

W. to boy: Ei! Ei! 'woreitili 'pik:abara 'wora 'witjalibil 'maul
go-on run-down "have-a-drink" presently

'tek':arlembil.
come-back-again.

(Shrubs, bushes, and a wattle tree were between the camp and the water. The boy goes away to drink, and the uncle sets himself in ambush against his return. The boy goes down one side to fetch water.)

W. to boy: **E**! **E**! 'wila'ŋaŋg!
Go-around-the-other-way.

Boy to W.: 'Wintjarndu 'jaŋka 'waŋga'latpai? 'Kaŋarnei 'jaŋkarn.
Did you-say that-side? "Which-way did-you-say."

W. to boy: 'ŋak:ur 'wilununj 'juwu 'waŋga'lunbar.
Go-back "around-the-other-way" that-side.

(W. desires the boy to come around the right side of the bush so that he may take fair aim with his spear and pierce his belly. He squats on the ground with his spear ['karlku] and spear-thrower ['ŋam:aga] (i.e. mother of the spear). He casts his weapon, and says:)

W. to self: 'Kaŋguin 'bandatuma.
"I-got-a-good-hit-at-you."

(The scene changes to the father. K. is hunting for wallaby. At the moment when his son is being speared he is raising his spear to a wallaby. He strikes, and misses the wallaby. He rubs his nose with his left fist, and wonders why he has missed the wallaby.)

K. to self: 'H! ja! naŋun 'djuljai 'keira 'wanga.
Why missed-I this meat.

(He wonders, for, until now, every wallaby he has aimed at he has "pinned" down to the ground: this is his first mistake.)

K. to self: ˈJak:ai! ˈnaŋgonj ˈkiki ˈkeira. ˈWi:mba
Exclamation! why ("what's wrong") "in-this-country". People

ˈjarti ˈkaŋarˈtanarn. ˈPaljartil ˈka:rananil ˈŋanmartu.
coming "I-think-there-must-be". Wait-a-while another-one I-will-try.

(He stalks another wallaby, but it also escapes his aim.)

He! ha! ˈnakarjitiŋ ˈwak:i:liŋ ˈno:lu. ˈPaljartil ˈŋitjuruin
those uncles-two they-two. Wait-awhile once-more

ˈka:ru ŋarmati:l.
another-one I'll-try.

(Ka:nau breaks his spear—the one that kills all his game for him. He now knows that something is wrong in the camp. He returns to see broken spears and pieces of boomerang scattered over the ground as though there has been a fight between many people. Wa:ku comes to him, limping, and crying like an old man.)

K. to W.: A! ˈondadja ˈnaŋonja ˈwaliji:m?
Brother-in-law what-is wrong-with-you?

W. to K. (in tremulous voice of an old man): O! O! ˈondadja ˈnarukaŋola
Brother-in-law many-people

ˈbindalaji ˈbira ˈmalkaji. ˈNanma ˈjinka ˈpandai ŋˈgurta ˈnaruˈka
assaulted-me with weapons. "I-chased-them" speared some others

ˈtambatamˈbai ˈŋoija ˈna:ro. ˈNaruˈka ˈtambatamˈbai ˈjarau ˈkarlku
running-away with-fright they-were. Others running-away spears

ˈralui ˈmik:ai.
full-of wounded.

(Wa:ku shows his legs.)

W. to K.: ˈKi:ki ˈŋokila ˈja:pa ˈkarlko ˈro:lka ˈna:ro. ˈEineinu
Here myself by-a-spear speared I-was. Then (while)

ˈnaruˈkarai ˈjorupa ˈŋokeila ˈkeiŋkutjai ˈnadlaijin ˈŋapen
I-was-hard-pressed they-hit my-sister's-son "in-confusion"

ˈnan ˈmalaji ˈap:a ˈnadlaji ˈnarn ˈŋok:eilai ˈkeiŋkutjai.
running-and-chasing then struck-down (was) my-sister's-son.

ˈUr:a ˈpam:i ˈtjinanka ˈi:tu ˈnaˈmaramilˈ:ai ˈŋim:ai.
We see tracks there of-chasing-fighting there-are.

(W. points): ˈWorilkata ˈtjinaŋka ˈit:uli.
Those-are tracks there.

(W. points out to his brother-in-law the tracks where his combat with many black-fellows has taken place. Ka:nau can only see the twisted tracks, "pigeon-toed", of Wa:ku.)

K. to self:	ˈKi:ki	ˈtangu	ˈki:ki	ˈwimbai	ˈmari	ˈnareˈkalai	ˈkeiŋkudjarndu.
	This	relation	this	man	has-done	to-death	his-sister's-son.

K. to W.:	E! he!	ˈKinortili	ˈtun:arta	ˈip:arleli.	ˈOndadja!	ˈTambili	ˈmeŋga	ˈkeiŋgutjarm	ˈmandi	ˈor:a	ipˈ:arleli.
		That-will-do	we-may-as-well	bury-him.	Brother-in-law	Dig	hole	for-sister's-son	that-we-may	him	bury.

W. commences to dig a grave, and prepares the first portion of the pit.)

W. to K.: O!	ˈOndadja!	ˈŋindu	ˈwili	ˈtambe.
	Brother-in-law	you	now	dig.

(K. goes down into the hole, digs, and comes out again.)

K. to W.:	ˈOndadja!	ˈŋindu	wil	ˈŋitjulun	ˈtamba.
	Brother-in-law	you		once-more	dig.

(W. goes down a second time. Soon K. peers in and sees that it is deep enough.)

K. to W.:	ˈKen:oˈtartiŋ	ˈgeito	ˈmeiŋga	inˈdjo	imˈ:aŋgaleil	ˈŋarltuˈtja ˈtar:
	That-is-enough	that	hole	you	lie-down	"bottom-of-hole-to-see-if-it-will-be-suitable".

(K. tells W. to lie down in the proper position in the hole to test its shape.)

K. to W.:	ˈŋartau	ˈnaŋonji	ˈim:an	ˈeno	ˈkeiŋkutjarn.
			lie-down		sister's-son.

(K. stands over the grave and watches, telling him to move first one way and then another, until he is in the correct position.)

K. to W.:	ˈKen:o ˈtartiŋeli	ˈim:aŋgaleil!
	That-is-enough	lie-still!

(So saying, K. picks up the body of his son, throws it down on W., and hastily fills the grave with earth. Thinking that he has made an end of Wa:ku, K. returns towards his camp. K. notices a dark cloud rising in the west. He says:)

K. to self: ′ŋinda ′waŋgalan ′komboi ′mari ′piŋgi ′alui.
You rising-in-West "there-will-be" thunder-and-lightning.

′Wilpi larn ′jap:arai ′piŋgi ′alui. ′K(e)i:ki:li ′tailpa′nili.
Build-I-must shelter from-the-storm. Here-it-comes close-overhead.

(W., meanwhile, is digging his way through the ground "like a wombat". K. makes three separate camps, one after the other, so that if one is struck by lightning he may use the other, or if one becomes wet, he may jump into the other; the third one is supposed to be substantial enough to keep out any amount of water. Rain drives him into the third hut.)

K. to self: He! He! ′Ki:kilinu ′jap:arai ′ila ′balkara ′ŋaji ′kaŋarn
Here-it-is in-camp cannot strike me in-this

′jap:arai.
camp.

(The finish comes—lightning strikes.)

Comment: ′Tal! ′tal! ′malajinu ′piŋgi ura ′balkeiruŋai. ′Keikil
Crash! crash! struck lightning struck-down. With-this

′wombi′la:pil.
he-flew-into-the-air.

(W. digs himself out of the ground, "like a goana", but it is a great struggle, and the effort turns him into a bird, and he becomes the crow. He is [′wanga] (i.e. a "meat" or totem). Each has condemned the other to be a bird. They speak to each other, as birds:)

W. to K.: ′Ondadja! ′woreimba ′wombilarli ′karkano
Brother-in-law from-now flying-in-the-air high-up

′keirama:′lina.
will-be-our-country.

K. to W.: ′ŋempa ′ka:ra ′ondadja ′wombilarn ora ′karkanj uo
You brother-in-law fly high-up

′jap:a′ra:lin ′i:mar: wombilarli.
camping will-be flying.

WA:KU KILLS HIS SISTER'S SON.

(English Rendering of Text.)

ACT I.

W. to K.: Brother-in-law, you have a wife, but I have not received any in return. Give me one, for it will be pleasant to have a woman. If you won't let me have a wife I will point a bone (perform magic bone rites) at you. I am going to take the two sisters (for whom you are caring).

K. to W.: Wait a few days, brother-in-law. Come and see me again about the matter. Your sister's son is listening to us. He may hear about the forbidden thing that we are discussing. (W.'s desire to wed women who stood in the sociological relationship of wife's mother.)

K. to Boy: Look! Your mother's brother is coming. Go and play. Your mother's brother and I must talk of secret things. Play far away from the secret. I forbid you to listen to our talk.

K. to W.: I cannot see a way in which to provide you with a wife; there is no suitable woman here.

W. to K.: I will point the bone at you, brother-in-law. I will not yield my rights to you.

K. to W.: Have patience; in a while I will see about it. By continually asking for a woman I might obtain one from the people. If not, I may be able to get one by threatening them. Perhaps the people will take pity on us. I will listen for any hint of good news. I will give you the tidings. However, if there is no word, we will have to consider the matter further. If we remain quiet these fellows will soon show us what they have in mind. You and I will sit and listen, and find out how they are dealing with the matter. Any good news will be told to us if we sit and wait. If they don't give us good news it will be their fault. We will sit down and await the turn of events.

W. to K.: I will return to my own camp now, brother-in-law. Some day I will return (to hold you to your word).

ACT II.

W. to self: I will go over and kill my sister's son.

W. to K.: How are you, brother-in-law? My foot is aching from walking. You go and hunt for game; my nephew and I will remain here. He is making a fire. We will share out this wallaby when it is cooked. Some of it we will eat, but we will leave your share. When you return to where we are camped you will find it prepared, ready to eat. To-morrow we can cook the raw meat you obtain. We will sleep here to-night.

Boy to W.: Uncle, my belly is aching. It is full.

W. to Boy: Don't stop eating yet; let me cut you off one more piece.

Boy to W.: Impossible. I am full. I am thirsty. I am going to fetch water to drink.

W. to Boy: Run down (to the water), have your drink, and come back again.

W. to Boy (after an interval): Go around the other way.

Boy to W.: Did you say the other side? What did you say?

W. to self: That will finish you.

K. to self: Why did I miss my aim at that animal? What is happening? Strangers must be coming. I will try another one, and see what happens. (Something is happening to those relations of mine.) Hold. I'll try once more.

K. to W.: Brother-in-law, what has gone wrong with you?

W. to K.: Oh! brother-in-law, a great crowd of people have assaulted me with weapons. Some of them I chased away wounded; others ran away in fright; still others ran away pierced full of spears. I was wounded here myself with a spear. While I was being assaulted and hard-pressed they hit my sister's son. In the confusion of running and chasing, my sister's son was struck down. See the tracks of the scrimmage there (on the ground).

K. to self: This relation of mine, this man, has murdered his sister's son.

K. to W.: All we can do is bury him. Brother-in-law, dig a hole for your sister's son, so that we may bury him.

W. to K.: Brother-in-law, it is your turn to dig.

K. to W.: Brother-in-law, continue the digging once more. That is deep enough. Lie down in the hole and test it. Lie down in the proper way, just as your sister's son will be placed. That is enough. Lie still.

K. to self: What is that rising in the west; there is going to be a thunderstorm. I must build a shelter from the rain. It is close overhead. It comes. It cannot strike me in this camp.

Comment: Crash struck the lightning; struck him down. At this he flew into the air (i.e. became transformed into a bird).

W. to K.: Brother-in-law, from now on our country will be high up in the air.

K. to W.: You, also, brother-in-law, will make your camp high in the air.

WA:KU SEEKS THE TWO SISTERS AS WIVES.

Following the events given in the first half of the above recital, Wa:ku was lonely, and because he was cunning ("much more clever than Makwora men") he sought ways to overcome the two sisters, his mothers-in-law.

From the Manara Range he watched the [ˈwitulin] squatting beside a claypan, gathering food. His penis became erect, and he sang a song which had magical power. Thereupon it became long, and, passing through the ground came up under first one of the women and then the other.

One said to her companion: "Older sister [ˈwit:uga], I have a strange feeling. What is wrong?"

The other replied: "We had better escape; old man Wa:ku is trying to trick us."

They both became big with child. The younger sister one day went away alone, for the first time, and gave birth to a male child. She made a bed of soft grass, with a bark covering, and left the child, returning empty-handed to the camp, where her older sister had already finished food preparations.

"What is wrong to-day ['kaitjaga], have you brought no food?"

To this the younger sister replied: "I have found something; it will be company for us. He is a little man. Come down the hill in the morning, and I will show him to you."

At daylight they went down on to the plain. "What a fine fellow! A little boy. He will catch game for us. Keep feeding him in the scrub until he grows up."

The elder gave birth to a girl in like manner. People began to notice their unusual actions, and say: "They have broken the rules. There is something wrong."

The ['witulin] saw they were hated by their own people, and ran away, travelling all day until they came to the ['Ba:ka], Darling River, at ['Pu:n'keiri], Pooncaira, of maps. Here they met a man named ['Tul:u], also called ['Tjul:u], or ['Tudlu], which is now the name of the kingfisher.

'Tul:u was a noted fisherman, for no one else on the river was skilled at catching ['parndu], Murray Cod (*McCullochella macquariensis*). Other people ate their food raw, but 'Tul:u had fire, and was able to cook all he ate. Ba:kindji people could not understand why he was so different. 'Tul:u watched the two fine, strange women as they came towards him.

"What are you?" he asked, and they replied, "Makwora".

"You are 'right' for me, for I am Ki:lpara." Then they took him as their husband, at ['Pu:n'keiri]. 'Tul:u fed them both well, and they were happy, for there was a big "hole" in the river stocked with abundance of fish.

Wa:ku, mischief-maker, followed after the ['witulin]. On finding them, he said to himself: "Ah! There they are. I'll kill that fellow, and take the two women for myself."

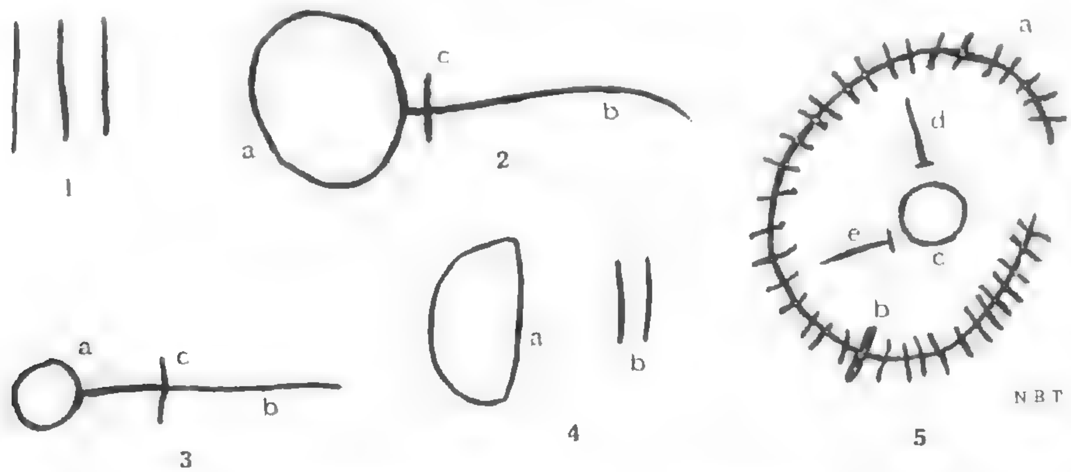
Even while he was still a long way off, it was his intention to kill 'Tul:u, and so he devised a trick. He pretended he was an old man, and lame.

The women, having never seen him at close quarters, did not recognize him, and took pity. ("It is a devil's trick still done to-day.") They fed and made a camp for him.

Wa:ku then asked Tulu why he was able to catch fish when all other men had failed. 'Tul:u led him to the water's edge, and showed him how to dive down and peer into hollow logs lying in the mud. He found a big cod in a specially large hollow tree trunk. They went down to see it. In diving, Wa:ku noticed the bones of men and a large spear lying in the log. When 'Tul:u urged him to dive through the log and secure the fish, he was too cunning to agree, and said to himself: "This is the trap of 'Tul:u. It is for people who ask him how to fish. They are all relations of mine. Many of my uncles (mother's brothers) have already died by the spear of 'Tul:u."

Wa:ku argued with 'Tul:u, who, to demonstrate that it was safe, himself dived into the end of the log, and followed the fish through it. Wa:ku made splashing noises, pretending that he was struggling with the cod. As 'Tul:u appeared, he grasped him by his long beard, and pierced his head with the fish spear. As Wa:ku struck the fatal blow, the two women had a feeling that some harm had come to their husband. They were sure when they saw Wa:ku approaching alone and without fish.

After the evening meal they made a camp for three, placing Wa:ku in between them (Fig. 1). They refused his embraces. When he had gone to sleep, the women commenced to groan and complain of pains, and of a desire to defecate. Each picked up her child and skin rugs. Their aches were a sham. They defecated, one on each side of the camp, and they practised magic by singing to their excreta, making them grow large. They taught them to say: "We are coming soon, we have bellyache, and cannot relieve ourselves."



Figs 1–5. Ground sketches by Maraura man made in illustrating story of Wa:ku. 1. Wa:ku sleeping between the two sisters. 2. Women fishing for bream: a. Limbari Lake. b. Creek. c. Net. 3. The magical tree. a. Camp. b. Tree. c. Gall lump. 4. The old woman's camp. a. Round Camp of old woman in a cave. b. The two sisters asleep. 5. Men sleep around the magic tree. a. Ring of sleeping men. b. The man Nankuru. c. The magic tree. d. and e. The two women.

Then they escaped with their children. Each time Wa:ku stirred and impatiently called to them, the faeces answered for the women. At last the old fellow impatiently picked up his swordstick club, and in the darkness struck first at one of the two black objects beside the camp, and then the other. The mess splashed and blinded him. He cleared his eyes. Then he sang a song to the daylight, and the dawn came up more quickly than usual. He saw the tracks of the women on the western banks of the river at ['Pu:nkeiri], and followed them to ['Limbari], a lake where he saw smoke rising from a fire, near where a creek entered the lake from the river. The two women had stretched a net across the channel, and, in the late afternoon, were engaged in catching bream (Fig. 2). They brought a few fish to him, and made their camp. Wa:ku at first refused to cohabit with the elder sister, for he desired the younger, but they would not allow this, and he had to be content with the older after all.

Next morning he sent them to fish while he nursed the babies. Still anxious to mate with the younger one, he pinched her baby till it cried; but the two women would not be separated, and came up the bank together. His patience was exhausted. He prepared "a camp" for the two children on a low gum sapling, and sang to the tree until it grew up quickly. Then he caused a large gum tree gall to appear halfway down the trunk (Fig. 3), to prevent the rescue of the children, now high up in the air.

Wa:ku then said to the children: "When you see the smoke of a fire in the distance, cry for your mothers."

The children cried out, and the women ran to the tree, but could not climb it. Then they ran back to the Darling River, and told all the Ba:kindji people. ['Nankuru], Pelican, was the head man, a Makwora man like Ka:mau. All the people came to the tree, and tried for many days to climb it; none succeeded in surmounting the gall swelling.

Then the ['wituliŋ] heard of a clever Maraura young man, a Ki:lpara youth named ['Walpu], who lived about Lake Victoria. 'Walpu was a ['tambar], set apart to undergo his initiation, and therefore plastered thickly with a coating of red ochre and oil. His body was ['tambar]. This youth lived with his mother in a cave.

"Fetch that boy; he is the only one to rescue your children." The women listened to the Ba:kindji men, and travelled in haste to Lake Victoria, accomplishing the journey in a single day. 'Walpu was away hunting. They told the old woman about the plight of their children.

The old woman was not anxious to help. "If he wishes to go, I will send him when he returns. I don't want him to go, for strange men may kill him."

The lad returned, saw the "two fine women" waiting for him, and learned that they were Makwora. He decided to go. Night fell, and the ['wituliŋ] made a bed for three people, for they wished to reward the youth. The boy remembered that he was ['tambar], and that the red ochre was still on his body, and refused their advances. He left secretly in the early hours of the night to rescue the children.

The old woman slept in the nearby cave (Fig. 4). At dawn she came and commiserated with the women. "He will not go with you. Go ahead; I will try and persuade him to go."

At noon, as the women trudged along, they found several fat opossums lying on the track. They were presents from the youth. They ate them, and kept finding others until they were in sight of the strange tree. The lad met and warned them not to disclose his presence, but to make all the Ba:kinji men lie around the tree. The ['wituliŋ] were told to sleep apart, close to and with their heads toward the butt of the tree (Fig. 5).

'Nankuru saw the women lying apart, and desired greatly to crawl over to one of them, but he saw that it could not be done while the children were still in the tree. Then the [tambar] youth sneaked into the circle, and quietly sang a magic song or ['wimbai'ŋalpa]. Old men still use this song formula when they desire to kill young men. The song made everyone sleep soundly. Then he jumped between and over their bodies, and came close to the tree. He sang another magic song, and this had the effect of making the tree become small. He did not climb the tree, but merely picked the children off, and placed one with each of the sleeping women. He spoke to them in turn, and said: "That is your mother. When you see a fire blaze up in the distance you must cry, 'Where is my mother?' "

He fled and lit the fire; the children cried, and the camp awoke. 'Nankuru was the first to see what had happened, and, leaping to the sides of the women's beds, pretended that he was the one who had rescued them. By this he hoped to win the favours of the two sisters.

They refused 'Nankuru, and went away down the ['Ba:ka] without anyone daring to stop them. They came to the Murray River, or ['Rinti], at Wentworth, and followed it downstream to Lake Victoria, keeping on the northern bank until they came to Morgan, where the river turns south. The Maraura call this the country of the [**T**anga:li]. They continued then on the western side of the stream beyond the country known to an older generation of Maraura.

Old Wa:ku, who meanwhile had discovered the escape of the two women, followed them. He was not able to catch up with them, for they had had a long start.

So far the story is as told to the informant by people who were alive before the white men came to the Darling River. Of the story of 'Wa:ku and the two women in the country of the people he called the Murundi, less is known; but the informant outlined it as he had heard it from them in later years. Murundi people are now all dead. The Murundi were a horde or clan of the Ngaiawang tribe, who inhabited the Murray River, from Herman Landing upstream to near Waikerie.

Wa:ku attempted to catch up to the women by taking a short cut across North-West Corner. At Loxton he made a cave, into which he went, and, travelling underground, emerged at Swan Reach. (The exit is a deep cave, which has been described by Parkin, 1938.)

When Wa:ku emerged from the cave at Swan Reach he was quite stupid from being so long underground. Many people lived at this place, and Wa:ku did not know quite where he was. In his own country, children followed their mothers (i.e. there was matrilineal inheritance of the moiety terms), but he was so confused that he "turned the people around, and made his children follow their father". He also desired to injure the two women for deserting him. Thus there are no moiety terms among the Murundi people, and children inherit their father's totem.

In Ngaiawang mythology the two women became the wives of the ancestral man Ngurunderi [ŋu'runde'ri]. They escaped from him downstream and, after many vicissitudes, were magically turned to stone by him as two small islands (the Pages), off the coast of Encounter Bay, while they were fleeing out to Kangaroo Island, which was then almost connected with the mainland.

After further adventures, which are not described in Maraura lore, Wa:ku returned to his country on the Darling River, and revisited his brother-in-law. He then took revenge on his sister's son (as told in the second half of the above recital).

DISCUSSION.

These stories of the Maraura people offer us more than the mere recital of a folk tale, for in them can be read much of the daily life and thoughts of these people, as well as some vague indications of their former history. Without this insight, our formal sociological diagrams, our lists of food-plants and relations, and our tribal maps mean little.

The southward direction of movement of the story is interesting. The migrations of people along the Darling and Murray Rivers, evidently one of the main corridors of Australia, in ancient times as well as in later days, is attested by many facts of distribution of material culture and language, and by archaeolgoical gleaning. Fraser (1892) mentions some Maraura as being on the Darling River in 1831, and moving downstream.

That the Crow stories are of rather remote origin in time may also be deduced from their widespread distribution in the southern half of Australia. Usually the Crow is the clever and mischievous one; Eagle a good man, although in more northern accounts the rôles are occasionally reversed. There is also the suggestion of racial differences between them, for Ki:lpara men are tall and light-haired, while Makwora are traditionally short, stout, and dark-haired. In this native observation we have perhaps some confirmation of the presence in former times on the Darling River of two forms of the Australian aboriginal, a stout, heavy, short, and hairy "Southern" people, and a more gracile and rather glabrous "Northern" folk.

In their possession of skin cloaks and rugs, the practising of southern forms of initiation rites, and in the focussing of the interests of the stories on the avoidance of a Ki:lpara man, may be read the suggestion that the Makwora persons involved in the story were mainly of the "Southern" type.

Elements of this story are found in many places. The unclimbable tree one is present in an unpublished story from the hills behind Encounter Bay. In an unpublished Tangane text, Crow kills his mother-in-law, and prepares tracks of a

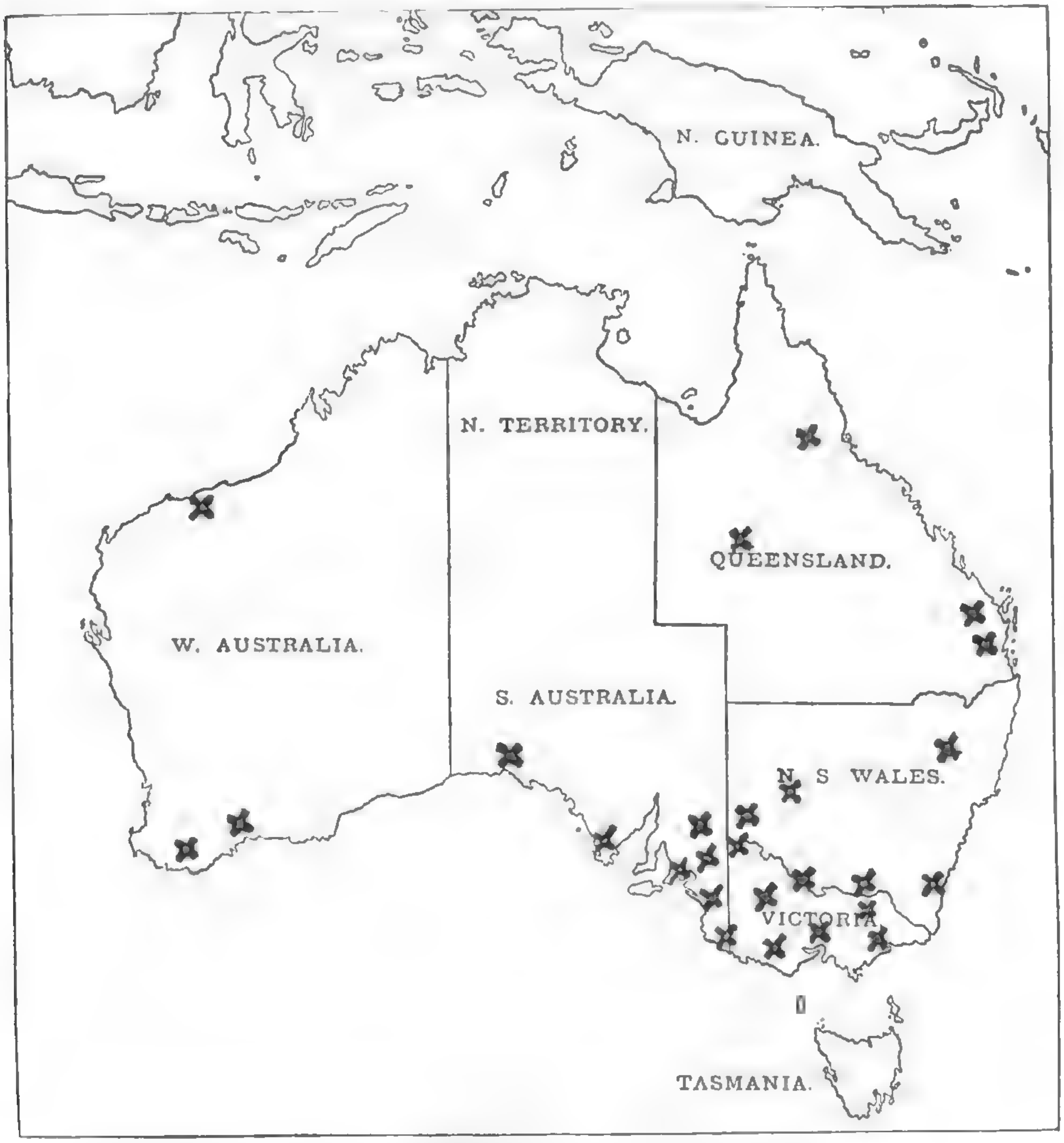


Fig. 6. Distribution of Eagle and Crow myths in Australia.

mock battle to deceive. At Waroonie Hill (Tindale, 1937) Eagle punishes Crow by setting him on fire, and turning him into a bird. The Crow wanders far into New South Wales. One of the lost stories concerned ['Wa:gen-'wa:gen], the town otherwise known as Wagga Wagga, which is named after Wa:ku.

Brough Smyth (1878, I, p. 425), Mathew (1910, p. 191), Roth (1903), have recorded myths of Eagle and Crow type. Roheim (1925) has utilized them in an analysis of the development of Australian totemism. He suggests that the "conflict myths" contain elements so old that they may well be a remembrance of that theoretical stage in the development of man when the Cyclopean horde family was the important unit of social organization. In their present form the stories are scarcely likely to be so ancient, and the present text may perhaps be equally readily interpreted as indicating the conflict to be due to ethnic clashes of the type suggested herein.

SUMMARY.

Crow and Eagle myths of the Maraura tribe of the Lower Darling River in New South Wales are detailed, partly in text, with interlinear translation. Wa:ku, or Crow, an ancestral human being, seeks to take his two sociological mothers-in-law as wives. Having failed, he kills his sister's son, and is turned into a bird by Ka:nau, whom he has thus injured.

In the discussion, some evidence is deduced for the belief that the stories recall the clash of two peoples along the Darling River. This river has evidently been, for a long time, an important corridor of migration from north to south in Australia.

REFERENCES CITED.

Fison, L. and Howitt, A. W.: Kamilaroi and Kurnai. Melbourne, 1880.

Fraser, John: The Aborigines of New South Wales, 1892.

Hassell, E.: Folklore. 1934, p. 331.

Mathew, J.: Eaglehawk and Crow. London, 1899, pp. 14–19.

Mathew, J.: Two Representative Tribes, 1910.

Parkin, L. W.: *South Australian Naturalist*, 19, 2, 1938, p. 6–9.

Roth, W. E.: North Queensland Ethnography Bulletin, 5, 1903.

Smyth, R. Brough: Aborigines of Victoria, 2 volumes. London, 1878.

Tindale, N. B.: Legend of Waijungari . . . . and the Phonetic System employed in its Transcription. *Rec. S. Aust. Mus.*, v, 3, 1935, pp. 261–274.

Tindale, N. B.: Native Songs of the South-East of South Australia. *Trans. Roy. Soc. S. Aust.*, lxi, 1937, pp. 107–120.

Tindale, N. B.: Two legends of the Ngadjuri Tribe from the middle north of South Australia. *Trans. Roy. Soc. S. Aust.*, lxi, 1937, pp. 149–152.

INTERNAL PARASITES OF THE PIGMY SPERM WHALE

BY T. HARVEY JOHNSTON AND PATRICIA M. MAWSON,
UNIVERSITY OF ADELAIDE.

Summary

The material on which this report is based was obtained from three pigmy sperm whales, Kogia breviceps (Blainville). From one specimen, stranded at Sandgate, Moreton Bay, Queensland, 2nd June, 1933, nematodes belonging to Anisakis and Porrocaecum and fragments of a large species of Crassicauda, were obtained by Mr. H. A. Longman, Director of the Queensland Museum, Brisbane, and forwarded to us for identification. The other two whales were a female and its calf, which were stranded at Port Victoria, Spencer Gulf, South Australia, in April, 1937, both specimens being obtained by Mr. H. M. Hale, Director of the South Australian Museum. From the adult we collected the same three species of Nematoda (Anisakis kogiae n. sp., Porrocaecum kogiae n. sp., and Crassicauda magna n. sp.), as well as encysted larvae of a cestode, Phyllobothrium delphini. The calf contained Anisakis kogiae. The stomach of each of the South Australian whales contained beaks of cephalopods, Sepioteuthis australis (identified by Mr. B. C. Cotton).

INTERNAL PARASITES OF THE PIGMY SPERM WHALE

By T. HARVEY JOHNSTON AND PATRICIA M. MAWSON, UNIVERSITY OF ADELAIDE.

Text-fig. 1–16.

THE material on which this report is based was obtained from three pigmy sperm whales, *Kogia breviceps* (Blainville). From one specimen, stranded at Sandgate, Moreton Bay, Queensland, 2nd June, 1933, nematodes belonging to *Anisakis* and *Porrocaecum*, and fragments of a large species of *Crassicauda*, were obtained by Mr. H. A. Longman, Director of the Queensland Museum, Brisbane, and forwarded to us for identification. The other two whales were a female and its calf, which were stranded at Port Victoria, Spencer Gulf, South Australia, in April, 1937, both specimens being obtained by Mr. H. M. Hale, Director of the South Australian Museum. From the adult we collected the same three species of Nematoda (*Anisakis kogiae* n. sp., *Porrocaecum kogiae* n. sp., and *Crassicauda magna* n. sp.), as well as encysted larvae of a cestode, *Phyllobothrium delphini*. The calf contained *Anisakis kogiae*. The stomach of each of the South Australian whales contained beaks of cephalopods, *Sepioteuthis australis* (identified by Mr. B. C. Cotton).

The only helminth previously recorded from this rare whale is a Phyllobothriid cestode larva, *Monorygma grimaldii* (Moniez), whose occurrence was reported by Baylis (1926, 666; 1932, 410). From the large sperm whale, *Physeter catodon*, two species of nematodes (*Anisakis* spp.), two of Acanthocephala (*Bolbosoma* spp.), and a cestode larva (*Phyllobothrium physeteris*) have been recorded.

The types of the species described as new in this paper are deposited in the South Australian Museum, Adelaide; paratype material has been placed in that institution, as well as in the Queensland Museum, Brisbane. Acknowledgment is made of the kindness of the Directors of those Museums, Messrs. Hale and Longman respectively, in giving us the opportunity to study the collections; and of assistance obtained through the Commonwealth Research grant to the University of Adelaide.

ANISAKIS KOGIAE n. sp. (fig. 1–6).

From the stomach of *Kogia breviceps*, Port Victoria, Spencer's Gulf, South Australia; and Moreton Bay, Queensland.

Male 5–5·5 cm.; female 4–6·5 cm. Interlabia absent. Dentigerous ridges present, bilobed on each lip, with about ten teeth on each lobe. Lips of approximately similar form and length; dorsal 0·05 mm. long, 0·1 mm. wide at base; laterals 0·13 mm. wide, anterior end with slightly narrower bilobed part not very distinct from basal portion; two double papillae on dorsal lip, a double papilla on each ventro-lateral. Excretory pore possibly between ventro-lateral lips. Cervical papillae at 0·44 mm., and nerve ring at 0·31 mm. from head end. Cuticle annulate, also transversely and finely longitudinally striate.

Male. Spicules unequal, 1·4 and 1·9 mm. long in a male 40 mm. in length, stout, tapering to rounded point. About 74 pairs of preanal papillae, arranged more or less in two longitudinal rows on each side, extending for about 2·4 mm. in front of anus; a pair of adanal, two pairs immediately postanal, succeeded by four pairs of stalked postanals arranged in two groups each of two papillae. Caudal alae about 0·35 mm. in maximum width, reached just in front of level of anus. Tail 0·18 mm. long.

Female. Tail bluntly conical, 0·2 mm. long, sometimes with small papilla-like termination. Vulva a little in front of mid-body; vagina 2·2 mm. long; median uterus 6·75 mm. Eggs in upper parts of uteri 0·32 by 0·25 mm.

Two species of *Anisakis* have been described from the sperm whale, *Physeter catodon*—*A. physeteris* Baylis (1923) and *A. catodontis* Baylis (1929). From the former it differs in size, length of spicules, and in the number and arrangement of the caudal papillae. It is distinguished from the latter in being shorter, and in possessing less prominent lobes on the lips, shorter tail and spicules, while the nerve ring and cervical papillae are more anteriorly situated. From *A. simplex* (Rud.), a species widely distributed amongst Cetacea, it differs in having the dorsal lip slightly larger than the others, a smaller number of postanal papillae, and spicules unequal. From *A. kükenthali* (which may perhaps be synonymous with *A. simplex*), it is distinguished by the possession of shorter length, shorter spicules, fewer and differently arranged preanal and postanal papillae. It is shorter than *A. dussumieri* (Beneden), and has fewer postanal papillae. It differs

---

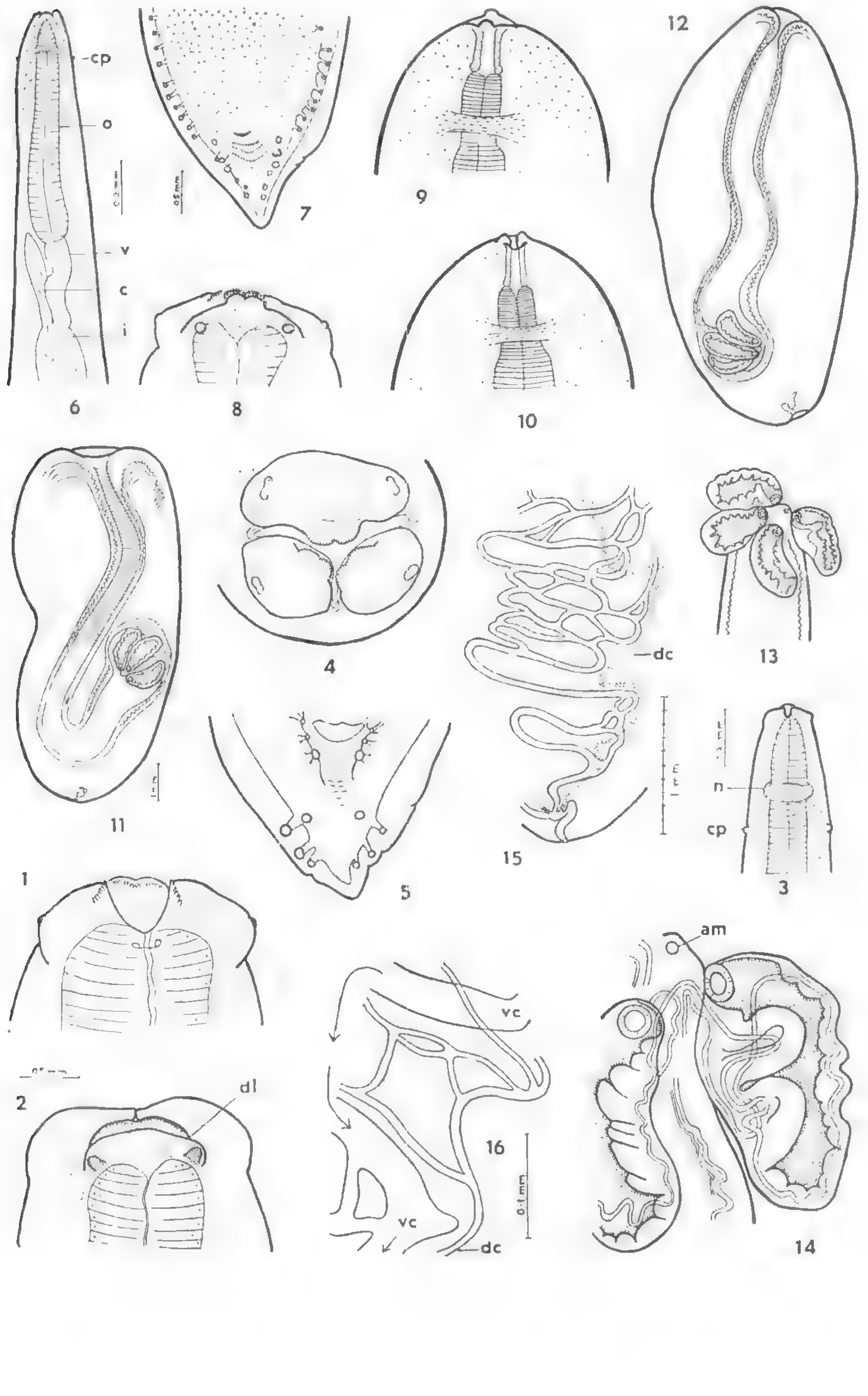
Figs 1–5. *Anisakis kogiae.* 1. head, ventral view; 2. head, dorsal view; 3. anterior end; 4. head, anterior view; 5. tail of male.

Figs. 6–8. *Porrocaecum kogiae.* 6. anterior end; 7. tail of male, ventral; 8. head, dorsal.

Figs. 9–10. *Crassicauda magna.* 9. head, lateral; 10. head, dorsal.

Figs. 11–16. *Phyllobothrium delphini.* 11–12. cysts, slightly flattened; 13. anterior end of scolex removed from cyst and compressed; 14. two bothridia and apex of scolex, showing arrangement of exeretory canals; 15. plexus of ducts belonging to the ventral excretory system of one side in the posterior part of the cyst; 16. portion of dorsal plexus of one side in the posterior region of the cyst, arrows indicate direction of ventral canal proceeding towards the excretory bladder.

Figs. 1, 2, 4 and 8 are drawn to scale below fig. 1; 5 and 7 to scale beside fig. 7; 3, 9 and 10 to scale beside fig. 3; 11, 12 and 13 to scale beside fig. 11; 14 and 15 to scale beside fig. 15. a m, apical muscle; c, caecum; c p, cervical papilla; d c, dorsal excretory canal; d l, dorsal lip; i, intestine; n, nerve ring; o, oesophagus; v, ventriculus; v c, ventral excretory canal.


cp
o
v
c
i
6
7
8
9
10
12
11
4
dc
13
n
cp
3
15
5
1
am
vc
2
dl
16
0·1 mm
vc
dc
14

from *A. typica* (Dies.) in the form of the lips, relatively shorter ventriculus, shorter oesophagus, less difference in the size of the two spicules, and number and arrangement of the postanal and preanal papillae.

PORROCAECUM KOGIAE n. sp. (fig. 7–8).

From the stomach of *Kogia breviceps*, Spencer's Gulf, South Australia; and Moreton Bay, Queensland.

Male 2–3 cm.; female 1·5–3 cm. Cuticle with annulations but without finer transverse striations. Lips of similar shape; dorsal about 0·04 mm. long, 0·09 mm. wide at base; ventro-laterals about as long, but narrower; internally-projecting bilobed part of each lip narrow (about 35μ wide, 10μ long in dorsal lip), with rather long teeth in dentigerous ridge; one papilla on each ventro-lateral lip, two on dorsal.

In a female 1·5 cm. in length, oesophagus 2 mm. long, 1 : 7·5 of body length, anterior portion 1·75 mm., ventriculus 0·35 mm. long, and usually more or less straight; intestinal caecum slightly longer than ventriculus. Nerve ring 0·3 mm. from the head end; cervical papillae just behind nerve ring. Excretory pore apparently at same level as nerve ring.

Male. Spicules unequal; 0·17 and 0·2 mm. long in a worm 14·7 mm. long, longer spicule 1 : 7·3 of body length; tapering. About 65–70 pairs of preanal papillae, arranged more or less in two longitudinal lines laterally, the more anterior being scattered, the series extending to 0·9 mm. from posterior end of worm. Six pairs of postanal papillae arranged in two groups of three; the more anterior group containing larger papillae, the middle one being double. Three transverse rows of denticles just posterior to anus. Gubernaculum present.

Female. Tail conical, pointed, 1 : 50 of body length. Vulva a short distance behind oesophagus.

P. kogiae appears to be the first member of the genus to be described from cetaceans. It shows resemblance to *P. decipiens*, a widely distributed parasite of seals, but differs in being generally shorter, in the position of the vulva, in the presence of three rows of post-anal denticles, and in the possession of unequal spicules and a greater number of preanal papillae.

Larvae of *Porrocaecum* were present amongst the material, these showing the same relative length of the oesophagus as in the adults. The three lips were not differentiated, but a larval tooth was present.

CRASSICAUDA MAGNA n. sp. (fig. 9–10).

From *Kogia breviceps*, Port Victoria, South Australia; and Moreton Bay, Queensland.

The South Australian worm, a female, was dissected from the neck region, where it occurred entwined in the connective tissue, lying in a very narrow tunnel. Its presence was revealed during flensing, the parasite having been cut across in several places. On account of the tangled manner in which it lay, it was difficult to extract it. The total length of the fragments obtained measured, when in a preserved state, about twelve feet (3·7 metres), the longest unbroken piece being over nine feet. The posterior region was not seen, and fragments were still traceable in the blubber when collecting ceased. The species appears to be the longest nematode yet described. The Queensland material is also fragmentary, and has the same appearance and diameter, and can safely be assigned to the same species.

Maximum diameter of preserved material 3–4 mm. Head rounded, with two small lips in lateral positions; the two lateral and four submedian papillae described by Baylis as characteristic of *Crassicauda* were not observed. Buccal cavity strongly chitinized; 0·14 mm. long; width from side to side 0·06 mm., from dorsal to ventral walls 0·08 mm. Head, measured across base of buccal cavity, 0·48–0·53 mm. Oesophagus total length 1·8 mm., first 0·3 mm. narrower than the remainder. Nerve ring 0·35 mm. from head end. Intestine 0·55 mm. wide anteriorly. Eggs extremely abundant, 40–42μ by 23–28μ, thick-shelled.

Our species exceeds *C. crassicauda* and *C. giliakiana* in diameter and in the recorded length of fragments. Its buccal cavity is relatively smaller than in any species in which it has been described. The eggs are much smaller than those recorded for other species. *C. bennetti* appears to be a larger worm than *C. magna*, its body diameter ranging to 8 mm., but the fragments described were shorter. *C. boopis* is about as wide as *C. magna*. *C. bennetti* and *C. boopis* are known only from posterior ends, while we have seen only an anterior end from each collection. The egg shells of *C. magna* do not show the thickened midregion which seems to be characteristic of those of *C. bennetti*. Our species appears to be nearest to *C. boopis* from the hump-back whale, *Megaptera boops* (= *M. nodosa*).

Crassicauda is restricted to cetaceans, *C. magna* being the sixth species to be described. It is to Baylis (1916; 1920; 1922) that we owe much of our knowledge of them.

The type *C. crassicauda* (Creplin, 1829) originally described as a *Filaria*, came from the urethra of a northern rorqual identified as *Balaena rostrata*, but which Baylis (1916, 145) showed to be probably *Balaenoptera physalus* L. Leiper and Atkinson (1914; 1915) erected *Crassicauda* to receive a parasite regarded by them as belonging to Creplin's species, but obtained from a humpback whale, *Megaptera nodosa* Bonn., from northern New Zealand waters. Hamilton (1916, 132) recorded the presence of *C. crassicauda* or a closely-related species in the urinary ducts of three species of rorquals, *Balaenoptera physalus* L., *B. musculus*

L., and *B. borealis* Less., especially the first-named, in Scottish waters. Baylis (1916) gave a description of the head region of a long fragment taken from the kidney of Cuvier's whale, *Ziphius cavirostris,* the worm being regarded as *C. crassicauda.* In a later communication (1934, 404 and 413) the specimen was assigned doubtfully to *C. boopis,* a species which Baylis (1920, 411) erected to receive Leiper and Atkinson's species, the latter being shown to be distinct from Creplin's. The true *C. crassicauda* was re-described, and both species were figured, material of the former having been collected from the blue whale, at Deception Island, South Shetlands. The presence of the genus, represented possibly by a third species, was recorded by Baylis (1920, 418) from the kidney of *Hyperoodon* sp. from the South Orkneys. Additional information regarding *C. crassicauda* from whales from South Georgia was published in 1922 by Baylis. Baylis's material from *Hyperoodon* was described by Spaul (1926) as *C. bennetti.* We consider it likely that Baylis's species from *Ziphius* was *C. bennetti* rather than *C. boopis.* Yorke and Maplestone (1926) republished Baylis's figures of *C. crassicauda.* Hoeppli and Hsü (1929, 33) described *Onchocerca fuelleborni* from nodules in the vagina of *Neomeris phocaenoides* in China, but Baylis (1934, 405) transferred it to *Crassicauda.* Joyeux and Baer (1931) recorded *C. crassicauda* from the mammary gland of *Tursiops tursio* Fabr. from the Mediterranean, but Skrjabin and Andreewa (1934, 28) consider that the parasite probably did not belong to that species, and preferred to designate it as *Crassicauda* sp. In 1932 Baylis, in his list of worms parasitic in Cetacea, mentioned (p. 410) that the original host of *C. bennetti* was probably *Hyperoodon planifrons.* Skrjabin and Andreewa (1934) described *C. giliakiana* from the beluga, *Delphinaptera leucas,* from the Sea of Okhotsk; published a summary and figures of *C. crassicauda, C. boopis,* and *C. bennetti*; and gave a key to these four species. Baylis (1920, 1922) had already expressed doubts regarding the correctness of assigning the genus to the Filariidae. Yorke and Maplestone (1926, 437) erected Crassicaudinae (Filariidae), but Skrjabin and Andreewa (1934) considered that the genus belonged to the Spirurata, and placed it in a separate family, Crassicaudidae (1934, 26–28).

PHYLLOBOTHRIUM DELPHINI (Bosc) Beneden (fig. 11–16).

A number of cysts, ovate to cylindrical and measuring (when uncompressed) 7·5 to 13·5 mm. long by 5 to 6 mm. wide, were found in the blubber of the tail region. A spherical form, 7·5 mm. in diameter, was also obtained. The smallest cyst seen was only 4 by 3 mm. They all possessed an invaginated scolex and neck, together measuring 10 mm. long in a slightly flattened cyst 18 mm. in length; and 22 mm. in one 15·5 mm. long, in which the head and anterior part of the neck were bent to become directed toward the region of invagination. The scolex was only slightly wider than the neck, the edges of the bothridia being considerably folded. The tissues of the cyst, except the invaginated portion and the outer body wall, were composed of a very loose parenchyma. The width of the invaginated neck region, including the denser tissue surrounding the cavity, was about one-fifth to one seventh that of the lightly compressed cyst.

The bothridia varied in dimensions according to the state of contraction and folding. They were usually about 1·15 mm. long by 0·5 mm. broad, with the margin thrown into rather deep folds, except anteriorly. Each was provided in front with a well-developed sucker 0·16 to 0·2 mm. in diameter when uncompressed. The front end of the scolex projected as a low dome with a very weak apical muscle plug seen only in favourable preparations, and measuring 0·07 mm. in diameter. The neck showed definite transverse musculature, closely arranged and beginning at about one-quarter its length from the head, and becoming more marked as it approached the bladder.

The excretory system was characteristic. The terminal bladder was usually somewhat twisted. The ventral and dorsal canals of each side subdivided and underwent anastomoses, so that four somewhat ladder-like plexuses were formed, the narrower dorsal vessels more or less accompanying the wider ventral canals. The latter anastomosed to a greater extent than the dorsals. The arrangement of part of the system of one side in the vicinity of the bladder is shown in figs 15 and 16. The plexuses extended forwards in the tissues of the cyst almost to the anterior end, where only the four chief canals passed over into the wall of the invaginated region, the two canals of each side then becoming very closely approximated and thrown into very close zigzags. These canals formed a series of loops in the scolex, the wider canals penetrating the bothridia, the arrangement being shown in fig. 14.

The form of the bothridia indicates that the larva belongs to *Phyllobothrium* and not to *Monorygma*. In order to determine its relationships more closely a survey of the recorded occurrences of similar cysts in cetaceans is necessary.

Bosc (in Buffon, Hist. Nat., 3, 1802) reported finding a larval cestode, named by him *Hydatis delphinii*, in fatty tissue of *Delphinus delphis*. Laennec, in 1804, regarded the hydatid of the dolphin as *Cysticercus delphini*. Rudolphi (1810, 265) mentioned Redi's earlier record of cysts in the viscera and intestine of *D. delphis*, and placed them as *Vermis delphini-delphis* amongst doubtful genera. In 1819 Rudolphi referred to the same record (1819, 186 and 799), using the term *delphini* under *Dubium*, but Bosc's form was placed by him (1810, 236; 1819, 182) amongst the doubtful species as *Cysticercus delphini*, though he gave a short account of it

(1819, 551) based on badly preserved material collected by Chamisso, no locality or host being mentioned.

In 1837 Bennett referred to the occurrence of numerous cysts of a species of cysticercus in the blubber of the sperm whale (cachalot). In 1850 Diesing (1850, 617), used the term *Cephalocotyleum Delphini delphidis* Rud. for the parasite referred to by Redi and by Rudolphi (1819, 186); but placed (1850, 493) *Hydatis delphini* Bosc and *Cysticercus delphini* Rud. (1810, 236; 1819, 182 and 551) under the latter name as *species inquirendae*. He also referred (1850, 493) to Bennett's cysts as *Cysticercus Balaenae mysticeti* Bennett, apparently having read incorrectly Bennett's statement regarding the host. Diesing, in a later work (1864), gave a brief summary regarding *C. delphini* from *Delphinus delphis* (p. 63); he also recognized his error regarding the host for Bennett's cyst, and called it (p. 67) *C. physeteris* Bennett.

Cobbold (1879, 421–2) referred to some of the foregoing records as well as to some relating to the presence of monostomes in the body wall of cetaceans, remarking on the possibility of such trematodes being confused with cysticerci. The occurrence of *Phyllobothrium* larvae in *Physeter tursio* (apparently *Tursiops tursio*, i.e. *T. truncatus*) was also noted. He also mentioned that Van Beneden (1870) considered *C. delphini* to be an immature stage of *Phyllobothrium delphini* found abundantly in a specimen of *D. delphis* in 1868. This latter material had been described by Gervais (1870, 779) as *Stenotaenia delphini*, this author referring in 1885 to *Phyllobothrium delphini* from *Delphinus tursio*. Beneden, in 1888, recorded finding an agamous *Phyllobothrium* in the subcutaneous tissues of *Ziphius cavirostris*. Moniez (1889) described as a new species *Taenia grimaldii*, in its cysticercus stage, which occurred in a dolphin, the parasite possessing a very long neck, but the account was incomplete. Leidy (1891, 418) gave a very brief account of *Phyllobothrium inchoatum* from the blubber of *Mesoplodon sowerbiensis* (i.e. *M. bidens*). Stossich, in 1898, reported *Scolex delphini* from the rectum of *Grampus griseus* in the Adriatic.

Linton (1905) gave a description of some cysts from *Lagenorhynchus acutus* from New England waters (U.S.A.). There were two kinds present, the smaller belonging to *Phyllobothrium*, while the larger were described as *Taenia chamissonii*. He stated that Rudolphi's *Cysticercus delphini* (1810) appeared to belong to *Phyllobothrium*, while his *C. delphini* (1819, 236) was almost certainly identical with *T. chamissonii*. Linton regarded the latter as being an immature stage of a species of *Taenia* or closely-related genus, whose adult condition was more likely to be reached in a mammal such as the killer whale, *Orcinus orca*. A feature of his species was the presence of a relatively very long invaginated region. He was evidently unaware of Moniez's observations.

Baylis (1919) gave a detailed account of Moniez's cysticercus, assigning it to *Monorygma*, its nearest known species being *M. elegans* Monticelli, 1890, as described by Zschokke (1889) under *M. perfectum* Dies. He also stated that *Stenotaenia delphini* Gervais appeared to be identical with, or closely related to, the cysticercus. Baylis's material was obtained from *Lagenorhynchus acutus* from English waters.

In 1924 Meggitt assigned to *Monorygma Taenia grimaldii* Moniez, *T. chamissoni* Linton, and *Stenotaenia delphini* Gervais, while *Cysticercus physeteris* Dies. was placed under *Phyllobothrium*. Southwell (1925, 152), in his monograph of the Tetraphyllidea, republished Leidy's account of *Phyllobothrium inchoatum*, and stated that the latter could not be differentiated from *P. lactuca*. He treated *Monorygma* Diesing (1863) as a synonym of *Phyllobothrium* Beneden 1849, and stated that *Cysticercus Taeniae grimaldii* probably belonged to *Phyllobothrium* (p. 165). He placed *P. delphini* Gervais (i.e. *Taenia chamissonii* Linton) amongst the doubtful species (p. 182).

Baylis (1926) recorded the occurrence of *C. Taeniae grimaldii* in a pigmy sperm whale, *Kogia* sp. ? *breviceps*, from southern India, and reported that *C. delphini* Rud. (1819, nec. 1810), as well as the cysts described by Moniez, Gervais, and Linton, were all closely related, and possibly identical, forms. In 1932 Baylis published his valuable list of worms recorded as parasitic in Cetacea.

We may now review the facts noted above. It is obvious that there are two distinct types of Phyllobothriid cysts to be found in cetaceans, both of them originally described with the specific name *delphini*—*C. delphini* (Bosc, 1802), Rud, 1810 (perhaps Laennec, 1804), and *C. delphini* Rud., 1819. The former belongs to *Phyllobothrium*, and includes also *Phyllobothrium* sp. of Linton (1905, 819) and *P. delphini* Beneden (1870). *C. delphini* Rud., 1819, is apparently the same as *Taenia grimaldii* and *T. chamissoni*, and has been adequately described by Baylis. This latter group represents the larval stage of a species of *Monorygma*, and it seems that Moniez's name is the earliest available, i.e. *M. grimaldii* (Moniez) Meggitt, since Rudolphi's (1819) and Gervais' names are invalidated by Bosc (1802) and Rudolphi (1810). *Stenotaenia* Gervais is a synonym of *Monorygma*. To which of these two groups the other cysts, to which some form of scientific name has been given, should be assigned, cannot be determined as yet. Most of them are nomina nuda. Baylis listed *P. physeteris* (Dies.) as possibly identical with *P. delphini* Bosc.

Southwell's statement (1925) that *P. inchoatum* Leidy is a synonym of *P. lactuca*, is not supported by our observations. Leidy's very brief account can be applied to our cysts, and the form of the scolex and of the bothridia in our specimens is not that of *P. lactuca*, but resembles more closely that of *P. unilaterale*

Southwell (1925, 155), syn. *P. thridax* Zschokke (1888, nec Beneden, 1850), but the bothridia are much more elongate and narrowed than in the European species. *P. inchoatum* can be regarded provisionally as a synonym of *P. delphini* (Bosc). We attribute our cysts to the latter species.

Kogia breviceps is now known to harbour two kinds of Phyllobothriid cysts—those belonging to *P. delphini* and to *Monorygma grimaldii*. The adult stage of each must occur in an elasmobranch, probably one of the larger sharks such as the widely distributed white pointer (*Carcharodon carcharias* L.) and tiger shark (*Galeocerdo arcticus* Fab.), or perhaps the Greenland shark, *Scymnus* or *Somniosus glacialis* and its southern representative, which is not as yet identified definitely.(1)

Linton (1922) described *Phyllobothrium tumidum* from *Carcharodon carcharias* and *Isurus dekayi* from Massachusetts waters. The form of the scolex and of the bothridia is essentially the same as that figured by us (compare Linton's fig. 15 and our fig. 14). He believed that cestode larvae found in squid and described by Leidy in 1887 as *Taenia loliginis*, and transferred in 1890 to *Tetrabothrium* or to *Phyllobothrium*, represented early stages of the parasite. He recorded finding this type of larva in cephalopods and various fish, and noted its very close resemblance to Beneden's figure of the scolex of *P. delphini* Ben., 1870, from the blubber of a porpoise. We regard *P. tumidum* Linton as the adult stage of *P. delphini* (Bosc) Beneden, the latter name having priority; and consider that *P. inchoatum* Leidy is also a synonym.

It may be pointed out that seals in the Antarctic and Subantarctic may contain large *Phyllobothrium* cysts (distinct from, but closely related to, *P. delphini*) in the blubber (Johnston, 1937, 21–24), while a species of *Monorygma*, *M. macquariae* Johnston (1937, 24–32), has been described from a southern *Somniosus* sp., the cestode later being considered (1937, 59) as identical with *M. magnum* (Hart, 1936) from the Greenland shark. Large sharks like the white and tiger sharks are known to prey on seals in the vicinity of Port Lincoln, South Australia, and could probably devour dolphins and small whales.

Blainville, in 1825, published a short account of a smooth cyst found at Havre, France, encysted in the blubber of *Delphinus dalei*, which Cobbold (1879, 421) stated was a synonym of *Micropteron sowerbiensis*, i.e. *Mesoplodon bidens*. The parasite was named *Monostomum delphini* by Diesing (1850, 390) and *M. blainvillei* by Cobbold in 1860. The latter (1879) referred to the possibility of the species occurring in *Hyperoodon* and *Lagenorhynchus*, and to the possibility of monostomes and cysticerci being confused. Brandes, in 1892, placed Diesing's

(1) Waite, E. R. Fishes. Austr. Antarct. Exp. Rep., Ser. C.3, 1916, 51.

species under *Monostomulum*. Price (1932, 57) republished Blainville's account, stated that the organism was not likely to be a larval monostome, and suggested that the worm was the metacercaria stage of *Alaria* or a related trematode genus, and accordingly transferred it to *Agamodistomum*. It seems to us that the species may have been a Phyllobothriid cysticercus, perhaps *P. delphini* (Bosc).

REFERENCES.

Baylis, H. A. (1916): On Crassicauda crassicauda (Crepl.) and its hosts. *A.M. N.H.* (8), 17, 144–48.

Baylis, H. A. (1919): A remarkable cysticercus from a rare dolphin. *A.M.N.H.* (9), 3, 417–24.

Baylis, H. A. (1920): On the Classification of the Ascaridae I, etc. *Parasitol.*, 12, 253–64.

Baylis, H. A. (1920): Observations on the Genus Crassicauda. *A.M.N.H.* (9), 5, 410–19.

Baylis, H. A. (1922): Note on the Habitat and Structure of Crassicauda. *Parasitol.*, 14, 9–12.

Baylis, H. A. (1926): Note on the Occurrence of "Cysticercus Taeniae grimaldii" in a New Host. *A.M.N.H.* (9), 18, 665–67.

Baylis, H. A. (1932): A List of the Worms Parasitic in Cetacea. *Discovery Reports*, 6, 393–418.

Bennett, F. D. (1837): On the Natural History of the Spermaceti Whale. P.Z.S., 1837, 39–42.

Cobbold, T. S. (1879): Parasites: A Treatise of the Entozoa of Man and Animals.

Creplin, F. C. (1829): Filariae et Monostomi speciam novam in Balaena rostrata repertam. *Verh. d. k. Leop. Carol. Ak. Naturf. (Bonn.)*, 14 (2), 871–82.

Diesing, K. M. (1850–1): Systema helminthum.

Diesing, K. M. (1864): Revision der Cephalocotyleen. Abt. Paramecocotyleen. *Sb. k. Ak. Wiss. Wien*, 48, 200–345.

Diesing, K. M. (1864): Revision der Cephalocotyleen. Abt. Cyclocotyleen. *Sb. k. Ak. Wiss. Wien*, 49, 357–430.

Gervais, H. (1870): Sur les entozoaires des dauphins. *C.R. Acad. Sci. Paris*, 71, 779.

Hamilton, J. E. (1916): [*Report on Belmullet Whaling Station.*] Brit. Assoc. Rep. (1915), 124–46.

Hoeppli, R. and Hsü, H. F. (1929): Helminthologische Beiträge aus Fukien und Chekiang. *Arch f. Schiffs. u. Tropen-Hyg.*, 33, *Beiheft* 1, 43 pp.

Johnston, T. H. (1937) : The Cestoda of the Australasian Antarctic Expedition. *Austr. Antarct. Exp. Sci. Rep.*, Ser. C, 10 (4), 74 pp.

Joyeux, C. and Baer, J. G. (1931) : Sur la présence du nématode Crassicauda crassicauda (Creplin, 1829) chez un dauphin des côtes de la France. *Bull. Soc. Path. exot.*, 24, 198–203.

Leidy, J. (1891) : Notices of entozoa. *Pr. Acad. Nat. Sci. Philad.* (3), 20, 410–18.

Leiper, R. T. and Atkinson, E. L. (1914) : Helminthes of the British Antarctic Expedition, 1910–1913. P.Z.S., 1914, 222–26.

Leiper, R. T. and Atkinson, E. L. (1915) : Parasitic Worms. *Brit. Antarct. (Terra Nova) Exp. Nat. Hist. Rep. Zool.*, 2 (3), 19–60.

Linton, E. (1905) : Notes on Cestode Cysts, Taenia chamissonii, New Species from a Porpoise. *Pr. U.S. Nat. Mus.*, 28, 819–822.

Linton, E. (1922) : A New Cestode from the Man-eater and Mackerel Sharks. *Pr. U.S. Nat. Mus.*, 61 (12), 1–16.

Meggitt, F. J. (1924) : The Cestodes of Mammals. London.

Moniez, R. (1889) : Sur la larve du Taenia grimaldii, nov. sp., parasite du dauphin. *C. R. Acad. Sci., Paris*, 109, 825.

Price, E. W. (1932) : The Trematode Parasites of Marine Mammals. *Pr. U.S. Nat. Mus.*, 81 (13), 68 pp.

Rudolphi, C. A. (1810) : Entozoorum sive vermium intestinalium historia naturalis. Amsterdam.

Rudolphi, C. A. (1819) : Entozoorum Synopsis. Berlin.

Skrjabin, K. I. and Andreewa, N. K. (1934) : Un nouveaux nématode, Crassicauda giliakiana n. sp., trouvé dans reins de Delphinoptera leucos. *Ann. Parasitol.*, 12, 15–28.

Southwell, T. (1925) : A monograph of the Tetraphyllidea, with Notes on the Related Cestodes. *Mem. Liverpool Sch. Trop. Med.*, 2, 368 pp.

Spaul, E. A. (1926) : Crassicauda bennetti, sp. n., a New Nematode Parasite from the Bottle-nosed Whale (Hyperoodon). *A.M.N.H.* (9), 17, 581–85.

Stiles, C. W. and Hassall, A. (1899) : Internal Parasites of the Fur Seal. Rep. Fur Seal Investigations. *Washington, D.C.*, 3, 99–177.

Yorke, W. and Maplestone, P. A. (1926) : The Nematode Parasites of Vertebrates.

STUDIES IN AUSTRALIAN GAMMARIDEA

(1) THE GENUS CERADOCUS

BY KEITH SHEARD, HONORARY ASSISTANT IN ZOOLOGY,
SOUTH AUSTRALIAN MUSEUM

Summary

This revision has been made possible by grants from the Trustees of the Science and Industries Endowment Fund of the Council for Scientific and Industrial Research and from the Board of Governors of the Public Library, Museum and Art Gallery of South Australia.
Acknowledgements are also due to the Council of the Canterbury University College, New Zealand, for the loan of the whole of the extensive Chilton collection of Amphipoda ; to the Trustees of the Australian Museum, Sydney, for the loan of their collection, including many of Haswell's type specimens; to the University of Sydney for the loan of the Macleay collection; to the Trustees of the National Museum, Melbourne, for the loan of the Sayce collection; and to Mr. H. M. Hale, Director of the South Australian Museum, whose extensive collections from South Australian waters provide a basis for these studies.

STUDIES IN AUSTRALIAN GAMMARIDEA

(I) THE GENUS CERADOCUS

BY KEITH SHEARD, HONORARY ASSISTANT IN ZOOLOGY, SOUTH AUSTRALIAN MUSEUM.

Text-fig. 1–8.

THIS revision has been made possible by grants from the Trustees of the Science and Industries Endowment Fund of the Council for Scientific and Industrial Research and from the Board of Governors of the Public Library, Museum and Art Gallery of South Australia.

Acknowledgments are also due to the Council of the Canterbury University College, New Zealand, for the loan of the whole of the extensive Chilton collection of Amphipoda; to the Trustees of the Australian Museum, Sydney, for the loan of their collection, including many of Haswell's type specimens; to the University of Sydney for the loan of the Macleay collection; to the Trustees of the National Museum, Melbourne, for the loan of the Sayce collection; and to Mr. H. M. Hale, Director of the South Australian Museum, whose extensive collections from South Australian waters provide a basis for these studies.

This paper is the first of a series redescribing early Australian type Gammaridea, together with related forms collected later. Keys to the species and genera dealt with will be given where possible, but it cannot be sufficiently stressed that these do not necessarily express relationships, but are designed to permit workers to effect a preliminary sorting-out of material.

The *Ceradocus* group of genera appears to consist of the following, which may be separated by the key given below:

Metaceradocus (Chevreux 1925, p. 304); *Ceradocoides* (Nicholls 1938, p. 123); *Paraceradocus* (Stebbing 1899, p. 426); *Ceradocopis* (Schellenberg 1926, p. 365); *Ceradocus* (A. Costa 1853, p. 170); *Quadrivisio* (Stebbing 1907, p. 160) (= *Pseudoceradocus* Shoemaker 1933, p. 11); *Bathyceradocus* (Pirlot 1934, p. 223).

CERADOCUS Group.

Gammaridae with the following characters (adapted from Stebbing 1906, p. 364).

Pleon segments 4–6 not coalesced; pleopods with two rami; uropod 3 with two elongate rami; telson cleft; antenna 1, accessory flagellum of more than 2 segments; body not at all or scarcely carinate, without groups of dorsal spinules; uropod 3 rami not very unequal.

a. Maxilla 1, inner plate setose at apex; maxilla 2, inner plate setose along inner margin.
  b. Antenna 1, shorter than antenna 2 .. .. .. *Metaceradocus*
  (*M. perdentatus* Chevreux. Senegal.)
  bb. Antenna 1, longer than antenna 2.
    c. Peraeopods 3–5 with bases linear .. .. .. *Ceradocoides*
    (*C. chiltoni* Nicholls, Commonwealth Bay, Macquarie Island.)
    cc. Peraeopods 3–5 with bases expanded .. .. *Paraceradocus*
    (*P. miersi* (Pfeiffer); South Georgia; ? *P. micramphopus* Stebbing, East Australia.)

aa. Maxilla 1 and 2, inner plate setose along inner margin.
  d. Uropod 3, outer ramus 2 segmented; lower lip without inner lobes .. .. *Ceradocopsis*
  (*C. kergueleni* Schellenberg, Kerguelen.)
  dd. Uropod 3, outer ramus normal, lower lip with inner plates.
    e. Side plate, gnathopod 1 produced forwards to an acute angle.
      f. Pleon segments postero-dorsally multidentate (*Denticeradocus*). *Ceradocus*
      C. (*D.*) *rubromaculatus* (Stimpson), *C.* (*D.*) *ramsayi* (Haswell), *C.* (*D.*) *serrata* (Spence Bate), *C.* (*D.*) *sellickensis*, *C.* (*D.*) *barrierensis* (Australian seas); *C.* (*D.*) *chiltoni* (New Zealand); *C.* (*D.*) *chevreuxi* (Pacific), *C.* (*D.*) *barnardi* (South Africa).
      ff. Pleon segments not postero-dorsally multidentate. *Ceradocus* (*Ceradocus*).
      C. (*C.*) *orchestiipes* A. Costa (Mediterranean, Bermudas); *C.* (*C.*) *semiserratus* (Bate) (North Atlantic); *C.* (*C.*) *torelli* (Goës) (Arctic Ocean); *C.* (*C.*) *parkeri* and *C.* (*C.*) *colei* Kunkel (Bermudas).
      C. (*C.*) *baffini* Stephenson (off Baffin Land) should probably be referred to at least a sub-genus.
    ee. Side plate, gnathopod 1, rounded.
      g. Mandible, palp, segment III longer than segment II. *Quadrivisio*. *Q. bengalensis* Stebbing (Pt. Canning, Bengal; brackish water, Zanzibar). *Q. lutzi* (Shoemaker) (British Guiana, West Indies).
      gg. Mandible, palp, segment III shorter than segment II. *Bathyceradocus*. *B. stephenseni* Pirlot (East Indies).

The group as a whole may be readily separated from the *Maera-Elasmopus* group by the setose character of the inner plates of maxillae 1 and 2. In this connection, the falcate segment III of the mandibular palp of *Metaceradocus* and the linear segment III of *Ceradocopsis* are of interest. Through the kindness of Professor G. E. Nicholls I am able to figure (Fig. 5, N–O) the mandible of *Ceradocoides chiltoni* Nicholls, which shows, in my opinion, the partial development of a process on segment I of the palp distally.

CERADOCUS A. Costa.

(For references see Stebbing 1906, p. 430, and 1910, p. 598.)

The examination of series of specimens related to *Ceradocus rubromaculatus* (Stimps.) makes it necessary to divide the genus into two sections, as follows:

(a) *Ceradocus* (*Ceradocus*): *Ceradocus* as defined by Stebbing (1906, p. 430), with the addition of: pleon segments with postero-dorsal margins not multidenticulate. Genotype *Ceradocus* (*Ceradocus*) *orchestiipes* A. Costa.

(b) *Ceradocus* (*Denticeradocus*) sub-gen. nov.: *Ceradocus* as defined by Stebbing (1906, p. 430), with the addition of: maxilla 1, outer plate with 9 spine-teeth, palp with 13 spines; pleon segments with postero-dorsal margins multidenticulate; mandible with segment I of palp always produced on inner margin distally.

It may be noted that in Stebbing's definition cited above, he states that gnathopod 2, among other appendages, are as in *Maera*, i.e. gnathopod 2 usually much the larger in the male. This is not strictly true for the subgenus *Denticeradocus*, as here gnathopod 2 is usually of a comparative size in the two sexes, with that of the female occasionally attaining the larger relative size in aged specimens.

KEY TO THE SPECIES OF CERADOCUS (DENTICERADOCUS).

a. Pleon segments 4 and 5 with a large medio dorsal tooth.
  b. Telson; each half with 3 apical spines; 1 lateral hair.
    C. (*D.*) *capensis*.
  bb. Telson; each half with 5 apical spines; 1 lateral hair.
    C. (*D.*) *ramsayi* (Haswell).
aa. Pleon segments 4 and 5; evenly dentate.
  c. Telson; each half with 2 apical spines, 1 lateral hair.
    C. (*D.*) *rubromaculatus* (Stimpson).
  cc. Telson; each half with 4 apical spines.
    d. One lateral hair on margin of telson.
      e. Mandible; palp, segment III about 2/3 segment I; pleon side plates 1 and 2 well toothed above and below.
        C. (*D.*) *sellickensis* sp. nov.

cc. Mandible; palp, segment III sub-equal to segment I;
pleon side plates 1 and 2 barely serrate.
plates 1 and 2 barely serrate.
C. (*D.*) *serrata* (Bate).
dd. Two lateral hairs on margin of telson.
C. (*D.*) *chilton*, sp. nov.
ccc. Telson, each half with 5 apical spines, 1 lateral hair.
C. (*D.*) *chevreuxi* sp. nov.

The species are fairly uniform as to their maximum recorded length, which is about 25 mm.

The specimen described by Miers (1884, p. 567, pl. 52, D, d) from the Seychelle Islands under the name of *Macra diversimanus* is undoubtedly to be placed in this subgenus, and had best retain the name *Ceradocus* (*Denticeradocus*) *diversimanus* (Miers).

CERADOCUS (DENTICERADOCUS) SELLICKENSIS sp. nov.

Ceradocus rubromaculatus (nec Stimpson); Hale, 1927, p. 314; 1929, pp. 213–214 excluding figs. 210 = *C.* (*D.*) *ramsayi* (Haswell), 211 = *C.* (*D.*) *serrata* Bate); Sheard, 1936, p. 177, fig. 4.

Description. Body elongate, head nearly equal to first two segments combined, inter-antennal angle produced and rounded, separated from lateral angle by a sinus. Eyes small, sub-oval, dark.

Antenna 2 with peduncle failing to reach to the end of the peduncle of antenna 1; the whole antenna reaching just beyond this point; gland cone just fails to reach next joint, ultimate segment of peduncle 4/5 of penultimate.

Mouth parts; upper lip rounded, lower lip with small inner lobes; mandible, palp, segment I with pronounced hinge-like process on inner end, segment II long and setose on inner margin, segment III cone-shaped with long setae, about 2/3 segment I.

Maxilla 1; outer plate with 9 spine-teeth, palp with 13 spines, inner plate fringed with long hairs to base of inner margin; this plate appears to vary slightly from the shape figured to nearly the normal subquadrate.

Maxilla 2; fringed along inner margin of inner plate with two rows of setae.

Side plates; first a little the deepest with its anterior angle forwardly drawn out to a sharp point, lightly fringed with small hairs along the lower margin; second and third rounded; fourth not excavate behind; fifth, sixth, and seventh, small, bilobed.

Gnathopod 1; small, basis a little indented on the inner margin; carpus, ratio of length to width = 2 : 1; propodus, ratio of length to width = 1·7 : 1.

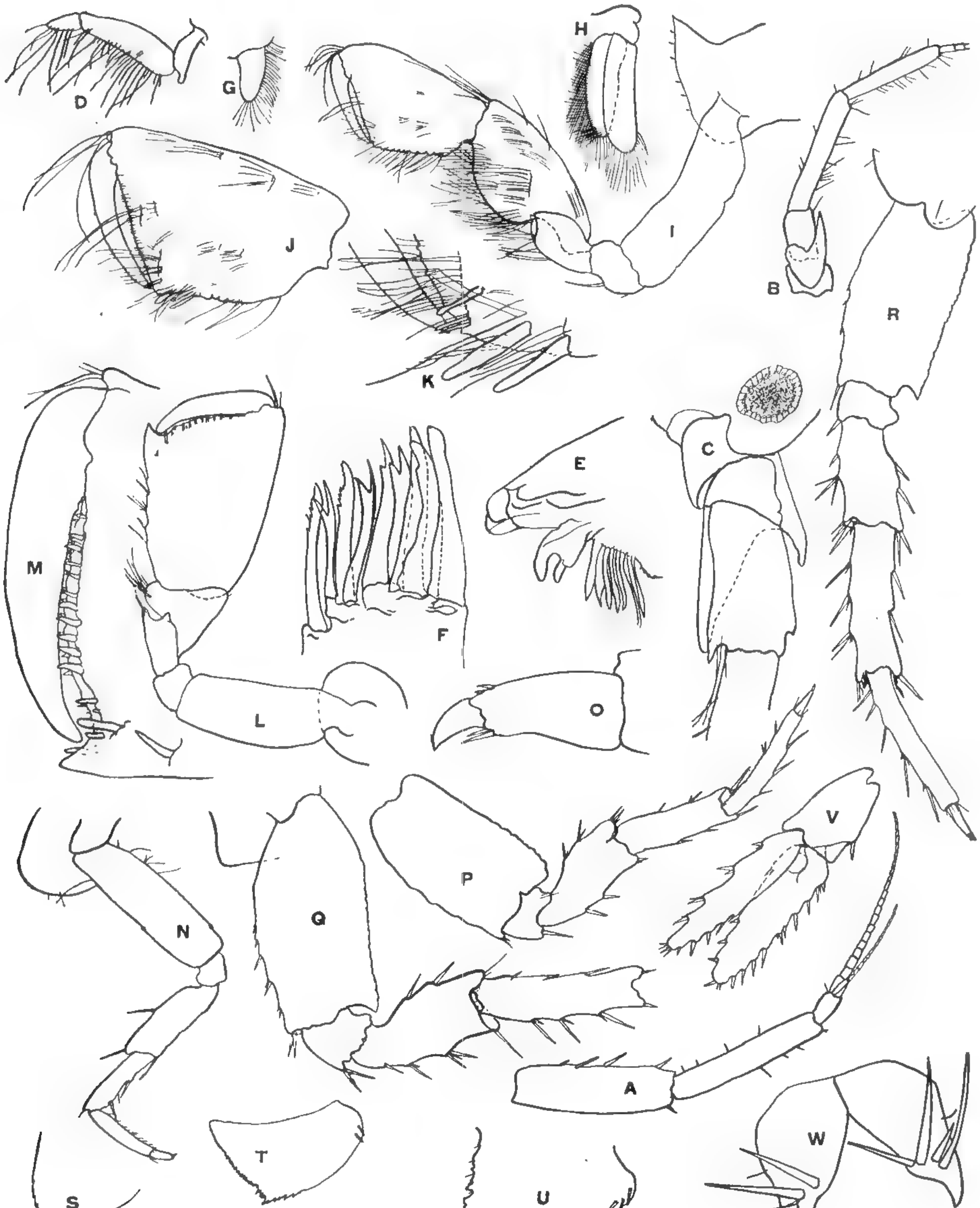


Fig. 1. *Ceradocus (Denticeradocus) sellickensis* (type ♂): A, antenna 1; B, antenna 2; C, eye lobe and basal joints antenna 2; D, mandible, palp; E, mandible, cutting edge; F, maxilla 1, spines of outer plate; G, maxilla 1, inner plate; H, maxilla 2; I, gnathopod 1; J, gnathopod 1, hand; K, gnathopod 1, defining angle palm; L, gnathopod 2; M, gnathopod 2, palm; N, peraeopod 1; O, peraeopod 1, dactyl; P–R, peraeopods 3–5; S–U, pleon side plates 1–3; V, uropod 3; W, telson. (K.S. *del.*)

Gnathopod 2; enlarged in both sexes, basis stout, propodus enlarged, palm transverse, defined by a tooth-like process (which is occasionally much enlarged) not toothed, but in older specimens occasionally becoming rugose, no differentiation between the sexes.

Peracopods 1 and 2; slender, shorter than remainder, basis the stoutest, not indentated along inner margin but with several small groups of hairs.

Peracopods 3–5; basis expanded and lightly serrate; the hinder margins produced to a simple, acute angle in peracopods 4 and 5.

Peracon smooth on dorsal surface, pleon serrate along the postero-dorsal margins of the segments, pleon side plates 1 to 3 serrate above and below. Uropods 1 and 2 reach just beyond the peduncle of uropod 3; rami subequal, slender, the dorsal margins of these pleon segments serrate.

Uropod 3; peduncle short, rami lanceolate and elongate but irregular in outline, spinulose and truncate at the tips.

Telson; cleft, with divergent lobes, each lobe bearing 3 large and one small apical spine, with a small hair midway on each lateral margin. Branchiae; medium size, sac-like, inner wall thick.

Type (Reg. No. C. 2121, S.A. Museum).

Loc. Vivonne Bay, Kangaroo Island (H. M. Hale and N. B. Tindale); Sellick's Beach, St. Vincent Gulf (H. M. Hale, Mar., 1936), (H. M. Hale and K. Sheard, Nov., 1936, Jan., 1937), K. Sheard (Apr., 1939), Port Willunga, St. Vincent Gulf (H. M. Hale, Mar., 1937), (H. M. Hale and K. Sheard, Jan., 1939); Marino, St. Vincent Gulf (C. Baker, 1910); Weeding's Reef, Moonta Bay, Spencer Gulf (B. J. Weeding, Nov., 1938); Investigator Straits (Dr. J. C. Verco, 1910); Coffin Bay (J. T. Mortlock, 1938).

CERADOCUS (DENTICERADOCUS) RUBROMACULATUS (Stimp.).

Gammarus rubromaculatus Stimpson, 1855, p. 394.

Moera rubromaculata (Stimpson) Haswell, 1880, p. 267, pl. X, fig. 4, 1882, p. 225; 1885, p. 105, pl. XV, figs. 5–12.

Ceradocus rubromaculatus (Stimpson), Della Valle, 1893, p. 720 (part).

Ceradocus rubromaculatus (Stimpson), Stebbing, 1906, p. 430 (part); ? 1910, p. 598.

? *Ceradocus rubromaculatus* (Stimpson) Barnard, 1931, p. 124.

Stimpson's original description is as follows:

"49. *Gammarus rubromaculatus.* Rather large, spotted with crimson above, white below. Eyes sub-ovate. Superior antennae half as long as the body, inferior ones much shorter and more slender. First pair of hands very small and weak; those of the second pair large, compressed, and with a sharp spine at the middle of the lower edge where the finger terminates. Abdomen exceeding the thorax in length or at least equalling it, the appendages excluded. Last pair of caudal stylets half as long as the abdomen; their rami long and broad, equal and spinulated along their edges. Length half an inch. Found on muddy bottom in the circum-littoral zone.

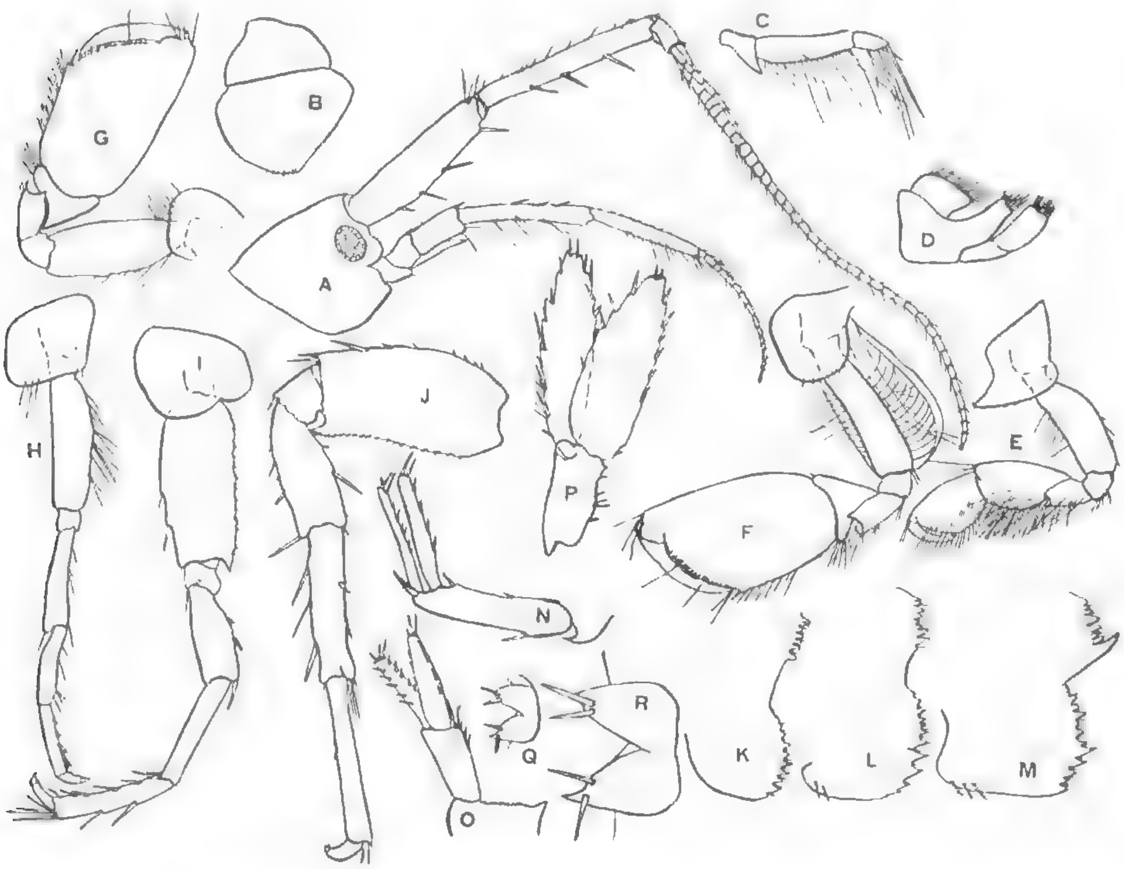


Fig. 2. *Ceradocus* (*Denticeradocus*) *rubromaculatus* (Stimpson); (Haswell's original specimen) (♀); A, head and antennae; B, upper lip; C, mandible, palp; D, maxilla 1; E, gnathopod 1; F–G, gnathopod 2; H, peraeopod 1; I, peraeopod 3; J, peraeopod 5; K–M, pleon side-plates 1–3; N–P, uropods 1–3; Q–R, telson. (K.S. *del.*)

"*Hab.* Australia, at Port Jackson."

