Two new Cestodes (Genus **Oochoristica**) one from the lizard, **Egernia whitii,** the other from the bat, **Nyctophilus geoffroyi**

By ·

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WITH 22 TEXT FIGURES

SUMMARY

Two new species of *Oochoristica*, namely *O. vacuolata* n. sp. from the lizard, *Egernia whitii* and *O. nyctophili* n. sp. from the bat, *Nyctophilus geoffroyi* are described, and their affinities with other species discussed.

Literature on the genus, published since the review by Hughes (1940), is cited.

INTRODUCTION

Hitherto only one species of the genus *Oochoristica* has been recorded from Australia, namely *O. trachysauri* (MacCallum 1921) Baer 1927. This species was first described from an Australian lizard *Trachysaurus rugosus,* which died in the New York Zoological Park. Later, Johnston (1932) supplemented the original description with information on specimens found in *T. rugosus* in South Australia, New South Wales, Victoria and Southern Queensland. In view of this solitary record, Wardle (1951 p. 123) in commenting on the distribution of tapeworms in the Southern Pacific region (excluding South America and Antarctica) remarks, " Striking is the absence of the marsupial-favouring species of *Oochoristica* Lühe, so well represented among the South American opossums, and the occurrence of only one of the reptile-favouring species of this supposedly primitive genus ".

Furthermore, up to the present no cestode has been recorded from Tasmanian lizards. The discovery of two new species of *Oochoristica,* one, *O. vacuolata* in the lizard, *Egernia whitii* (Lacépède), the other, *O. nyctophili,* in the bat, *Nyctophilus geoffroyi* Leach, is therefore of interest. Descriptions of the new species are given hereunder.

Genus **Oochoristica** Lühe (1898, p. 652)

Diagnosis: Unbewaffnete Taenien, ohne rudimentäres Rostellum und ohne axialen Muskelzapfen, mit randständigen, unregelmässig abwechselnden Genitalöffnungen, deren Uterus eine sehr rasch erfolgende Umbildung erfährt, dergestalt, dass in reifen Proglottiden die Eier einzeln in das Parenchym eingebettet sind. Typische Art: *Oochoristica tuberculata* (Rud.).

Oochoristica vacuolata n. sp.

The following description is based on an examination of about thirty specimens. Twenty specimens were fixed in sublimate acetic. Of these some were stained in either alum carmine or haematoxylin and mounted whole, others were used for serial sections. Whole mounts were also made of compressed specimens fixed in 90% alcohol and stained.

Unless otherwise indicated, quantitative data relating to the type specimen are given in parentheses.

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EXTERNAL MORPHOLOGY

The cestode is dorso-ventrally compressed. Mature worms fixed in sublimate acetic and preserved in 90% alcohol measure 8·2-53·0 (43·0) mm. long and 0·42-1·03 (1·02) mm. wide.

The scolex measures 285·0-405·0 (405·0) μ long and 225·0-375·0 (360·0) μ wide and has a dorso-ventral diameter of about 135·0 μ. It is rounded in front and bears four unarmed suckers, which in life, are directed anteriorly. They are situated laterally, so that on each side there is a dorsal and a ventral sucker. Each sucker is approximately circular and measures 101·0-160·0 (150·0) μ in diameter. The muscular wall forming the floor of the cavity of the sucker varies from 39·0 to 55·0 μ in thickness.

Behind the scolex there is usually a distinct neck 225·0-1050·0 (375·0) μ long, 165·0-300·0 (300·0) μ wide and about 103 μ thick.

The strobila, which increases in width and thickness from the neck to the posterior end, consists of 14-53 (47) proglottides. In relaxed specimens the segmentation is distinct but in contracted worms it becomes obscured by the development of secondary and tertiary folding of the cuticula. The segments are acraspid and increase in length towards the posterior. Immature proglottides are almost as broad as they are long, being 285·0-375·0 (360·0) μ in width and 300·0-390·0 (360·0) μ in length. They are about 140 μ thick. Mature segments (except when contracted) are longer than broad 400·0-1120·0 (1000·0) x 320·0-570·0 (570·0) μ. Gravid segments are always longer than broad and measure 570·0-4275·0 (1200·0-3600·0) μ long, 345·0-1025·0 (600·0-1020·0) μ wide and about 285 μ thick.

CUTICULA AND PARENCHYMA
(FIGURE 1)

The cuticula varies in thickness from 1 to 3 μ. It consists of three layers. There is an outer layer beset with numerous small projections. Underneath the outer layer is a thicker homogeneous layer. Inside this layer is the basement membrane. Hooks and spines appear to be absent.

Cortical and medullary parenchyma are recognisable. The outermost layer of the cortical parenchyma is composed, almost entirely of extremely large vacuolated cells. These cells are visible both in live specimens and in whole mounts. They attain their maximum size in mature and gravid segments. When the segments are extended the cells measure up to 62·0 μ in depth and 40·0 μ in diameter. They form a layer 40·0-62·0 μ in thickness. Owing to the development of large vacuoles the nuclei of these cells are situated excentrically and are closely applied to the walls of the cells.

Calcareous corpuscles are distributed throughout the parenchyma. They appear to be more numerous in the cortical parenchyma and outer parts of the medullary parenchyma than elsewhere. Their form is spherical to ovoid and their greatest diameter measures 4·6-9·2 μ. Young worms have a higher concentration of these corpuscles than do mature worms.

In the neck region the cortical parenchyma is approximately the same thickness as the medulla, that is to say the greatest distance from the cuticula to the transverse muscles is about the same as the maximum dorso-ventral distance between the two layers of the transverse muscles.

For both cortex and medulla the thickness ranges from 34·5 to 40·0 μ. However, in the region of the immature proglottides the thickness of the cortex varies from 46·5 to 57·5 μ and is only about two-thirds that of the medulla, which, in this region, varies from 69·0 to 80·5 μ. In mature and gravid proglottides the sub-cuticular cells enlarge causing the thickness of the cortex once more to approach that of the medulla. For example in the mature proglottides the thickness of the cortex varies from 57·5 to 80·5 μ and that of the medulla from 69·0 to 110·0 μ while in the gravid proglottides the thickness of the cortex varies from 80·5 to 115·0 μ and that of the medulla from 69·0 to 138·0 μ.

MUSCULAR SYSTEM
(FIGURE 1)

Immediately beneath the cuticula is a very thin layer of extremely fine fibres forming the subcuticular circular and longitudinal musculature.

There are two sets of longitudinal muscles in the cortex. The outer set is weakly developed consisting of single fibres, or bundles of two to four fibres, situated immediately beneath the large subcuticular cells. These fibres are most easily seen in mature segments. The inner set of longitudinal muscles is fairly well developed. It consists of 26-34 muscle bundles, separated from each other by distances up to 23·0 μ. The number of bundles in the dorsal half of the segment is generally the same as that in the ventral half. In mature segments the distance of the bundles from the cuticula measures 46·0-69·0 μ and in gravid segments 69·0-103·0 μ. Each bundle consists of 3-10 fibres. Bundles of eight contracted fibres measure 11·5-16·0 μ in diameter. The diameter of contracted fibres varies from 2·3 to 6·9 μ. The transverse and dorso-ventral muscles are poorly developed. They consist of very fine fibres which are not grouped into bundles.

No special musculature is associated with the genital atrium. The subcuticular musculature closes and opens the atrium.