Haswell (1880, p. 267, pl. X, fig. 4), describes and figures with reasonable accuracy a specimen which he attributes to Stimpson's species from the same locality. In the same paper (p. 268, pl. X, fig. 5) he describes a new species *Moera spinosa*, from Tasmania, evidently having overlooked Bate's *Megamoera serrata* from the same locality.

Earlier in the same paper (p. 264) he ascribes provisionally to *Mělita*, a new species (*M* (?) *ramsayi*) with uropod 3 missing. In a later note (p. 335) this species is placed in *Moera*. Haswell (1885, p. 105) then unites the three species and includes *Moera festiva* Chilton in the synonomy. This amalgamation is made on the form of gnathopod 2. Stebbing (1906, p. 430) follows the usage then current, but later (1910, p. 643) regards the position as still doubtful. Chilton (1916, p. 359) separates *M. festiva* Chilton from this synonomy.

The confusion was probably caused, in the first place, by the fact that Stebbing (1888, p. 1008, plates 95, 96) gave a composite description, under the name *M. rubromaculatus* Stimpson, of two species, *M. ramsayi* Haswell, and the one which is described in this paper as *Ceradocus* (*Denticeradocus*) *capensis*. Later authors, lacking material, have had no option but to ascribe specimens to this species, and the tradition has grown up that *Ceradocus rubromaculatus* (Stimp.) is a cosmopolitan species. Were the forms pelagic, this possibility would of course have to be very seriously regarded, but as they are littoral, such an easy way out cannot be taken without very serious consideration.

For my part, after studying Haswell's MS. notes, I am reasonably certain that he described a specimen which specifically conforms to Stimpson's type. Haswell's specimen is here refigured, and such parts as are necessary are redescribed. In the Port Jackson material, it is easy to find specimens, male and female, immature and adult, which vary around the type specimen, and which do not cross over into the *ramsayi* form.

Actually it would appear that here we have a case of two closely-related populations existing side by side. There is some evidence to show that their breeding rates and breeding seasons are slightly different, but this is inconclusive. At all events, in life, they are readily distinguished since *C.* (*D.*) *rubromaculatus* (Stimp.) is spotted with crimson, while *C.* (*D.*) *ramsayi* (Haswell) is banded. In littoral crustacea generally, colour patterns appear to be an unreliable guide, but in this case there is a high degree of correlation between the colour and other characters.

Additions to Haswell's Description (1880, p. 267):

Mouth parts; in general like *C.* (*D.*) *sellickensis*, but mandibular palp with segments I and III subequal; maxilla 1 with inner plate more truly subquadrate, wider than deep.

Gnathopod 1 with side plate produced; basis with scattered hairs on both margins; carpus, ratio length to width $= 2:1$; propodus, ratio length to width $= 1 \cdot 6 : 1$.

Gnathopod 2; like *C.* (*D.*) *sellickensis* but palm more oblique; as in the former species no specimens have been found with a tendency to the development of teeth on the palm.

Peraeopods 1 and 2; basis indented and setose along inner margin, merus very little expanded, almost linear.

Peraeopods 3–5; basis moderately expanded, hinder edge produced to longer point than in the preceding species.

Pleon side plates 1–3 well toothed above and below; 4 and 5 regularly dentate. no large teeth.

Uropods 1 and 2 reaching to end of peduncle of 3; uropod 3 with rami lanceolate and elongate but strong and wide. Telson with two apical spines and one short lateral hair on each half.

Branchiae of medium size, sac-like.

Loc. Port Jackson (Australian Museum, Reg. Nos. G. 5391, P. 2151, P. 3479, P. 3480–3481 (part), P. 3489).

CERADOCUS (DENTICERADOCUS) RAMSAYI (Haswell).

Melita ? ramsayi Haswell, 1880, p. 264, pl. X, fig. 1.

Moera ramsayi (Haswell), 1880, p. 334; 1882, p. 253.

Moera rubromaculatus (Stimps.) Haswell, 1885, p. 105, pl. XV, figs. 5–12 (part).

Maera rubromaculata (Stimpson) Stebbing, 1888, p. 1008 (part), pl. XCV A, pl. XCVI B.

Ceradocus rubromaculatus (Stimpson) Della Valle, 1893, p. 720 (part).

Ceradocus rubromaculatus (Stimpson) Stebbing, 1906, p. 431 (part).

Maera ramsayi Haswell, Stebbing, 1910, p. 642.

Ceradocus rubromaculatus var. *ramsayi* (Haswell), Chilton, 1923, p. 94, fig. 4.

Ceradocus rubromaculatus non. Stimpson, Hale, 1929, fig. 210.

Ceradocus rubromaculatus (Stimpson), Sheard, 1937, p. 24 (part).

To Haswell's description (1880, p. 264) is added the following:

Antenna 1; peduncle relatively stout, a little shorter than that of antenna 2. Eye sub-oval. Mouth parts; of same general type as in *C.* (*D.*) *sellickensis*, but mandible or palp with segment II longer than segment I, hinge process rounded.

Maxilla 1 with spines of palp and outer plate weak, inner plate like that of *C.* (*D.*) *rubromaculatus* (Stimpson); maxilla 2 with setae very long, plates widened. Lower lip setose.

Gnathopod 1 with side plate forwardly pointed, but not very much outdrawn; basis, with margins not indented; carpus, ratio of length to width, 2 : 1; propodus, ratio of length to breadth, 1·5 : 1.

Gnathopod 2; one side, the right in the specimen described, but generally the left, enlarged, with the propodus well expanded, and always toothed on the palm

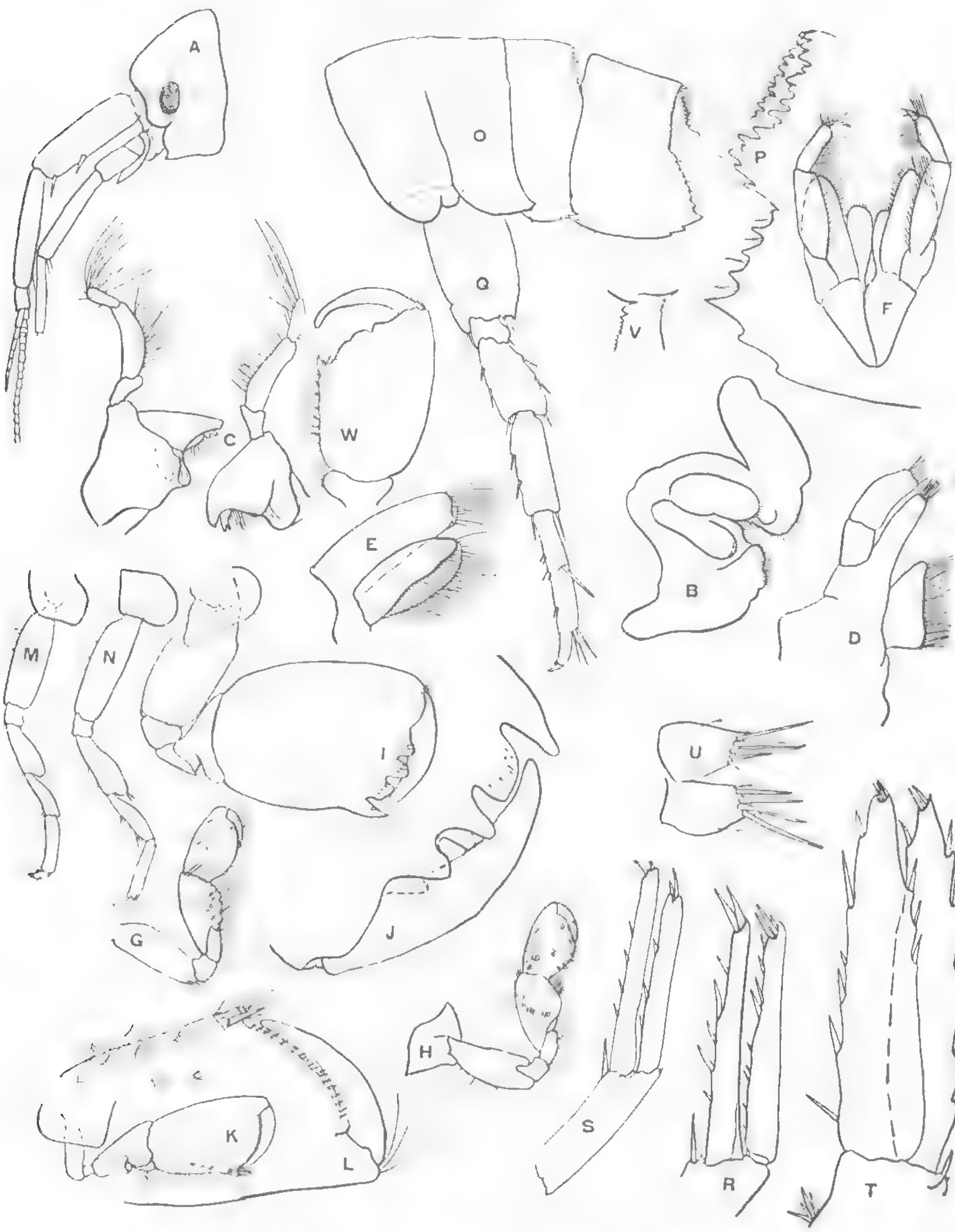


Fig. 3. *Ceradocus (Denticeradocus) ramsayi* (Haswell), (type ♂): A, head; B, lower lip; C, mandibles; D, maxilla 1; E, maxilla 2; F, maxilliped; G–H, gnathopod 1; I, gnathopod 2, right; J, gnathopod 2 right, palm; K, gnathopod 2, left; L, gnathopod 2, palm; M–N, peraeopods 1–2; O, peraeon segment 7, pleon segments 1–3; Q, peraeopod 5; R–T, uropods 1–3; U, telson; V, dorsal outline, pleon segments 4–5; W, gnathopod 2, hand, Port Stephens specimen, immature ♂. (K.S. *del.*)

in older specimens; sometimes in even immature specimens, the toothing may be solid across the palm or sometimes indented by the pressure of the finger (as figured); where teeth are present they are always three in number between the large defining tooth and the hinge.

Peraeopods 1 and 2 slender, as is usual, the basis not indented but furnished with a few setae on the inner margin; the merus is moderately expanded on its forward edge; 3–5, basis expanded, hind margin distally produced to an obtuse angle.

Pleon side plates; the first, with two very small teeth below, none above; the second with two slightly larger teeth below, slightly serrate above; and the third with two larger teeth below, more definitely serrate above. In this respect, the species is very different from *C.* (*D.*) *rubromaculatus* (Stimp.) (well serrate above and below on pleon side plates 1–3) and from *C.* (*D.*) *capensis* (side plate 2 smooth above, side plate 3 well serrate above and below). Pleon segment 4 dorsally denticulate, the mesial tooth well produced; 5 smooth, but with a prominent mesial tooth; 6 produced mesially to a small tooth.

Uropods 1 and 2 reaching just to the end of the peduncle of 3, slender. Uropod 3 with rami lanceolate and elongate, fairly strong.

Telson with four long and one short spine apically, and one short plumose hair on the mid-lateral margin of each half.

Loc. Port Jackson (W. A. Haswell); off Eden, N.S.W., 25–30 fathoms (A. Livingstone, Apr., 1922); off Norah Head, Newcastle, N.S.W., 26–38 fathoms (F. A. McNeill, June, 1921) (Chilton collection); Port Stephens; Balmoral, Port Jackson (T. Whitelegge) (Australian Museum, Reg. Nos. P. 5876, P. 3480–3481 part).

CERADOCUS (DENTICERADOCUS) SERRATA (Bate).

Megamacra serrata Bate, 1862, p. 226, pl. XXXIX, fig. 5.

Moera spinosa Haswell, 1880, p. 268, pl. X, fig. 5; 1882, p. 257; 1885, p. 105, figs. 5–12 (part).

Ceradocus rubromaculatus (Stimpson) Della Valle, 1893, p. 720 (part).

Ceradocus rubromaculatus (Stimpson) Stebbing, 1906, p. 431 (part).

Maera spinosa Haswell, Stebbing, 1910, p. 642.

Ceradocus rubromaculatus non Stimpson, Chilton, 1921, p. 71, fig. 9.

Ceradocus rubromaculatus non Stimpson, Hale, 1929, fig. 211.

It appears reasonably certain that the species described by Haswell and Bate are the same. The figures given by both authors are poor, but coupled with the descriptions, they are sufficient to justify the union. An examination of a number

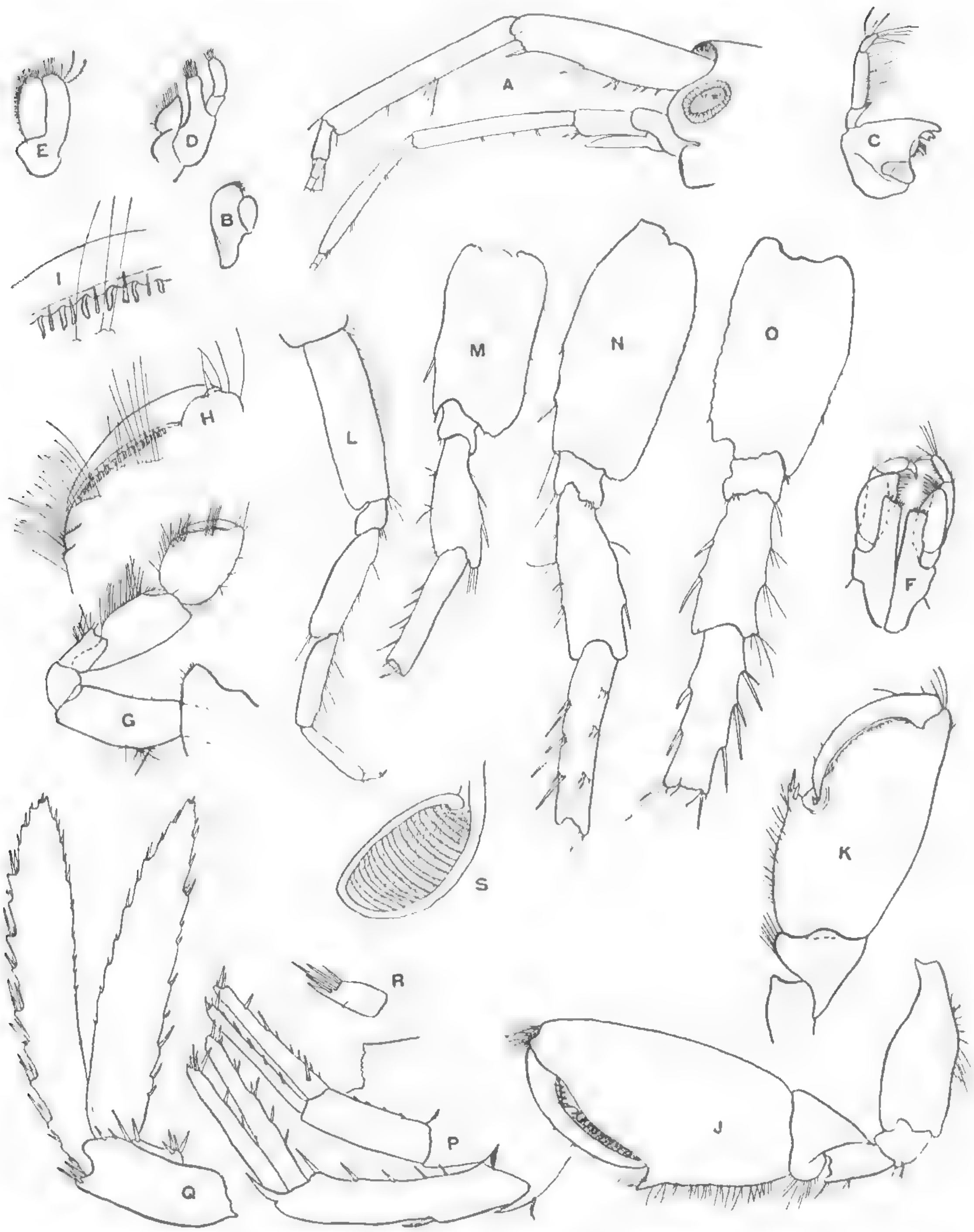


Fig. 4. *Ceradocus (Denticeradocus) serrata* (Bate); (Haswell's original specimen ♀) A, head; B, lower lip, half; C, mandible; D–E, maxillae 1–2; F, maxilliped; G, gnathopod 1; H, gnathopod 1, palm; I, gnathopod 1, detail of palm; J–K, gnathopod 2, right and left; L, peraeopod 1; M–O, peraeopods 3–5; P, uropods 1–2; Q, uropod 3; R, telson; S, branchia. (K.S. *del.*)

of specimens from Tasmanian localities gives no reason to suppose that there are two species occupying that area, although on the Victorian coast specimens occur which exhibit slight variations not sufficiently marked, however, to justify any separation. Additions to Bate's (1862, p. 226) and Haswell's (1880, p. 268) descriptions are:

The peduncle of antenna 2 just reaches to the end of that of antenna 1, the whole antenna reaches well beyond this point; gland cone reaching to end of next segment.

Mouth parts as usual, but mandibular palp with segment III sub-equal to segment I, hinge process pronounced.

Maxilla 2 with two plumose setae on the outer edge of the outer plate distally.

Gnathopod 1 with side plate moderately produced and pointed forwards, basis moderately expanded, setose behind, carpus longer than propodus, carpus ratio length to width = 2·3 : 1; propodus ratio length to width = 1·4 : 1, the palm ridged in the female as figured.

Gnathopod 2; both enlarged, with one as a rule slightly larger in both sexes, hand swollen and in very old specimens irregular in outline; palm oblique, in young specimens with a clean outline, later becoming more rugose and sometimes becoming split to form near the hinge a large flat tooth, followed by a depression, then a long, rounded rugose bulge. The finger fits into a deep pocket near the defining tooth, which is occasionally worn nearly flat.

In specimens from Westernport, Victoria, the two-toothed form, similar to that found in *C. (D.) chiltoni*, occasionally appears.

Peracopods 1 and 2 with basis very lightly indented near the body, a row of hairs along the hinder margin; 3–5 with basis expanded and sometimes produced to a small angle distally on the hinder edge; however, this is a very variable character, and I can find no correlation between this factor and others. The best that can be said is that generally there is a tendency for the basal expansion to be produced to a pointed angle in peraeopods 4 and 5, particularly in the male.

Pleon side plate 1 lightly crenulate behind, a nearly obsolete tooth present above and below; 2 lightly toothed above, two very small teeth below; 3 moderately toothed above, two teeth below; 4 and 5 denticulated strongly but evenly.

Uropods 1 and 2 fairly strong, reaching just beyond the peduncle of 3; uropod 3 with rami lanceolate, strong, and elongate.

Telson with four spines, one usually small, and one lateral hair on each half. Branchiae very large, inner wall very thin.

Loc. Tasmania (Haswell's original specimens); 10 miles north of Circular Head, Tasmania, Endeavour 492; Port Wynyard, Tasmania (N. B. Tindale, Apr., 1936); Altona, Port Phillip, Victoria (M. Freame, Jan., 1933), "colour uniformly bright scarlet" (Aust. Mus. Reg. No. P. 10398); Port Phillip (O. A. Sayce); West Channel, Victoria (O. A. Sayce); Shoreham, Victoria (O. A. Sayce).

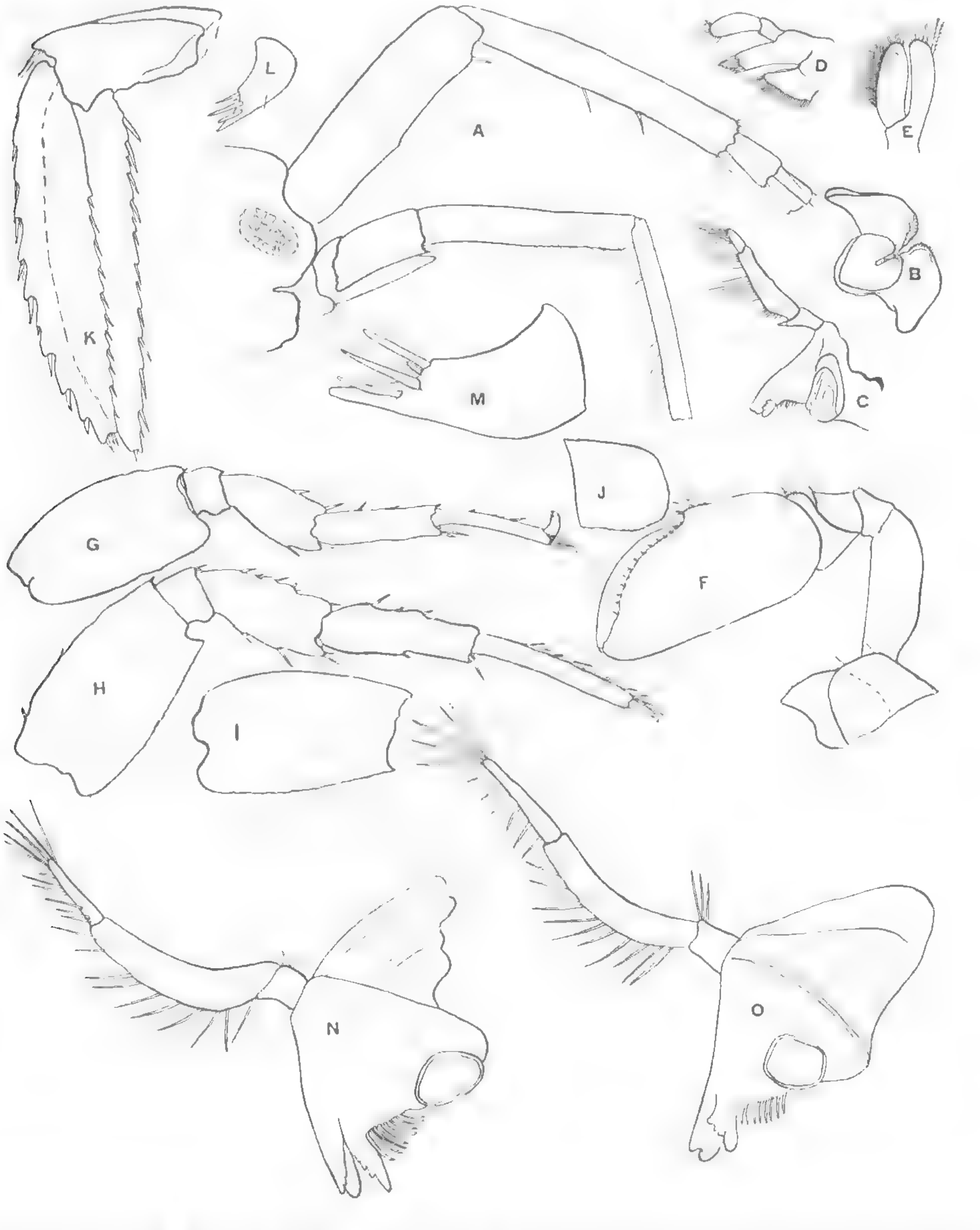


Fig. 5. A–M, *Ceradocus (Denticeradocus) serrata* (Bate); (Haswell's original specimen ♂): A, head; B, lower lip; C, mandible; D–E, maxilla 1–2; F, gnathopod 2; G–I, peraeopods 3–5; J, pleon side plate 1; K, uropod 3; L–M, telson. (K.S. *del.*) N–O, *Ceradocoides chiltoni* Nicholls; N–M, two views of left mandible.

CERADOCUS (DENTICERADOCUS) CHILTONI sp. nov.

Maera spinosa Chilton non Haswell, Chilton, 1883, p. 81, t 2, f 3; 1916, p. 369.

Very like *C.* (*D.*) *serrata* (Bate), but with the following differences:

Antenna 2; peduncle fails to reach the end of the peduncle of antenna 1. Maxilla 2 without plumose setae.

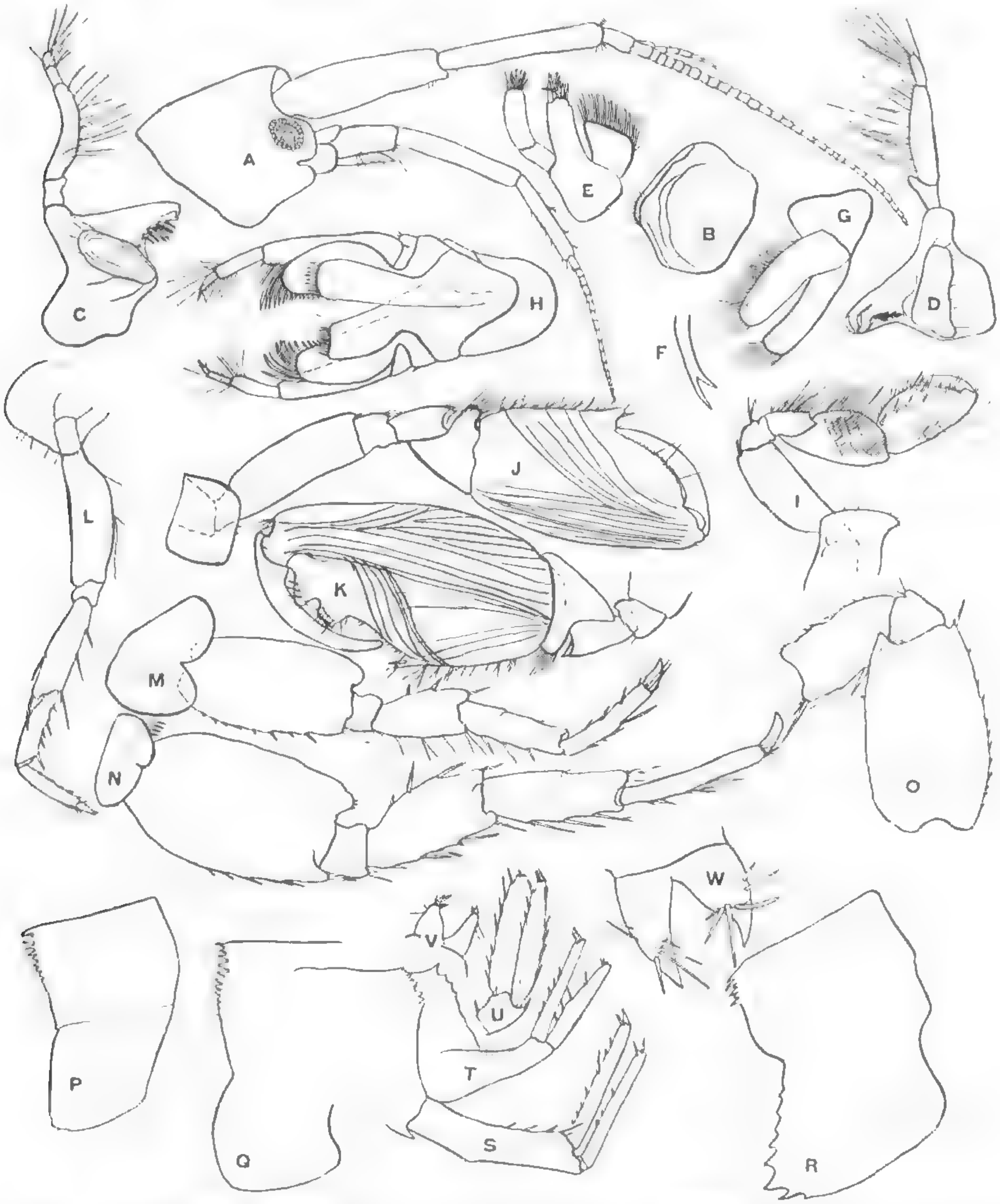


Fig. 6. *Ceradocus* (*Denticeradocus*) *chiltoni* (Chilton's original specimen ♀): A, head; B, upper lip; C–D, left and right mandibles; E, maxilla 1; F, spine-tooth from outer plate; G, maxilla 2; H, maxilliped; I, gnathopod 1; J–K, gnathopod 2, left and right; L, peraeopod 1; M–O, peraeopods 3–5; P–R, pleon sideplates 1–3; S–U, uropods 1–3; V–W, telson. (K.S. *del.*)

Gnathopod 1; carpus sub-equal to propodus, ratio length to width =1·9:1; propodus ratio length to width =1·9:1.

Pleon side plate 1 with margin a little uneven above, two small teeth below; 2 with margin smooth above, two small teeth below; 3 well toothed above, two teeth below; 4 and 5 evenly but lightly denticulate.

Uropods 1 and 2 not as strong as in *C.* (*D.*) *serrata* (Bate), but reach well beyond the peduncle of 3, to halfway up the rami; 3 with rami slender, lanceolate but not elongate.

Telson with 4 spines set fairly well back (see figure), and with two lateral spine-like hairs on each half. Branchiae very large, sac-like, with a thick inner wall.

In this species gnathopod 2 is subject to considerable variation (see figures) in both males and females. The tendency, however, is always towards the development of two flat-topped palm teeth, an oblique palm, and a well-developed defining tooth. Generally the left gnathopod is more strongly developed.

Locality. Auckland; Akaroa, New Zealand. Chilton collection.

A single specimen which is attributed to this species from Great Barrier Island, New Zealand, is figured.

The most noteworthy point is the fact that uropod 3 is elongate and strong, although 1 and 2 reach well beyond its peduncle.

CERADOCUS (DENTICERADOCUS) CHEVREUXI sp. nov.

Ceradocus rubromaculatus Chevreux non Stimpson, Chevreux, 1908, p. 479, fig. 6.

? *Ceradocus rubromaculatus* non Stimpson Schellenberg, 1938, p. 63.

This species is clearly marked off from the others of its section by the possession of five spines on the apex of each half of the telson. The ciliations of the inner margin of the telson lobes, the downward production of the posterior margin of the basis of peraeopod 5, and the reduction of teeth, dorsal edge of the pleon segments, are of interest.

The fact that, in these specimens, the dorsal edge of the pleon segments is somewhat crenulate, suggests the retention of *Denticeradocus* as a sub-genus only.

Loc. Archipelagoes of Gambier and Tuamotu (Dr. Seurat, 1904); ? Fiji, Marshall Islands, British Solomon Islands, Philippines (Dr. Sixten Bock).

CERADOCUS (DENTICERADOCUS) CAPENSIS sp. nov.

Maera rubromaculatus Stebbing non Stimpson; Stebbing 1888, p. 1008 (part), pl. XCV (E).

Ceradocus rubromaculatus Stebbing non Stimpson, 1908, p. 81; 1910 A, p. 456.

? *Ceradocus rubromaculatus* Schellenberg non Stimpson, Schellenberg, 1925, p. 154.

This species may be separated from *C. (D.) ramsayi* (Haswell) the only other species possessing a large mesio-dorsal tooth on the margins of pleon segments 4 and 5, by the possession of only three spines on the apex of each lobe of the telson. However, from Stebbing's figures (1888, pl. XCV) other good differences are:

The eye in *C. (D.) ramsayi* (Haswell) small and sub-oval, in *C. (D.) capensis* large, egg-shaped, filling most of the interantennal angle.

Peracopods 1 and 2 with the basis strongly indented on the inner margin and strongly setose. Pleon side plate 3 with four teeth below. Uropods 1 and 2 with relatively shorter and stouter peduncles.

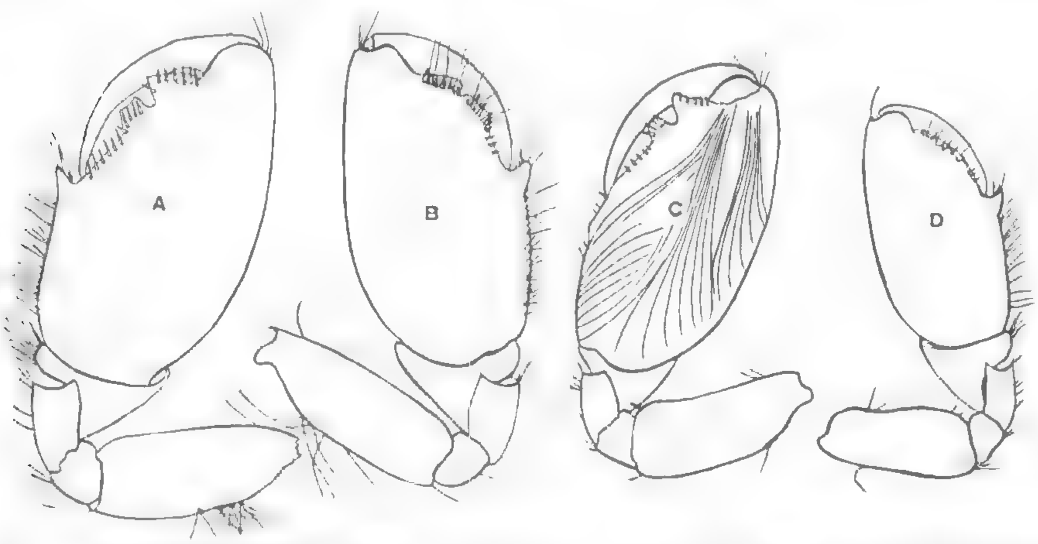


Fig. 7. *Ceradocus (Denticeradocus) chiltoni*; variation in gnathopod 2: A–B, gnathopod 2, left and right, aged ♀; C–D, gnathopod 2, left and right, aged ♂. (K.S. *del.*)

Re-examination of the South African specimens is needed.

Loc. Off Cape Agulhas, 274 metres, Table Bay; ? German West Africa, ? Swakopmund.

The following records cannot be evaluated from the literature. A recheck from the specimens is necessary.

Maera rubromaculatus Stimpson. Miers (1884, pp. 315–316; Port Molle; Dundas Straits; Northern Territory.

Ceradocus rubromaculatus (Stimpson) Walker (1904, p. 272, fig. 30). Gulf of Manaar. Walker's specimens certainly belong to the sub-genus.

Ceradocus rubromaculatus (Stimpson) Walker, 1909, p. 364. Wasin, in mud. Record only.

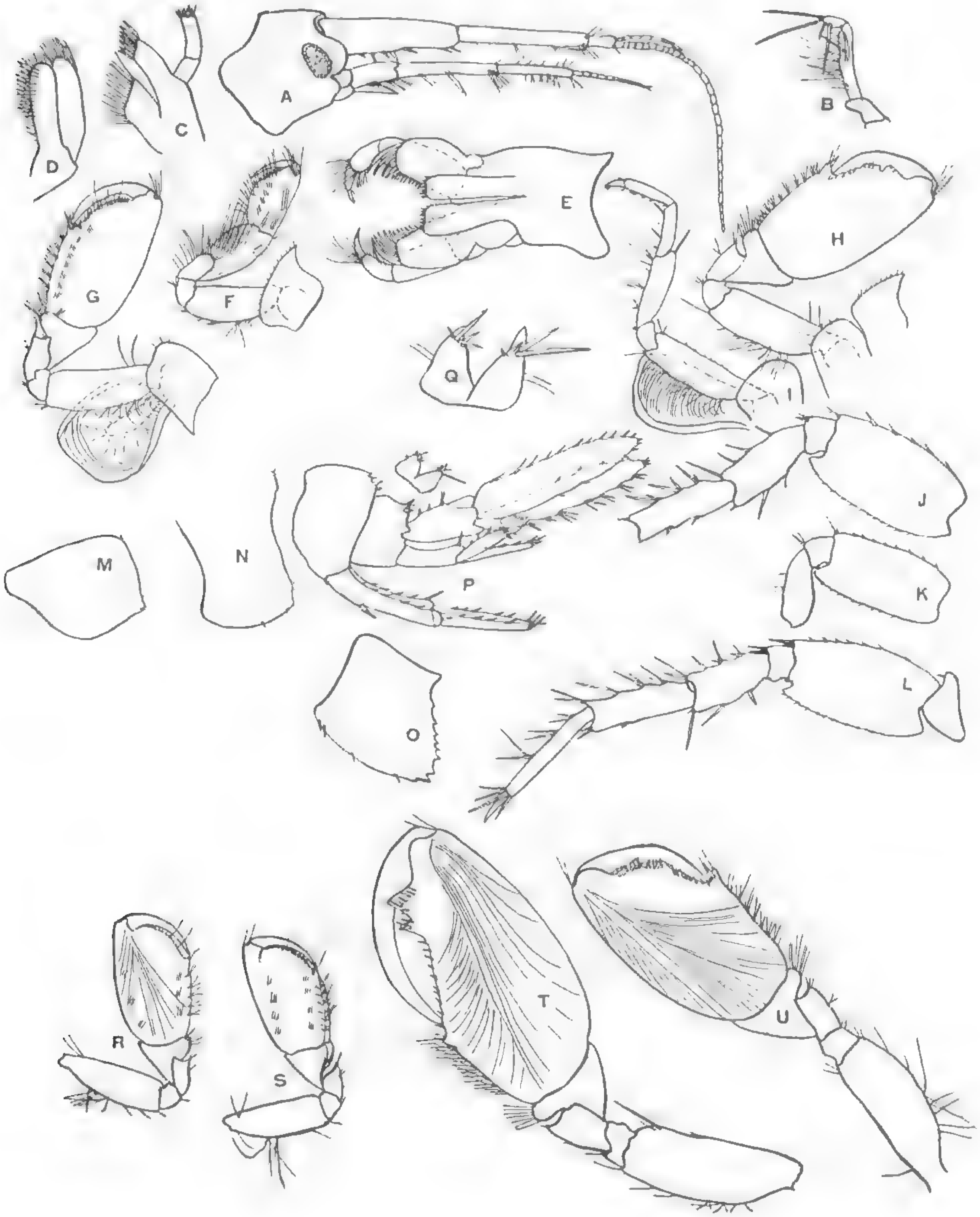


Fig. 8. A–Q, *Ceradocus (Denticeradocus) chiltoni*, Great Barrier Is., mature ♀: A, head; B, mandible, palp; C–D, maxillae 1–2; E, maxilliped; F, gnathopod 1; G–H, gnathopod 2, left and right; I, peraeopod 1; J–L, peraeopods 3–5; M–O, pleon side plates 1–3; P, urosome; Q, telson. R–U, *Ceradocus (Denticeradocus) chiltoni* from Auckland: R–S, gnathopod 2, left and right, young ♂; T–U, gnathopod 2, left and right, aged ♂. (K.S. *del.*)

Ceradocus rubromaculatus (Stimpson) Chilton, 1922, p. 8. 45 miles S.W. Cape Jaubert, N.W. Australia.

Ceradocus rubromaculatus (Stimpson) Tattersall, 1922, pp. 6–8, pl. I, fig. 15, 16. Abrolhos Islands, Western Australia. This is almost certainly a new species.

Ceradocus rubromaculatus Stimpson. Pirlot, 1934, p. 222. 6° 8′ lat. N., 121° 19′ long. E., 275 m.; 8° 43′ lat. N., 127° 16′ long. E., 828 m. (These depths are extreme for forms usually found in littoral waters.) Pirlot, 1936, p. 305. Lombok, Paternoster Island, etc., 0–90 m.

Ceradocus rubromaculatus (Stimpson) Barnard, 1937, p. 160, fig. 9. Red Sea. (This is probably a new species. The tendency to a very oblique palm with little definition is certainly not characteristic of the known members of the sub-genus. Probably, examination will show that other differences are correlated with this.)

Ceradocus rubromaculatus (Stimpson) Walker, 1905, p. 927. (This paper is not available to me.)

The Australian and New Zealand species may be readily separated by the character of the telson and by the presence or absence of teeth on the posterior margins of pleon side plates 1 and 2. *Ceradocus* (*Denticeradocus*) *ramsayi* (Haswell) is recognized by the prominent medio-postero dorsal tooth on each of the pleon segments 4 and 5, as noted by Haswell.

SYSTEMATIC CHARACTERS IN THE SUB-GENUS DENTICERADOCUS.

As I have not seen sufficient specimens of the *Ceradocus* group, it is not possible to generalize on the systematics of the group as a whole. However, within the sub-genus *Denticeradocus*, the following observations appear to hold good.

Growth Stages. In the immature stages both sexes are very similar, and the palm of gnathopod 2 is regular. The denticulation of the pleon appears to be fixed in pattern. Some differentiation occurs during the sexually mature stage: the palm of gnathopod 2 in the male becomes irregular and toothed, occasionally on both sides of the body, occasionally on the left, but more often on the right. The serration of the bases of peracopods 3–5 becomes more marked and the dentation of the pleon more evident. During the later stages, gnathopod 2 of the female tends to become irregular, and in some cases is more heavily toothed than in the corresponding male. Generally the more heavily toothed gnathopod is also the larger.

It would appear that the shape of the palm of gnathopod 2 is a very unreliable specific character, although its general shape and liability to the development of teeth or not may be useful as a check. In *Ceradocus* (*Denticeradocus*) *rubromaculatus* (Stimps.) and in *C.* (*D.*) *sellickensis* Sheard, no trace of the breaking-up of the palm into teeth has been observed, although a long range of specimens has been examined. Characters which appear to be unaltered in the various growth stages, and which appear to exhibit very little variability, are: the telson, mouthparts, particularly the palp of the mandible, and the dentation of the side plates of pleon segments 1–3. Accordingly these characters have been used for the separation of the species.

Other characters which appear to be specific but which have not been checked over a wide range of specimens are: the proportion of length to width of segments V and VI of gnathopod 1, the proportionate length of the gland cone, the character of the margins of the basis of peraeopods 1 and 2, and the shape of the lower hind corner of the basis of peraeopods 3–5.

The eye shape and colour varies to about the same extent in all the species, the shape oval to round, colour dark red to light red (in spirit dark to pale). None of the Australian or New Zealand specimens furnish examples of the eye shape of *C.* (*D.*) *capensis* Sheard.

The close resemblances which exist between the two subgenera make me hesitate to effect any further separation on the basis of literature, particularly as it would appear that some of the Northern species are misplaced in the subgenus *Ceradocus* (*Ceradocus*). However, this is a problem which can only be solved by a worker with access to the Northern material.

Of very great interest is the tendency to the formation of flat-topped teeth on the palm of gnathopod 2, particularly in older specimens of a number of the species. It would be idle to speculate on their origin until more work has been done on the problem. An experiment carried out on *Talorchestia novaehollandia* Stebbing (Sheard, 1938, p. 29) tends to show that the forces operating in the production of malformations of this kind are complex.

However, it might not be out of place to suggest here that the position and incidence of the teeth may be controlled by factors affecting the growth rate of the segment and by the position of the powerful muscles within it. In all animals whose exoskeleton is periodically renewed, and which for varying periods of time is in a plastic state, mechanical stresses and strains can be expected to produce very definite effects.

LITERATURE.

Barnard, K. H. (1931): *Great Barrier Reef Exped. Brit. Mus. (Nat. Tist.)*, Sci. Rep. Vol. 4, No. 4.

Barnard, K. H. (1937): *The John Murray Exp. 1933–1934 Brit. Mus. (Nat. Hist.)* Sc. Rep. 4, Nr. 6, Lond.

Bate, C. S. (1862): *Cat. Amph. Crust. Brit. Mus. Lond.*

Chevreux, E. (1908) : *Mem. Soc. Zool. France,* Vol. 20.
Chevreux, E. (1925) : *Bull. Soc. Zool. France,* Vol. 50.
Chilton, E. (1883) : *Proc. Linn. Soc. N.S. Wales,* Vol. 9.
Chilton, E. (1916) : *Trans. N.Z. Inst.,* Vol. 48.
Chilton, E. (1921) : *Biol. Res. Endeavour, Sydney,* V. part 2.
Chilton, E. (1922) : *Kungl. Svensk. Vetensk. Handl.* Bd. 63, No. 3.
Chilton, E. (1923) : *Rec. Aust. Mus.,* Vol. 14, No. 2.
Costa, A. (1853) : *Rend. Soc. Bourbon N.S.W.,* Vol. 2.
Della Valle, A. (1893) : *F. Fl. Neapel,* Vol. 20.
Hale, H. M. (1927) : *Trans. Roy. Soc. S. Aust.,* Vol. 51.
Hale, H. M. (1929) : *Crust. of S. Aust., Adelaide.*
Haswell, W. A. (1880) : *Proc. Linn. Soc. N.S. Wales,* Vol. 4.
Haswell, W. A. (1882) : *Aust. Stalk and Sessile Eyed Crust.*
Haswell, W. A. (1885) : *Proc. Linn. Soc. N.S. Wales,* Vol. 10.
Miers, E. J. (1884) : *Rep. Voy. Alert. Lond.*
Nicholls, G. E. (1938) : *Austr. Ant. Exped.* 1911–1914, Sci. Reps. Series C, Vol. 10, pt. 4.
Pirlot, J. M. (1934) : *Siboga Exp.* Mono., 33d.
Pirlot, J. M. (1936) : *Siboga Exp.* Mono., 33E.
Schellenberg, A. (1925) : *Beit. Kenntis. Meeresfauna West Afrikas,* Vol. 3, No. 4.
Schellenberg, A. (1926) : *Deutsche Sudpolar-Exped. 1901–1903,* Vol. 18.
Schellenberg, A. (1928) : *Trans. Zool. Soc. Lond.,* Vol. 22.
Schellenberg, A. (1938) : *Kungl. Sv. Vet. Akad. Handl.,* Bd. 16, No. 6.
Sheard, K. (1936) : *Trans. Roy. Soc. Sth. Austr.,* Vol. 60.
Sheard, K. (1937) : *Trans. Roy. Soc. Sth. Aust.,* Vol. 61.
Shoemaker, C. (1933) : *Am. Mus. Nat. Hist. Novitates,* No. 598.
Stebbing, T. R. R. (1888) : *Rep. Voy. Challenger,* Vol. 29.
Stebbing, T. R. R. (1899) : *Trans. Linn. Soc. Lond.,* Ser. 2, Vol. 7.
Stebbing, T. R. R. (1906) : *Das Tierreich,* Vol. 21.
Stebbing, T. R. R. (1907) : *Rec. Ind. Mus.,* Vol. 1, part 2.
Stebbing, T. R. R. (1908) : *Ann. Sth. African Mus.,* Vol. 6.
Stebbing, T. R. R. (1910) : *Mem. Aust. Mus. Sydney,* Vol. 4, part 2.
Stebbing, T. R. R. (1910a) : *Gen. Cat. Sth. African Crust. Ann. Sth. African Mus.* Vol. 6.
Stephensen, K. (1933) : *Medd. Om. Groenland,* Bd. 79, No. 7.
Stimpson, W. (1855) : *Proc. Ac. Philadelphia,* Vol. 7.
Tattersall, W. M. (1922) : *Jour. Linn. Soc. Lond.,* Vol. 35.
Walker, A. O. (1904) : *Rep. Ceylon Pearl Fisheries, Lond.,* Vol. 2.
Walker, A. O. (1905) : *Fauna, Geog. Maldive and Lacc. Arch,* Vol. 2, Supp. 1.
Walker, A. O. (1909) : *Trans. Linn. Soc. Lond.,* Ser. 2, Zool., Vol. 12.

THE EVOLUTION OF THE HUMAN MOTIF IN PAPUAN ARROW DESIGNS

*BY R. M. BERNDT, HON. ASSISTANT IN ETHNOLOGY,
SOUTH AUSTRALIAN MUSEUM*

Summary

The following observations record designs found on the heads of conical and barbed arrows from the south coast of New Guinea; the specimens being from the South Australian Museum collection. The paper is illustrated by drawings which have been prepared from rubbings of the arrows to show specific details.

Although in this paper interest centres around the actual design, it is perhaps appropriate to review the peculiarities which appear in the arrow itself.

THE EVOLUTION OF THE HUMAN MOTIF IN PAPUAN ARROW DESIGNS

By R. M. BERNDT, Hon. Assistant in Ethnology, South Australian Museum.

Plate xxii, text-fig. 1–4.

The following observations record designs found on the heads of conical and barbed arrows from the south coast of New Guinea; the specimens being from the South Australian Museum collection. The paper is illustrated by drawings which have been prepared from rubbings of the arrows to show specific details.

Although in this paper interest centres around the actual design, it is perhaps appropriate to review the peculiarities which appear in the arrow itself.

An examination of many specimens from the southern coastal region indicates that the designs illustrated are peculiar to arrows of which the heads are of conical or of barbed type (fig. 4, A and B).

Arrows with Heads of Conical Form.

This type consists of blackwood or palmwood arrows with the heads carved with a series of cones inserted one into the base of another, and of equal or unequal length. At about the middle of the head (x, fig. 4, A a) there is a carved band of varied pattern. The fibre used for lashing the head to the shaft, shown at C, fig. 4 A, is usually of gummed palmleaf plaiting. The greater portion of the reed shaft is generally scraped and blackened, but part may be varnished with red gum, the rest remaining completely untouched. The upper internode is often left intact, and the end of the shaft un-notched.

These arrows average 155 cm. in length, and probably each tribe preserves an established length of its own.

The average lengths of the different parts are:

(a) the head, 42 cm.
(b) incised band, 4·5–6 cm.
(c) plaited cane band, connecting head to shaft, 3 cm.
(d) cane shaft, 108 cm.

Variations occurring in this type are:

(a) plain conical.
(b) a series of cones, tipped with cassowary bone.
(c) barbed and conical (see also barbed type).
(d) barbed and conical, with cassowary bone tip (see also barbed type).

The cones are often coloured at each division with red ochre, and the middle incised band filled in with white.

Haddon (1912, 177) states that the necks of the individual cones or other constrictions on the head were nicked before use, so that they might the more readily break off and remain within the body of the enemy.

ARROWS OF BARBED TYPE.

The barbed type of head such as is illustrated in fig. 4, B, is of blackwood or heavy palmwood, and is joined to the shaft by a plaited cane band; at about the middle of the head (fig. 4, B b) is a carved band of varied pattern.

The relative lengths of the portions are as in the conical type. The upper portion of the head is armed with adpressed barbs.

The following variations occur in this type of head:

(a) with single row of barbs;
(b) with barbs projecting on either side;
(c) with single row of barbs, apex tipped with cassowary bone;
(d) with double row of barbs, tipped with cassowary bone;
(e) with double row of barbs, and with grooved head;
(f) barbed and conical (see also conical type);
(g) barbed and conical, with cassowary bone tip (see also conical type);
(h) with a triangular-shaped head, and single row of barbs at the tip;
(i) with a notched head, cassowary tip.

On all examples examined, the main shaft of cane is devoid of nodal decoration, and the hilt of the arrow butt un-notched. The designs described in this paper are only found on this type of arrow.

Many arrows have no decoration at the centre of the head, but these probably were manufactured and sold to European traders as curios. (Haddon, 1894, 203.)

Only in the more highly decorated specimens are found the series of intricate incisings which may be here termed band designs. These band designs, when they occur, are longitudinal to the arrow, and are incised on the round or oval blackwood head, sometimes with rubbed-in white lime decoration accentuating the work. In such arrows the cones or barbs are usually highly finished, but some are rough and unpolished.

Berndt (1939, pp. 8–12) has referred to the conical arrow, and has given examples of the similar occurrence of the cone within cone construction in the northern Australian spear-heads, many specimens showing a similarity both in decoration and manufacture to the Papuan arrows.

The large bows from Papua are made usually of bamboo, although blackwood and light palmwood examples exist. In some cases these are ornamented at the ends. The shaping of the bow is done by holding a length of selected wood over the fire (Haddon, 1912, p. 173). The bow string is a broad strip of the tough outer rind of a bamboo, but, in some examples, plaited cord fibre is used.

Haddon (1912, p. 174) states that extra arrows are held in the bow-hand, that a quiver is not employed, and that the bundles of arrows are tied in two places with string, the intermediate portion forming a handle for carrying the bundle.

As sketched in Edge-Partington's Album (p. 343, No. 4), a plaited strap connecting the two string bands is sometimes used for carrying the bundle when going out to fight.

Distribution.

Occurrence of these arrows is believed to be widespread. Haddon (1894, p. 134) suggests that they were probably brought in from the Toaripi area, and (1912,

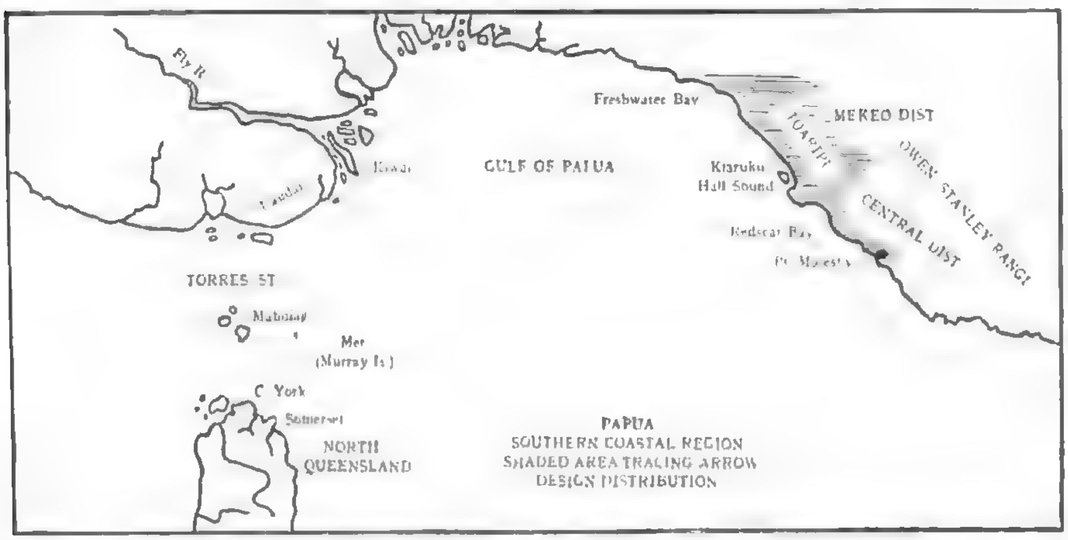


Fig. 1. A map of the south coast of Papua (Papuan Gulf region). The shaded area shows the distribution of the arrow designs mentioned in the text.

p. 177) notes that they are traded from Papua into the Torres Strait Islands, while Edge-Partington (p. 260) records the conical arrow as being found at Redsear Bay. The South Australian Museum possesses specimens from Hanuabada (Port Moresby), the Toaripi area, and the Mekeo and Central districts.

It appears then that both the conical and barbed variety of these arrows are derived from the shaded area in the accompanying map (fig. 1).

Design.

On examination of these arrows, one is struck by the persistence of the designs illustrated in this paper. These appear to have some definite significance, such as would be suggested by a real object, in this case a human form or face conventionalized, and representing in this manner a gradual degeneration by successive copyings of the design.

When analysing primitive art, it is often found that such designs assume a number of forms, many of which have scarcely any resemblance to the original object, but which strictly symbolize its most significant aspects.

The native knows that the figure thus drawn is not like the original, for example, "a man", but it does symbolically satisfy his desire for expression.

Primitive art tends to be bound down by the traditional code of the artists' forefathers, and very rarely is this altered, except slowly over a period.

The designs illustrated are of various patterns whose evolution can be traced from a common source.

Haddon (1894, p. 135), in noting arrow decorations, mentions that there can be no doubt that the designs are derived from a human face, the features of which have been laterally compressed and vertically extended, through the exigencies of a restricted space and the difficulty of more realistic carving on such a slender rod.

By tracing this anthropomorph through the designs found on a large number of arrows in the South Australian Museum collection, and by confining these observations to a restricted geographical area, as well as a particular type of arrow, the conventionalization of this figure becomes apparent.

In the ultimate designs simple geometrical decoration such as is illustrated in fig. 4, J and K, and in fig. 4, C, K, and L, are evolved.

It has already been stated above that Haddon holds that these arrow-designs are derivatives of the human face form, yet it must be indicated that each carving has retained also in fundamental principle, ingredients which can be derived from a human figure in the squatting posture.

This human figure can be defined as having the legs haunched or in a squatting position, the arms either flexed with the hands under the chin, or with the arms outstretched.

The Haunched Figure.

The human haunched figure appears widely in the art of primitive people. Berndt (1939, p. 51–62) has dealt with this type as it occurs in the spatula decoration of the south-east coast of Papua, and in that paper a series was arranged to demonstrate a gradual evolution from the natural to the extremely conventionalized form, the main ingredients of the original figure being persistent throughout the series.

The importance of the haunched figure in arrow design is shown by the appearance in the figures of three definite types indicated in fig. 2, A, B, and C respectively. Other designs seem to have all been evolved from these three fundamental types.

The sex of the figure in arrow designs, like that of the spatula figure, has not been ascertained.

In addition to arrows and spatulae, large-sized carved figures are made and used in this area, and in these the haunched figure design is also prominent. Haddon (1901, p. 106–7, fig. 9) for example, illustrates a female figure in the squat posture. This was the wooden image of a girl with scarification markings on her body from Erub, but originally from the island of Masig, in Torres Strait. Called *uewr madub*, it was used as a love charm. Similar male figures, *sokop madub*, were used as tobacco-growing charms. At Mabuiag Island, wooden human effigies, *madub*, kept in a small hut along with bullroarers, were believed to "turn devil" at night time, and go around the gardens swinging the bull-roarers to make the yams grow. Another male figure, from Mabuiag Island, called *oraoradubu* (*dubu* means male or man) was consulted before fighting, presents being given to it to invoke help in success in head-hunting raids.

The example, illustrated in plate xxii, figs. A and C (from the South Australian Museum collection) is an ornamented canoe mast from the D'Entrecasteaux Group, New Guinea, and is 25 cm. in height, and shows a similar type of *dubu* to that described above.

THE HUMAN FACE MOTIF.

Haddon's (1894, p. 135) contention that designs of types illustrated are derived from the human face, may have to be modified in the light of data presented in this paper.

Besides arrows, designs appear on other objects manufactured by the natives in this area (southern coastal region of Papua), and in the majority of bark-belts, the decoration has a definite resemblance to the human face (see plate xxii, fig. B). In this case, even when excessively conventionalized, the design has a zig-zag appearance which represents serrated teeth, and this may occur, not only at the region of the mouth, but also on the rest of the face. Such an example is illustrated on plate xxii, fig. B, and shows the face decoration in a bark-belt from the Papuan Gulf.

In comparing the haunched figure, arrow design, and human face derivative, one must take into account the object upon which the artist carved, the small space for expression, and the extreme conventionalization possible.

When either the haunched figure or human face become excessively conventionalized, the fundamental outlines become the same and the original motif is lost. The following two examples (fig. 2, H and J) show how the elements of the haunched figure, as well as of the human face, may be extracted. Considering the haunched figure first: a horizontal line conventionalizes the head, acute angles the eyes, and a perpendicular the body. The line at the extreme left running from the

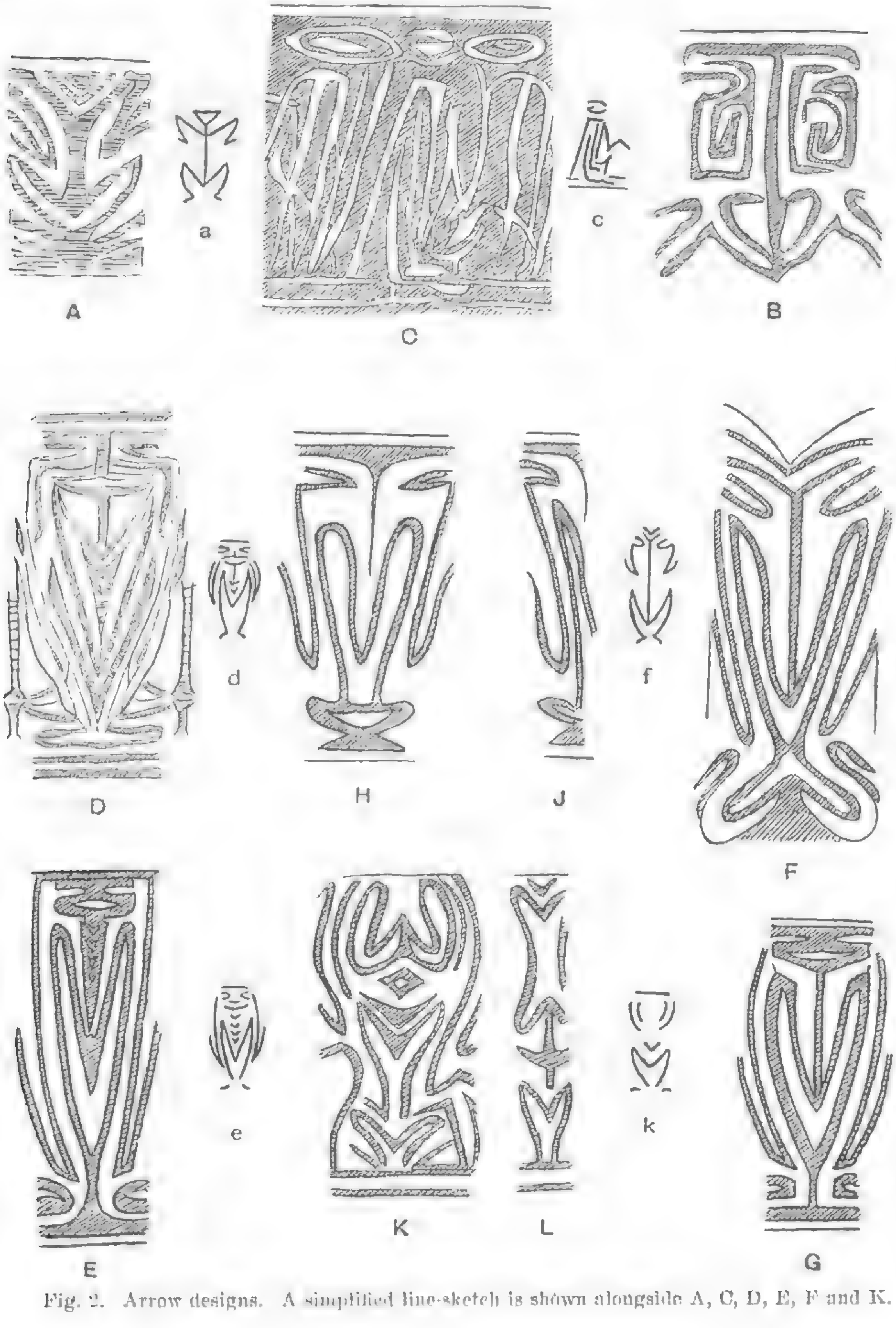


Fig. 2. Arrow designs. A simplified line-sketch is shown alongside A, C, D, E, F and K.

eye downwards and then upwards, represents the arm. The M motif at centre gives the conventionalized equivalent of the haunched posture. The base represents feet. A clearer outline of the posture is given in 2 J.

Secondly, in extracting the ingredient of the human face, the flexed "elbows" of the squatting figure design become the eyes of the face design. The flexed "knees" represent the upturned corners of the mouth.

All the arrow designs illustrated in this paper (except fig. 2, A, B, and C) may be considered open to either interpretation. As is often the case, the native mind may have played with the design and deliberately represented both a face and haunched figure at one and the same time.

DESCRIPTION OF ILLUSTRATIONS.

In fig. 2, the arrow incisings A(a), C(c), D(d), E(e), F(f), and K(k) have a line-sketch alongside of each to assist in tracing the human motif and the compressed M (except in C(c)) of the haunched attitude.

In C, the line-drawing illustrates the centre figure. B is descriptive within itself, while H corresponds with F(f) and G with E(e).

Fig. 2 A is a human figure in haunched posture, having the M-like motif for the legs, the outstretched arms, and a V and triangle conventionalizing the head.

Fig. 2 B is a remarkable engraving from a conical arrow collected at Port Moresby. At the top of the design a horizontal line represents the head, while at each side of the perpendicular body the arms are conventionalized. Again the M-motif symbolizes the figure's haunched attitude, while the buttocks are also included in the artist's conception of this traditional design.

Fig. 2 C is an exceptional piece of incising, in that the whole figure is in profile. In order to make the interpretation of this engraving clear, a simple figure has been drawn at the side (c).

The heads are conventionalized in an oval within an oval, while the perpendicular bodies, horizontal shoulders, arms, and, in the second figure, one arm resting on the line upon which the body is seated, as well as the bent elbow, are as clearly shown as the buttocks indented upon the horizontal line, which possibly represents the ground. This is the only example of the style that can be found among the many hundreds of arrows examined.

In the actual figure, but more so in the line-sketch (c), an analogy with Egyptian treatment is shown.

The three examples described above are of the haunched figure design, and in the illustrations following the same motif is used. At first sight these represent the haunched figure highly conventionalized (fig. 2, D, E, F, G, H, and K), but, upon further examination, a doubt as to this origin may occur, for it has already

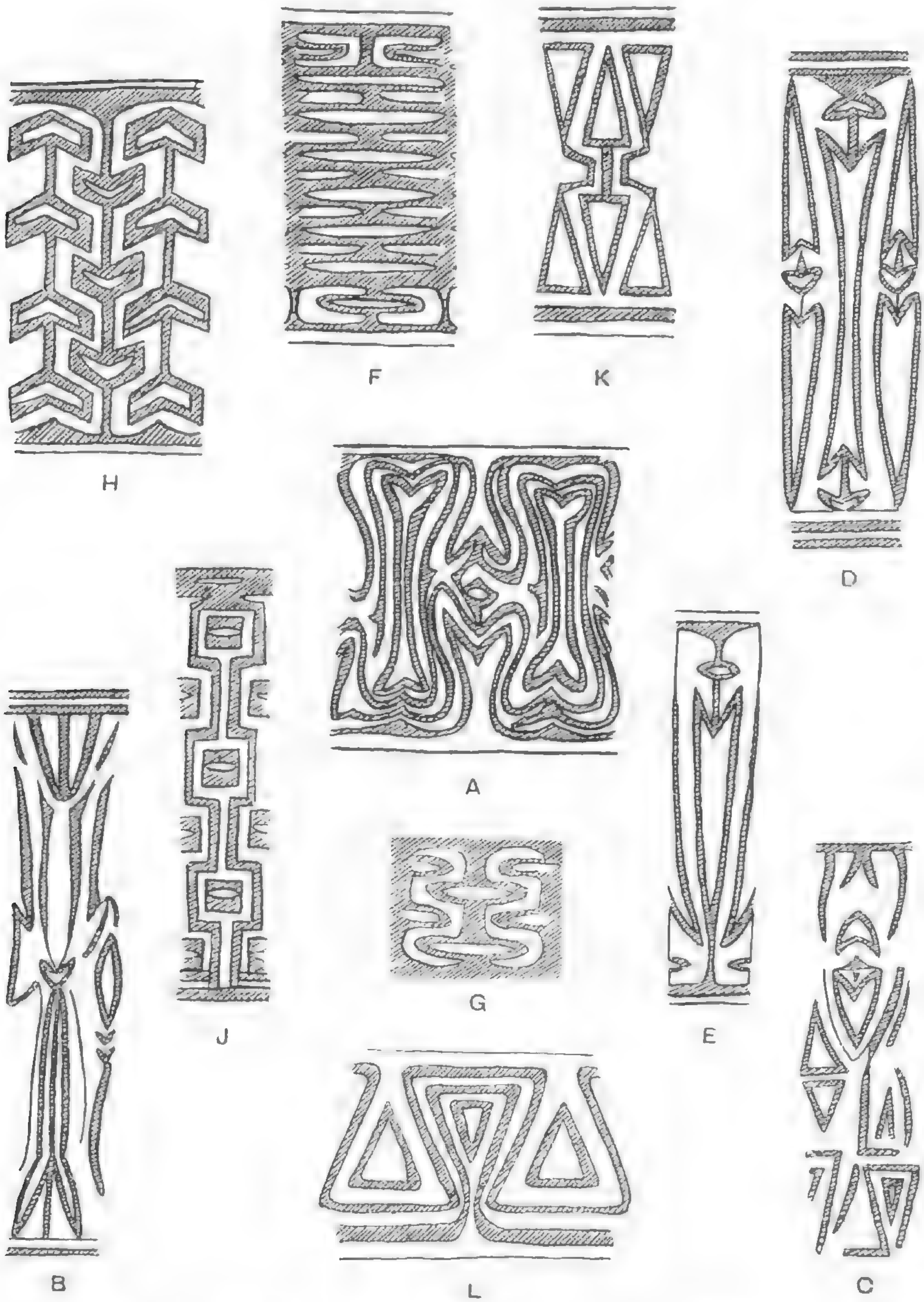


Fig. 3. Arrow designs, showing transition from the conventionalized type of A to the geometrical figures of K and L.

been shown that such a design as fig. 2, H and J, may be taken as representing either a squat figure or a human face.

The following designs have therefore been arranged to show their connection with the above.

Fig. 2 D is a spirited carving from a barbed arrow collected in the Toaripi area, and corresponds with E in that the V-shape is perceivable together with the series of smaller V's, one above the other, on the perpendicular line. If this figure represents a human form, it may be that the series of V's represent the ribs. If, on the other hand, it represents the face, they may be a series of ornamentations accentuating the mouth. Fig. 2 F is an even clearer example than either D or E, having the main outlines of A, while in fig. 2 G, the upper design on the perpendicular line is surely a face derivation. Fig. 2 K is a typical design, from a single barbed arrow. It resembles a mask, and still retains the compressed M, the conventionalized design following a curve around the centre diamond. L is the side elevation of the same.

Fig. 3 A has the main aspect, that is the M, retained by the artist. The centre is a diamond with an M below, and an inverted M above. Comparison with the traditional type, fig. 2 K shows the modification that has occurred.

Fig. 3 B is a peculiar modification, intermediate between 2 G and 2 K, conventionalized into a meandering style comparable with the head of the design in E, thus assuming the human face aspect, although F may be a better intermediate.

Fig. 3 C serves to link 3 B and 3 E, in which the triangular decoration appears. Fig. 3 D retains the compressed M and inverted V, as in 2 F, while 3 E has the actual base of the figure similar to that of 2 G.

Fig. 3 H is seemingly derived from G, the face becoming the essential accentuated, while Fig. 3 J is more formal but still comparable with H. In 3 L, the key pattern has become complicated, and a more elaborated version of the Z and triangle at the right-hand base of C.

In the triangle motif appearing in K, each pair of geometrical figures in the course of conventionalization has become joined by a line.

The extreme is shown in the designs in fig. 4, where in H the heart-shaped centre (originally the compressed M), the V at the base, and the inverted V at the head, show some similarity to the design in fig. 3 D.

Fig. 4, C and D, may be derived from 3, H and J, as also may be 4 E, F, and G, while 4 H can be linked with 4 J, which has the centre diamond as in 2 K, and 4 K is possibly derived from either J or G, or both.

The last three are difficult to allocate, except in that they retain perpendicular (fig. 4 D) and other lines running from head to base with a break at centre, all that remains in 4 M being wavy broken lines.

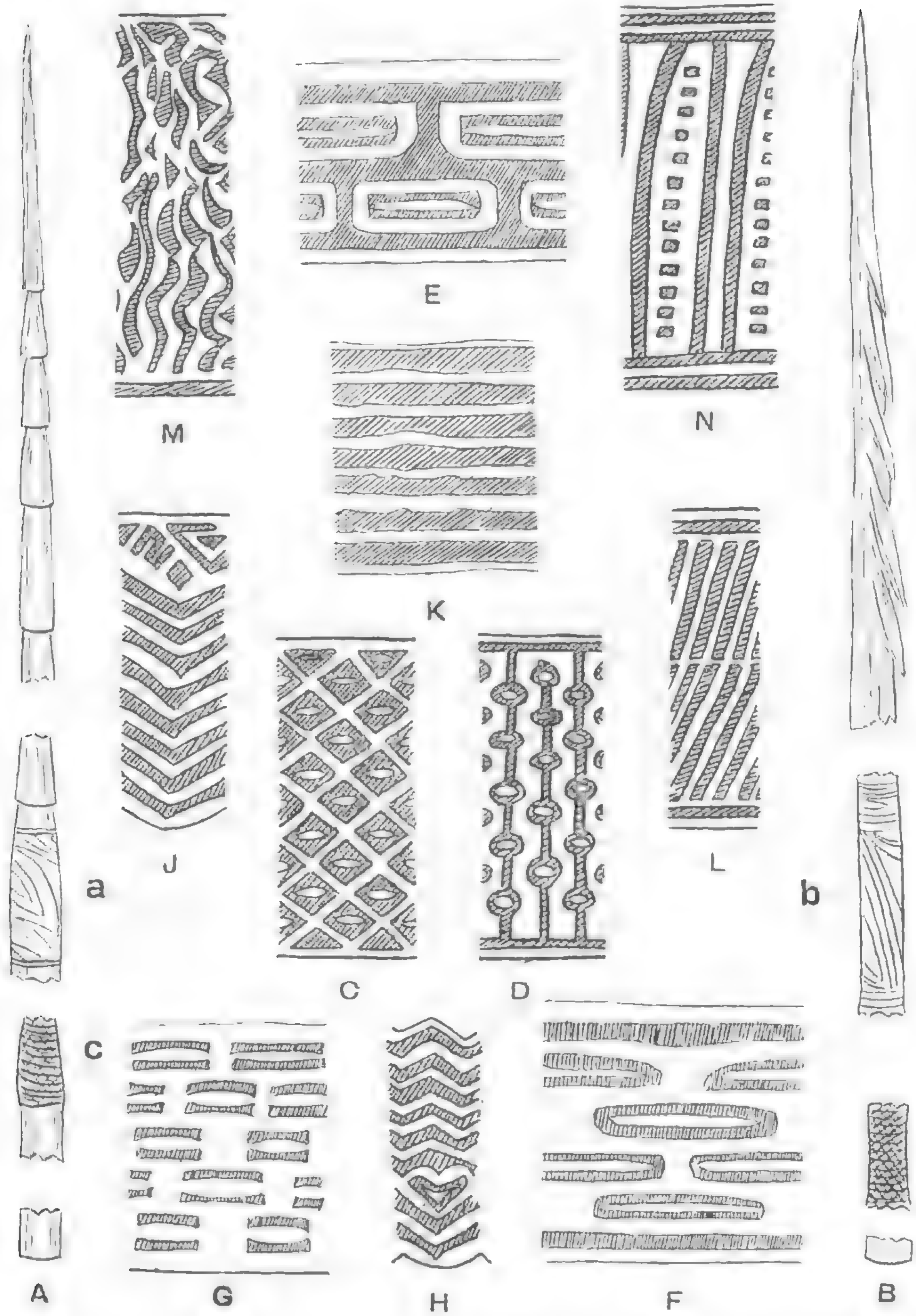


Fig. 4. A, Portions of conical type of arrow head. B, Portions of barbed type of arrow head. C–N, Extreme modifications of arrow designs.

Little or no connection can be traced in fig. 4 N, and it is doubtful whether it can have originated from the others of the series. It is inserted here only because it appeared on the arrows of this area.

SUMMARY.

This paper records designs found on the middle section of the heads of conical or barbed arrows of Papua, the actual specimens studied being in the South Australian collection.

Descriptions are given of the two distinctive types of arrows, together with a classification of the variations, occurring in the restricted area of the southern coast of Papua bordering the Papuan Gulf.

The main discussion is on the incised decoration, but primitive art and its inspiration is considered, together with the native artists' mode of approach.

The evolution of the human motif in the designs, and its conventionalization, is analysed.

The illustrations may be modifications of either the haunched figure or the human face, and both origins are discussed.

REFERENCES CITED.

Berndt, R. M. (1939) : Human Figure in Papuan Spatula decor. *Trans. Roy. Soc., S. Aust.*, Vol. 63, pt. 1, pp. 51–62. Adelaide.

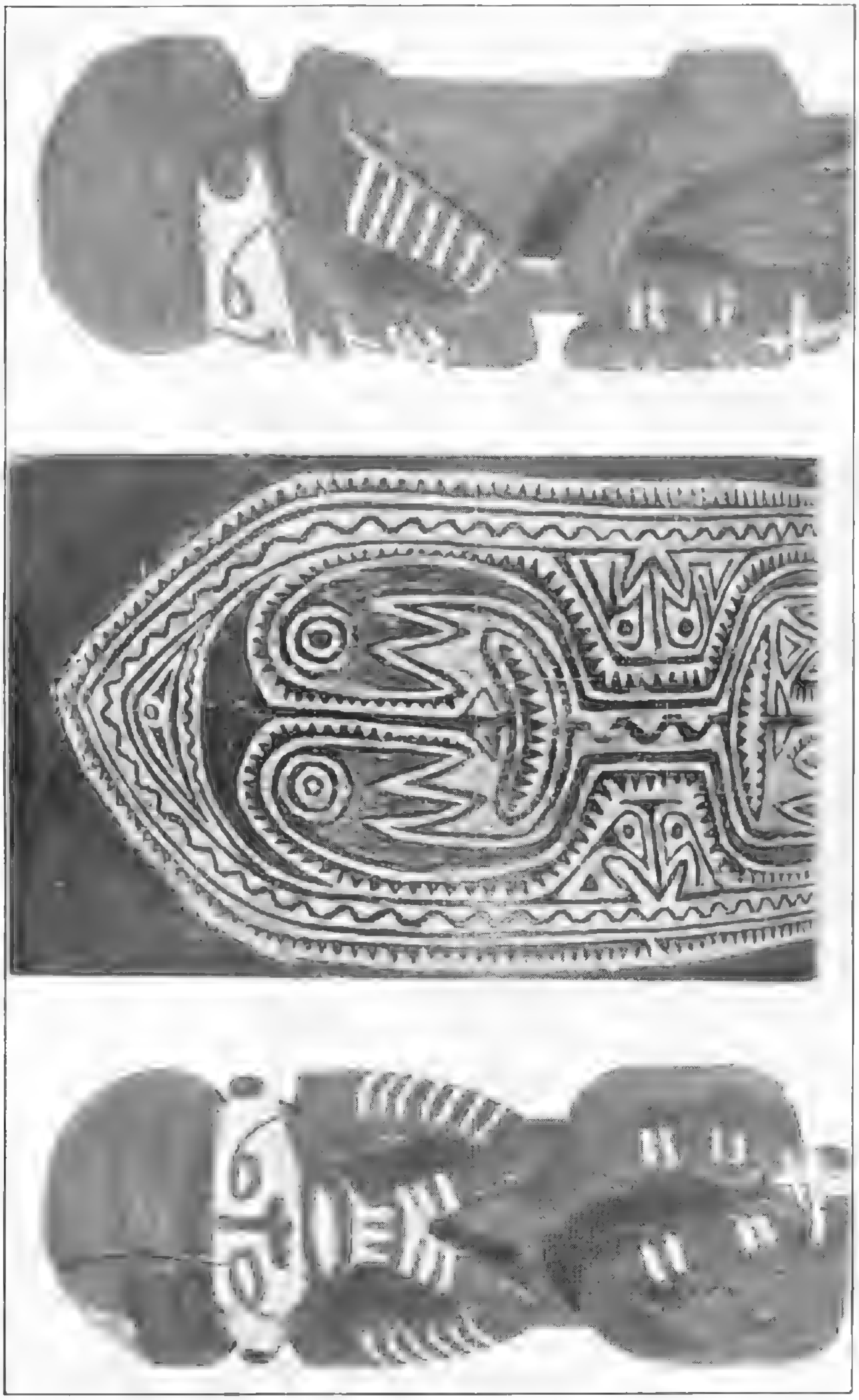
Berndt, R. M. (1939) : Comparison between N. Austr. Spear and N. Guinea Arrowhead. *S. Austr. Naturalist,* Vol. 19, pt. 4, pp. 8–12. Adelaide.

Edge-Partington, J. (1890) : Album of the Natives of Pacific Islands (pt. 1), pp. 260, 343.

Haddon, A. C. (1894) : Decor. Art of Brit. N. Guinea, pp. 134, 135, 203. Dublin.

Haddon, A. C. (1901) : Head-hunters, black, white, and brown, pp. 106, 107. London.

Haddon, A. C. (1912) : Anthrop. Exp. to Torres Strait Is. (pt. 4), pp. 173, 174, 177. Cambridge.



C

B

A

Plate xxii.

A. A haunched figure from D'Entrecasteaux group.
B. A human face design from a bark belt, showing serrated teeth.
C. A haunched figure, profile of last.

THE PROPHLIANTIDAE

A PROPOSED NEW FAMILY OF AMPHIPODA, WITH DESCRIPTION OF A NEW GENUS AND FOUR NEW SPECIES

By George E. Nicholls, University of Western Australia

Summary

The discovery, in the collection of Amphipods brought back in 1914 by the "Aurora" from Macquarie Island of a new genus Cylindryllioides (1938), closely akin to Bircenna, revived the question of the systematic position of the latter genus.
Erected by Chilton, in 1883, for a single New Zealand species (Bircenna fulva), that author remarked: "I do not know where to place this peculiar-looking Amphipod ; it may come near to Phlias, but the species of that genus . . . . are not described in sufficient detail to warrant one in forming any definite conclusion as to their relationship."

The PROPHLIANTIDAE

A proposed new family of Amphipoda, with description of a new genus and four new species

By GEORGE E. NICHOLLS, University of Western Australia.

Text-figs. 1–10.

The discovery, in the collection of Amphipods brought back in 1914 by the "Aurora" from Macquarie Island of a new genus *Cylindryllioides* (1938), closely akin to *Bircenna,* revived the question of the systematic position of the latter genus.

Erected by Chilton, in 1883, for a single New Zealand species (*Bircenna fulva*), that author remarked: "I do not know where to place this peculiar-looking Amphipod; it may come near to *Phlias,* but the species of that genus . . . . are not described in sufficient detail to warrant one in forming any definite conclusion as to their relationship."

Chilton's original account, which was very brief, unfortunately inaccurately recorded the telson as "simple, not divided". While this may or may not have influenced Stebbing in assigning *Bircenna* (in "Das Tierreich", 1906) to the Phliantidae, it was, almost certainly, responsible for Chevreux's proposal of a new genus *Wandelia* (1906) for a subantarctic species which was referred to the Phliantidae (Phliasidae), and was said to differ from *Bircenna* notably in that the telson was completely cleft.

In 1903 another peculiar Amphipod was recorded by Walker. He placed it in a new genus, *Kuria,* noted its resemblance in many particulars to *Bircenna,* called attention to its cleft telson, questioned the propriety of the reference of such forms to the Phliantidae, and finally left it *incertae sedis.* Stebbing, in 1906, included it in the Phliantidae.

Chilton (1909) having re-examined *Bircenna fulva,* recognized the error in his description of the telson, and correctly described it as "split to the base". He went further, and concluded that "*Wandelia* is identical with *Bircenna,* and, indeed, *Wandelia crassipes* is specifically not very different from *Bircenna fulva*".

Chilton, however, in his examination of *Bircenna fulva,* completely overlooked one very curious and indeed unique character in that genus, viz. the occurrence of a deep and strongly curved transverse plate projecting ventrally like a collar, from the under surface of the first peraeon segment (fig. 7 A). It is obviously a development of the sternite of that segment, and may be referred to as the *ventral flange.* I find this present in all undoubted species of *Bircenna,* and consider it a character of generic importance.

In the Western Australian species *B. ignea,* described below, this semi-circular flange extends sufficiently far forward to actually underlie the base of the head, its anterior surface being strongly concave, bounding a watch-pocket shaped recess.

In the South Australian species, *B. nichollsi* Sheard, and in the New Zealand *B. fulva* Chilton, it is, perhaps not quite so strongly developed, but is, nevertheless, a quite conspicuous feature.

In most of the members of this group of genera there is an unusually long articular region, or "neck", separating the head from the peraeon, but the head can be strongly retracted, in which case its lower surface and the hinder mouth parts are, in *Bircenna,* partly received in this pocket. In the genus *Eophliantis,* recently established by Sheard, as well as in *Cylindryllioides,* this structure is absent, nor can I find it in any of the new species *Prophlias anomalus, Biancolina australis* and *Wandelia japonensis.*

The specimens of *Wandelia crassipes* examined by Chevreux were smaller than fully-grown *B. fulva,* and correspondingly more difficult to study, yet since Chevreux correctly recorded the cleft condition of the telson of his species, I cannot believe that he would have overlooked the above quite conspicuous sternal development had it been present. Indeed, his figure certainly suggests its absence, and for this reason I consider that *Wandelia* must be retained as a distinct genus, related much more closely to *Eophliantis* than to *Bircenna.*

In his "Note on the Amphipodan genera, *Bircenna, Kuria,* and *Wandelia*", Chilton (1909), while amending his account of *Bircenna* and proposing the abandonment of *Wandelia,* recognized that, in the completely cleft condition of the telson, this genus and *Kuria* differed from all the remaining Phliantidae known at that time. A further difference is found in that all the then remaining genera (*Iphinotus, Percionotus,* etc.) are markedly dorso-ventrally flattened. Indeed, in their appearance, they are utterly unlike the cylindriform *Bircenna.*

He hesitated, however, at the obvious step of establishing another family, and suggested, instead, the enlargement of the characters of the Phliantidae to accommodate these very dissimilar forms—but omitted to formulate the suitably modified family diagnosis he recommended.

Recently Sheard has tentatively proposed the division of the Phliantidae into two subfamilies, which he named respectively the *Eophliantinae* and the *Phliantinae.*

Classification must be, to a considerable extent, a matter of convenience, and the separation of these genera into two subfamilies does not completely meet the case. That they are not very distantly related may be at once conceded, but that is true of many accepted Amphipodan families.

Since there are now recorded no fewer than eight genera of this cylindroidal or compressed Amphipodan type, with telson cleft more or less completely, it seems reasonable to establish for them a distinct family, for which the name *Prophliantidae* is suggested, the depressed forms with entire telson constituting the Phliantidae.

Of these genera one, *Prophlias,* is new. In some particulars it seems least specialized, and, in these, probably comes nearest to the condition of the ancestral forms of both the Prophliantidae and of the Phliantidae: there is something about it curiously suggestive of the Lysianassidae. In other characters it is quite unusual, in many linking up with *Kuria.* It is represented by a single species *P. anomalus* n. sp.

As regards *Biancolina,* it seems extremely probable that under the name *B. cuniculus,* Stebbing (1906) has united two entirely distinct forms, and, while his species may well prove to be correctly referred to the Ampithoidae, *Biancolina algicola* Della Valle should, in my opinion, be removed from that family. With the new Western Australian Amphipod described under the name *B. australis,* it is here included in the Prophliantidae.

A third species of *Bircenna, B. ignea* n. sp., also from Western Australia, is here named and described.

The distribution of the species, at present recorded, is mainly Australasian, eight out of the twelve (or perhaps thirteen) occurring in that area; the remaining four (or five) consisting of one of the two *Biancolina* spp. (Mediterranean) *Wandelia,* with one sub-antarctic American and one Japanese species, and *Kuria* from the neighbourhood of Sokotra. If the *Ceina sp.* taken by the Siboga Expedition near Sulu, proves to be actually identical with *C. egregia* (Chilton) it will be the only example of wide distribution of a species.

All species, however, are very small, and, from the nature of their habitat, likely to be taken only by chance; they seem never to have been secured except in small numbers. It is probable that careful search will reveal the family to be of very wide occurrence.

I desire to take this opportunity of recording my thanks to Mr. K. Sheard, of the South Australian Museum, for facilitating my examination of the material in that Collection, as well as for help in several other ways, not least of these being the undertaking to see the paper through the press; also, in acknowledging my indebtedness to Dr. A. G. Nicholls for his assistance in the making of the prepara-

tions required, and of the camera lucida drawings from which the illustrations have been made.

NOTE.—The term *parachelate* is proposed for that prehensile condition where a markedly convex palm or a produced thumb is relatively minute and *meets the base only*, of the dactyl. The description "minutely chelate" is obviously suitable only where the dactyl is small and fits against the tip of an equally small thumb.

PROPHLIANTIDAE, fam. nov.

Body compressed or cylindrical, rostrum minute or absent. Eyes present. Peraeon strongly developed. Pleon segments 5 and 6 generally reduced or coalesced. Side plates generally shallow. Telson short, cleft or apically incised. Antennae short, without accessory flagellum. Mandible without palp, molar generally vestigial or wanting. Lower lip with or without inner lobes. Palp of maxilla 1 usually reduced or absent. Maxilliped generally with inner plate well developed. Gnathopod 1 and 2 subchelate, parachelate, or simple. Branchial lamellae small. Uropods 1 and 2 biramous, uropod 3 variable.

With eight genera and twelve species.

1. Body compressed, carinate, side plates deep .. .. 2.
   Body sub-cylindrical, side plates shallow .. .. 4.
2. Fifth side plate very large, uropod 3 well developed, biramous. *Prophlias* g. nov. (1).
   Fifth side plate small, uropod 3 small, uniramous .. .. 3.
3. Side plates 1–4 shallower than their related segments, maxilliped outer plate large, telson apically cleft .. .. *Ceina* Della Valle (2).
   Side plates 1–4 deeper than their related segments, maxilliped outer plate small, telson cleft almost to the base .. .. *Kuria* Walker (3).
4. Telson apically incised or partly cleft, uropod 3 biramous. *Biancolina* Della Valle (4).
   Telson cleft to base, uropod 3 not biramous .. .. 5.
5. Pleon segments 5–6 small but distinct .. .. *Eophliantis* Sheard (5).
   Pleon segments 4–6 coalesced .. .. 6.
6. Pleopods biramous, uropod 3 uniramous.
   Peraeon segment 1 without ventral flange .. *Wandelia* Chevreux (6).
   Peraeon segment 1 with ventral flange .. .. *Bircenna* Chilton (7).
   Pleopods uniramous, uropod 3 without distinct ramus. *Cylindryllioides* Nicholls (8).

1. PROPHLIAS gen. nov.

Integument hard, calcified; body robust, compressed, sub-carinate; head deep, with minute rostrum; eyes round; mouth parts prominent; side plates not quite as deep as their related segments. Peraeon segments 4–7 and pleon segments 1–3 with postero-lateral corner produced into rounded tubercle, pleon segments 4–6 moderately well developed, but boundaries not distinctly indicated; telson deeply cleft. Antenna 1 short, stout, with large first segment; antenna 2 short, broad, flagellum wanting, the appendage carried flat upon the anterior surface of the head; labrum short, broad, entire; mandible with small molar on left appendage; lower lip with well-developed inner lobe; maxilla 1, inner plate small, one-segmented palp; maxilla 2, inner plate feeble, shorter than outer; maxilliped long, palp, 4-segmented, outer plate well developed, extending beyond second segment of palp, inner plate short, not reaching middle of first segment of palp.

Gnathopods slender, alike, subequal, subchelate, palm short, transverse, convex, dactyl short; peraeopod 3 has side plate, basos and meros greatly expanded, peraeopods 4 and 5 side plates relatively small, basos expanded; pleopods biramous, with peduncle relatively long and moderately produced mesially, two coupling hooks at postero-mesial angle; uropods biramous, 1–2 with long slender peduncle, rami short, unequal; uropod 3 peduncle stout, rami equal, stout and conical, rather longer than peduncle.

Remarks. This genus differs from all the others included in this family, excepting *Ceina* and *Kuria*, in its compressed condition and the degree of development of the side plates. Except, however, that it is compressed instead of depressed, it approaches the Phliantidae in its hard exoskeleton and deep side plates 1–4, and (apart from the unusual development of third peraeopod) recalls the *habitus* figure of *Phlias serratus* Guerin and *Heterophlias seclusus* Shoemaker.

There is likewise a remarkable resemblance to some members of that family in the antennae, but with the difference that it is the second antenna of *Prophlias* which is flattened and reduced. The first antennae arise close together near the middle line, separated only by the minute rostrum. The second are inserted more ventrally upon the anterior surface of the head, and are carried so flattened against that surface so that, in profile, they are difficult to recognize.

The pleopods, though modified, are less aberrant than in any other member of either the Prophliantidae (with the exception of *Ceina egregia*) or of the Phliantidae, while the urus and the uropods are little reduced. The third uropods, in particular, are almost normal; in size and proportions they come nearest to some of the Phliantidae, e.g. *Quasimodia barnardi* Sheard, where, however, only one stout ramus persists.

The expansion of the hinder peraeopods, also recalls the condition found in those flattened forms, but in *Prophlias* in peraeopod 3 it reaches an extreme development, and involves the side plate as well.

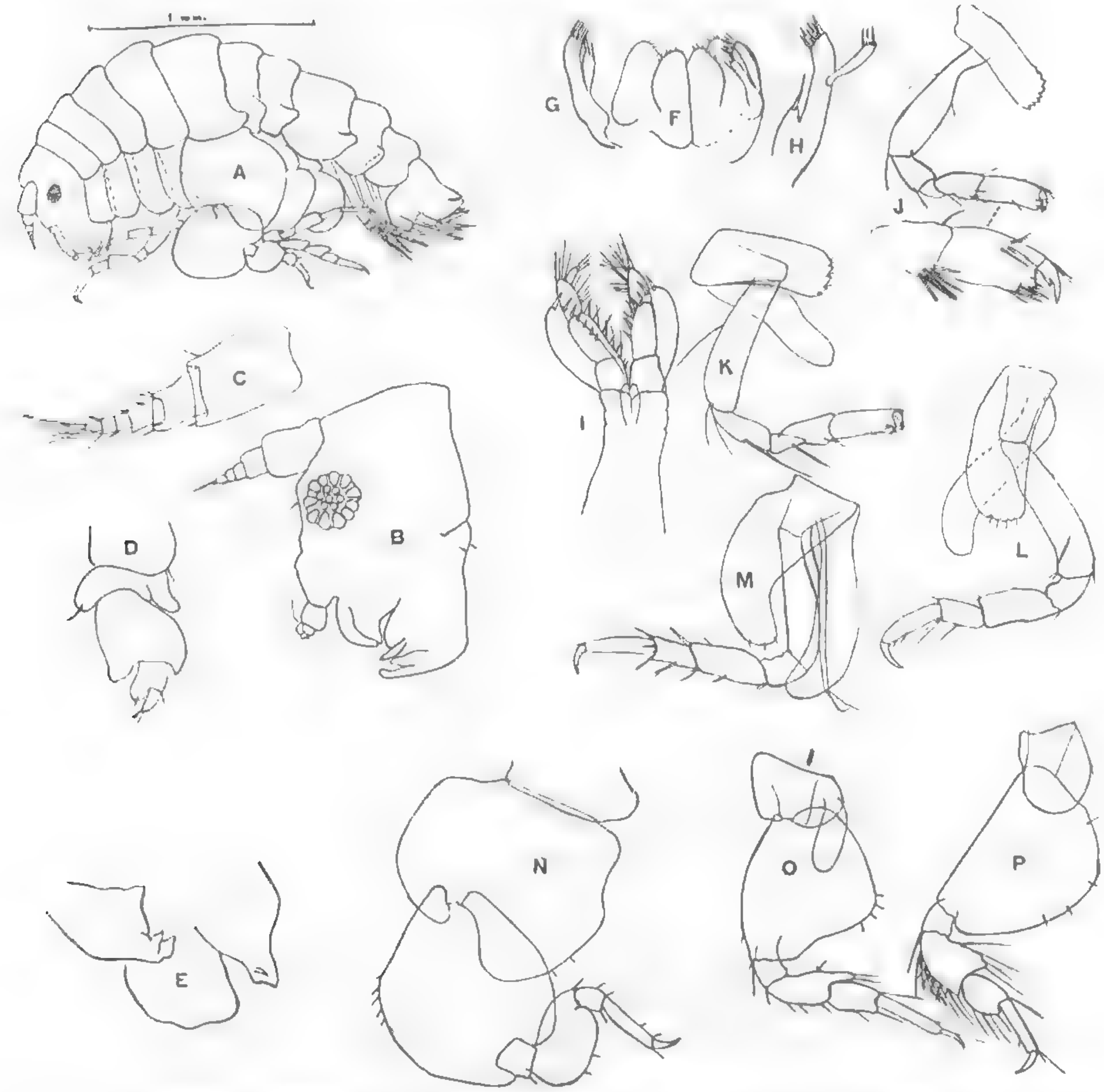


Fig. 1. *Prophlias anomalus*: A, ♀, lateral view; B, head (slightly flattened); C, antenna 1; D, antenna 2; E, labrum with both mandibles; F, lower lip with maxilla 2 still attached; G, maxilla 2 of opposite side; H, maxilla 1; I, maxilliped; J, gnathopod 1, with hand (enlarged) from another specimen; K, gnathopod 2; L, peraeopod 1, with gill; M, peraeopod 2 with gill and narrow brood lamella; N, O, P, peraeopods 3, 4, and 5 (peraeopod 4 with gill).

PROPHILIAS ANOMALUS sp. nov.

With the characters of the genus. A more detailed description of some of the appendages may be added.

Female. Antenna 1. First segment of peduncle very stout, second and third progressively shorter and more slender, flagellum 4-segmented with aesthetes on distal three segments. In *antenna 2,* only five segments were made out, the second with a well developed antennary cone, segments 1–4 flattened, the last short.

Labrum short and broad, with slightly sinuous free border.

The left *mandible* bears a reduced molar, its cutting edge apparently with two prominent teeth, the right with a small secondary cutting edge.

The *lower lip* is unusual in this family, with inner and outer lobes of almost equal size.

The *maxillae* seem to have undergone displacement: laterally occurs a pair of appendages, which I must suppose to be maxilla 1 with small inner plate armed with a single seta, while the moderately long palp appears unsegmented. Mesial, *and adhering upon dissection to the lower lip,* is the small maxilla 2, its inner plate, armed with few setae, shorter than the outer.

The *maxilliped* with very long basal segment, the distal (horizontal) portion bent upon the proximal almost at right angles, and consisting of a *relatively* short 4-segmented palp, the well developed outer plate armed mesially with spines, inner plate difficult to make out, but seemingly short and unarmed.

The side plates 1–3 increase progressively in length and depth, the ventral margins are notched, 2 and 3 bearing setae in the notches; 4 strongly emarginate behind, armed with a few setae. The gnathopods are unusual in this family (excepting *Ceina*) in that the propod is rather wide and the dactyl short, scarcely projecting beyond the short convex palm, thus producing a subchelate hand. It seems probable that the simple or the parachelate gnathopods found in most members of this family have arisen by reduction from an originally subchelate condition such as this. In the second gnathopod the ischium is particularly long, as in Lysianassids. Peraeopods differ from gnathopods in having the carpus linear and the propod narrow.

The third peraeopod is peculiar. The side plate is relatively immense, deeper than all the rest, rather longer than the combined length of side plates 1–4, and markedly bilobed. The basos is somewhat similar in shape and size, the meros broadly expanded. The limb appears to be partly retroverted (probably the distal 4 segments). Peraeopod 4 has basos expanded, narrowing rather abruptly towards its distal end; while the basos of 5 is more regularly convex behind, the fourth and fifth segments strongly spined. Small simple gills are borne on thoracic legs 2–6. The brood lamellae are long and strap-shaped (fig. 1 N).

The pleopods are biramous, the long peduncle being expanded mesially, two coupling hooks on inner distal angle. Uropod 1 longer than 2, inner ramus little more than half the length of outer; uropod 2 with peduncle slender, the linear rami subequal and shorter than peduncle, the inner ramus in both uropods 1 and 2 armed terminally with two setae and a stout spine, which may represent a second segment. Similar stout terminal spines are found in *Cylindryllioides, Bircenna, Eophliantis, Kuria,* and *Wandelia.* The third uropod has a short stout peduncle, the two rami stout, conical, equal and rather longer than peduncle.

The telson is cleft nearly to the base, each half tapering to a pointed extremity and armed with a single seta.

Length. From 1·5 mm.–3 mm. Eight examples were taken, Apr., 1939. Two large specimens dissected were both female—one with four embryos (0·3 mm. long). I cannot discern any difference which could be regarded as related to sex.

Colour. In spirit, pure white.

Loc. *Rottnest*, Western Australia. On west side of Bathurst Point, in fine sand and weed between large boulders where waves break continually. (Cotypes in South Australian Museum.)

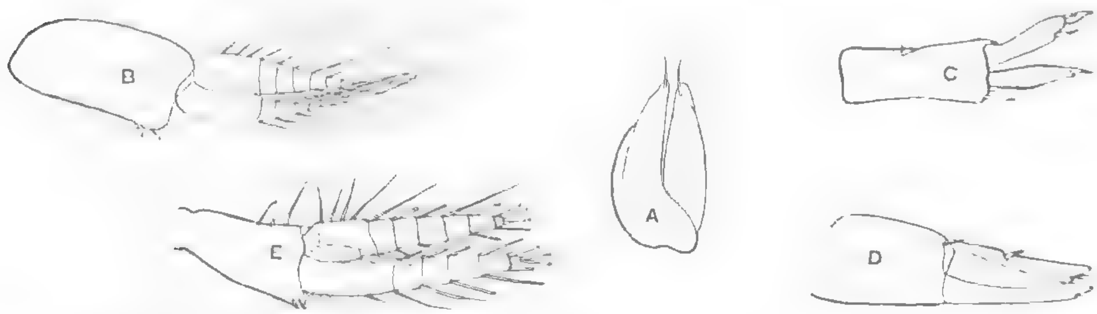


Fig. 2. A–D, *Prophlias anomalus*: A, telson; B, pleopod; C, D, uropods 1–3. E, *Ceina egregia* Chilton; pleopod.

2. CEINA Della Valle.

Della Valle, 1893; Stebbing, 1899 and 1906; Chilton, 1919; Pirlot, 1936 (*Periphlias*) and 1938.

Body carinate, moderately compressed, head small, not deep, without rostrum; eye small, red; peraeon segment 1 produced into "hood" overhanging the head, longer than second segment; pleon segments 4–6 reduced; telson apically cleft; side plates 1–4 less deep than related segments; side plate 5 bilobed, shallow.

Antennae short, slender, antenna 2 the longer; mandible with molar small, modified; lower lip with inner lobe slightly indicated; maxillipedes normal; gnathopods subchelate, gnathopod 2 (in male) chelate; uropods 1 and 2 biramous; uropod 3 uniramous.

Remarks. Just as this paper was practically completed, my attention was directed by Mr. Sheard to Pirlot's references to this genus, who kindly sent me a copy of that author's later paper. Pirlot's description (under the generic name *Periphlias*) of his species *carinatus* had suggested that the Amphipod in question was a fairly typical Phliantid. In 1938 the genus *Ceina* is listed among the Talitridae, and the species *carinatus* sunk in *egregia*. The genus differs, so far as at present known, from all of the remaining members of this family, as well as from all of the Phliantidae, in the condition of the second gnathopod of the male. That condition, however, differs, in degree only, from what I have called the parachelate, and, since several of the species here recorded are known from the female only, *Ceina* may prove not to be peculiar in this feature.

With one species.

CEINA EGREGIA Chilton.

Chilton, 1883, p. 77, pl. ii (*Nicea*); Della Valle, 1893, p. 530, pl. lviii, figs. 14–21; Stebbing, 1906, p. 54; Chilton, 1919, p. 120, figs. 1–25; ? Pirlot, 1936, p. 295, figs. 121–3, and 1938, pp. 329–30.

Remarks. Pirlot (l.c. p. 330) considers that, apart from the shape of the head (which he says Chilton has figured incorrectly), the discrepancies between his account and that of Chilton are to be attributed to the smaller size of his Siboga specimen.

While that may well be true of the antennae and perhaps of the mandible, the carpus of peraeopod 5, and the dactyl of 4 and 5, it is rather unexpected to find changes (consequent on growth) such as those in side plates 1 and 4 or the meros of peraeopods 3 and 4. In view of the fact that *C. egregia* has apparently a limited distribution in New Zealand, it seems quite possible that the Sulu specimen will prove to belong to a distinct species.

3. KURIA Walker.

Walker, 1903; Stebbing, 1906; Sheard, 1936.

Body compressed, head small, partly concealed by first side plate, without rostrum; side plates 1–4 deeper than their related segments; pleon segments 4–6 coalesced; telson divided almost to the base. Antennae subequal, short, few segmented. Mandible with dentate primary and secondary edges; molar rather large; maxilliped with both plates small, especially the outer. Gnathopods alike, slender, subequal, subchelate; peraeopods 3–5 very robust; side plates moderate, basos and meros well expanded. Uropods 1 and 2 with peduncle shorter than the rami, which are equal and similar; uropod 3, the single ramus as long as peduncle.

Remarks. Of this genus, Walker remarks that it is very aberrant, but apparently most nearly related to *Bircenna* which, as he points out, "seems . . . . out of place with genera such as *Perionotus*, *Iphinotus*, etc".

The generic definition given by Walker has been somewhat amplified, additional characters being introduced for comparison with *Prophlias*, to which, much more than to *Bircenna*, does it show kinship. From *Bircenna* it differs most conspicuously in its compressed body and deep side plates, in both of which it resembles *Prophlias*.

With one species.

KURIA LONGIMANA Walker.

Walker, 1903, p. 228, pl. xiv B, figs. 5–5n; Stebbing, 1906, p. 726; Chilton, 1909, p. 63; Sheard, 1936, pp. 457 and 463.

Remarks. It is of interest that while this species has so much in common with *P. anomalus*, it yet differs quite strikingly in numerous details; and one or the other may retain a less specialized condition in respect to any given character. Thus in *Kuria* the head appears less deep, the side plates deeper. Side plate 4 is large, excavate behind, principally dorsally; side plates 5, 6, and 7 are apparently small and alike, whereas in *Prophlias* side plate 4 is curved and slender (that is, greatly excavated), and side plate 5 is extraordinarily developed. In *Kuria* it is the basos of peraeopod 5 which makes the largest contribution to the lateral shield, in *Prophlias* the basos of peraeopod 3 is most developed. Uropod 3 is reduced in size and uniramous in *Kuria*, whereas in *P. anomalus* it is well developed and retains the more generalized equal biramous condition.

Similarly with the head appendages. *Kuria* shows both antennae unmodified except that they are small, and few segmented, the peduncle being scarcely distinguished from flagellar portion.

In *Prophlias* the second antenna is curiously modified, and so flattened down upon the head that under cursory inspection it appears absent. In the mouth parts the mandible is less reduced in *Kuria*, but *Prophlias anomalus* (alone of the members of this family in which the mouth parts are fully described) has the first maxilla moderately complete, and the lower lip well developed and bilobed, in which latter it is approached by the condition in *Biancolina*.

The maxilliped of *Kuria* shows the outer plate almost vestigial, whereas in *Prophlias* it is the inner plate which is very reduced.

In both species the ischium is unusually long in the gnathopods, and the hands more nearly retain the subchelate condition, although in *Kuria* the dactyl is shown extending well beyond the palm, approaching the condition for which I have proposed the term *parachelate*.

Notwithstanding these differences *Kuria* and *Prophlias* constitute a distinct group in this family remote from the more vermiform genera—*Biancolina*, perhaps, providing a link.

4. BIANCOLINA Della Valle.

Della Valle, 1893, p. 562; Stebbing, 1906, p. 646, part.

Body slightly compressed, peraeon strongly developed, segments subequal, pleon segments 4–6 not greatly reduced. Head longer than deep, as long as combined length of peraeon segments 1 and 2. Eye small, round, red. A moderately well developed intersegmental region or "neck"; antenna 1 longer than antenna 2. Labrum wide, short, its anterior border slightly emarginate. Mandible with toothed cutting edge, without molar.

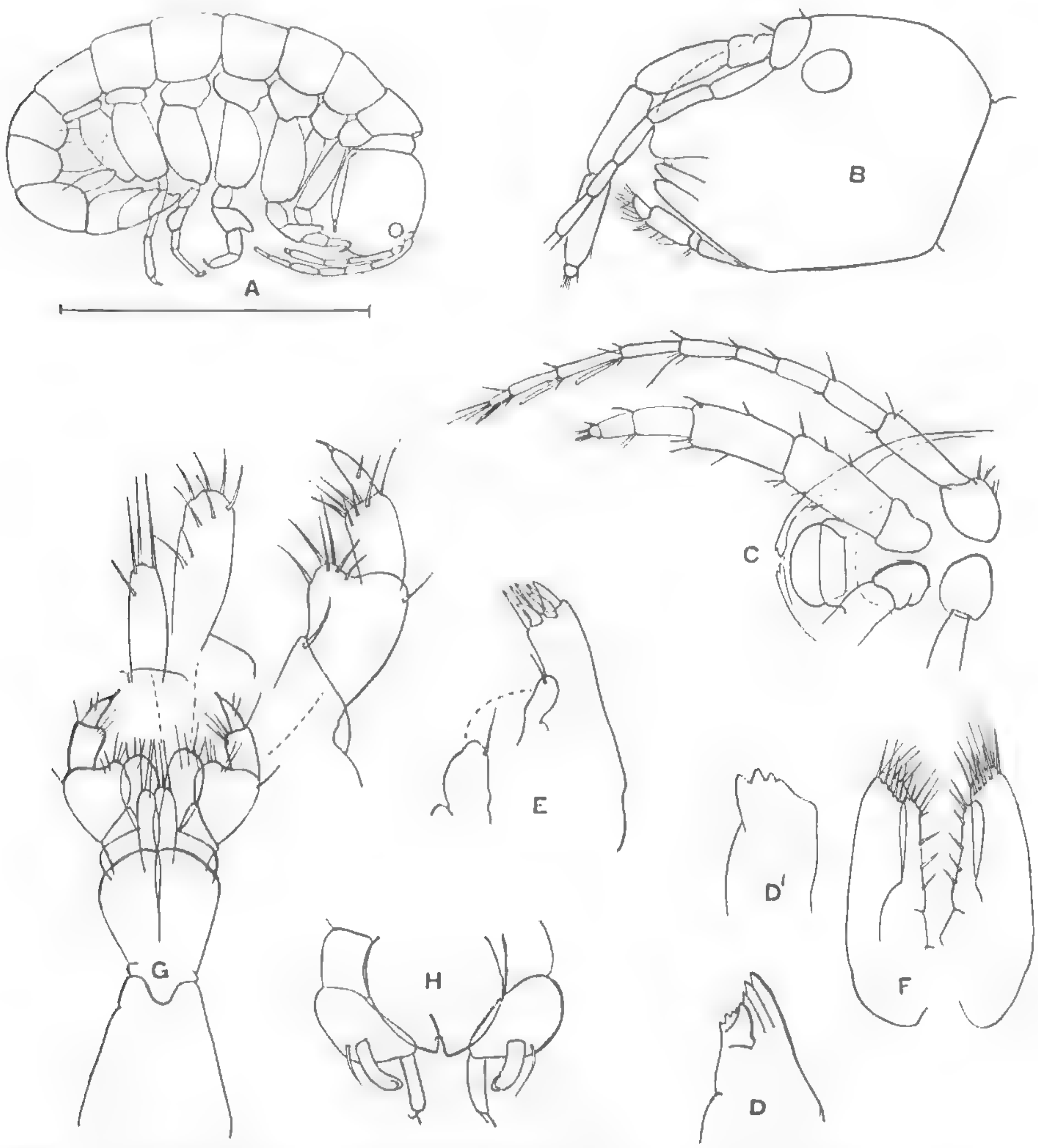


Fig. 3. *Biancolina australis*: A, ♀, lateral view; B, head; C, head, antero-dorsal view, showing insertion of antennae, and labrum with an overlying plate which from its position can scarcely be a rostrum, but may be an epistome; D, D', mandibles; E, maxilla 1, with inner plate from opposite side; F, maxilla 2; G, maxilliped, with plates and palp more highly magnified; H, telson and uropod 3.

Lower lip with large inner lobe; maxilla 1 without palp, inner plate small with single seta; maxilla 2 small, inner plate slender with few terminal setae, and others scattered along its mesial border. Maxilliped with small inner plate, palp three- or four-segmented.

Side plates shallow, gnathopods slender, subchelate or parachelate. Peraeopods 1–5 with basos expanded, oval; 1–2, robust with expanded meros; 3–5 slender with short narrow carpus, propod and dactyl forming prehensile, parachelate hand.

Pleopods with wide rami, peduncle, therefore, not appearing widened mesially. Uropods biramous, peduncles lamellar; those of 1 and 2 provided with plumose setae on their lateral border.

Telson apically cleft or emarginate.

Remarks. The likeness of the Western Australian species to that from the Mediterranean is extraordinarily close, extending frequently to such minute details that their close kinship is scarcely open to doubt. The head is, however, altogether unlike that figured by Stebbing (1874, fig. 1b) for *Ampithoe cuniculus*, with which that author had identified (1899) Della Valle's species. This species described by Stebbing from the English littoral is more than three times the length of that from the Mediterranean, and his suggestion that Della Valle's small specimens were but juvenile females (1906, p. 647) was apparently an assumption, for, in uniting these forms (1899, p. 350), Stebbing did not claim to have examined the Mediterranean species. The Western Australian specimen is equally small, but is fully adult (a female with embryos).

It seems probable, therefore, that this identification is mistaken, and that the two European forms are, as Della Valle believed, generically distinct and referable to different families.

Like *Prophlias anomalus*, the Australian species of *Biancolina* Della Valle departs in several particulars from the Bircennid facies, but these differences appear, in every case, as retentions of a more primitive (i.e. less reduced) condition. In the relative length of the peraeon segments this genus is in close agreement with *Kuria*.

With two species, known from female only.

Telson apically emarginate, uropods 1 and 2 with peduncle armed with few setae and with rami unequal .. .. *algicola*.
Telson apically cleft, uropods 1 and 2 with peduncle armed with several setae, rami subequal .. .. *australis*.

BIANCOLINA ALGICOLA Della Valle.

Della Valle, 1893, p. 562, pl. iii, figs. 11 and 32, figs. 38–53.

Biancolina cuniculus Stebbing, 1906, p. 647, part.

Remarks. Apparently known from two specimens only, probably female, 1·5 mm. in length. Bright yellow in colour. Taken in water less than 1 m. in depth in the Bay of Naples.

BIANCOLINA AUSTRALIS sp. nov.

Integument parchment-like. Body slender, sub-cylindrical. Head rounded, longer than deep. Eye small, round. Peraeon well developed, first segment not longer than second, side plates shallow, scarcely touching, pleon downturned, segments distinct, urus not extremely reduced, telson cleft at apex.

Antennae arising close to middle line on antero-dorsal surface of the head. Antenna 1 slender with rounded basal segment, remaining segments without differentiation into peduncle and flagellum, linear, 10 segments, with setae and with

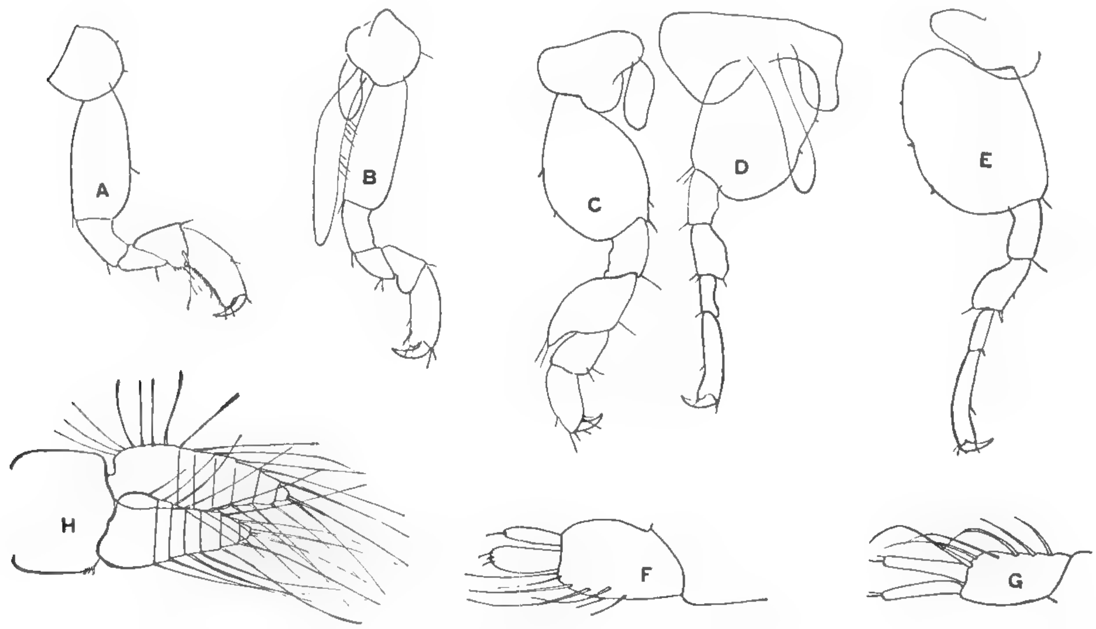


Fig. 4. *Biancolina australis*: A, gnathopod 1; B, gnathopod 2; C, D, and E, peraeopods 2, 3 and 4; F, G, uropods 1 and 2; H, pleopod.

aesthetes on 7, 8, 9. Antenna 2 stouter and shorter than antenna 1, only five distinct segments, with scattered setae, the last segment minute. Labrum wide and shallow, its free border faintly emarginate.

Mandibles exactly as in *algicola*: lower lip not seen; maxilla 1, with small inner plate armed with single seta, outer plate stout, with about seven stout spine teeth, palp wanting. Maxilla 2 and maxilliped agreeing with those of *algicola*, except that the appendages of *australis* are apparently slightly more setose, and that the palp is four-segmented (Della Valle shows but three, perhaps overlooking a basal segment). Gnathopods nearly alike, the hand rather closely resembling that of *Bircenna* (*B. nichollsi* and gnathopod 2 of *B. ignea*), the dactyl overlapping considerably the short convex palm. The carpus, however, is shorter and more triangular in outline, as in *Prophlias*. In gnathopod 1 the hinder border of carpus and propod is armed with close-set setae, appearing denticulate.

Peraeopods 1 and 2, short and stout, with sub-oval basos and wide decurrent meros; peraeopods 3–5 longer and more slender, basos uniformly expanded with few crenations and setae, meros less widened, carpus distinctly narrowed, propod long and curved, and with the dactyl apparently prehensile on a minute palm. Short simple gills on thoracic legs 2–5, brood lamellae wider than in *Prophlias*. The pleopods biramous, wide peduncle with three coupling hooks, the rami being so broad that the expansion of the peduncle is less obvious.

Uropods biramous; uropod 1, peduncle wide, longer than rami, inner ramus more slender and slightly shorter than outer; uropod 2, peduncle shorter and narrower than in uropod 1, subequal to rami, which are slender and equal. In both uropod 1 and 2 the outer aspect is set with long plumose setae more numerous than in *algicola*. Uropod 3 lamellar with two equal slender rami and one long seta. The inner ramus is straight, and bears two terminal setae; the outer is curved, its apex upturned, and bears a terminal hooked spine.

Size. Length as figured, 1·3 mm. Female, four embryos.

Colour (in spirit) pale yellowish-green.

Loc. Rottnest, Western Australia. West of Bathurst Point, in sand and weed among boulders with waves breaking continually. Collected Apr., 1939.

Remarks. The likeness to *algicola* is astonishingly close, and in size the two species also agree. Of the Prophliantidae, this genus has undergone least modification of the pleopods and least reduction of urus and uropods. In its external form its shallow side plates, its antennae, mouth parts, gnathopods, etc., it has attained the condition typical of the family.

5. EOPHLIANTIS Sheard.

Peraeon strongly developed (sub-cylindrical). Head almost spherical, separated by well-marked neck from the first peraeon segment, which is little longer than second, without sternal flange. Side plates shallow. Pleon segments 4–6 distinct. Telson small, upturned, cleft to base. Antennae short, slender, subequal, the first slightly longer; molar present on right mandible; maxilla 1 with palp vestigial; gnathopods simple, 1 moderately slender, 2 longer and more slender, with distal end of propod produced into slight tooth; peraeopods 3–5 with basos broadly produced, peraeopod 5 the longest; pleopods biramous, 2–3 with peduncle widely expanded. Uropods 1 and 2 biramous, uropod 3 a very small bilobed structure.(1)

(1) Mr. Sheard informs me that a re-examination of the type confirms his original description of this appendage as "biramous".

Remarks. Very near to *Wandelia,* from which it is distinguished by relative shortness of first peraeon segment, the shallowness of the side plates, the simple gnathopods, the expanded peduncles of pleopods 2 and 3, and the condition of the third uropod.

With one species.

EOPHLIANTIS TINDALEI Sheard.

Sheard, 1936, p. 457, figs. 1–2.

Remarks. Through the kindness of Mr. K. Sheard I have been able to examine a cotype of this species.

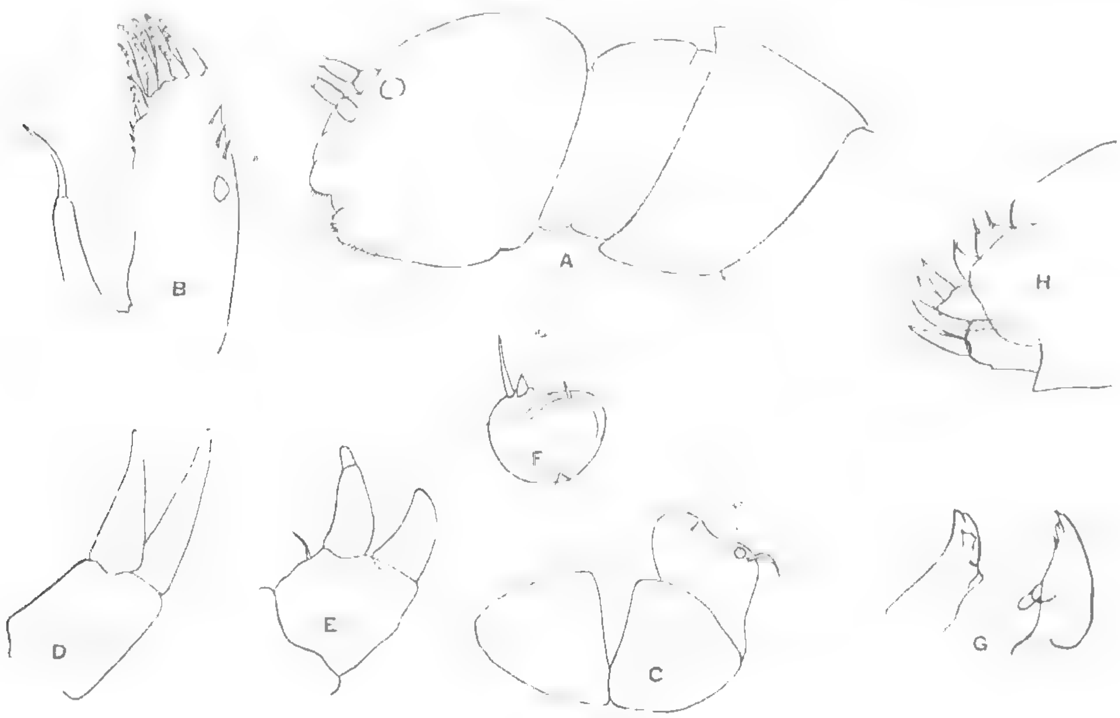


Fig. 5. A–F, *Eophliantis tindalei* Sheard: A, head and peraeon segment 1, lateral view; B, maxilla 1; C, telson with uropod 3 in position, in dorsal view; D, E, uropods 1 and 2; F, uropod 3 dissected out. G–H, *Wandelia crassipes* Chevreux G, mandibles; H, urus in side view.

In the first maxilla I find the palp represented by a vestige only (fig. 5 B). Mr. Sheard, to whom I have referred this point, has examined further material, and, in a recent letter, states that he is able to confirm this. Further, in the very small specimen (possibly very immature) which I have examined, the two lobes of uropod 3 are not separate from the peduncle. The species may prove to be less distinct from *Wandelia crassipes* than has been supposed, and a study of more abundant material render it necessary to transfer this species to *Wandelia.* Judging from

Sheard's figures, there seems to be a small difference in the first and second uropods of male and female, the first pair in the female and the second in the male being the longer.

6. WANDELIA Chevreux.

Body robust, sub-cylindrical; head without rostrum. Eye small, oval. First peraeon segment much longer than second, its sternite not produced into ventral flange. Pleon segments 4–6 reduced. Telson cleft to the base.

Antennae short, slender, sub-equal, the second slightly the longer; upper lip with margin entire, rounded; mandible with vestigial molar; first maxilla without palp; maxilla 2 with outer plate longer than inner; maxilliped with inner plate longer than outer, palp 4-segmented.

Gnathopods alike, slender; ischium long, propod produced into a small tooth; peraeopods short and stout; 3–5 with basos expanded; pleopods biramous, with peduncle only moderately widened; uropods 1 and 2 biramous, 3 with single ramus incompletely marked off from peduncle.

With two species.

Head sub-globular, gnathopods long and slender, peraeopods 3–5 with carpus linear .. .. *crassipes*.
Head longer than deep, gnathopods short, peraeopods 3–5 with carpus expanded and decurrent .. .. *japonensis*.

WANDELIA CRASSIPES Chevreux.

Chevreux, 1906, p. 45, figs. 24–6; Chilton, 1909 (*Bircenna crassipes*), p. 59; Chevreux, 1913 (*B. crassipes*), pp. 113–4; Sheard, 1936, p. 460 (*B. crassipes*).

Remarks. This species differs from *Bircenna* spp. chiefly in the absence of the sternal flange on the first peraeon segment. Other differences are found in the gnathopods and pleopods. In the second, figured by Chevreux, the peduncle is shown having a width one-and-a-half times as great as the length. In preparations made [2] by Chilton, one of the pleopods, probably the first, shows the peduncle only as wide as long. In *Bircenna*, as noted below, all of the pleopods have the peduncle expanded, the width being twice the length. In *Prophlias*, as already stated, the more usual Amphipodan condition is found with length of peduncle greater than width, although some widening is evident. In every case, however, the expansion is mesial, so that the rami of any pair of pleopods tend to be more widely removed, and the peduncles to come into contact.

(2) In one particular this specimen appears to differ from that described by Chevreux. The partly dissected head shows the two mandibles still attached. The left is as figured by Chevreux but the right *seems* to have a prominence representing the molar.

The third uropod is said by Chevreux to possess a short peduncle from which the lamellar ramus is not distinctly separated, whereas in *Bircenna fulva*, according to Chilton (1909), the third uropod consists in but a single bifid segment.

WANDELIA JAPONENSIS sp. nov.

Description. ♀. Body robust, sub-cylindrical; head longer than deep; eye small, oval; first peraeon segment considerably longer than second; side plates very shallow, widely separated, telson appearing oblong, with corners rounded, cleft to the base.

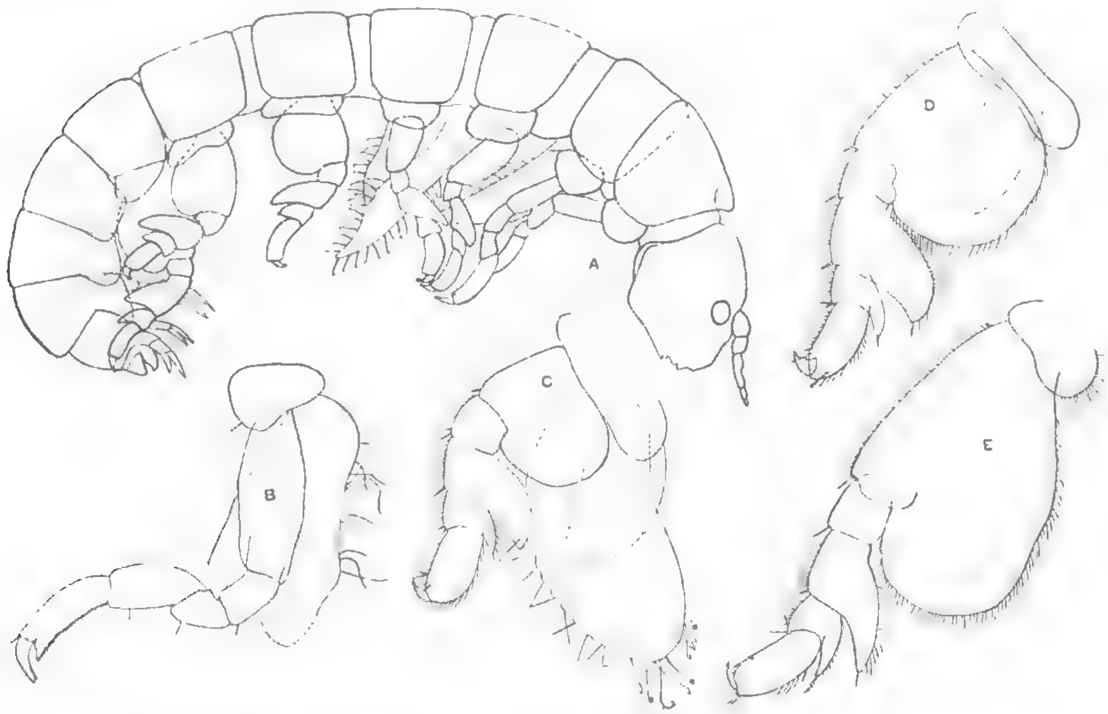


Fig. 6. *Wandelia japonensis*: A, lateral view (♀); B, gnathopod 2; C–E, peracopods 3–5.

Antennae short, sub-equal; antenna 1 with six segments, aesthetes on the last two; antenna 2, also with six segments, slightly longer and stouter than antenna 1; upper lip, mandibles, maxillae, and maxillipeds as in *crassipes* except that the inner plate of maxilla 1 appears to bear but a single seta.

Gnathopods alike, parachelate; less slender and relatively shorter than in *crassipes*, ischia not unusually long, propod in gnathopod 1 minutely denticulate, its distal end produced into blunt tooth-like prominence. Peracopods robust; 1 and 2 with basos oval, 3–5 with basos expanded, but the hinder border not crenate, the carpus as well as the meros expanded and decurrent; most of the segments fringed with setae.

Pleopods, with peduncle comparatively little expanded mesially, most noticeably in pleopod 3, which is shortest; in 1 and 2 there is a marked production of the peduncle distally along the mesial edge of the inner ramus.

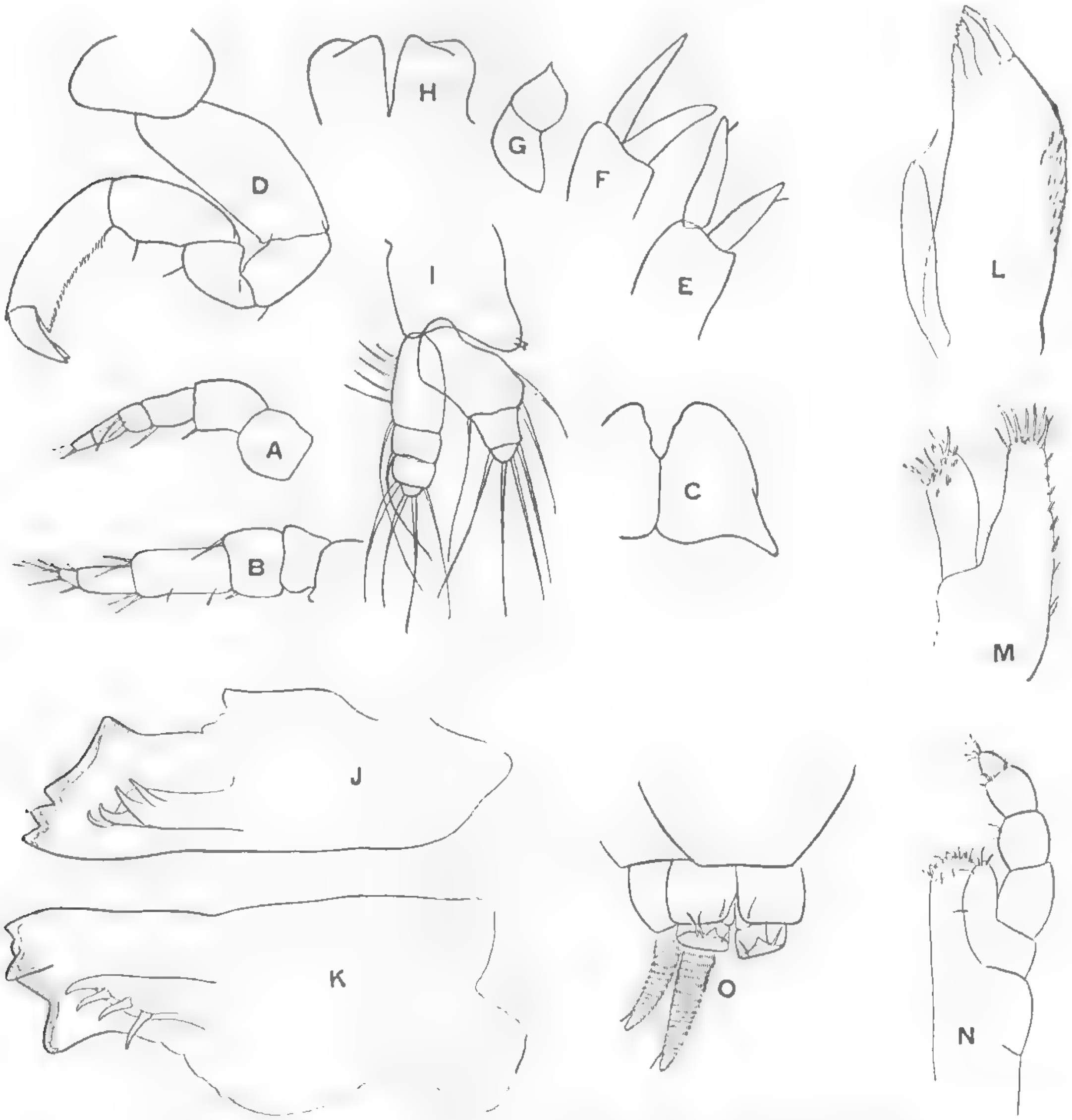


Fig. 7. A–I, *Wandelia japonensis*: A–B, antennae 1 and 2; C, lower lip; D, gnathopod 1; E–G, uropods 1–3; H, telson; I, pleopod 3. J–O, *Wandelia japonensis* (Chilton's figs.): J–K, mandibles; L–M, maxillae 1 and 2; N, half maxilliped; O, uropod 2, uropod 3, telson.

Uropods 1 and 2 alike, sub-equal, 3 with ramus indistinct (?).

Size: 3·5 mm. Three ♀ ♀, two with fully-developed brood pouch.

Loc. Otaru, Hokkaido, Japan. Coll. Dr. Hatta, "From the Medulla of *Undaria*".

Remarks. These specimens form part of Dr. Chilton's collection of Amphipoda, and seem not to have been described. They were labelled *Bircenna japonensis* n. sp., but lack, however, the flange on the first peraeon segment, which is characteristic of *Bircenna.* From *Wandelia crassipes* they differ most noticeably in the long *Caprella*-like head (*crassipes* apparently agreeing with *Eophliantis tindalei* in having the head sub-globular), in the shorter and stouter gnathopods, and in the oval basos of peraeopods 1 and 2. The long first peraeon segment is found in both *crassipes* and *japonensis.* The mouth parts and peraeopods are strikingly like those of *crassipes* excepting that more of the joints are widened and decurrent, and many are abundantly fringed with setae, which is unusual in this family.

Of interest is the occurrence of a short tendril-like twisting at the ends of many of the setae of the brood lamella. In the specimen dissected, so firmly were the lamellae linked by this device that they would more readily tear than separate. A similar twisting of these setae has been observed in *Ceina egregia, Bircenna ignea, Cylindryllioides mawsoni,* and in a new and undescribed Western Australian species of *Quasimodia.* In *Prophlias,* setae were wanting from most lamellae, but when present they show a slight apical twisting. It will probably prove to be of general occurrence in both the Prophliantidae and the Phliantidae.

Since writing the above notes, Mr. Sheard has informed me that he has obtained, through the courtesy of the Canterbury University Museum, New Zealand, manuscript and drawings of the late Professor Chilton referring to this species. These notes and drawings, which were made from a relatively fresh specimen, substantially agree with my own observations.

With regard to the mouthparts, uropod 3, and telson, Chilton states: "The first maxilla has no sign of a palp, the outer lobe is strong with tufts of setae near the middle of the outer margin and about 6 or 7 stout, dentate teeth at the extremity; the inner lobe is slender, slightly more than half as long as the outer, and ends in a single fine setae.

"The second maxilla has the two lobes of about the same size, the setae at the extremity of both lobes are rather stouter than usual in this appendage; the outer lobe has also several tufts of fine setae on its outer margin and a fringe of fine setae on its inner margin.

"The mandibles are slender, entirely without palp, and there is no molar tubercle; the cutting edge is broad, formed of three or four teeth, one larger than the others and triangular; the accessory process is small, and in each mandible ends in four very sharp curved teeth. The third uropod consists of a single piece which may represent the peduncle and ramus combined. The extremity curves upwards, and is shown in the figure as bent back on its more proximal portion; it ends in a short sub-acute tooth, with two setae on its outer side and one on its inner. The telson appears cleft to the base, each half is rectangular, and bears a fine seta at the inner distal angle."

Chilton's figures of these parts are reproduced (fig. 6, P–U).

Mr. Sheard has called my attention, also, to the fact that Stephensen (Trans. Sapporo Nat. Hist. Soc., Vol. 13, 1933) had published a description of a new Japanese Amphipod very probably from the same locality as *W. japonensis*, which he named *Ceinina japonica.* This was said to be taken on brown algae, and was referred by Stephensen to the Talitridae.

It seems probable that, like *Ceina*, it should also be assigned to the Prophliantidae, but I am unable to determine this, as no copy of Stephensen's paper is available to me.

It is, of course, a possibility that it may prove to be identical with the species here referred to *Wandelia*. As set out, above, this species differs in several details from *W. crassipes*, but these differences seem scarcely sufficient to warrant the establishment of a new genus.

7. BIRCENNA Chilton.

Body sub-cylindrical; head large, sub-spherical, without rostrum; eyes small, round or oval. First peraeon segment longer than second; its sternite ventrally produced into a deep, curved transverse flange, the concavity forwardly directed. Pleon segments 4–6 greatly reduced. Telson cleft to the base.

Antennae short, slender, sub-equal, the first slightly larger; mandible with molar weak or wanting; first maxilla without palp; maxilliped with palp four-segmented; gnathopods short, moderately stout, parachelate or imperfectly subchelate; peraeopods 3–5 with basos expanded; pleopods biramous, with peduncles broadly produced mesially; uropods 1 and 2 biramous, 3 with single ramus incompletely indicated.

With three species.

1.	Molar wanting on mandible	*fulva.*
	Weak molar present on both mandibles	2.
2.	Antennae slender, peraeopods 3–5 scarcely longer than depth of body	*nichollsi.*
	Antennae stout, peraeopods 3–5 longer than depth of body	*ignea.*

BIRCENNA FULVA Chilton.

Chilton, 1883 (*B. fulvus*), p. 264, pl. xxi, fig. 1; 1909 (*B. fulva*), p. 59, figs. 1–3; Stebbing, 1889 (*B fulvus*), p. 421, and 1906, p. 205; Sheard, 1936, p. 460, fig. 3.

Remarks. The rather scanty figures of this species given by Chilton have been supplemented by Sheard in a number of drawings made from preparations of a syntype. The figure (3 E) of maxilla 1 is, in my opinion, the complete appendage, otherwise it is difficult to reconcile with the condition of this appendage in the two remaining species of this genus, which appear in other respects very closely akin to *fulva*. It seems probable that the third member (fig. 3 G) is the detached outer plate of maxilla 2.

Chilton's *habitus* figure (1883, fig. 1) fails to show the greater length of the first peraeon segment on which, too, the ventral sternal flange is quite well developed.

BIRCENNA NICHOLLSI Sheard.

Sheard, 1936, p. 461, fig. 4.

Remarks. Since 1936, when the first specimen (an ovigerous ♀) of this species was collected, numerous other examples have come to light not only from Sellick Reef but also from other localities in St. Vincent Gulf.

♂♂ are perhaps represented in the collection, but if so, differences between the sexes must be very slight, appearing only in gnathopods and uropods. So far as the gnathopods are concerned small differences, which I take to be related to sex, are seen in propod and dactyl, the former stouter and the dactyl shorter in the presumed male. In uropod 1 the inner ramus is the more slender, and is longer than the peduncle; uropod 2 shows the inequality of the rami more markedly; but these may prove to be merely individual variations. In uropod 3 the small conical ramus is very incompletely separated from the peduncular region, and in side view the appendage has the appearance of being bilobed. Pleopods 1 and 3 exhibit that projection at the proximal end of the outer margin of the inner ramus, to which Chilton has called attention in *fulva* (1909, fig. 1).

BIRCENNA IGNEA sp. nov.

Description. Body sub-cylindrical, rather short and stout; head nearly globular, more massive in the ♂; eye small, nearly round, with few ocelli (17–20), peraeon strongly developed, peraeon segment 1 much longer than 2; side plates very shallow; pleon segments 4–6 greatly reduced; telson completely cleft, the apices broadly rounded.

Antennae sub-equal, short, antenna 1 of ♀ with seven segments, all but the last of the four flagellar segments with aesthetes, antenna 2 slightly stouter, with six distinct segments; in the ♂ the antennae are markedly stouter, antenna 1 flagellum with five segments, four bearing bushy tufts of aesthetes. Upper lip

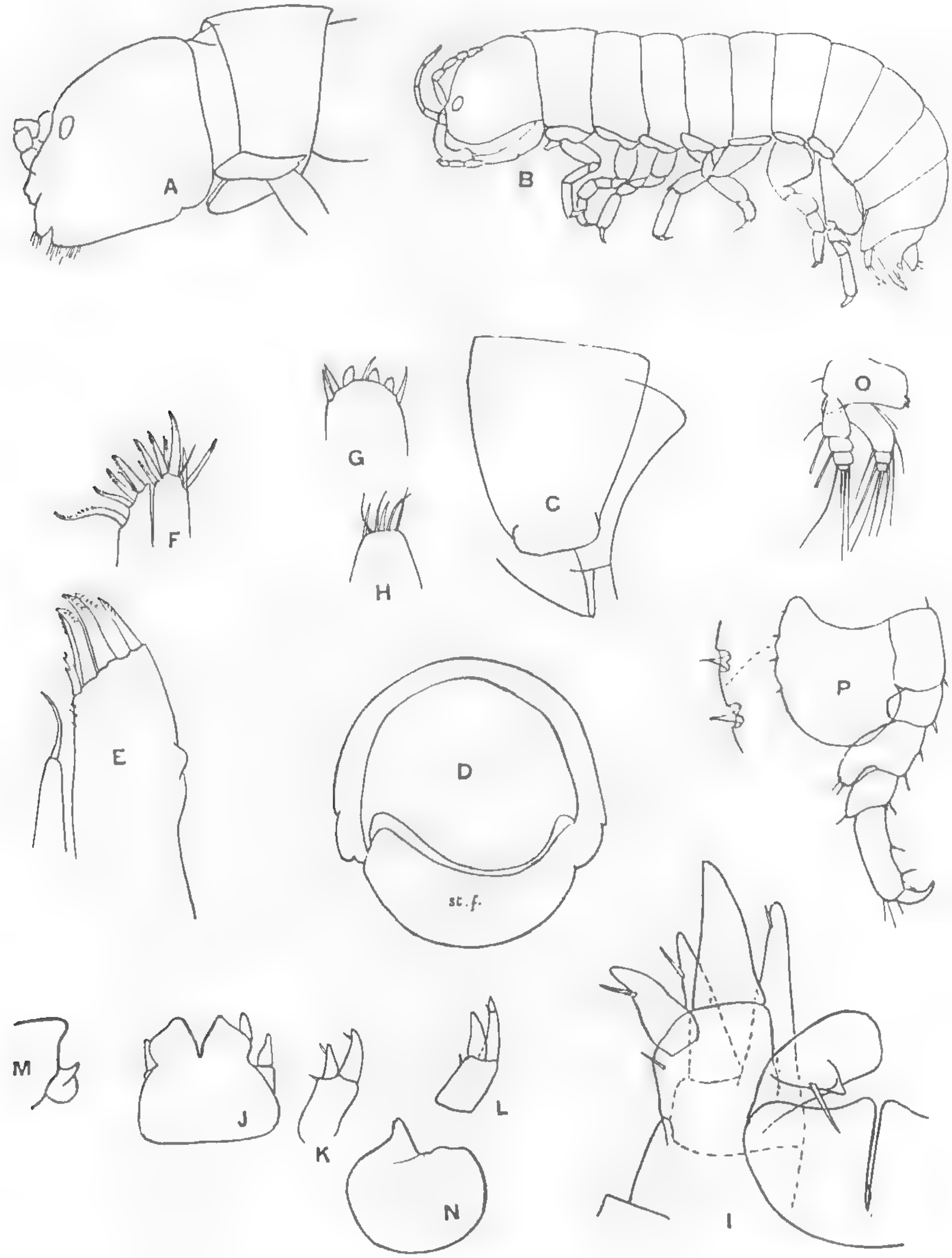


Fig. 8. A, *Bircenna fulva*: head and peraeon segment 1, lateral view. B–P, *Bircenna nichollsi* Sheard: B, entire animal, lateral view; C, peraeon segment 1, from the side, and D, from the front; E, maxilla 1; F, distal part of maxilla 2; G, H, inner and outer plates of maxilliped; I, urus and uropods from above; J, the same partly dissected and somewhat flattened; K, L, uropods 2 and 1; M, uropod 3, lateral view; N, the same removed and more highly magnified; O, pleopod 3; P, peraeopod 5, with part of hinder border of basos enlarged.

rounded, wider than deep. Mandible with molar weak, primary edge not definitely toothed, minute secondary cutting edge with three slender teeth. Lower lip without inner lobes, rounded apices of outer lobes with setules; maxilla 1 with vestige of palp, inner plate with single seta reaching almost as far distally as the spines on outer plate; maxilla 2, with plates sub-equal, inner plate much less ob-

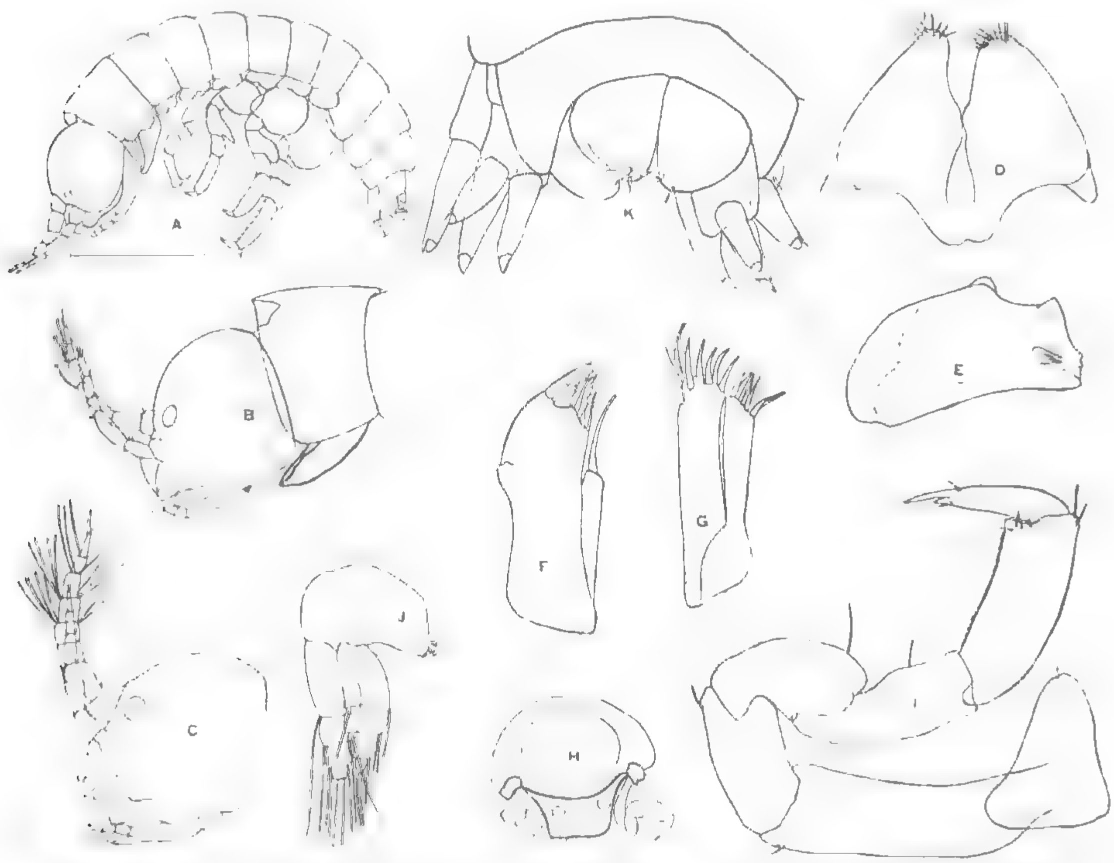


Fig. 9. *Bircenna ignea*: A, lateral view; B, head, with peraeon segment 1 (♀); C, head (♂); D, lower lip; E, mandible; F–G, maxillae 1 and 2; H, front view of peraeon segment 1; I, gnathopod 1; J, pleopod 3; K, urus, in dorsal view, uropod 3 removed from one side.

liquely truncate than in *nichollsi*. Maxilliped with outer plate armed with setae along its inner border, shorter than inner plate.

The sternite of the first peraeon segment downwardly produced, the curved plate showing a paired circular perforation (or perhaps merely thin transparent area).

Gnathopods alike, minutely parachelate, slender, gnathopod 1 carpus as long as propod, the latter with minute palm, slender dactyl as long as hinder border of propod; gnathopod 2 with dactyl about three-fourths of length of propod. Peraeopods stout, peraeopod 1 with postero-distal angle of propod produced into strong tooth, approaching the condition figured by Sheard for gnathopod 2 of *fulva* (1936, fig. 3R); peraeopods 4 and 5, expansion on hinder border of basos with but a single notch and seta. Uropods 1 and 2 stout, rami subequal and longer than peduncles, each bearing stout terminal spine; uropod 3, short lamellar with single small conical ramus. Apices of telson each bearing a seta and a spinule.

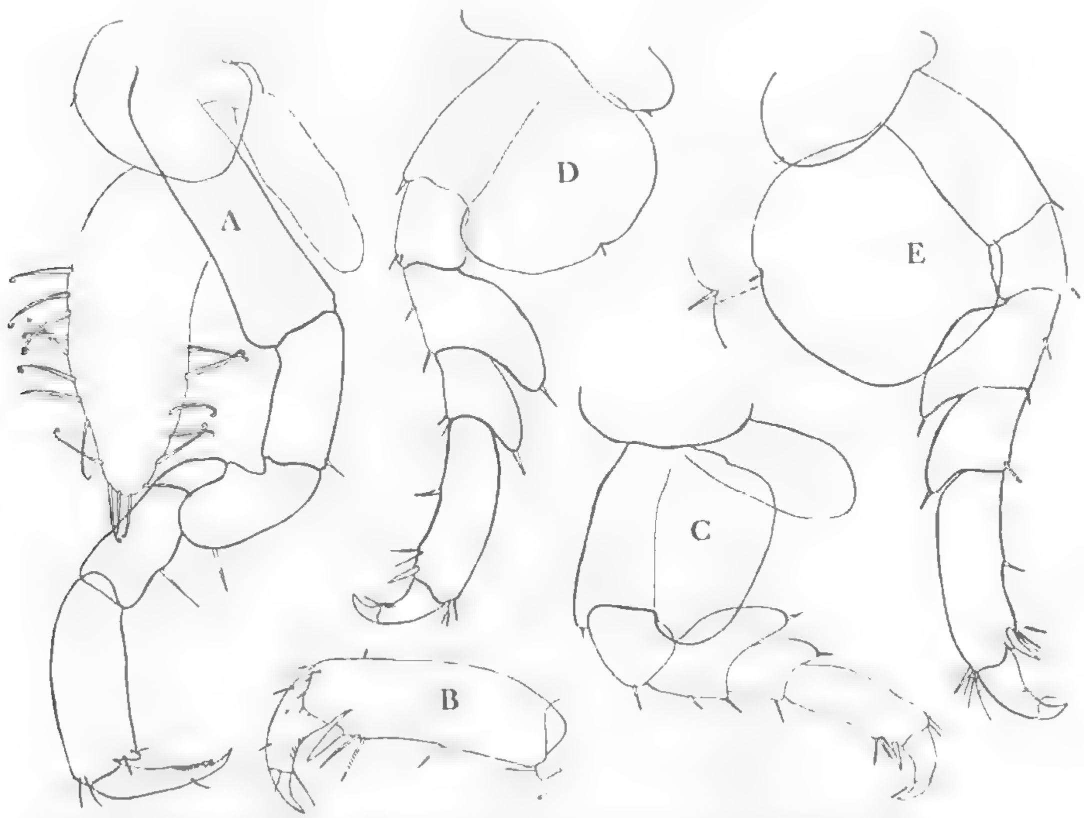


Fig. 10. *Bircenna ignea*: A, gnathopod 2; B, propod and dactyl, peraeopod 1; C–E, peraeopods 3–5.

Length: 1·5 mm.–2 mm.

Colour. A fiery red.

Loc. Amongst fine seaweed and sand; nearly a dozen specimens, including four ♂♂, taken in November, 1938, Shelly Beach, Nornalup, South-western Australia.

Remarks. All three species of this genus are very closely alike. From *nichollsi*, *ignea* may be distinguished by the lesser depth of its peraeon segments and the greater relative length of the hinder peraeopods. The expansion of the basos of these peraeopods (3–5) is greater in *nichollsi*, although the legs are actually shorter. There is a difference in the shape of the head of these two species. The antennae are distinctly stouter in *ignea*, the only species in which sex distinctions affecting the antennae have been seen. The eyes are larger, but seem to have fewer ocelli, which are black on a red pigmented ground. In *nichollsi* the ocelli are difficult to make out, but they appear to be more numerous and, in preserved specimens, quite black; the colour in life of this species is not recorded.

CYLINDRYLLIOIDES Nicholls.

Nicholls, 1938.

Body slender, sub-cylindrical. Head longer than deep, without rostrum, with sub-ocular incisure (?), and in the relaxed condition separated from the first peraeon segment by a wide intersegmental region or "neck". Peraeon long, first segment slightly longer than the second, and without ventral sternal projection. Side plates short and very shallow, widely separated. Metasome well developed, but pleon segments 4–6 greatly reduced without definite intersegmental boundaries. Telson minute, deeply cleft.

Antennae short, stout, subequal, 2 the shorter; upper lip rounded, with shallow median emargination; reduced molar on left (?) mandible; lower lip without inner lobes; maxilla 1 without palp; maxilla 2 plates sub-equal; maxilliped with short stout four-segmented palp, inner and outer plates sub-equal. Gnathopod 1 shorter than 2, otherwise alike, slender, parachelate; peraeopods short, stout, basos expanded in 3–5; pleopods with short peduncle, the single slender ramus with few segments; uropods 1 and 2 biramous, rami sub-equal, 3 peduncle lamellar, without rami.

With one species.

CYLINDRYLLIOIDES MAWSONI Nicholls.

Nicholls, 1938, p. 59, figs. 30, 31.

Remarks. Of all of the species of this family, this has attained most nearly to the vermiform condition.

The side plates are extremely reduced and widely spaced, the urus quite minute, and the pleopods with but a single ramus, the peduncle small and scarcely widened.

Taken at Macquarie Island, by H. Hamilton, in 1913.

With the exclusion, from the Phliantidae, of *Bircenna, Wandelia,* and *Kuria*, the remaining genera constitute a more coherent family, which may be defined as follows:

PHLIANTIDAE Stebbing.

Body depressed; peraeon side plates expanded. Pleon strongly flexed ventrally, subject to degradation. Antennae 1 and 2 very short. Antenna 1 with peduncle expanded, no accessory flagellum. Upper lip with distal margin usually undivided. Lower lip with or without inner lobes. Mandible without palp. Maxilla 1 without inner lobe, palp absent or one-jointed, small. Maxilliped with palp variable. Gnathopods 1 and 2 simple or subchelate.(3) One or more pleopods with peduncle expanded. Pleopod 3 with inner ramus subject to degradation. Uropod 3 usually not biramous. Telson short, entire, not upturned.

With 10 genera, 13 species, including a new and as yet undescribed *Quasimodia* species from Western Australia.

These are all to be readily recognized by their broadly depressed body, short entire telson, and wide side plates.

Rather similar side plates are met with in the more compressed Prophliantidae, and in *Biancolina* the telson is almost entire. In the mouthparts the families are sharply separated by the condition of the first maxilla, and, in both, parallel degeneration has occurred in one or more of the parts and of the pleopods—perhaps consequences of similar habitat and mode of life.

LITERATURE.

Chevreux, E. (1906) : *Exped. Ant. Franc.* (1903–1905), "Amphipodes".
Chevreux, E. (1913) : *Deuxieme Exp. Franc.* (1908–1910), "Amphipodes".
Chilton, C. (1884) : *Trans, N.Z. Inst.,* Vol. 16.
Chilton, C. (1909) : *Trans. N.Z. Inst.,* Vol. 41.
Chilton, C. (1919) : *Trans. N.Z. Inst.,* Vol. 51.
Della Valle, A. (1893) : *F. Fl. Neapel,* Vol. 20.
Nicholls, G. E. (1938) : *Austr. Ant. Exped.* (1911–1914), Sci. Rep. Ser. C, Vol. 2, pt. 4.
Pirlot, J. M. (1936) : *Siboga Expeditie* Mono., 33e.
Pirlot, J. M. (1938) : *Siboga Expeditie* Mono., 33f.
Sheard, K. (1936) : *Rec. S. Austr. Mus.,* Vol. V, pt. 4.
Sheard, K. (1937) : *Trans. Roy. Soc. Sth. Austr.,* Vol. 61.
Stebbing, T. R. R. (1874) : *Ann. Mag. Nat. Hist.,* Ser. 4, Vol. 14.
Stebbing, T. R. R. (1889) : *Ann. Mag. Nat. Hist.* Ser. 7, Vol. 3.
Stebbing, T. R. R. (1899) : *Trans. Linn. Soc. Lond.,* Ser. 2, Vol. 7.
Stebbing, T. R. R. (1906) : *Das Tierreich,* Vol. 21.
Stephensen, K. (1933) : *Trans. Sapporo Nat. Hist.,* Vol. 13.
Walker, A. O. (1903) : *Nat. Hist. Sokotra.*

(3) Mr. Sheard informs me that the word "sub" was omitted between the words "weakly" and "chelate" in his definition of the sub-family *Phliantinae* (Sheard, 1936, p. 463).

RECORDS

OF THE

SOUTH AUSTRALIAN MUSEUM

Vol. VII, No. 4

Published by the Museum Board, and edited by the Museum Director,
Herbert M. Hale

[illegible]

[illegible]

FOSSIL HUMAN SKULL FRAGMENTS OF PROBABLE PLEISTOCENE AGE FROM AITAPE, NEW GUINEA

By Frank J. Fenner, M.B., B.S., D.T.M., Assistant Physical Anthropologist, South Australian Museum, Adelaide.

Summary

This paper consists of a description of fragments of a fossil human skull found in situ in the Barida Area of the Aitape district of the Mandated Territory of New Guinea by Paul S. Hossfeld, now Senior Geologist of the Northern Australia Survey.

A short account of the discovery and geological surroundings of the specimen is given herewith from information communicated by the finder. Mr. Hossfeld intends to prepare a detailed geological description on his return from the extensive fieldwork on which he is at present engaged.

FOSSIL HUMAN SKULL FRAGMENTS OF PROBABLE PLEISTOCENE AGE FROM AITAPE, NEW GUINEA

By FRANK J. FENNER, M.B., B.S., D.T.M., Assistant Physical Anthropologist, South Australian Museum, Adelaide.

Plates xxiii–xxiv, Text-fig. 1–9.

This paper consists of a description of fragments of a fossil human skull found *in situ* in the Barida Area of the Aitape district of the Mandated Territory of New Guinea by Paul S. Hossfeld, now Senior Geologist of the Northern Australia Survey.

A short account of the discovery and geological surroundings of the specimen is given herewith from information communicated by the finder. Mr. Hossfeld intends to prepare a detailed geological description on his return from the extensive fieldwork on which he is at present engaged.

LOCALITY OF THE DISCOVERY.

The skull was found in 1929 and note was made of the fact at that time by Nason-Jones (1930) in the report of the operations in New Guinea of the Anglo-Persian Oil Company. The account reads, "From the ill-bedded blue clays of the Paniri Creek, which are typical of the argillaceous facies throughout the area, were obtained the following fossils, indicating the life of the period [Upper Wanimo, Pleistocene] which was very much that of the present day. Perhaps of most note is the record of a fragment of a human skull, which, together with carbonized coconut-shell, was found in a thin bed of Mollusca outcropping in the side of the stream. A further search for teeth or other remains was conducted without success, and the skull fragment remains in the possession of the finder, Mr. P. S. Hossfeld." There is no record of any other mammalian bones being present. The original specimen is now housed in the Australian Institute of Anatomy, Canberra.

Fig. 1 shows the locality of the find and a geological section of the area. The exact location is on the east bank of the Paniri Creek near Barida Village, Aitape, New Guinea, 10 miles inland and about 300 ft. above sea-level.

The skull was overlain by four feet of undisturbed littoral marine deposit and six feet of alluvial gravel. Above this was soil with primary forest (1). In

(1) Hossfeld makes the note "There are two types of forest in New Guinea, primary and secondary. The primary forest is the true virgin forest, the secondary may appear to be so but is in fact the forest which has grown up after the primary forest has been cleared for a temporary garden by the natives".

the littoral marine deposits in which the skull occurred several specimens of shells were collected. They include *Arca granosa* (marine), *Neritina cornea* (brackish water, mangrove), *Telescopium fuscum* (brackish water), *Cyrena coaxans* (fresh to brackish water), *Melania ?juncea, M. ?canaliculata, ?M. recta* (fresh water), *Laoma* sp., *Cyclophorus* sp., *Papuina* sp. (land shells). In addition there were partly lignified remains of (?) coconut husk. Pl. xxiii shows some of the shells found in close association with the skull. The determination of these was carried out by Mr. B. C. Cotton, conchologist at the South Australian Museum, whose comments are attached as a supplement to this paper.

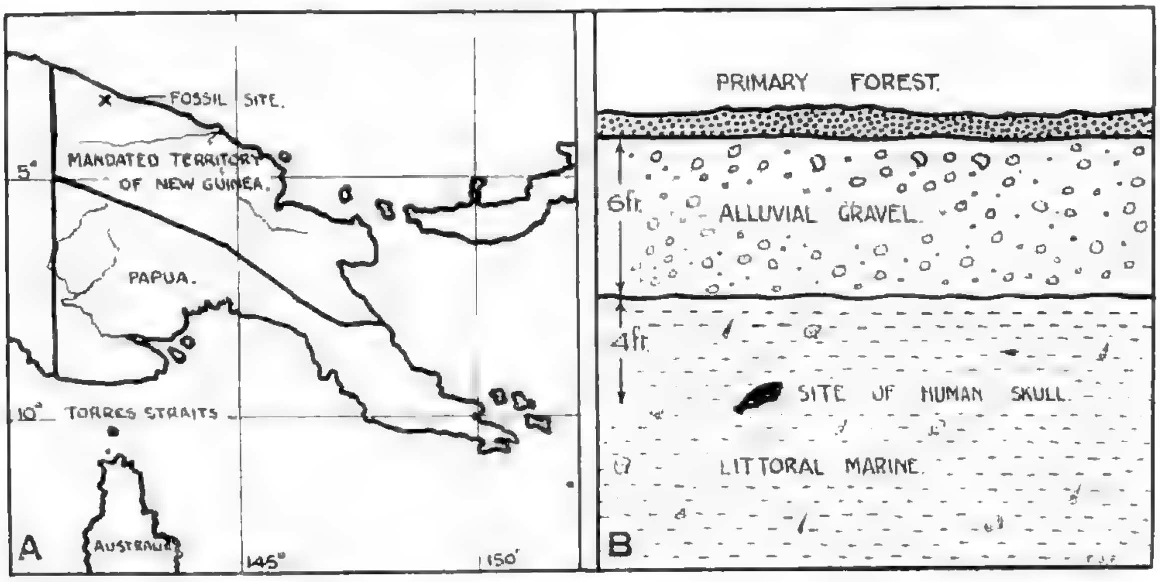


Fig. 1. A, Map of New Guinea showing locality of find. B, Diagrammatic section of beds to show occurrence of Aitape skull fagment.

PARTS PRESENT.

The fragment consisted originally of four pieces, three of which were easily fitted together. The fracture lines between these pieces were fresh and the breaks were caused by the implement used at the time of discovery. The reconstructed calvarium comprises the greater part of the frontal bone, the parts absent being the left external angular process, the lower sections of both temporal processes and both orbital plates. The nasal process is almost entire, and the sutural impressions for the nasal bones and the nasal processes of the maxilla are preserved. On the right side the sutural impression for the frontal process of the zygomatic bone is undamaged. Portions of both parietal bones are present, their broken edges running roughly parallel to the coronal suture and about three centimetres behind it. The specimen shows no evidence of being waterworn.

The small piece which could not be fitted to the other fragments probably consists of parts of the left frontal and left great wing of the sphenoid and their intervening suture. Its exact position being indeterminate, it can yield no accurate information and will not be mentioned further.

Pl. xxiv shows the extent and condition of the skull. The apparent whiteness of the broken edge is due to a protective veneer of mineral wax.

ORIENTATION.

The problem of orienting the specimen correctly is a difficult one. The Frankfurt plane, involving the estimation of two points, is obviously unsuitable as a base line.

Keith (1925) has shown that a plane through the central parts of the fronto-malar and parieto-mastoid sutures corresponds approximately to the base of the cerebrum. Since the right fronto-malar suture is complete, I have adopted this subcerebral plan as a base line, as it yields more information than the nasion-inion plane or Schwalbe's glabella-inion plane. To allow ease of comparison with other tracings the reconstruction has been made in the left lateral norma.

The difficulties of correctly orienting the Aitape fragment are considerably greater than Keith (1927) experienced with the Galilee skull owing to the absence of malar and sphenoid bones, which Keith used to check his reconstructions.

During the discussion which follows I shall anticipate some of the conclusions reached in later sections of the paper. Firstly, there are no features of the remnant which demand its separation from the modern neanthropic type of skull. Secondly, comparing its general outline and measurements with large series of Australian and New Guinea skulls, it seemed that there were closer resemblances to the southern type of Australian skull (type A, Fenner (1939)) than to modern specimens from New Guinea. This does not imply that the Aitape fragment is identified with the southern Australian type.

It was decided, therefore, to orientate it on the assumption that the complete skull bore some resemblance to the southern type of Australian skull, and use was made of Berry and Robertson's tracings (1914) to determine certain average values which might help in this attempt. Series of 25 skulls (unsexed) from New Guinea and 50 skulls (unsexed) from Swanport, South Australia, were measured, and the average figures used in the reconstruction of the skull.

In southern Australian skulls the bregma lies about 88mm., and the vertex about 95mm. above the subcerebral plane, the vertex being 33mm. posterior to the bregma. Orientating the Aitape skull with the bregma 88 mm. above the subcerebral plane and using the mean southern Australian values for sagittal parietal,

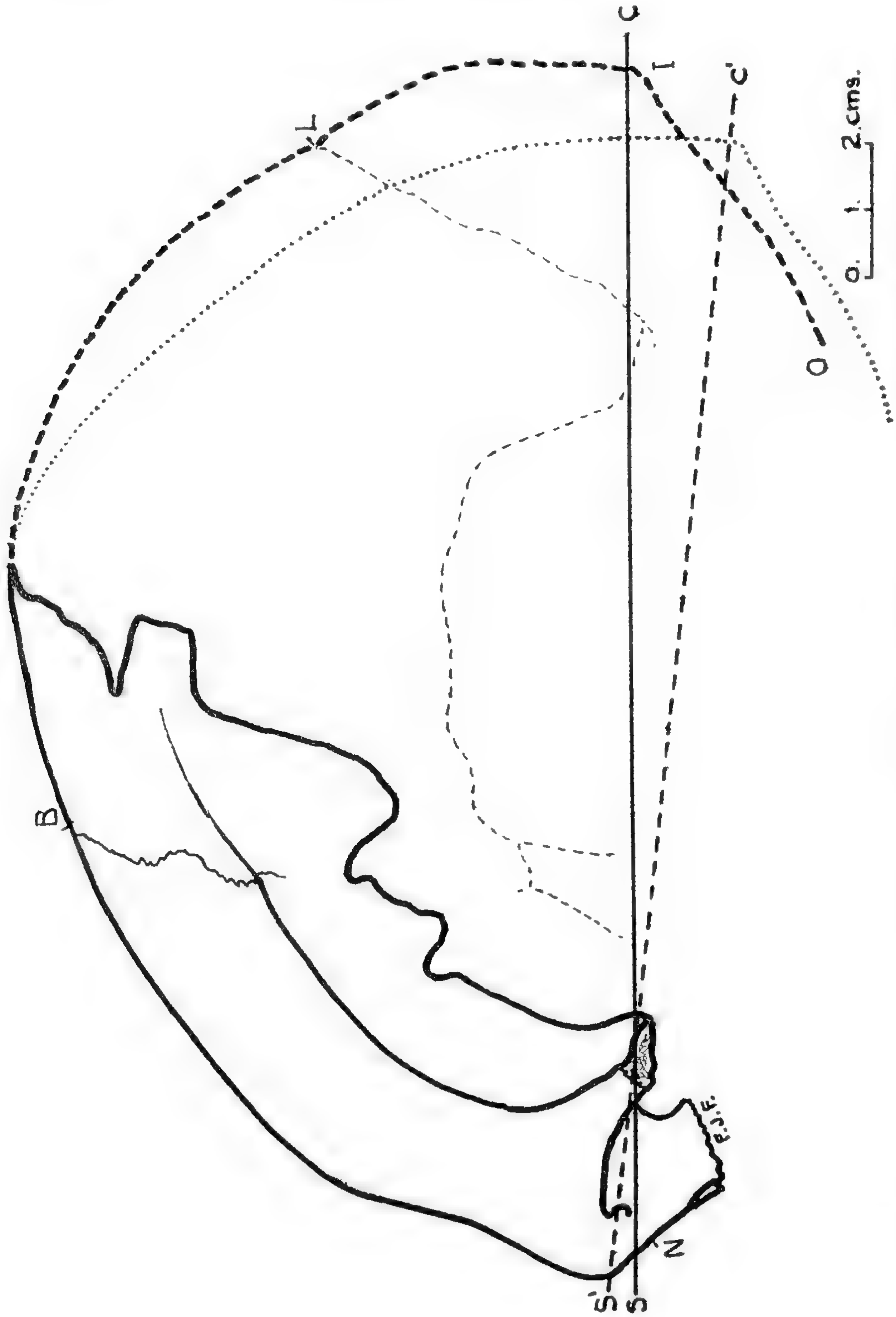


Fig. 2. Suggested reconstructions, from lateral aspect. S' C': initial subcerebral plane. SC: final subcerebral plane. Broken line = final reconstruction. Dotted line = reconstruction using the initial subcerebral plane S'C' (see text).

sagittal occipital, parieto-frontal and occipito-frontal indices, the outline of the posterior part of the skull was completed. (Fig. 2, broken line on base S′C′).

It is obvious that this throws the lambda, the inion and the opisthion out of their true relations with the subcerebral plane. Two methods exist by which to bring them into position; the bregma may be lowered (or subcerebral plane raised),

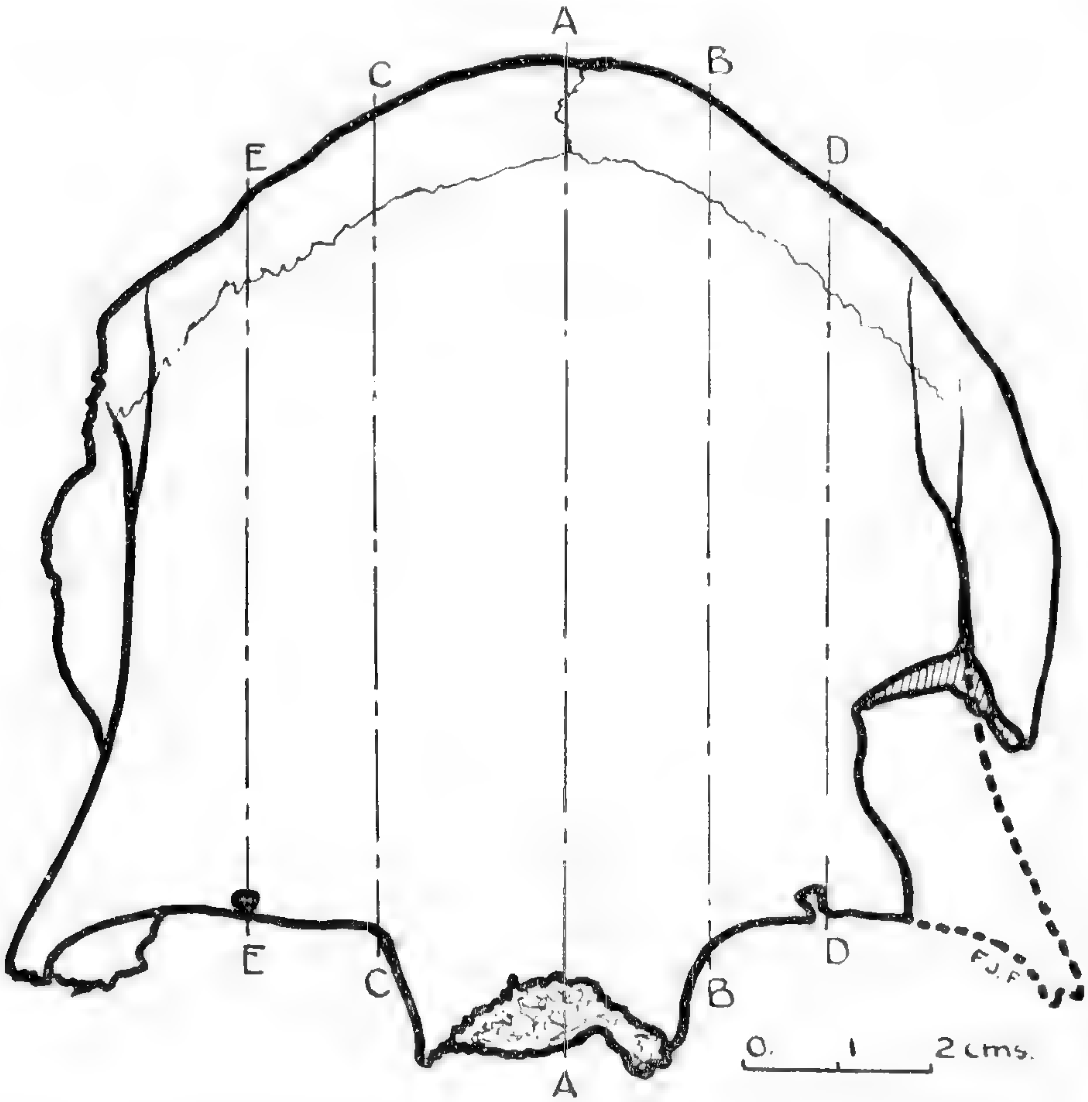


Fig. 3. Diopterographic tracing from facial aspect, skull orientated on subcerebral plane. AA, BB, CC, DD, EE lines of sections shown in figs. 5, 6 and 7.

or the sagittal parietal index may be reduced (i.e. the curvature of the parietal bone increased). These alternatives are shown in fig. 2, SC being the subcerebral plane in its raised position and the fine dotted line representing the curvature with a reduced sagittal parietal index. Owing to the deficiency of the parietal bones it is impossible to say with certainty which is the correct method. However, from the specimen one gains the impression that the parietal bones were gently curved posteriorly, and thus the more strongly defined of the suggested outlines (on plane SC) is more probably correct. Another feature suggesting that the bregma should be brought nearer the subcerebral plane is that in the first position (fig. 2) the vertex lies 14 mm. above the bregma, compared with an average of 7 mm. for the southern Australian skulls previously mentioned.