EXCRETORY SYSTEM
(FIGURES 2-7)

In each lateral half of the strobila there is a dorsal longitudinal vessel and a ventral longitudinal vessel. These traverse the whole length of the worm and are situated in the medulla, $\frac{1}{4}$-$\frac{1}{3}$ the width of the strobila from the lateral margin. In the neck, the distance separating dorsal and ventral vessels from each other is about 16·0 μ and in the immature segments, about 20·0 μ. In the mature segments, the separation of the vessels is somewhat greater and more variable, averaging 29·0 μ. In the gravid proglottides the distance between dorsal and ventral vessels is 23·0-80·5 μ, the separation being greatest where the genital ducts pass between the two vessels. The diameter of the dorsal vessels measures 6·9-11·5 μ, whilst that of the ventral vessels 8·0-20·7 μ. In mature segments the average diameter of the dorsal vessel is 9·2 μ, that of the ventral vessel 11·5 μ. Near the posterior of each segment the ventral vessels are connected by a transverse vessel. In mature and gravid segments this transverse vessel is often curved posteriorly so that its connections with the ventral vessels are oblique. The diameter of the transverse vessel varies from 4·6 to 9·2 μ.
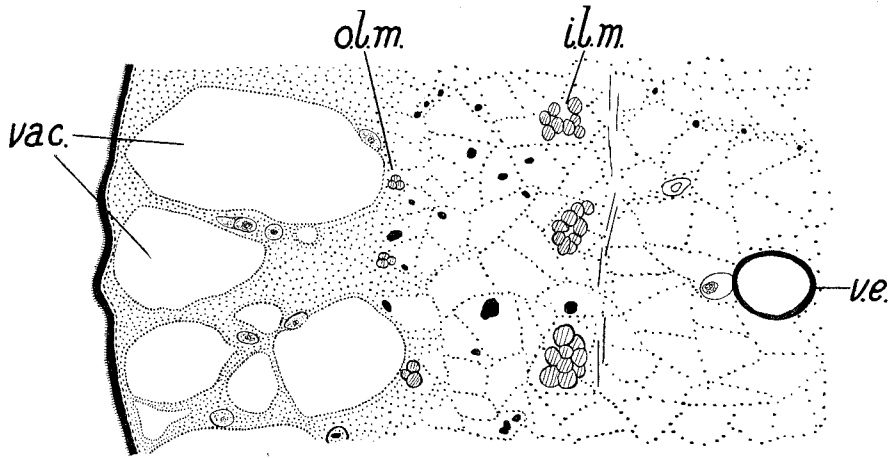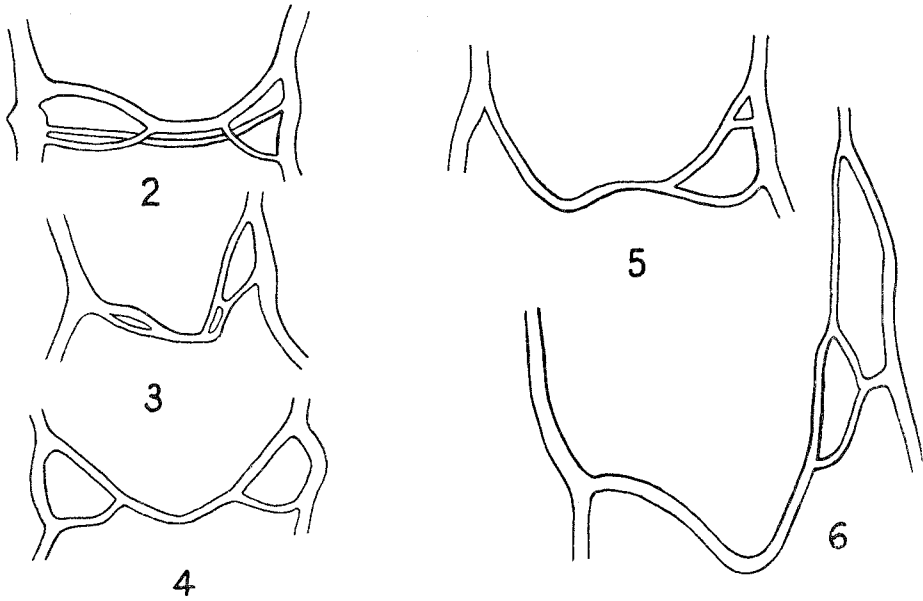
Oochoristica vacuolata n. sp.

Fig.   1.—Transverse section of body wall.
Figs. 2-6.—Variations in the connections between the transverse excretory vessel
                and the ventral longitudinal excretory vessels.

In the first formed proglottis the longitudinal vessels unite posteriorly in a common elongated vesicle which is surrounded by darkly staining cells and opens to the exterior through a median posterior pore. After the casting off of this proglottis the longitudinal vessels may open separately or the dorsal vessel of each side may unite with the ventral vessel of the same side to form a small posterior vesicle, which opens to the exterior. Between the anterior limits of the suckers the dorsal and ventral vessels on each side unite. In a specimen whose scolex measures 253·0 μ in width, the union of the vessels occurs at 70·0 μ from the anterior margin. The two vessels so formed have a diameter of 6·9 μ. They pass anteriorly for a distance of 20·0 μ and then join in a transverse loop. This loop is situated at about 50·0 μ from the anterior margin of the scolex.

Irregularities such as duplication of parts of the main vessels, are common, especially in the scolex and at the connections with the transverse vessels.

NERVOUS SYSTEM

The two main lateral nerves have diameters of 11·5-13·8 μ and traverse the entire length of the strobila external to the excretory vessels but inside the medulla. The distance of the nerves from the lateral margin measures 3/20-3/11 the width of the strobila.

The nervous system of the scolex consists of two lateral ganglia which are connected dorsally with a median dorsal ganglion and ventrally with a median ventral ganglion. The lateral ganglia are connected by a narrow transverse commissure which passes between the dorsal and ventral excretory vessels, just posterior to the union of the latter. The lateral ganglia measure 23·0-34·5 μ in diameter. They are situated about 69 μ apart, between and slightly internal to the dorsal and ventral suckers of each side. The lateral nerves arise from these ganglia and diverge towards the margins of the strobila.

The dorsal and ventral ganglia are situated between the dorsal and ventral suckers respectively. They are rather smaller than the lateral ganglia and measure 18·4-23·0 μ in diameter. Slender dorsal and ventral nerves arise from these two ganglia. The transverse commissure linking the lateral ganglia has a diameter of about 4·6 μ.
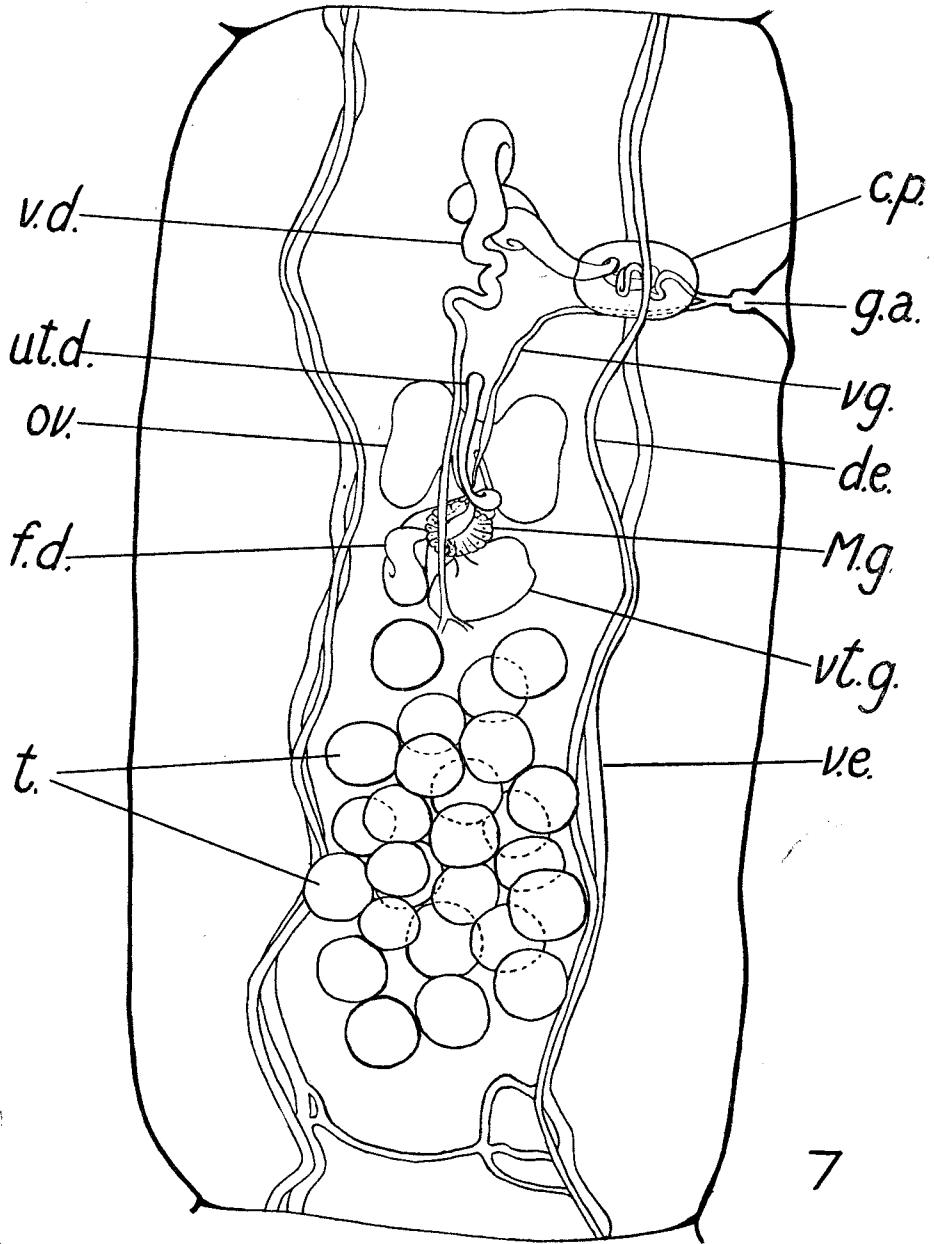
Oochoristica vacuolata n.sp.
FIG. 7.—Dorsal view of mature proglottis.

REPRODUCTIVE SYSTEM
(FIGURES 7-11)

The primordium of the reproductive system appears 0·65-1·5 (0·9) mm. from the anterior end of the scolex and within the first four proglottides. It has the form of a mass of centrally-placed darkly staining cells, from which, in the succeeding segments, the ovary and vitelline gland are developed. The former is situated anterior to the latter. Within segments 8-10 (10), 1·8-2·4 (1·8) mm. from the anterior end of the worm, a transversely elongated group of cells appears to the left or right of the anterior of the ovary. This group of cells gives rise to both the vagina and the vas deferens. In the same region of the worm but posterior to the female glands the testes appear. Within the following five to eighteen segments the ovary becomes clearly bilobed, the vitelline gland is seen as a distinct structure, the testes mature and the genital ducts become visible. Finally the uterus and Mehlis's gland appear. Maturity is attained within segments 14-31 (29-31), 3·1-11·0 (11·0) mm. from the anterior end of the worm. The uterus develops rapidly and resolves itself into numerous uniovulate capsules which gradually become scattered through the medullary parenchyma of the segments posterior to those that are mature. With the growth of the uterus, other organs begin to degenerate. The testes are first to disappear and are followed by the ovary and vitelline gland. Next, the vagina and vas deferens degenerate and finally the cirrus pouch. Within segments 22-40 (40), 22·5-25·0 (25·0) mm. from the anterior end of the worm onchospheres are developed.

The common genital pores are situated laterally and alternate irregularly. The distance of the pore from the anterior margin of the proglottis varies from $\frac{1}{6}$ to $\frac{1}{4}$ ($\frac{1}{5}$-$\frac{1}{4}$) the length of the proglottis. There is often a slight protuberance of the margin surrounding the pore. Inside the pore the atrium measures 13·8-20·7 μ in diameter and 9·2-18·4 μ in depth. The atrium which has a cuticular lining is surrounded by darkly staining cells. It appears to lack any particular musculature. Opening into the inner end of the atrium in mature and gravid segments is a small common canal (fig. 8). In immature segments the opening is closed by the cuticular lining of the atrium. The canal communicates with the poral end of the transversely elongated cirrus pouch. It is thin walled and measures 29·9-32·2 μ in length and 2·3-4·6 μ in diameter. The vagina joins the canal ventrally at 18·4 μ from the atrium.

Female

The ovary is bilobed and its two lobes are not subdivided. In the mature region of the strobila the distance of the front of the ovary from the front of the proglottis is $\frac{1}{4}$ to $\frac{1}{3}$ (7/24) the length of the segment. The ovarian bridge is either central or slightly poral to the midline and unites the anterior ventral parts of the ovarian lobes. It has a diameter of 23·0-34·5 μ. The ovary is 96·6-184·0 μ wide and 46·0-80·5 μ thick. The width of the aporal lobe measured from the ovarian bridge to the lateral margin of the lobe varies from 48·3 to 92·0 (75·0-90·0) μ and is generally slightly greater than that of the poral lobe which varies from 46·0 to 92·0 (75·0-82·0) μ. Sometimes the lobes are equal in width but rarely is the poral wider than the aporal lobe. The lobes are seldom equal in length, one lobe being nearly always slightly longer than the other. The

length of the poral lobe measures 36·8-138·0 (105·8-120·0) μ and that of the aporal lobe 48·3-120·0 (105·0-120·0) μ. Usually the aporal lobe is closer to the anterior of the proglottis than is the poral lobe.

The vitelline gland is situated posterior to the ovary and near the middle of the segment. In extended proglottides the distance from the anterior margin of the ovary to the posterior margin of the vitelline gland measures 225·0-255·0 μ. The distance from the posterior of the ovarian bridge to the anterior of the vitelline gland varies from 73·6-103·5 μ. The vitelline gland is variable in shape but always compact and usually broader than long, 36·8-98·9 (75·0-90·0) x 32·2-92·0 (75·0-90·0) μ. It has a dorso-ventral diameter of 46·0-80·5 μ.

Mehlis's gland is situated dorso-anteriorly to the vitelline gland. It has a diameter of 23·0-36·8 (34·5) μ.

On leaving the vaginal pore the vagina, which seems to be lined with cilia, passes inwards as a narrow duct 2·3 μ in diameter. A sphincter muscle is absent. The vagina either passes directly inwards along the postero-ventral side of the cirrus pouch or curves forward beneath the pouch to pass inwards along its antero-ventral side. In either case it passes dorsal to the lateral nerve and either between or dorsal to the poral excretory vessels. On reaching the inner end of the pouch it curves in a wide arc towards the ovarian bridge. Some distance in front of the ovary the vagina forms a somewhat elongated receptaculum 80·5-92·0 μ in length. The width of the receptaculum is variable and depends to some extent on the presence or absence of sperms in the lumen. The posterior end of the receptaculum which may measure 16·1 μ in diameter passes over the ovarian bridge, sometimes slightly to the poral side. From here the vagina narrows, bends ventrally and enters the oviduct.

The oviduct arises ventrally from the ovary in the region of the bridge. It passes back between the lobes of the ovary for a distance of about 51·7 μ. A muscular oocapt is absent. However, at a distance of about 46 μ from the ovarian bridge there is a marked constriction of the wall of the oviduct. A short distance beyond this constriction, the oviduct bends back on itself dorsally and passes forward in an antero-dorsal direction for a distance of approximately 28·7 μ. At this point it is joined by the vagina. That part of the oviduct preceding and including the constriction is thin-walled. Beyond the constriction the wall of the duct increases in thickness and the duct measures about 27·6 μ in diameter. Following its junction with the vagina the duct continues as the fertilization canal and immediately folds back on itself dorsally. It passes back in a postero-ventral direction and may curve to either side so as to pass between the front of the vitelline gland and either the poral or aporal lobe of the ovary. After traversing a distance of about 92·0 μ, the canal bends back dorsally on itself to pass forwards and then inwards towards Mehlis's gland which it penetrates from behind and below. The ferilization canal has a thick wall like that of the oviduct. Its diameter also is about 27·6 μ.