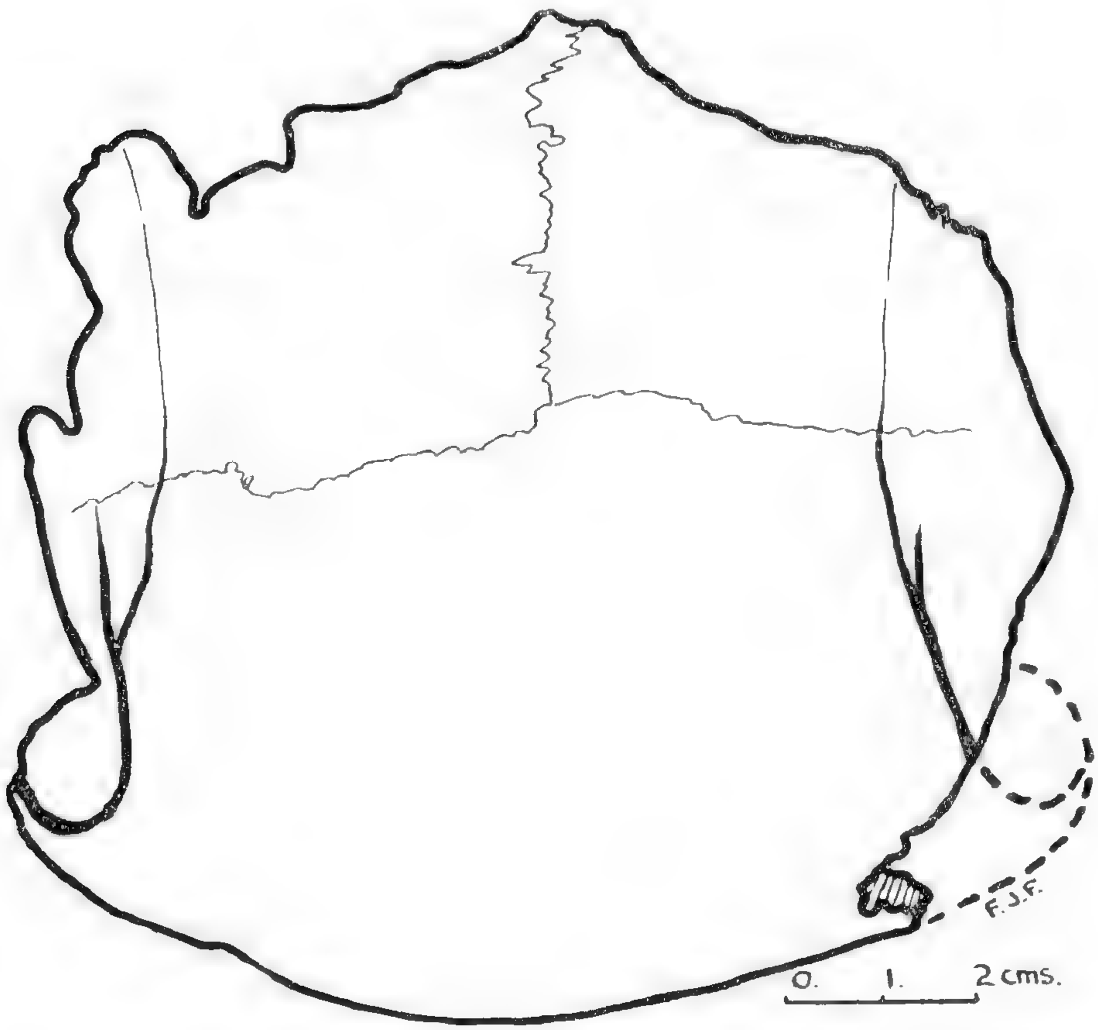


Fig. 4. Diopterographic tracing from vertical aspect, skull orientated on subcerebral plane.

Controlling figures, for example, the projected distances along the subcerebral plane of the bregma, the lambda, the inion and the opisthion, and the angles of coronal suture and nasion-bregma line to the subcerebral plane, support the final reconstruction given in fig. 2.

The estimated greatest length of the skull is 185mm.

We may next consider the rather meagre data that is available for the estimation of the maximum width:

smallest frontal width	92 mm.
greatest frontal width	110 mm. (estimated)
stephanion width	94 mm.
post-orbital width	94 mm. (estimated)
upper facial breadth	114 mm. (estimated)

The most notable of these figures is the upper facial breadth which exceeds the greatest frontal width (cerebral) by 4 mm. This is the reverse of the conditions found in any modern race except the Australian, and even here the disproportion is usually smaller.

Two indices are available which will give some idea of the maximum skull width: the relations of the minimum and maximum frontal widths to the maximum parietal width. In the southern Australian series these indices are 73% and 83% respectively, giving values of 126mm. and 132mm. for the maximum width of the Aitape skull.

The cranial index derived from these measurements is about 70%, which agrees with the impression that the skull was long and narrow.

Fig. 3 and 4 show facial and vertical aspects of the skull, orientated on the subcerebral plane.

GENERAL FEATURES.

The surface of the bone is smooth and has no incrustration, the bone substance being fairly highly and uniformly mineralized. The weight of the original fragments before their assemblage was 105 grammes.

The bone of the vault is not unduly thick, its dimensions in various regions are compared with some Australian specimens in table I. It will be noticed

TABLE I.(2)

	Aitape	A25341	A38030	A16531	119	340
Above supra-orbital notches	14	12	15	12	15	–
On right supraciliary eminence	17	12	15	15	15	17
On left supraciliary eminence	15	12	18	15	15	19
At supra-glabellare	5	7	7	7	9	6
At bregma	8	9	6	10	9	9
Left and right parietal	4	—	—	—	7	8
Mid-frontal region	6	7	6	9	8	6
Frontal tuberosities	5	7	5	7	11	8
At bifurcation of temporal lines	7	9	7	9	9	8

(2) All measurements in millimetres. A25341, A38030 and A16531 housed in S.A. Museum, Adelaide; 119 and 340 housed in the Museum of the Department of Anatomy, University of Sydney.

and supra-orbital elements of the upper orbital boundary, the supra-orbital element constitutes 45% of this boundary. Corresponding figures are 55% for the southern Australian series, 53% for the New Guinea series, and 59% for *Homo soloensis* (skulls I, IV, V, VI). In this feature, therefore, the Aitape fragment falls within the neanthropic range and departs from the Neanderthal feature of a great preponderance of supra-orbital element.

Fig. 5 is a section of the Aitape frontal just to the left of the midline and shows the strong internal frontal crest, which is about 50mm. long and is 10mm. deep at its deepest part.

An estimation of the glabellar projection can be made by taking the following measurements from this section—(a) the supra-glabellar thickness, measured a sufficient distance from the midline to exclude the effect of the internal frontal crest, (b) the basal thickness of the frontal bone, from nasion to foramen caecum, and (c) the glabellar thickness.

TABLE II.

Skull.	Basal thickness of frontal.	Glabellar thickness.	Supra-glabellar thickness.	Glabellar projection.
Aitape	18	17	6	11
Australian (Keith)	21	21	11	10
Galilee	24	18	5	13
(3) Australian 792	19	29	11	18
337	17	19	7	12
340	21	20	8	12
119	16	14	8	6

The glabellar projection is smaller, therefore, than in some large southern Australian skulls.

If we now take sections in the mid supraciliary region we can get a picture of the maximum development of the supraciliary ridges (fig. 6). From these the vertical and antero-posterior thicknesses of the supra-orbital region are determined (table III). There is obviously none of the shelf-like projection of the supra-orbital region which characterizes the Neanderthal type.

TABLE III.

Skull.	Vertical thickness of supra-orbital region.	Antero-posterior thickness of supra-orbital region.
Aitape	19·6 (left)	16·1 (left)
	20·5 (right)	18·0 (right)
Australian (Keith)	17·0	14·0
Galilee	16·5	21·0

(3) These skulls are housed in the Museum of the Department of Anatomy, University of Sydney.

CURVATURE OF THE FRONTAL BONE.

There are several methods of expressing the curvature of the frontal bone. Some of these are greatly affected by varying degrees of development of the glabella, and thus they do not always provide an accurate picture of the cerebral curve.

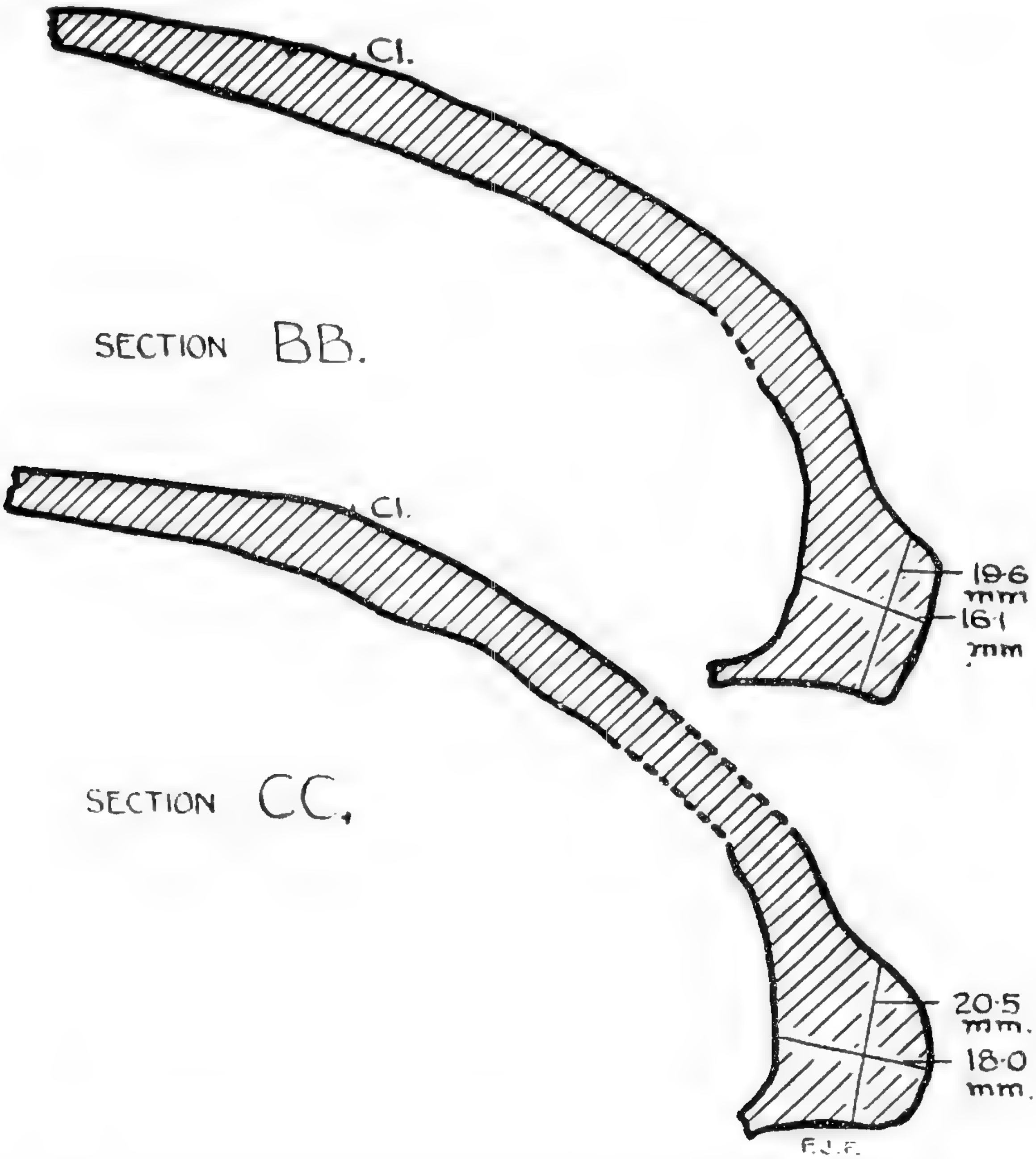


Fig. 6. Sagittal sections of Aitape frontal at points of maximum thickness of supra-orbital region. Above: 15 mm. to left of midline (BB fig. 3). Below: 20 mm. to right of midline (CC fig. 3). Maximum vertical and anteroposterior thicknesses of supra-orbital region shown. Cl. = coronal suture.

of the primitive neanthropic skull. Here again the Aitape skull contrasts with the low flattened gable of the Ngandong specimens.

There is no evidence that the parietal bones fell away sharply posteriorly; the prevailing contour suggests that they were gently rounded. It is most unlikely that the parietal tuberosities were at all prominent.

ENDOCRANIAL CAST.

An endocranial cast was made of the Aitape skull, and fig. 8 and 9 illustrate different aspects of this cast when it was orientated in the subcerebral plane. Bony deficiencies of the inner table interrupt the fissural pattern in several places. These are indicated by dotting in the figures.

In general outline the frontal lobes, which constitute the greater part of the cast, are long and narrow. They are quite well rounded, showing no trace of the paramedian flattening or depression found in many Australian brains. The orbital keel is not entire owing to the deficiency of the orbital plates of the frontal bone, but enough of the orbital borders is present to show that the keel was well developed.

The frontal cap is missing on both sides, but on the right its approximate position can be estimated. Further posteriorly the imprint of the meningeal vessels is clear, and corresponding to the parietal part of the vault are several arachnoidal granulations.

In the report on the Galilee brain-cast Keith discussed the effect of the cerebral cisterns in causing the obliteration of sutural pattern. In this specimen the paramedian frontal cisterns cannot be clearly defined, but elevations corresponding approximately to the sub-coronal cisterns are present.

In the discussion of the sutural pattern which follows the sulci have been numbered according to the system of Kappers (1929) and comparison has been made throughout with the description by Shellshear (1937) of the morphology of the Australian aboriginal brain.

Right Hemisphere.

The inferior frontal sulcus (4) corresponds approximately with Shellshear's group 1 of this sulcus. Posteriorly it is confluent with the inferior part of the precentral sulcus (5i) and from here it proceeds forwards curving slightly downwards to end by bifurcating into two branches which spread out widely to form a terminal transverse piece of the furrow. The lower of these terminal branches is continuous with the sulcus radiatus (3).

A short distance in front of its union with the precentral sulcus there is a connection with a branch of the middle frontal sulcus (7) which rises vertically

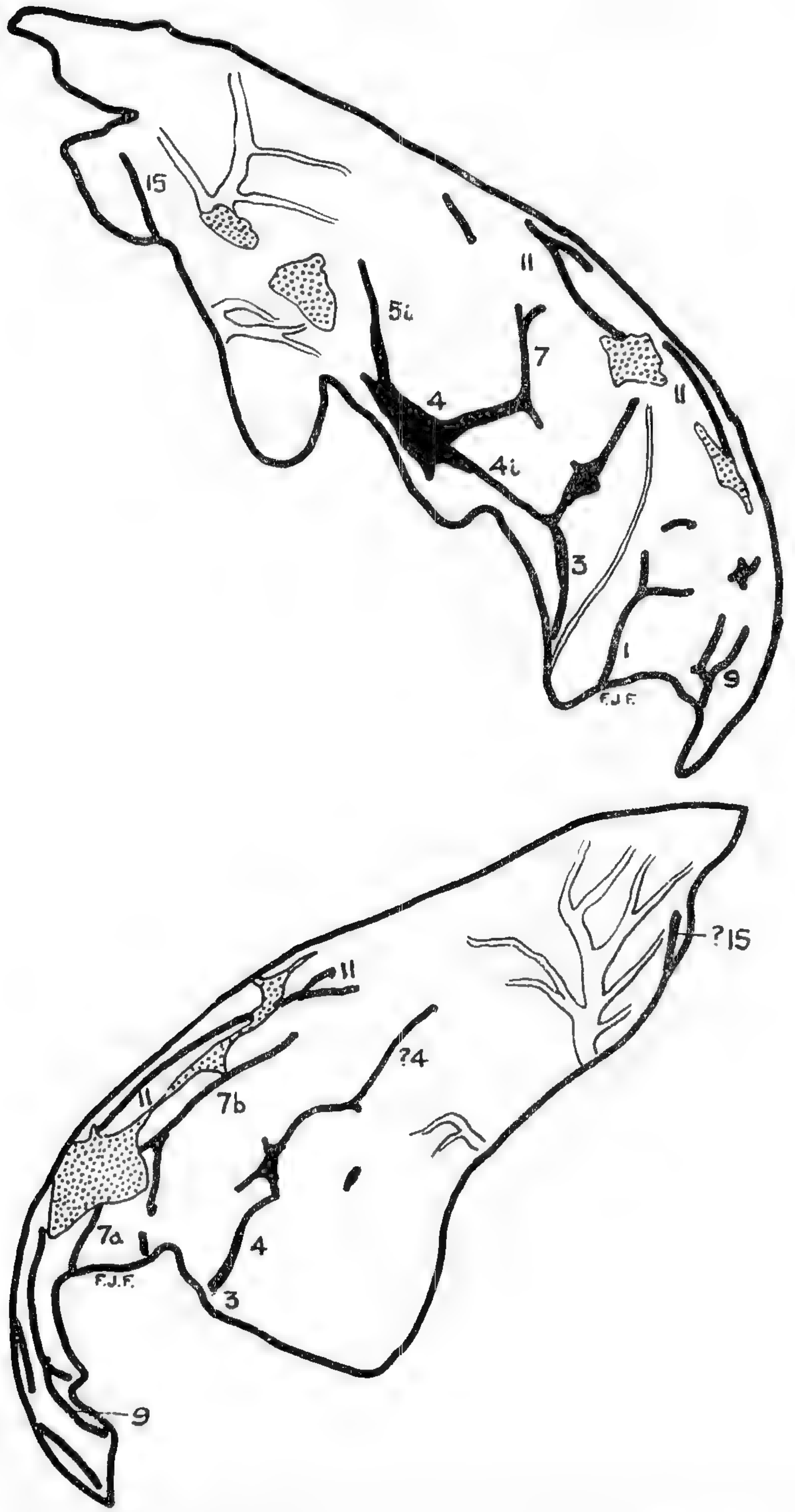


Fig. 8. Right (above) and left (below) lateral aspects of the Aitape endocranial cast orientated on the subcerebral plane (diopterographic tracings). Dotting corresponds to areas of broken bone. Numbering after Kappers (1929).

on the wall of the hemisphere. The whole arrangement resembles that of Shell shear's specimen Q2788L.

There is no obvious middle frontal sulcus on the right side. Several indeterminate furrows, running upwards and slightly backwards, are present; the most definite of these is that previously referred to as being connected with the inferior frontal sulcus.

The superior frontal sulcus (11) is fairly clearly marked and appears to be broken into two parts. This is not quite definite owing to a flaw on the inner table in the vicinity.

The fronto-marginal sulcus (9) is clear. It does not become confluent with any of the horizontal frontal sulci. Arising on the frontal aspect of orbital rostrum it passes up and divides into two branches which then run parallel to each other over the frontal pole.

The distinct furrow rising vertically between the sulcus radiatus (3) and the fronto-orbital sulcus (9) probably represents the anterior end of the sub-frontal sulcus of Kappers (1). Shellshear notes that this sub-frontal suture is common in Australian brains, and his figures show that it sometimes rises fairly high on to the anterior surface of the frontal lobe.

Several small unnamed sulci separate off the paramedian frontal convolutions.

Behind the region of the sub-coronal cistern, which here appears as post-coronal rather than sub-coronal, is a small vertically directed sulcus. This may represent portion of the post-central sulcus (15).

LEFT HEMISPHERE.

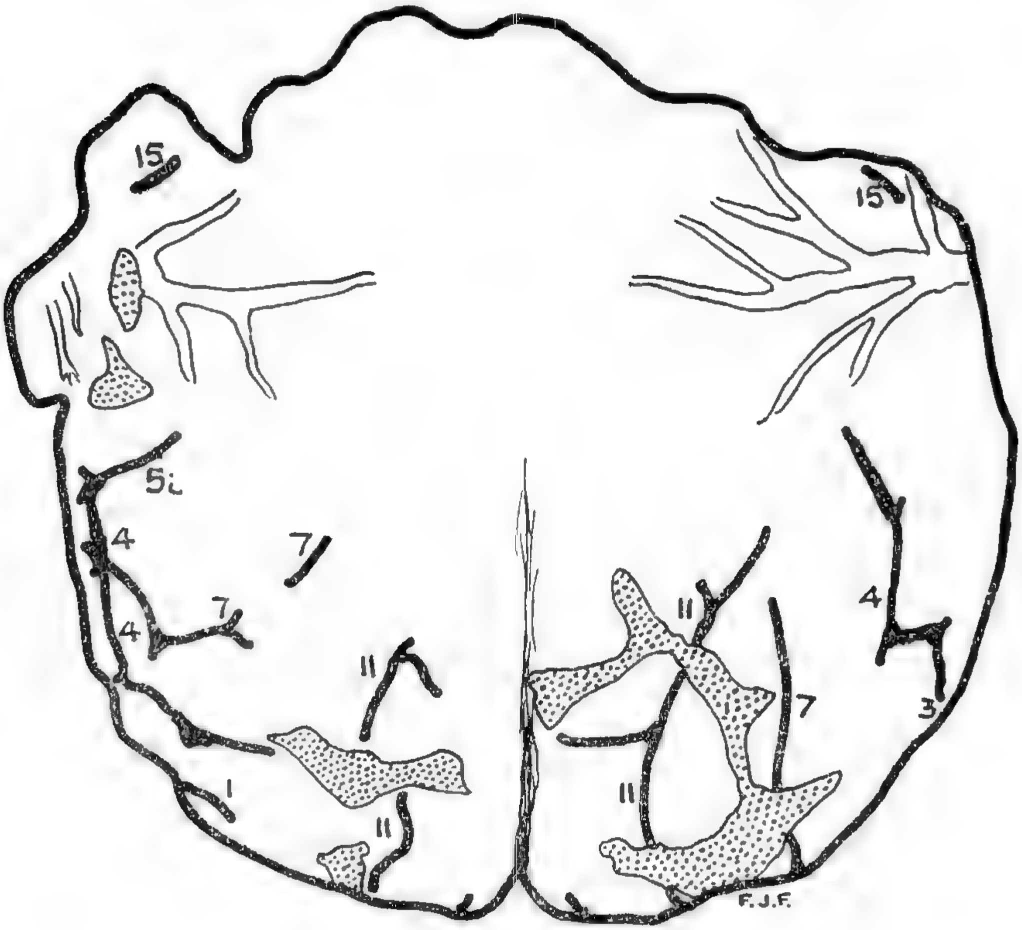
The convolutionary pattern is less clear on this side. The inferior frontal sulcus cannot be accurately defined. The upper extremity of the sulcus radiatus (3) courses up from the region in front of the frontal cap to become confluent with a sulcus which probably represents the anterior transverse part of the inferior frontal sulcus (4). There are several smaller shallow sulci running vaguely towards the middle frontal sulcus. The pre-central sulcus cannot be defined.

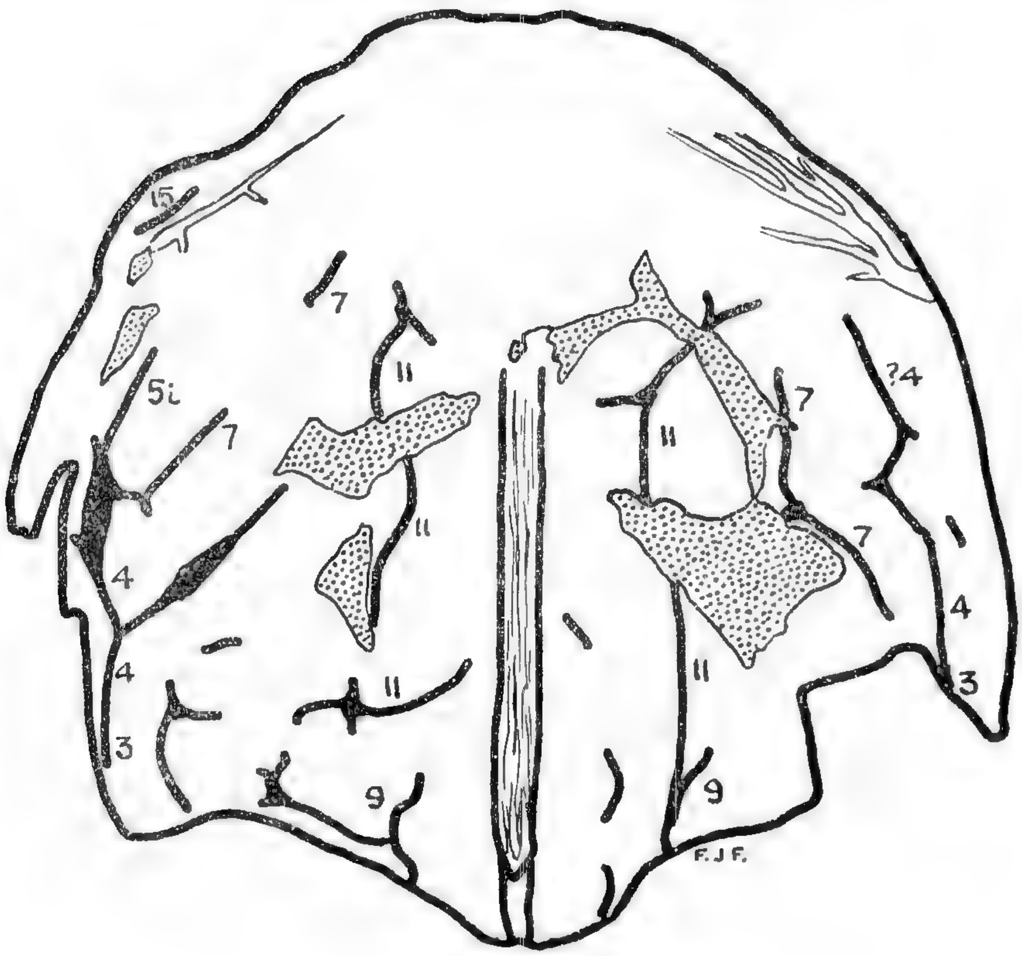
The middle frontal sulcus (7) is not clear, but appears to be represented by a long sulcus passing back roughly parallel to the midline. Its two parts (7a and 7b) appear to be confluent and anteriorly there is no connection with the fronto-marginal sulcus.

The superior frontal sulcus (11) comprises a continuous sulcus lying parallel to the medial border of the hemisphere. Anteriorly it appears to effect a connection with the fronto-marginal sulcus.

There is a sulcus corresponding with that described on the right side at the posterior end of the cast.

Fig. 9. Vertical (above) and facial (below) aspects of the Aitape endocranial cast orientated on the subcerebral plane (diopterographic tracings).


15
15
5i
4
7
4
7
11
11
7
4
3
1
11
11
F.J.F.


15
7
11
5i
7
?4
7
11
11
4
7
4
4
3
11
11
3
9
9
F.J.F.

MEASUREMENTS.

Comparative skull material from the Aitape district of New Guinea was not available. Twenty-five unsexed specimens from Sepik River and Papua, housed in the museum of the Department of Anatomy of the University of Sydney, were measured and the average measurements are given below as "New Guinea Series".

Fifty unsexed Australian skulls from Swanport, River Murray, South Australia, in the collection of the South Australian Museum, were measured and their average measurements are given in table VI as "Swanport Series".

Useful comparative measurements (necessarily approximate) were made on the casts of the Ngandong skulls and on the original Cohuna skull (which has been cleaned by Professor Shellshear). This was all done in the Department of Anatomy, University of Sydney.

The definitions of measurements and points given by Martin (1928) have been used and his reference numbers are indicated in table VI.

TABLE VI.

Description of measurement.	Ref. No. Martin.	Aitape.	Swanport Series.	New Guinea Series.	Cohuna.	Ngandong Skulls.
Smallest frontal breadth (ft.–ft.)	9	92	93·9	91·2	86	101
Post-orbital breadth	9 (1)	94(4)	90·6	92·3	90	100
Greatest frontal breadth (co.–co.)	10	104(4)	106·9	103·8	105	121
Stephanion breadth (st.–st.)	10b	94	97·8	101·4	95	111
Median sagittal frontal arc (n.–b.)	26	120	125·7	122·1	140	131
Median sagittal glabella arc (n.–sg.)	26 (1)	32	—	—	—	—
Median sagittal cerebral arc of frontal (sg.–b.)	26 (2)	88	—	—	—	—
Median sagittal frontal chord (n.–b.)	29	108	109·3	107·1	126	118
Median sagittal glabellar chord (n.–sg.)	29 (1)	29	—	—	—	—
Median sagittal cerebral chord of frontal (sg.–b.)	29 (2)	84	—	—	—	—
Angle of frontal convexity	32 (5)	142°	133°	—	147°	—
Angle of convexity of cerebral part of frontal bone	32 (6)	155°	—	—	158°	—
Upper facial breadth (fmt.–fmt.)	43	114(4)	107·3	103·2	117	122
Bi-orbital breadth	44	106(4)	100·8	97·0	110	—
Anterior inter-orbital breadth (mf.–mf.)	50	25	21·9	21·2	27	27
Orbital breadth	51	43(4)	40·8	40·0	44	—

DISCUSSION.

The difficulty of accurately sexing skulls is well known. When one has only a fragment of the vault that difficulty is much greater. It is with considerable caution, therefore, that I suggest that the fragment is part of a female skull, and the only support for this opinion lies in the comparative thinness and lightness of the bone of the vault.

(4) Estimated measurements.

Concerning its age, we know that the sagittal and coronal sutures are obliterated endocranially and that the fronto-nasal and fronto-malar sutures are still open. Using Todd and Lyons figures we may say that the skull is that of an individual more than forty years old.

The fragment is too small to allow more than an approximate racial diagnosis to be made. It shows no affinities with any of the ancient human races (*Homo neanderthalensis*, *Homo soloensis*, etc.), the supra-orbital region being definitely neanthropic in type.

Comparing it with modern races from adjacent regions it seems to correspond more closely with the Australian than the New Guinea type, although the latter is admittedly very variable. One might go further and suggest that its affinities are with the southern Australian type (type A, Fenner). The low forehead, the build of the supra-orbital region and the flat parietal bones all recall this form of skull.

The main points of distinction between the Australian and the Aitape frontal are the definite ophyronic groove and the wide upper facial diameter with great post-orbital narrowing, both primitive features.

There are no characters suggesting affinities with the Tasmanians; the absence of the paramedian frontal and parietal groove stressed by Wunderly (1939) and the fairly obvious narrowness of the parietal region definitely excluding this possibility.

The endocranial cast shows less frontal flattening than is usually found in the Australian, but there is nothing in its form or sulcal pattern to differentiate it from a primitive neanthropic brain.

CONCLUSIONS.

A fragment of a fossil human skull found at Aitape, New Guinea, in beds of Pleistocene age (Upper Wanimo Series) is described. It may be accepted as the first evidence from New Guinea of human remains of apparent Pleistocene age.

It is suggested that the fragment is portion of a female skull about 45 years of age. The racial affinities of the skull are discussed. There is no evidence that it belonged to an individual differing greatly from the modern Australian aboriginal (southern type). It must be remembered that occasional rare "Australoid" types of New Guinea skull (e.g. those described by Cave in Moyne (1936)) differ from the Aitape fragment little more than do average Australian skulls.

ACKNOWLEDGMENTS.

My thanks are especially due to Dr. F. W. Clements, Director of the Australian Institute of Anatomy, Canberra, who kindly lent me the specimen for some months; and to Professors Burkitt and Shellshear, of Sydney University, who placed their comparative material at my disposal. Professor Shellshear also helped me considerably in the study of the endocranial cast.

I am deeply indebted to my colleagues of the South Australian Museum, especially Mr. N. B. Tindale, who made the endocranial cast and photographed the skull. Professor F. Wood Jones has kindly read through the manuscript, and his criticisms and suggestions are gratefully acknowledged.

Financial aid for this study was rendered by the David Murray Scholarship Fund of the University of Adelaide.

REFERENCES CITED.

Berry, R. J. A., and Robertson, A. W. D. (1914): *Trans. Roy. Soc., Vict.*, vi.

Cunningham, D. J. (1908): *Trans. Roy. Soc., Edin.*, xlvi (2), p. 283.

Fenner, F. J. (1939): *Trans. Roy. Soc., S. Aust.*, lxiii, p. 248.

Jones, J. Nason (1930): Geology of the Finsch Coast Area, North-west New Guinea *in* The Oil Expl. Work in Papua and N. Guinea by the Anglo-Persian Oil Company on behalf of the Comm. Govmt. of Aust., 1920–1929, iii, p. 44 (Harrison & Sons Ltd., London).

Kappers, C. U. A. (1929): Evolution of the Nervous System in Invertebrates, Vertebrates, and Man. (Haarlem).

Keith, A. (1925): The Antiquity of Man, p. 579 (Williams & Northgate, London).

Keith, A. (1927): *In* Turville-Petre, Researches in Prehistoric Galilee (British School of Archaeology in Jerusalem, London).

Martin, R. (1928): Lehrbuch der Anthropologie, ii (Jena).

Moyne, Lord (1936): Walkabout (Heinemann, London).

Shellshear, J. L. (1937): *Phil. Trans. Roy. Soc., Lond.*, B, No. 545, ccxxvii, pp. 293–409.

Wunderly, J. (1939): *Biometrika*, xxx (3 and 4), p. 305.

EXPLANATION OF PLATES.

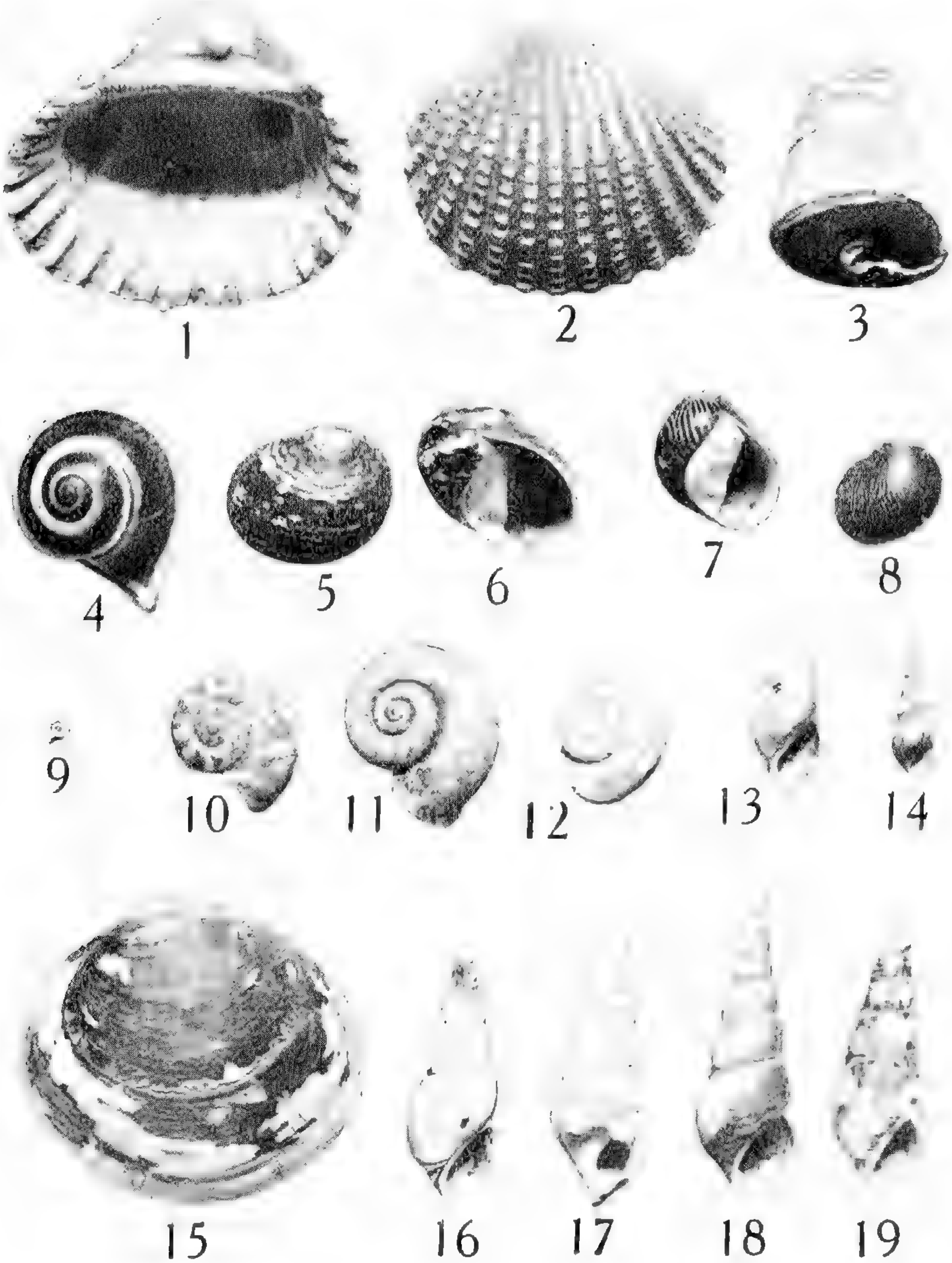
Plate xxiii.

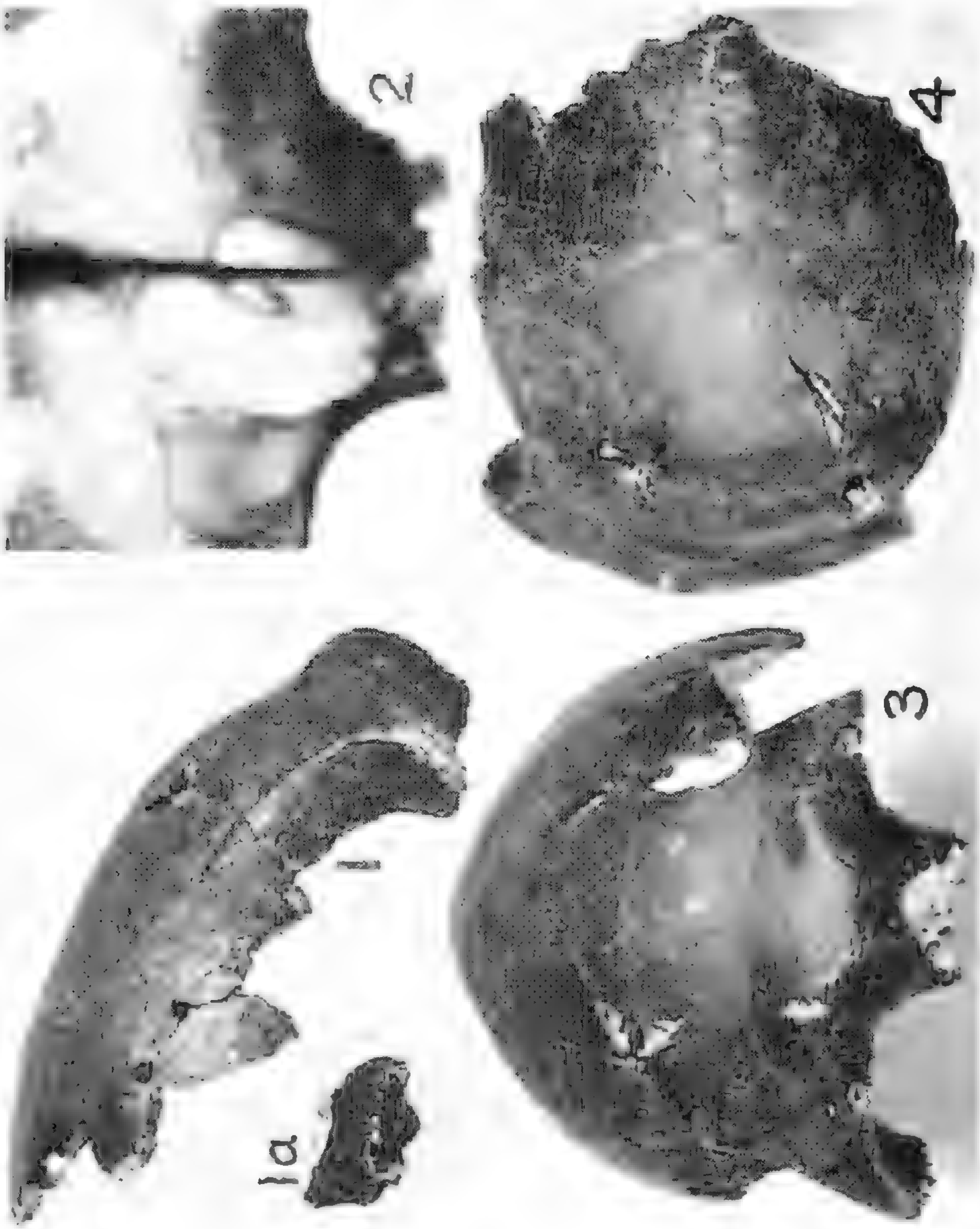
Shells occurring in association with the Aitape skull.

1, 2, *Arca granosa* Linn.; 3, *Telescopium fuscum* Schumacher; 4, *Papuina* sp.; 5, 6, *Neritina cornea* Linn.; 7, 8, *Neritina* cf. *souverbiana* Montr.; 9, *Laoma* sp.; 10, 11, 12, *Cyclophorus* sp.; 13, 14, 18, 19, *Melania* cf. *juncea* Lea; 15, *Cyrena coaxans* Gmelin; 16, *Melania* cf. *canaliculata* Reeve; 17, *Melania* cf. *recta* Lea.?

Plate xxiv.

Aspects of the Aitape skull. 1, right lateral view; 1a, small separate fragment; 2, skiagram showing development of frontal sinuses; 3, facial aspect; 4, vertical aspect. Skiagram on larger scale than photographs.


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19


2
4
3
1a

THE ASSOCIATED MOLLUSCA.

By B. C. COTTON.

A few mollusca from the Upper Wanimo Series have been reported upon in the Anglo-Persian Oil Company's Survey on behalf of the Commonwealth of Australia (Vol. III, 1929, p. 44). The tentative identifications are in the main generally significant. The list served the purpose for which it was made, enabling the generally accurate conclusion to be arrived at that "the evidence of brackish and fresh-water mollusca coupled with a foraminiferal fauna in which pelagic forms are practically absent, points to the history of the group being that of the last phases of sedimentation and deposition along a rising littoral much indented by mud flats, large shallow bays and lagoons, evidence of a receding ocean".

The accurate determination of the species is a matter of some difficulty in the present state of our knowledge. Only a proper and extensive survey could give reliable information, the marine mollusca being one problem and the dissimilar northern and southern New Guinea terrestrial faunas another.

The genus *Melania*, for example, has not been systematically worked out either for Northern Australia or New Guinea, and it is therefore a matter of conjecture whether our series is different from those dealt with in the Commonwealth Report or whether obscure specific identifications are responsible for the seeming discrepancies. This is a matter for future study. The full value of the indications will only be realized when the genus *Melania* has been systematically surveyed.

Arca (Tegillarca) granosa Linn. (fig. 1–2); type locality, Philippine Islands. The *Arca granosa* complex is widely distributed in tropical regions to the North of Australia. Subspecies and related species have been recorded from the Gulf of Carpentaria, Western Australia (*A. rhombea*), Japan, Papua, and from the Barrier Reef (*A. granosa bessalis*). Iredale groups them under the genus *Tegillarca*. This is the same species as that identified as *Arca nodosa* (author ?) in the Commonwealth Report.

Telescopium fuscum Schumacher (fig. 3); type locality, East Indies (*T. telescopium* is a synonym). Widely distributed in North and North-western Australia; this species is not listed in the series recorded in the Commonwealth Report.

Papuina sp.; Land shell (fig. 4).

Neritina cornea Linn. (fig. 5–6); type locality, Philippine Islands.

Neritina souverbiana Montrouzier (fig. 7–8); type locality, New Caledonia.

Laoma sp. (fig. 9).

Cyclophorus sp. (fig. 10–12).

Melania cf. *juncea* Lea (fig. 13, 14, 18, 19).

Melania cf. *recta* Lea (fig. 17).

Melania cf. *canaliculata* Reeve (fig. 16).

Cyrena coaxans Gmelin (fig. 15).

Genera not represented in our series but listed in the Report as occurring in the Upper Wanimo series are: *Erycina*, *Paphia* and *Placenta*.

SOME POLYCHROME INCISED POTTERY WARE FROM MT. TURU, NEW GUINEA

BY NORMAN B. TINDALE, B.SC., ETHNOLOGIST, SOUTH AUSTRALIAN MUSEUM

Summary

In 1939 Dr. A. G. Schroeder, Medical Officer at the Government Station of Wiwiak, in North-East New Guinea, made a journey through some recently-opened country in the Upper Sepik District of the Mandated Territory of New Guinea. He visited villages about Mount Turu in the Biligil area.

Among ethnological objects of special interest collected were three examples of a type of hand-turned, incised and painted pottery from the village of Ambakunja, in the vicinity of Mount Turu (on the Dividing Range east by south from Wiwiak, 143° 22´ East Long. x 3° 37´ South Lat.).

SOME POLYCHROME INCISED POTTERY WARE FROM MT. TURU, NEW GUINEA

By NORMAN B. TINDALE, B.Sc., Ethnologist, South Australian Museum.

Plates xxv–xxvi and Text-fig. 1–3.

In 1939 Dr. A. G. Schroeder, Medical Officer at the Government Station of Wiwiak, in North-East New Guinea, made a journey through some recently-opened country in the Upper Sepik District of the Mandated Territory of New Guinea. He visited villages about Mount Turu in the Biligil area.

Among ethnological objects of special interest collected were three examples of a type of hand-turned, incised and painted pottery from the village of Ambakunja, in the vicinity of Mount Turu (on the Dividing Range east by south from Wiwiak, 143° 22′ East Long. x 3° 37′ South Lat.).

The inhabitants of this portion of the Upper Sepik district are relatively short, thick-set folk, only a few of them reaching 5 ft. 6 in. in height. They have uniformly woolly hair. Being keen agriculturalists, they live in open villages among their gardens. Maprik, situated 19 miles to the west of Mount Turu, is a typical example. Within 30 miles radius of this village it has been estimated there is a population of sixty thousand people. Houses in Maprik are centred around a tall ceremonial house over fifty feet high, built on a triangular ground plan (pl. xxvi, fig. 1). The ridge-beam is formed by implanting a pole of considerable height in a leaning position in the ground, and the ridge is supported by two logs of smaller diameter used like sheer-legs. The relatively small triangle enclosed by the three poles is closed in with thatching to form a men's house. The decorations take the form of large painted face-designs. All such houses have a rope hanging from the eaves in front of the entrance, and reaching to within six feet or so of the ground. The masks kept within these houses are of basket work with body drapings of grass (pl. xxvi, fig. 2).

Villages are partially migratory within short distances, the movements being rendered necessary by the methods of gardening which are such as to deplete the soil of its most fertile constituents within a few years. At Maprik village a new ceremonial house had just been completed, replacing an older one which, through slow migration of the village, had come to be almost outside the inhabited area instead of near its centre.

Three examples of Mount Turu pottery ware, collected by A. G. Schroeder and presented to the South Australian Museum, may be listed as follows:

A.19924. Hand-coiled pot from Ambakunja village; with incised and strongly contrasted painted design in red, white, yellow, and black; a single pierced lug on the rim. Diameter 28 cm., weight 65 ounces (fig. 1).

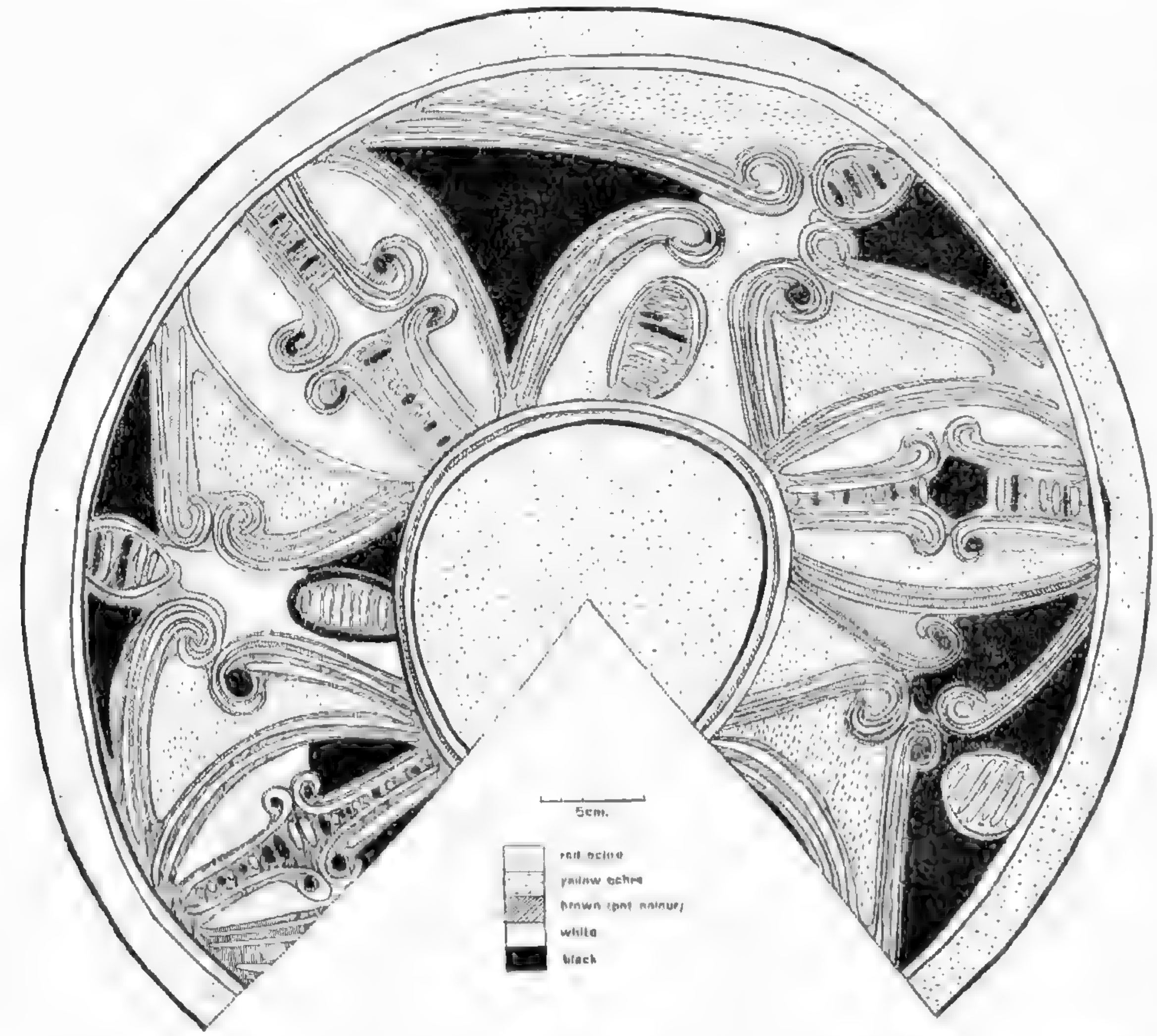


Fig. 1. Design on black, red, yellow, and white painted pot, Mount Turu. (A.19924.)

A.19925. Hand-coiled pot from Ambakunja village, with incised and moderately contrasted painted design in red, white, and yellow; two pierced lugs, asymmetrically placed, about 45° apart, on the rim. Diameter 25 cm., weight 56 ounces (fig. 2).

A.19926. Hand-coiled pot from Ambakunja village, with incised design in red and white on painted red background; two pierced lugs approximately 170°

apart on the raised rim; this has been incised with a series of nearly vertical marks. Diameter 31 cm., weight 92 ounces (fig. 3).

The importance of Ambakunja as a pot-making centre in the Biligil area is partly determined by the possession of adequate sources of clay. Pots from this village are traded chiefly to villages in a direction north of Mount Turu. The only other pots at present known to be made in this area are from an as yet unlocalized

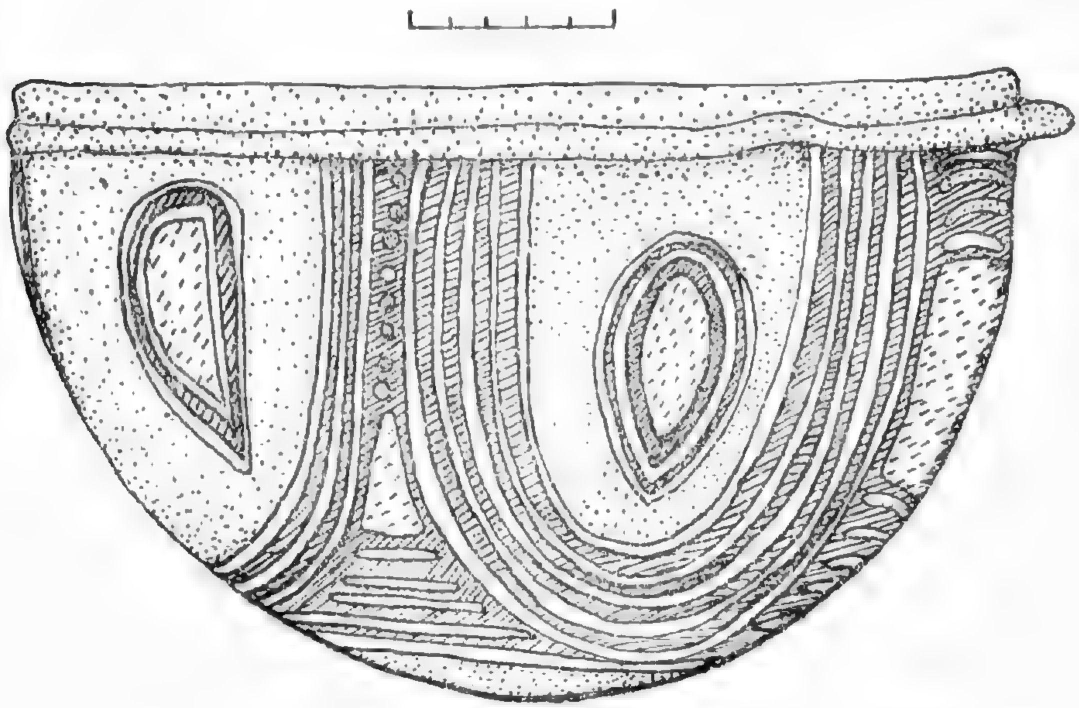


Fig. 2. Red, yellow, and white painted pot, Mount Turu. (A. 19925.)

village in the Upper Sepik district, south of Matapau; pots are also traded northwards from there. They pass through several intermediaries before reaching villages in the Bombita area. From Bombita they are passed on north-eastwards to Samark, and to several other villages on the south side of the Sepik-Pacific Divide. Examples of this latter type of pot have not yet been obtained.

Mount Turu pots are made of a rather coarse-textured paste, which fires to a dull brick-red. The firing is well done and rather complete. The example A.19925, which is the lightest of the three, has been made by means of a coiling technique, and traces of the coils are still present in the finished pot. The other two show less marked traces of the same method of manufacture. In the smallest example, which is relatively much the heaviest, the traces are little evident. The asymmetrically placed lugs appear to have lost their primary function; the piercing is carelessly done, so that there seems little chance of their being of use for suspension.

The designs on the pots are reminiscent of some patterns recorded by Joyce (1912) on archaeological sherds from Rainu in the North-Eastern Division of Papua. They have been incised in the damp clay, and then much of the areas between the designs has also been reduced so that the primarily incised portion and its margins come to stand partly in relief. Crudely painted pottery has been recorded by Edge-Partington (1898) from about the Mambare River, but the present examples appear to be rather different from those hitherto described.

Mr. A. N. Chittleborough, in a recent address to the Anthropological Society of South Australia, briefly mentioned a pot-making village named Kintavu, which

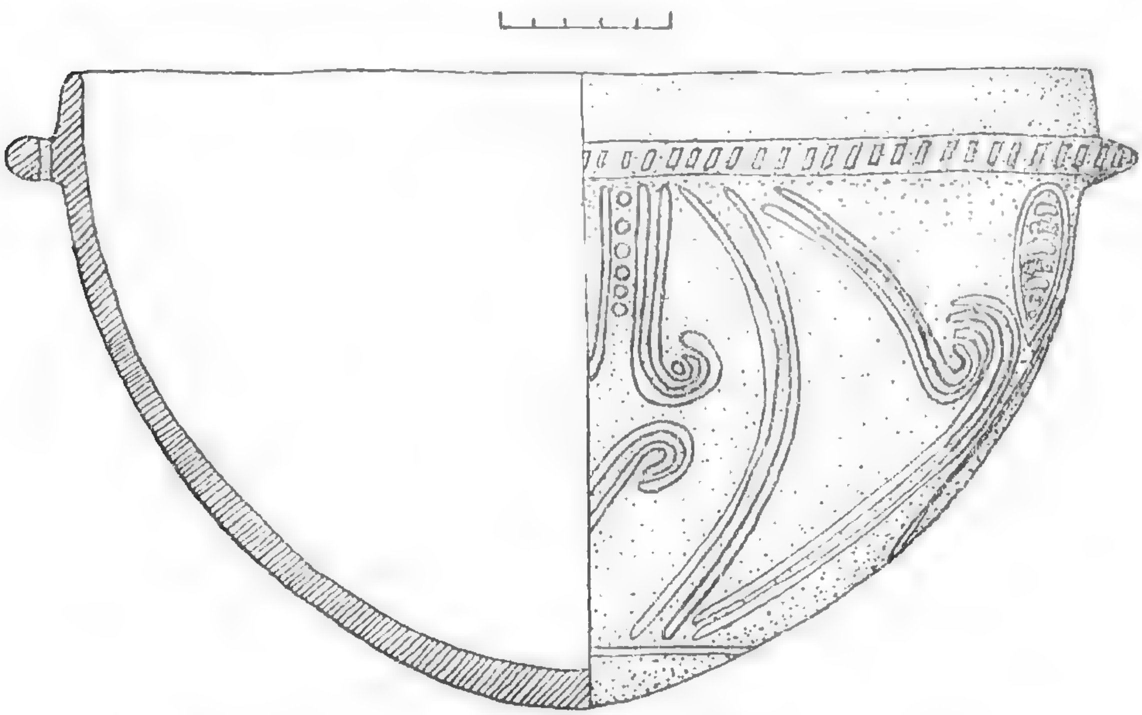


Fig. 3. Red pot with white painted design, Mount Turu. (A. 19926.)

he saw in 1922–23, while engaged in a geological survey with Dr. G. A. V. Stanley. This village is situated about thirty miles inland on the mountains above Mambare. In the centre of the village is a stone platform on which is placed a wooden frame. When he saw it this framework had strings bound to it in various directions, and at the intersections of strings were clay balls. This was described to him as a map of islands off the coast of New Guinea, the clay balls representing islands, and the strings the projections of directions of stars, utilized when navigating out to these places. In some ways it was reminiscent of a Polynesian "sailing chart", but made on a large scale. Although these Kintavu pot-makers were frequently engaged in hostilities with the coast peoples, they managed to maintain a trade in pots with the islands off the coast. Their canoes, laden with pots, were portaged to the coast in darkness, and they set out by night on their trading voyages. Return landings were also made in secrecy. Owing to the exigencies of survey work on which he was engaged, Mr. Chittleborough was unable to secure examples of Kintavu wares.

His description of the pots suggests that they were not unlike the previously mentioned examples from Mambare River district, which are in the Brisbane Museum, and which were collected by Sir William McGregor.

DISCUSSION.

The study of New Guinea pottery is not yet on a very firm basis. Probably examples still exist in Museums without adequate description, and there are gaps in our knowledge of the use and dispersal of these elements of culture. Sherds and pots from Panaeati have been recently described (Tindale and Bartlett, 1937). The desirability of collecting and recording pots as well as potsherds from New Guinea and the surrounding islands cannot be too strongly stressed. We are indebted to Dr. A. G. Schroeder for the photographs accompanying this note.

SUMMARY.

Polychrome incised pots made by the inland Mount Turu people of the Biligil area of the Upper Sepik district, New Guinea, are described and figured; some notes on the pot-makers of Kintavu in the Mambare district are given.

REFERENCES CITED.

Edge-Partington, J. and Heape, C. (1898) : Album of the Natives of the Pacific Islands, iii, pl. lxxvi.

Joyce: T. A. (1912) : *Journ. Roy. Anthrop. Inst. Lond.*, xlii, pp. 545–546.

Tindale, N. B. and Bartlett, H. K. (1937) : *Trans. Roy. Soc. S. Aust.*, lxi, pp. 159–162, pl. ix–x.

EXPLANATION OF PLATES.

Plate xxv.

Fig. 1. Maprik men.

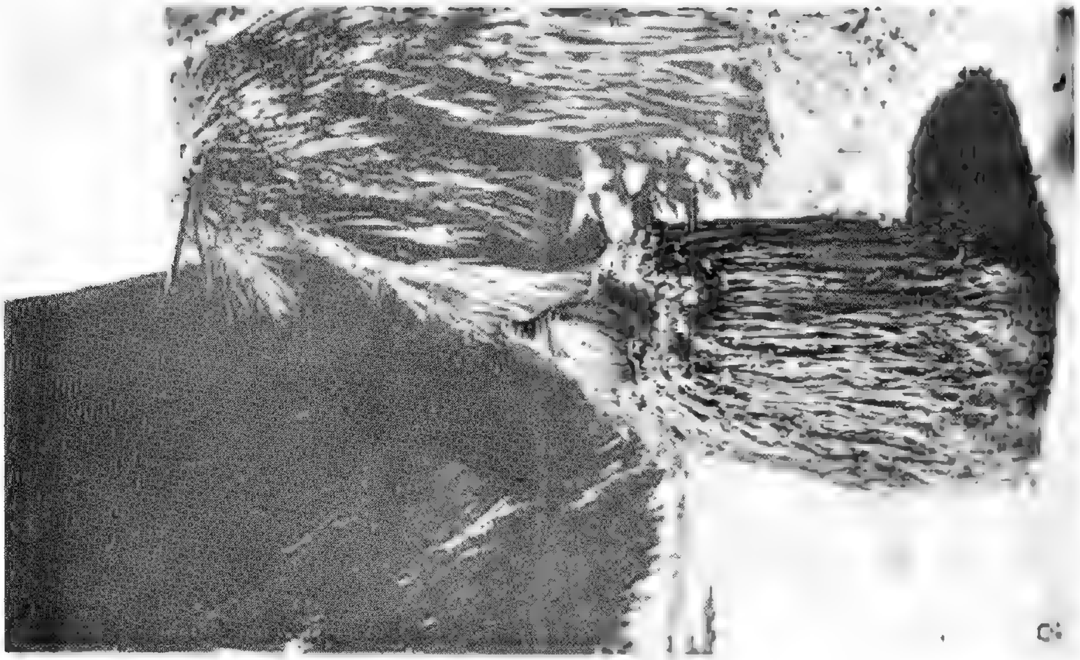
Fig. 2. Maprik husband and wife (same man as in fig. 3).

Fig. 3. Maprik men wearing artificial hair coiffures.

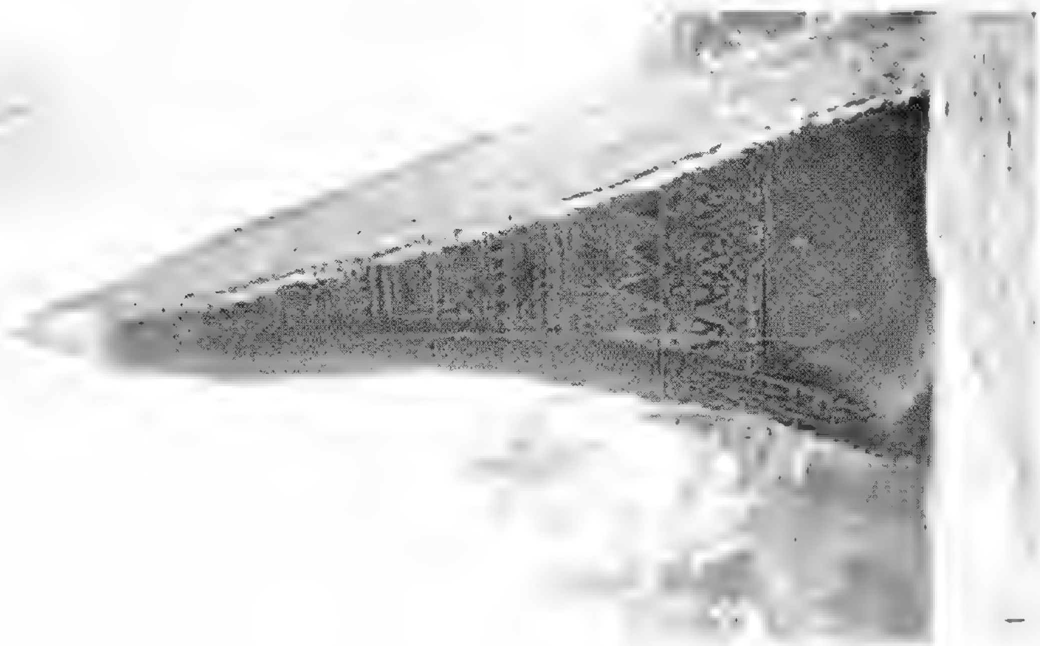
Plate xxvi.

Fig. 1. Newly-constructed ceremonial house at Maprik.

Fig. 2. Man concealed under mask, Maprik.



2



1

FLINT IMPLEMENTS OF TASMANIAN MANUFACTURE FOUND AT CAPE HART, KANGAROO ISLAND

BY ALISON HARVEY, B.A., HONORARY ASSISTANT IN ETHNOLOGY, S.A. MUSEUM

Summary

Archaeological research in the past decade has established the existence of an extinct Kangaroo Island stone implement culture of characteristic type associated with an ancient human occupation of the island. The “karta” and “sumatra” type of implements described by Tindale and Maegraith (1931) dominate the archaeological remains of this industry, and were apparently characteristic of the culture.

FLINT IMPLEMENTS OF TASMANIAN MANUFACTURE FOUND AT CAPE HART, KANGAROO ISLAND

By ALISON HARVEY, B.A., Honorary Assistant in Ethnology, S.A. Museum.

Fig. 1–14.

Archaeological research in the past decade has established the existence of an extinct Kangaroo Island stone implement culture of characteristic type associated with an ancient human occupation of the island. The "karta" and "sumatra" type of implements described by Tindale and Maegraith (1931) dominate the archaeological remains of this industry, and were apparently characteristic of the culture.

Early in 1936, an apparently new series of implements on Kangaroo Island came to light when Mr. H. M. Cooper, at sites on Cape Hart and Antechamber Bay, on the east coast of the island, collected flint implements whose appearance, as Tindale (1937, p. 32) says, "suggested a Tasmanian origin". At both the localities in question, the implements were collected on sites associated with the remains of early white settlement.

Tindale records his examination of the site, and describes some of the flint tools collected at the Antechamber Bay site. In his paper, it was concluded, from the archaeological evidence of the site and the appearance of the implements themselves, and from comparisons with flint implements of Tasmanian industries from N.W. Tasmania, that the Antechamber Bay series were of Tasmanian manufacture, made by Tasmanian native women, who were brought there by some members of the whaling colony in the early nineteenth century. They could be linked with a newer Tasmanian implement series.

The implements from Cape Hart, here described, comprise 23 flint tools and 22 unworked flints. Most of them were collected by Mr. Cooper in 1936. Associated with them are three pieces of worked flint identified as European gun flints.

I am indebted to Mr. Cooper for his permission to describe these specimens, which have been shared equally between his collection and that of the South Australian Museum, and to Mr. Tindale for his advice in the preparation of this paper.

THE SITE.

The Cape Hart area comprises two associated sites, one being in the immediate vicinity of the remains of a European-built stone chimney, which is described by

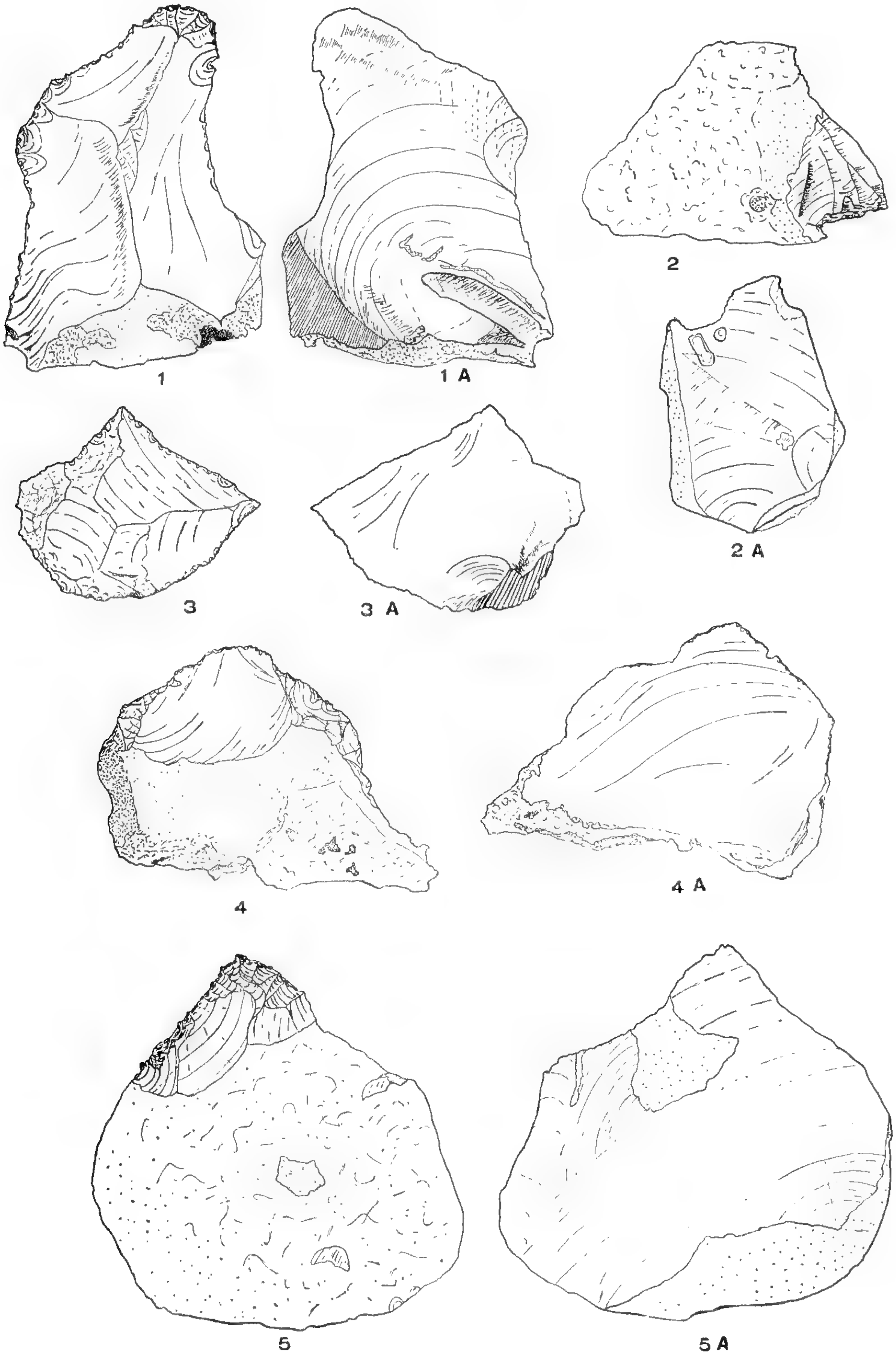


Fig. 1–5. Stone implements from Cape Hart, Kangaroo Island.

Mr. Cooper as being on "a wind-blown sand flat under the lee of a high-wooded coastal dune". It lies approximately a half-mile west of the cape, and near the shore. It was from here that the flint implements and the gun flints were recovered.

The other site is a small area on the edge of a limestone shelf approximately a quarter-mile west from this area; here Tindale, in 1936, found a series of flint implements and a quantity of chippings. Flint boulders occur on the adjoining beach, and broken ones associated with chippings on the hut site were also found.

THE CAPE HART IMPLEMENTS.

The flint is a smooth, dark bluish-grey, and has been eroded from Tertiary marine limestone beds. Traces of limestone matrix remain on many of the worked tools (e.g. fig. 2, 3, 4, 5, 8, 9, 12).

The implements themselves are, with the exception of fig. 5, made from flakes struck from a platform on a prepared core. Highly characteristic is the obtuse angle formed by the plane of the striking platform and the flaked face, which, in all cases, is between the limits of 110° and 120° (v. fig. 3, 6, 8, 10, 12, etc.).

The fashioning of the tool from the flake was carried out with the utmost crudity, further shaping consisting merely of secondary flaking along portion of one margin; the unworked part of the tool apparently served as a handhold.

The present series, together with examples collected at Antechamber Bay, and already referred to, is further characterized by the frequent presence, in more or less marked degree, of a worked point or semi-circular projection as part of the tool. This eminence has, in all cases, received careful secondary working (fig. 1, 3, 5, 6, 7, 10, 12, etc.) A general approximation to an ovate shape appears to have been aimed at in the manufacture of the implements, but many divergences from this occur, notably in the case of several high-backed scrapers (fig. 2), one elongated narrow worked flake tool (fig. 9), two irregularly leaf-shaped points, of which one is shown on fig. 3. Unlike all others in the series, the implement shown in fig. 5 has been made from a core or accidental flake of flint, probably selected on account of its convenient shape, and the flint has been trimmed by flaking and secondary chipping to form the characteristic pointed tool.

Measuring the specimens produced no evidence of preference for any particular size or weight. Most examples ranged between 6·3 gm. (fig. 8) and 51 gm. (fig. 3), there being a rather even and random distribution of weights between the two limits. Two are outstanding, one at 113 gm. (fig. 1) and the other at 296 gm. (fig. 2).

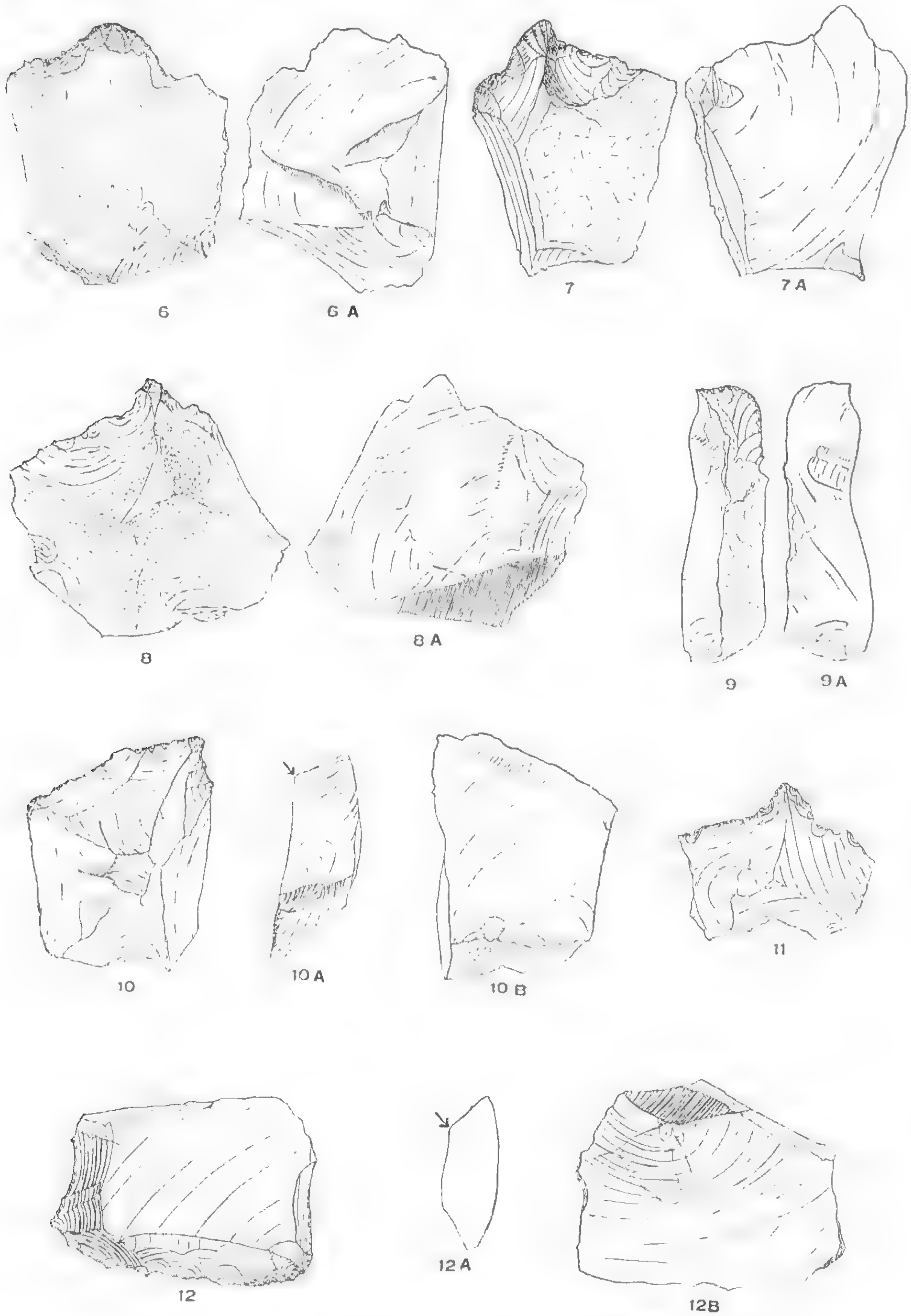


Fig. 6-12. Stone implements from Cape Hart, Kangaroo Island.

DISCUSSION.

Early writers refer to the settlements of whalers along the east coast of Kangaroo Island; some were certainly at Antechamber Bay and the surrounding district.

The presence of native Tasmanian women in the households of some of the whalers was also noted. Tindale (*loc. cit.* pp. 30–33) gives a description, from historical sources, of the native women members of these settlements, together with a description of the archaeological evidence of their presence on the island. In his

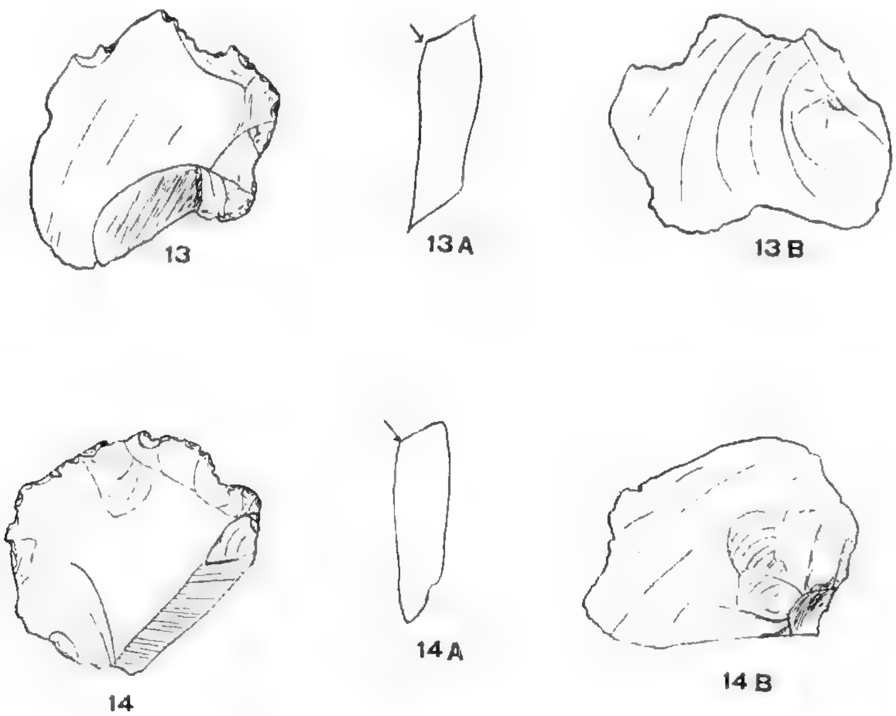


Fig. 13–14. Stone implements from North-West Tasmania.

description of the implements from Antechamber Bay, he drew attention to their similarity to examples of the Newer Tasmanian industry from North-western Tasmania; this resemblance is particularly notable in the specialized form of the tool, in the technique of manufacture, and in the angle between the platform and the flaked face, already referred to.

The pointed form of gouge or scraper, so prominent in the series figured, seems to have been a characteristic feature of Tasmanian implements, both of the Older and the Newer Tasmanian industries. Of the series of Tasmanian implements figured by Hambly (1931) several show the pointed form, the author referring to one example as having "a useful projection or duck bill" (*loc. cit.* p. 89).

Many implements of the Newer Tasmanian series, two of which (figs. 13, 14) from the South Australian Museum Collection are figured in this paper, exhibit this characteristic.

The implements from Cape Hart under discussion share, in a marked degree, in the characteristics of the Antechamber Bay examples and those from the newer Tasmanian series, being apparently identical in their method of manufacture. The deduction is that they have the same cultural affinities and are of Tasmanian manufacture, and the handiwork of the Tasmanian native women brought to whalers' camps on Kangaroo Island in the early years of the nineteenth century.

The shape of the tools is suggestive of their use as scrapers or gouges. Hambly suggests the use of these as elastic terms in the classification of Tasmanian types of implements (*loc cit.* p. 90). Several writers who have described the early settlements on Kangaroo Island have referred to the trade in wallaby skins from the whaling camps, and the skin clothing worn by the men. An early reference in "The South Australian Register" (Sept. 25, 1844) suggests that the native women were adept in the catching of these animals.

REFERENCES CITED.

Hambly, W. D. (1931) : *Amer. Anthrop.*, xxxiii.

Tindale, N. B. and Maegraith, B. G. (1931) : *Rec. S. Aust. Mus.* iv (3), p. 275–289.

Tindale, N. B. (1937) : *Rec. S. Aust. Mus.*, vi (1), p. 29–37.

THE INITIATION OF NATIVE-DOCTORS, DIERI TRIBE, SOUTH AUSTRALIA

By R. M. Berndt, Hon. Assistant in Ethnology, South Australian Museum, and T. Vogelsang

Summary

The following paper records some observations and discussions on the methods and beliefs concerning native-doctors or medicine-men among the Dieri Tribe's people on the eastern shores and neighbourhood of Lake Eyre. The Dieri Tribe is divided into several groups, namely the [nadi´nani] or [Bukatjiri] who inhabit the country around Lake Perigundi; the [Pandu] or Lake Hope Dieri; the [Ku´na:ri] the Cooper's Creek Dieri inhabiting the country around the Kopperamanna and Killalapaninna districts; the [´Paritiltja] in the country from Kopperamanna northwards to the Salt Creek, and the [Tirari] who live on the south-east shores of Lake Eyre. The Tirari have been cited as a tribe by Stirling and Waite (1919, p. 106). These groups are bordered on the north by the Ngameni and ´Jauraworka; the north-west by the Wongkanguru; the north-east by the ´Jandruwanta; the east and south-east by the Pilatapa; the south-west by the Kujani; and on the south by the Wailpi and the ´Jadliaura.

The INITIATION of NATIVE-DOCTORS, DIERI TRIBE, SOUTH AUSTRALIA

By R. M. BERNDT, Hon. Assistant in Ethnology, South Australian Museum, and T. VOGELSANG.

The following paper records some observations and discussions on the methods and beliefs concerning native-doctors or medicine-men among the Dieri Tribe's people on the eastern shores and neighbourhood of Lake Eyre. The Dieri Tribe is divided into several groups, namely the [ŋadi'ŋani] or [Bukatjiri] who inhabit the country around Lake Perigundi; the [Pandu] or Lake Hope Dieri; the [Ku'na:ri] the Cooper's Creek Dieri inhabiting the country around the Kopperamanna and Killalapaninna districts; the ['Paritiltja] in the country from Kopperamanna northwards to the Salt Creek, and the [Tirari] who live on the south-east shores of Lake Eyre. The Tirari have been cited as a tribe by Stirling and Waite (1919, p. 106). These groups are bordered on the north by the Ngameni and 'Jauraworka; the north-west by the Wongkanguru; the north-east by the 'Jandruwanta; the east and south-east by the Pilatapa; the south-west by the Kujani; and on the south by the Wailpi and the 'Jadliaura.

The principal information is based on a Dieri text, recorded by one of us (T. Vogelsang), who was born at Boocaltaninna, called in Dieri [Buka'ŋandru] (*buka'-buka*, trees or thick scrub; *'ŋandru*, close together) on Lake Boocaltaninna, south-east of Killalapaninna in the Dieri country, and lived there for many years.

In transcribing this Dieri text, the alphabet of the International Phonetic Association as modified for Australian languages has been adhered to as closely as possible. Details of the system are recorded by Tindale (1935 and 1940).

The first vocabulary and grammar of the Dieri was compiled by Gason (1874); another important work on the language was undertaken by Gatti (1930). A Dieri vocabulary, as yet unpublished, is contained in the J. G. Reuther manuscript in the possession of the South Australian Museum. Other workers in the Dieri field have been O. Siebert, A. W. Howitt, C. Strehlow, M. von Leonhardi, H. Basedow and A. P. Elkin.

THE DIERI TEXT.

This unique Dieri text relates the experiences of a postulant during his initiation as a native-doctor. It was taken down and translated by one of us (Vogelsang) from the lips of Palkalina (English name, Elias), an old native-doctor.

Palkalina was a reliable informant, whose portrait has been illustrated by Horne and Aiston (1924, p. 14, fig. 2; to the right). Palkalina is also mentioned in the Reuther Manuscript in this Museum.

In telling of the story, each word would be pronounced deliberately, in a manner that is called [ŋapu] (meaning quiet; said of an utterance of importance). In the relating of unimportant phrases of non-dramatic effect, the words would be quickly passed over.

The original version of the text, with its interlinear translation, is followed by a general rendering of the experiences of Palkalina.

THE MAKING OF PALKALINA INTO A NATIVE DOCTOR.

"Nulu kutjiele mili ˊmarapu ŋamalkai, ditjini nauja ˊkuruˊkuru
"He spirit followers many have, daytime he secretive

ŋamai ˊminkani, ˊkaijeri ˊmikirini, mita ˊwipaˊwipani, mita
sits holes, creeks deep place valleys, place

ˊbukaˊbukani, mita ˊpidaruni, ˊja piri ˊpilki ˊja ˊpilkini.
timbered country, place desert and places different and different.

Kutji ŋurali ˊtinkani ˊwirariai ˊja ditjini windri putapalpa
Spirit always night-time walks and daytime only sometimes

ˊkantjiriai, ˊja winta ˊwaldra ˊpirna ŋananani nauja wopai ˊtalara
appears, and when heat great is he goes rain

ˊpalkuni ma:runi, ˊja nauja bakana ˊkuruˊkuru ŋamai watara
cloud black, and he also secretly sits dust-storm

ˊpirnani ˊja ˊpildriˊpildrini ˊja ˊnidlaˊnidlani, ˊpatara kukoni,
big and thunder and mirage, trees hollow,

ˊja kana ˊjapali ŋanai winta nauja ˊwirariai ˊpaiaˊjeri.
and people frightened are when he walks about birdlike.

Windri kulno ŋanai kana ˊkulkala ˊnunˊkaŋundru, nauˊu ŋanai
Only one is people safe from him, he is

kunki. ˊJeruja ŋato ŋundrana warai bakana kunki
native-doctor. Therefore I thought did also native-doctor

ŋanala, ŋadani ŋakani mili ˊŋakaŋundru ˊpirna ŋundrala ŋanai.
to get, then my people of me great think will.

ˊJeruja ˊŋaianani kunki ˊja ŋani wopana warai ˊTipapil:a[1]
Therefore our native-doctor and I went did Tipapilla

mitaia, naka mandurila kunki tulani nauja kutji ˊjeri
place, there to meet native-doctor stranger he spirit like

[1] ˊTipapil:a, in the Salt Creek country. This place is sometimes called ˊTippamara.

ŋaliŋu ′wokarana warai, ′ja winta ŋani nina najina warai
to we two come had, and when I him saw had

ŋani ′pirna ŋarʼana warai ′japali ′ja ′pirna ŋaru′parana warai,
I awful shivered did fear and very much alarmed was,

′ja nuru′jeli nauja kutji kutiŋana warai, ′ja ŋadani ′nakaldra
and suddenly he spirit disappeared had, and then again

′tikana warai, ′ja ŋani mauali ′pirna ′pantjina warai, ′jeruja nulu
return did, and I hungry very get did, so he

ditji ŋoparani ′taijini ′pilki ′jinkina warai, kutjia ′taijini,
day first food different gave did, spirit's food,

kujamara(2), ′ja ŋani ′para′warana ŋanana warai, ′jeruja nulu
kujamara, and I a native tobacco been had, so he

′kanaŋundrani ′ŋakaŋundru ′dukarana warai ŋani wata ′ŋundrananto
man mind from me took out had I not shall think

kana ′pilki ′jeri, windri kutji ′jeri, ′ja winta nulu ŋarana
people others like, only spirit like, and when he hear

warai ŋani ′tjau′tjau ′jatanani nulu ŋana ′jakalkana warai.
did I confused spoke he me questioned had.

Mina ′jundru najiai? ′Ja ŋani ′kalabaŋa warai, kutji marapu.
What you see? And I answered did, spirit many.

Nadani nauja jatana warai. ′Jidni matja kunki ′jeri,
Then he said had. You now native-doctor like,

ŋundrai ′wolja ′jidni kunki ŋumu ′pantjila ŋanai. Ditji
think in time you native-doctor good be shall. Day

′mandruni nulu ′jenilu ŋakaŋu ŋankana warai. Ditji
second he the same to me performed (rites) did. Day

′parkulani nauja ′ŋakaŋu ′jatana warai, matja ′jidni kunki ŋumu,
third he to me said had, now you native-doctor good,

′jeruja ŋato ′jinkaŋu ′jinkiai kunki ′potu, Wodna,
therefore I you give native-doctor articles, Digging-stick,

′Pili, ′Maltara, ′Turuŋpita, ′ja ŋadani nauja kutji
Dilly-bag, Emu-feathers, Fire-stick, and then he spirit

kutiŋana warai. ′Ja ŋakani kunki ′ja ŋani ′jelalu
disappeared did. And my native-doctor and I both (went)

(2) *Kujamara*, a species of bush, used as a native tobacco. Professor T. Harvey Johnston is not acquainted with this term. As a conjecture he states that it may refer to *pituri* when it is being worked up in the hand. The usual term, however, for prepared *Duboisia* in the Dieri and associated tribes is *pituri*. Howitt (1904, p. 448) mentions that the name of the plant called *kuja-mara* means new fish. This plant is particularly used in sorcery; for instance the *dukana* (pointing-bone) ceremony. It is often the especial property of the *kunki*. *Kujamara* is further used in the mortuary ceremonials. It is used in poisoning waterholes to catch emus.

'tikana	warai	'Lauerikudu(3)	mitai."
home (our camp)	did	to Loweri-hole	place."

A GENERAL RENDERING OF THE STORY.

"He, the Spirit, has many followers. During the daytime he is secretive, hiding in deep holes, creek beds, valleys, thickly-timbered country, desert wastes, and in other different places. In the night-time he always walks, but does not usually during the day. When the weather is very hot, he goes into a black rain-cloud. He also secretly sits (or is present in) dust-storms, during thunder, and is in the mirage one often sees. He inhabits hollow trees too.

People are most frightened of him when he walks about in the form of a bird.

Only one person is safe from the spirit, and he is the *kunki.*

Therefore, I thought that I would get a *kunki* to show me his art. I could then be made into one. Knowing that I am a powerful *kunki,* my people would esteem me and think me great.

Our *kunki* and I went to a place called Tipapilla. There we met a stranger *kunki,* who resembled the spirit. When I saw him, I shivered with great fear, being much alarmed. Suddenly the spirit disappeared, but almost immediately returned. I became very hungry.

The first day of our seclusion in the bush, with the spirit, at Tipapilla, he gave me food that I had not had before. It was called Kujamara, or "spirit's food", which was a native tobacco. He then read my thoughts, and saw that I desired to be made into a *kunki.* He said that I should not think about other people, but only of the spirits. I then went back to my companion, the *kunki.* I spoke to him in a confused manner. He questioned me, "What see you*!*" To which I answered, "Many spirits". He then said, "You are now a *kunki.* In time, I believe, you will be a good one."

On the second day I went back into the bush, and the spirit came to me and performed certain rituals which I learned. I then returned to my companion.

THE KUNKI.

Gason (1874, p. 28–29) was the first to record the "making" of a Dieri native doctor and his subsequent duties. He says: "The *Koonkie* [kunki] is a native who has seen the devil when a child (the devil is called *kootchie* [kutji]), and is supposed to have received power from him to heal all sick. The way in which a man or

(3) *'Lauerikudu,* a native name retained by the Europeans. It is on Salt Creek, and was the site of a large cattle station.

woman becomes a doctor, is, that if when young they have had a nightmare or an unpleasant dream, and relate this to the camp, the inmates come to the conclusion that he or she has seen the devil. The males never practise until after circumcision, and, in fact, are not deemed proficient till out of their 'teens.''

Howitt (1904, p. 358-9) has also elaborated on this data, having as his authorities O. Siebert and S. Gason.

In the Dieri country and the south-eastern region of the continent, the native-doctors often act as sorcerers. Those who are not endowed with the extra power that a *kunki* has received during his initiation know little about the profession, as the more secretive and mysterious the practitioners are with regard to it, the more impressed are both they themselves and others by the wonder of its form and the greatness of its effects.

The *kunki* wields more power and authority in a Dieri community than do any other individuals therein. Usually he is an elder of a totemic group, but not all elders are native-doctors. Frazer (1911, p. 367-7), when writing of Australian native-doctors, mentions that ''on a whole, it is highly significant that, in the most primitive society about which we are accurately informed, it is especially the magicians or medicine-men who appear to have been in process of developing into chiefs''.

THE DUTIES OF A KUNKI.

The native-doctor's duties are many. He not only practises black-magic, thus assuming the rôle of the sorcerer, but is the oracle of his group, foretelling coming events, mediating at quarrels, offering advice, curing patients, and counteracting alien magical influences.

The sorcery practised by the *kunki* has been recorded by O. Siebert (1910, p. 55, 97), but the following may be added:

In the use of the pointing-bone [dukana] (a striking bone), the *kunki* is assisted by an elder of his totemic group or by another native-doctor. At the completion of the bone-pointing ceremony, and the soul of the victim has been caught and is drawn into the bone through the blood of the *kunki*, a lump of wax or clay is attached to the point. This lump is very necessary, as the soul might try to escape at the point. This done, they bury the bone, wrapping it in emu feathers and in the [kujamara] plant, and leave it in the earth for several months. At the end of this period it is disinterred and ritually burnt. As the bone burns, the victim becomes seriously ill, until finally, when it is completely consumed, he is dead.

When the *dukana* is pointed, it is believed that a quartz-crystal which is usually endowed with a life-giving substance, bone or pebble passes from the pointer through space into the victim. On the other hand, the blood or soul of the victim is drawn out and enters into the pointer. The quartz-crystal which is possessed of magical qualities is received by the *kunki* at his "making". The belief that native-doctors can project substances in an invisible manner into their victims is widespread in Australia. One of the principal projectives is quartz, especially in the crystallized form. Such as carried as part of the "stock-in-trade" of the native-doctors, and it is said that they are associated with the mythical past, being portion of the excreta of a *mura'mura* (an ancestral being). Howitt (1896, p. 90) states that the Wurunjerri natives believed that evil magic manipulated by their medicine-men acts through quartz-crystal, which could be projected into a man.

In several different tribes with which one writer (R. M. Berndt) is acquainted, the 'Anta'kirinja, the Ngadjuri of the middle-north of South Australia, and the 'Jaralde of the lower River Murray, quartz-crystal is attributed with magical qualities, is zealously guarded from the eyes of women and the uninitiated, and is hidden in a pouch.

As a quartz-crystal may be projected by a *kunki* into the body of a victim, it may be removed by sucking and massage by another *kunki*. It is in this duty that the *kunki* assumes his real rôle of native-doctor. In curing a patient, he may use various methods at which he is adept. A cure is affected by rubbing, pressing, or sucking the affected part, sometimes accompanied by an incantation or song, and the subsequent extraction of a foreign body, as the cause of evil. Sleight-of-hand is most often used during the treatment of a patient. In this case, at the psychological moment, the cause of the sickness in the form of a bone, stone or piece of wood may be removed from the afflicted part of the body. Again, in the curing of a patient, a quartz-crystal as a curative charm is used in conjunction with the sucking method.

The *kunki* will conduct inquests, assisted by an elder or another native-doctor. During the inquest ceremony the dead body is carried on the heads of three men, who kneel at the grave-side. The *kunki*, holding a baton of wood in each hand, asks it who or what has been the cause of its death. To receive an answer the native-doctor uses the art of ventriloquism, as recorded by Berndt and Vogelsang (1939, p. 169). There are also further methods of inquest at which the *kunki* presides: the examination of the bodies of the dead and the divining of certain signs appearing on the grave of a recently-dead person. The common belief is that the spirit of the "murderer", unknown to him, will visit from time to time and haunt the grave or be present at the inquest ceremony of the victim. It is the *kunki's* duty to find the spirit and identify it, thus revealing the real "murderer". Most often the haunting spirit will betray its own presence.

The spirit of the *kunki*, during sleep, may visit distant persons or be visited by them. Often the spirit takes the totemic form to which the dreamer belongs. The spirit may also come into touch with the departed. The interpretation of dreams [apitja] and visions seen during meditation form an important duty of the *kunki* or "spirit-men". Howitt (1904, p. 358) mentions that the *kunki* may interpret dreams, and reveal to the relatives of the dead the person by whom the deceased has been killed. Visions seen in dreams are attributed to spirits. The phenomena of sleep (with dreams) and visions of the waking life, as animistic conceptions, have been dealt with by various writers, including Róheim (1930) and Elkin (1937, p. 55). The last-named writer, when speaking of some tribes in Eastern Australia, says that spirit-snakes are sent out by the medicine-man during a vision to gather information of what is happening at a distance.

If the *kunki* declares that he has had a real vision of his departed friend, he may order food to be placed for the dead, or a fire to be made so that he can come and warm himself. By reason of his spiritual experience at his "making", the *kunki* is believed to have direct communication with spirits, called [kutji], and also with [mura'mura].

The native-doctor's rôle as rain-maker will be dealt with later in this paper. It is important to stress, however, that the above duties could not be performed until the postulant had received the power from the [kutji] at his "making".

THE MAKING OF A NATIVE DOCTOR.

The *kunki* must have a knowledge of the method and procedure, and an understanding of the ritual by which he was initiated or "made". He must not only be able to perform this ritual, but must be invested with the power with which to do it. Among the Dieri, this power is acquired, not from learning, but by a spiritual experience. He is "made" by the spirits alone, although he may be assisted by a native-doctor belonging to his own totemic group.

After the postulant has been subincised, he "feels" that he wants to be a *kunki*. He goes to his native-doctor and asks the latter to "make" him. There are, however, other signs which the aspirant is expected to show: a great interest in the traditional lore of his group; a tendency to psychic experiences, and an attachment to the elders and *kunki*. He is taught the method and procedure appropriate to his profession. He learns to conduct inquests, interpret dreams, cure the sick, and perform other duties which have been described above.

To receive this power from the spirit called *kutji*, the postulant, accompanied by a *kunki*, retires into the scrub. He is decorated in a special manner by his companion. At a pre-decided place he must stay for three days, the period of seclusion. In this time he meditates on the spiritual experiences he has been told about, and the powers he will receive from the *kutji*, until it occurs in a mystic fashion. The *kutji* is materialized, being psychically projected by the state of trance the postuland is under, and initiates him. The first day the aspirant is given food by the spirit, who at the same time substitutes the initiate's "man mind" with that of a "spirit" or medicineman mind. The *kutji* afterwards disappears. The postulant reports his experience to his companion, who is some little distance away. The *kunki* explains to the former the significance of the experience. The second day the spirit appears and performs certain rites. The *kutji* then disappears. The third day it appears once more, and finally completes the "making". The postulant becomes a fully-initiated *kunki*, by receiving certain articles, as a digging-stick, dilly-bag, emu-feathers, fire-stick, and, what is perhaps most important, a piece of quartz-crystal, which is possessed of magical qualities.

Upon the completion of his period of "making", the native-doctor has been reborn; he is a new person, possessed of powers which no ordinary person may even suspect. Upon the day that he enters the scrub for his period of seclusion and meditation, he is believed to ritually die, being mourned for by his parents. It is not until the completion of the "making" on the third day that he is reborn. His old life has been completely forgotten.

The secret rites that occur on the second day are somewhat obscure, but it is known that the postulant receives a spirit-snake which is inserted into his stomach, through an incision, by the *kutji*. This spirit-snake may be sent during meditation to gather information for the *kunki*. Further, on that same day, he may visit the sky-world and receive his power from there. Siebert, as recorded by Howitt (1904, p. 359), states that the *kunki*, like a *kutji*, can fly up to the sky by means of a hair-cord, and see a beautiful country full of trees and birds. It is said that they drink the water of the sky-land, from which they obtain the power to take the life of those they doom. Gason (1874) mentions that the *kunki* relate their wanderings in the sky-country in the form of crows, snakes, or other creatures. Elkin (1938, p. 224–5) writes that the native-doctor is taken up to the sky by means of the magic-cord, and also to the foot of the rainbow. In this way he receives not only his endowment of magical substances, but also the power to hold intercourse with the dead, and to visit the sky-world.

It is clearly seen that, during the postulant's meditative seclusion, when his mind is in a state of receptivity during the trance, he experiences this spiritual phenomenon.

Among the Ngadjuri people of the middle-north of South Australia, an informant working with one of the above writers (R. M. Berndt) relates that the native-doctor [mindapa] has to undergo a similar process of initiation. The Ngadjuri have a similar culture to that of the Dieri.

As a child, he is singled out by his tribal elders for the future profession of a *mindapa*. He is chosen because he does not mix with those children of his own age, but prefers to play and stay with his parents in their own camp. The postulant, as he is considered by the elders, is specially taught, not only by his parents, but by the other native-doctors of his group. When he reaches puberty he still avoids those of his own age, and will not take part in their games or amusements. At this period when the other boys are becoming sex-conscious, he rigidly avoids all young women. After the circumcision and cicatrization ceremonies, from which he has emerged a man, he does not return to the young men's camp, but retires alone to a place some distance away. There he meditates and has converse with the spirits, which at special times he may see. He will go into trances and see visions in which would be portrayed important forthcoming events of tribal significance. During this period of seclusion he receives his real power to perform subsequent magical acts which are expected of him when he is a *mindapa*. For the period he is considered ritually dead, as it is only on the completion of his seclusion that he becomes "alive" or reborn as a new man. On receipt of his power from the spirit, he is received by the other tribal native-doctors, and duly taught the method and procedure of the profession. Until he reaches the age of about thirty, he must abstain from sexual intercourse. Female *mindapa* are also considered clever, and to possess powers at least equal to those of the male *mindapa*. They abstain from sexual relations until their twenty-fourth or twenty-fifth year. Their method of "making" is similar to that of the males.

THE KUNKI AS A RAIN-MAKER.

In the Dieri country, a region subject to frequently recurring periods of drought, the whole tribe or group joins under the direction of the *kunki* in the ritual of making rain.

Howitt (1904, p. 394) states that the clouds are supposed to be bodies in which rain is made by rain-making *mura'mura* (chiefly [Darana]), influenced by the ceremonies of the Dieri.

The clouds are called ['thalara'paulka], the substance of rain. *Darana* is considered a powerful rain-making *mura'mura*. He not only controlled the rain but also the wind [watara], thunder ['pildri'pildri] and lightning ['pildri'pildri-'paratji] (*'pildri'pildri*, thunder; *'paratji* light). It is said that lightning comes from thunder, while the wind "was born" or originated in the deep recesses of some caves in the hills about two miles east of Boolcaltaninna.

The *'mura'mura Darana*, while on earth, wandered through the country around Lake Eyre. *Darana* is one of the most powerful of the Pandu Dieri *'mura-'mura*. In a description of *Toas*, or aboriginal direction signs from this region, Stirling and Waite (1919, pp. 124, 126, 131, 134, 135, 136, 138, 139, 141, 143, 147, 148, 149, 152, 153) have recorded some of the places this *mura'mura* visited. Howitt (1904, p. 198–800) has a rendering of the *Darana* Legend; it is also referred to by Berndt and Vogelsang (1939, p. 171).

It was in the power of *Darana* to give or withhold rain. In asking for rain, the *kunki* directly invoked the power of this *'mura'mura* by the performance of a rain-making ritual.

The following methods of making rain are practised by the *kunki*:

(a) Rain-making *'mura'mura* are called on to give the *kunki* power to cause heavy rain to fall.

(b) The bull-roarer is used by the *kunki* during the rain-making ceremony.

(c) According to Howitt (p. 396) the prepuce, carefully preserved from a previous circumcision, is believed to have great power of producing rain, because of its association with the flow of urine and ejaculation of seminal fluid. It is kept in a parcel, which, when opened by a council of *kunki* or elders, loses its virtue.

(d) Goanna fat rubbed on a youth's body causes steam to rise. This is supposed to form into a cloud from which rain would fall. The rain-maker performs this ritual act most often on his son.

(e) Howitt (1904, p. 394–5) has described a rain-making ceremony in which many members of the tribe take part. A hut is built in which elders sit. Two *kunki* who have received power from the rain-making *'mura'mura* have their arms cut so that the blood flows on the men sitting round in the hut, during which they throw handsful of down into the air. The blood symbolizes the rain, the down the clouds. The large stones are placed in the centre of the hut (these are associated with *Darana*), representing gathering clouds presaging rain. The two *kunki* afterwards place the stones in the branches of the largest tree, and other men throw fine powdered gypsum [kopi] into a waterhole. These ritual actions completed, the *'mura'mura* causes clouds to appear in the sky. A ceremony is also enacted in the pulling-down of the hut.

In the arid Dieri country where droughts often occur, the native must be sure of his water-supply. He knows every waterhole in his surrounding territory, but even these at times may dry up. Then he has recourse, as described by Cleland (1939, p. 9), to the water-bearing root of the Mallee or other succulent plants. The frog, buried in the bed of a creek, may be found, and, by compressing the urinary bladder, water is obtained. Howitt (1889, p. 54) relates that, in some parts of South-Eastern Australia, when the rainfall is likely to be excessive, the natives feared to injure *Tidelek*, the frog, or *Bluk*, the bull-frog, because they were said to be full of water instead of intestines, and great rains would follow if one of them were killed.

THE KUTJI (OR SPIRIT).

It was seen that the *kunki* was "made" by a *kutji*, which is a spirit. It is an important figure in the Dieri belief in spirits, and the shapes that it assumes are diverse.

The *kutji* or [kutjieli] dwell usually in the shade of bushes, and deep holes. They show themselves in various forms, such as a black crow [kawalka], sandhill crow, raven, eagle, owl, or as a kangaroo or emu. They may be distinguished from the ordinary bird or animal by their circling round a person's head or behaving in a like manner. Actually, the spirit of the *kutji* takes possession of the bird or animal concerned, but does not remain therein for any length of time. This does not detract from the inherent virtue or worthlessness of a particular natural species, as dictated by legend. Usually the eagle is a good man, the crow disliked generally, being mischievous, as is the case among the Dieri. However, the rôles are occasionally reversed. The owl is almost universally regarded with great apprehension, so that while some creatures are regarded with fear and may naturally be thought to harbour readily an evil spirit, it is still unexplained why those which are liked should become, for a time at least, objects of fear. The birds or animals become possessed, and outwardly show this evil possession by strange or unusual actions. Naturally the native explains any deviation from the orthodox as being supernatural. Thus a kangaroo with agreed virtue, if noticed to be acting in an unusual manner, is regarded with mixed fear; a *kutji* has possessed it or taken its form.

In the warm weather the *kutji* may be in a black rain-cloud, or present in a dust-storm, during thunder, or in the distant mirage.

Whirlwinds, frequent in the Lake Eyre region during dust-storms, contain these malignant spirits. Clouds of dust raised on the plains of Central Australia are ascribed by the Dieri to *kutji*, and if one of these dust-whirlwinds passes through the midst of a camp, there is great consternation, as they fear that some great calamity will follow. Howitt (1904, p. 446) relates how a man of the Yendákarangu section of the Urabunna (Arabana) tribe chased a whirlwind, trying to kill the *kutji* with boomerangs. He told afterwards that he had had a fight with this spirit which "growled" at him. Soon afterwards he died.

Whirlwinds can be controlled by the *kunki*, who have special incantations for this purpose. It is said that, under the spell of a *kunki*, the whirlwind will turn aside from its course. Spirits are said to inhabit whirlwinds in the Great Victoria Desert region. The 'Anta'kirinja say they are malignant camp spirits in flight, while the Ngadjuri natives associate the whirlwind with a snake-like creature. The whirlwind collects victims, which it draws into a waterhole to be swallowed whole by this monstrous snake. The *kutji* delight in these whirlwinds (or willy-willies) [*'watara'watara*], as the crow and the raven would fly into them, and when beaten by the fury of the *'watara'watara*, would caw. People stop their ears so as not to hear this noise. A person who hunts away a *kutji* crow or other creature will be stricken with sickness. According to Elkin (1937a, p. 288), the *kutji* will carry a man away while he is sick, and the [mungara] (a grave-spirit which goes to the south, the Spirit Land, after death) will extract his kidney-fat.

There is also the long-tailed wren ['kutji'kutji], which is a small spirit, not so powerful as the *kutji*. The *'kutji'kutji* live in bushes, and are important birds used by the *kunki*.

The native-doctor is not afraid of the *kutji*, from whom he has received his power, and with whom he is in direct communication.

The *kutji* may cause sickness, and could only be driven out by suitable means applied by the *kunki*.

Visions are attributed to *kutji*. Indeed, any strange apparition is called by the same term.

SUMMARY.

This paper records some new information about the initiation of native-doctors or medicine-men among the Dieri. A Dieri text is given, together with a detailed discussion of the place of the native-doctor in the South Australian aboriginal community.

REFERENCES CITED.

Berndt, R. M. (1940) : *Oceania*, x (3).

Berndt, R. M. and Vogelsang, T. (1939) : *Trans. Roy. Soc., S. Aust.*, lxiii.

Cleland, J. B. (1939) : *Proc. Roy. Soc., Tasmania.*

Elkin, A. P. (1937) : *Mankind*, ii.

Elkin, A. P. (1937a) : *Oceania*, vii.

Elkin, A. P. (1938) : The Australian Aborigines (Sydney).

Frazer, J. G. (1911) : The Magic Art, i.

Gason, G. (1874) : The Dieri Tribe, Adelaide.

Gatti, G. (1930) : La lingua Dieri. Contributo alla conoscenza delle Lingue Australiane (Rome).

Horne, G. and Aiston, G. (1924) : Savage life in Central Australia (London).

Howitt, A. W. (1889) : *Journ. Roy. Anthrop. Inst.*, xviii.

Howitt, A. W. (1896) : *Journ. Roy. Anthrop. Inst.*, xvi.

Howitt, A. W. (1904) : Native Tribes of South-East Australia.

Roheim, G. (1930) : Animism, Magic, and the Divine King.

Siebert, O. (1910) : *Globus.*

Stirling, E. C. and Waite, E. R. (1919) : *Rec. S. Aust. Mus.*, i.

Tindale, N. B. (1935) : *Rec. S. Aust. Mus.*, v.

Tindale, N. B. (1940) : *Trans. Roy. Soc., S. Aust.*, lxiv.

LITTORAL COPEPODA FROM SOUTH AUSTRALIA
(I) HARPACTICOIDA

By A. G. Nicholls, Ph.D., University of Western Australia

Summary

The collection of littoral copepods in the South Australian Museum has been sent to me for examination, and I am indebted to the Director of the Museum, Mr. H. M. Hale, for this opportunity of studying them.

This collection comprised 15 tubes, divisible into two categories: A, samples taken by townet; and B. shore collections and dredgings. One of the former was taken at night, a light being used to attract animals, and so might be expected to contain bottom-living as well as planktonic forms. All of the collections were made in South Australia in the region of St. Vincent and Spencer Gulfs, with one exception from a salt lake at Beachport, with which we are not concerned at present.

LITTORAL COPEPODA FROM SOUTH AUSTRALIA
(1) HARPACTICOIDA

By A. G. NICHOLLS, Ph.D., University of Western Australia.

Fig. 1–23.

The collection of littoral copepods in the South Australian Museum has been sent to me for examination, and I am indebted to the Director of the Museum, Mr. H. M. Hale, for this opportunity of studying them.

This collection comprised 15 tubes, divisible into two categories: A, samples taken by townet; and B, shore collections and dredgings. One of the former was taken at night, a light being used to attract animals, and so might be expected to contain bottom-living as well as planktonic forms. All of the collections were made in South Australia in the region of St. Vincent and Spencer Gulfs, with one exception from a salt lake at Beachport, with which we are not concerned at present.

The samples listed below, although divided into the two categories mentioned, are numbered consecutively, and these numbers are used in defining the occurrences of each species described.

A. Townettings.

I. Smith Bay, Kangaroo Island, from 8.0–8.15 p.m., 15/3/38; contained *Calanopia thompsoni* only.

II. Western Shoal, on the west side of Spencer Gulf, at 8.30 p.m., 20/2/38 (Calanoids and Harpacticoids), by K. Sheard and F. W. Moorhouse.

III. Blanche Harbour, at the north end of Spencer Gulf, 8.30 p.m. 8/3/38, by K. Sheard. (Mainly Calanoids, a few Harpacticoids.)

IV. Wallaroo Harbour, on the east coast of Spencer Gulf, at 8.15 p.m., 26/2/38. "Light shone on water from deck for 7 minutes, then townet hauled vertically." (Mainly Calanoids and one Peltidiid.)

V. Spencer Gulf, Eastern Shoal, mid-day haul, 4/3/38. (Calanoids only.)

VI. Beachport, on south-east coast of S. Australia, from a salt lake. (Calanoids and Ostracods only.)

B. Shore Collections and Dredgings.

VII. Moonta Bay, Spencer Gulf, from a weed-covered reef exposed at very low tide; coll. B. J. Weeding, Feb., 1939. (*Calanopia thompsoni*, Peltidiids, Laophontid, *Amphiascus* sp.)

VIII. Port Willunga, from southern face of reef in one fathom at low tide; coll. H. M. Hale and K. Sheard, 17/1/37. (Peltidiid.)

IX. Sellick Beach, to the south of Port Willunga, from a stone in five feet of water at low tide on south edge of reef; coll. H. M. Hale, 31/1/37. (*Calanopia thompsoni*, many Harpacticoids and some Cyclopoids.)

X. Sellick Beach, from Cambrian Rocks in one fathom at low tide; coll. H. M. Hale, 13/2/37. (Numerous Harpacticoids and Cyclopoids.)

XI. Sellick Beach, at low tide; coll. H. M. Hale, 25/3/39. (Numerous Harpacticoids and Cyclopoids.)

XII. Sellick Beach, coll. K. Sheard, April, 1939. (Numerous Harpacticoids and Cyclopoids.)

XIII. Sellick Reef, coll. K. Sheard, April, 1939. (Some Calanoids, numerous Harpacticoids and Cyclopoids.)

XIV. Spencer Gulf, washed from dredgings, March, 1938. (*Calanopia thompsoni*, Harpacticoids and Cyclopoids.)

XV. Reevesby Island, Sir Joseph Banks group on the western side of Spencer Gulf. (One Notodelphyoid, from east coast of island; coll. H. B. Cotton, 7/12/36.)

Dissections have been made of all the species described in the following pages, and the preparations have been deposited in the South Australian Museum. Picro-indigo-carmine was used for staining in every case, and Monk's (1938) Medium and Euparal for mounting. This method is very convenient, and the stain is most effective for chitin, as stated by Monk.

I am indebted to Mr. K. Sheard, of the South Australian Museum, for valuable advice and help in nomenclatorial matters, in which connection I have also received assistance from Professor G. E. Nicholls, of the University of Western Australia, to both of whom I offer my best thanks. It is a pleasure here to express my thanks to the Trustees of the Science and Industry Endowment Fund for a grant enabling me to purchase a dissecting microscope, which has been of the greatest use in carrying out this work.

NOTES ON THE DISTRIBUTION OF SPECIES.

There is little to remark upon concerning the distribution within the area from which the collections were made, since all those from the shore, where Harpacticoids are more abundant, were taken in a comparatively small region extending for about 10 miles or so along the coast, about 30 to 40 miles south of Adelaide.

The distribution of those species which have previously been recorded is, however, of interest. In general, the Harpacticoid fauna of this region shows a relationship with that of Ceylon and the Malay Archipelago, the Red Sea, Mediterranean, and even the Bermuda region, which Willey (1930, p. 113; and 1935, p. 98) has shown to be affiliated with that of the Red Sea and Suez Canal.

This is particularly exemplified by the occurrence in this region of such forms as *Longipedia coronata*, *Peltidium speciosum*, *Porcellidium fimbriatum* and *P. acuticaudatum*, *Phyllothalestris mysis*, *Amphiascoides intermixtus*, *Laophonte cornuta*, *Ceyloniella armata* and *Metis jousseaumei*.

On the other hand there is also a relationship with the more southern islands, such as New Zealand and Kerguelen, as shown by the occurrence of *Alteutha signata* and *Porcellidium australe*, described from Kerguelen and *Porcellidium fulvum* from New Zealand.

FAMILY LONGIPEDIIDAE Sars 1903.

Genus LONGIPEDIA Claus 1863.

The genus comprises seven species, to which is added an eighth from this collection.

KEY TO THE FEMALES.

1. End segment of second endopod with 2 inner spines and 1 outer spine .. 2.
   End segment of second endopod with 2 inner spines only. *longispina* Monard 1928.
2. End segment of second endopod with first inner spine the most proximal .. 3.
   End segment of second endopod with outer spine the most proximal .. 6.
   End segment of second endopod with first inner spine exactly opposite the outer spine .. .. *rosea* Sars 1903.
3. Caudal rami as long as wide .. .. 4.
   Caudal rami half as long again as wide .. .. 5.
4. End segment of second endopod 3 times as long as two basal segments together; anal operculum with 4 denticles on each side of median spine, which extends beyond the caudal rami .. .. .. *minor* T. & A. Scott 1893.
   End segment of second endopod 4 times as long as two basal segments together; anal operculum with 2 denticles on each side of median spine, which extends beyond the caudal rami .. .. *weberi* A. Scott 1909.
5. Fifth leg with 1 terminal and 4 outer setae; anal operculum with long median spine extending beyond caudal rami and 2 lateral denticles and a fine hair on each side .. .. *coronata* Claus 1863.
   Fifth leg with 3 inner, 2 terminal and 2 outer setae; anal operculum with short median spine and 2 lateral spines as long as median spine and a fine hair on each side .. .. *brevispinosa* Gurney 1927b.
6. Fifth leg twice as long as wide; caudal rami as wide as long; anal operculum with median spine extending beyond caudal rami and with 1 large and 4 small denticles on each side .. .. *scotti* Sars 1903.
   Fifth leg 2·7 times as long as wide; caudal rami half as long again as wide; anal operculum with median spine extending beyond caudal rami and with 1 large and 3 small denticles and a fine hair on each side .. *australica* sp. nov.

LONGIPEDIA CORONATA Claus.

Occurrence: III, 2 females; XII, 1 female.

Distribution: Widely distributed on the shores of the North Sea, North Atlantic, Mediterranean, and Suez Canal, also taken at Ceylon, Nicobar Islands, Chilka Lake, and Malay Archipelago.

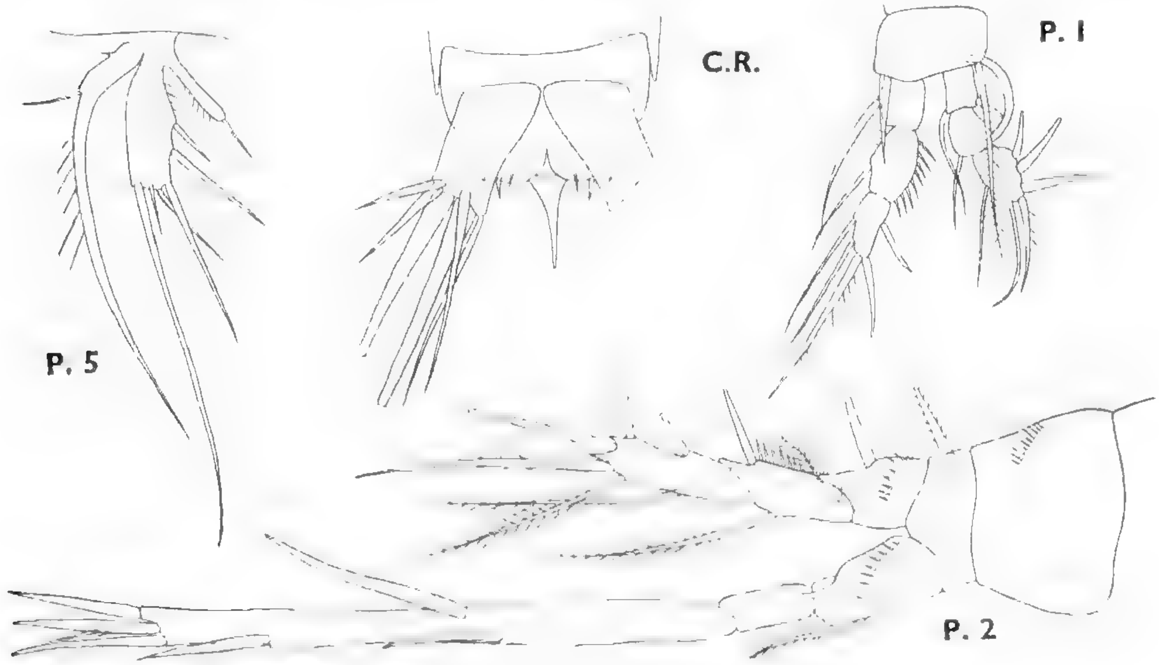


Fig 1. *Longipedia coronata* Claus, female.

This species is very variable, as has been shown by Gurney (1927b), and the specimens taken in these collections differ slightly from other forms (fig. 1), but there is little doubt that they should be referred to this species.

The most variable feature is size, which ranges from 0·56 mm. to 1·3 mm.; specimens found here measured about 1 mm.

LONGIPEDIA AUSTRALICA sp.nov.

Occurrence: II, 2 females; XII, 2 females, 1 male; XIV, 1 female.

Female: Length 1·1 mm. to 1·3 mm. This form resembles *L. scotti* in many respects, and might well be referred to that species but for some striking differences in the male. In the female the chief difference is in the shape of the fifth leg. The armature of the operculum is much as in *scotti*. The relative position of the spines on the end segment of the second endopod is somewhat different in *australica*, but in another specimen examined the positions were such as in *scotti*. The inner seta on the basal segment of the second endopod is quite short in *scotti*, and of a much greater length in the species found here (fig. 2).

The shape of the fifth leg in the form described as *L. scotti* Sars, by A. Scott (1909) and the very much longer setae, both on the basal segment of the second endopod and on the fifth leg, suggest that Scott's form is referable to the species described here. It is necessary that the male of his species should be found to be certain.

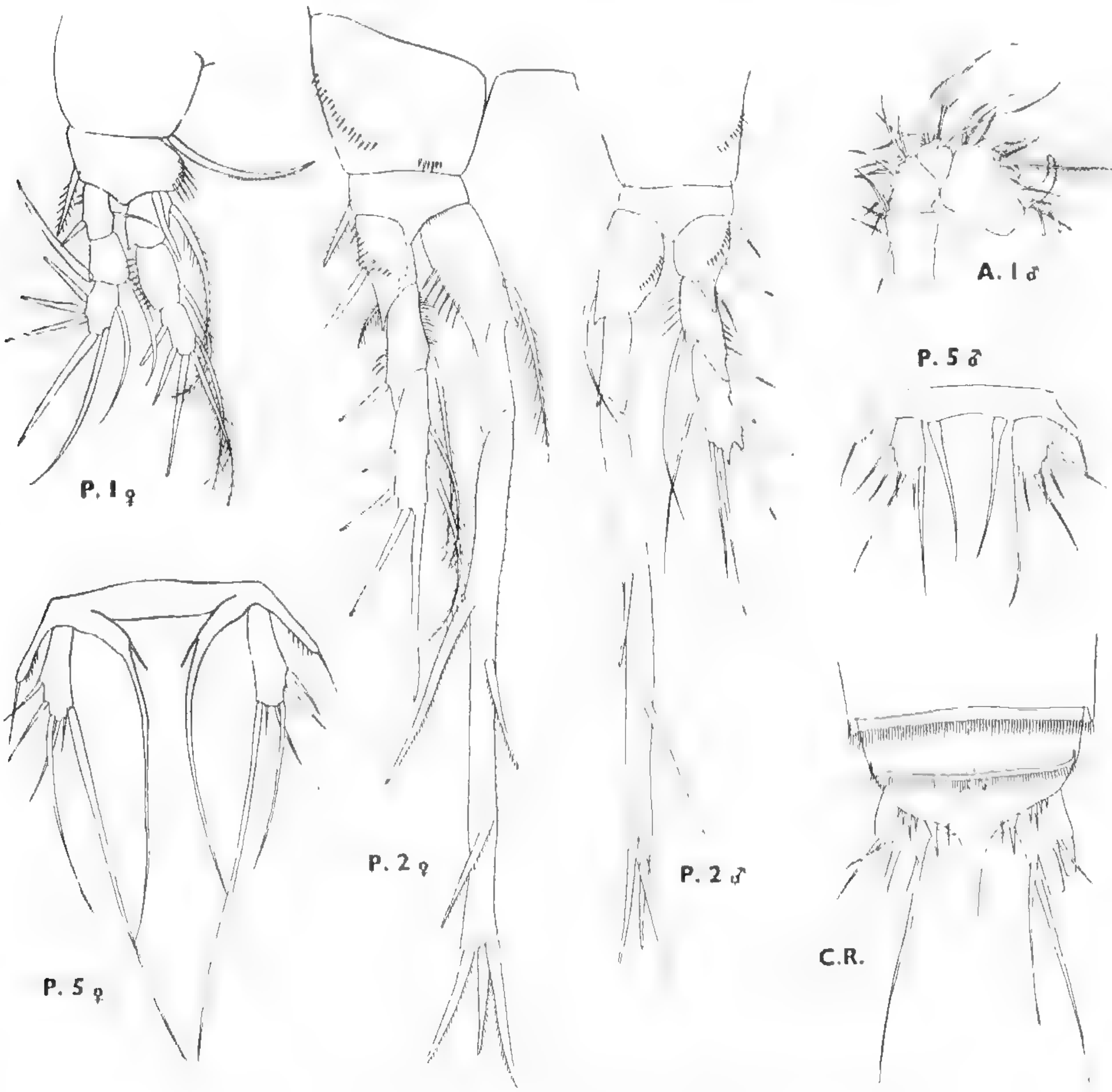


Fig. 2. *Longipedia australica* sp. nov., male and female.

Male: Length 0·96 mm. In the first antenna the swollen fifth segment is almost as wide as long, and bears several hook-like spines on its outer margin. These were not seen in *scotti* (Nicholls, 1935, p. 43), and the fifth segment is half as long again as wide. The better development of the setae on the basal segment of the second endopod and fifth legs also forms a distinctive feature of this species.

In the males of this genus the long segment of the second endopod bears only two spines (*coronata* appears to be an exception), and it is worth noting that in both *scotti* and *australica* it is the outer spine which disappears.

FAMILY PELTIDIIDAE Sars 1904.

The family is represented here by three genera, *Alteutha*, *Peltidium* and *Parapeltidium*. Numerically the material is very rich.

Lang (1936e, p. 30) suggests that *Dactylopusia platysoma* Thompson and Scott (1903) is a Peltidiid and not a Thalestrid, but if it is excluded from the latter family by the swimming legs and flattened body it is equally excluded from the *Peltidiidae* by the first legs. It appears to be intermediate and should perhaps be placed in a separate family.

The genus *Parapeltidium* was established by A. Scott (1909) for one specimen which differed from *Peltidium* in the possession of a narrow endopod to the first legs and in having the two segments of the fifth leg completely fused. As regards the first endopod this condition is regarded as being a male characteristic (see below), and has therefore no taxonomic value. The highly chitinized, fused fifth legs may be distinctive, and were found in two of the species taken here, which have, therefore, been assigned to *Parapeltidium*. The 5-segmented first antenna of *Parapeltidium johnstoni* Scott is not of generic value either, since it finds a parallel in *Peltidium aurivillii* (Cleve).

KEY TO PELTIDIIDAE.

1.	Body with anastomosing chitin bands	2.
	Body without such bands	3.
2.	Fifth leg 2-segmented	*Peltidium* Philippi 1839.
	Fifth leg 1-segmented	*Parapeltidium* A. Scott 1909.
3.	First endopod 3-segmented	4.
	First endopod 2-segmented	5.
4.	Fifth leg 2-segmented; first exopod with 2 or more terminal claws.	*Alteutha* Baird 1845.
	Fifth leg 1-segmented; first exopod with single large terminal claw.	*Alteuthella* A. Scott 1909.
5.	Rami of first leg subequal	6.
	Exopod of first leg twice as long as endopod	*Eupelte* Claus 1860.
6.	Basal segments of first leg linear, at right angles, rami long and slender.	*Paralteutha* T. Scott 1912.
	Basal segments of first leg as wide as long, rami short and stout.	*Eupeltidium* A. Scott 1909.

ALTEUTHA Baird 1845.

The following species have been assigned to this genus:

aberrans Czerniavski 1868,	*purpurocincta* Norman 1868,
austrina T. Scott 1912,	*sarsi* Monard 1924,
depressa Baird 1845,	*signata* Brady 1910,
dubia T. Scott 1912,	*triarticulatum* (Haller) 1879,
interrupta (Goodsir) 1845,	*trisetosa* Lang 1936e,
messinensis Claus 1863,	*typica* Czerniavski 1868,
nana Brady 1910,	*villosa* Brady 1910.
novae-zealandiae (Brady) 1899	

Of these *triarticulatum* (Haller) is insufficiently described; of *aberrans* and *typica* I have not seen the descriptions, and these species are therefore not included in the key given below. According to Monard (1935a, p. 73) *typica* is probably a synonym of *messinensis* Claus. *A. villosa* Brady should clearly be transferred to Scott's genus *Paralteutha*.

Acording to Sars (1911, p. 365) the species described by him (1904) as *depressa* Baird should have been identified as *purpurocincta* Norman, and since I have not seen Baird's original description, *depressa* has also been left out of the key.

KEY TO ALTEUTHA FEMALES.

1.	Size 0·4 mm.	*nana* Brady 1910.
	Size at least 0·6 mm.	2.
2.	Exopod of second antenna 2-segmented	3.
	Exopod of second antenna 3-segmented ..	*messinensis* Claus 1863.
3.	Basal segment of fourth exopod with inner seta	4.
	Basal segment of fourth exopod without inner seta	7.
4.	End segment of fourth exopod with 2 outer spines.	*novae-zealandiae* (Brady) 1899.
	End segment of fourth exopod with 3 outer spines	5.
5.	First antenna 7-segmented	*spinicauda* sp.nov.
	First antenna 8-segmented	*interrupta* (Goodsir) 1845.
	First antenna 9-segmented	6.
6.	Distal segment of fifth leg 3 times as long as wide ..	*signata* Brady 1910.
	Distal segment of fifth leg twice as long as wide ..	*sarsi* Monard 1924.
7.	Middle segment of fourth endopod with inner seta	8.
	Middle segment of fourth endopod without inner seta	*austrina* T. Scott 1912.
8.	Basal segment of fifth leg with inner extension	9.
	Basal segment of fifth leg without inner extension	*purpurocincta* Norman 1868.
9.	Caudal rami with four terminal setae	*dubia* T. Scott 1912.
	Caudal rami with 3 terminal setae	*trisetosa* Lang 1936e.

ALTEUTHA SPINICAUDA sp.nov.

Occurrence: XI, 3 females (1 ovigerous); XII, 1 male.

Female: Length 0·72–0·75 mm., width 0·39 mm. First antenna 7-segmented, with sensory filaments on third and fourth; second antenna with 2-segmented

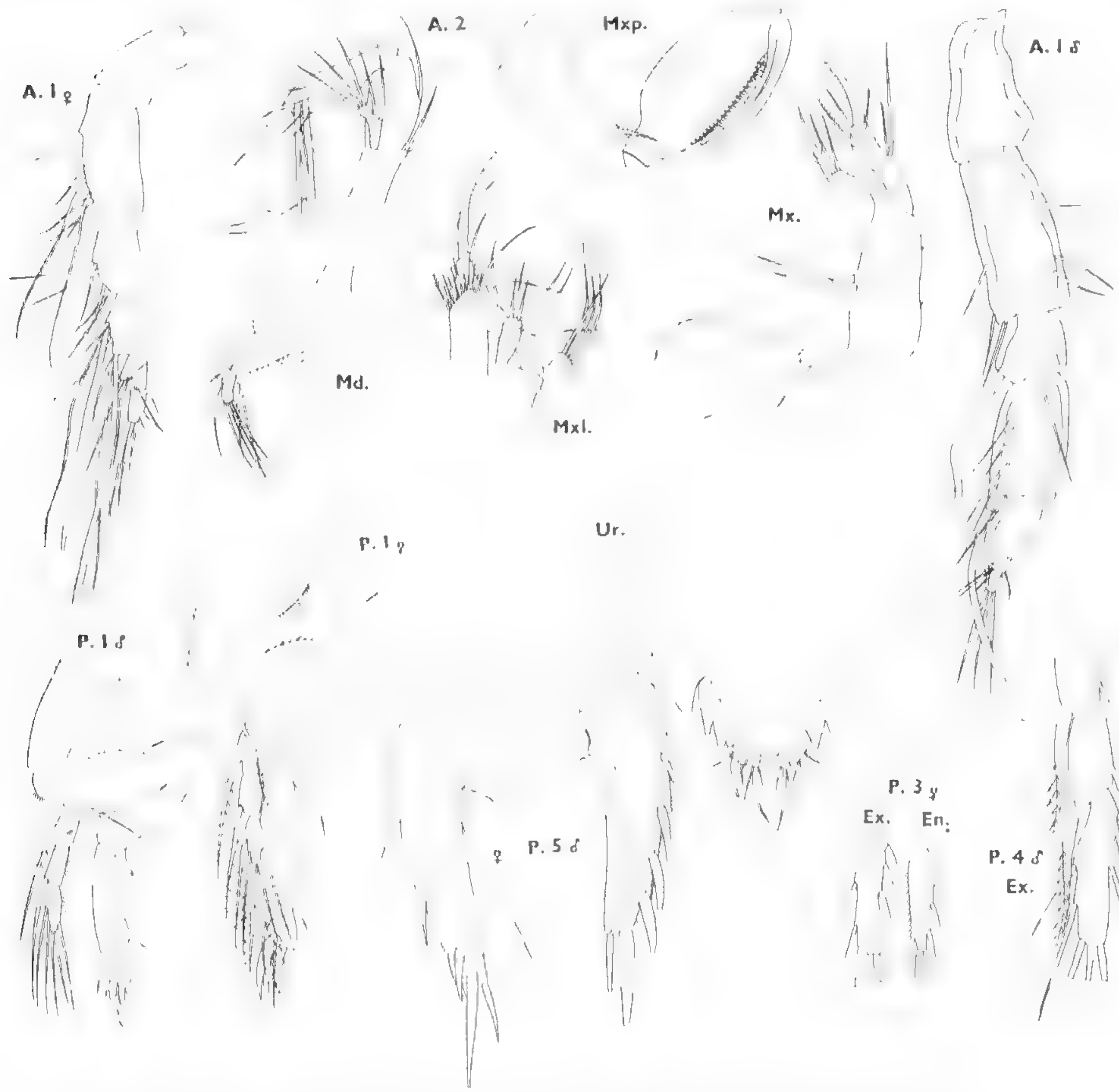


Fig. 3. *Alteutha spinicauda* sp. nov., male and female; the maxillule and maxilla are from the male, other mouth parts from the female.

exopod; mandible palp bilobed; maxilliped well developed, with long claw. First legs with 2-segmented exopod with 3 terminal claws, endopod 3-segmented; legs 2–4 with following seta formula:

	endopod.	exopod.
p.2.	1.2.221.	1.1.223.
p.3.	1.2.321.	1.1.323.
p.4.	1.2.221.	1.1.323.

Fifth legs of usual shape. Caudal rami wider than long, with large spine at outer corner (fig. 3).

Male. Length 1·0 mm., width 0·48 mm. First antenna 7-segmented and somewhat modified; first legs with terminal portion of exopod, bearing claws, distinctly separated from end segment. Legs 2–4 as in female, but outer spines of fourth exopod modified on first and second segments; fifth legs strongly chitinized, with spines only, no setae. Caudal rami as in female.

This species differs from all but *nana* in having only 7 segments in the first antenna; the fifth legs are not unlike those of *nana*, allowing for the spines to have been broken in Brady's specimen, but the shape of the body and much greater size preclude this species from identity with Brady's.

? ALTEUTHA SIGNATA Brady 1910.

Occurrence: IX, 1 ovigerous female, 1 male.

Distribution: Kerguelen (Brady 1910, p. 552, pl. lxi, 10–18).

Female: Length 0·60 mm., width 0·31 mm. The head was unfortunately lost during dissection, but Brady states that the first antenna is 9-segmented. First legs

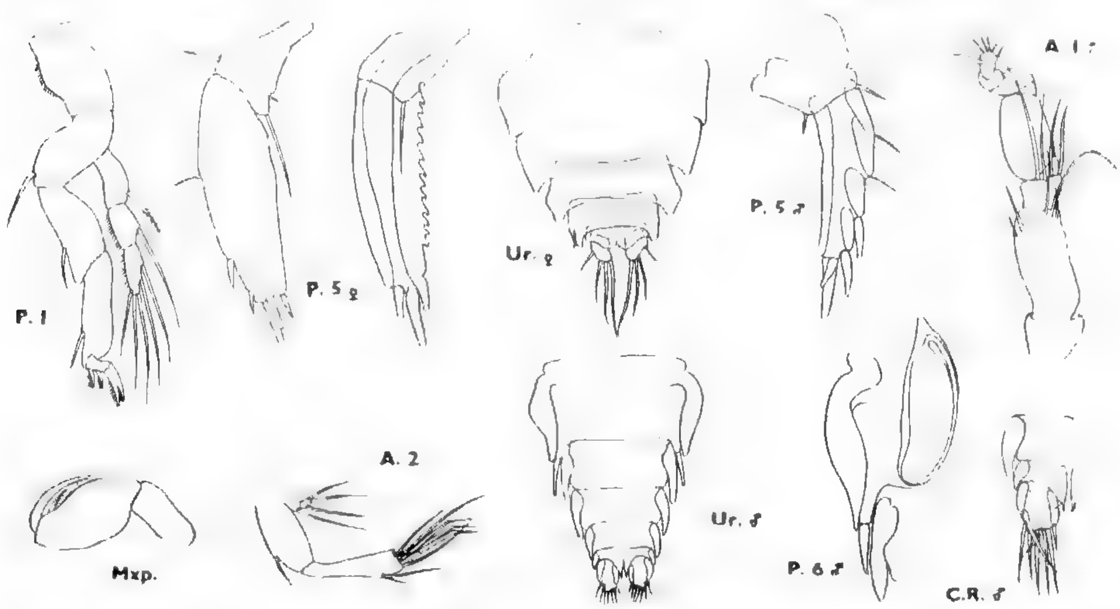


Fig. 4. ? *Alteutha signata* Brady, male and female. The female 5th leg is shown in two positions, and like that of the male is strongly chitinized.

with 3-segmented rami; setae of legs 2–4 eactly as in *spinicauda* (above); caudal rami at least as long as wide, armed with setae only.

Male: First antenna 8-segmented, slightly modified; second antenna with 2-segmented exopod; legs 1–4 as in female; urosome more slender than in female; fifth legs strongly chitinized, with spines and setae; sixth legs represented by a single spine; caudal rami as in female.

This species is almost certainly that described by Brady as *signata*, but his drawings make comparison difficult. In the text (p. 552) he states that the body is almost as wide as long, but this is not borne out by his figure (pl. lxi, 10), in which it is more than twice as long as wide. It is clear from his figures that the fifth legs have been drawn without dissection, so that a close comparison with the material found here cannot be made, but the position of the spines appears to be rather similar. The maxiliped is short and strongly constructed in both, and the caudal rami are very similar. The size and proportions are similar to those of Brady's species. In Brady's drawing the first exopod is relatively more slender than in the specimens found here.

PELTIDIUM Philippi 1839.

Pesta (1935, p. 367) lists 22 species of *Peltidium*, including the three new species described by him; Monard (1936) has since added another species, *rosei*; but *minutum* A. Scott (1909) is a synonym of *speciosum* Thompson and Scott (1903), and *serratum* Thompson and Scott should be transferred to *Parapeltidium*.

Two new species are described here, each represented by both sexes; in addition the previously unknown male of *speciosum* is described.

The males are distinguished in each case by three features: 1, modification of the first antenna, which may not be very marked; 2, structural difference in the first legs; 3, presence of sixth legs.

The difference in the first legs consists of a more slender structure; the basipod segments are longer than wide, the second segment carried at an angle to the first; the endopod does not have its segments broadened as in the female. In the first antenna the penultimate and ante-penultimate segments are usually modified with more or less pronounced hooks.

Amongst the species of *Peltidium* hitherto described, males are known in four cases: *purpureum* Philippi 1839, *rubrum* Brady 1915, *saccsphorum* and *forcipatum* Monard 1928.

Sars (1911) figures the male of *purpureum*, showing the urosome with sixth legs, and the modified first antenna. He does not illustrate the first legs of the male. The male of *rubrum* was lost in dissection, so that its complete structure is not known, but Brady (1915, pl. xiii) figures the first legs of both sexes. In his drawings the exact opposite condition to that found here appears to be the case. He makes no reference to the difference between the first legs of male and female in the text, and in view of his not infrequent mistakes of such a nature, it is not unreasonable to assume that he has transposed the two appendages in his plate. For *saccsphorum* Monard (1928, p. 316, fig. ix, x) gives a full description of the female, in which the first endopods are of the broad type, but dismisses the male in a few words, with no information on the structure of its first legs. Of *forcipatum* Monard (1928, p. 317, fig. x) only the male is known. Here the first legs are of exactly the same type as has been found in the males of this collection.

Arising out of this three more species must be considered. Pesta (1935, p. 372, fig. 5) has described a species *graciloides*, which he regards as close to *gracile* Claus 1889 (the specific name in both cases appears to have reference to the slender first endopod). He states that it is a female, but it is not apparently ovigerous, and he does not illustrate the first antenna. The first legs are clearly of the type found in the males of other species. It is possible, therefore, that he was here dealing with a male, although the urosome shows no sixth legs (but these are easily overlooked unless sought for). The same may apply to *gracile* Claus, though I have unfortunately not seen his description.

P. ovale Thompson and Scott (1903) was described as a female, the male being unknown. From a comparison of this species with the new species described below as *simplex*, which is distinguished from *ovale* chiefly on certain differences in the skeletal pattern, it is almost certain that *ovale* has been described from a male specimen. The urosome is not illustrated, so that it is not possible to discover whether sixth legs were present or not. In *simplex* the first antenna of the male is not modified, and is indistinguishable from that of the female; the fifth legs also show no difference, and the only distinguishing character, apart from the presence of the sixth legs, is the narrowness of the endopods of the first legs. For these reasons *ovale* is regarded as having been described from a male and therefore does not form an exception to the rule.

It is of interest to note that as a general rule in this genus the adult male is smaller than the ovigerous female. Furthermore, it is almost certain that the male transfers the spermatophore to the female when she is in the pre-adult stage, and at least no larger than the male. Three couples of *P. simplex* sp. nov. were taken in the paired state, and in each case the female was about to moult, and showed no trace of a skeletal pattern, whereas the male was mature.

Pesta's implication (indicated by a query, *loc. cit.*, p. 367) that *aurivillii* (Cleve) may be a male (owing presumably to the few segments in the first antenna) is not supported either by the structure or number of segments in the first antenna as shown by Cleve (1901), or by the structure of the first legs. It is usual for the male of *Peltidium* species to have more segments in the first antenna than has the female.

KEY TO PELTIDIUM FEMALES.

1.	End segment of first endopod with 3 appendages	2.
	End segment of first endopod with 4 appendages	6.
	End segment of first endopod with 5 appendages	16.

2. All appendages simple setae of equal thickness .. .. .. 3.
   Inner appendage a thicker seta or spine .. .. 4.
3. Setae of equal length .. .. *conspicuum* Norman and Scott 1905.
   Middle seta twice as long as other two .. .. *rosei* Monard 1936.
4. First antenna 6-segmented .. .. 5.
   First antenna 7- to 9-segmented .. .. *purpureum* Philippi 1839.
5. End segment of fifth leg with 5 setae .. .. *simplex* sp.nov.
   End segment of fifth leg with 6 setae .. *saccsphorum* Monard 1928.
6. The 2 inner appendages of first endopod thick setae or unmodified spines 7.
   These appendages modified spines, usually laminate or scroll-like .. 9.
7. First antenna 6-segmented .. .. *exiguum* A. Scott 1909.
   First antenna 7-segmented .. .. 8.
   First antenna 8-segmented .. .. .. *robustum* Claus 1889.
8. End segment of fifth leg with 5 setae *speciosum* Thompson and Scott 1903.
   End segment of fifth leg with 6 setae .. .. *rubrum* Brady 1915.
9. First antenna 7-segmented .. .. 10.
   First antenna 8-segmented .. .. 15.
10. End segment of fifth leg with 4 setae .. *cinereum* Brady 1915.
    End segment of fifth leg with 5 setae .. .. 11.
11. Fifth leg with outer branch of basal segment of three-quarters of end segment, extending beyond base of first seta . .. . 12.
    Fifth leg with outer branch of basal segment half of end segment, not reaching base of first seta .. .. *intermedium* A. Scott 1909.
12. Basal segment of first antenna half as long again as second segment. *perplexum* Thompson and Scott 1903.
    Basal segment of first antenna about equal to second .. .. .. 13.
13. Rostrum rectangular; claw of maxilliped about half-length of end segment, forming an arc .. .. .. *angulatum* Thompson and Scott 1903.
    Rostrum rounded; claw of maxilliped four-fifths of end segment, curved only distally .. .. 14.
14. Terminal claws of first exopod not more than 3 times end segment. *falcatum* A. Scott 1909.
    Terminal claws of first exopod at least 5 times end segment. *proximum* sp.nov.
15. Caudal rami extending beyond end of genital segment *monardi* Pesta 1935.
    Caudal rami not reaching end of genital segment *hawaiiense* Pesta 1935.
16. First antenna 5-segmented; setae of first endopod unmodified. *aurivillii* (Cleve) 1901.
    First antenna 9-segmented; 2 inner setae of first endopod modified. *elegans* Wolfenden 1905a.

Note. The data for *robustum* Claus 1889 have been taken from Pesta (1935, p. 367) since I have not seen the original work.

KEY TO PELTIDIUM MALES.

1. End segment of first endopod with 3 appendages .. .. .. 2.
   End segment of first endopod with 4 appendages .. .. .. 7.

2.	All these appendages simple setae	3.
	Inner appendage a spine	5.
3.	Setae of equal thickness .. *gracile* Claus 1889 and *graciloides* Pesta 1935.	
	Inner seta thicker than terminal setae	4.
4.	End segment of fifth leg with 5 setae *ovale* Thompson and Scott 1903.	
	End segment of fifth leg with 6 setae .. *purpureum* Philippi 1839.	
5.	End segment of fifth leg with 5 setae	6.
	End segment of fifth leg with 6 setae .. *saccsphorum* Monard 1928.	
6.	Terminal setae of first endopod unequal; first antenna modified. *forcipatum* Monard 1928.	
	Terminal setae of first endopod equal; first antenna unmodified. *simplex* sp.nov.	
7.	Two inner spines unmodified .. .. .. *rubrum* Brady 1915.	
	Two inner spines modified, scroll-like	8.
8.	First antenna 7-segmented . .. . *proximum* sp.nov.	
	First antenna 8-segmented .. .. *speciosum* Thompson and Scott 1903.	

As explained in the text, *gracile*, *graciloides* and *ovale* are regarded as males, all the available evidence pointing in that direction, while there is no positive evidence against this interpretation. They are, therefore, included in this key.

Details for *gracile* are taken from Pesta (1935, p. 367), from which it appears that the original description is somewhat inadequate.

Although the description of the male of *saccsphorum* is incomplete, I have included it in the key to the males, since there is some doubt in my mind whether the illustration of p. 1 female given by Monard (1928, p. 315, fig. ix, 3) is not really that of the male. The slender condition of the first endopod (ignoring the fringed lamella) and the strongly developed inner spine lend support to this view.

Brady's illustration of the male of *rubrum* is confined to the first leg, and as explained above I consider that the first leg of male and female have been transposed. The illustration does not make clear the condition of its armature, but it appears to have 2 lateral setae and 2 inner simple spines on the endopod.

PELTIDIUM SIMPLEX sp.nov.

Occurrence: IX, several specimens of both sexes and young; X, 1 specimen; XI, 4 females; XII, 1 specimen; XIII, 1 immature.

Female: Length 1·56–1·68 mm.; width 0·90–0·99 mm. Body rounded in front, with rostrum projecting slightly towards the ventral surface, invisible dorsally; skeletal pattern strongly developed on a simple plan (fig. 5, A). First antenna 6-segmented, sensory filaments on third and fourth segments; second antenna with basal segment incompletely divided, exopod 2-segmented, attached at middle of basal segment; mouth parts more or less normal (fig. 6).

First legs with basal segment of endopod expanded, terminal segment less so, bearing 2 terminal setae and 1 inner spine; legs 2–4 with the following seta formula:

	endopod.	exopod.
p.2.	1.2.120.	1.1.223.
p.3.	1.2.220.	1.1.323.
p.4.	1.2.220.	1.1.323.

Fifth legs with end segment indistinctly separated from basal segment, elongate, with setae and spines all inserted distally; like the other appendages, the fifth legs are strongly chitinized. Caudal rami short, not visible dorsally.

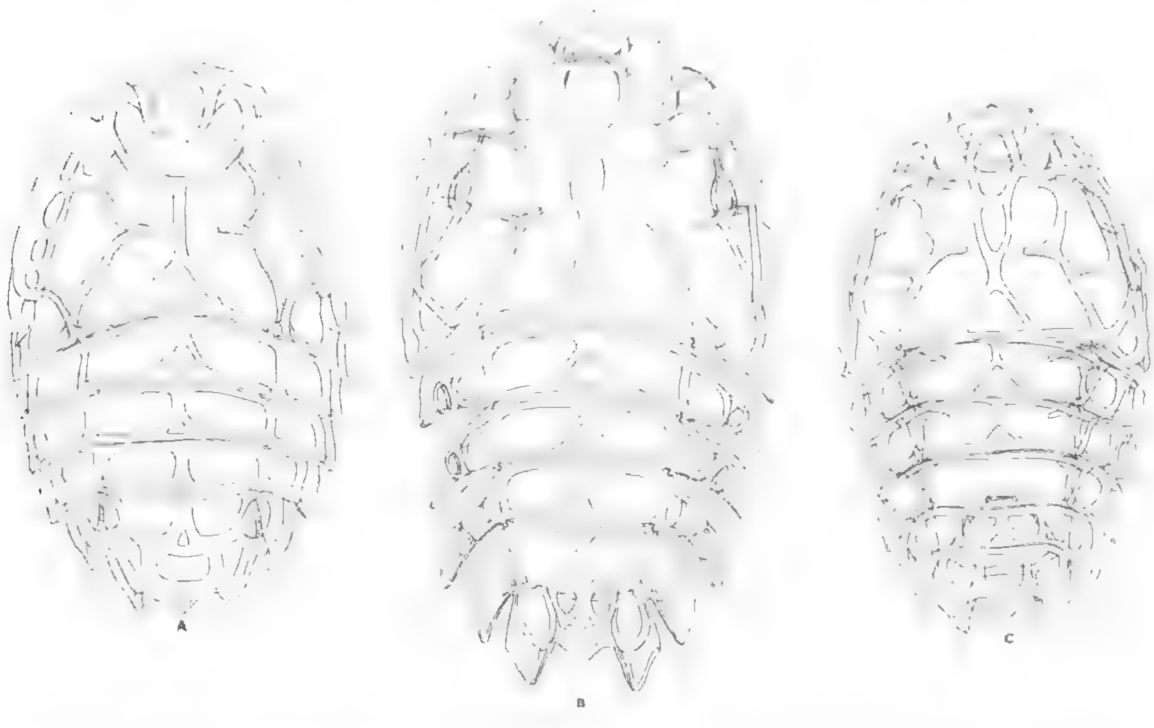


Fig. 5. A, *Peltidium simplex* sp. nov. B, *Peltidium proximum* sp. nov. C, *Peltidium speciosum* Thompson and Scott; skeletal patterns seen from above, not to same scale.

Male: Length 1·38 mm.; width 0·69 mm. Differs from female only in the smaller size of the first legs, with more slender endopods which are similarly armed, and in the possession of sixth legs. The male examined was obviously mature, and contained a spermatophore, but the first antenna is quite unmodified and indistinguishable from that of the female. The fifth legs are identical in both sexes.

This species resembles *ovale* in shape, but has a simpler design in its skeletal pattern, and differs in the fifth legs. The pattern is on the same general plan as in *ovale*, but differs in the anterior and posterior regions. The first antennae and end segments of the first endopods are very similar to *ovale*, and it is probably an Australian form of this species.

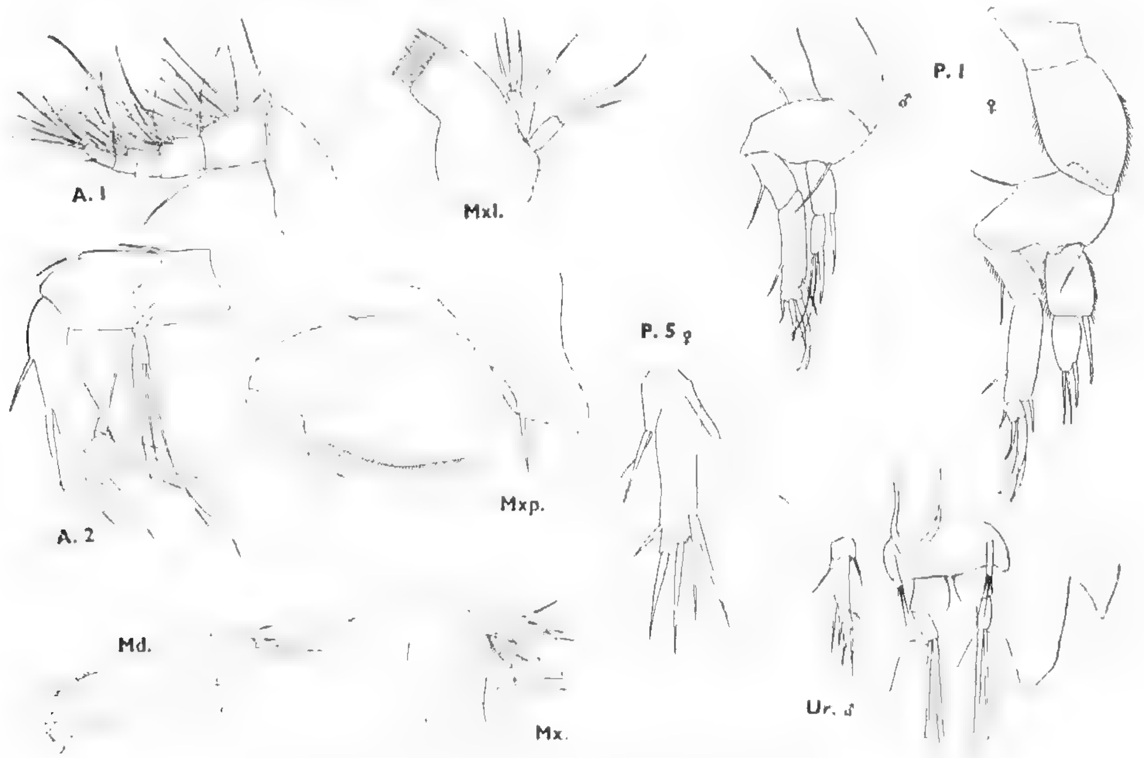


Fig. 6. *Peltidium simplex* sp. nov., male and female.

As already stated, in view of the similarity of the first antennae in both sexes of *simplex* and of its resemblance as a whole to *ovale*, it is assumed that *ovale* has been described from the male, since the first legs of that species show the usual modification found in males.

PELTIDIUM PROXIMUM sp.nov.

Occurrence: VII, 13 females, 1 male; IX, several specimens; X, numerous specimens; XII and XIII, 5 females (1 ovigerous); XIV, 4 females.

Female: Length 1·62–1·80 mm., width 0·87–1·11 mm. Body with prominent rostrum; very slight dorsal crest on head and thoracic segments; segment bearing fifth legs fused with following segments; first antenna 7-segmented; second antenna with distinctly divided basal segment and long 2-segmented exopod; mouth parts normal (fig. 7).

First legs with basal segments sub-rectangular, endopod widened, end segment with 2 thin terminal setae and 2 inner setae, the latter strongly modified; seta formula of legs 2–4 as in *simplex*. Fifth legs with segments distinct, very small inner expansion and long outer branch. Caudal rami short with long terminal setae.

Male: Length 1·38 mm.; width 0·75 mm. Body as in female. First antenna 7-segmented, with usual sensory filaments and modified segments; first legs with elongate second basal segment, endopod slender, with two inner setae modified,

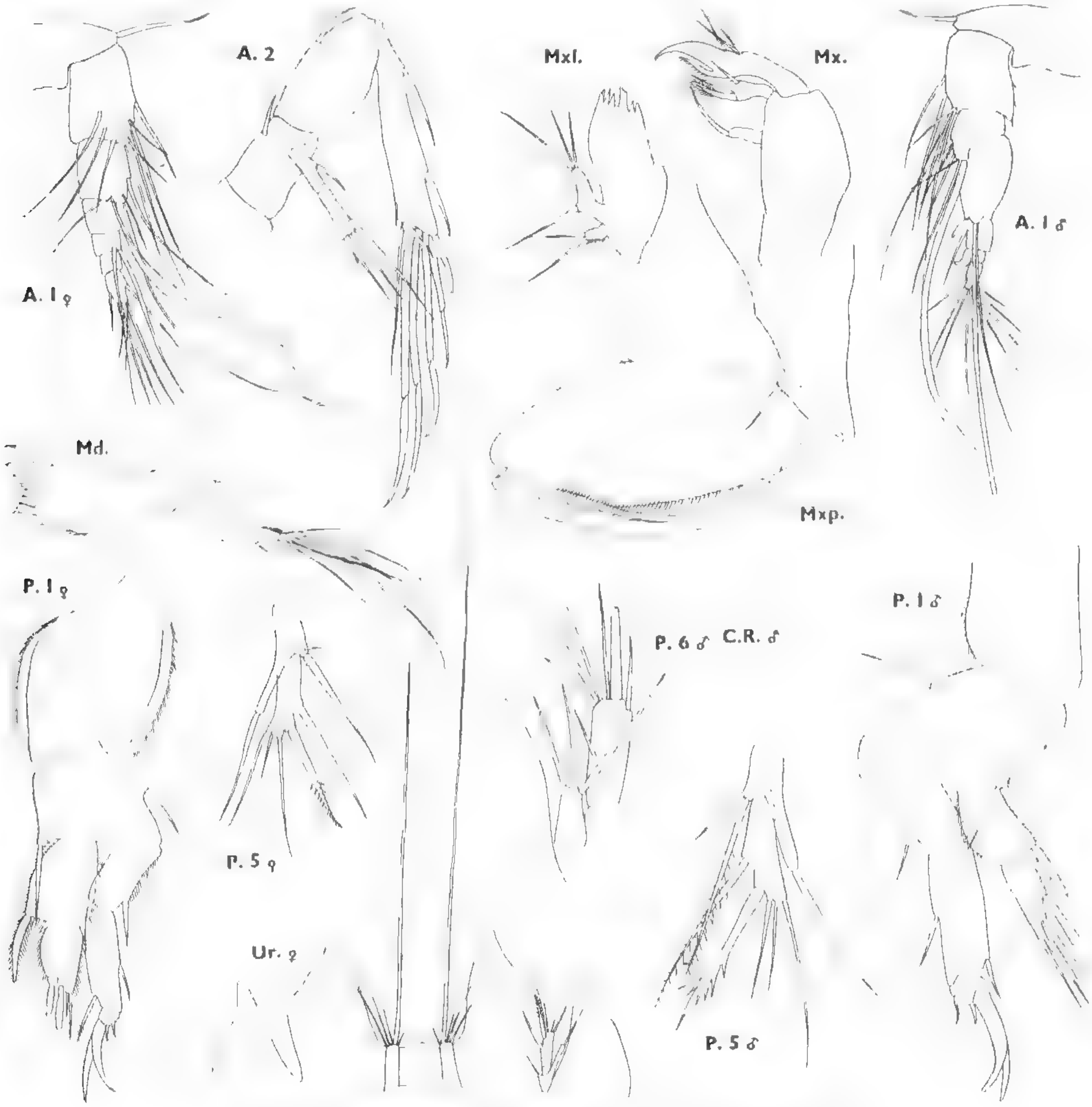


Fig. 7. *Peltidium proximum* sp. nov., male and female.

scroll-like as in *Parapeltidium dubium* (fig. 11); legs 2–4 as in female; fifth legs with second outer spine much more strongly denticulate than in female; sixth legs with 3 setae.

In the first and fifth legs this species resembles *perplexum* Thompson and Scott, but the skeletal pattern (fig. 5, B) shows certain differences, and the size of *perplexum* is much smaller (1·1 mm.).

PELTIDIUM SPECIOSUM Thompson and Scott 1903.

Peltidium speciosum Thomps. and Scott, 1903, p. 274, pl. xiii, fig. 12–17.
P. minutum A. Scott, 1909, p. 205, pl. lxv, fig. 16–20.

Occurrence: II, 5 specimens; VII, 5 specimens; X, numerous specimens; XI, 1 female; XII, 4 females; XIII, 1 female, 2 males; XIV, 6 females.

Distribution: Ceylon, washed from dredgings from pearl banks; Aru Islands, washed from dredgings from pearl banks, in 13 metres.

This species has been identified with *speciosum* on account of the structure of the appendages rather than the similarity of the skeletal pattern (fig. 5, C).

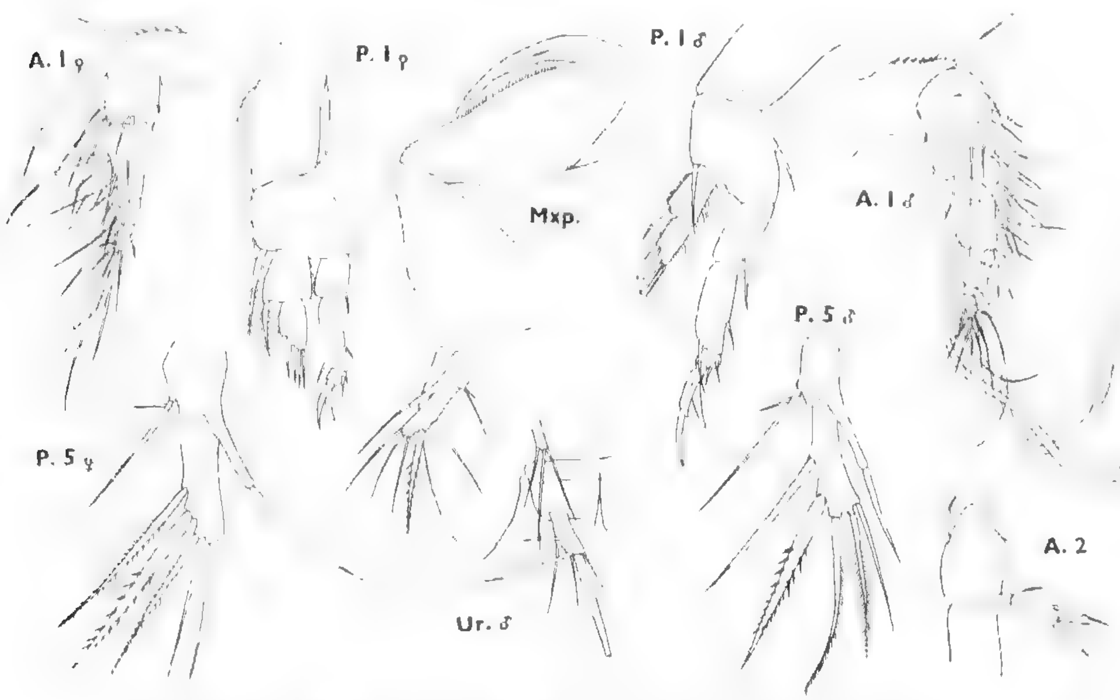


Fig. 8. *Peltidium speciosum* Thompson and Scott, male and female.

In both the Ceylon material and the Australian specimens the design reaches a rather complicated condition, and it is not certain whether all the longitudinal bars in the original drawings are on the dorsal surface or whether some may be ventral in position but connecting with those of the dorsal surface, as is the case in my specimens. For this reason a close comparison is not possible, but in general both A. Scott's *minutum* and the specimens found here agree with the original drawings, and in the structure of the appendages all three are in very close agreement. In size *minutum* is somewhat smaller (0·8 mm.), whereas this material agrees with that of Thompson and Scott, but the size of these Peltidiids varies over a considerable range, as has been shown.

Female: First antenna 7-segmented, with the usual sensory filaments; second antenna with basal segment distinctly divided; mouth parts as usual. First legs with both segments of the endopod widened, end segment with 2 thin terminal setae and two lateral modified setae; seta formula differs from the usual:

	endopod.	exopod.
p.2.	1.2.120.	1.1.223.
p.3.	1.2.320.	1.1.323.
p.4.	1.2.220.	1.1.323.

Fifth legs with segments distinct, second outer seta strong and spine-like with several large denticles.

Male: Length 1·08–1·32 mm., width 0·62–0·69 mm. The male has not previously been described. First antenna 8-segmented, modified as usual; second antenna with basal segment divided, exopod long, 2-segmented; mouth parts as in female. First legs with elongate basal segments and slender endopod, end segment with 2 long thin terminal setae and 2 inner modified setae. Legs 2–4 with seta formula as in female; fifth legs similar to those of female, but second outer spine more strongly denticulate; sixth legs with 3 setae.

PARAPELTIDIUM A. Scott 1909.

This genus was created for a single specimen taken in a vertical haul from 10 metres to the surface at night, while at anchor in Laiwui, Obi Major, Station 142 of the "Siboga" Expedition. An electric light was used in the net, and this is most probably a bottom living form.

The genus is retained, for the present, for such species of *Peltidium* as show a distinct fusion of the two segments of the fifth legs, and therefore includes *serratum* Thompson and Scott (1903), on whose "remarkable" fifth legs the authors commented at the time. Further points of similarity between the members of this genus, distinguishing them from *Peltidium,* are the noticeably flattened body and the development of dorsal crests to the body segments in the mid-line. These are stated to be present in *johnstoni* (A. Scott, 1909, p. 212) though not shown in the figure (pl. lxv, fig. 1). In the case of *serratum* they are illustrated (Thompson and Scott, 1903, pl. xiii, fig. 18) but not mentioned in the text. They are present and strikingly developed in both the species described here (fig. 9, 10). The males show the same sexual differences found in *Peltidium.*

There are, therefore, now 4 species to be included in this genus: *serratum* Thomp. and Sc., *johnstoni* Scott, *cristatum* and *dubium* spp.nov. The second of these, *johnstoni,* is presumably a male. Though described as a female there are no specifically female characters described or portrayed, whereas the first leg is obviously that of a male, and although supporting male characters are lacking, yet in *Peltidium* also males with unmodified first antennae are known. The very strong chitinization of the fifth leg may perhaps be regarded as a male characteristic.

Thompson and Scott's species *serratum* is clearly a female; *cristatum* is here described from both sexes, while *dubium* is known only as a male.

As already shown the 5-segmented first antenna here has no generic value, while the slender endopod of the first legs has no systematic significance.

KEY TO PARAPELTIDIUM FEMALES.

First antenna 6-segmented; first endopod with 3 small subequal terminal setae; fifth leg with 6 setae .. .. .. *serratum* Th. and Sc. 1903.

First antenna 7-segmented; first endopod with 2 terminal setae and 1 inner spine-like seta; fifth leg with 5 setae .. .. .. *cristatum* sp.nov.

KEY TO THE MALES.

1. First endopod with 2 terminal setae and 1 inner thicker seta .. .. 2.
   First endopod with 2 terminal setae and 2 inner modified spines. *dubium* sp.nov.
2. Fifth leg with 1 short terminal spine, 1 inner and 3 outer spines and setae; first antenna 5-segmented .. .. .. *johnstoni* A. Scott 1909.
   Fifth leg with 1 long terminal spine, 2 inner and 2 outer spines; first antenna 8-segmented .. .. *cristatum* sp.nov.

PARAPELTIDIUM CRISTATUM sp.nov.

Occurrence: VII, 1 ovigerous female; VIII, 1 female; IX, 1 specimen; Rottnest Island, Western Australia, from weed-covered rocks on the shore at Bathurst Point, April, 1939, 1 male.

Female: Length 1·5–1·65 mm., width 1·08–1·11 mm. Body flattened in usual Parapeltidiid manner, with large rectangular rostrum and dorsal crest, each segment produced dorsally as well as laterally (see male in fig. 9, lateral view). Margin slightly serrated as in *serratum*. The skeletal pattern is of a simple design, with weak anterior and stronger posterior transverse bands to each segment, but without longitudinal connecting bars in the epimeral expansions. First antenna 7-segmented, with sensory filaments on third and fourth segments; second antenna 3-segmented, with 2-segmented exopod attached at distal end of basal joint; mouth parts normal (fig. 9).

First leg with endopod much broadened, bearing 3 unmodified terminal setae, the inner of which is much thicker than the other two and spine-like; seta formula of legs 2–4:

	endopod.	exopod.
p.2.	1.2.120.	1.1.223.
p.3.	1.2.220.	1.1.323.
p.4.	1.2.220.	1.1.323.

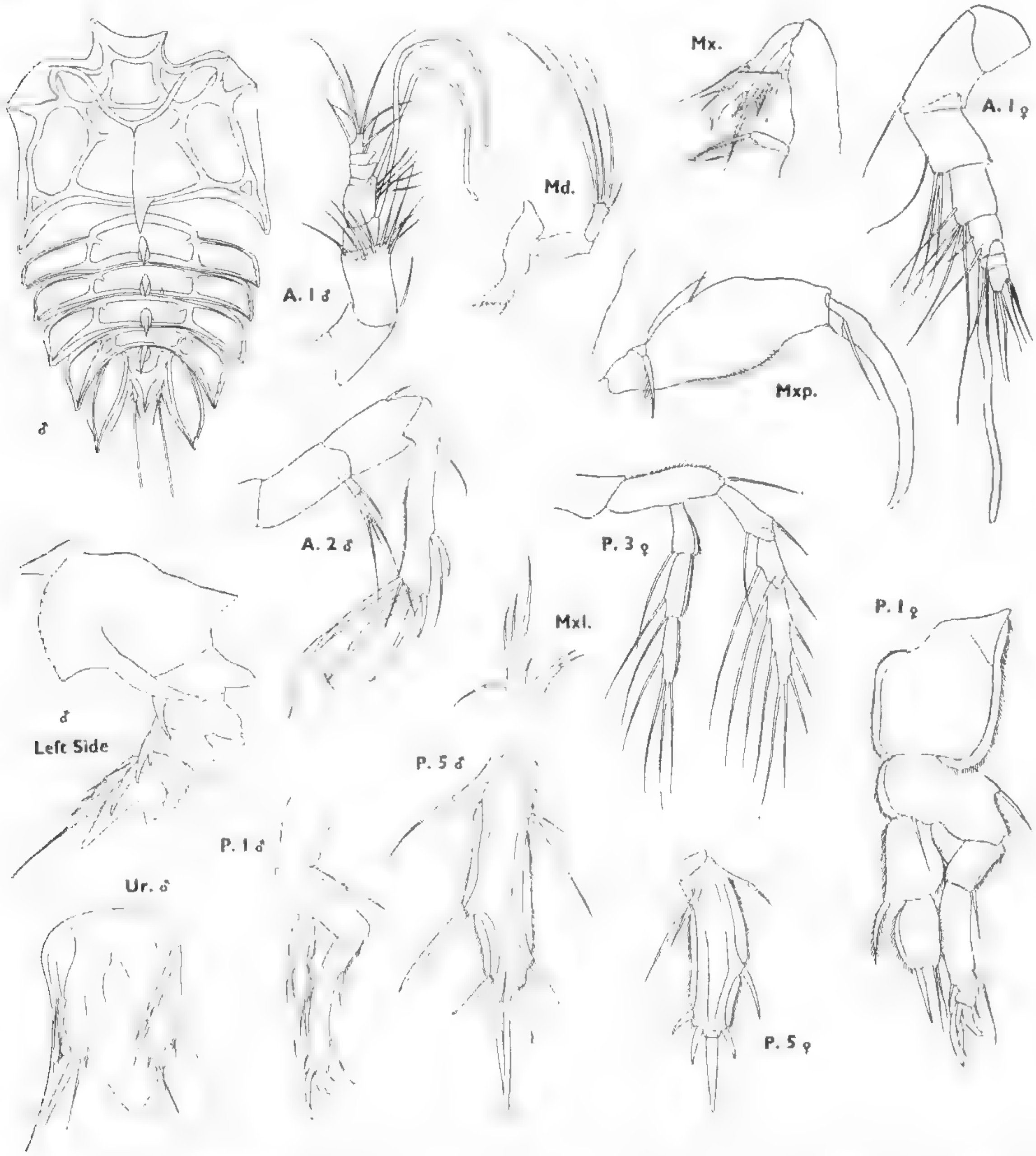


Fig. 9. *Parapeltidium cristatum* sp. nov., male and female. The first legs of both sexes are drawn to the same scale, but the male 5th leg is drawn at a magnification equal to twice that of the female 5th leg; mouth parts are drawn all to the same scale, but those of the male are slightly smaller than those of the female; maxilla from female, mandible, maxillule, and maxilliped from male.