The vitelline duct arises from the dorsal aspect of the vitelline gland and passes anteriorly to enter Mehlis's gland from behind. It has a diameter of 6·9-18·4 μ.
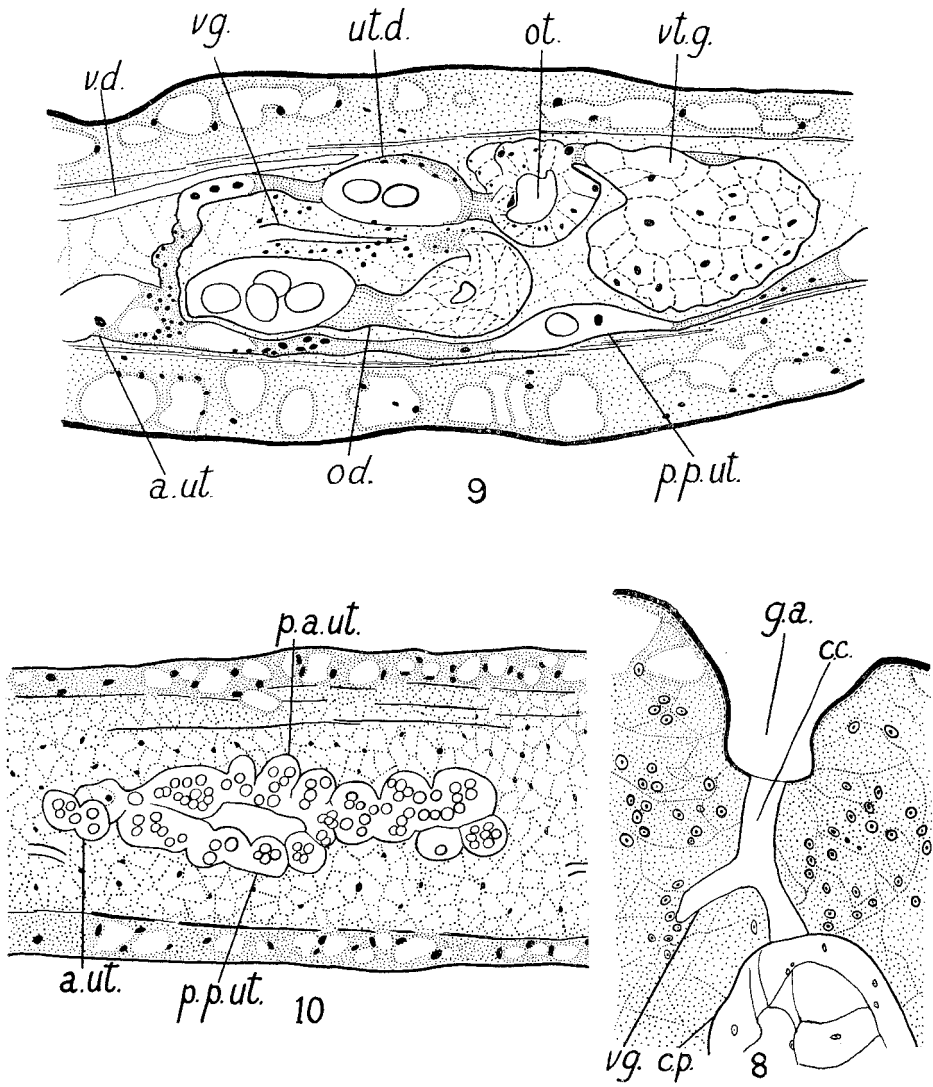
Oochoristica vacuolata n.sp.

FIG. 8.—Part of transverse section through a mature proglottis in the region
of the genital atrium.

FIG. 9.—Paramedial section through a semigravid proglottis.

FIG. 10.—Horizontal section through the ventral medulla of a semigravid pro-
glottis showing the uterus.

Inside Mehlis's gland the vitelline duct unites with the fertilization canal to form an ootype. The ootype is spherical or ovoid in shape, 13·8-29·9 μ in diameter.

The uterine duct arises from the anterior of the ootype and passes forward ventrally to the vas deferens and dorsally to the oviduct, receptaculum and ovarian bridge. As it passes forward its course becomes rather sinuous. Immediately in front of the ovary the duct curves ventrally, aporal to the vagina (receptaculum) and passes to the anterior ventral side of the ovary where it enters the uterus. The uterine duct has a diameter of 11·5 μ except near Mehlis's gland where it may measure 23·0-34·5 μ wide. The wall consists of a single layer of flat cells. From the place of entrance of the uterine duct, the uterus spreads out anteriorly and posteriorly. Initially the uterus has a short median anterior prolongation and a pair of longer posterior outgrowths. The latter pass ventrally to the lobes of the ovary on either side of the midline and merge with each other ventrally and posteriorly to the vitelline gland (fig. 10). At this stage the uterus consists of a series of cavities which are in communication with each other and which have a dorso-ventral diameter of about 11·5 μ. The eggs pass forward through the uterine duct into the cavities of the uterus. As the uterus fills with eggs it grows rapidly towards the anterior and posterior of the proglottis to fill the entire ventral part of the medulla. It then develops numerous branches which pass upwards between the degenerating genital organs. Finally the uterus appears to resolve itself into a large number of uniovulate capsules. These capsules vary in shape from spherical to ovoid and measure 52·9-87·4 × 34·5-57·5 μ. In the posterior gravid segments each onchosphere is surrounded by two membranes. The outer membrane is thin and irregularly shaped, whilst the inner membrane (embryophore) is thick and oval. The embryophore measures 37·9-46·0 × 32·2-39·1 μ and contains an oval onchosphere 34·5-41·1 × 27·6-34·5 μ. The hooks of the onchosphere vary in length from 18·4 to 25·0 μ.

Male.

The testes are situated in the medulla of the posterior half of the proglottis, some being disposed dorsally, others ventrally, the upper ones frequently overlapping the lower ones. They lie between the lateral nerve cords and may occur on each side of the vitelline gland. However, they do not extend above, below or in front of this gland. The number of testes in any one proglottis varies from 19 to 45, the most usual number being 33. They are clearly distinguishable in 5 to 18 segments. The testes are generally spherical and measure 25·3-69·0 μ in diameter. In mature proglottides they are commonly 46·0-57·5 μ in diameter. They increase in size as they discharge the sperms, and attain their maximum size in semi-gravid proglottides. The vasa efferentia from the testes join up and form two main ducts. These unite above the vitelline gland and form the vas deferens, which passes forward dorsally to the ovary. It generally lies slightly aporal to and above the uterine duct, receptaculum and ovarian bridge, where it has a diameter of 4·6-6·9 μ. At about the level of the cirrus pouch and atrium it becomes highly convoluted and its diameter increases to

about 18·4 μ. Here its wall measures 6·9-9·2 μ in thickness and is composed of a single layer of very large cells. The nuclei of these cells are of remarkable size, measuring 2·3-4·6 μ in diameter. This part of the vas deferens is usually filled with spermatoza and appears to function as a vesicula seminalis. After forming about 7 loops it enters the cirrus pouch. Within the pouch it forms 3-5 loops and then decreases in diameter giving rise to a thin walled unarmed cirrus. The latter measures about 36·8 μ long and has a diameter of 3·4 μ. When everted, the cirrus protrudes through the short common canal leading to the genital atrium. The cirrus pouch has a thin muscular wall and varies from 46·0 to 69·0 (46·0) μ in diameter. It has a length of 73·6-119·6 (87·4) μ and lies above the poral longitudinal nerve. In mature segments it extends either above or between and beyond the poral excretory vessels for a distance of about half its length, but in gravid segments it barely reaches the excretory vessels. A retractor muscle to the cirrus pouch is absent.

Type host: Egernia whitii (Lacépède).

Type locality: Domain, Hobart.

Type specimen: In Department of Zoology, University of Tasmania.

Affinities of *O. vacuolata* n. sp.

Hughes (1940) in a review of the genus of *Oochoristica* lists 28 species from reptilian hosts. Hughes, Baker and Dawson (1941) record 30 species from reptiles. Four other species, one subspecies and one variety, all from reptiles, may now be added to the list. They are as follows: *O. africana* Malan (1939) from *Agama hispida* var. *distans*, *O. africana* var. *ookiepensis* Malan (1939) from *Scaptira knoxi, O. anniellae* Stunkard and Lynch (1944) from *Anniella pulchra nigra, O. indica* Misra (1945) from *Calotes versicolor, O. scelopori* Voge and Fox (1950) from *Sceloporus occidentalis occidentalis* and *O. amphisbeteta junkea* Johri (1950) from *Gecko gecko*.

In reference to *O. amphisbeteta junkea,* which Johri records from a reptile, it may be pointed out that *O. amphisbeteta* was originally recorded by Meggitt (1924) from a mammal. It seems very unlikely that the same species of cestode occurs in such different hosts and one may doubt whether the form described by Johri is assignable to *O. amphisbeteta*.

The tapeworm described in the present paper brings the total species of *Oochoristica* recorded from reptiles to 35. Unfortunately the descriptions of many of the species are incomplete and frequently limited to quantitative characters. As a result it is often difficult satisfactorily to distinguish species.

When compared with those species which have been adequately described, *O. vacuolata* n. sp. is seen to resemble *O. trachysauri* (MacCallum 1921) as described by Johnston (1932). However, it differs from *O. trachysauri* in the position and development of the uterus, the presence of a constriction of the oviduct, the form of the ovarian lobes .and the absence of special musculature of the atrium. Moreover, the

genital ducts of *O. vacuolata* n. sp. do not open independently into the atrium, but by way of a short common canal. The size of the worm, scolex and suckers, the dimensions of the cirrus pouch, the size and number of the testes and the size of the ovary, vitelline gland, eggs and onchosphres are quantitative characters in which the new species often differs from other members of the genus.

The specific name *vacuolata* was suggested by the vacuolated nature of the subcuticular cells.

Infestation of Host.

Sixty specimens of the lizard, *Egernia whitii* were examined. Of these 55 came from the Domain, near Hobart, 2 from Mt. Nelson and 3 from Cooee, near Burnie. Forty of the specimens were found to be infested and all of these were from the Domain.

The cestode was generally present in the anterior part of the small intestine and attached to the wall a short distance from the pyloric valve. In some cases, however, the tapeworm was attached further away from the pyloric valve and the posterior proglottides extended into the rectum. Starvation of the host for about a fortnight caused the cestodes to undergo marked destrobilization. Of the forty lizards harbouring the tapeworm 19 were males and 21 were females. The intensity of infestation varied from 1-16 worms per host.

The following table shows the relative frequency of infestation of the sexes correlated with intensity of infestation.

Number of Worms		1	2	3	4	5	6	7	9	12	14	16
Number of Lizards infested	Male	4	2	3	1	1	1	2	1	2	1	1
	Female	2	3	6	1	3	2	1	1	0	1	1

From the above table it may be seen that the lizards showed no evidence of sex resistance to infestation. The lizards varied in size but no correlation between size and intensity of infestation was evident. The total number of cestodes found was 212.
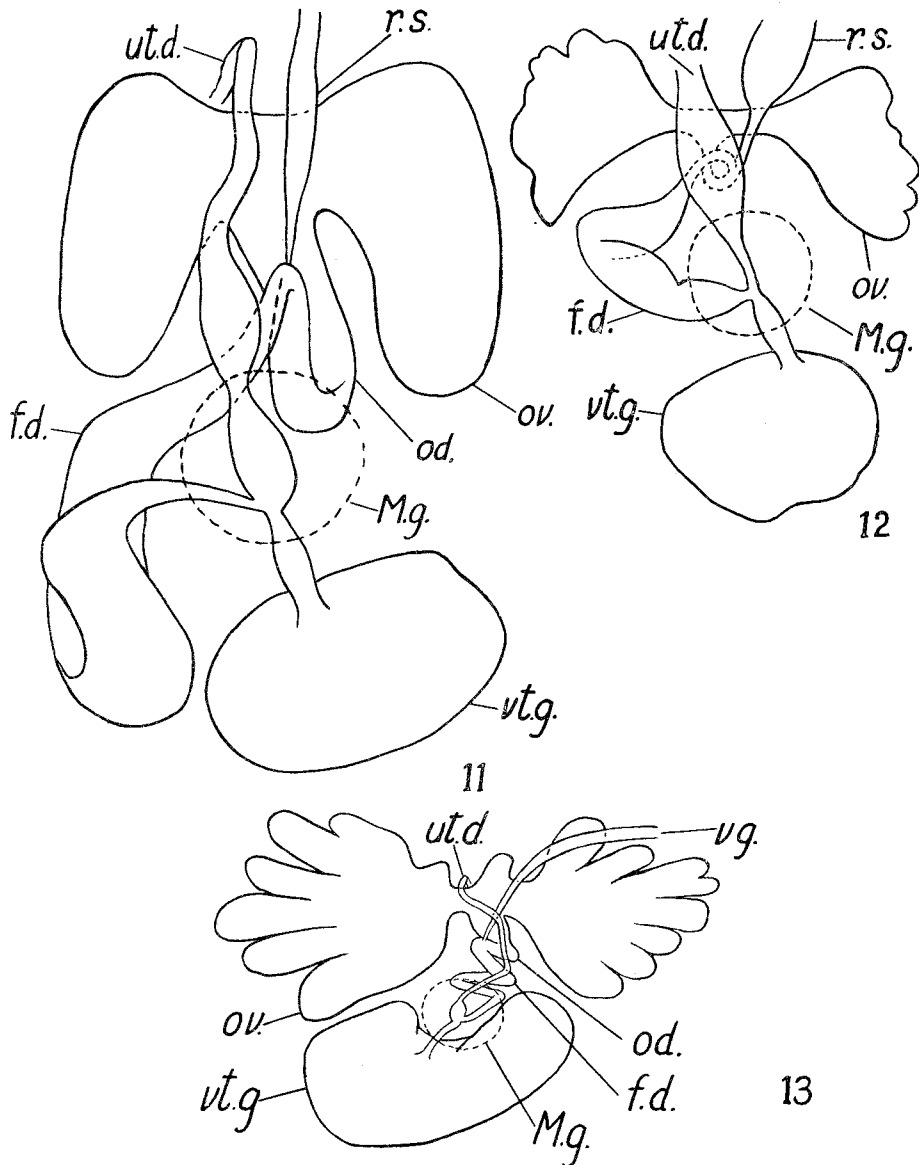
Oochoristica nyctophili n. sp.

The following description is based on three specimens, two of which are complete and one lacks the scolex and some of the anterior segments of the strobila. The worms were fixed in sublimate acetic and sectioned at 8-10 μ.

Unless otherwise indicated, quantitative data relating to the type specimen are given in parentheses.

EXTERNAL MORPHOLOGY.

The mature worm is 11-31+ (28) mm. long and has a maximum width of 0·975-1·65 (0·975) mm. It is dorsoventrally compressed, having a maximum thickness of 345·0-420·0 (360·0) μ.

Oochoristica vacuolata n.sp.

FIG. 11.—Ovary and associated organs in dorsal view.

Oochoristica trachysauri (MacCallum)

FIG. 12.—Ovary and associated organs in dorsal view.   (After Johnston, 1932, p. 66, fig. 7.)