Fifth legs with segments fused, strongly chitinized, with thin marginal lamella fringed with fine hairs. Caudal rami elongate, with terminal and lateral setae.

Male: Described from a single specimen taken in Western Australia. Length 1·23 mm., width 0·93 mm. Shape of body and skeletal pattern as in female. First antenna 8-segmented, sixth and seventh slightly modified for grasping, sensory filaments on third and fourth; other head appendages as in female—the maxillule is somewhat reduced from the usual Peltidiid condition.

First legs with slender endopod, with 3 unmodified setae, the inner seta slightly thicker than the two terminal setae; legs 2–4 as in female; fifth leg scarcely different from that of female.

That this species is distinct from Scott's is evident from the relatively simple design of the skeletal pattern, and the greater number of segments in the first antennae. It differs from *serratum* in the skeletal pattern, first endopod and fifth legs.

PARAPELTIDIUM DUBIUM sp.nov.

Occurrence: IV, 1 male.

Male: Length 1·29 mm., width 0·81 mm. Body with rather irregular outline, rostrum asymmetrical, projecting; body segments with large lateral expansions

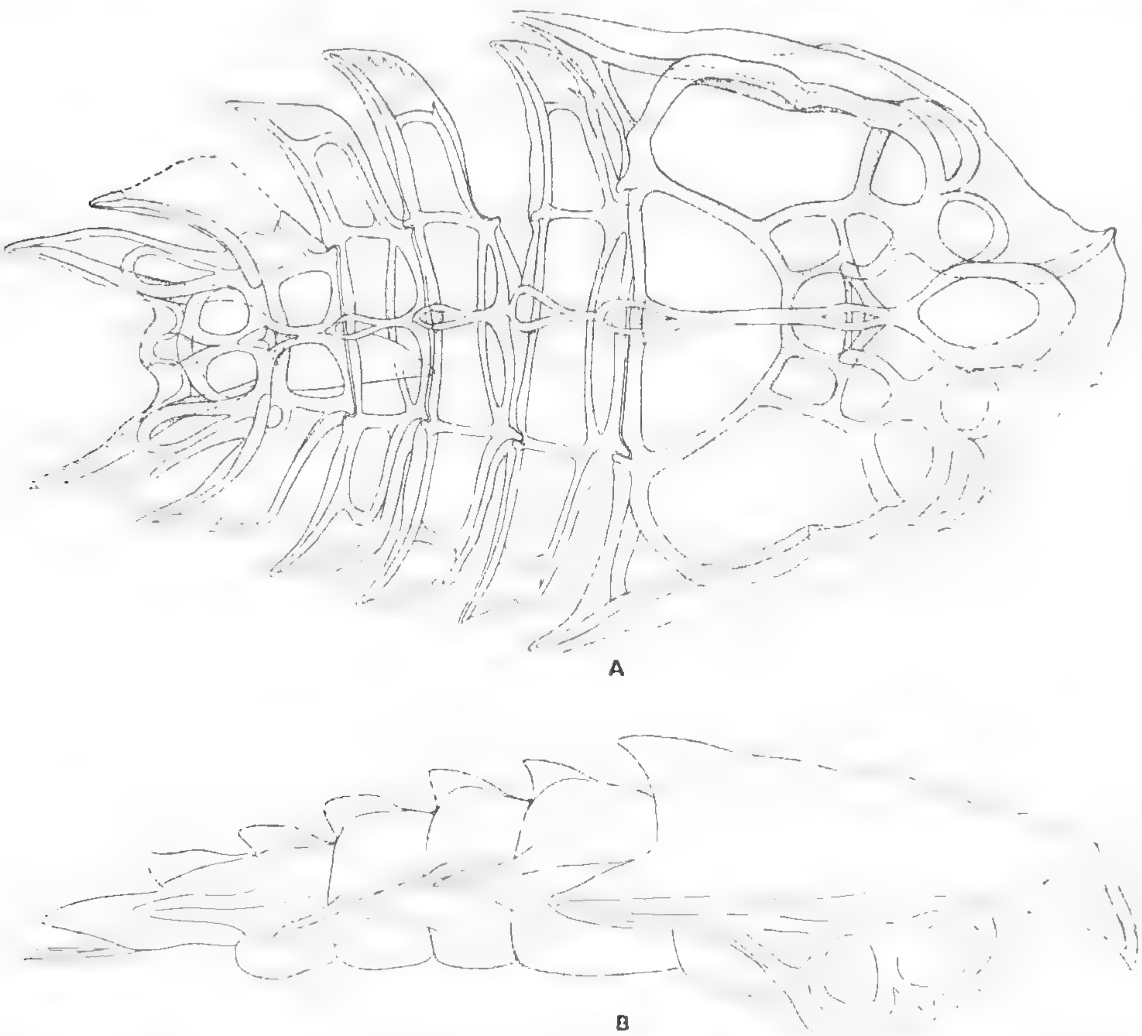


Fig. 10. *Parapeltidium dubium* sp. nov. A, skeletal pattern from above; B, male from right side.

and dorsal crests (fig. 10). First antenna 8-segmented, third and fourth with sensory filaments, sixth and seventh modified; second antenna with basal segment divided, exopod long, 2-segmented; mouth parts normal (fig. 11).

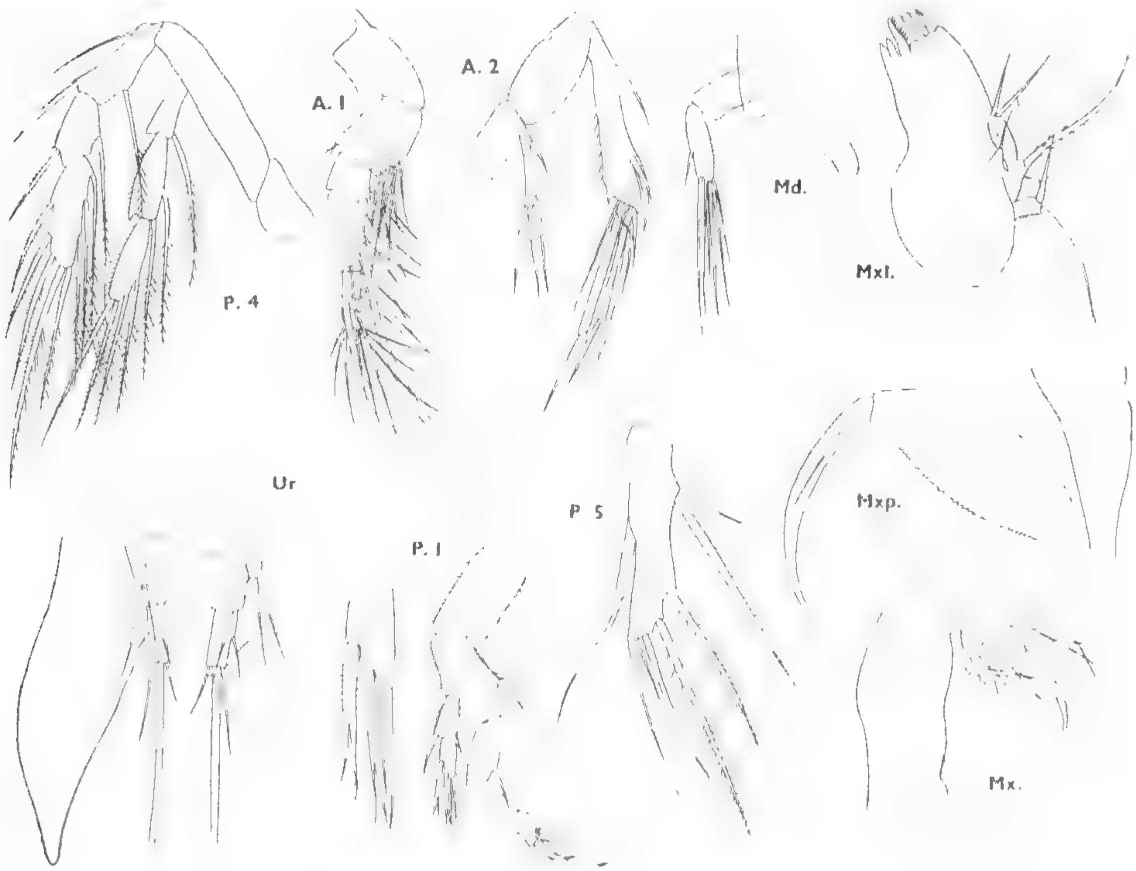


Fig. 11. *Parapeltidium dubium* sp. nov., male.

First legs with elongate basal segments and slender endopod, bearing 2 thin terminal setae, and 2 modified scroll-like inner setae; legs 2–4 with the following seta formula (right side):

	endopod.	exopod.
p.2.	1.2.120.	1.1.223.
p.3.	1.1.320.	1.1.323.
p.4.	1.2.220.	1.1.323.

The third endopod on the right side is somewhat abnormal, but the left third leg was quite abnormal, the second and third segments of the endopod were fused and the exopod was 4-segmented; fifth legs with segments distinctly fused. Caudal rami long, with long setae, but invisible from above.

FAMILY TEGASTIDAE Sars 1904.

TEGASTES Norman 1903.

A single male specimen of a species of *Tegastes* measuring 0·33 mm. occurred in this collection (III), which I have been unable to identify with any of the known species. The dissection was, however, somewhat incomplete, and the species will not be described until more material has been obtained to enable a full study to be made.

FAMILY PORCELLIDIIDAE Sars, 1904.

PORCELLIDIUM Claus 1860.

Pesta (1935) has reviewed this genus, added two new species, and described a male and young without naming them. In his list of species (p. 375) No. 9 is missing (probably through a printer's error), and this is presumed to be *scutatum*, which is later mentioned in the text, but with no reference; unfortunately I have been unable to trace this species.

Of those listed by Pesta he states that *parvulum* and *ovatum* Haller (1880) are insufficiently described, and he regards them as *species incertae*; *tuberculatum* Wolfenden (1905a) is the young of *acuticaudatum* Thompson and Scott, according to Gurney (1927b); *wolfendeni* Brady (1910) is a synonym of *affine* Quidor (1906); and *rotundum* Brady (1910) is probably immature.

To these he adds *scotti* for *fimbriatum* of Thompson and Scott (1903), which he regards as distinct from *fimbriatum* Claus (1863), and *clavigerum* a new species from Hawaii. To these have been added two varieties of *fimbriatum*, described by Monard (1928): var. *macrurum* and var. *heraldicum*. Lang (1935) has suggested that *lecanoides* Claus (1889) is a variety of *fimbriatum*.

Pesta (*loc. cit.*) makes a new species of *fimbriatum* as described by Thompson and Scott on the proportions of the segments of the first antenna, length and position of the inner seta on the first endopod, the position of the rib in the fifth leg, differences in the caudal rami and the different distribution.

The proportions of the segments of the first antenna as stated in the text by Thompson and Scott are not borne out by the illustration (pl. xii, fig. 2), in which they closely resemble the proportions quoted by Pesta from Claus, and also agree with Sars' drawing (1911, pl. lxv, a.1). The position of the inner seta on the first endopod is probably due to faulty observation since the point of attachment of this seta is always hard to make out (cf. Pesta's drawing of this seta in *clavigerum*, *loc. cit.*, p. 377, in which it is stated to be attached basally). The position of the rib in the fifth leg is merely a question of the position in which the leg is drawn, since it is always more or less central, and forms the angle at which the two halves of the boat-shaped segment meet. The difference in distribution has little value, since many Mediterranean species have been found as far away as the Malay Archipelago and Australia.

But the caudal rami show certain differences, as stated by Pesta, and even more important, the postero-lateral projections from the genital segment are distinctly rounded in *fimbriatum* Claus, and the fifth legs do not reach the ends of these projections, whereas in Thompson and Scott's drawing the projections are pointed, and the fifth legs extend beyond these points. For these reasons, therefore, *fimbriatum* of Thompson and Scott may be regarded as a distinct species, to which the name *scotti* has been given by Pesta.

As pointed out by Pesta (*loc. cit.*, p. 377) *clavigerum* is of the *fimbriatum* type, and its caudal rami resemble those of *fimbriatum* var. *macrurum* Monard (1928) in their armature. Monard's variety in the female shows a considerable difference in the proportions of the caudal rami from those of *fimbriatum* (length to width nearly 7 : 2 compared with 2 : 1), and *clavigerum* has the normal proportions of *fimbriatum*. Furthermore, Lang (1935) has illustrated the caudal rami of *lecanoides* Claus (1889) (the original description of which I have not seen), and stresses the resemblance between this species and *fimbriatum* var. *macrurum* Monard. It is probable, therefore, that *clavigerum* is identical with *lecanoides*, and this view is supported by comparison with the illustrations of this species given by Norman and Scott (1906).

Below is a key to the females of *Porcellidium*, from which are excluded those species which are uncertain, and those which appear to be synonyms as well as *scutatum*. For *tenuicauda* Claus (1860) and *lecanoides* Claus (1889) I have relied on the descriptions given by Brady (1880) and Norman and Scott (1906) respectively.

KEY TO PORCELLIDIUM FEMALES.

1. Genital segment with postero-lateral projections .. .. .. 2.
   Genital segment without such projections .. .. 11.
2. Projections from genital segment reaching end of anal segment but not to end of caudal rami .. .. 3.
   Projections from genital segment reaching end of caudal rami .. .. 9.
3. Caudal rami rectangular, truncate .. .. 4.
   Caudal rami tapering, pointed or rounded .. .. 5.
4. Projections from genital segment with convex outer margin; caudal rami tipped with 4 short spines and 1 seta .. *lecanoides* Claus 1889.
   Projections from genital segment with concave outer margin; caudal rami tipped with setae only .. .. *scotti* Pesta 1935.
5. Projections from genital segment reaching middle of caudal rami. *acuticaudatum* Thomp. and Scott 1903.
   Projections from genital segment extending only slightly beyond anal segment .. .. 6.

6. Caudal rami pyriform, tapering distally .. .. 7.
Caudal rami sub-rectangular proximally, outer margin rounded distally 8.
7. Caudal rami each tipped with a single spine, without other armature.
tenuicauda Claus 1860.
Caudal rami tipped with a single seta, and with 4 outer and 2 dorsal setae.
brevicaudatum Thomp. and Scott 1903.
8. First antenna 6-segmented .. *ravanae* Thompson and Scott 1903.
First antenna 7-segmented .. .. .. *affine* Quidor 1906.
9. Fifth legs extending round caudal rami, overlapping posteriorly.
interruptum G. M. Thompson 1883.
Fifth legs not meeting behind caudal rami .. .. 10.
10. Body length to width as 3 : 2 .. .. *fimbriatum* Claus 1863.
Body length to width as 2 : 1 .. .. *fulvum* G. M. Thompson 1883.
11. Caudal rami as long as wide .. .. .. *australe* Brady 1910.
Caudal rami wider than long .. .. *charcoti* Quidor 1906.

PORCELLIDIUM FIMBRIATUM Claus 1863.

Occurrence: XII, 1 female.

Distribution: British Isles, Norway, Mediterranean.

A single specimen, an ovigerous female, was found in this collection, which showed the typical features of this species as described and illustrated by Sars

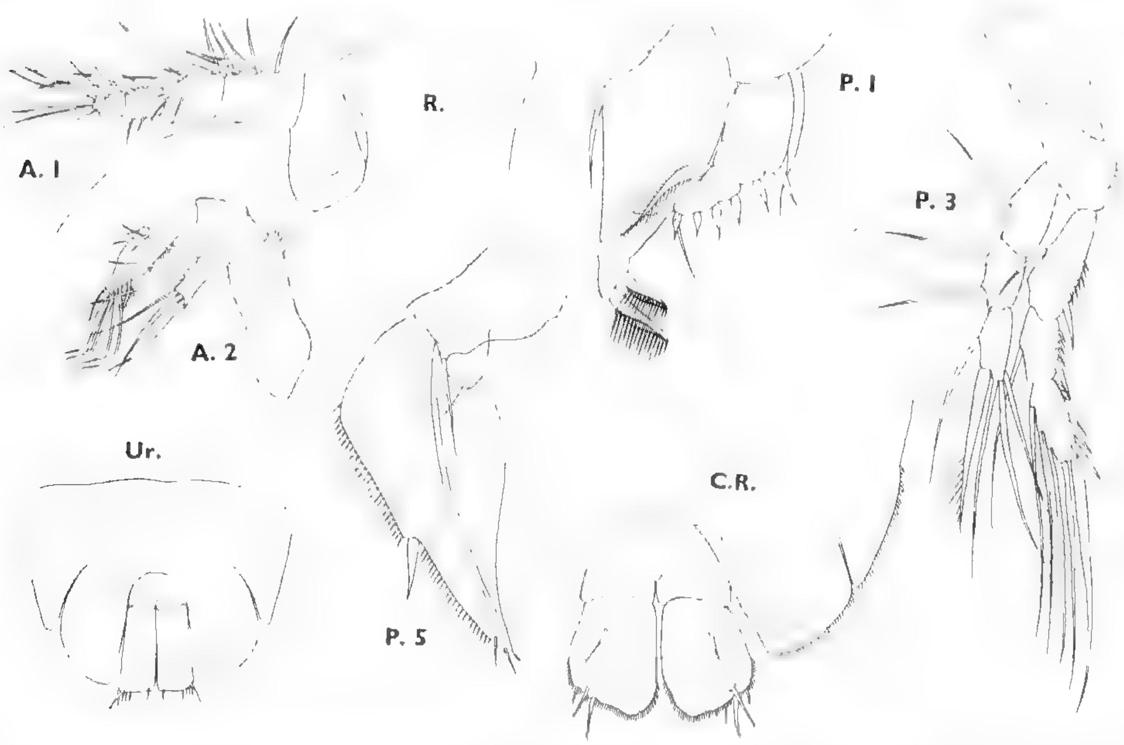


Fig. 12. *Porcellidium fimbriatum* Claus, urosome (Ur); and *Porcellidium fulvum* G. M. Thompson.

(1911). The lateral incisions in the expansions from the genital segment (fig. 12, Ur) are somewhat deeper than is shown by Sars, but there is little doubt that it is identical with Claus' species. Length 0·96 mm., width 0·60 mm.

PORCELLIDIUM FULVUM G. M. Thompson 1883.

Occurrence: IX, 1 female.

Distribution: Otago and Lyttleton Harbours, New Zealand.

This single specimen, which was not ovigerous and may not have been mature, is almost certainly identical with that described by Thompson. He states that it is "hardly more than half as long as broad"; this specimen was slightly narrower. "Anterior antennae very short . . . . not half the width of the body." "Caudal segments quadrate, ciliated at the extremity." The size of his specimen, however, was considerably greater than mine (1·25 mm. as against 0·66 mm.), but this is probably unimportant. Apart from the unusual shape, the most striking resemblance is in the shortness of the inner seta on the first endopod, which does not reach the end of the basal segment (fig. 12). The absence of an inner seta from the end segment of the first exopod in Thompson's drawing (pl. vi, fig. 10) cannot be regarded as important since it is easily overlooked.

Seta formula for legs 2–4:

	endopod.	exopod.
p.2.	1.2.121.	1.1.223.
p.3.	1.2.221.	1.1.323.
p.4.	1.1.121.	1.1.323.

PORCELLIDIUM ACUTICAUDATUM Thompson and Scott 1903.

Occurrence: XI, 1 ovigerous female.

Distribution: Suez Canal, Ceylon, Maldives, and Laccadives.

This species was originally described from Ceylon, and later described by Gurney from the Suez Canal. There can be little doubt that Wolfenden's *tuberculatum* is identical with this as stated by Gurney (1927b). The single ovigerous female taken here is somewhat larger than the type; it is intermediate in body proportions between the type and Wolfenden's form, and lacks the tuberculate exoskeleton. Length 1·08 mm., width 0·78 mm. The seta formula for legs 2–4 is as in *fulvum* above.

PORCELLIDIUM AUSTRALE Brady 1910.

Occurrence: XI, 2 specimens, male and female taken together.

Distribution: Kerguelen Island.

The single female, taken with the male attached, was unfortunately immature, and a condition similar to that in the *Peltidiidae* is observed here in that the male

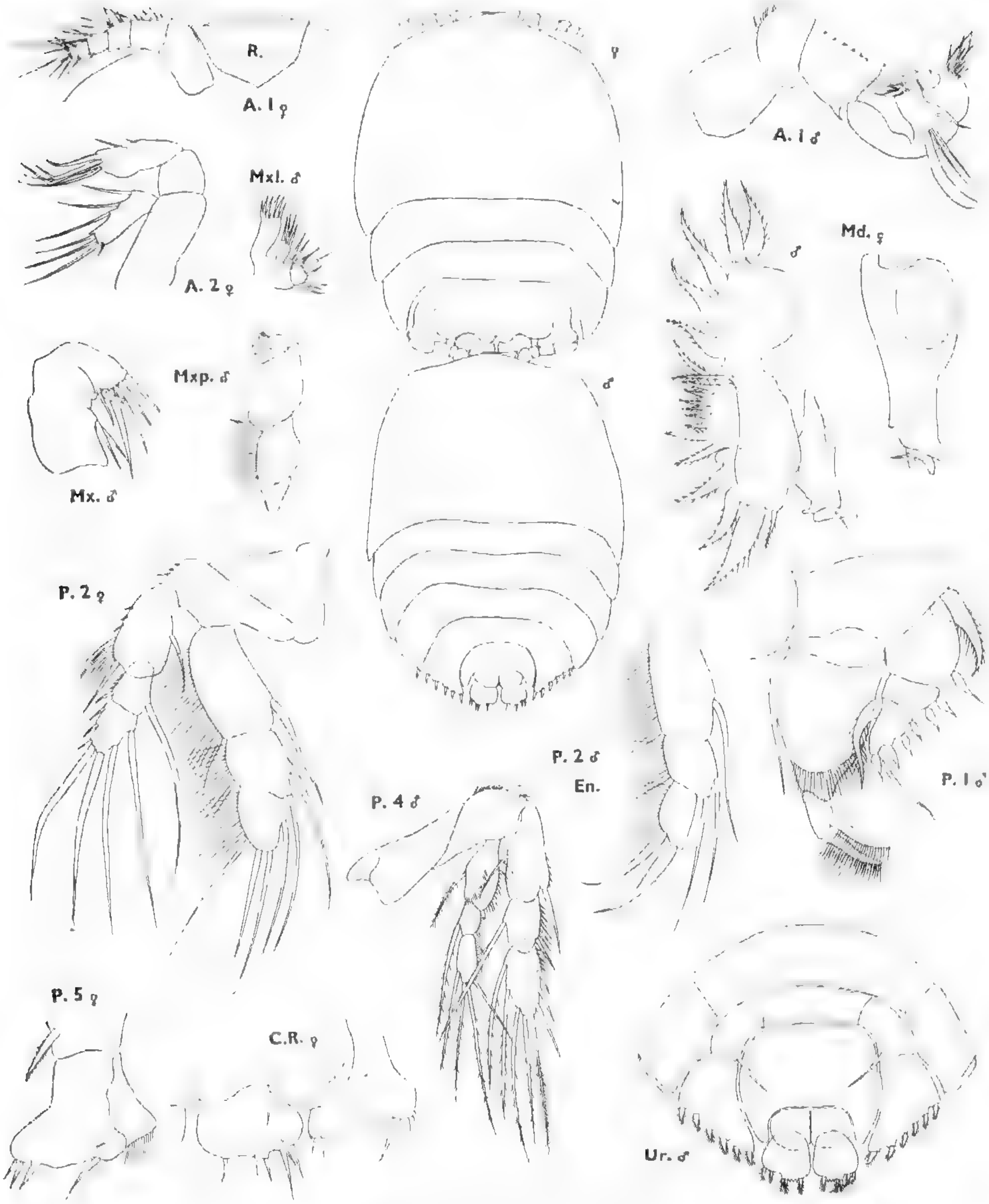


Fig. 13. *Porcellidium australe* Brady. The female rostrum and 1st antenna and male urosome are drawn in ventral view.

is found attached to immature females, while the latter is no larger than the male, whereas the adult female is always larger than the male. Unlike the Peltidiids, however, when the sexes pair the male is attached to the fifth legs of the female by means of its strongly prehensile first antennae, so that they are arranged *in tandem*. In the Peltidiids the male clasps the female around the cephalosome, or between that and the first free thoracic segment, by means of its powerful maxillipeds. In both cases, where paired animals have been taken, the female was immature and about to moult into the adult condition, while the male was fully mature.

Although the female was immature it could be identified with Brady's species, and the male agrees well with his drawings as far as comparison could be made. Since his description is not very full, the specimens taken here are fully illustrated.

Length 0·60 mm., width 0·45 mm., both specimens the same size. The dorsal surface of the male is strongly tuberculate.

FAMILY TISBIDAE (Sars) 1904.

MACHAIROPUS Brady 1883.

Lang (1936b) in a revision of this genus has concluded that the genus *Psamathe* Philippi is identical with *Machairopus*, and since the older name is preoccupied, Brady's name must stand. He gives a key to the species, from which only *sarsi* Brady 1910 is excluded. Since then he has described another species, *antarcticus* Lang (1936c).

Two species occurred in this collection.

MACHAIROPUS INTERMEDIUS sp.nov.

Occurrence: IX, several specimens; X, 1 female, 1 young; XI, 4 ovigerous females, 4 young; XII, 4 females (3 ovigerous), 2 males.

Female: Length 0·84 mm. First antenna 9-segmented; second antenna with 4-segmented exopod, of which the third segment is the shortest; mouth parts more or less typical (fig. 14); first leg with middle segment of exopod swollen basally as in *plumosa* (Brady), though to a less extent. Seta formula of legs 2–4:

	endopod.	exopod.
p.2.	1.2.221.	1.1.223.
p.3.	1.2.321.	1.1.323.
p.4.	1.2.221.	1.1.323.

Fifth legs very much as in the type species, caudal rami as in *plumosa*. The genital segment is partially divided, ventrally and laterally.

Male: Length 0·66 mm. The male differs from the female only in the first antennae, which are 8-segmented, and fifth and sixth legs.

It is with some hesitation that this species is separated from *plumosa*, which has been redescribed by Lang (1934). A comparison with the original and with Lang's description shows several points of difference. Firstly in the proportions of the segments of the first antenna, in which it also differs from *longicauda*

(Philippi, 1840). The exopod of the second antenna lacks setae on the second and third segments; the mandible palp is different from that of Philippi's species. One of the distinguishing characters of Brady's species, according to Lang, is the swollen middle segment of the first exopod. In *intermedius* this segment is swollen but to a much smaller extent, the swelling being restricted to that portion proximal

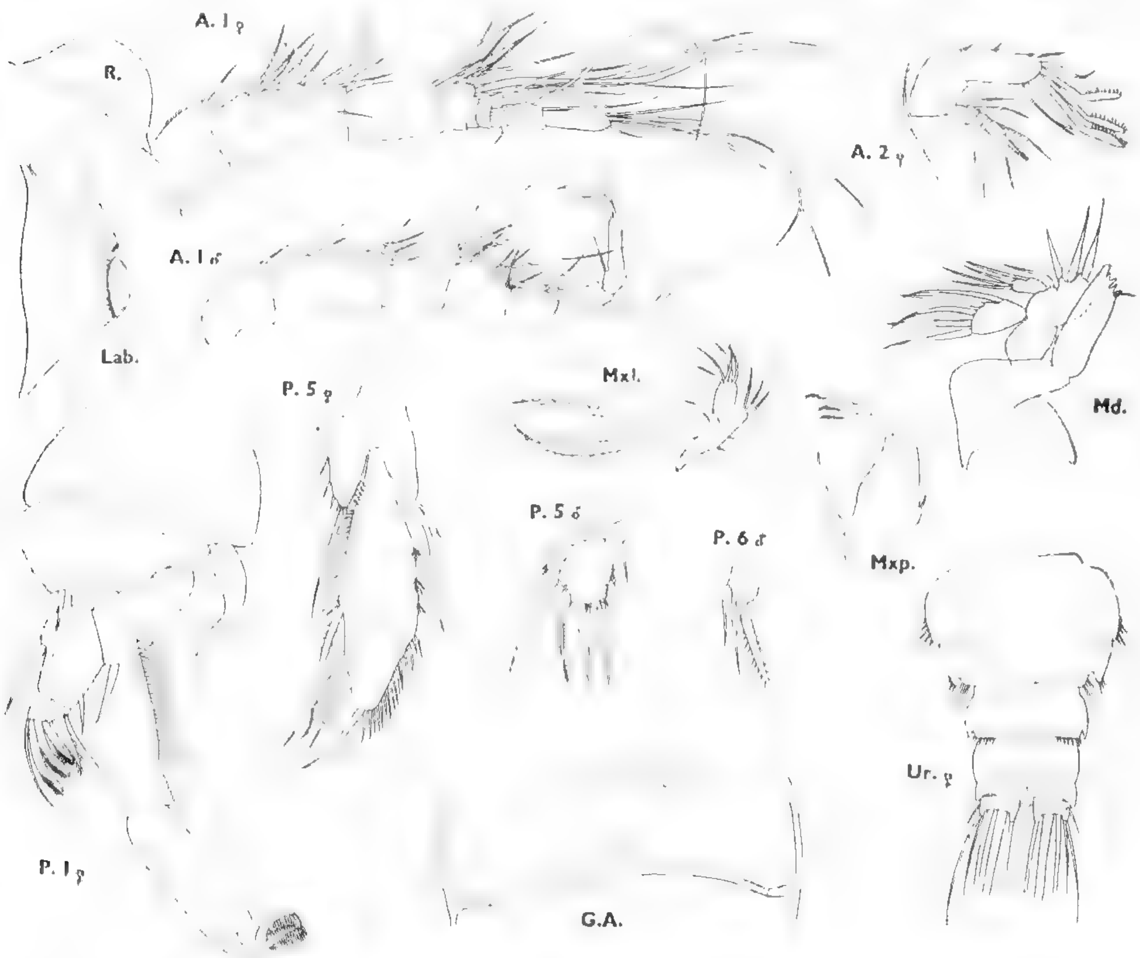


Fig. 14. *Machairopus intermedius* sp. nov., male and female. The labrum shows a recurved tip, and is accompanied by a mandible *in situ*; the drawing of the maxillule is taken from the male. The genital area of the female was drawn as seen through the urosome from the dorsal surface.

to the attachment of the seta. The fifth leg is very similar in all three species, and the caudal rami show only slight differences from those of *plumosa* (cf. Lang, *loc. cit.*, p. 19). The male differs from *plumosa* in the first antenna and fifth and sixth legs.

A second species of *Machairopus* occurred in collections from Sellick Beach (IX). An ovigerous female, measuring 0·69 mm., was found, but unfortunately the fifth legs were lost during dissection, and without these it is useless to describe the species.

FAMILY THALESTRIDAE Sars 1905.

Lang (1936c) has recently revised this family, and gives keys to the family and genera. He divides the family into four sub-families, chiefly on the sexual characters.

Sub-family DACTYLOPODIINAE Lang 1936.

EUDACTYLOPUS A. Scott 1909.

This genus contains three species, which are discussed by Lang (*loc. cit.* p. 35).

EUDACTYLOPUS AUSTRALIS sp.nov.

Occurrence: IX, 2 females; XII, 1 female; XIV, 1 female.

Female: Length 1·26–1·38 mm. Body comparatively slender, the urosome forming more than half the total length. First antenna 9-segmented; rostrum prominent, rounded, mobile—not always visible dorsally; second antenna with exopod distinctly 2-segmented; mouth parts showing greater development than in

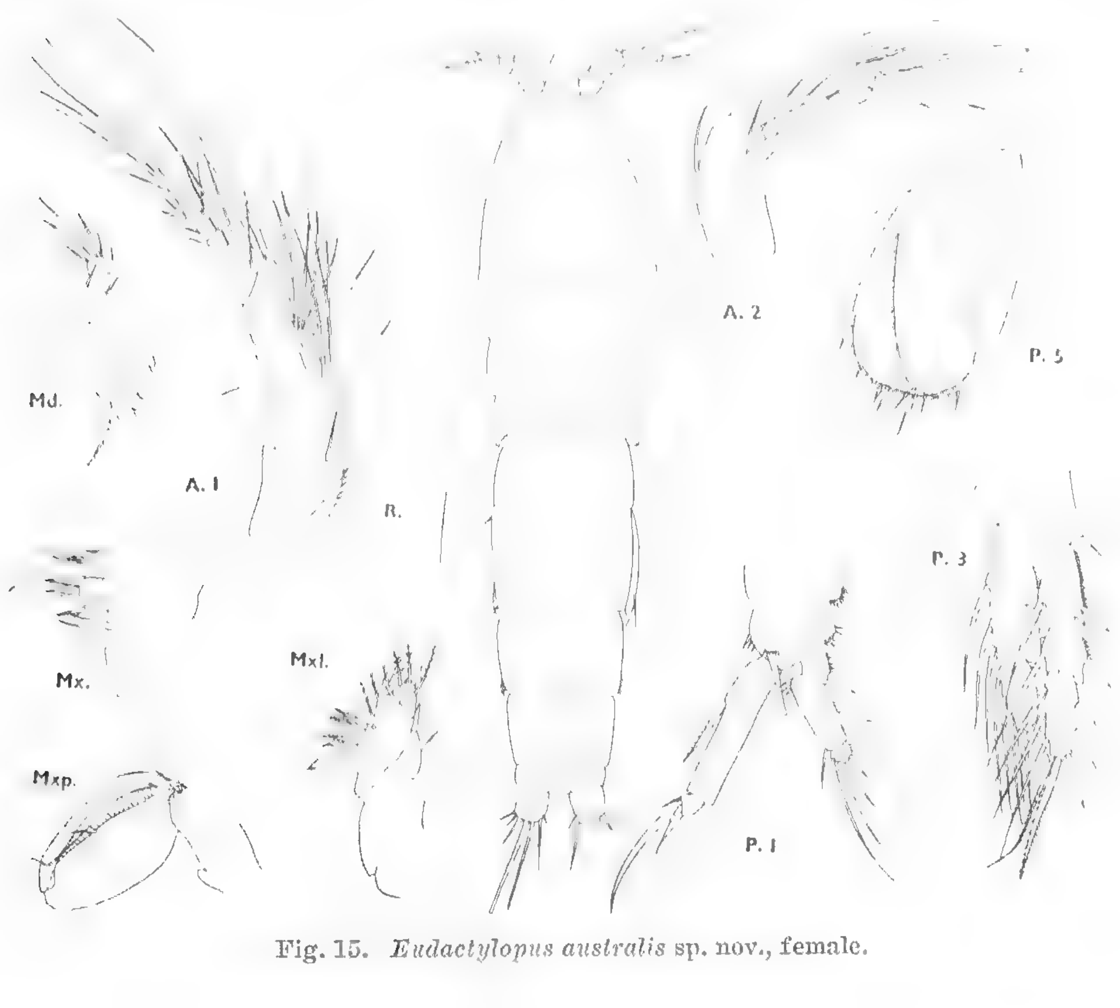


Fig. 15. *Eudactylopus australis* sp. nov., female.

type species (fig. 15). First legs like those of *robustus* (Claus, 1863); legs 2–4 with seta formula:

	endopod.	exopod.
p.2.	1.2.221.	1.1.223.
p.3.	1.2.321.	1.1.323.
p.4.	1.1.221.	1.1.323.

Fifth legs large, extending to the middle of the post-genital segment, basal segment with more or less parallel sides, end segment pyriform. Caudal rami as wide as long.

Male: Unknown.

This species shows several differences from previously described species. The genital segment is very large, and is almost as long as the remaining three urosome segments together. At the same time the body is relatively much more slender than in *robustus*. While the fifth legs are long, as in *robustus*, their segments are of a shape quite different from those of *robustus*, and they extend no further than the middle of the post-genital segment, whereas in *robustus* they reach at least to the hind margin of this segment. In *latipes* (T. Scott, 1894) they attain approximately the same position as in *australis*, but are of an entirely different shape. The 2-segmented exopod of the second antenna further distinguishes this species from *robustus* and from *spectabilis* (Brian, 1923).

Sub-family THALESTRINAE Lang 1936.

PHYLLOTHALESTRIS Sars 1905.

According to Lang (*op. cit.*, p. 43) the genus contains 3 species, with a possible fourth.

PHYLLOTHALESTRIS MYSIS (Claus) 1863.

Occurrence: XIII, 2 females (1 ovigerous).

Distribution: Norway, British Isles, Madeira, Mediterranean, Suez Canal, Ceylon, Obi Islands.

The two females in this collection show only small differences from the type. The size is somewhat smaller, 1·1 mm. instead of 1·4 mm., and the end segment of the second exopod has only 2 inner setae instead of 3 as shown by Sars (1911, pl. lxxi). Moreover, the inner seta on the basal segment of the fifth leg is relatively closer to the terminal setae, and the second outer seta of the distal segment is not differentiated as a spine, but this and the third seta are slightly stronger than the other 4. In a specimen taken in Western Australia these 2 setae are both small spines. There seems to be a certain amount of variation in the fifth legs of this species (cf. Sars 1911, pl. lxxi, and Monard 1928, fig. xvii, 1). The Western Australian form agrees with that from Sellick Reef in the second exopod, but the inner seta on the basal segment of the fifth leg is missing.

FAMILY DIOSACCIDAE Sars 1906.

In conjunction with the present work I have made a revision of this family, dealing in particular with the genus *Amphiascus* and its closely-related genera.

This revision will be published separately. It need only be noted here firstly, that Gurney's (1927b) genus *Amphiascopsis* is retained, but has been enlarged to include a number of related forms, and, secondly, that the *debilis* forms and related species are placed in a new genus *Amphiascoides*.

A short definition of this new genus is given in the appropriate place.

AMPHIASCOPSIS Gurney 1927b.

AMPHIASCOPSIS LONGIPES sp.nov.

Occurrence: VII, 1 female, X, 5 females (4 ovigerous), 2 males; XIII, 2 females (1 ovigerous).

Female: Length 0·93–1·05 mm. Rostrum round anteriorly, with 1 seta on each side; first antenna 8-segmented; exopod of second antenna 3-segmented, middle segment with seta; first legs with very long endopod and large middle segment in exopod, typical of the genus; legs 2–4 also typical, with the following seta formula:

	endopod.	exopod.
p.2.	1.2.121.	1.1.223.
p.3.	1.2.321.	1.1.323.
p.4.	1.1.221.	1.1.323.

Fifth leg with distal segment nearly as wide as long, bearing 6 setae, basal expansion with 5 setae. Caudal rami as wide as long, setae unmodified.

Male: Length 0·90–0·96 mm. Differs from female only in the usual way. Basis of first endopod with large inner spine, which is strongly developed and curved; end segments of first endopod relatively longer than in female; second endopod modified as usual, with the spines strongly developed. Fifth legs with basal segments of opposite sides united in mid-line and each bearing 2 small spines; distal segments with 6 setae (2, 1, 3).

This species shows considerable resemblance to *lagunaris* Grandori, as illustrated by Brian (1928). It differs in the very long first endopod, with its short end segments, and in the second endopod of the male. Other species of *Amphiascopsis* with very long first endopods are *sexsetatus*, *tenuiculus*, *gracilis*, *latifolius*, *minutus*, *aegyptius*, *phyllopus*, *havelocki*, *banyulensis*, and *hirsutus*. It differs from

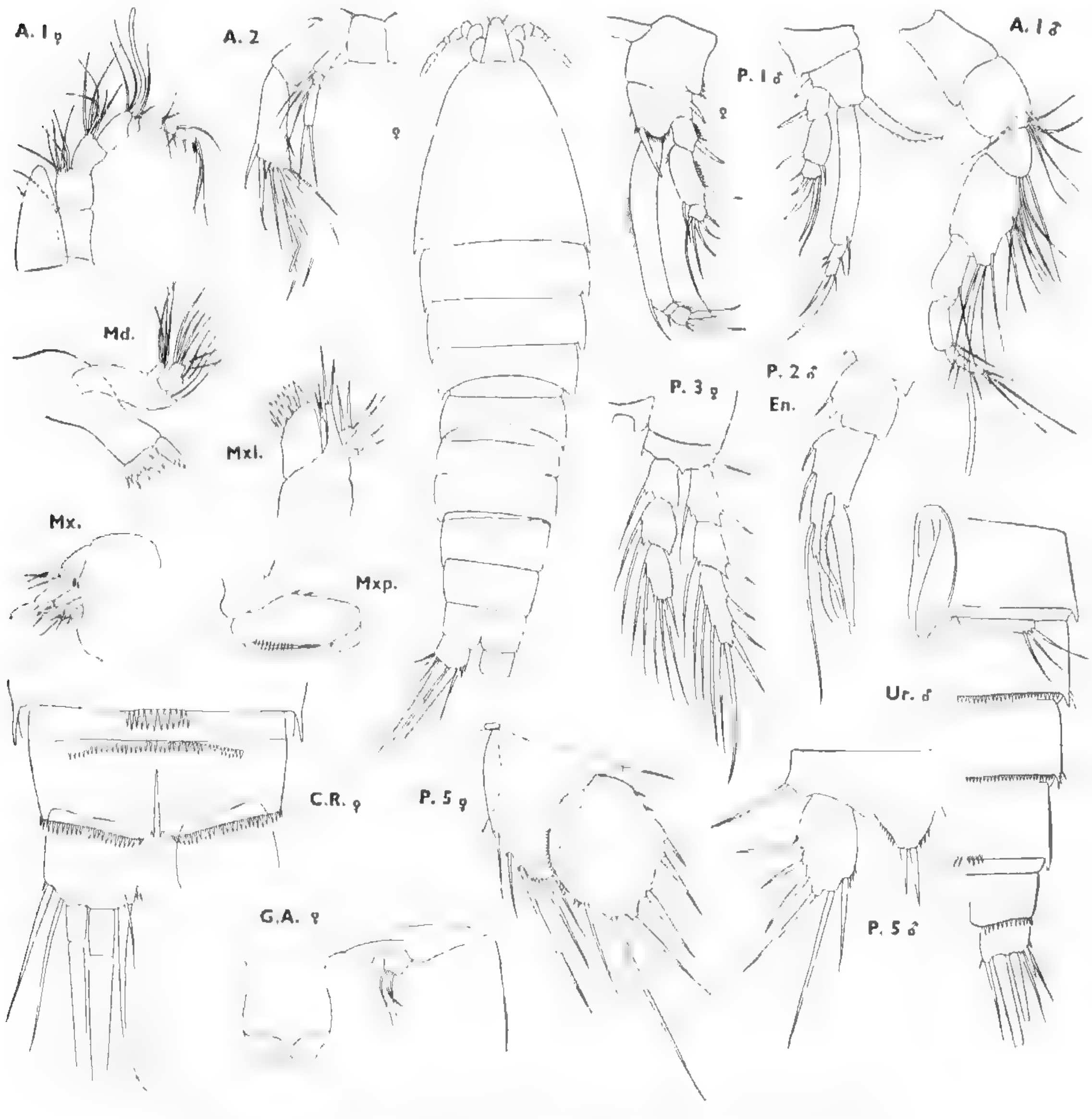


Fig. 16. *Amphiascopsis longipes* sp. nov., male and female.

the first two in the shape of the fifth legs, and from these and *gracilis* in having 3 inner setae on the end segment of the third exopod; from *latifolius* and the last 5 species in the first exopod, and from *minutus* in the fifth leg and male second endopod.

AMPHIASCOPSIS AUSTRALIS sp.nov.

Occurrence: XIII, 4 females, 1 male.

Female: Length 0·75–0·93 mm. Rostrum triangular, pointed, without lateral setae; first antenna 9-segmented, segments short and compact; exopod of second antenna 3-segmented, middle segment without seta; first legs of Amphiascopsid type but endopod not greatly elongated nor very slender; legs 2–4 with the usual seta formula for the genus, i.e. exactly as in *longipes* (above); fifth legs with basal

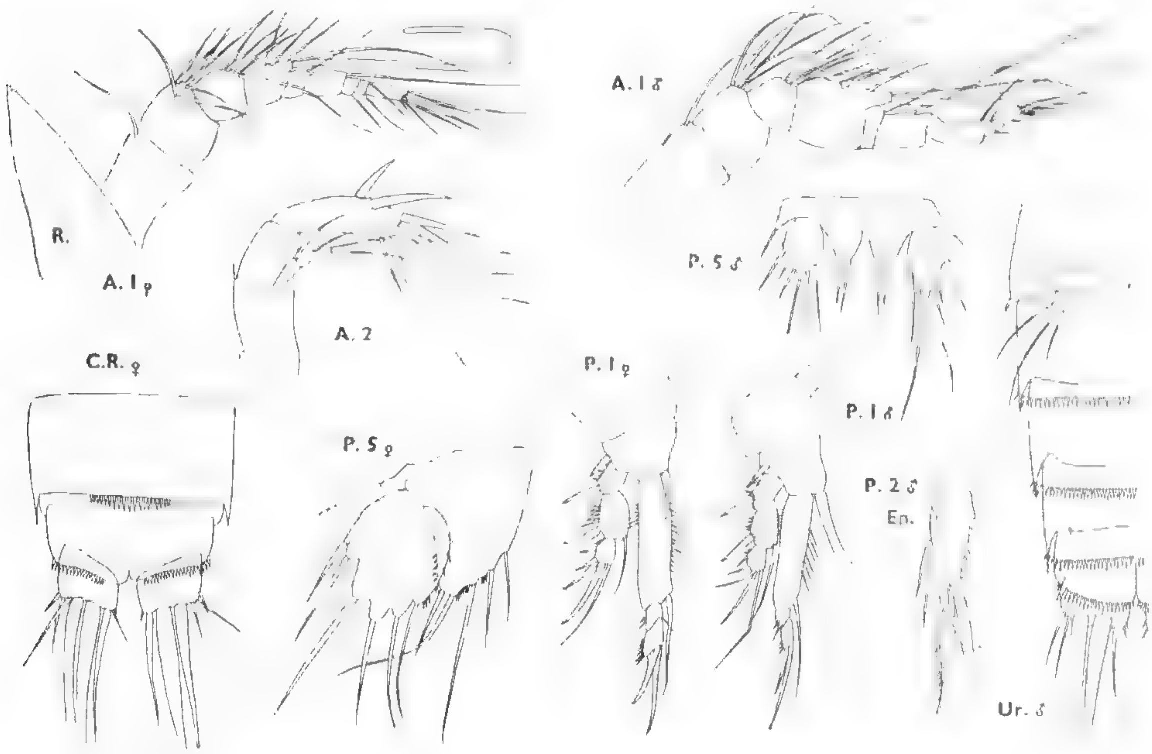


Fig. 17. *Amphiascopsis australis* sp. nov., male and female.

segment triangular, bearing 5 setae, end segment subcircular, with 6 setae. Caudal rami wider than long and nearly as long as anal segment, setae unmodified.

Male: Length 0·99 mm. First antenna 9-segmented; second antenna as in female. First legs with enlarged spine at base of endopod, otherwise as in female; second endopod modified, with 1 seta on basal segment, end segment with 3 lateral setae, 1 terminal spine-like seta and 2 spines attached about middle of segment. Remaining legs as in female. Fifth legs with basal segments of opposite sides united in mid-line, each bearing 2 spines; distal segments each with 6 setae (2, 1, 3).

This species, which was found associated with that described above, is very like it in some respects, but differs in the first antenna, exopod of second antenna, first legs, caudal rami and rostrum. In several respects, particularly in the proportions of the first endopod, it resembles *attenuatus* (Sars 1906) but differs in the clearly 3-segmented exopod of the second antenna, the relatively wider first endopod, and in the shape and armature of the fifth legs. The male differs from that of *attenuatus*, which has been described by Wilson (1932, p. 218), in the first and second legs.

AMPHIASCOIDES gen. nov.

The following two characters serve to define this genus, which is composed of the *debilis* group of *Amphiascus sens. lat.*, with additions.

1: Middle segments of second and third endopods each with 1 inner seta.

2: Middle segment of first exopod without inner seta, end segment with only 4 setae and/or spines.

For the full description of the genus and list of species reference will have to be made to the text of the revision which it is hoped will be published during 1941.

AMPHIASCOIDES INTERMIXTUS (Willey) 1935.

Occurrence: X, 2 females; XIII, 1 ovigerous female.

Distribution: Bermuda.

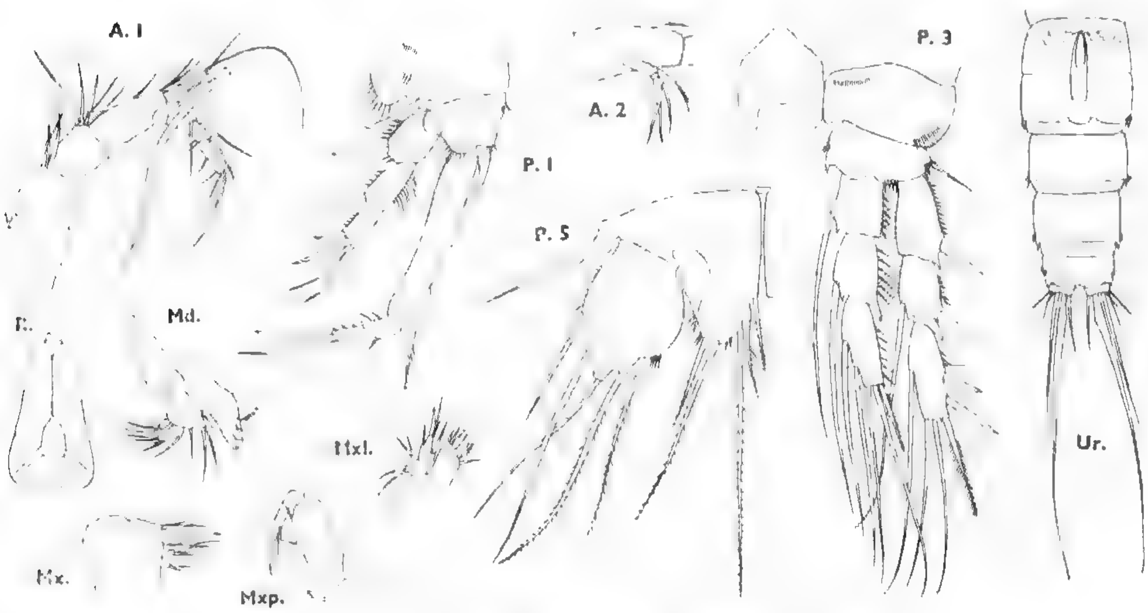


Fig. 18. *Amphiascoides intermixtus* (Willey), female.

In 1935 (p. 64) Willey described a species of *Amphiascus* from Bermuda, which was close to *A. debilis* (Giesbrecht) and which he named *subdebilis*; at the same time he found a variety (*intermixtus*) which differed only in the shape of the fifth leg. He has not illustrated his species very fully, and it is not known to what extent *subdebilis* departs from *debilis*, except in the seta formula, fifth leg, and caudal rami. The species found here has the distal segment of the fifth leg indistinguishable from that of his variety, while the seta formula for legs 2–4 also agrees with *subdebilis*. In the proportions of the segments of the first endopod, however, it differs from *debilis* to a certain extent, as does also the rostrum, and failing information to the contrary it must be assumed that *subdebilis* agrees with *debilis* in these respects. It is uncertain what value should be ascribed to the proportions of legs, from a systematic aspect, and only extensive breeding experiments can enlighten us. The size of *subdebilis* is given as 0·47 mm., that of the variety as 0·69 mm.—the examples found here measured 0·90 mm.

In view of the considerable difference in size and its wide distribution I have raised the variety to the rank of a species, intermediate between *debilis* and *subdebilis*, as Willey's choice of name implies.

TYDEMANELLA A. Scott 1909.

Tydemanella A. Scott, 1909, p. 216.
Ialysus Brian, 1927.
Ialysus Gurney 1927b, p. 505.

The genus was regarded by Scott as a Thalestrid, related to *Dactylopodella*, which it resembles in shape and in the relatively large basal segment of the first endopod. It is, however, as stated by Lang (1936e, p. 18) clearly a Diosaccid, and belongs to the *Diosaccinae*. *Ialysus*, which I regard as synonymous with *Tydemanella*, was correctly placed in the *Diosaccidae* by its author, though both Gurney (1927b) and Monard (1935, p. 38) placed it in the *Thalestridae*. Furthermore, Monard (*loc. cit.*) includes *Tydemanella* in the *Thalestridae*, and Gurney (*loc. cit.*) states that *Ialysus* "differs very little" from *Vallentinia*, which Lang (*loc. cit.*) regards as synonymous with *Dactylopodella*. It is of interest to note that Scott (*loc. cit.*) states that *Tydemanella* "is closely related to *Dactylopodella*".

The close relationship of *Tydemanella* and *Ialysus* is thus independently established.

The generic diagnosis given by Scott (1909, p. 216) suffices for the two species hitherto described and for the new species described below. These are *typica* A. Scott 1909; *rufus* (Brian) 1927; and *robusta* sp.nov.

KEY TO THE FEMALES.

1. Segments 2, 3, and 4 of first antenna long and slender, at least twice as long as wide .. .. *typica* A. Scott 1909.
   These segments short and stout, no more than half as long again as wide .. 2.
2. Second segment of first antenna with large spine at distal corner. *rufus* (Brian) 1927.
   Second segment of first antenna without spine. .. *robusta* sp.nov.

TYDEMANELLA ROBUSTA sp.nov.

Occurrence: IX, 1 female, ovigerous; XIV, 1 male.

Female: Length 0·78 mm. (anterior portion 0·54, urosome 0·24 mm.); greatest width 0·36 mm. Body wide anteriorly, tapering gradually posteriorly.

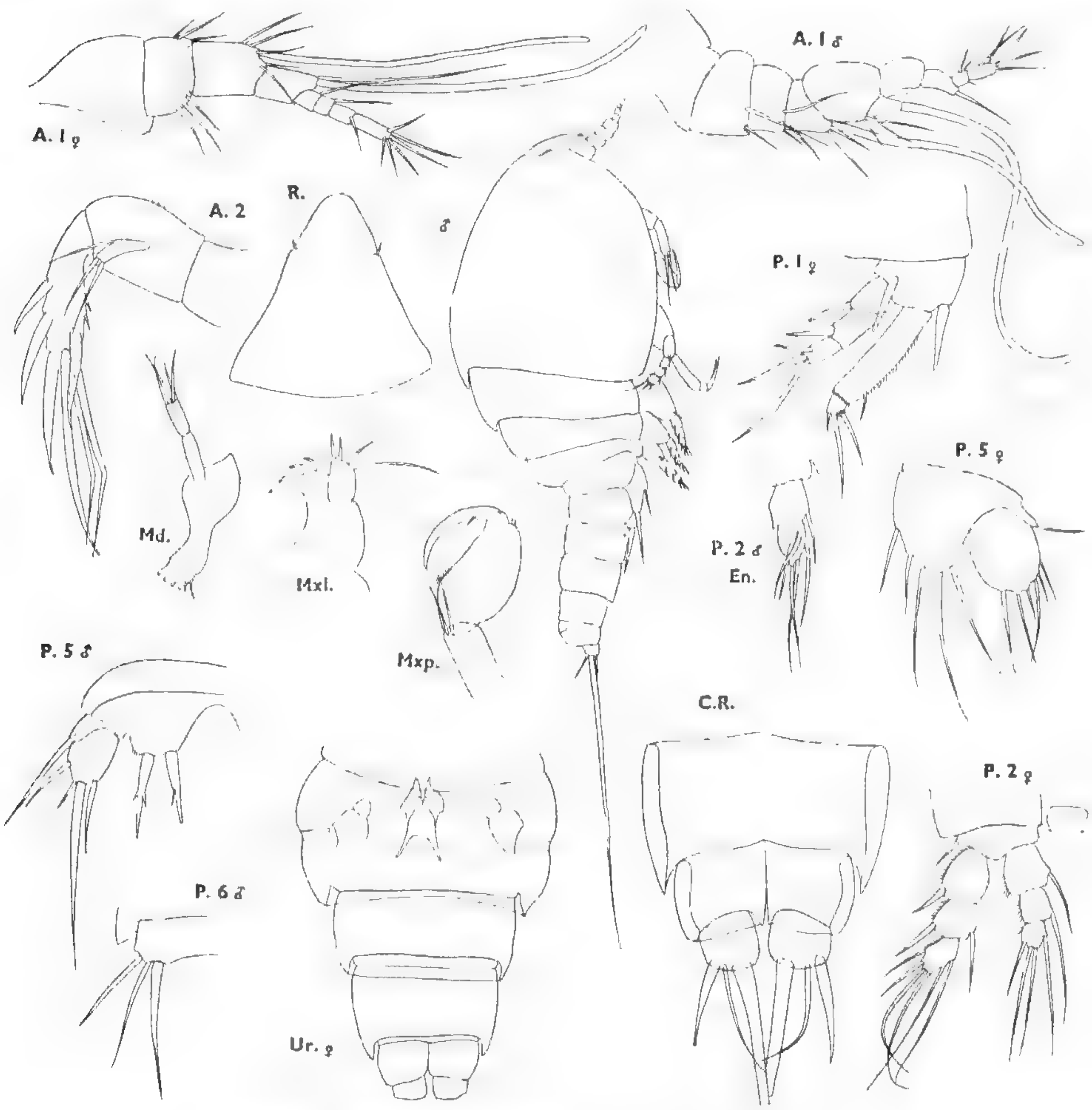


Fig. 19. *Tydemanella robusta* sp. nov., male and female.

Rostrum large, not always visible from above owing to curvature of body. Urosome wide anteriorly and tapering strongly to caudal rami, segments strongly chitinized; genital segment imperfectly divided. Caudal rami at least as wide as long, with 1 long terminal seta as long as the anterior portion of the body, 1 small seta, and 1 spine.

First antenna 8-segmented, the basal segments short and strongly built, and bearing sensory filaments on the third and fourth segments; distal portion with 3 short subequal segments and a long end segment; second antenna 2-segmented, with a small 1-segmented exopod attached at middle of basal segment, bearing 1 lateral and 2 terminal setae; mandible palp uniramous, 2-segmented, linear, the end segment with 4 setae; maxillule simply constructed, with 1 lobe; maxilla not seen; maxilliped normal.

First leg with 3-segmented exopod, without inner setae, and only 3 setae on end segment; endopod 2-segmented, basal segment as long as exopod but not greatly widened, end segment with 2 claws and 1 seta. Seta formula for legs 2–4:

	endopod.	exopod.
(1) p.2.	1.1.121.	0.1.222.
p.3.	1.2.221.	0.1.322.
p.4.	1.1.221.	0.1.322.

Fifth leg with wide basal segment bearing 5 setae, an oval distal segment with 6 setae. The female carries 2 egg-sacs, each with a few large eggs.

Male: Length 0·81 mm. (anterior portion 0·54, urosome 0·27 mm.). Body as in female, but urosome 5-segmented. First antenna 8-segmented, slightly modified; second antenna and mouth parts as in female; legs 1–4 as in female, but second endopod modified, 2-segmented, end segment with 1 lateral and 2 terminal setae, and a pair of spines inserted close together. Basal segment of first legs with large, strong, inner spine. Fifth legs with 2 strong spines on basal segment and 4 setae on distal segment; sixth legs with 1 large spine and 2 setae.

In the shape of the body this species agrees with the descriptions given for *typica* and *rufus*, but has a greater depth than is indicated in Scott's drawing. The first antenna closely resembles that of *rufus*, with the exception of the spine on the second segment in the latter. The second antenna is very like that of *rufus*, though with 2 terminal setae on the exopod in place of 1; in *typica* the exopod is very long and slender, and has a single terminal seta. The mandible palp differs from *typica* in the structure of the gnathobase. The mouth parts of *rufus* are neither described nor illustrated by Brian except for the maxilliped which is stated to be rather robust. Gurney (1927b, p. 505) describes the mandible palp as "apparently a long, slender, unbranched rod with three setae", which would

(1) In the single female at my disposal the 2nd endopods were asymmetrical, the end segment being imperfectly developed on one side. It is possible that there should be 2 setae on the middle segment, as in *rufus* (cf. Gurney 1927b, p. 506).

closely resemble the condition in the species described here. His illustration (fig. 133, D) of the maxilliped shows similarity with that of *robusta*. In *typica* the maxilliped is slender, differing from both *rufus* and *robusta*. The first legs agree in general with both species, but the endopod differs from *typica* in the relatively shorter terminal segment armed with 2 spines and 1 seta. In *rufus* the basal segment of the endopod is considerably broadened and not unlike that of *typica*. The exopod in *robusta* differs from the others in having only 3 appendages on the end segment (4 in the male, which has an additional small outer spine) and no inner seta on the middle segment. Legs 2–4 in *typica* are stated to be "nearly similar to those of *Dactylopodella*", which differs from that found here; in *rufus* they are described as being more or less like other Diosaccids.

The fifth legs are like *typica*, but with setae instead of spines on the basal segment, and are not very different from *rufus*. As in Brian's species, there are two egg-sacs, laterally compressed, with a few large ova. The egg-sacs of *typica* are unknown.

The male shows many points of similarity with that of *rufus*, particularly in the structure of the second endopod, though the shape of the end segment is not so strongly modified, and the inner spine on the basipod of the first legs is not enlarged as it is in *rufus*, but resembles that of the female.

FAMILY CANTHOCAMPTIDAE Sars 1906.

MESOCHRA Boeck, 1864.

? MESOCHRA PYGMAEA (Claus) 1863.

Occurrence: IX, 1 female.

Distribution: Norway, Heligoland, Bermuda, Woods Hole, Mediterranean, Suez Canal.

The single specimen, a female, occurring in this collection measured 0·27 mm., whereas previous records have given its size as from 0·33–0·40 mm. The structure of the first antenna could not be made out clearly in my preparation, neither was the exopod of the second antenna visible. It appears to differ in the number of setae on the end segment of the fifth leg, having only 4, and the inner seta on the basal segment of the first endopod is inserted mid-way along the margin instead of being slightly nearer the base. Since there is only the single specimen, and that not fully examined, it has been placed for the present, with Claus' *pygmaea*, which it very closely approaches.

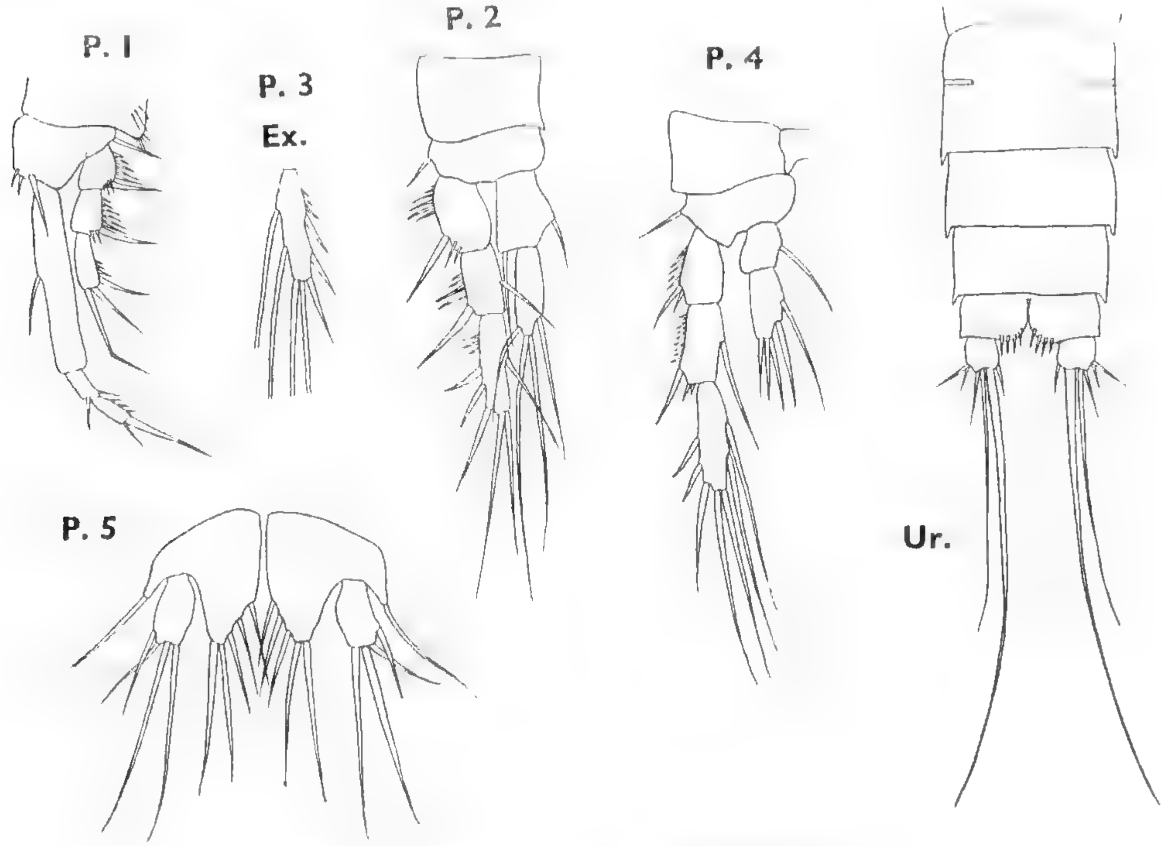


Fig. 20. ? *Mesochra pygmaea* (Claus), female.

ORTHOPSYLLUS Brady and Robertson 1873.

Until quite recently this genus has been regarded as a Cletodid, but it has been established by Lang (1936d) that it belongs to the *Canthocamptidae* (*loc. cit.*, p. 451). Four species have been described: *linearis* (Claus) 1866; *propinquus* Monard 1926a; *wallini* Lang 1934; and *major* Klie 1939.

The last of these has, so far, been described only in a preliminary notice, without illustrations.

ORTHOPSYLLUS RUGOSUS sp.nov.

Occurrence: X, 2 females.

Female: Length 0·81 mm. for specimen in contracted condition, 1·05 mm. for specimen with body segments extended. Body of usual shape, tapering slightly posteriorly; rostrum prominent, slightly down-turned at extremity; anal operculum and portions of anal segment strongly denticulate; caudal rami with similar denticulate fringes to inner and outer margins.

Head appendages more or less normal, first antennae with the spur on the second segment slightly different on right and left sides (see fig. 21); end segment of mandible palp with 3 setae.

First legs with endopod segments subequal, basal segment without inner seta; legs 2–4 without inner setae on exopods, but 4th leg has a few inner hairs; seta formula:

	endopod.	exopod.
p.2.	0.110.	0.0.013.
p.3.	0.111.	0.0.013.
p.4.	1.111.	0.0.013.

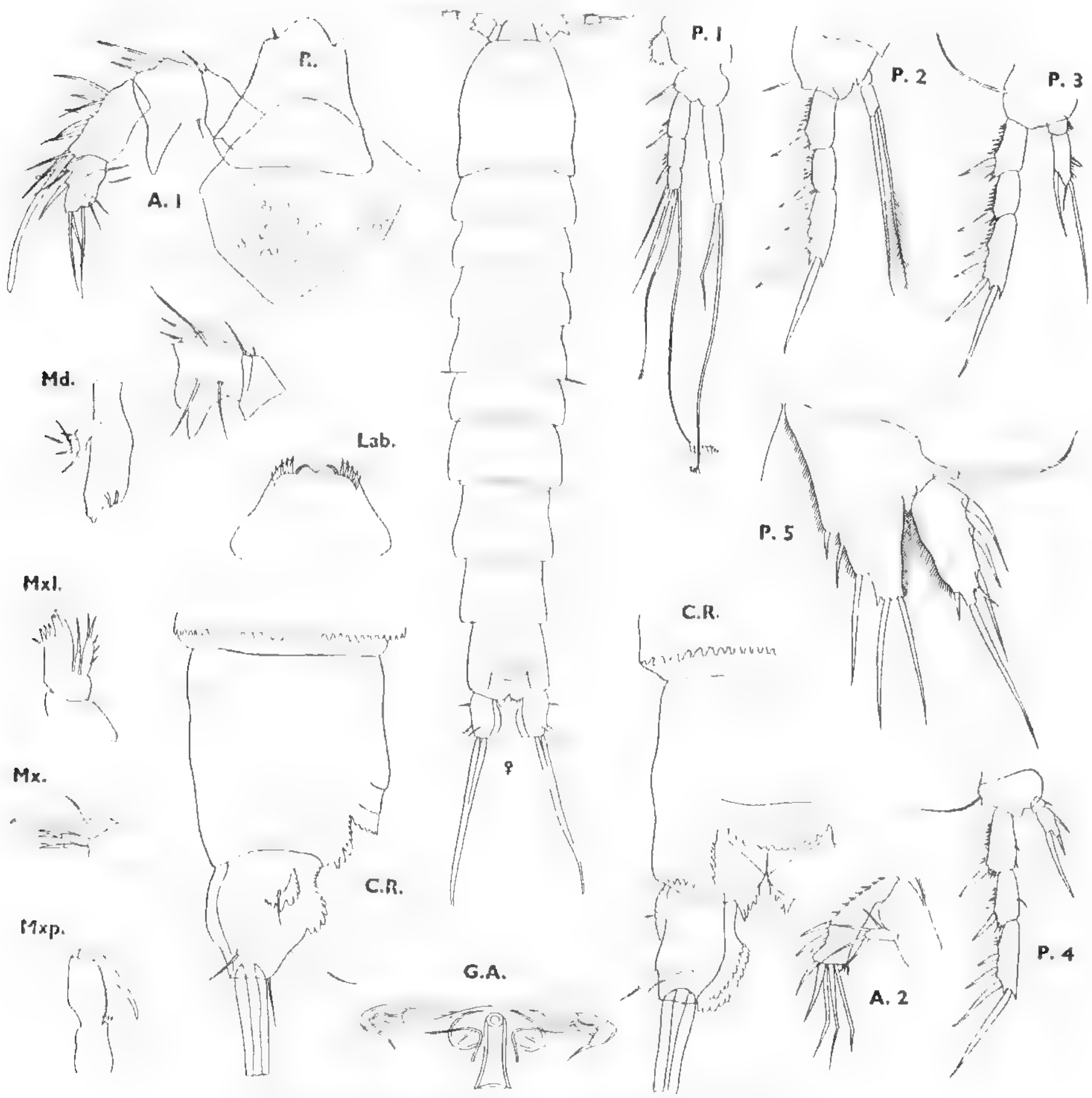


Fig. 21. *Orthopsyllus rugosus* sp. nov., female.

On the exopod of these legs the terminal seta which usually accompanies the spine, and is reduced in *linearis*, is absent. The terminal seta on the third endopod is reduced to a fine hair. The fifth legs resemble those of *linearis* rather than any other species; Lang (1936e) has shown that Claus' species does occur with the segments of the fifth legs distinct.

Male: Unknown.

This species resembles *linearis* in the structure of the fifth legs (allowing for the segments to be distinct) but differs from it in the caudal rami. In this respect it resembles the other three species. It differs from *propinquus* in the first legs, exopods of legs 2–4, fifth legs and caudal rami; *wallini* has only 2 outer spines on exopods 2–4, whereas here there are 3. Without illustrations it is difficult to compare this species with *major*, but it would appear to differ in the first legs, which are assumed to be like those of *linearis*, and certainly differs in the maxillipeds.

FAMILY LAOPHONTIDAE Sars 1907.

LAOPHONTE Philippi 1840.

LAOPHONTE CORNUTA Philippi 1840.

Occurrence: VII, 2 females (1 ovigerous); IX, 3 ovigerous females; X, 1 female; XI, 1 female, 1 male; XIV, 1 ovigerous female.

Distribution: British Isles, Norway, Madeira, Mediterranean, Black Sea, Suez Canal, Ceylon, Malay Archipelago, Kerguelen, Falkland Islands.

Female: Length 0·90–1·02 mm. Several specimens of this clearly defined and widely distributed species were found; they do not depart from the description given by Sars 1911.

Male: Length 0·90 mm.

LAOPHONTE LONGISETA sp.nov.

Occurrence: IX, 1 male.

Male: Length 0·30 mm. Body of usual shape; first antenna 6-segmented, with the fourth segment only slightly swollen; second antennae and mouth parts normal; first legs very slender, exopod 2-segmented, endopod with very short end segment, terminal claw with small accessory seta; second legs apparently without endopod, but this may have been lost in dissection; third endopod with spine-like process at outer corner of middle segment; seta formula:

	endopod.	exopod.
p.2.	—	0.0.022.
p.3.	1.1.110.	0.0.012.
p.4.	0.120.	0.0.112.

Fifth legs with well developed end segment, bearing 5 setae, no inner basal expansion. Caudal rami little longer than wide, with an inner basal tuft of fine hairs projecting laterally, giving a somewhat indistinct outline to the bases of the rami, and also imparting a superficial resemblance to *bulbifera*. Caudal setae longer than the whole body.

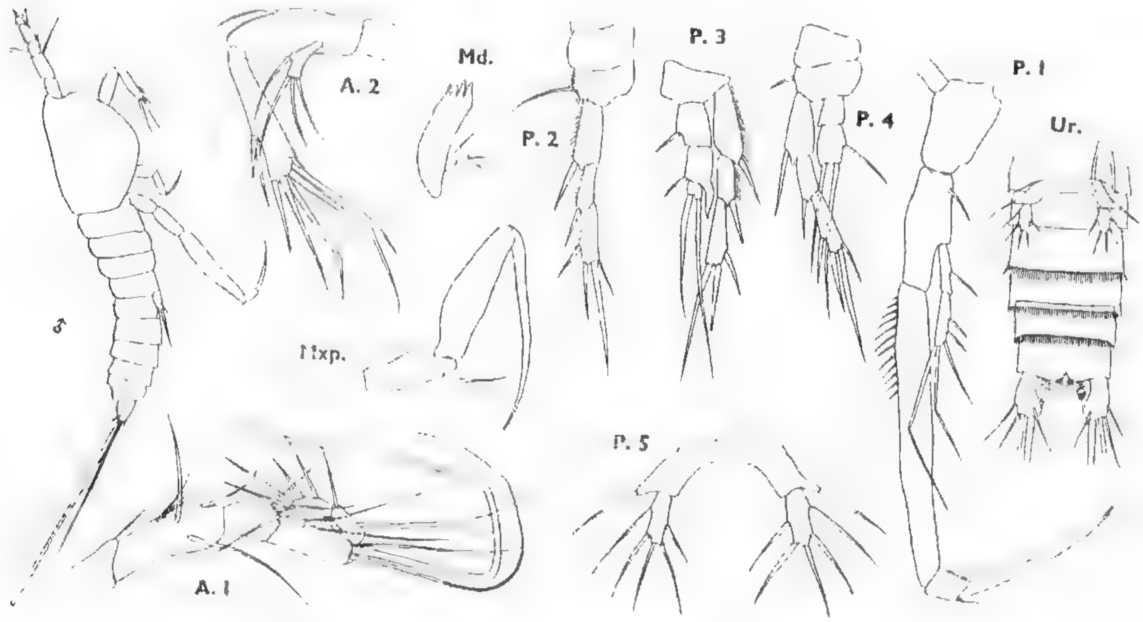


Fig. 22. *Laophonte longiseta* sp. nov. male.

This species approaches *rhodiaca* Brian (1928), of which only the male is known, but has fewer setae on the swimming legs. The fifth legs and caudal rami are remarkably alike in both. It seems possible that *rhodiaca* may be the male of *bulbifera*—the similarity extends to several points, but it will be necessary for them to be taken together for such a relationship to be established. In some respects also this new species resembles *bulbifera*, but there are no spurs on the first antennae, and the caudal rami do not project inwards.

FAMILY CEYLONIELLIDAE A. Scott.

CEYLONIELLA ARMATA (Claus).

Jurinia armata Claus 1866, p. 25.
Ceylonia aculeata Thompson and Scott 1903, p. 265.
Ceylonia armata A. Scott 1909, p. 227.
Ceylonia aculeata var. *adriatica* Brian 1923, p. 130.
Ceyloniella aculeata Wilson 1924 (1925), p. 14.
Lourinia armata Wilson 1924 (1925), p. 15.

Ceylonia armata Gurney 1927b, p. 567.
Ceyloniella aculeata var. *adriatica* Brian 1938, p. 23.
Ceyloniella armata Willey 1930, p. 111.
Ceyloniella armata Monard 1935a, p. 84.
Ceyloniella armata Monard 1937, p. 83.

This copepod was first described as *Jurinia armata* by Claus (1866) from the Mediterranean. In 1903 Thompson and Scott described a copepod *Ceylonia*

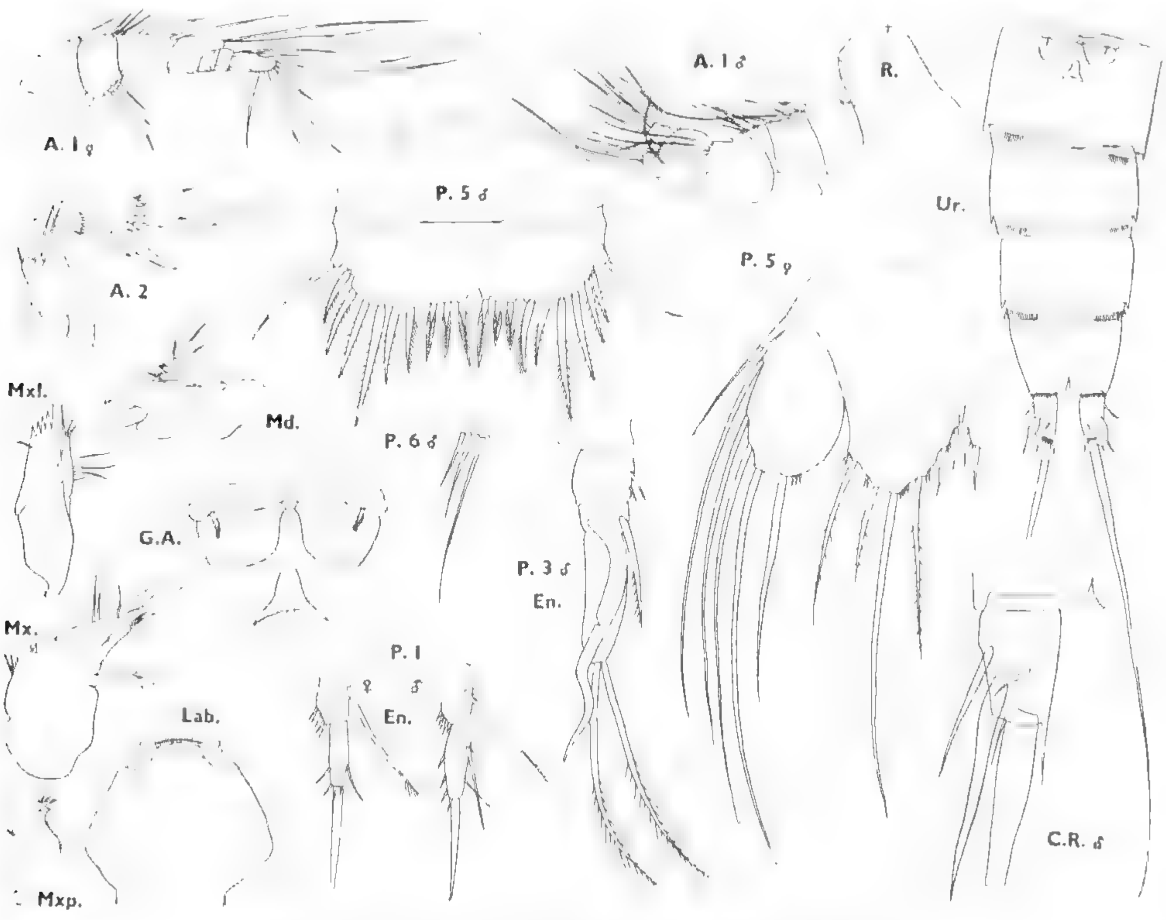


Fig. 23. *Ceyloniella armata* (Claus), male and female.

aculeata which A. Scott (1909) showed to be identical with Claus' *Jurinia armata*, but since Claus' generic name was preoccupied Thompson and Scott's generic name was retained. In 1924 Wilson showed that *Ceylonia* also was preoccupied, and renamed Thompson and Scott's genus *Ceyloniella*; at the same time he changed *Jurinia* to *Lourinia* without regard to its synonymy with *Ceylonia*. *Ceyloniella* stands as the correct generic name.

Occurrence: X, 5 females (4 ovigerous), 1 male; XI, 1 female, 2 males.

Distribution: Mediterranean, Suez Canal, Ceylon, Malay Archipelago.

Female: Length 0·93–1·32 mm.

Male: Length 1·02–1·23 mm. Despite certain minor differences when compared with Thompson and Scott's figures there can be no doubt that the specimens found here belong to this species. The caudal rami of the female illustrated show peculiar setae, which were not found in the male, nor in other specimens. The female fifth leg, moreover, lacks one seta on the distal segment, in comparison with the Ceylon material, thus conforming to Claus' and Gurney's descriptions. The seta formula for both sexes is identical, except for the male third endopod which is modified:

	endopod.	exopod.
p.2.	1.311.	0.1.123.
p.3.	1.321.	0.1.123.
p.4.	1.211.	0.1.123.

A single specimen of what may prove to be a new species occurred in the collection (also from Sellick Reef), but since it is represented by a non-ovigerous female, somewhat smaller than the other specimens, it is possibly only an immature specimen.

FAMILY METIDAE Sars 1911.

METIS Philippi 1843.

This genus has recently been revised by Steuer (1937), who includes a key to the species.

METIS JOUSSEAUMEI (Richard) 1892.

Occurrence: A considerable number of specimens occurred in the collections from Sellick Reef, both sexes being represented.

Distribution: According to Steuer (1937) it ranges from the North Atlantic to the Pacific (for details see Steuer, *op. cit.*).

There is nothing to distinguish the specimens found here from those found elsewhere. The depth of pigmentation appears to be a variable feature of the members of this genus. Specimens from South Australia were all colourless, whereas others taken from Rottnest Island, Western Australia, were bright red when captured. The pigment is destroyed on preservation in dilute formalin.

As in the case of Gurney's specimens (1927b, p. 571) the long caudal seta is longer than the whole body.

LITERATURE.

References marked (*) have not been consulted.

*Baird, W. (1845) : *Trans. Berwick Nat. Club*, ii, p. 155.
*Boeck, A. (1864) : *Vid. Selsk. Forh., Christiania.*
Brady, G. S. (1880) : Mon. British Copepoda, ii (Ray Society, London).
Brady, G. S. (1883) : *Challenger Reports, Zool.*, viii.
Brady, G. S. (1899) : *Trans. Zool. Soc., London*, xv, pp. 31–54.
Brady, G. S. (1910) : *Deutsche Südpolar-Exped.*, xi, Zool., iii, pp. 497–593.
Brady, G. S. (1915) : *Ann. Durban Mus.*, i, pp. 134–146.
Brady, G. S. and Robertson, D. (1873) : *Ann. Mag. Nat. Hist.* (4), xii, pp. 126–142.
Brian, A. (1923) : *Monit. Zool. Ital.*, xxxiv, pp. 126–135.
Brian, A. (1927) : *Boll. Mus. Zool. Anat. comp. Univ. Gen.* (2), vii, No. 9.
Brian, A. (1928) : *Boll. Mus. Zool. Anat. comp. Univ. Gen.* (2), vii, No. 18.
*Claus, C. (1860) : *Beitrage zur Kenntniss der Entomostraken.* Heft 1, Marburg.
Claus, C. (1863) : Die freilebenden Copepoden (Leipzig).
*Claus, C. (1866) : Die Copepoden Fauna von Nizza (Leipzig).
*Claus, C. (1889) : Copepodenstudien. Die Peltidien.
Cleve, P. T. (1901) : *Kongl. Svenska Vetens.-Akad. Handl.*, xxxv (5).
*Czerniavski, V. (1868) : *Verh. Versammi. Russ. Naturf., St. Petersburg, Abt. Zool., Copepoda*, pp. 39–57.
*Goodsir, H. (1845) : *Ann. Mag. Nat. Hist.* (1), xvi.
Gurney, R. (1927a) : *Trans. Zool. Soc. London*, xxii, pp. 173–177.
Gurney, R. (1927b) : *Ibid.*, xxii, pp. 451–577.
*Haller, G. (1879) : *Zool. Anz.*, ii, pp. 178–180.
Haller, G. (1880) : *Arch. f. Naturg., Jahrg.*, xlvi, pp. 55–70.
Klie, W. (1939) : *Zool. Anz.*, cxxvi, pp. 223–226.
Lang, K. (1934) : *Kungl. Fysiogr. Sällsk. Handl., N.F.*, xlv, No. 14.
Lang, K. (1935) : *Kungl. Fysiogr. Sällsk. Lund Forhandl.*, v, No. 9.
Lang, K. (1935a) : *Ibid.*, No. 21.
Lang, K. (1936a) : *Zool. Anz.*, cxiii, pp. 174–177.
Lang, K. (1936b) : *Ibid.*, cxiv, pp. 33–40.
Lang, K. (1936c) : *Ibid.*, cxv, pp. 152–156.
Lang, K. (1936d) : *Zool. Jahrb., Syst.*, lxviii, pp. 445–480.
Lang, K. (1936e) : *Swedish Antarc. Exped.* (1901–1903), iii, 3.
Monard, A. (1924) : *Bull. Soc. Zool. France*, xlix, pp. 656–672.
Monard, A. (1926a) : *Arch. Zool. exp. gen.*, lxv, pp. 39–54.