Oochoristica nyctophili n. sp.

FIG. 13.—Ovary and associated organs in dorsal view.

The scolex is rounded in front and bears four unarmed suckers. It measures 207·0-270·0 (207·0) μ in width and has a dorso-ventral diameter of 168·0-195·0 (168·0) μ. The suckers are situated laterally so that on each side there is a dorsal and a ventral sucker. They are cup-shaped and oval, measuring 100·0-115·0 $\times$ 64·5-80·5 (100·0-115·0 $\times$ 64·5-73·6) μ. The depth of the cavity of the sucker varies from 36·8 to 55·2 (36·8-48·3) μ and the muscular wall at the bottom of the cavity is 23·0 μ thick.

The strobila increases in width and thickness from the neck to the posterior end. The segmentation is distinct, the strobila consisting of 40-46 (46) segments. In relaxed specimens the segments are acraspid and increase in length towards the posterior. The anterior segments are broader than long but the posterior segments are longer than broad.

CUTICULA AND PARENCHYMA.
(FIGURE 14)

The cuticula varies in thickness from 2·3 to 3·4 μ. It consists of three layers, an outer comidial layer, a central homogeneous layer which constitutes the greatest portion of the cuticula, and a basement membrane.

Hooks and spines are absent.

The cortex and medulla are quite distinct. Immediately beneath the basement membrane the cortex consists of numerous cells which are closely packed and elongated at right angles to the basement membrane.

Nearer the medulla the cortex consists of a smaller number of cells, more loosely packed and forming a meshwork. The cortex varies in thickness from 69·0 to 92·0 μ.

The cells of the medulla also form a meshwork. As the segments mature the medulla increases in thickness from 80·0 μ in immature segments to 172·0 μ in gravid segments. However, in a contracted mature segment the medulla measured 200·0 μ thick. No calcareous corpuscles were observed. However, they may have been removed by the fixative.

MUSCULAR SYSTEM
(FIGURE 14)

Situated immediately beneath the basement membrane is the subcuticular circular and longitudinal musculature. It is composed of extremely fine fibres. There are two sets of longitudinal muscles in the cortex. The outer set consists of separate fibres and bundles of 2 to 6 fibres scattered in the meshwork of the cortical parenchyma. The largest bundles are found nearest the medulla. The fibres are each about 2·3 μ in diameter and a bundle of six such fibres measures 9·2 μ in diameter. The inner set consists of a single layer of 35-50 muscle bundles surrounding the medulla. Each bundle is composed of 2 to 10 fibres. The fibres measure 2·3 to 3·5 μ in diameter. The bundles of fibres are frequently dorso-ventrally compressed and a bundle of six fibres measures 13·8 μ in diameter.

The transverse musculature (circular musculature) which separates the cortex from the medulla consists of separate fibres. These fibres appear intermingled with the inner longitudinal muscle bundles. There is a well-developed dorso-ventral musculature consisting of separate fibres which pass either through the medulla from the dorsal to the ventral transverse muscles or to the genital organs situated in the medulla.

EXCRETORY SYSTEM
(FIGURE 15)

In each lateral half of the medulla there is a dorsal and a ventral longitudinal vessel. These traverse the whole length of the strobila. The dorsal vessels are very narrow and in mature proglottides have a diameter of $4 \cdot 0$ μ. They are frequently linked with the ventral vessel of the same side by short dorso-ventral vessels. The diameter of the ventral vessels is very variable and in mature segments averages $9 \cdot 2\mu$. The vessels occasionally anastomose and in each segment they are linked by 2 or more transverse vessels. The separation of the dorsal and the ventral vessels of the same side and the distance of the ventral vessel from the lateral margin of the strobila vary considerably.

In the scolex the dorsal vessel and the ventral vessel on each side unite and the two vessels so formed pass forwards to join in a transverse loop situated 60 μ from the anterior margin of the scolex.

NERVOUS SYSTEM

In the scolex there is a small ganglion at the base of each sucker and a larger ganglion between the dorsal and ventral sucker of each side. The small ganglia measure $13 \cdot 8$ μ and the larger lateral ganglia $23 \cdot 0$ μ in diameter. These ganglia are joined together to form a nerve ring. In addition, the lateral ganglia are joined by a transverse commissure which passes between the dorsal and ventral excretory vessels of each side. This transverse commissure has a diameter of $4 \cdot 6$ μ. From each lateral ganglion a stout nerve passes posteriorly through the whole length of the strobila. These lateral nerves which measure $13 \cdot 8$ to $23 \cdot 0$ μ in diameter are situated just inside the medulla, $85 \cdot 0$ to $110 \cdot 0$ μ in from the lateral margin of the strobila.

REPRODUCTIVE SYSTEM
(FIGURES 13, 15-22)

In the centre of segment 2, about 600 μ from the anterior of the worm, the primordium of the ovary and vitelline gland appears. In segment 11-13 (11), $1 \cdot 4$-$1 \cdot 7$ ($1 \cdot 7$) mm. from the anterior of the scolex, the cells destined to form the vagina and vas deferens appear to the left and right of the anterior of the developing ovary. Posterior to the female glands in segment 12-14 (12) and $1 \cdot 5$-$1 \cdot 9$ ($1 \cdot 9$) mm. from the anterior of the worm, the testes appear. In segment 16-18 (16), $2 \cdot 3$-$2 \cdot 6$ ($2 \cdot 6$) mm. from the anterior of the scolex, the ovary, vitelline gland, vagina, uterine duct, testes, vas deferens, and cirrus pouch are all distinguishable.
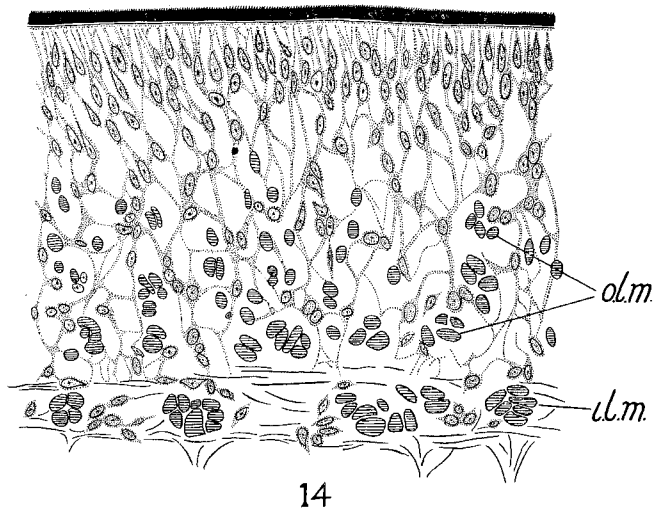
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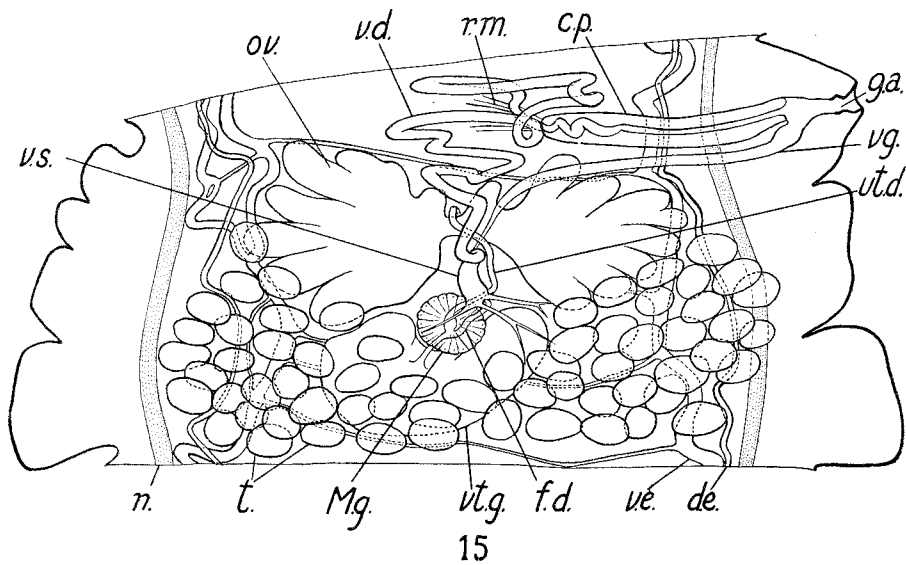
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Oochoristica nyctophili n.sp.