Monard, A. (1928) : *Ibid.*, lxvii, pp. 259–443.
Monard, A. (1934) : *Rev. Zool. Bot. Africaines*, xxvi, fasc., 1.
Monard, A. (1935) : *Trav. Stat. Biol. Roscoff*, Fasc., xiii.
Monard, A. (1935a) : *Stat. Oceanogr. Salammbo*, Bull. 34.
Monard, A. (1936) : *Bull. Trav. Stat. d'Acquic. et de Peche, Castiglione, Alger.*
Monard, A. (1937) : *Ibid.*
Monk, C. R. (1938) : *Science*, lxxxviii, p. 184.
Nicholls, A. G. (1935) : *Journ. Mar. Biol. Assoc.*, xx, pp. 29–45.
*Norman, A. M. (1868) : *Brit. Assoc. Reps.* pp. 247–336 and 344–345.
Norman, A. M. (1903) : *Ann. Mag. Nat. Hist.* (7), xi, pp. 367–369.
Norman, A. M. and Scott, T. (1905) : *Ann. Mag. Nat. Hist.* (7) xv, pp. 284–300.
Norman, A. M. and Scott, T. (1906) : The Crustacea of Devon and Cornwall (Wesley & Son, London).
Pesta, O. (1935) : *Zool. Jahrb., Syst.*, lxvi, pp. 363–379.
Philippi, A. (1839) : *Arch. f. Naturg.*, v, pp. 131–132.
Philippi, A. (1840) : *Ibid.*, vi, pp. 188–190.
*Philippi, A. (1943) : *Ibid.*, ix.
Quidor, A. (1906) : Copepodes. *Expedition Antarctique française* (1903–1905). Paris.
*Richard, J. (1892) : *Bull. Soc. Zool. France*, xvii.
Sars, G. O. (1903–11) : An Account of the Crustacea of Norway, v, Copepoda (Harpacticoida). (Bergen.)
Scott, A. (1909) : *Siboga-Exped.*, Mon. xxixa, pp. 1–323 (Leyden).
Scott, T. (1894) : *Trans. Linn. Soc. London*, 2nd ser., vi, pp. 1–161.
Scott, T. (1912) : *Trans. Roy. Soc. Edin.*, xlviii, pp. 521–599.
*Scott, T. and Scott, A. (1893) : *Ann. Scot. Nat. Hist.*, April.
Steuer, A. (1937) : *Not. Ist Biolog. Rovigno*, ii (8).
Thompson, G. M. (1883) : *Trans. N.Z. Inst.*, xv. pp. 93–116.
Thompson, I. C. and Scott, A. (1903) : Report on the Copepoda. Ceylon Pearl Oyster Fisheries, Supp. Rep. Pt. 1, No. 7 (London).
Willey, A. (1930) : *Ann. Mag. Nat. Hist.* (10), vi, pp. 81–114.
Willey, A. (1935) : *Ann. Mag. Nat. Hist.* (10), xv, pp. 50–100.
Wilson, C. B. (1924) : *Proc. U.S. Nat. Mus.*, lxiv (1925).
Wilson, C. B. (1932) : *Bull U.S. Nat. Mus.*, No. 158.
Wolfenden, R. N. (1905a) : Fauna and Geography of the Maldive and Laccadive Archipelagoes, ii, Suppl. 1, pp. 989–1,040.

NEMATODES FROM AUSTRALIAN MARINE MAMMALS

BY T. HARVEY JOHNSTON AND PATRICIA M. MAWSON, UNIVERSITY OF ADELAIDE

Summary

Very little attention has been paid to the nematode parasites of Australian marine mammals. The first to mention their presence was Krefft, who, in 1871, reported Ascaris sp. from Delphinus forsteri from Port Jackson. One of us (Johnston 1937) recorded Contracaecum osculatum (Rud.) from the hair seal from Pearson Island, Great Australian Bight, the host being indicated as Arctocephalus forsteri in error for Neophoca cinerea, the former name being that reserved for a New Zealand seal. We reported the occurrence of Anisakis kogiae J. & M., Porrocaecum kogiae J. & M., and Crassicauda magna J. & M. from pigmy sperm whales, Kogia breviceps (Blainville) stranded in Moreton Bay, Queensland, and at Port Victoria, Spencer Gulf (Johnston and Mawson, 1939).

NEMATODES FROM AUSTRALIAN MARINE MAMMALS

By T. HARVEY JOHNSTON AND PATRICIA M. MAWSON, UNIVERSITY OF ADELAIDE.

VERY little attention has been paid to the nematode parasites of Australian marine mammals. The first to mention their presence was Krefft, who, in 1871, reported *Ascaris* sp. from *Delphinus forsteri* from Port Jackson. One of us (Johnston, 1937) recorded *Contracaecum osculatum* (Rud.) from the hair seal from Pearson Island, Great Australian Bight, the host being indicated as *Arctocephalus forsteri* in error for *Neophoca cinerea*, the former name being that reserved for a New Zealand seal. We reported the occurrence of *Anisakis kogiae* J. & M., *Porrocaecum kogiae* J. & M., and *Crassicauda magna* J. & M. from pigmy sperm whales, *Kogia breviceps* (Blainville) stranded in Moreton Bay, Queensland, and at Port Victoria, Spencer Gulf (Johnston and Mawson, 1939).

The material now reported on was collected by Dr. J. B. Cleland; the Australian Museum, Sydney; the South Australian Museum; the Tasmanian Biological Survey; and the senior author. The investigation has been assisted by the Commonwealth Research Grant to the University of Adelaide.

The following is a list of the parasites now recorded, arranged under their hosts:

Dugong australis (Owen), Cairns, North Queensland.

Dujardinia halicoris (Owen).

Delphinus delphis L.

Echinocephalus uncinatus Molin (probably ingested with the prey), St. Vincent Gulf, S.A.; *Anisakis simplex* (Rud.), Port Jackson, N.S.W.

Tursiops truncatus Montagu, Encounter Bay, S.A.

Halocercus lagenorhynchi Baylis and Daubney. Iredale and Troughton (1934, 68) regard the short-nosed dolphin of southern Australia as being distinct from Montague's species, and have named it *T. maugeanus*.

Grampidelphis exilis Iredale and Troughton, Manly, N.S.W.

Crassicauda grampicola sp.nov.

Neophoca cinerea (Peron and Lesueur), Pearson I., S.A.

Contracaecum osculatum Rud.

Gypsophoca tasmanica (Scott and Lord), Derwent Heads, Tasmania.

Contracaecum gypsophocae sp.nov., *Anisakis* sp.

Hydrurga leptonyx (Blainville), Port Adelaide, S.A.

Anisakis similis (Baird), *Contracaecum osculatum* (Rud.), *Phocascaris hydrurgae* sp.nov., *Contracaecum ogmorhini* sp.nov.

CONTRACAECUM GYPSOPHOCAE sp.nov.

Fig. 1–2.

Numerous specimens from the Tasmanian fur seal, *Gypsophoca tasmanica* from Franklin Island, off Derwent Heads, Tasmania, collected by the Tasmanian Biological Survey.

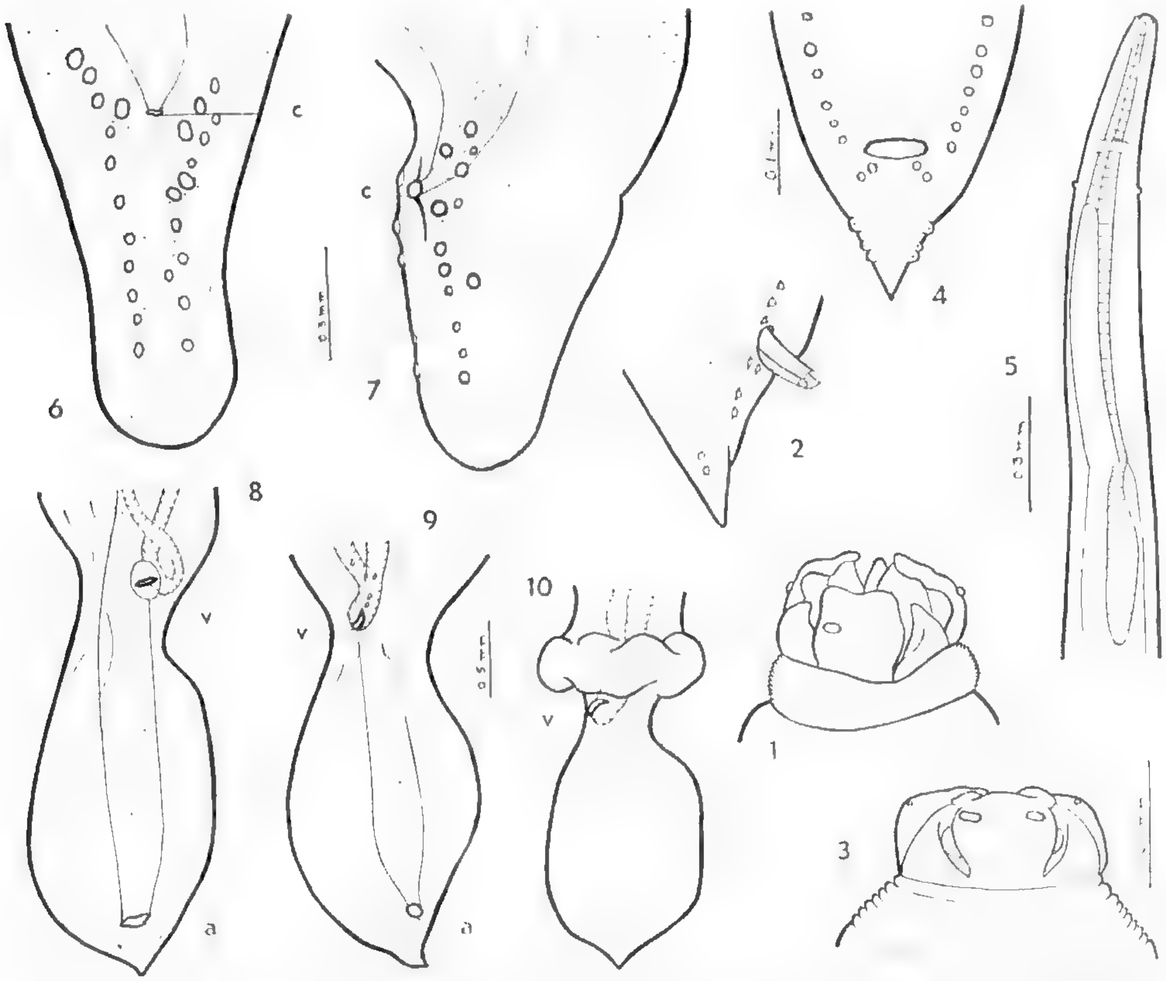


Fig. 1–2. *Contracaecum gypsophocae*: 1. head, 2. male tail. Fig. 3–4. *Contracaecum ogmorhini*: 3. head, 4. male tail. Fig. 5. *Phocascaris hydrurgae*: anterior end. Fig. 6–10. *Crassicauda grampicola*: 6. male tail ventral view, 7. male tail sublateral view, 8–10. posterior ends of females. Fig. 1, 6 and 7 to same scale; 8, 9, 10 to same scale. a, anus; c, cloaca; cp, cervical papilla; v, vulva.

Females 45–65 mm. long, 1·5–2 mm. wide; young adults, 35 mm. long, 1 mm. wide; immature worms 25 mm. Male (one specimen) 30 mm. long, 1 mm. wide. Lips short, wide, without marked lateral expansions; in female 45 mm. long, lips 0·5 mm. wide, 0·2 mm. long. Interlabia about two-thirds length of lips, with truncated extremity. Collar region about as wide as head, narrower than succeeding part of body. Oesophagus one-seventh to one-ninth body length; appendix about one-sixth oesophageal length; intestinal caecum nearly reaching collar region. Nerve ring at about level of anterior end of caecum.

Male: Tail conical, 0·25 mm. long. Papillae six pair postanal arranged as in fig. 2, 12–14 pair preanal in single row on either side of body. Only one spicule seen, narrow, with wide alae, tip broken off, remainder 12·1 mm. long.

Female: Vulva at end of anterior third of body. Tail short, conical. Eggs 40 by 65μ, smooth-shelled.

The species differs from others of the genus described from mammals in the arrangement of the caudal papillae and in the great length of the spicule. Type male and female in Tasmanian Museum, Hobart; paratypes in that Museum and in the South Australian Museum.

CONTRACAECUM OSCULATUM (Rud.) Baylis.

The species has already been recorded by one of us (Johnston, 1937a) from the South Australian hair seal, *Neophoca cinerea*, incorrectly indicated as *Arctocephalus forsteri*, which is a New Zealand species.

CONTRACAECUM OGMORHINI sp.nov.

Fig. 3–4.

From *Hydrurga leptonyx*, Port Adelaide, October, 1940.

Males up to 18 mm. long; females to 30 mm. Each lip with anterior lateral projection, dorsal lip with two, and laterals each with one large and one small papillae. Interlabia nearly as long as lips. Oesophagus $\frac{1}{7}$–$\frac{1}{10}$ body length. Oesophageal appendix $\frac{1}{2\cdot8}$–$\frac{1}{3\cdot9}$, intestinal caecum $\frac{1}{1\cdot3}$–$\frac{1}{1\cdot5}$, oesophageal length. Nerve ring about half, and cervical papillae three-quarters distance between head and anterior end of intestinal caecum. Male tail 0·2 mm. long, pointed; seven pair postanal papillae, arranged as in fig. 4; young males with twenty-three pair preanal papillae, older with about forty pair, the additional ones being much smaller. Preanal papillae always arranged in straight row on either side, the first ten on each side being closer together than the succeeding ones. Spicules equal, about one-third body length.

Female tail short, conical, 0·24 mm. long. Vulva two-fifths body length from head. Eggs about 39μ by 40μ. The species is distinguished from *C. gypsophocae* by the lengths of interlabia, of oesophageal appendix, and of intestinal caecum, and by position of nerve ring, and number of preanal papillae in male. In the relative lengths of oesophageal parts it resembles *C. osculatum*, but differs in position of cervical papillae and size of eggs, as well as in the number of postanal and regular arrangement of preanal papillae in male.

The specific name is based on a synonymic name for the host genus.

PHOCASCARIS HYDRURGAE sp.nov.

Fig. 5.

Immature forms from a leopard seal, *Hydrurga leptonyx* Blainville, which came ashore from the Port River, Port Adelaide, in 1939. Worms about 6 mm. long, 0·35 mm. wide. Head without interlabia; dorsal lip with two papillae, ventrals each with one; dentigerous ridges absent. Oesophagus 1·2 mm. long, with appendix 0·6 mm. long; intestinal caecum 0·75 mm. long. Nerve ring at 0·32 mm., and small rounded cervical papillae at 0·37 mm. from head end. Tail conical, 0·15 mm. long.

In spite of the absence of teeth, as figured and described for *Phocascaris* by Höst, we have assigned our species to that genus, the absence of interlabia, combined with the presence of an oesophageal appendix and an intestinal caecum, precluding its entry into any other. The ratios of the parts of the alimentary canal and the position of the cervical papillae differentiate it from *P. phocae* Höst. Type and paratypes in the South Australian Museum.

DUJARDINIA HALICORIS (Owen) Baylis.

This large species was taken from an Australian dugong, *Dugong australis* Owen, from Yarrabah, near Cairns, North Queensland (Austr. Museum, Reg. No. W2543).

ANISAKIS SIMILIS (Baird) Baylis.

Numerous immature females from *Hydrurga leptonyx*, from the Port River, Port Adelaide, in 1937 are assigned to this species. The shape of the lips, length of oesophagus and ventriculus, and position of the vulva agree with Baylis' description (1916, 370). The species had previously been recorded by one of us (Johnston 1937, 18) from a leopard seal from Macquarie Island.

ANISAKIS sp.

An immature female Anisakid worm was found in company with a number of *Contracaecum* from *Gypsophoca tasmanica*, Franklin Island, Derwent Heads, Tasmania (Tasmanian Biological Survey). Length 42 mm., width 0·9 mm. Head 0·23 mm. wide, 0·09 mm. long; ventral lips each with one papilla, dorsal lip with two. Posterior limit of oesophagus not clear, but cannot be more than 5 mm. from head end. Cervical papillae large, slightly asymmetrically placed, 0·62 and 0·55 mm. from anterior end. Tail end rounded. The head resembles that of *A. similis* (Baird), but we consider it preferable to identify the worm as *Anisakis* sp.

ANISAKIS SIMPLEX (Rud.) Baylis.

Krefft's specimen of *Ascaris* sp. (1871, 212) from *Delphinus forsteri* L. from Sydney Harbour (Austr. Museum, Reg. No. G11105) has been re-examined. It is a male *Anisakis simplex*. According to Iredale and Troughton (1934, 65), *D. forsteri* is a synonym of *D. delphis*.

HALOCERCUS LAGENORHYNCHI Baylis and Daubney.

Specimens agreeing with the description given by Baylis and Daubney (1925) were obtained from the lung of a short-nosed dolphin, collected by Dr. J. B. Cleland at Encounter Bay, S.A. According to Wood Jones (Handbooks South Austr. Fauna, Mammals, Part 3) the cetacean is *Tursiops truncatus* Montagu, but Iredale and Troughton (1934, 68) consider the southern Australian animal to be distinct from the European and have named it *T. maugeanus*.

ECHINOCEPHALUS UNCINATUS Molin.

A single immature worm was taken from the intestine of *Delphinus delphis* from St. Vincent Gulf. It agrees closely with Baylis and Lane's account (1920, 275) of larval forms from *Pinna* and *Myliobatis*. The presence of this parasite in a dolphin suggests that it was ingested along with its normal elasmobranch host. The worm is in a good state of preservation, though other nematodes taken along with it were in such an unsatisfactory condition as to be worthless for study.

CRASSICAUDA GRAMPICOLA sp.nov.

Fig. 6–10.

From the pterygoid fossa of a grampus stranded at Manly, N.S.W. (Austr. Museum, Reg. No. W2631). The label indicates the name of the host as *Grampus griseus*, but Iredale and Troughton (Rec. Austr. Mus., 19, 1933, 32) subsequently described the specimen as *Grampidelphis exilis* I. and T.

Several headless males and females; longest pieces 10 cm. in length; males 0·9 mm. wide; females 1·5 mm. wide.

Male: Posterior end without caudal alae or inrolling of lateral regions; no spicules present; small circular cloaca 0·7–0·8 mm. from bluntly rounded posterior end; 13 papillae on one side, 12 on the other, arrangement asymmetrical and inconstant, generally a group of three or four on each side just in front of cloaca, the remaining papillae extending in a more or less straight line on each side toward posterior end of body.

Female: Tail varying in form, possibly with age; some elongate, some nearly as broad as long; all ending in short conical tip with anus at its base (fig. 6–8). Vulva in constriction around posterior end, as in other species of the genus; vagina very short; eggs oval, 29 by 40μ. In one, apparently young, female there was very little constriction of the body at the level of the vulva.

Owing to the absence of head ends, the variation in the shape of the posterior end of females, and the fact that males have not been described for many species, we are unable to compare adequately our form with all those already named. *C. grampicola* is the first *Crassicauda* to be recorded from a grampus, and appears to be smaller than any described. The shape of the male tail and the position of the anus in the female indicate that we are dealing with a new species. Types in the Australian Museum, Sydney; paratypes in the Australian and South Australian Museums.

LITERATURE.

Baylis, H. A. (1937): *Parasitol.*, xxix, pp. 121–130.

Baylis, H. A. and Daubney, R. (1925): *Parasitol.*, xvii, pp. 201–216.

Baylis, H. A. and Lane, C. (1920): *Proc. Zool. Soc. London*, pp. 245–310.

Höst, P. (1932): *Zbl. Bakt. Jena Orig.*, cxxv, pp. 335–340.

Iredale, T. and Troughton, E. (1934): *Mem. Aust. Mus.*, vi, pp. 1–122.

Johnston, T. H. (1937): *Rep. Aust. Antarc. Exped.*, C, x (5), pp. 1–31.

Johnston, T. H. (1937a): *Proc. Linn. Soc., N.S. Wales*, lxii, pp. 9–16.

Johnston, T. H. and Mawson, P. M. (1939): *Rec. S. Aust. Mus.*, vi, pp. 263–274.

Krefft, G. (1871): *Trans. Ent. Soc., N.S. Wales*, ii, pp. 2–6–232.

THE CORRELATION OF RECENT AND FOSSIL CREPIPODA (MOLLUSCA) OF THE AUSTRALIAN SUB-REGION

By Bernard C. Cotton, Conchologist, South Australian Museum, and Benjamin J. Weeding

Summary

Study of the Molluscan Fauna of the Australian seas has received considerable attention during the past half-century, and useful work has been done in this field. Naturally this has entailed considerable reclassification of the living Mollusca, and many alterations and additions have been made to the nomenclature.

With Australian Fossil Mollusca little has been done, consequently the nomenclature of this branch of the subject is in need of revision. There is a confusing diversity between the classification and nomenclature of the Fossil and the Recent species which can only be adjusted by extensive correlations. This work has been commenced, and some advance has been made in several groups: Pectinidae, Gatliff and Singleton (1930) ; Harpidae, Cotton and Woods (1933) ; Viviparidae, Cotton (1935) ; Turritellidae, Cotton and Woods (1935) ; and the Dentaliidae, Cotton and Ludbrook (1938). Much remains to be done. Since this paper was set up some fossiliferous material from a bore at Salisbury, near Adelaide, 331 feet, Lower Pliocene, has been examined, and it may prove even richer in chitons than the Victorian exposure.

The CORRELATION of RECENT and FOSSIL CREPIPODA (Mollusca) of the AUSTRALIAN SUB-REGION

By BERNARD C. COTTON, Conchologist, South Australian Museum, and
BENJAMIN J. WEEDING.

INTRODUCTION.

Study of the Molluscan Fauna of the Australian seas has received considerable attention during the past half-century, and useful work has been done in this field. Naturally this has entailed considerable reclassification of the living Mollusca, and many alterations and additions have been made to the nomenclature.

With Australian Fossil Mollusca little has been done, consequently the nomenclature of this branch of the subject is in need of revision. There is a confusing diversity between the classification and nomenclature of the Fossil and the Recent species which can only be adjusted by extensive correlations. This work has been commenced, and some advance has been made in several groups: Pectinidae, Gatliff and Singleton (1930); Harpidae, Cotton and Woods (1933); Viviparidae, Cotton (1935); Turritellidae, Cotton and Woods (1935); and the Dentaliidae, Cotton and Ludbrook (1938). Much remains to be done. Since this paper was set up some fossiliferous material from a bore at Salisbury, near Adelaide, 331 feet, Lower Pliocene, has been examined, and it may prove even richer in chitons than the Victorian exposure.

A SURVEY OF RECENT AUSTRALIAN CREPIPODA.

The name Crepipoda Goldfuss 1820 is here used for the Order of Mollusca commonly known as Chitons. For many years the Ordinal name Polyplacophora Gray 1821 was used for this group for reasons of priority, but later workers have introduced a name Loricata Schumacher 1817 on the same grounds. However, the name Loricataus was used by Desmarest in 1804 for a group of mammals, and this renders it undesirable for use in the Mollusca. Also the name Loricata has been used in the classification of reptiles, crustaceans and rotifers.

It has been asserted that the international rules regarding priority do not apply to Ordinal names, but we can see no hope of finality or stability in our nomenclature unless this principle be accepted. On these grounds we have accepted the name introduced by Goldfuss in 1820, since it appears to be the first legitimate term available.

Also we are using the word "chiton" as a general name. Strictly speaking it should be retained for a West Indian genus, but we believe it to be too firmly fixed in our vocabulary to be easily dropped.

A large percentage of the world's chitons are found around the Australian coasts. All four Orders are represented, and these include ten Families with forty-three genera and the one hundred and ninety-five species which have been recognized to date. These are classified as follows:

Order EOPLACOPHORA.

This Order is characterized by the absence of insertion plates and the small, weak sutural laminae. It is represented by one Family in this sub-region.

Lepidopleuridae, with two genera; *Terenochiton* (eight species); *Parachiton* (nine species).

Order MESOPLACOPHORA.

This Order has well developed but small and smooth insertion plates and sutural laminae. Two Families are found here.

Ischnochitonidae with five genera; *Subterenochiton* (two species); *Ischnochiton* (thirty-eight species); *Stenochiton* (four species); *Ischnoradsia* (four species); *Anisoradsia* (one species). Callistochitonidae with four genera; *Callistalasma* (eight species); *Callistassecla* (one species); *Solivaga* (one species); *Lophochiton* (two species).

Order ISOPLACOPHORA.

The distinguishing features of this Order are the large sutural laminae and insertion plates and non-scaly girdle. There are four Families in this sub-region.

Cryptochitonidae with seven genera; *Craspedochiton* (two species); *Craspedoplax* (three species); *Meturoplax* (one species); *Acanthochiton* (twenty-two species); *Notoplax* (eleven species); *Bassethullia* (two species); *Crocochiton* (two species).

Cryptoplacidae has one genus; *Cryptoplax* (eleven species).

Choriplacidae has one genus; *Choriplax* (two species).

Plaxiphoridae has three genera; *Acrilamma* (one species); *Poneroplax* (four species); *Kopionella* (two species).

Order TELEOPLACOPHORA.

This Order contains all the most highly developed forms, characterized by grooved and pectinated insertion plates. It has three Families in these waters.

Aulacochitonidae(1) with two genera; *Aulacochiton* (three species); *Loricella* (two species).

Callochitonidae with three genera; *Eudoxoplax* (one species; *Paricoplax* (two species); *Acutoplax* (five species).

Chitonidae with fourteen genera; *Delicatoplax* (one species); *Tegulaplax* (one species); *Anthochiton* (thirteen species); *Mucrosquama* (five species); *Amaurochiton* (one species); *Acanthozostera* (one species); *Acanthopleura* (one species); *Onithella* (two species); *Onithochiton* (two species); *Lucilina* (six species); *Schizochiton* (one species); *Sypharochiton* (two species).

A SURVEY OF AUSTRALIAN FOSSIL CHITONS.

LOCALITIES.

Fossil chitons have been found in New South Wales, Victoria, Tasmania, and South Australia. The greatest number of specimens has been found in the world-famous Muddy Creek shell beds which are situated five miles west of Hamilton, Western Victoria. In this area the following localities should be noted:

1. Forsyth's Bank, situated on the Grange Burn, which is a small stream flowing westerly to the Wannon River. This horizon is recorded as Kalimnan and regarded as Pliocene.

2. MacDonald's Bank is on the Muddy Creek, a tributary of the Grange Burn, and is also recorded as Kalimnan.

3. Clifton Bank is also situated on the Muddy Creek, but the strata here are recorded as Balcombian and regarded as Miocene.

Other localities in Victoria are Balcombe Bay (Mornington) and Gellibrand River (near Williamstown). These localities are both on Port Phillip Bay and are regarded as Balcombian.

In Tasmania the Table Cape beds are situated between Table Cape and Wynyard in North-West Tasmania. The fossils from this locality are recorded as Janjukian.

From South Australia the following localities are recorded:

1. Torrensville Bore, 490 ft., at Torrensville.
2. Holden's Bore, 380 ft., at Woodville.
3. Gaza Bore, 80 ft., at Payneham.

These localities are near Adelaide, and are regarded as Pliocene.

(1) The name *Lorica* Broun 1848 was introduced for a genus of Crustacea so is not available for chitons. The name accepted is *Aulacocochiton* Shuttleworth 1853 Genotype, *Chiton volvox* Reeve 1847, Sydney, N.S. Wales.

As will be seen, all the fossil chitons are from the comparatively recent Tertiary Era, but in New South Wales the cast of a chiton has been taken from the Permo-Carboniferous of Bundanoon, Iredale and Hull (1926), and this record from the Palaeozoic Era is the only one from such an early period. The debatable *Cheloides calceoloides* Etheridge (1897) from the Upper Silurian of Derrengullen Creek, Yass, N.S. Wales is not regarded by us as a chiton valve.

CLASSIFICATION OF FOSSIL CHITONS.

In the classification of living chitons the general form of the animal, the gills, radula, girdle, as well as the size, shape, and sculpture of the shell and, in some cases, the station and habitat, all contribute to the identification of the species. It is obvious that with fossil specimens comprising often worn and broken fragments of valves, most of these features are absent, and identification depends wholly upon the shape and sculpture of the valves, from which even the insertion plates and sutural laminae may be missing. Sonsequently all classifications must be regarded to a great extent as artificial and tentative. Workers have compared fossil with living species, and by analogy placed them in the various families and genera. In some cases genera and sub-genera have been introduced by some workers to focus attention on some distinctive feature. This practice would not be justified in living forms, but in the absence of other features is condoned as a means of emphasizing differences and as an aid to a more accurate classification.

As might have been expected, owing to these difficulties, many of the specimens named have been valves, which more material has proved to belong to species already named by other workers. Of the seventy-five specimens named, sixty-five are here listed as distinct species, but this number may be reduced when more material is available. Several doubtful names have been retained until more specimens are discovered to prove or disprove their validity.

No primitive fossil chitons have been discovered in this sub-region. The material before us is as highly developed and in some cases as highly specialized as any living forms, but generally speaking the forms appear to be much smaller than similar material found in present-day shell sand around our coasts, a fact which appears to indicate warmer seas in the Tertiary.

The name *Lepidopleurus* is now reserved for a living European genus, and the small granulated forms formerly placed in this genus are here included in the genus *Terenochiton*. There are several generic names available for small granulose chitons without insertion plates, but *Terenochiton* is a genus found living around the coast of the region where these fossil ancestors are found. In the Family Lepidopleuridae several specimens could be removed with justification to the Family

Ischnochitonidae, but until specimens are found with insertion plates, we leave them where their authors placed them.

PLEISTOCENE.

The odd valves which occur in raised beaches and sub-fossil beds are all referable to living species in the material examined to date.

PLIOCENE.

The Order Eoplacophora is represented by one Family, Lepidopleuridae with two genera; *Terenochiton* (five species); *Belchiton* (one species).

The Order Mesoplacophora is represented by two Families, Ischnochitonidae with one genus; *Ischnochiton* (eight species); Callistochitonidae one genus; *Callistelasma* (three species).

The Order Isoplacophora is represented by two Families. Cryptoconchidae with five genera; *Afossochiton* (one species); *Telochiton* (one species); *Acanthochiton* (four species); *Lirachiton* (one species); *Eoplax* (one species).

Cryptoplacidae one genus; *Cryptoplax* (three species).

The Order Teleoplacophora is represented by three Families. Aulacochitonidae one genus; *Loricella* (two species). Callochitonidae one genus; *Paricoplax* (four species). Chitonidae one genus; *Anthochiton* (four species).

MIOCENE.

The Order Eoplacophora is represented by one Family. Lepidopleuridae one genus; *Terenochiton* (four species).

The Order *Mesoplacophora* represented by one Family, *Ischnochitonidae* one genus; *Ischnochiton* (two species).

The Order Isoplacophora represented by three Families. Cryptoconchidae four genera; *Protochiton* (one species); *Afossochiton* (two species); *Acanthochiton* (five species); *Telochiton* (two species). Cryptoplacidae one genus; *Cryptoplax* (one species). Plaxiphoridae one genus; *Poneroplax* (two species).

The Order Teleoplacophora is represented by four Families. Callochitonidae with one genus: *Ocellochiton* (one species). Aulacochitonidae four genera; *Protolorica* (one species); *Aulacochiton* (three species); *Pseudoloricella* (one species); *Loricella* (two species). Chitonidae three genera; *Anthochiton* (one species); *Oochiton* (one species); and *Lucenachiton* (one species).

REVIEW OF PLIOCENE SPECIES.

FAMILY LEPIDOPLEURIDAE.

Of the five species recorded from this horizon, *Terenochiton sincerus* Ashby and Cotton, *T. singus* Ashby and Cotton, *T. uxellus* Ashby and Cotton, and *T. babidus* Ashby and Cotton are minute fragments of valves with fine granulose sculpture similar to living species. The last-named has corrugated lateral areas similar to the recent *T. liratus* H. Adams and Angas. The fifth species, *T. sephus* Ashby and Cotton will probably prove to be an *Ischnochiton*.

The genus *Belchiton* was introduced to emphasize the distinctive sculpture of the shell. *Belchiton pulcherrimus* Ashby and Cotton has enough of the sutural laminae preserved to indicate the Family, and the holotype is better preserved than most of the specimens in this Family.

FAMILY ISCHNOCHITONIDAE.

The material in this Family is so poor that it is better to leave the species as originally identified until more specimens are available. If *Ischnochiton vinazus* Ashby and Cotton and *I. tisurus* Ashby and Cotton prove to be identical, the former name has priority. *I. cossyrus* Ashby and Cotton is a badly-eroded specimen which will be hard to identify again, and I. *durius* Ashby and Cotton is a minute juvenile valve probably of the same species. *I. neglectus* Ashby and Cotton is a fragment of a strongly granulose posterior valve. Ashby and Cotton (1936) described the minute posterior valve of a chiton from the Gaza Bore under the heading of *Ischnochiton* ?. The specimen soon crumbled away when exposed to the air, and we can only leave it where the authors placed it. *Ischnochiton varenae* Cotton and Godfrey (1940) is a posterior valve which was originally described and figured as *Ischnochiton tisurus* Ashby and Cotton (1939) and recorded as a hypotype of that species. It was re-described as *I. varenae* Cotton and Godfrey (1940) because the granules of the anti-mucronal area are finer and more evenly spaced than those of the pleural area of *I. tisurus*, and the post-mucronal shows none of the coarse crumpled sculpture of the lateral area of that species.

FAMILY CALLISTOCHITONIDAE.

In this Family the generic name *Callistelasma* is used as the specimens recorded are quite distinct from the South American genus *Callistochiton*. *Callistelasma inexpecta* Ashby and Cotton was recorded as *Callistochiton meridionalis* Ashby (1925, p. 187). It is closely allied to that recent Flindersian species. *Callis-*

telasma reticulata Ashby and Cotton has the network sculpture formed by straight ridges similar to *C. antiqua* Reeve, and *C. greedi* Ashby and Cotton has stronger sculpture and wider ribs.

FAMILY CRYPTOCONCHIDAE.

Several fossil generic terms have been introduced in this Family. *Afossochiton*, with unslit insertion plates, has one species in this horizon, *A. sulci* Ashby and Cotton with fine irregularly granulose sculpture, *Telochiton* with ray ribs or folds extending across the articulamentum, *T. magnicostatus* Ashby and Cotton has coarse, elongated oval, separated pustules. The most interesting form is *Lirachiton inexpectus* Ashby and Cotton, *Lirachiton* appears to be the fossil equivalent of the living genus *Bassethullia* where the granulose sculpture becomes linear as the shell develops. In the specimen described the insertion plates are well developed, but slits are not visible. *Molachiton naxus* Ashby and Cotton appears to be a part of the median valve of the same species, and is here regarded as a synonym. The genus *Eoplax* must be regarded as the fossil equivalent to the living *Notoplax* s.s. *Eoplax adelaidae* Ashby and Cotton 1936 is obviously closely allied to the rare *Notoplax speciosa* H. Adams.

The four species of the genus *Acanthochiton* are all interesting. They have evidently been placed in this genus provisionally as there are no insertion plates or sutural laminae to denote their generic position. However, the sculpture is very distinctive, and further specimens should be readily recognizable. *A. drunus* Ashby and Cotton has long overlapping pustules similar to *A. lachrymosus* May and Torr. *A. forsythensis* Ashby and Cotton has triangular pustules, while *A. trianguloides* Ashby and Cotton has smaller and more crowded triangular pustules. *A. singletoni* Cotton and Godfrey has irregular elongated pointed pustules. This last specimen was erroneously figured by Ashby and Cotton (1939, pl. xx, fig. 22) as the holotype of *Afossochiton cudmorei* Ashby. *Afossochiton cudmorei* Ashby 1925 is a Miocene fossil, and the holotype is in the National Museum, Melbourne.

FAMILY CRYPTOPLACIDAE.

The genus *Cryptoplax* has four species. *Cryptoplax pritchardi* Hall (1905) was described from valves too worn to show sculpture, and their identity as chiton valves was doubted. Recently many hundreds of these eroded valves have been discovered, and from this material Ashby and Cotton (1939) have selected and illustrated a plesiotype which can now be accepted as this species. Two other species have been named from the same locality, and we have left the names separate. *Cryptoplax numicus* Ashby and Cotton is probably a juvenile of *C. prit-*

chardi, but *C. sicus* Ashby and Cotton is in good condition and appears to be distinct. *C. ludbrookae* Ashby 1940 is a well preserved anterior valve from Holden's Bore, South Australia; it is sculptured with irregular granules.

FAMILY AULACHOCHITONIDAE.

In this Family the only genus recorded is *Loricella,* and three species have been separated, two of which are accepted. *Loricella magnopustulosa* Ashby and Cotton is very small for the genus, but appears to be distinctive. *Loricella concava* Ashby and Cotton is a minute juvenile specimen with too few characteristics to be easily recognized again. The name *Loricella paucipustulosa* Ashby and Torr is reserved for the Miocene species, and the two specimens recorded as such from MacDonalds, Muddy Creek, are tiny undeveloped eroded specimens that can only be left with *L. magnopustulosa.*

FAMILY CALLOCHITONIDAE.

One specimen in this Family has been recorded as *Callochiton macdonaldi* Ashby and Cotton. It looks like a badly-eroded juvenile valve of *Paricoplax crocina* Reeve. We record it in that genus.

FAMILY CHITONIDAE.

In this Family the genus *Anthochiton* is represented by three species from Victoria and one from South Australia. Of the first three, *Anthochiton macdonaldensis* Ashby and Cotton, *A. duodeni* Ashby and Cotton, and *A. octocostatus* Ashby and Cotton are regarded as distinct; if further material proves them to be identical the first name has priority. As the authors indicated, *Anthochiton relatus* Ashby and Cotton is very closely related to *A. tricostalis* Pilsbry.

LIST OF PLIOCENE SPECIES.

Order EOPLACOPHORA.

FAMILY LEPIDOPLEURIDAE.

Terenochiton Iredale 1914 (*subtropicalis* Iredale).
- *sincerus* Ashby and Cotton 1939, Forsyths, Victoria.
- *singus* Ashby and Cotton 1939, MacDonalds, Victoria.
- *uxellus* Ashby and Cotton 1939, Forsyths, Victoria.
- *babidus* Ashby and Cotton 1939, MacDonalds, Victoria.
- *sephus* Ashby and Cotton 1939, Forsyths, Victoria.

Belchiton Ashby and Cotton 1939 (*pulcherrimus* Ashby and Cotton).
pulcherrimus Ashby and Cotton 1939, MacDonalds, Victoria.

Order MESOPLACOPHORA.

FAMILY ISCHNOCHITONIDAE.

Ischnochiton Gray 1847 (*textilis* Gray).
vinazus Ashby and Cotton 1939, MacDonalds, Victoria.
tisurus Ashby and Cotton 1939, MacDonalds, Victoria.
cossyrus Ashby and Cotton 1939, MacDonalds, Victoria.
durius Ashby and Cotton 1939, MacDonalds, Victoria.
neglectus Ashby and Cotton 1939, Forsyths, Victoria.
numantius Ashby and Cotton 1939, Forsyths, Victoria.
varenae Cotton and Godfrey 1940, MacDonalds, Victoria.
sp. indet. Ashby and Cotton 1939, Gaza Bore, South Australia.

FAMILY CALLISTOCHITONIDAE.

Callistelasma Iredale and Hull 1925 (*antiqua* Reeve).
inexpecta Ashby and Cotton 1939, MacDonalds, Victoria.
reticulata Ashby and Cotton 1939, Victoria.
greedi Ashby and Cotton 1939, Forsyths, Victoria.

Order ISOPLACOPHORA.

FAMILY CRYPTOCONCHIDAE.

Afossochiton Ashby 1925 (*cudmorei* Ashby).
sulci Ashby and Cotton 1939, MacDonalds, Victoria.
Telochiton Ashby and Cotton 1939 (*dendus* Ashby and Cotton).
magnicostatus Ashby and Cotton 1939, MacDonalds, Victoria.
Acanthochiton Gray 1821 (*fascicularis* Linn).
forsythensis Ashby and Cotton 1939, Forsyths, Victoria.
trianguloides Ashby and Cotton 1939, Forsyths, Victoria.
drunus Ashby and Cotton 1939, MacDonalds, Victoria.
singletoni Cotton and Godfrey 1940, MacDonalds, Victoria.
Lirachiton Ashby and Cotton 1939 (*inexpectus* Ashby and Cotton).
inexpectus Ashby and Cotton 1939, MacDonalds, Victoria.
Eoplax Ashby and Cotton 1939 (*adelaidae* Ashby and Cotton).
adelaidae Ashby and Cotton 1936, Torrensville, South Australia.

Family CRYPTOPLACIDAE.

Cryptoplax Blainville 1818 (*larvaeformis* Burrow).
 pritchardi Hall 1904, MacDonalds, Victoria.
 sicus Ashby and Cotton 1939, MacDonalds, Victoria.
 numicus Ashby and Cotton 1939, MacDonalds, Victoria.
 ludbrookae Ashby 1940, Holden's Bore, South Australia.

Order TELEOPLACOPHORA.

Family AULACOCHITONIDAE.

Loricella Pilsbry 1895 (*angasi* H. Adams).
 magnopustulosa Ashby and Cotton 1939, MacDonalds, Victoria.
 concava Ashby and Cotton, Macdonalds, Victoria.

Family CALLOCHITONIDAE.

Paricoplax Iredale and Hull 1929 (*crocina* Reeve).
 macdonaldi Ashby and Cotton 1939, MacDonalds, Victoria.

Family CHITONIDAE.

Anthochiton Thiele 1893 (*tulipa*).
 macdonaldensis Ashby and Cotton 1939, MacDonalds, Victoria.
 duodeni Ashby and Cotton 1939, MacDonalds, Victoria.
 octocostatus Ashby and Cotton 1939, MacDonalds, Victoria.
 relatus Ashby and Cotton 1936, Torrensville, South Australia.

REVIEW OF MIOCENE SPECIES.

Family LEPIDOPLEURIDAE.

Of the six names recorded in this Family, four have been placed in the genus *Terenochiton*. They are *T. magnogranifer* Ashby 1925, *T. babioides* Ashby and Cotton, and *T. diversigranosus* Ashby and Cotton. *T. relatus* Ashby and Cotton is also included, although it is probably an eroded fragment of the first. *Lepidopleurus nivarus* Ashby and Cotton has been removed to the *Ischnochitonidae*. *Lepidopleurus pamphilius* Ashby and Cotton is a fragment of *Protochiton granulosus* Ashby, and becomes a synonym of that species.

FAMILY ISCHNOCHITONIDAE.

This Family is very poorly represented, and only two species are here recorded. *Ischnochiton nivarus* Ashby and Cotton is added to this genus as the features seem too distinctively Ischnochitonoid to leave with the *Lepidopleuridae*. *Ischnochiton ashbyi* Cotton and Godfrey was described and figured by Ashby (1929) as *Ischnochiton* (*Heterozona*) *cariosus* Pilsbry. Although this Miocene fossil may possibly be allied to the living species the differences warrant the separation. *I. ashbyi* does not show the strong broken rays which are prominent features on the lateral areas of *I. cariosus*. The sub-granulose lirae of the pleural area of *I. cariosus* become zig-zag usually only at the jugum, but in *I. ashbyi* zig-zag lirae cross the whole of the pleural area and the raised lateral area as well.

FAMILY CRYPTOCONCHIDAE.

This Family is represented by four genera. *Protochiton granulosus* Ashby and Torr has been well described and figured several times. *Afossochiton cudmorei* Ashby has triangular pustules, and *Acanthochiton casus* Ashby and Cotton is a very small juvenile with similar sculpture, so may prove to be a juvenile of that species. *Afossochiton rostratus* Ashby and Torr should be easily recognized by the few irregularly-shaped pustules. *Telochiton dendus* Ashby and Cotton with fine granules, and *T. iscus* Ashby and Cotton with coarse granules both show the characteristic ribbing of the genus. Neither *Acanthochiton sabratus* Ashby and Cotton with semi-circular granules, nor *Acanthochiton pilsbryoides* Ashby and Cotton with ovately-pointed granules, have insertion plates, so the correct generic position cannot at present be ascertained, but *Acanthochiton balcombiensis* Ashby 1939 with elliptical flat-topped pustules is a well-preserved and typical *Acanthochiton* valve.

FAMILY CRYPTOPLACIDAE.

In this Family the name *Cryptoplax gatliffi* Hall has been left on the list. It has been recorded as a synonym of *Cryptoplax pritchardi* Hall, a Pliocene fossil. The species was founded on a valve from which all distinguishing tegmentum had been eroded; further research in the locality may produce material with sufficient sculpture to justify its separation.

FAMILY PLAXIPHORIDAE.

In this Family two species have been described which are here placed in the genus *Poneroplax*. *Poneroplax gellibrandi* Ashby and Torr differs from the living

P. costata Blainville chiefly in the colour, the tegmentum is black, and the articulamentum white. *P. concentrica* Ashby and Torr is a small eroded specimen with pale buff tegmentum and white articulamentum.

FAMILY CALLOCHITONIDAE.

This Family is represented by one species which has been described as *Callochiton (Ocellochiton) sulci* Ashby 1939. This tiny, fragile species is beautifully preserved and, curiously enough, appears to be closely allied to *Callochiton (Isoplax) septemcostatus* Bergenhayn 1914, a very small species dredged off the shores of Japan. The genus *Ocellochiton* is here used as the fossil equivalent to the living genus *Icoplax* Thiele.

The specimens recorded as *Lorica oculea* Ashby and Cotton and *Lorica ravena* Ashby and Cotton are both worn median valves of this species, and become synonyms.

FAMILY AULACOCHITONIDAE.

All but one of the described species of this Family have been found in the Table Cape beds of Tasmania. Four genera have been used. *Pseudoloricella*, introduced for species with continuous sutural laminae, has one species, *P. sculpta* Ashby. It will be easily recognized by the distinctive sculpture. The genus *Loricella* has two species, *Loricella paucipustulosa* Ashby and Torr with *L. atkinsoni* Hull, *L. magnifica* Hull and *L. octoradiata* Hull as synonyms. The other species is the large *L. gigantae* Ashby and Torr. *Protolorica* was introduced for the specimen of a posterior valve which in general appearance is similar to an *Aulacochiton* valve but without the anal sinus and not recurved. *Protolorica atkinsoni* Ashby is the only species, and its relationship to *Aulacochiton cudmorei* Ashby has not yet been determined, but the two forms are probably identical. *Aulacochiton compressus* Ashby and Torr with *A. affinis* Ashby and Torr and *A. duniana* Hull as synonyms is very closely allied to the living *Aulacochiton cimolius* Reeve, which it found along the whole coast-line of the Flindersian Province. So also is *Aulacochiton erma* Cotton and Godfrey, the only representative of this Family from the Muddy Creek beds. It is very similar to the Tasmania fossils, but until more specimens are found to prove or disprove them to be identical it is advisable to leave them separate.

FAMILY CHITONIDAE.

Three genera are included in this Family. *Anthochiton* is represented by one species, *A. fossicus* Ashby and Torr, a badly-worn but recognizable median valve. *Oochiton* is also represented by only one species, *Oochiton halli* Ashby. This distinctive species is provisionally placed in the Family. In general appearance it is very unlike any living species found around our coasts. This remark also applies to the genus *Lavenachiton* which was introduced for the unique species *L. cliftonensis* Ashby and Cotton. The median valve of this species has been recorded as *Ischnochiton* (*Radsiella*) *cliftonensis* by Ashby and Cotton (1939, p. 231). The more recent discovery of a posterior valve with identical sculpture but triangular in shape and with terminal mucro, definitely separated it from the Ischnochitonidae, and a new genus *Lavenachiton* was introduced for it by Cotton and Godfrey (1940, p. 569). The genus is placed in the *Chitonidae* provisionally; it is unlike any living form with which we are familiar. As may be expected, in the Australian fossil beds, as in every Region in the world where fossil chitons are found, forms are discovered which are certainly not congeneric with, and which appear to have no phylogenetic relationship with, any living species. They are either representatives of groups which have become extinct or the species which would form the connecting link have not yet been discovered. This is another reason why at present the classification of our fossil chitons must to some extent be regarded as artificial.

LIST OF MIOCENE SPECIES.

Order EOPLACOPHORA.

FAMILY LEPIDOPLEURIDAE.

Terenochiton Iredale 1914 (*subtropicalis* Iredale).
- *magnogranifer* Ashby 1925, Cliftons, Victoria.
- *badioides* Ashby and Cotton 1939, Cliftons, Victoria.
- *diversigranosus* Ashby and Cotton 1939, Cliftons, Victoria.
- *relatus* Ashby and Cotton 1939, Cliftons, Victoria.

Order MESOPLACOPHORA.

FAMILY ISCHNOCHITONIDAE.

Ischnochiton Gray 1847 (*textilis* Gray).
- *ashbyi* Cotton and Godfrey 1940, Balcombe Bay, Victoria.
- *nivarus* Ashby and Cotton 1939, Cliftons, Victoria.

Order ISOPLACOPHORA.

FAMILY CRYPTOCONCHIDAE.

Protochiton Ashby 1925 (*granulosus* Ashby and Torr).
granulosus Ashby and Torr 1901, Balcombe Bay, Victoria.
Afossochiton Ashby 1925 (*cudmorei* Ashby).
cudmorei Ashby 1925, Cliftons, Victoria.
rostratus Ashby and Torr 1901, Balcombe Bay, Victoria.
Telochiton Ashby and Cotton 1939 (*dendus* Ashby and Cotton).
dendus Ashby and Cotton 1939, Cliftons, Victoria.
Acanthochiton Gray 1821 (*fascicularis* Linn).
pilsbryoides Ashby and Cotton 1939, Cliftons, Victoria.
sabratus Ashby and Cotton 1939, Cliftons, Victoria.
casus Ashby and Cotton, 1939, Cliftons, Victoria.
chapmani Ashby 1925, Cliftons, Victoria.
balcombiensis Ashby 1939, Balcombe Bay, Victoria.

FAMILY CRYPTOPLACIDAE.

Cryptoplax Blainville 1818 (*larvaeformis* Burrow).
gatliffi Hall, Cliftons, Victoria.

FAMILY PLAXIPHORIDAE.

Poneroplax Iredale 1914 (*costata* Blainville).
gellibrandi Ashby and Torr 1901, Gellibrand, Victoria.
concentrica Ashby and Torr 1901, Gellibrand, Victoria.

Order TELEOPLACOPHORA.

FAMILY CALLOCHITONIDAE.

Ocellochiton Ashby 1939 (*sulci* Ashby).
sulci 1939, Cliftons, Victoria.

FAMILY AULACOCHITONIDAE.

Protolorica Ashby 1925 (*atkinsoni* Ashby).
atkinsoni Ashby 1925, Table Cape, Tasmania.

Aulacochiton Shuttleworth 1853 (*volvox* Reeve).

cudmorei Ashby 1925, Table Cape, Tasmania.

compressus Ashby and Torr 1901, Table Cape, Tasmania.

crma Cotton and Godfrey 1900, Cliftons, Victoria.

Pseudoloricella Ashby 1925 (*sculpta* Ashby).

sculpta Ashby 1921, Table Cape, Tasmania.

Loricella Pilsbry 1892 (*angasi* H. Adams).

paucipustulosa Ashby and Torr 1901, Table Cape, Tasmania.

gigantae Ashby and Torr 1901, Table Cape, Tasmania.

Family CHITONIDAE.

Anthochiton Thiele 1893 (*tulipa* Quoy and Gaimard).

fossicus Ashby and Torr 1901, Table Cape, Tasmania.

Oochiton Ashby 1934 (*halli* Ashby).

halli Ashby 1934, Cliftons, Victoria.

Lavenachiton Cotton and Godfrey 1940 (*cliftonensis* Ashby and Cotton).

cliftonensis Ashby and Cotton 1939, Cliftons, Victoria.

Other Strata.

PERMIAN.

Permochiton australianus Iredale and Hull 1926, Bundanoon, N.S. Wales.

REFERENCES CITED.

Ashby, E. (1921) : *Proc. Roy. Soc., Tasm.*, p. 38, pl. xv, fig. 1–2.

Ashby, E. (1925) : *Trans. Roy. Soc., Vict.*, xxxvi, n.s., pp. 17–205, pl. xviii–xxii.

Ashby, E. (1929) : *Trans. Roy. Soc., Vict.*, xli, n.s. pp. 220–230, pl. xxiv.

Ashby, E. (1939) : *Proc. Linn. Soc.*, pp. 186–189, pl. iii.

Ashby E. and Torr, W. G. (1901) : *Trans. Roy. Soc., S. Aust.*, xxv, pp. 136–144, pl. iv.

Ashby, E. and Cotton, B. C. (1936) : *Rec. S. Aust. Mus.*, v, pp. 509–512.

Ashby, E. and Cotton, B. C. (1939) : *Rec. S. Aust. Mus.*, vi, pp. 209–242, pl. xix–xxi.

Chapman, F. (1908) : *Trans. Roy. Soc., Vict.*, xx, n.s. p. 218, pl. xxii, fig. 5–7.

Cotton, B. C. (1935) : *Rec. S. Aust. Mus.*, v, p. 339.

Cotton, B. C. and Godfrey, F. K. (1940) : Molluscs S. Aust.

Cotton, B. C. and Ludbrook, N. (1938) : *Trans. Roy. Soc., S. Aust.*, xvii, pp. 217–228, pl. xii.

Cotton, B. C. and Woods, N. (1933) : *Rec. S. Aust. Mus.*, v, p. 43.

Cotton, B. C. and Woods, N. (1935) : *Rec. S. Aust. Mus.*, v, pp. 369–387.

Etheridge, R. (1897) : *Rec. Geol. Surv., N.S. Wales*, v, pp. 67–70, text-fig.

Gatliff, J. H. and Singleton, F. A. (1930) : *Trans. Roy. Soc., Vict.*, xlii, pp. 71–77, pl. ii–iv.

Hall, T. S. (1905) : *Trans. Roy. Soc., Vict.*, xvii, n.s., pp. 391–393, pl. xxx.

Hull, B. (1901) : *Proc. Linn. Soc., N.S. Wales*, xxxv, p. 654, pl. xvii, fig. 1–2.

Hull, B. (1915) : *Proc. Linn. Soc., N.S. Wales*, xxxix, pp. 855–857, pl. xciv, fig. 1–2.

Iredale, T. and Hull, B. (1926) : *Aust. Zool.*, iv, p. 141, pl. xiv.

STUDIES IN AUSTRALIAN ACARINA
(2) TYROGLYPHIDAE (s.l.)

BY H. WOMERSLEY, F.R.E.S., A.L.S., ENTOMOLOGIST,
SOUTH AUSTRALIAN MUSEUM

Summary

The mites with which this paper deals are small, and except when they force themselves on our notice by sheer weight of numbers, are little known in Australia; nevertheless, they are of much economic importance.
Most of the species are free-living as adults, feeding upon organic matter such as various foodstuffs, grain, flour, cheese, etc., as well as in galls, where they eat the dead or dying gall-makers. These have sometimes been classed as the "Detriticolae", the few remaining forms which are parasitic on insects being the "Insecticolae".

STUDIES IN AUSTRALIAN ACARINA

(2) TYROGLYPHIDAE (s.l.)

By H. WOMERSLEY, F.R.E.S., A.L.S., Entomologist, South Australian Museum.

Fig. 1–21.

The mites with which this paper deals are small, and except when they force themselves on our notice by sheer weight of numbers, are little known in Australia; nevertheless, they are of much economic importance.

Most of the species are free-living as adults, feeding upon organic matter such as various foodstuffs, grain, flour, cheese, etc., as well as in galls, where they eat the dead or dying gall-makers. These have sometimes been classed as the "Detriticolae", the few remaining forms which are parasitic on insects being the "Insecticolae".

Frequently certain species become serious pests of stored food materials, and, during the war of 1914–18, much work was done in England by Newstead and his associates on their effect upon flour and wheat. Other species attack cheese, and one may at times be a serious domestic nuisance in the upholstery of furniture.

During this present war period the necessity for again storing large quantities of wheat and other foodstuffs in Australia stresses the importance of the recognition of these mites, and this paper should assist in the determination of the species known to occur here. Most are cosmopolitan, and probably have been introduced by way of commerce; they are potential pests, and given suitable conditions may become of serious importance.

Apart from brief notes in Agricultural Journals, little has previously been recorded of their occurrence here. Rainbow, in his "Synopsis of the Australian Acarina" (Rec. Aust. Mus., vi, pt. 3, 1906), lists only the following: *Tyroglyphus queenslandiae* Canestrini 1885, *T. entomophagus* Laboul. 1862, *T. siro* L. 1758, *Pullea discoidalis* Canestr. 1885, *Aleurobius farinae* De Geer 1778, and *Glyciphagus domesticus* De Geer 1778; while Lea, 1908, in "Insect and Fungus Pests of Orchard and Farm" (Tasmania), records *Rhizoglyphus echinopus* F. and R. 1868.

The material studied here, apart from that collected by the author and that housed in the South Australian Museum collections, includes a considerable amount kindly forwarded to me by the different State Departments of Agriculture, by the

Division of Economic Entomology, C.S. and I.R., Canberra, and by the Waite Institute, Adelaide. To all of these I extend sincere thanks for their assistance.

Diagnosis: Mostly small, soft-skinned mites of oval to rounded form. Gnathosoma visible from above, sometimes hidden beneath a camerostome. Mandibles usually chelate, sometimes with a thin saw-like blade. Maxillary palpi 2–5-segmented. Frequently a suture line between propodosoma and hysterosoma. A pair of vertical setae at front of propodosoma. Eyes usually absent except in some deutonymphs. Rarely with tracheae, but never with stigmal openings. Legs short or long, sometimes with spines; tarsi with sessile or pedunculate caruncle and claw, I and II usually with a more or less clavate sensory rod, IV in male frequently with a pair of adhesive discs. Sexual dimosphism generally well-marked, males often with a pair of round discs on each side of anus; genital aperture in both sexes mostly with a pair of tubercles on each side.

Nymphal stage frequently of two forms—one a hypopus, deutonymph, or resting stage without mouth-parts and with a posterior ventral plate furnished with 2–8 suctorial discs; generally found upon insects or other Arthropods.

Not parasitic on feathers of birds or fur of animals.

Recent studies of the Acarina by Oudemans, Vitzthum and others has led to the old family *Tyroglyphidae* s.l. being subdivided into 21 families for the recognition of which the following key is given. Nine are so far known to be represented in Australia.

KEY TO FAMILIES OF TYROGLYPHIDAE s.l.

(Mainly after Oudemans).

1. Mandibles chelate, without the saw-like process .. .. .. 2.
   Mandibles saw-, knife-, or stylet-like. Form variable. With or without suture between propodosoma and hysterosoma. Maxillary palpi flattened with two flagella-like appendages. Legs I and II lateral. Ambulacra with sessile claw and small caruncle. Female genital aperture a transverse slit between propodo- and hysterosoma. With pores (or discs) in female laterally between coxae II and III and medially between coxae IV, in male forming a quadrangle between coxae III and IV. Legs III and IV in deutonymph directed forwards. ANOETIDAE Oud. 1904.

2. Ambulacra with so-called sessile claw and caruncle; latter often small; suture between propodo- and hysterosoma; with propodosomal shield; ♀ genital aperture between coxae II and IV, ♂ between coxae IV; discs near anus and on tarsi IV in male. Larvae with sternal chitinous rods ("Bruststiele") 3.
   Ambulacra in adults with caruncle only, in larvae and nymphs with minute claws on pedunculate caruncles; tarsi ending claw-like. Suture between propodo- and hysterosoma. Genital aperture in both sexes behind coxae IV; ♀ with anal discs but no suckers on tarsi IV. Body setae loose; cuticle smooth; tarsi without spines. Larvae ? .. .. NANACARIDAE Oud. 1923.
   Ambulacra with pedunculate caruncle and apical claw, often minute .. 8.

3. Longer body setae loose and whip-like; in young stages often stiff and rod-like .. .. 4.
Body hairs rather short, hairy setae; body elongate, constricted behind legs IV; cuticle smooth .. .. Genus: ACARIDINA van Beneden 1870.

4. No cervical setae, these replaced by eye-like organs on a level with trochanters I .. .. LENZIIDAE Oud. 1928.
Cervical setae present or absent .. .. 5.

5. Cervical setae dorsal, on level with trochanter I, minute, smooth or absent. Cuticle smooth .. .. 6.
Cervical setae marginal, before trochanter I, minute, smooth; tarsi ventrally and distally with minute spines. Cuticle granulate EBERTHIDAE Oud. 1927.
Cervical setae marginal, before trochanter I, long, hairy, directed forwards and curved inwards and downwards; cuticle smooth; tarsi ventrally (sometimes also dorsally) and distally with minute spines TYROPHAGIDAE Oud. 1924.

6. No strong stout setae before sensory club on tarsi I and II; legs with or without spines, if present, may be long but never stout and conical. .. .. 7.
A stout conical spine before sensory club on tarsi I and II; legs short and thick with robust spines .. .. .. RHIZOGLYPHIDAE Oud. 1922.

7. Posterior portion of propodosoma with a transverse row of four long and equal setae .. .. TYROGLYPHIDAE Donn. 1868.
Posterior portion of propodosoma with only 2 long lateral setae or, if 4, then median ones very short .. .. .. CALOGLYPHIDAE Oud. 1929.

8. Cuticle smooth, shape more or less *Tyroglyphus*-like; partly with, partly without suture between propodo- and hysterosoma. Propodosomal shield uncertain. Larvae without sternal rods .. .. CARPOGLYPHIDAE Oud. 1923.
Cuticle smooth but not shining, distinctly but variably punctate or granulate. Dorsal setae strongly ciliated, feathered or comb-like. Larvae with sternal rods .. .. GLYCIPHAGIDAE Berl. 1887.
Cuticle leathery or scaled. Dorsum flattened, plate-like, round oval, diamond-shaped, or quadrangular. No sensory rod on tarsi I and II. Parasitic on insects .. .. CANESTRINIIDAE Berl. 1884.
Cuticle smooth, comparatively strongly chitinized. Form oval to spindle-like. No suture between propodo- and hysterosoma. No propodosomal shield. Mouth-parts hidden under a production of the propodosoma (camerostome).
CHORTOGLYPHIDAE Berl. 1897.
Cuticle smooth. Tarsi I and II with a long flexible process like an accessory claw. Not *Tyroglyphus*-like. With or without suture between propodo- and hysterosoma. With propodosomal shield. Larvae without sternal rods. Amongst seaweeds and algae between tide marks LENTUNGULIDAE Berl. 1897.
Cuticle smooth. Form *Tyroglyphus*-like. With propodosomal shield and suture between propodosoma and hysterosoma .. .. .. 9.

9. Tarsi with (at least ?) 3 spoon-shaped or lanceolate setae; claws with ventral knob. Cervical setae marginal, minute, almost curved spines (adults unknown) .. .. OLAFSENIIDAE Oud. 1927.
Tarsi without such spoon-shaped or lanceolate setae .. .. .. 10.

10. No cervical setae; ♂ without suckers near anus or on tarsi IV .. .. 11.
Cervical setae dorsal, minute, smooth; with easily visible "pinch organs"; ♂ with suckers near anus and on tarsi IV PONTOPPIDANIIDAE Oud. 1925.

Cervical setae marginal, long, hairy, directed forwards and curved inwards and downwards .. .. 12.

11. Female genital aperture between coxae III and IV, male between coxae IV. ENSLINIELLIDAE Vitz. 1924.

Male and female genital apertures between coxae IV. WINTERSCHMIDTIIDAE Oud. 1924.

Female and male genital aperture behind coxae IV. CZENSPINSKIIDAE Oud. 1927.

12. Claws in larvae and nymphs single, in ♀ all legs, and legs I and II of ♂ Y-shaped; ♀ genital aperture between coxae III, heteromorphous ♂ between trochanters IV; ♂ with anal suckers and discs on tarsi IV. Larvae with sternal rods .. .. LARDOGLYPHIDAE Oud. 1927.

Claws single; ♀ genital apertures between coxae IV, ♂ between trochanters IV; no anal suckers or tarsal discs in ♂ .. SAPROGLYPHIDAE Oud. 1924.

In this paper 21 species are listed. Six of these are regarded as new, the remainder, with three exceptions, being cosmopolitan and probably introductions to Australia. Two previously described species are regarded as requiring rediscovery and study.

LIST OF SPECIES.

Tyroglyphus farinae (Linné 1758).
Thyreophagus entomophagus (Lab. 1852).
Thyreophagus corticalis (Michael 1885).
Caloglyphus berlesei (Michael 1903).
Caloglyphus mycophagus (Megnin 1874).
Rhizoglyphus echinopus (Fumouze and Robin 1868).
Rhizoglyphus termitum sp.nov.
Tyrophagus putrescentiae (Schrank 1781).
Saproglyphus cocciphagus sp.nov.
Carpoglyphus lactis (Linné 1763).
Calvolia glabra sp.nov.
Glycyphagus domesticus (De Geer 1778).
Glycyphagus cadaverum (Schrank 1781).
Ctenoglyphus plumiger (Koch 1835).
Sennertia queenslandica sp.nov.
Sennertia bifilis (Canestrini 1898).
Histiostoma feroniarum (Dufour 1839).
Histiostoma nichollsi sp.nov.
Anoetostoma oudemansi g. et sp.nov.
Incertae sedis:
Pullea discoidalis Canestrini 1898.
Tyroglyphus queenslandiae Canestrini 1898.

FAMILY TYROGLYPHIDAE Donnadieu (1868), Oudemans (1932).

Oudemans, 1932, restricts this family to the single genus *Tyroglyphus* Latreille, of which there appears to be only one (at least well known) species, *Tyroglyphus farinae*.

TYROGLYPHUS Latreille.

Acarus (*part*) Linnaeus: Syst. Nat. ed. x, 1758, p. 617.

Aleurobius Canestrini: Tiroglifidi 1888, p. 7; Berlese: A.M.S., fasc. lxxxv, No. 12, 1898; Kramer: Das Tierreich, Lfg. vii, 1899, p. 137; Michael: Brit. Tyroglyphidae, ii, 1903, p. 71; Rainbow: Rec. Aust. Mus., vi, 1906, p. 180; Newstead: Rept. Grain Pests (War) Committee, No. 8, Roy. Soc., 1920, p. 20.

Tyroglyphus Latreille: Precis Caract. Ins., 1796, p. 185; Vitzthum: Tierwelt Mitteleuropas, iii, 1929, p. 73; Oudemans: Ent. Bericht., viii, 1932, p. 356.

Propodo- and hysterosoma separated by a suture. Propodosoma with a posterior row of four long, subequal setae. Cervical setae (a pair of short setae on sides of propodosoma about in line with trochanters of leg I) present and ciliated. Tarsi I and II with sensory club. Long seta of segment II of legs arising beyond middle of segment. Genital aperture in both sexes with a pair of tubules on each side. Male with a pair of large anal discs, a pair of discs on tarsi IV, and with a strong spine-like apophysis on second segment of leg I. Apex of hysterosoma in both sexes with only a single pair of long setae.

Deutonymph with dorsal cuticle finely punctate; suctorial plate with 8 discs, median pair a little larger than rest, one on each side of vulva, none on coxae I and III.

TYROGLYPHUS FARINAE (Linnaeus).

(Meal or Flour Mite).

Acarus farinae Linnaeus: Syst. Nat., ed. x, 1758, p. 617.

Tyroglyphus farinae Gervais in Walckenaer, Ins. Apt., iii, 1844, p. 142; Berlese: A.M.S., fasc. xiv, No. 9, 1884; Vitzthum: Tierwelt Mitteleuropas, iii, 1929, p. 73.

Aleurobius farinae Canestrini: Tiroglifidi, 1888, p. 7; Kramer: Das Tierreich, Lfg. vii, 1899, p. 137; Michael: Brit. Tyroglyphidae, II, 1903, p. 71; Rainbow: Rec. Aust. Mus., vi (3), 1906, p. 180; Newstead: Rept. Grain Pests (War) Committee, No. 2, Roy. Soc., 1920, p. 20.

Length of adults, ♀ to 0·7 mm., width to 0·4 mm.; ♂ length to 0·55 mm., width to 0·35 mm.; of deutonymph, length 0·215 mm., width 0·17 mm. Body of both sexes ovate as figured. The dorsal and ventral views of female, ventral view of male, first leg of male, and fourth tarsus of male showing suctorial discs are figured and require no further description.

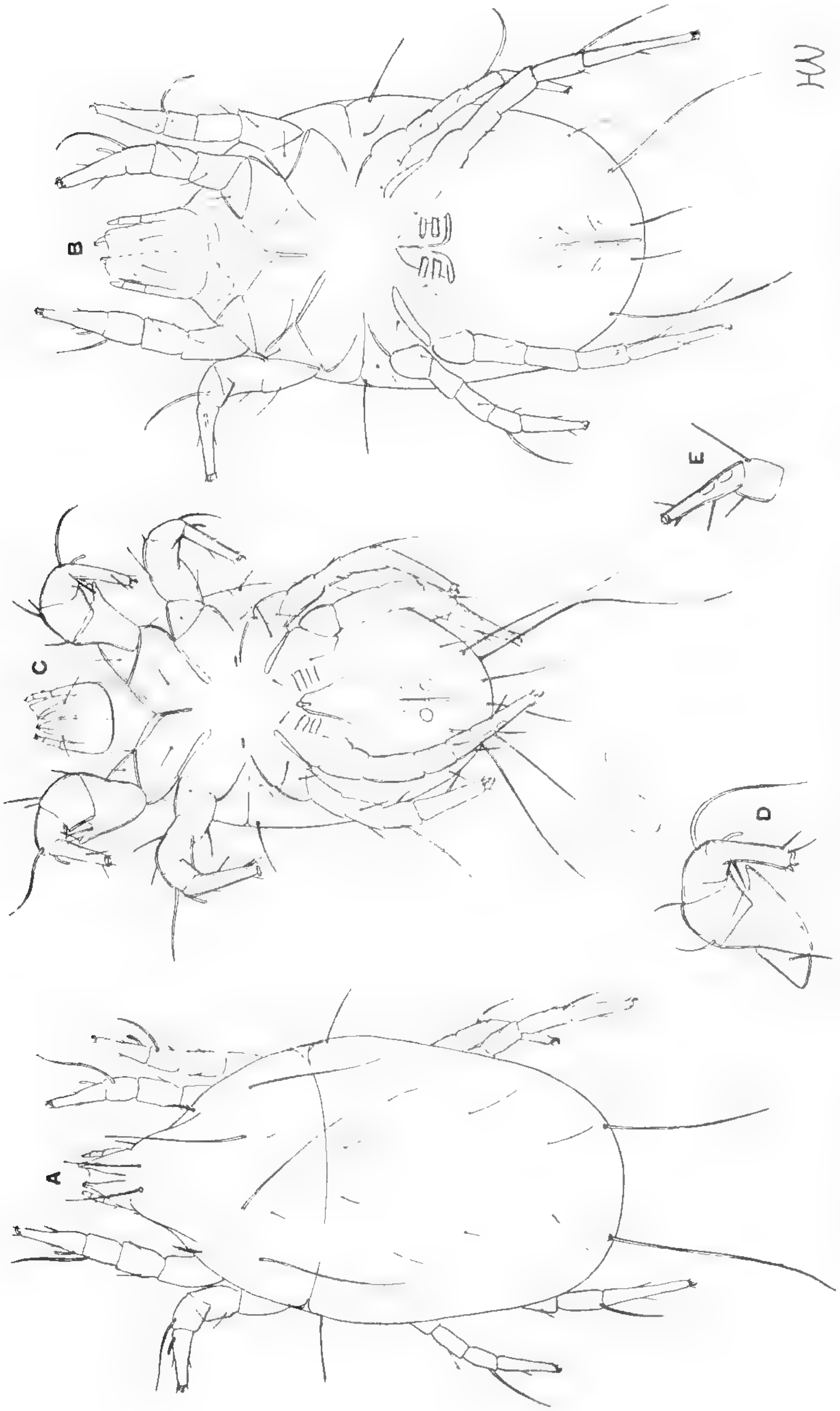


Fig. 1. *Tyroglyphus farinae* (L.) (adult). A, ♀ dorsal; B, same, ventral; C, ♂ ventral; D, leg 1 of ♂; E, tarsus 4 of ♂.

The deutonymph or "hypopus" is also figured from specimens taken in packing straw from England.

As the name of this species implies, it is a frequent pest in all kinds of stored farinaceous material, but it is also known to attack cheese and the pollen of beehives. The male is at once recognized by the first leg.

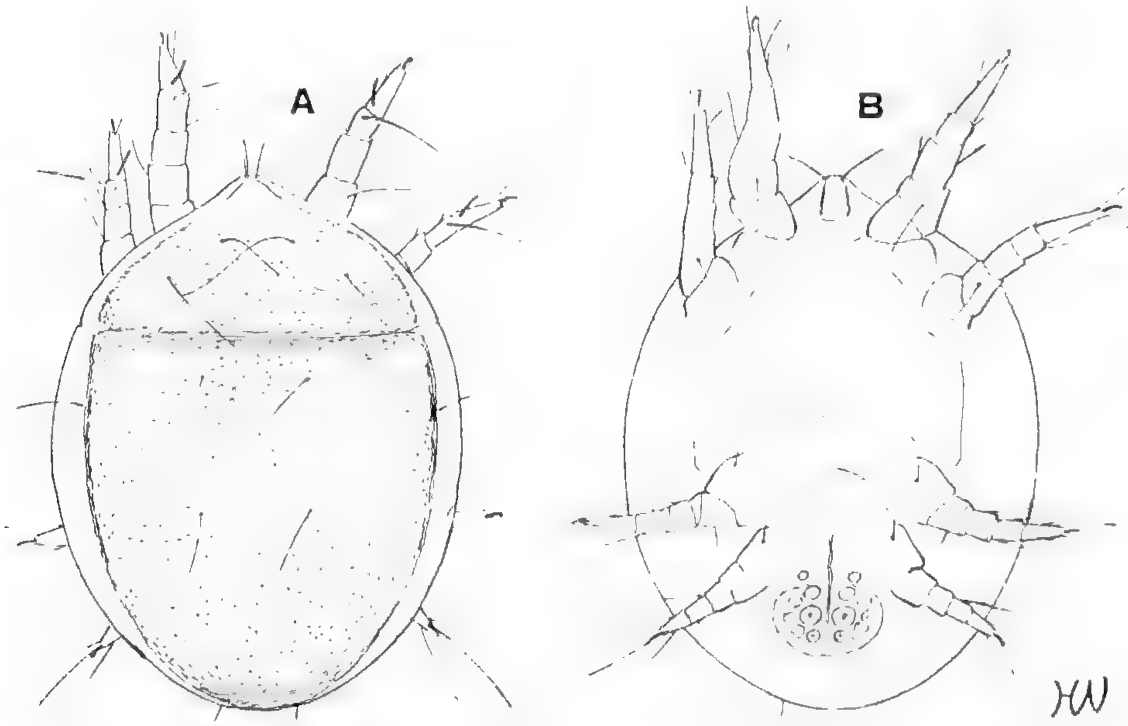


Fig 2. *Tyroglyphus farinae* (L.) (deutonymph): A, dorsal view; B, ventral view.

Loc. South Australia, Adelaide: Adults and deutonymphs from packing straw from England, May, 1934. Victoria, Burnley: On ground near mustard crop, July, 1934. (R.T.M.P.)

Rainbow (1906) only says "Australia (introduced)".

FAMILY CALOGLYPHIDAE Oudemans (1932).

Acarologische Aanteekeningen, cxii, Entom. Berichten, 1932, Dl. viii, p. 356.

This family was erected by Oudemans to include all the genera previously considered as in the Tyroglyphidae, with the exception of *Tyroglyphus* itself.

It is represented in Australia by the two genera *Thyreophagus* and *Caloglyphus*, each with two species, all of which are well-known in Europe and probably introduced into Australia.

THYREOPHAGUS Rondani.

Thyreophagus Rondani: Bull. Soc. ent. Ital., vi, 1874, p. 67.
Histiogaster Berlese: Riv. Acc. Padova, xxxiii, 1883, p. 45.
Monieziella Berlese; A.M.S., fasc. lxxxix, No. 9, 1897.

Genotype: *Tyroglyphus entomophagus* Lab. 1852.

Elongate to elongate-oval species with suture between propodo- and hysterosoma. Propodosoma with two posterior long setae only. Cervical setae? Both sexes with genital tubules; ♀ genital aperture between coxae III and IV, ♂ between coxae IV. Male with a posterior shield-like projection and a pair of discs near anus. Tarsi of legs I and II with sensory club; long seta of segment II of legs arising beyond middle; leg IV of ♂ without discs. Deutonymph, where known, with a pair of eye-like organs on a level with bases of trochanters I and placed laterally.

THYREOPHAGUS ENTOMOPHAGUS (Lab.).

Acarus entomophagus Laboulbene: Ann. Soc. ent. France, 1852; "Bull.", p. 54 (lit.).
Thyreophagus entomophagus Rondani: Bull. Soc. ent. France, v, 1874, p. 67.
Tyroglyphus entomophagus Laboulbene et Robin: Ann. Soc. ent. France, ser. 4, ii, 1868, pp. 317–338, pl. x; Rainbow: Rec. Aust. Mus., vi (3), 1906, p. 180.
Tyroglyphus malus Murray: Econ. Entom., Aptera, 1877, p. 275.
Monieziella entomophaga Berlese: A.M.S., fasc. lxxxix, No. 9, 1898.
Histiogaster entomophagus Kramer (part): Das Tierreich, Lfg. vii, 1899, p. 142.

This is a less elongate and more oval species than the following, and is at once distinguished therefrom. Beyond giving the present figures from Australian material, it is hardly necessary to describe it in detail, for this has been done very thoroughly by Michael (1903) and Newstead (1930).

Length of ♂ 0·4 mm., width 0·18 mm.; of ♀ 0·5 mm., and 0·21 mm. respectively. The deutonymph is devoid of a suctorial plate and discs, but is said to possess lateral eyes as in the next species. It is unknown to me.

This species is as important a pest of flour and other farinaceous material as the previous one, and causes similar damage. Both species are responsible for the characteristic odour of infected flour.

Rainbow (1906) merely states "Australia, introduced", but I have material from flour labelled "Sydney, N.S.W., July 6, 1934".

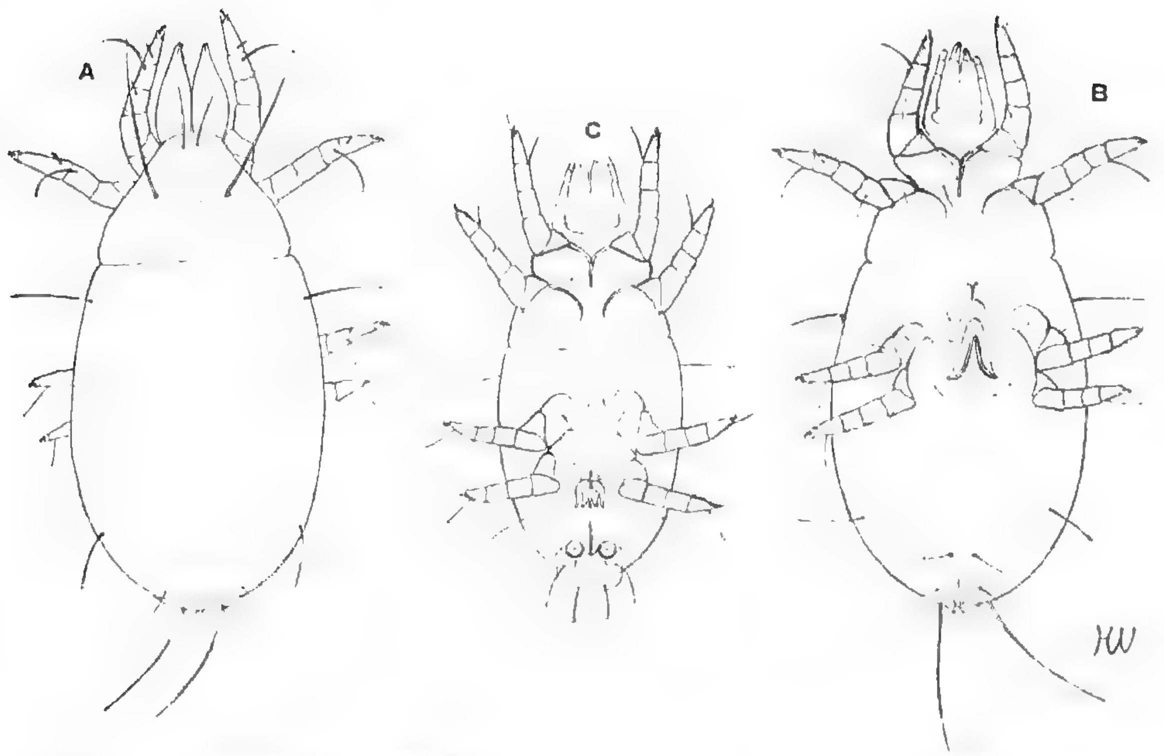


Fig. 3. *Thyreophagus entomophagus* (Lab.) (adult): A, ♀ dorsal; B, same, ventral; C, ♂ ventral.

THYREOPHAGUS CORTICALIS (Michael).

Tyroglyphus corticalis Michael: J. R. Microsc. Soc., ser. II, v, 1885, pp. 27–31, p. 885, pl. iii, figs. 1–14.

Histiogaster entomophagus Kramer (part): Das Tierreich, Lfg. vii, 1899, p. 142.

Histiogaster corticalis Berlese: A.M.S., fasc. lvii, No. 7, 1890; Michael: Brit. Tyroglyphidae, ii, 1903, p. 66; Vitzthum: Tierwelt Mitteleuropas, iii, 1929, p. 74.

Monieziella mali Berlese: A.M.S., Crypt, 1897, p. 107.

A much more elongate and parallel-sided species than the preceding, it is easily recognized. Vitzthum (*loc. cit.* 1929), because of the supposed absence of the vertical setae, which are not figured by Michael (1903) or Berlese (1889–91), questions the placing of this species in the above genus. In all the Australian material before me, however, these vertical setae are distinctly present as in figure 3A; otherwise my material agrees, and one can only assume that this pair of setae was overlooked.

The size of the specimens is: ♂ length to 0·35 mm., width to 0·1 mm.; ♀ 0·45 mm. and 0·12 mm. respectively. The cuticle is generally not so chitinized as in *entomophagus*. As to the detailed description, the figures are sufficient. The deutonymph possesses a pair of lateral eye-like organs on the level of trochanters I, and to facilitate its recognition I give figure 35 (after Michael).

Michael found this species feeding under the epidermis of *Arundo phragmites* in England, and Berlese found it on *Polyporus hirsutus* in Italy.

Loc. New South Wales: Castle Hill, 24th July, 1934, in frass on Cypress Pine; Sydney, 16th August, 1934, under bark of Mistletoe; Sydney, 16th May, 1939, on Camellia bud.

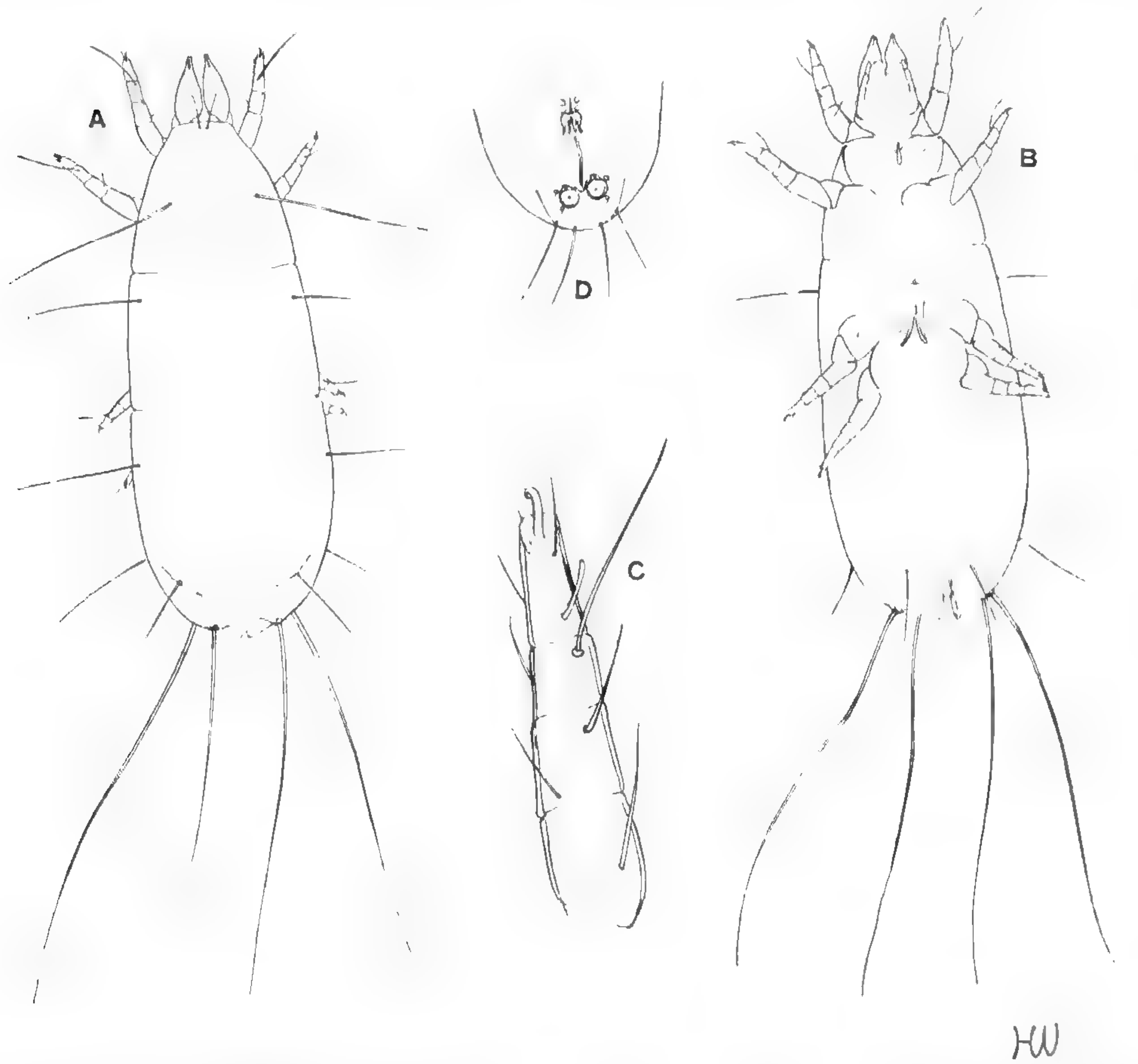


Fig. 4. *Thyreophagus corticalis* (Mich.) (adult): A, ♀ dorsal; B, same, ventral; C, leg I of ♀; D genital aperture and anal discs of ♂.

CALOGLYPHUS Berlese.

Centuria sesta di Acari Nuovi: Redia xv, 1923, p. 262.
Genotype: *Tyroglyphus krameri* Berlese, 1881.

Oval form, with suture between propodosoma and hysterosoma. Propodosomal shield present or doubtful. Propodosoma with posterior row of 4 setae of which the median pair are very short. Cervical setae present or not, sometimes ventro-laterally at extreme apex of propodosoma a pair of thick rod-like setae. Tarsi I and II apically with a pair of long setae sometimes lanceolate; without a stout spine in front of the sensory club; segment II of legs with the long seta arising subapically; tarsi with a few stoutish spines; tarsi IV in male with a pair of discs. Genital aperture in both sexes between coxae IV, with a pair of tubules on each side. Male with a pair of anal discs.