FIG. 14.—Transverse section of body wall.
FIG. 15.—Dorsal view of a mature proglottis reconstructed from a series of horizontal
            sections.

Although the uterus and Mehlis's gland are evident in segment 21-23 (21), 3·2-4·0 (4·0) mm. from the anterior of the worm, maturity is not attained until segments 25-31 (25, 26) at a distance of 5·6-5·7 (5·7) mm. from the anterior of the scolex. In the succeeding segments eggs pass into the uterus and the genital organs degenerate. As the uterus fills with eggs it rapidly resolves itself into a large number of uniovulate capsules which fill the entire medulla of gravid segments. In the type specimen, onchospheres are present in segments 41-46, 18·7-28·0 mm. from the anterior of the worm.

Mature segments are broader than long 690·0-1000·0 × 610·0-338·0 (810·0 × 338·0) μ. The common genital pores are situated laterally and alternate irregularly. The distance of the pore from the anterior margin of the proglottis is 1/8-1/4 (1/8) the length of the proglottis. There is often a slight protuberance of the margin surrounding the pore.

The genital atrium measures 15·0-30·0 μ deep and 9-15 μ in diameter. It has a thick cuticular wall and is surrounded by a dense mass of darkly staining cells. It appears to lack special musculature. Opening into the inner end of the atrium, in mature and gravid segments, is a wide thin-walled common canal. In immature segments the opening is closed by the cuticular lining of the atrium. The canal communicates with the poral end of the transversely elongated cirrus pouch. It measures 45·0-66·0 × 9·0-48·0 (57·5 × 11·5) μ. The vagina joins the inner end of the canal behind or below the male pore (figs. 17 and 18).

Female

The ovary is bilobed and measures 345·0-450·0 (435·0) μ wide and 120·0-190·0 (190·0) μ thick. The distance of the front of the ovary from the anterior of the proglottis is 1/7-1/4 (1/7) the length of the proglottis. Uniting the anterior ventral parts of the main lobes of the ovary is a narrow ovarian bridge about 70 μ in diameter. This bridge is situated on the longitudinal axis of the proglottis. The poral lobe of the ovary measures 165·0-225·0 (225·0) μ wide and 105·0-260·0 (150·0) μ long. It is generally only slightly smaller than the aporal lobe which measures 190·0-225·0 (210·0) μ wide and 120·0-260·0 (165·0) μ long. Each lobe is further subdivided into five or six finger-like lobules.

The vitelline gland is situated posterior to the ovary and just posterior to the centre of the segment. The distance between the posterior of the ovarian bridge and the anterior of the vitelline gland is 60·0-150·0 (60·0) μ. In horizontal sections of mature segments the vitelline gland appears kidney-shaped with its concavity anterior. It is also notched dorsally. The gland is compact and broader than long measuring 250·0-285·0 (285·0) × 120·0-200·0 (150·0) μ. It has a dorso-ventral diameter of 105·0-140·0 (140·0) μ.

Mehlis's gland is situated dorsal and slightly anterior to the vitelline gland. It has a diameter of 46·0-69·0 (69·0) μ.

Surrounding the poral end of the vagina is a well-developed sphincter muscle (figs. 17 and 18). From here, the vagina, which has a diameter of 9·2-23·0 (11·5) μ passes inwards along either the posterior or postero-ventral side of the cirrus pouch. It passes dorsal to the lateral nerve

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and either dorsal to or between the poral excretory vessels. On reaching the inner end of the cirrus pouch it narrows and curves in a wide arc towards the ovarian bridge. Throughout its length the vagina is surrounded by darkly staining gland cells. It decreases in diameter, passes over the ovarian bridge slightly to the poral side, and enters the oviduct. A receptaculum seminis is absent.

The oviduct arises from the postero-ventral aspect of the ovarian bridge and passes back ventrally for a distance of 69·0-92·0 (69·0) μ. The first part of the duct is surrounded by numerous long-necked gland cells and a muscular thickening of its wall forms a conspicuous oocapt (figs. 19 and 20). Beyond the oocapt the oviduct has a thick non-muscular wall (fig. 21). It bends back on itself dorsally and passes in an antero-dorsal direction for a distance of 69·0-92·0 (69·0) μ. Except in the vicinity of the oocapt, the oviduct has a diameter of 20·7-23·0 (20·7) μ. As it approaches the postero-dorsal aspect of the ovarian bridge its diameter decreases slightly and at this point it is joined by the vagina.

It now continues as the fertilization canal and once more bends back on itself dorsally to pass in a postero-ventral direction towards the vitelline gland. After traversing a distance of 69·0-92·0 (69·0) μ it reaches the antero-ventral aspect of the vitelline gland and then curves dorsally, becoming narrow and penetrating the poral or aporal side of Mehlis's gland. The fertilization canal, like the oviduct, has a thick non-muscular wall and throughout the greater part of its course has a diameter of 16·1-20·7 (16·1) μ. In mature segments this canal is full of sperms. Sperms also occur in that part of the oviduct extending from the oocapt to the entrance of the vagina.

The vitelline duct arises from the dorsal notch of the vitelline gland and passes dorsally and then anteriorly to enter Mehlis's gland from behind. This duct, which is surrounded by darkly staining cells has a diameter of 6·9-11·5 (11·5) μ. In immature proglottides the vitelline duct appears to arise from the gland as two short ducts which immediately unite. Inside Mehlis's gland the vitelline duct unites with the fertilization canal to form a thin-walled ootype.

The ootype which is ovoid in shape, measures 20·0-23·0 (20·7) $\times$ 11·5-25·0 (13·8) μ and is surrounded by the ill-defined cells of Mehlis's gland.

The uterine duct arises from the anterior of the ootype and passes forwards ventral or lateral to the vas deferens but above the oviduct, vagina and ovarian bridge. It has a diameter of 13·8-16·1 (16·1) μ and its wall is composed of a single layer of flat cells. As it proceeds anteriorly its course becomes somewhat sinuous. In front of the ovarian bridge, the duct curves ventrally, passes down on the aporal side of the vagina and enters the uterus antero-ventrally to the ovary (fig. 16).

The uterus develops in the ventral part of the medulla, beneath the cirrus sac, vas deferens, vagina, ovary, vitelline gland and testes. Its wall is very thin and appears to consist of a single layer of cells. The early stages in the growth of uterus were not observed. However, in

the mature and semigravid segments the uterus appears as a series of cavities in the ventral part of the medulla. These cavities are in communication with each other and have a dorso-ventral diameter of 6·9-34·5 μ. The fertilized ova pass along the uterine duct and enter these cavities. As the uterus fills with eggs it develops numerous branches which pass upwards between the degenerating genital organs. Finally it appears to resolve itself into irregularly shaped capsules each containing a single egg. These uterine capsules are oval or spherical 36·8-57·5 × 25·3-57·5 μ. In the posterior gravid segments each onchosphere is surrounded by two membranes. Between the uterine capsule and the thin outer membrane of the egg is a darkly staining cellular mass. This mass appears either as an internal thickening of the uterine capsule or as an external thickening of the outer membrane. The outer membrane forms an irregularly-shaped thin walled capsule enclosing a slightly thicker inner membrane (or embryophore) which in turn encloses the onchosphere (fig. 22). The embryophore and onchosphere are spherical or slightly oval. The diameter of the former measures 16·2-20·7 μ and that of the latter 14·9-18·4 μ. The hooks of the onchosphere are 11·5-13·8 μ long.