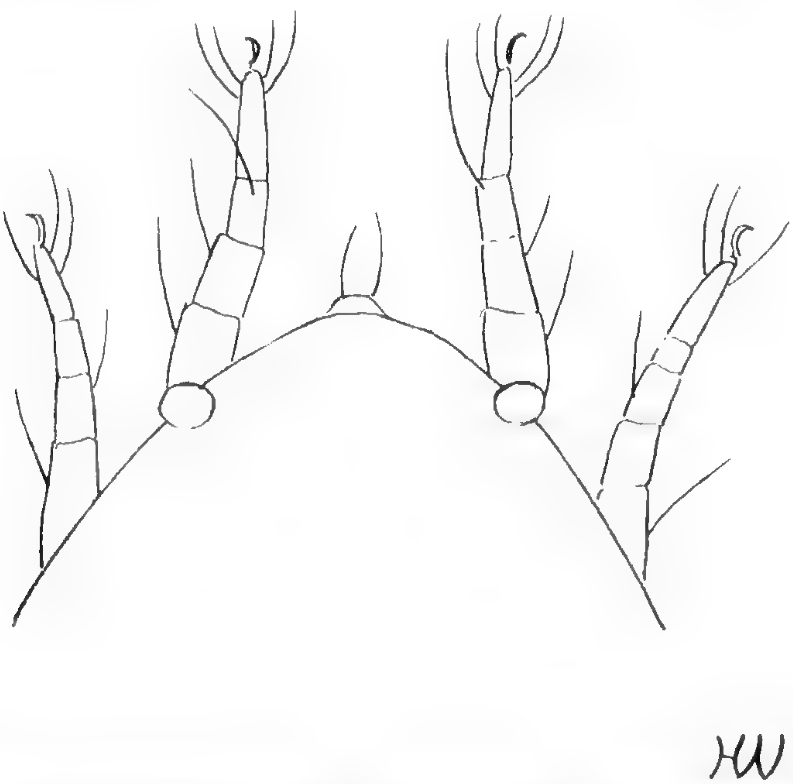


Fig 5. *Thyreophagus corticalis* (Mich.) (deutonymph): Anterior portion from above showing eye-like organs (after Michael).

CALOGLYPHUS BERLESEI (Michael).

Tyroglyphus mycophagus Berlese: A.M.S., fasc. lviii. No. 1, 1891; Kramer: Das Tierreich, Lfg. vii, 1899, p. 139.
Tyroglyphus berlesei Michael: Brit. Tyroglyphidae, ii, 1903, p. 116.
Caloglyphus berlesei Berlese: Redia, xv, 1923. p. 262.

I have a large amount of Australian material of this species, all of which agrees with the descriptions and figures given by Berlese and Kramer for *Tyroglyphus mycophagus* Megnin 1874. Michael (1903), however, has shown that *mycophagus* Megnin is quite a different species, being really that figured by Berlese in 1888 (A.M.S. xlix, No. 10) as *Tyroglyphus krameri*.

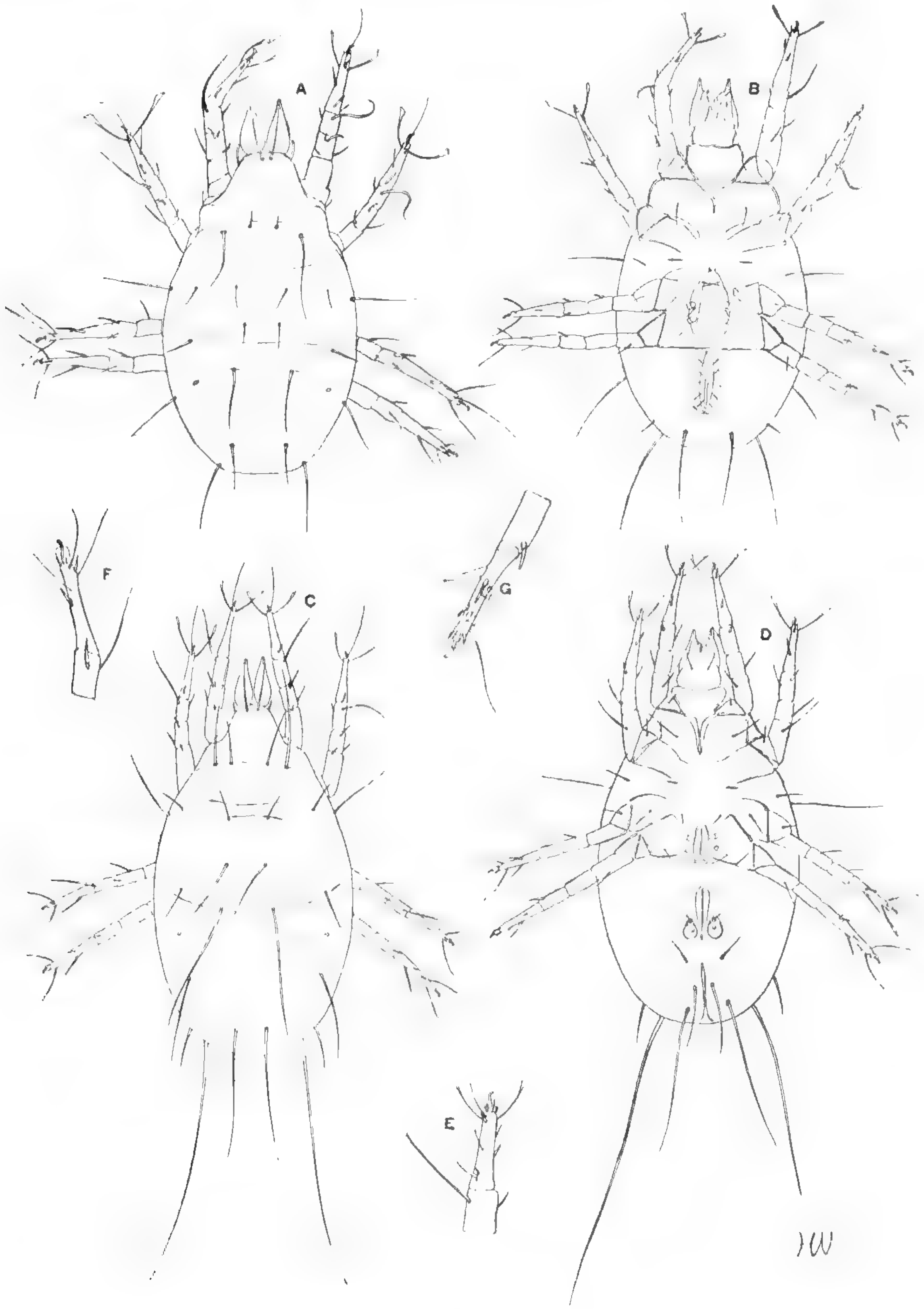


Fig. 6. *Caloglyphus berlesei* (Michael) (adult): A, ♀ dorsal; B ♀ ventral; C, ♂ dorsal; D, ♂ ventral; E, tarsus 1; F, tarsus 3; G, tarsus 4 of ♂.

In my specimens there does not appear to be any cervical setae, unless the pair of curved rods near the extreme tip of the propodosoma can be regarded as such. The median pair of setae in the row of four on the posterior part of the propodosoma are longer and not so spine-like as those shown by Berlese and Kramer, but in these latter they may possibly be fore-shortened.

Length of ♂ to 0·95 mm., width to 0·42 mm.; of ♀ to 2·0 mm. and 1·0 mm. respectively.

Loc. Western Australia: Claremont, 21st April, 1931 (H.W.). South Australia: Adelaide, on yam from China, 1909 (T.H.J.). Aust. Capital Territory: Canberra, from killed mound of *Eutermes exitiosus* (no date, G.F.H.); in laboratory culture of same termite, June, 1934 (G.F.H.). Fiji: On banana beetle, 2nd May, 1934; on copra, Levuka, 1939 (R.A.L.).

CALOGLYPHUS ? MYCOPHAGUS (Megnin).

Tyroglyphus mycophagus Megnin: J. Anat. Physiol., x, 1874, p. 225.
Tyroglyphus phylloxerae Riley: Sixth Rept. Ins. Missouri, 1874, p. 52.
Tyroglyphus krameri Berlese: Atti. Ist. Veneto, ser. 5, viii, 1881, p. 13; A.M.S. fasc. xlix, No. 10, 1888; Michael: Brit. Tyroglyphidae, ii, 1903, p. 109.
Caloglyphus mycophagus Vitzthum: Tierwelt Mitteleuropas, iii, 1929, p. 74.

This species in the adult stage differs from the preceding in the strength of the dorsal setae, the apparent lack of the antero-lateral rod-like setae on the anterior part of the propodosoma, and the presence of distinct ciliated cervical setae. The last feature, however, does not appear to be figured by either Michael or Berlese, hence the material is referred to *mycophagus* with some doubt. The propodosomal shield is also distinctly present in my material.

Loc. Victoria, Burnley, October, 1939 (R.T.M.P.) on bulbs imported from China.

FAMILY RHIZOGLYPHIDAE Oudemans 1923.

Characterized by the short thick legs and the presence of a stout short conical spine immediately in front of the sensory rod on tarsi I and II.

RHIZOGLYPHUS Claparède.

"Studien an Acariden" in: Zeit. f. wiss. Zool., xviii (1868), p. 508.

Broadly oval species with short stout legs; generally well chitinized. Ambulacra sessile. With suture between propodosoma and hysterosoma. Propodosoma with distinct shield and a posterior row of only two long setae. Front portion of hysterosoma with a quadrilateral of four setae. No posterior hysterosomal shield.

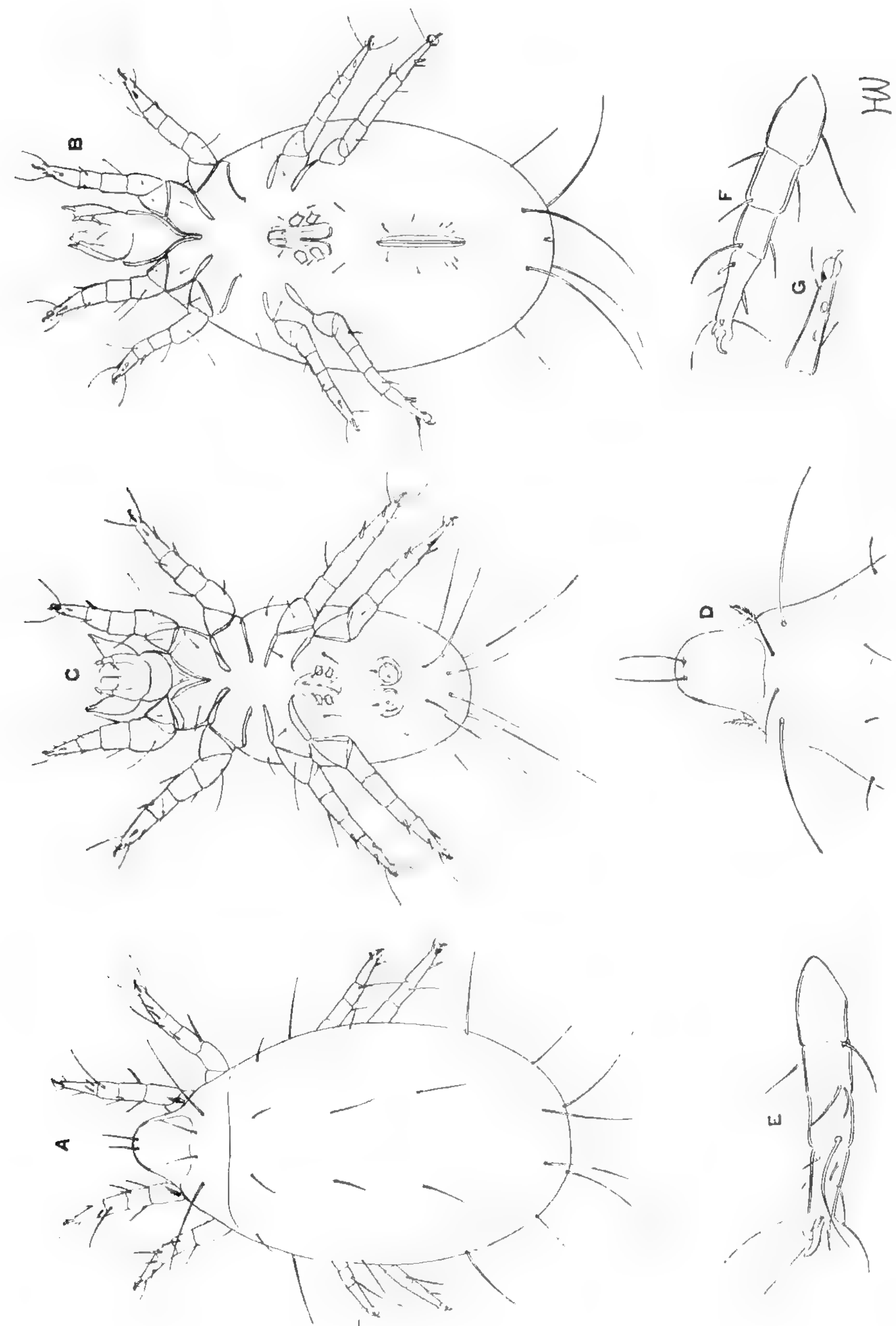


Fig. 7. *Caloglyphus mycophagus* (Megnin) (adult): A, ♀ dorsal; B, ♀ ventral; C, ♂ ventral; D, propodosoma dorsal; E, leg 1 of ♀; F, leg 2 ♂; G, tarsus 4 ♂.

Cervical setae absent. Tarsi apically with 2 ventral, more or less lanceolate setae; a short stout conical spine immediately after the sensory club. Genital aperture of ♀ between coxae III and IV, ♂ between coxae IV, both with a lateral pair of tubules. Anus of ♂ with a pair of large semi-circular discs.

Deutonymph with all coxae touching, I and III with a small circular pore or disc; another on each side of vulva. Suctorial plate with 8 discs, the median pair long.

RHIZOGLYPHUS ECHINOPUS (Fumouze et Robin).

(Bulb or Eucharis Mite).

Tyroglyphus echinopus Fumouze et Robin: J. Anat. Physiol., v, 1868, p. 287.
Rhizoglyphus echinopus Murray: "Econ. Entom." Aptera, 1877, p. 257; Kramer: Das Tierreich, Lfg. vii, 1899, p. 143; Michael: Brit. Tyroglyphidae, ii, 1903, p. 84; Lea: Insect and Fungus Pests of Tas., 1908, p. 89; Vitzthum: Tierwelt Mitteleuropas, iii (7), 1929, p. 74.
Coepophagus echinopus Megnin: "Les Parasites", 1880, p. 144.
Tyroglyphus megnini Berlese: A.M.S., fasc. xiv, No. 7.

There appears to be but one well-known species, characterized as in the generic details given above and the accompanying figures.

It is a well-known pest in Europe and America on all kinds of bulbs and tubers, but whether it actually initiates damage to healthy bulbs has been doubted by Michael.

According to Michael (1903), p. 95, Mangin and Viala, in C.R. Ac. Sci. cxxxiv, pp. 151–3, say that they received this species from Australia. The figure given by Lea (1908) for this species, which he refers to as "A Destructive Root Mite", leaves no doubt but that his determination was correct. He gives no locality other than Tasmania in general.

Loc. New South Wales: Windsor, 15th May, 1934, on dahlia tubers (Dept. Agr.). New Zealand: Auckland, from bulbs, 1938.

RHIZOGLYPHUS ? TERMITUM sp. nov.

Deutonymph: Length 78μ., width 65μ, almost round in form and strongly convex. Dorsum with a shield of the same outline, outside of which the cuticle is longitudinally striated, while laterally inside the shield are a pair of longitudinal sinuate lines almost extending to the posterior margin; laterally outside these lines the shield is longitudinally striated, while inside the surface is finely spotted (or pitted), in places the spots (or pits) clumping together. Dorsum apparently without setae, except for 2 pairs of very small fine ones posteriorly. Ventrally the

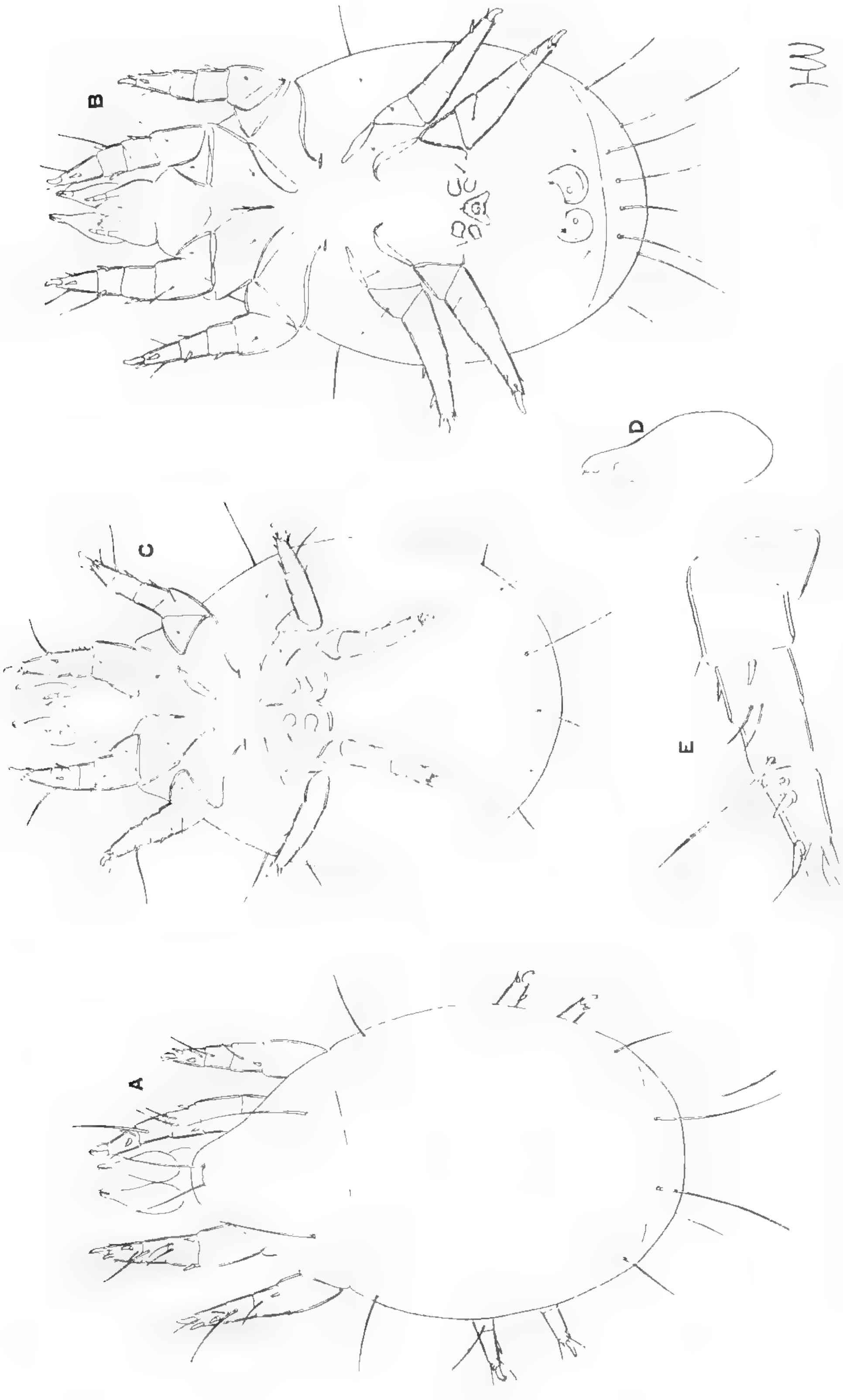


Fig. 8. *Rhizoglyphus echinopus* (R. and F.) (adult): A, ♂ dorsal; B, ♂ ventral; C, ♀ ventral; D, mandible; E, leg 1.

coxae are very large, all in contact and occupying most of the surface. Legs fairly short and stout, all tarsi with a long sinuate claw and strong spines, but without subapical lanceolate setae. Legs I and II with long and strong spines. Segment II of leg I with an apical clavate rod-like seta. Gnathosomal process as figured. Coxae I and III with a small disc or pore, and another on each side of vulva. Suctorial

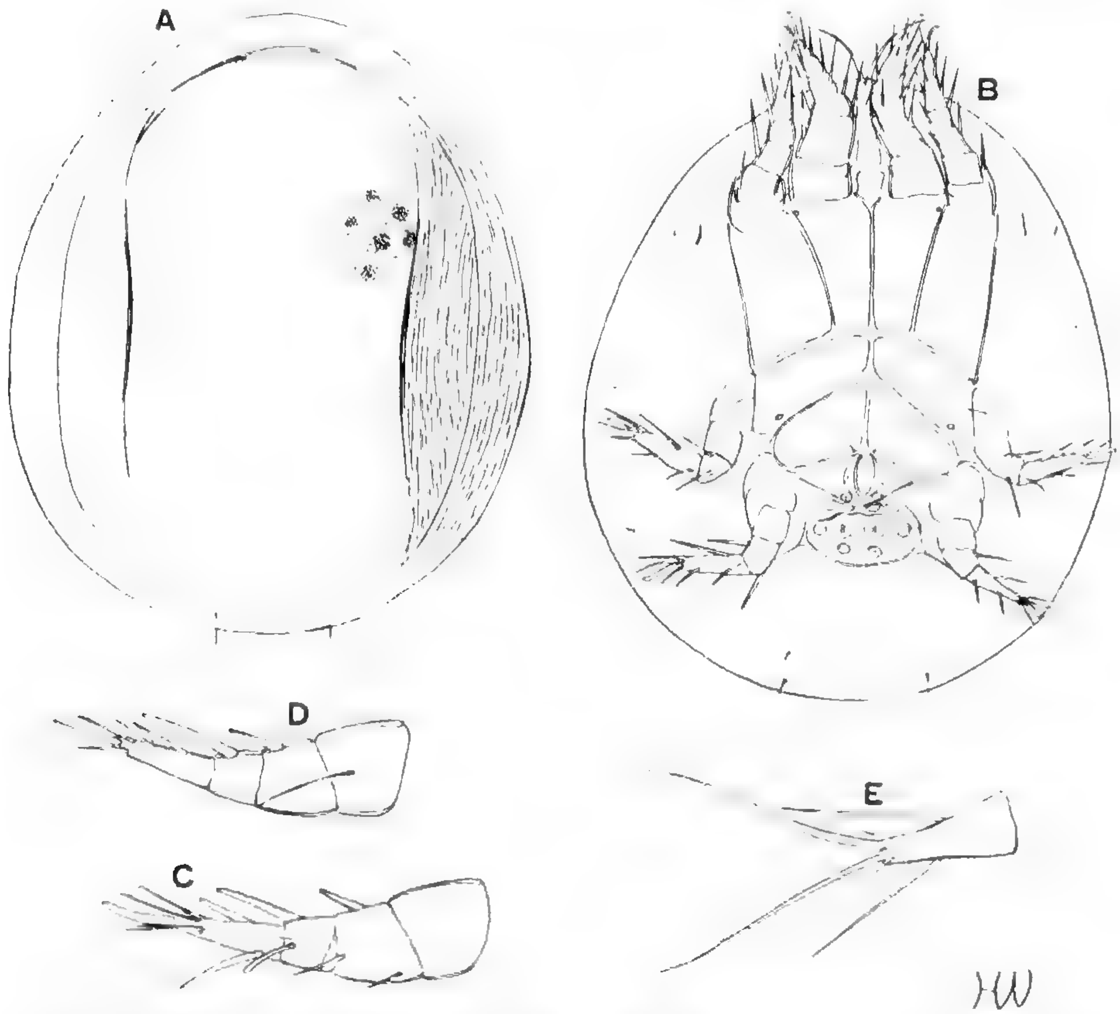


Fig. 9. *Rhizoglyphus termitum* n.sp. (deutonymph): A, dorsal; B, ventral; C, leg I dorsal; D, same, ventral; E, tritosternum.

plate with 6 (?8) discs, a pair of large median ones, a smaller one on each side of these, and two small posterior ones; anterior of the large median discs there may be another pair, but it is difficult to decide whether these are discs or the semicircular structure found between each two outer discs. Outside of the coxae are a few short fine setae.

Remarks: The uncertainty of the anterior pair of suctorial discs, the strong spines on tarsi I and III, the lack of lanceolate tarsal setae, and the structure of the dorsal plate render it uncertain whether this deutonymph is a true *Rhizoglyphus* or not.

Loc. Aust. Capital Territory: Canberra, associated with *Eutermes exitiosus*, May, 1930 (G.F.H.). New South Wales: With *Porotermes* sp., Eden, June, 1940 (S.L.A.).

FAMILY TYROPHAGIDAE Oudemans.

Ent. Berichten, 1924, D1, vi, p. 302.

Characterized as in the key to families. With only one genus so far known to occur in Australia.

TYROPHAGUS Oudemans.

Ent. Berichten, 1924, D1, vi, p. 250.

Of oval form with distinct suture between propodosoma and hysterosoma. Propodosoma with a posterior row of four long setae, the inner pair slightly the longer. Cervical setae present and ciliated. Hysterosomal setae long and shortly (often uncertainly) ciliated. Genital aperture of ♀ between coxae III and IV, of ♂ between coxae IV, on each side a pair of tubules. Male with a pair of anal discs, and discs also on tarsi IV. Tarsi I and II with sensory rod but no strong spines; the long seta on segment II of legs subapical. Tarsi relatively long and slender.

Genotype: *Acarus putrescentiae* Schrank 1781.

This genus is represented in Australia by the following ubiquitous and cosmopolitan "humus mite".

TYROPHAGUS PUTRESCENTIAE (Schrank).

Acarus putrescentiae Schrank: Enum. Ins. Austriae, 1781, p. 521.
Acarus dimidiatus Herman: Mem. Apt., 1802, p. 85.
Tyroglyphus longior Gervais: Aptera, iii, 1844, p. 262.
Tyroglyphus infestans Berlese: A.M.S., fasc. xiv, No. 8.
Tyroglyphus lintneri Osborne: 1894 (Banks: U.S. Dept. Agric., Techn. Ser. No. 13, 1906, p. 15.
Tyroglyphus siro Rainbow: Rec. Aust. Mus., vi (3), 1906, p. 180; Lea: Ins. and Fungus Pests, Tas., p. 112.
Tyrophagus humerosus Oudemans: Ent. Ber., vi, 1924.
Tyrophagus dimidiatus Vitzthum: Tierwelt Mitteleuropas, iii, 1929, p. 74.
Tyrophagus putrescentiae Vitzthum: Treubia, viii, 1926, p. 180.

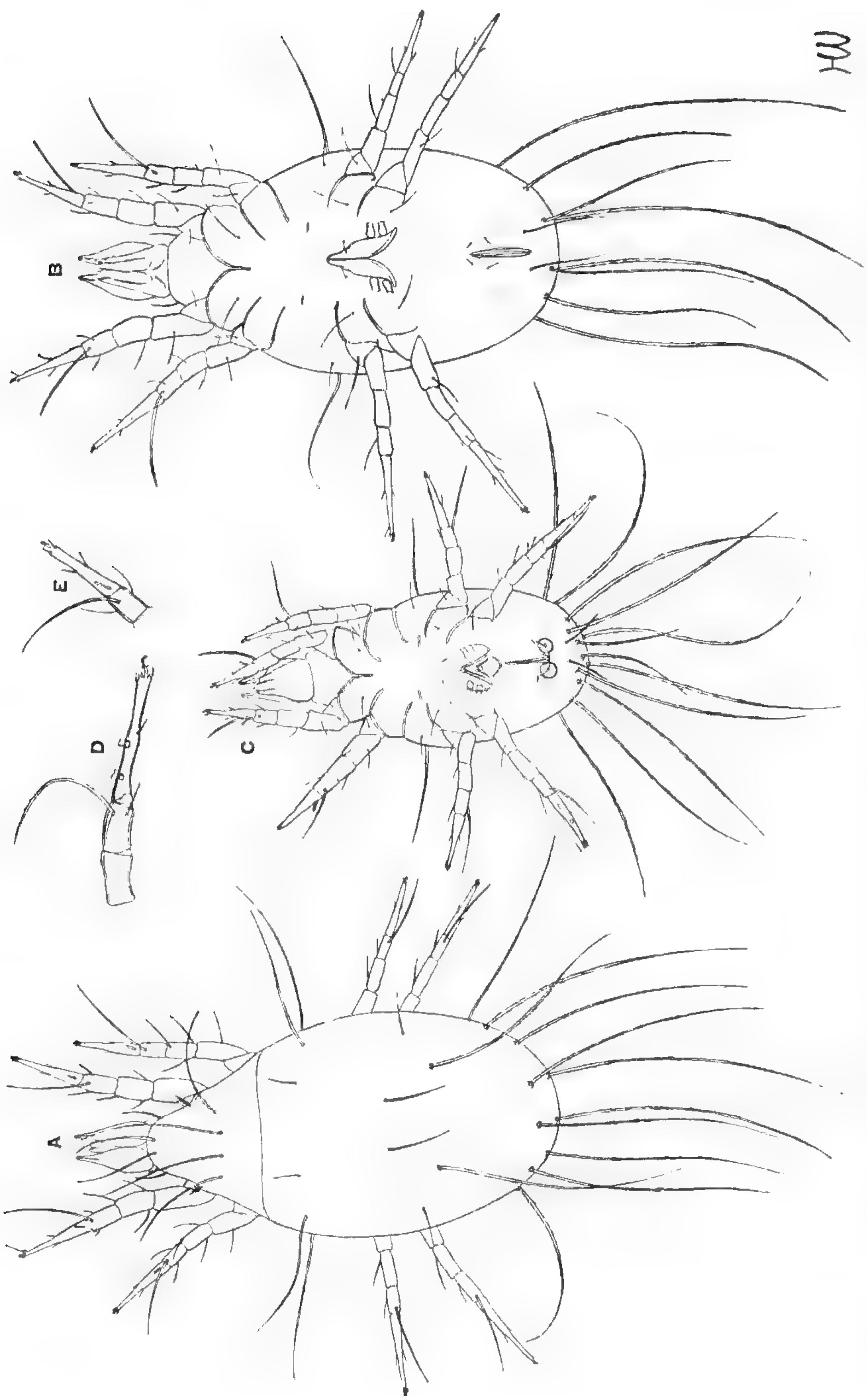


Fig. 10. *Tyrophagus putrescentiae* (Schrank) (adult): A, ♀ dorsal; B, ♀ ventral; C, ♂ ventral; D, tarsus 4 ♂; E, tarsus 2.

The first five of the above synonyms are generally regarded as varieties, but the differences are very small and uncertain, being to a large extent based on habitat, so that there seems little point in regarding them all other than as the one species. The essential characters of the species are adequately shown in the accompanying figures.

This species occurs almost everywhere in decaying humus, dung, rotting timber and fruit, and even on cheese and other foodstuffs; it is widespread in Australia.

Loc. South Australia: Adelaide, in egg powder from London, labelled as "*T. siro*", no date; on decaying mushrooms, Feb., 1934 (D.C.S.); on *Cryptes baccarum*, Aug., 1933; in moss, Mount Barker, June, 1934 (H.W.); on decaying coconut, Adelaide, Aug., 1939 (H.W.). Western Australia: Perth, April, 1931 (H.W.); Wooroloo, Aug., 1932 (H.W.). Victoria: In leaf debris, Mount Dandenong, May, 1932 (J.W.R.). New Zealand: Auckland, May, 1940, in fungus culture (W.C.); Lincoln, August, 1935 (L.M.).

Rainbow (1906) merely says: "Australia, introduced."

FAMILY SAPROGLYPHIDAE Oudemans.

Entom. Berichten 1924, D1, vi, p. 303.

Cuticle polished. Mandibles chelate. Ambulacra with sessile claw and caruncle. Body more or less Tyroglyphid-like, with suture between propodosoma and hysterosoma. Female genital aperture between coxae III and IV. Male without discs near anus or on tarsi IV; larvae without sternal rods (?).

This family contains only the genus *Saproglyphus* Berlese, although Vitzthum (1931) is inclined to include the genus *Acaridina* van Beneden.

SAPROGLYPHUS Berlese.

A.M.S., fasc. lvii, No. 6, 1890.

Elongate species with more or less parallel sides. Propodosoma separated from hysterosoma by a suture. Propodosoma with a posterior transverse row of 4 setae, the laterals very long and strong, medians small. Cervical setae absent. Hysterosoma with 2 or 4 long posterior setae. Ambulacra and claws sessile. Tarsi rather elongate, without strong spines, with the usual sensory rod on I and II; segment II of legs with the long seta subapical. Genital aperture of ♀ between coxae III and IV, ♂ between IV, in both sexes with a pair of tubercles on each side. Male without anal discs or suckers on tarsi IV.

Genotype: *S. neglectus* Berlese 1890.

This genus is represented in Australia by the following new species or what may be only a variety of the European form.

SAPROGLYPHUS COCCIPHAGUS sp.nov.

Description: Female, length to 340μ, width to 185μ; male, length to 270μ, width to 135μ. Female, dorsal surface: propodosoma with the usual pair of vertical setae 65μ long, and 4 posterior setae in a transverse row, the outer ones very long and strong, 130μ, inner ones very much shorter, 26μ; hysterosoma with a pair

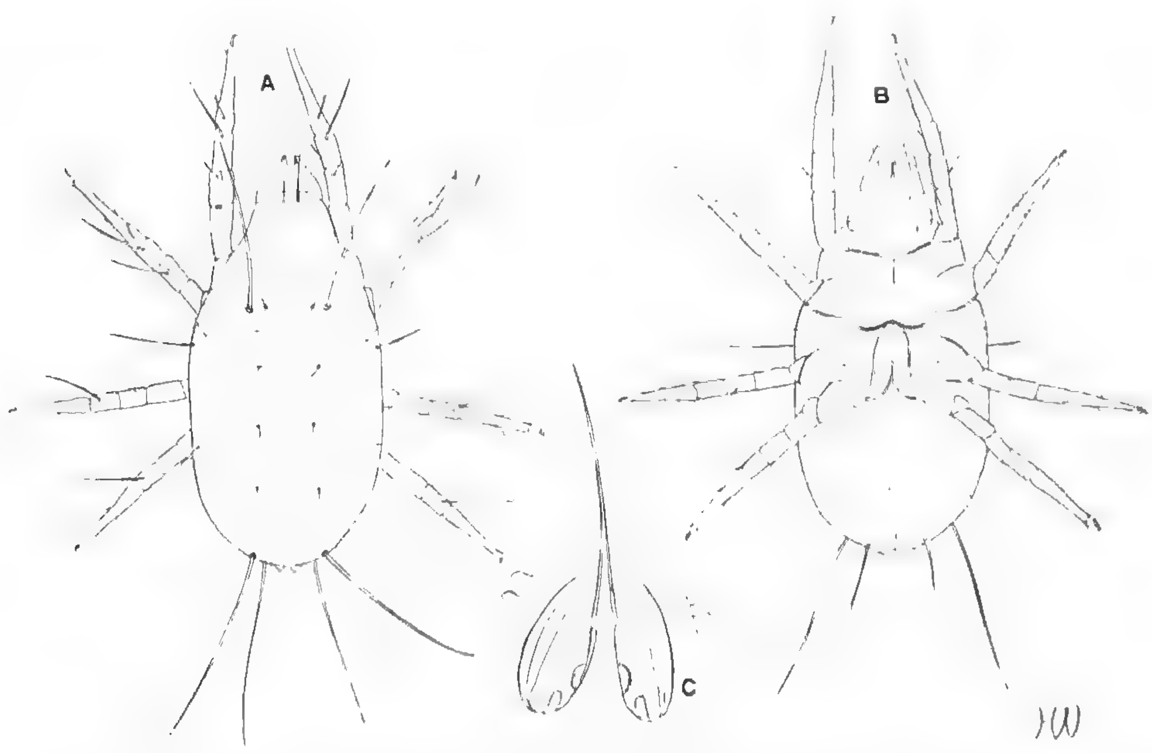


Fig. 11. *Saproglyphus cocciphagus* n.sp. (adult): A, ♀ dorsal; B, ♀ ventral; C, genital aperture and penis of male.

of humeral setae, outer 104μ, inner 26μ; dorsally with 3 pairs of fine and moderately long setae; apically with only one pair of long setae, 260μ; laterally, on a level of trochanter IV, a pair of medium fine setae; all setae simple. Ventral surface: coxae I, III and IV with one fine seta of medium length; apex with one pair of long setae 130μ; anterior of apex with a transverse row of fine setae; genital aperture large, placed between coxae III and IV with the usual 2 pairs of tubercles. Male, as in female, but the apical setae of the hysterosoma not so long; genital opening between coxae IV with the usual 2 pairs of tubercles; penis long, fine and pointed;

tarsi IV and anus without suctorial discs. Legs relatively long and slender, ambulacra and claws sessile, tarsi elongate without spines, tarsi I and II with a rather slender sensory rod near base, segment II of legs with a long seta arising subapically.

Loc. South Australia: Adelaide, Aug., 1933, on *Cryptes baccarum* (type material). New South Wales: Goulburn, 7th June, 1934, from gall on tree-lucerne.

Remarks: This new species is very close to the genotype, *S. neglectus* Berlese, but differs in having only one pair of long dorsal apical setae instead of two.

FAMILY CARPOGLYPHIDAE Oudemans.

Ent. Berichten, D1, vi, 1923, p. 206.

Ambulacra pedunculate with apical claw. Without suture between propodosoma and hysterosoma. Propodosomal shield doubtful, probably absent. Cervical setae absent. Posterior row of propodosomal setae only two. Tarsi elongate without strong spines; I and II with usual sensory rod; long seta of segment II of legs arising near middle. Genital aperture of ♀ between coxae II and III, ♂ between III and IV, in both sexes with usual pair of tubercles on each side. Male without anal discs or suckers on tarsi IV. Dorsal setae rather strong and spine-like.

Represented in Australia by the following cosmopolitan genus and species.

CARPOGLYPHUS Robin.

J. Anat. Physiol., *6*, 1869, 197–204, pl. 7–8.

With the characters as outlined for the family. Dorsal setae rather short and spine-like, simple; apex of hysterosoma with a pair of long setae and a pair of median setae. The setae of legs not plumed.

Genotype: *Acarus lactis* Linne 1763.

CARPOGLYPHUS LACTIS (Linnaeus).

(Dried-fruit Mite).

Acarus lactis Linnaeus: Syst. Nat. ed. xii, 1763, p. 1024.
Acarus passularum Hering: N. Acta Ac. Leop. xviii, 1836, p. 618.
Glyciphagus anonymus Haller: Jahresh. Ver. Württemb., xxxviii, 1882, p. 297.
Trichodactylus anonymus Berlese: A.M.S., fasc. xiv, No. 10, 1884.
Phycobius anonymus Canestrini: Prosp. Acarofauna, iii, p. 392.
Acarus dysenteriae Schrank: Enum. Ins. Austriae, 1781, p. 510.

Shape oval. Length of male 400μ, female 350μ; width of male 250μ, of female 240μ. No suture between propodosoma and hysterosoma, only 2 setae in posterior

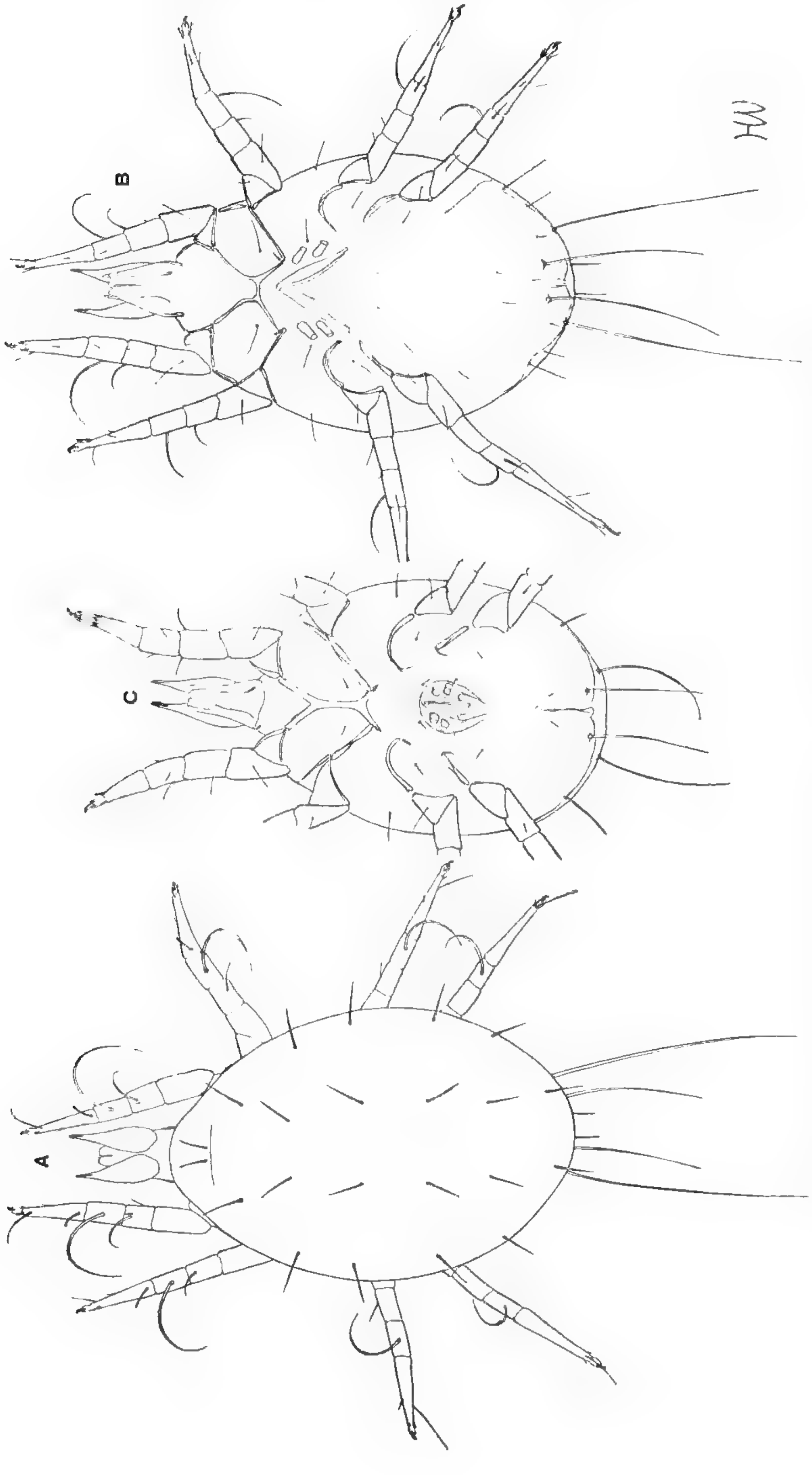


Fig. 12. *Carpoglyphus lactis* (L.) (adult): A, ♀ dorsal; B, ♀ ventral; C, ♂ ventral.

row of propodosoma. Dorsal setae relatively short and spine-like, except two pairs at posterior end. Legs relatively long and slender, with long tarsi and pedunculate caruncles; tarsi I and II with the usual basal dorsal sensory rod; the long setae on metatarsi curved and arising from about the middle; the preceding segment of leg I with two subapical setae, one fairly long, the other very short. Other characters as in the generic diagnosis and the figures. Apparently without a deutonymphal stage.

This mite commonly infests sugary material, such as dried fruit, and milk products and, from one of the following records, also scale-insects, possibly attracted by sugary secretions.

Loc. South Australia: Adelaide, 19th Jan., 1934, on dried fruits; Port Adelaide, Feb., 1932, on stored prunes. Western Australia: Upper Swan, May, 1931, on dried figs. Victoria: Melbourne (no date), on figs. New South Wales: Allandale, June, 1934, on scale-infested *Pittosporum*.

FAMILY PONTOPPIDANIIDAE Oudemans.

Entom. Berichten, D1, vii, 1927, p. 244.

This family was erected for the genus *Pontoppidania* Ouds. 1923, with *Tyroglyphus littoralis* Halbert 1920, an adult species, as type. In *Ent. Ber.*, D1, vi, 1924, p. 231, Oudemans synonymizes this genus with *Calvolia* Ouds. 1911, based on a two-eyed deutonymphal form. In the same publication, D1, vii, p. 247, he corrects himself, and recognizes both genera.

The family can be distinguished by the characters given in the key. It contains only the two genera *Pontoppidania* and *Calvolia*, of which the latter is represented in Australia.

CALVOLIA Oudemans.

Ent. Ber., 1911, D1, iii, p. 187.

Deutonymphal forms with a pair of eye-like organs at the apex of the propodosoma. Propodosoma and hysterosoma separated by a distinct suture. Legs III and IV very short and stumpy, without claws, IV with a pair of long setae. Suctorial plate with 8 discs, no discs near vulva or on coxae I and III.

Genotype: The deutonymph of Michael's *Tyroglyphus heterocomus* (Brit. Tyrogl., vol. 2, 1903).

CALVOLIA GLABRA sp.nov.

Description: Deutonymph. Length 195μ, width 126μ. Dorsally with a distinct suture between propodosoma and hysterosoma, the former appearing to fit into the latter. Apex of propodosoma with a pair of distinct eye-like lenses. Dorsal surface apparently (even under $1/_{12}$ in. oil immersion) devoid of setae, except for a pair of short ones at posterior end. Ventrally under the gnathosoma with a pair of long curved setae arising from a bilobed process. Legs I and II stout, but of moderate length, with distinct caruncle and claw, III and IV short and stumpy,

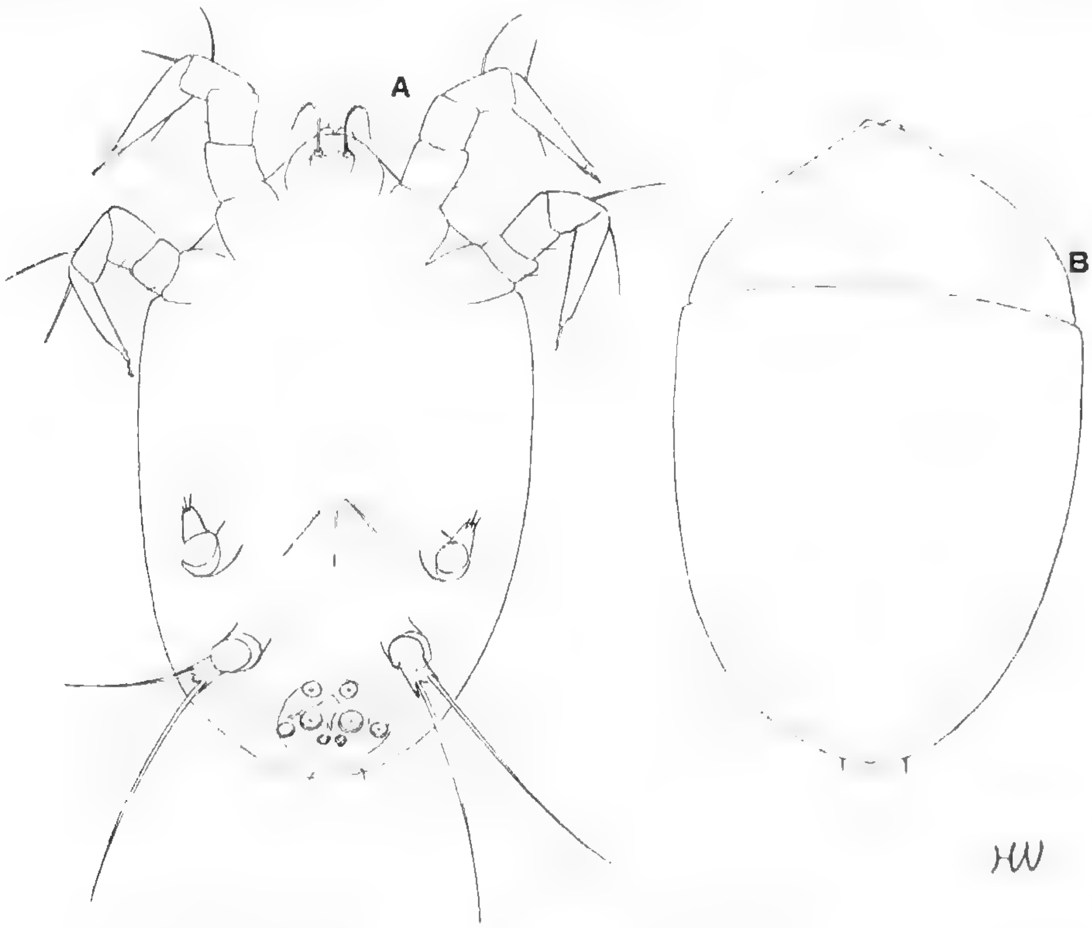


Fig. 13. *Calvolia glabra* n.sp. (deutonymph): A, ventral; B, dorsal.

without claws, IV with a pair of long setae; coxae apparently without setae. Suctorial plate with 8 discs, a large middle pair, with a smaller one on each side, a pair of still smaller ones behind, and a pair of larger ones anteriorly.

Loc. South Austral. Museum collections labelled "from the branchium of a Boa, Adelaide Zoo (A.E.J.)".

Remarks: The above record may be doubtful, but even Michael (*loc. cit.* p. 109) is not at all definite as to the habitat of what he considered the deutonymph of *T. heterocomus*, for, speaking of the species as a whole, he says that he first beat it from oak trees, and later found it in numbers in the moss of a squirrel's summer nest. He claims to have reared it by feeding on *Boletus*.

FAMILY GLYCYPHAGIDAE Berlese.

Cryptostigm., i, 1897, p. 100.

Ambulacra pedunculate with terminal claw. With indistinct suture between propodosoma and hysterosoma. Dorsum smooth or granulate; dorsal setae ciliated or feathered, long and numerous.

Of the genera placed in this family, *Glycyphagus*, *Ctenoglyphus* and *Sennertia* occur in Australia.

GLYCYPHAGUS Hering.

Acta. Acad. Caes. Leop. Car. Nat. Cur., vol. 8, pt. 2, 1838, p. 619.

Abdomen with dorsal setae long and more or less thickly ciliated, but not feathered or plume-like. Cuticle not strongly, if at all granulate. Tarsi elongate, caruncle and claws weak, tarsi I and II with sensory rod, but no spines. Genital aperture between coxae III and IV, with a pair of small tubules on each side. No discs near anus or on tarsi IV. Tip of hysterosoma with a distinctly visible copulatory tubule. Deutonymph contained within larval skin, not free-living.

The following two species have been found in Australia.

GLYCYPHAGUS DOMESTICUS (DeGeer).

Acarus domesticus DeGeer: Mem. Hist. Ins., vii, 1778, pp. 88–89.
Glycyphagus domesticus Rainbow: Rec. Aust. Mus., vi (3), 1906, p. 181.

Somewhat oval in shape with a suture line between propodosoma and hysterosoma. Propodosoma with a posterior row of 4 long, strongly ciliated setae. Cervical setae present, strongly ciliated. Dorsal setae numerous, as long as, or longer than body and strongly ciliated. Legs long, tarsi elongate, I and II with a sensory rod, but without the long scale-like seta of the next species. Claws and caruncle small. Female genitalia between coxae III and IV. Tip of hysterosoma with tubular copulatory process. Length, female to 550μ, male 500μ; width, female 400μ, male 350μ.

This species differs from the following in the lack of the long scale-like seta arising near the base of tarsi (see fig. 10D). It is a common species in dried plant material, debris from beehives, and frequently infests houses, occurring in sugar, etc., as well as in upholstery.

Loc. South Australia: Adelaide, 11th Sept., 1933, in tobacco seeds; Glen Osmond, July, 1934, in moss (R.V.S.); Adelaide, Sept., 1940, in beehive debris. Western Australia: Perth, 1931; Waroona, May, 1931. Victoria: Burnley, July, 1938 on sugar-beet (R.T.M.P.). New South Wales: Paddington, Sydney, in furniture (Rainbow).

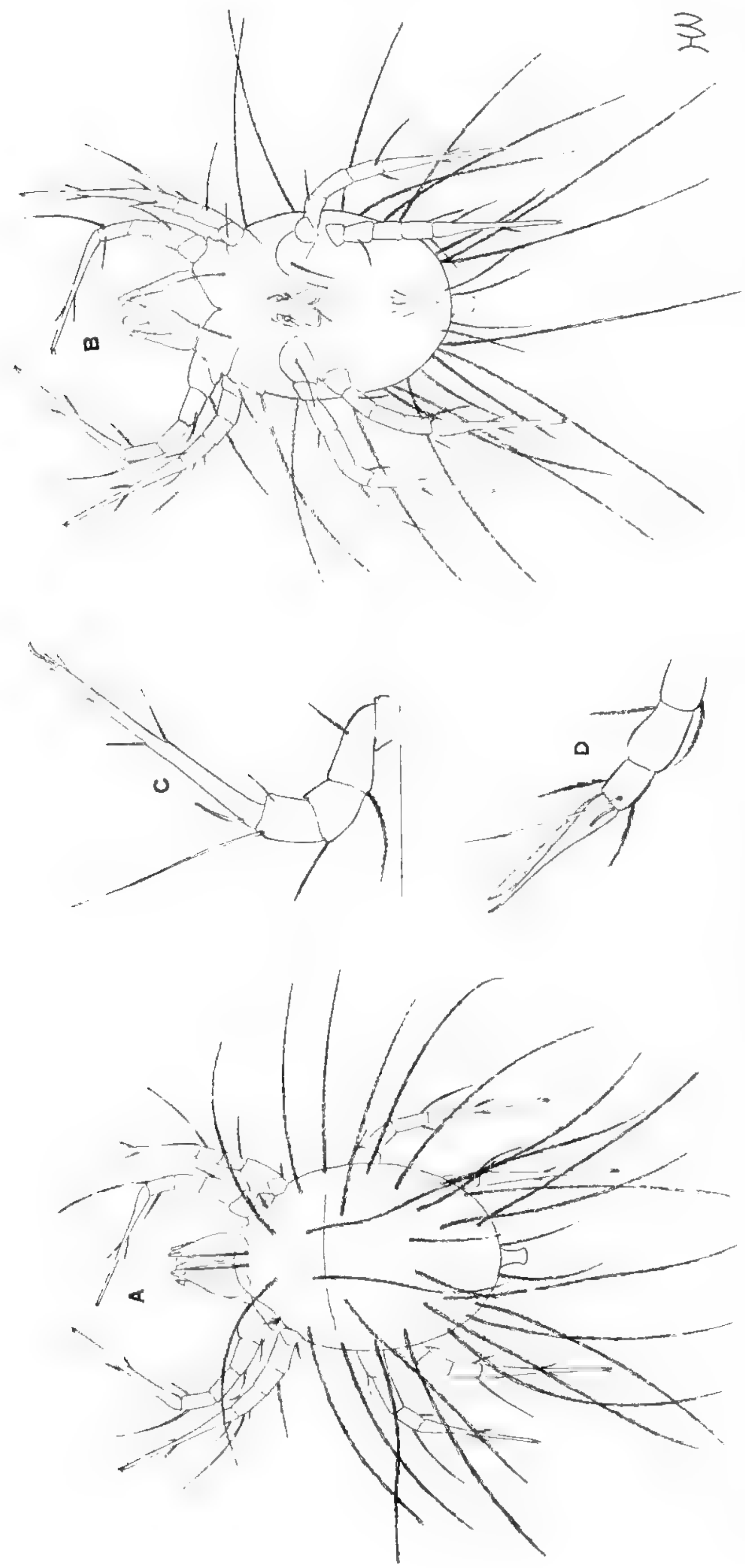


Fig. 14. A–C *Glycyphagus domesticus* (DeGeer) (adult): A, ♀ dorsal; B, ♀ ventral; C, leg 1 ♀. D, *G. cadaverum*: tarsus 1.

GLYCYPHAGUS CADAVERUM (Schrank).

Acarus cadaverum Schrank 1781: Enum. Ins. Austriae, p. 512.

Differs only from the above in the presence of the long, scale-like seta on tarsi. It has similar habits.

Loc. South Australia: Adelaide, May, 1934, in packing straw from England; Glen Osmond, Waite Institute, in grass seeds, March, 1936. Victoria: Melbourne, Aug., 1932, on imported seeds (R.T.M.P.); Melbourne, Aug., 1938.

CTENOGLYPHUS Berlese.

A.M.S., 1884, fasc. xiv, No. 1 (as *Cthenoglyphus*).

As in the genus *Glycyphagus*, but the cuticle is granular, and the setae comb-like. Legs rather shorter.

CTENOGLYPHUS PLUMIGER (Koch).

Acarus plumiger Koch, C. L.: C.M.A. Deutschl., fasc. v, 1835.
Cthenoglyphus plumiger Berlese: A.M.S., fasc. xiv, No. 1, 1884.

Rather small oval species with granular cuticle and a line or depressed suture between propodosoma and hysterosoma. Length, female to 300μ, width 200μ, male

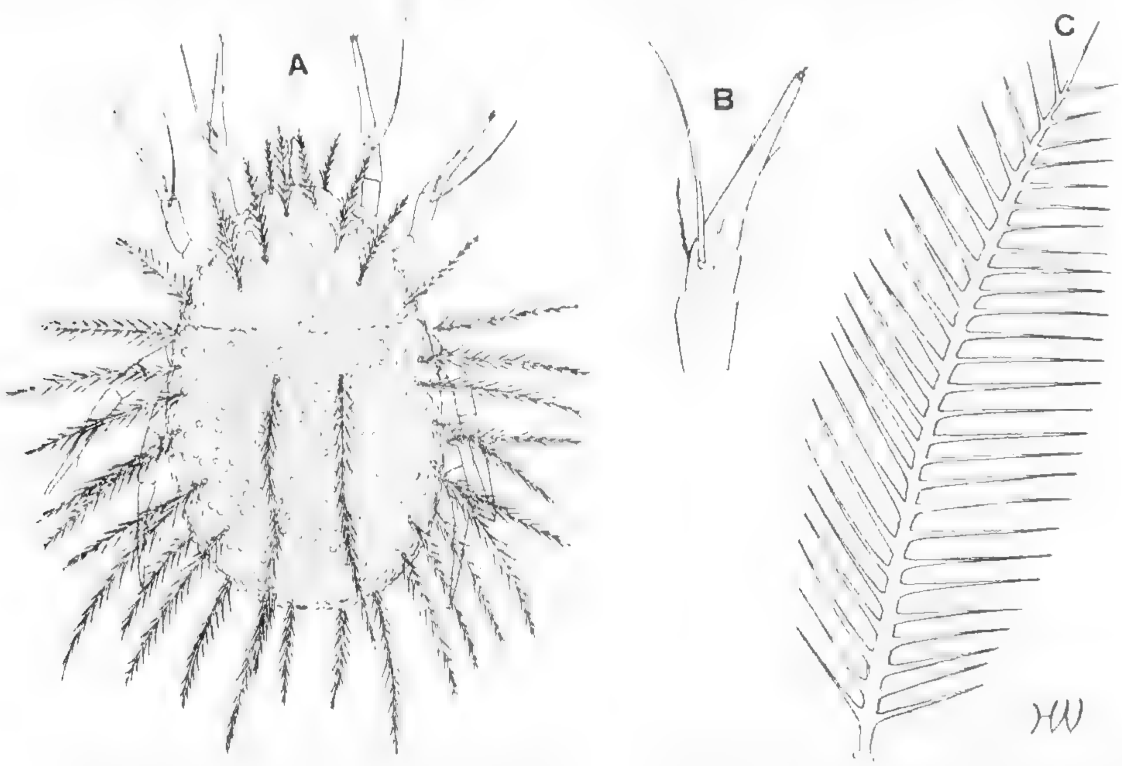


Fig. 15. *Ctenoglyphus plumiger* Koch (adult): A, ♀ dorsal; B, tarsus 1 ♀; C, dorsal seta.

rather smaller. Legs relatively short but slender, tarsi I and II with usual sensory rod, claws and caruncle weak. Dorsal setae strongly comb-like, but the teeth straight and not curved inwards and upwards. Tarsi without long scale-like seta.

Two specimens only of this species were found amongst packing straw from England, at Adelaide in May, 1934.

SENNERTIA Oudemans.

Entom. Ber., 1905, D1, 2, p. 21.

Ambulacra with strong claws; with propodosomal plate only. Without suture line between propodosoma and hysterosoma. Dorsal setae coarse, haired or feathered, or fan-like. Epimera I united to sternum. Deutonymph; shape somewhat pentagonal, without suture. Cuticle striated, only one dorsal shield posteriorly. Dorsal setae relatively long and spine-like. Eyes absent. Legs I, II, and III with very strong sickle-shaped claws; tarsi I and II with sensory rod, IV without claws but usually with one or more long terminal setae. Venter with shorter spines; suctorial plate not in a chitinized horseshoe-like frame, with 8 discs, 2 median large, 4 small posterior and 2 small anterior ones near vulva.

Genotype: *Acarus cerambycinus* Scopoli 1763.

This genus is mainly known from the deutonymphal forms; only in a few species have the adult and other stages been described. The deutonymphs live amongst the hairs of various species of Xylocopid bees, and the adults in the nests of the same. The extraordinary large claws of the deutonymphs are specially adapted for clinging to the hairs of their host.

The following two species have been found in the hairs of specimens of bees of the genus *Xylocopa* in the collections of the South Australian Museum.

SENNERTIA QUEENSLANDICA sp.nov.

Description: Shape somewhat pentagonal. Length 410μ, width 330μ. Dorsum with a single posterior triangular shield which appears to broadly turn over to the venter, and anteriorly does not reach beyond the line of coxae III. Cuticle transversely striated, shield pitted. Dorsum with 5 pairs of stiff long spines, 162μ, but not as long as in the following species; on the shield are 6 very small fine setae. Legs moderately long and strong, tarsi I–III with strong and large grasping claws; I and II with a stout sensory rod, IV without claws but with a single long apical seta. Ventrally the setae are very fine and simple, one on coxae I, one laterally between coxae II and III, a row of four between coxae III, and one on each side between coxae IV and the suctorial plate; on the portion of dorsal shield turned over is a pair of fairly long setae with a pair of shorter ones between. Suctorial plate as figured, with 8 discs, a median large pair, a posterior row of four very small ones, and an anterior pair of small ones, one on each side of the vulva.

Fig. 16. *Sennertia queenslandica* sp.nov. (deutonymph): A, dorsal; B, ventral.

Loc. Moa Id., Torres Straits (S.W. Schomberg). Found amongst the hairs of specimens of *Mesotricha bryorum* in the South Australian Museum, Adelaide.

In both this and the following species the adults are unknown to me.

SENNERTIA ?BIFILIS Canestrini.

Termez. Fuzetek., 1898: vol. 21, 196; *ibid.* 1897, vol. 20, 174.

Deutonymph: Shape somewhat pentagonal. Length 250μ, width 170μ. Dorsum with a single posterior oval shield which reaches forward almost to the line of coxae II; outside of the shield with 4 pairs of long strong setae (104μ), on each shoulder a long but finer seta and a pair of similar ones at apex of hysterosoma. Legs moderately long and strong, I–III furnished with large, strong sickle-shaped grasping claws, IV without claws but with one long seta, and a very short one apically; tarsi I and II with rod-like sensory seta. Ventrally the setae are short with broad base, then tapering sharply; there is one on coxae I, one between coxae II and III laterally, a row of four between coxae III and four between coxae

IV. The ventral suctorial plate has 8 discs, a large median pair, a posterior row of four smaller ones, and anterior of the medians, a very small one on each side of the vulva.

Specimens, as described above, appear to be this species as far as I am able to judge from the meagre details given by Kramer 1899, Giard 1900 and Michael 1903. I have not been able to see Canestrini's original paper.

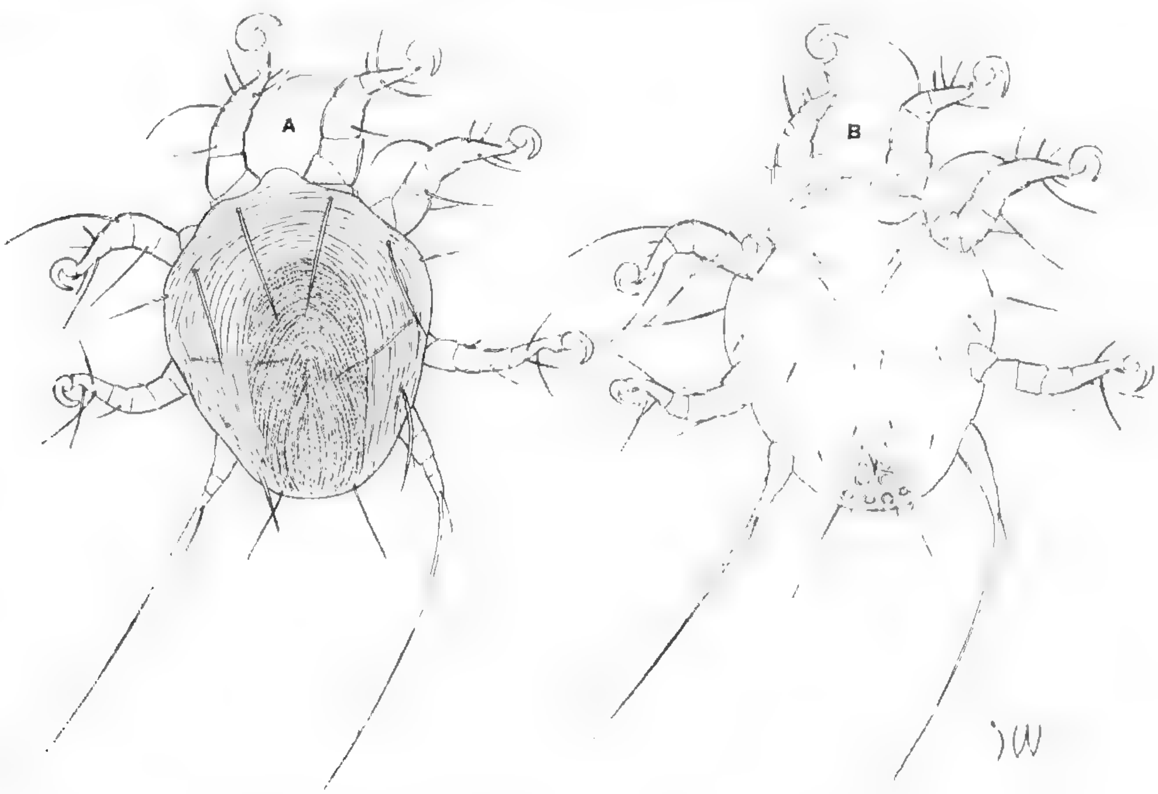


Fig. 17. ***Sennertia bifilis*** **(Canestr. 1898) (deutonymph): A, dorsal; B, ventral.**

They were found amongst the hairs of specimens of the large carpenter bee, *Mesotricha bryorum* in the collections of the South Australian Museum.

Loc. Bowen, Queensland—no date. Moa Id., Torres Strs. (J. W. Schomberg).

The species was originally described from New Guinea on *Xylocopa combinata.*

FAMILY ANOETIDAE Oudemans.

Entom. Ber., 1904, D1, i, p. 191.

Adults with mandibles provided with a more or less toothed "augur-like" process. The apical segment of the 2-segmented palpi somewhat leaf-like and with two long setae. With a suture line between the propodosoma and hysterosoma.

Ventrally there are 2 pairs of circular or oval discs, one pair in the region of coxae II and the other between coxae III and IV. Caruncle absent, claws sessile, tarsi with some small spines and I and II with sensorial rod. Without anal discs or discs on tarsus IV in male.

Deutonymph with suture between propodosoma and hysterosoma. Legs III and IV directed forwards, tibia and tarsus indefinitely separated; all legs slender, claws small, tarsi and metatarsi apically usually with clavate or spathulate long setae. Suctorial plate with 4–8 discs. With or without discs or pores on coxae and near vulva.

This family contains a large number of genera, most of which are based on the deutonymphal forms. The following are known to occur in Australia.

HISTIOSTOMA Kramer.

Arch. Naturges., 1876, vol. 42 (i), 105.

In 1904 Oudemans synonymized this genus with *Anoetus* Dujardin 1842 (L'Institut. vol. 10 (i), fasc. 454), but later (Ent. Ber., D1, vii, p. 449–451 and viii, p. 53) he modified his views and regarded Dujardin's genus as only in part synonymous with *Histiostoma*. Both genera were based upon deutonymphal forms, the type of *Anoetus* being *Hypopus alicola* Duj. 1849 and of *Histiostoma* being *Histiostoma (Phyllostoma) pectineum* Kramer 1876 = *Hypopus feroniarum* Duf. 1839.

The only genera of which the adults appear to be at all well known are *Histiostoma* Kramer 1876, *Sellea* Oudemans 1929, and *Wichmannia* Oudemans 1929.

Adult forms with suture between propodosoma and hysterosoma, former somewhat triangular, latter quadrangular with flattened apex. Dorsum often with rounded bosses. Otherwise as in family characterizations. Deutonymph with broadly oval suctorial plate wider than long and with 8 subequal discs. A small circular pore or disc on coxae I and III and on each side of vulva.

Genotype: *Pyllostoma pectineum* Kramer 1876.

HISTIOSOMA FERONIARUM (Dufour).

The synonymy of this species seems to be very confused, but appears to be as follows:

Hypopus feroniarum Dufour: Ann. Sci. nat. ser. 2, xi, 1839, p. 278.
Tyrolglyphus rostro-serratus Megnin: J. Anat. Physiol., ix, 1873, pp. 369–78.
Phyllostoma pectineum Kramer: Arch. Naturges, xlii (i), 1876, p. 39.
Histiostoma pectineum Kramer: Arch. Naturges, xlii (i), 1876, p. 105.
Histiostoma feroniarum Kramer: Das Tierreich. Lfg. vii, 1889, p. 135.

Histiostoma rostro-serratus Michael: Brit. Tyroglyphidae, i, 1901, p. 208.
Anoetus feroniarum Oudemans: List, 1898, p. 252; Vitzthum: Tierwelt Mitteleuropas, iii, 1929, p. 80.

Female: Length to 385μ, width to 215μ. Gnathosoma distinctly visible from above in front of propodosoma. Palpi 2-segmented, the segments expanded laterally leaf-like, with 2 long setae. Mandibles with a long, toothed "augur-like"

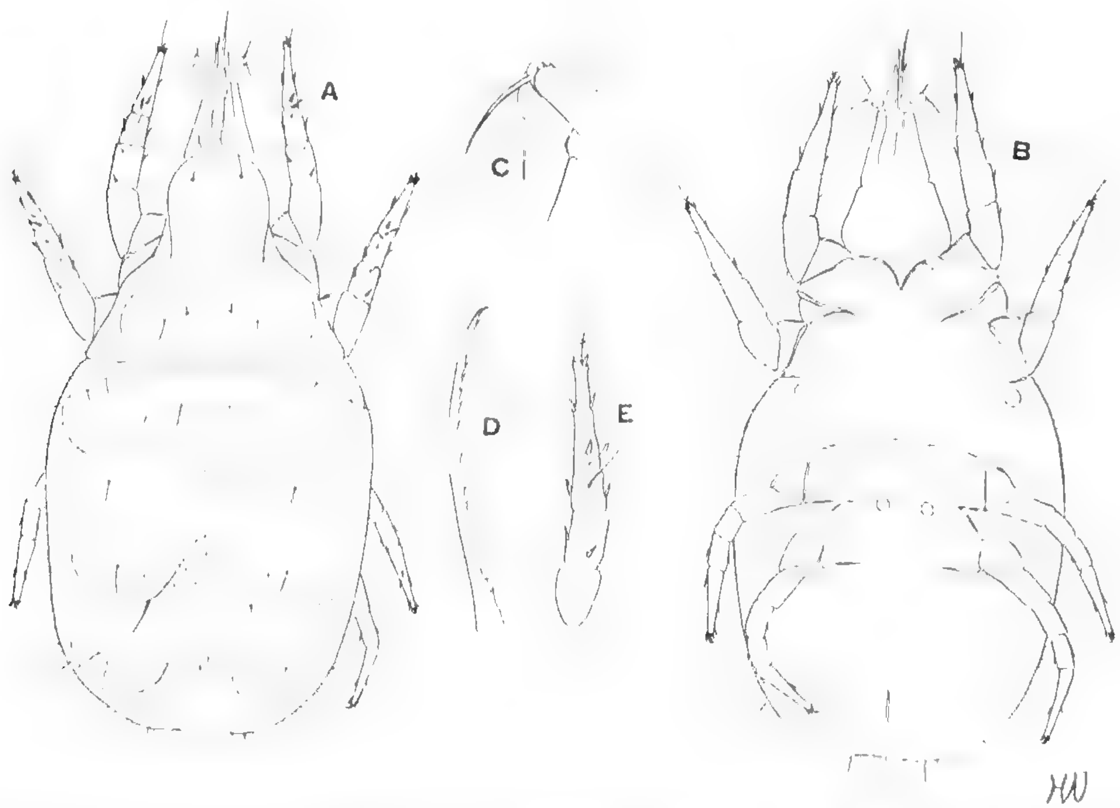


Fig. 18. *Histiostoma feroniarum* (Duf.) (adult): A, ♀ dorsal; B, ♀ ventral; C, tip of palp; D, mandibular saw-like organ; E, leg 1.

process (fig. 18d). Propodosoma triangular, separated from hysterosoma by a distinct suture; hysterosoma quadrangular. Dorsum with a number of rounded bosses, 3–4 on propodosoma and 9 on hysterosoma; dorsal setae fine and difficult to see (fig. 18a), cuticle with fine pubescence. Legs with short spines; claws sessile. The anus appears to be dorsal. Ventrally I can see no setae, but there are two pairs of circular discs or pores, one pair immediately behind coxae II and other pair in the line between coxae III and IV. The male is unknown to me.

Deutonymph: Length 185μ, width 150μ. Suture distinctly present. Dorsum apparently without any trace of setae. Ventrally as figured. Suctorial plate with

8 discs, subequal in size; a pair of small discs or pores on coxae I, coxae III and near vulva.

The material from which the above descriptions and figures are drawn I believe belongs to this species.

Loc. New South Wales: Bathurst, from dahlia tuber, 23rd Nov., 1932 (S.L.A.); Lindfield, on tiger lily, 15th May, 1932 (S.L.A.) (adults). South Australia: Mount Barker, in moss, 24th June, 1934 (H.W.); Hallet, on millipede, 1st Oct., 1938 (D.C.S.) (deutonymphs). New Zealand: Auckland, on rotting bulbs, Jan., 1940 (W.C.) (adults).

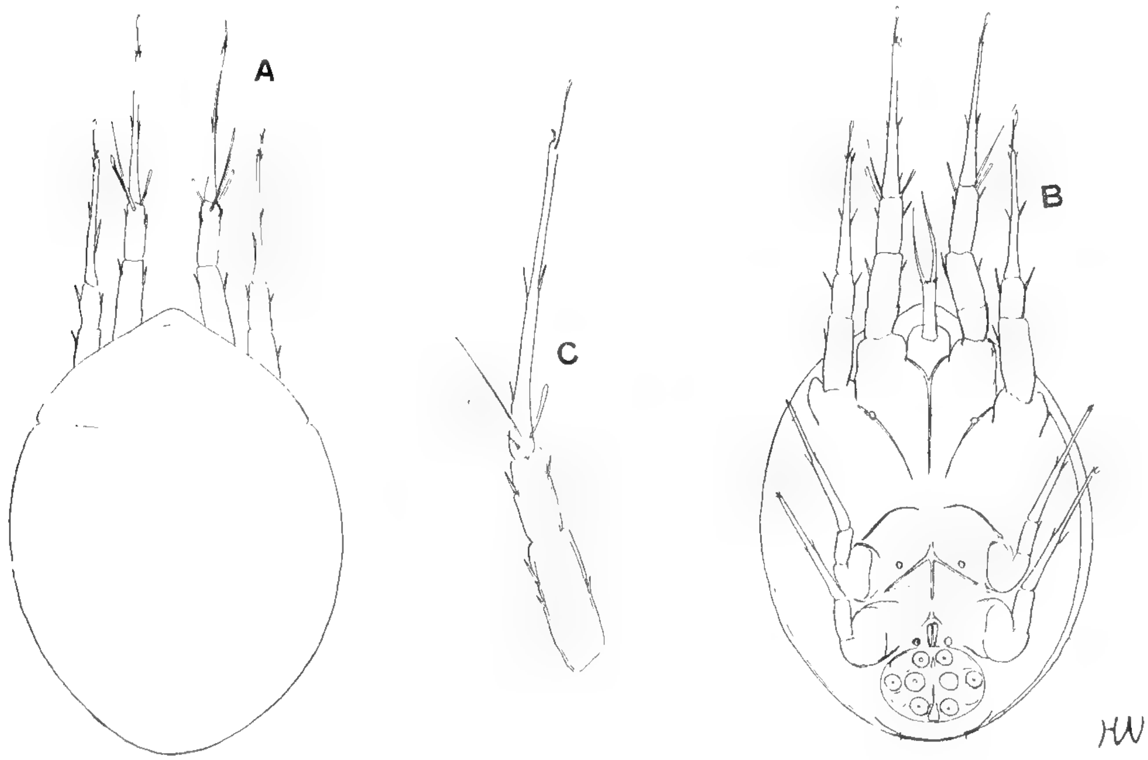


Fig. 19. *Histiostoma feroniarum* (Duf.) (deutonymph): A, dorsal; B, ventral; C, leg 1.

HISTIOSTOMA NICHOLLSI sp.nov.

Description: Deutonymph, length 185μ width 135μ. Shape oval as figured with distinct suture between propodosoma and hysterosoma. Cuticle granular with long fine setae, somewhat resembling *H. lorentzi* (Ouds.), but longer and differently arranged. As in Oudemans' species, there is a striated band of cuticle near the dorsal suture. There appears to be a more hyaline area outside of the propodo- and hysterosomal shields.

Loc. Western Australia, on a small beetle from Crawley, Sept. 14, 1940 (G. Snowball).

Remarks: This species appears to be nearest to Oudemans' *Histiostoma lorentzi* from New Guinea (Ent. Ber., D1, 2, p. 223, 1906, and Nova Guinea, vol. v (i), 1906, p. 146–7).

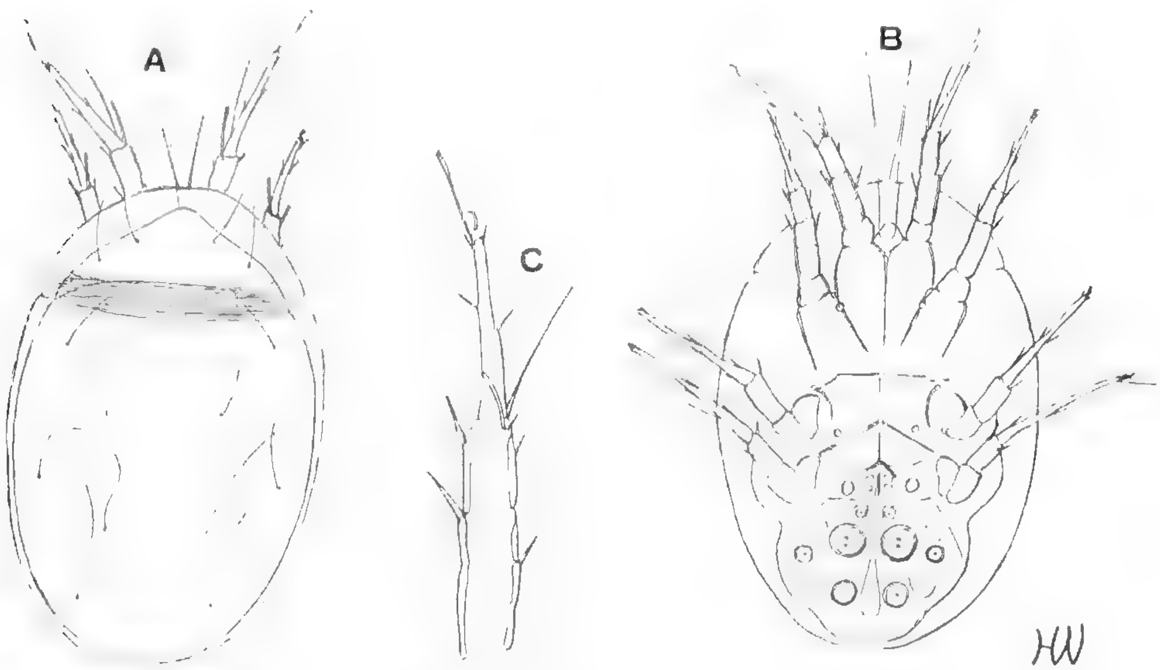


Fig. 20. *Histiostoma nichollsi* n.sp. (deutonymph): A, dorsal; B, ventral; C, leg 1.

ANOETOSTOMA gen. nov.

Differs from all other genera in which the deutonymphs have been described in the arrangement of the discs of the suctorial plate. In this plate there are only 6 discs, a median pair of large ones, posterior of which is a transverse row of 4 small ones. Off the plate and on each side of the vulva is a small disc. There are no pores or discs on any coxae. The dorsal surface lacks a suture between propodosoma and hysterosoma, but there is a transverse depression at about one-third from apex; the surface is coarsely granular.

ANOESTOSTOMA OUDEMANSI sp. nov.

Description: Deutonymph, length 165μ, width 126μ; oval, broadest at about one-third from front, no suture, but at one-third from apex a transverse depression. Dorsum apparently without setae (even under oil-immersion). Legs fairly long and slender, tarsi with small claws; tarsi I and II apically with a long clavate seta, I at base with a long, clavate, rod-like sensory seta; second segment of leg I with long seta arising near apex, none present on leg II; tarsi III and IV with long pointed apical seta; femur of leg II with a long apical seta. Suctorial plate as in genus.

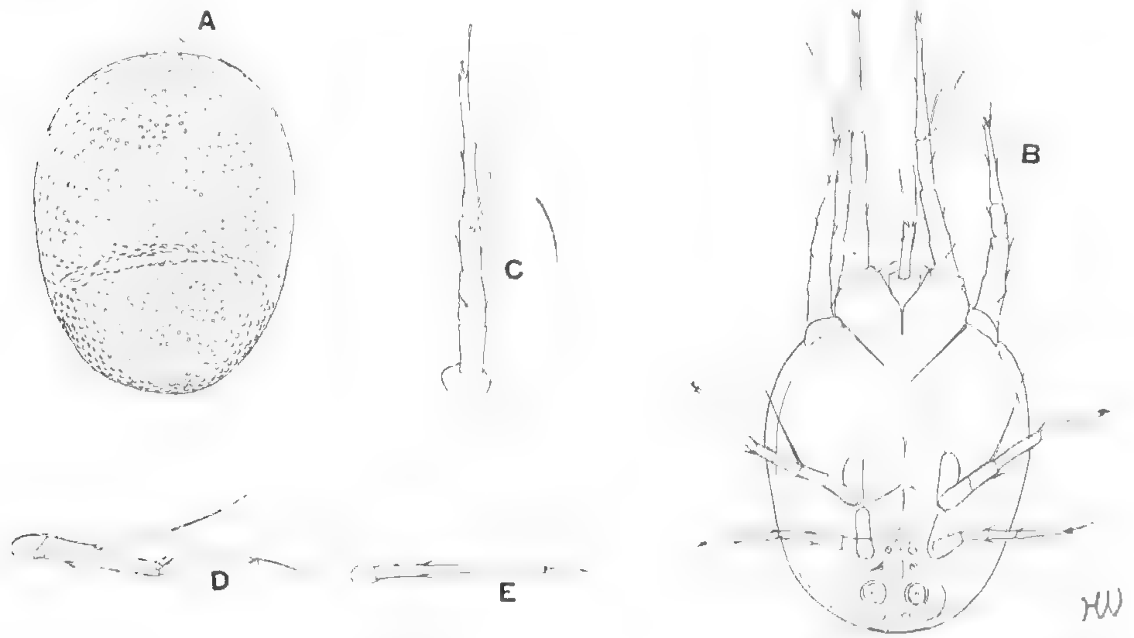


Fig. 21. *Anoetostoma oudemansi*, gen. et sp.nov. (deutonymph): A, dorsal; B, ventral; C, leg 1; D, leg 3; E, leg 4.

Loc. New South Wales: Sydney, June, 1940, on *Musca domestica* (A.L.R.).

To relate this new genus to those previously described from the deutonymphs, I give the following key:

KEY TO THE GENERA OF ANOETIDAE,
BASED ON THE DEUTONYMPH.

1. Suctorial plate with only 4 discs; no discs near vulva or on coxae I and III. *Myianoetus* Ouds. 1929. Type *Anoetus muscarum* (L. 1758).
   More than 4 discs on suctorial plate .. .. 2.
2. Suctorial plate with 6 discs .. .. 3.
   Suctorial plate with 8 discs . .. . 4.
3. The suctorial discs of equal size; apparently none near vulva or on coxae I or III. Leg III without the long femoral seta .. .. *Sellea* Ouds. 1929. Type *Histiostoma pulchrum* Michael 1901.
   The two median suctorial discs very large, others very small; a small one on each side of vulva, none on coxae. Leg III with a long femoral seta. *Anoetostoma* nov. Type *A. oudemansi* sp. nov.

4. Suctorial plate with 2 large discs and 6 small posterior ones arranged in a hexagon; discs near vulva and on coxae I and III .. *Wichmannia* Ouds. 1929.
Type *Histiostoma spiniferus* Mich. 1901.
The 6 small discs of suctorial plate arranged around the two central large ones .. .. 5.

5. Two small discs near vulva . .. . 6.
No discs near vulva, but bristles instead .. .. *Zwickia* Ouds. 1924.
Type *Anoetus guentheri* Ouds. 1915.

6. On coxae I and III a small club-like seta arising from a small basal ring.
Anoetus Duj. 1842.
Type *Hypopus alicola* Duj. 1849.
Not as above .. .. 7.

7. Coxae I or III or both with small discs .. .. 8.
Both coxae I and III without discs or setae .. *Mauduytia* Ouds. 1929.
Type *Anoetus tropicus* Ouds. 1911.

8. Small discs on both coxae I and III .. .. *Histiostoma* Kramer 1876.
Type *Histiostoma pectineum* Kramer 1876.
Small discs on coxae I but not III .. .. *Anoetoglyphus* Vitz. 1927.
Type *A. ateuchi* Vitz. 1927.
Small discs on coxae III but not I .. .. *Glyphanoetus* Ouds. 1929.
Type *G. fulmeki* Ouds. 1929.

GENERA ET SPECIES INQUIRENDAE.

Genus PULLEA Canestrini.

Canestrini Atti Ist. Veneto, ser. vi, vol. 2, 1884, p. 723, pl. ix, f.1, 1a, 1b.

PULLEA DISCOIDALIS Canestrini 1884.

Ibid.

Canestrini gives a figure of the entire dorsal view, the gnathosoma and leg I, and the suctorial plate of the deutonymph as well as a general description of the animal.

The shape is more or less round with a suture line on level of coxae II and another on level of coxae III. The dorsal setae are long and fine. There is a short but distinct caruncle and claw on all legs. In the deutonymph the discs of the suctorial plate are 6 in number, subequal, and arranged in a median row of 4 and a posterior row of 2.

Oudemans (Ent. Ber., 1924, D1, vi. p. 232 and 328) is disposed to place this genus in the Carpoglyphidae, near to *Carpoglyphus*. In the 6 discs of the suctorial plate of the deutonymph it is closely related to the genus *Sellea* Ouds. of the Anoetidae, but if Canestrini correctly associated adult and deutonymph then it cannot possibly belong to this family, but more probably as Oudemans suggests. However, pending re-discovery, it is impossible to definitely ascertain its status.

It was found on a species of *Chrysomela* (Coleoptera) from Queensland.

TYROGLYPHUS QUEENSLANDIAE Canestrini 1884.

Ibid., p. 724, pl. ix, f.3.

This species is described from the deutonymph only. It is shown to have a dorsal furrow running backwards from the second legs, and then connecting by a transverse line. Canestrini's figure shows the suctorial discs as being on the dorsal surface; of these there are 8, a median row of 4 subequal, two in front and two behind; there is also one on each side of where the vulva should be.

It was found on a species of *Cetonia* from Queensland.

As with the previous species the description and figure do not permit of its recognition.

INDEX TO GENERA AND SPECIES

INDEX TO GENERA AND SPECIES.