Male

The testes are situated in the medulla of the posterior half of the proglottis. They are arranged in two to three rather indefinite layers posterior and lateral to the vitelline gland and lateral to the ovary. However, they never extend anteriorly beyond the level of the ovarian bridge. They overlie the posterior of the vitelline gland, and occasionally overlap the ends of the lobules of the ovary. They never extend ventrally to either the vitelline gland or ovary. A total of 64 testes were counted in a mature segment of the type specimen. However, the number of testes per segment may vary from 53 to 79. The testes are oval or nearly spherical varying in size from 39·1 × 30·0–69·0 × 46·0 μ.

The vasa efferentia join and give rise to two or three main ducts. These unite above Mehlis's gland to form the vas deferens. The first part of the vas deferens is dilated, forming an elongated vesicula seminalis which in mature segments is filled with sperms and measures 57·5-70·0 (57·5) × 18·4-27·6 (23·0) μ. From here the vas deferens proceeds anteriorly, dorsal or lateral to the uterine duct and above the ovary. As it passes forwards its course is somewhat sinuous and, at about the level of the atrium, it becomes highly convoluted. At this point it has a diameter of 11·5-13·8 (13·8) μ and is surrounded by a few relatively large and darkly staining cells. After forming about five major loops, one of which frequently lies antero-ventral to the cirrus pouch, it enters the cirrus pouch. Inside the pouch it is folded on itself about three times to form an ejaculatory duct. It then decreases in diameter to 9·2 μ giving rise to a straight unarmed thin-walled cirrus, 149·5-165·0 (149·5) μ long. The cirrus opens into the inner end of the common canal. Surrounding the ejaculatory duct and the cirrus, are numerous darkly staining gland cells.
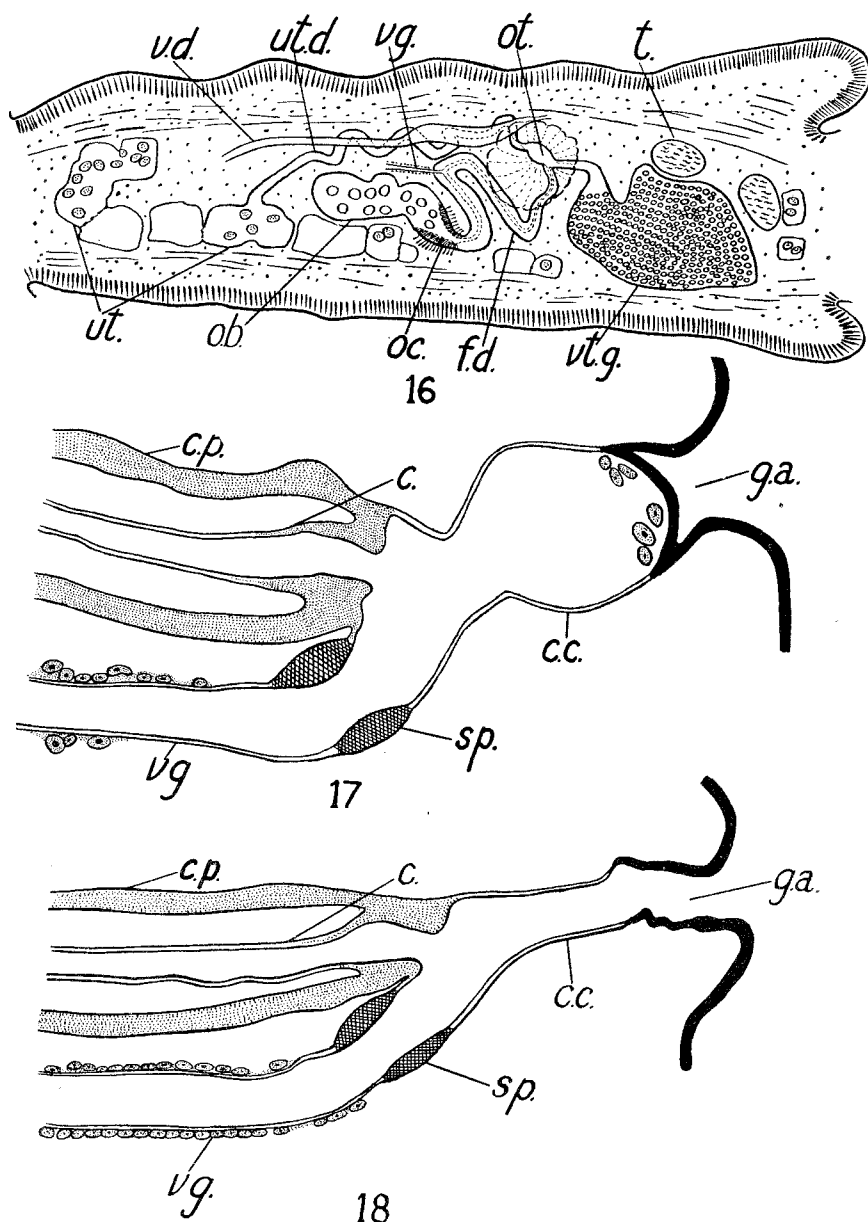
Oochoristica nyctophili n.sp.

Fig.   16.—Medial section of a mature proglottis.
Fig.   17.—Horizontal section through part of an immature proglottis in the region
              of the genital atrium.
Fig.   18.—Horizontal section through part of a mature proglottis in the region
              of the genital atrium.

The cirrus pouch is transversely elongated, measuring 165·0-300·0 (240·0) × 30·0-53·0 (30·0) μ. It has thick muscular walls and in mature segments it extends in from the atrium for a distance of about 2/5 the width of the segment. It lies above the poral longitudinal nerve and either above or between the poral excretory vessels. From the aporal end of the pouch a few retractor muscles fan out and appear to join the transverse muscles of the proglottis.

Type Host: Nyctophilus geoffroyi Leach.

Type locality: Mt. Nelson, Hobart, Tasmania.

Type specimen: In Department of Zoology, University of Tasmania.

Affinities of *O. nyctophili* n. sp.

Hughes (1940) lists 17 species of *Oochoristica* from mammalian hosts. The following four species have since been recorded from mammals:—*O. procyonis* Chandler (1942) from *Procyon lotor; O. pennsylvanica* Chandler and Melvin (1951) from *Blarina brevicauda; O. wallacei* Chandler (1952) from *Spilogale interrupta* and *O. pedunculata* Chandler (1952) from *Mephitis* sp. (presumably *M. mephitis hudsonica*). In addition Baer (1949) redescribed *Taenia dipi* Parona (1900) and transferred it to the genus *Oochoristica*. Moreover Joyeux and Baer (1945) consider *O. ratti* Yamaguti and Miyata (1937) as a synonym of *O. symmetrica* (Baylis 1927) Meggitt and Subramanian (1927). In 1950 Self and McKnight recorded from *Mephitis varians* some cestodes which, in their opinion, were difficult to distinguish from either *O. mephitis* Skinker (1935) or *O. oklahomensis* Peery (1939). They placed their specimens in the species *O. mephitis* and extended the characters of this species so as to include those of *O. oklahomensis* which they then considered as a synonym of the former species. Finally, Choquette (1951) reported *O. mephitis* from *Mephitis mephitis* in Quebec.

The cestode described in the present paper brings the total species recorded from mammals to 23. Only one other species has so far been recorded from the Chiroptera, namely *O. taborensis* Loewen (1934) from *Lasiurus borealis borealis*.

O. nyctophili n. sp. may be readily distinguished from *O. taborensis* Loewen in that the testes do not occur anterior to the ovary, and the vitelline gland is not bilobed. Also the present species differs from all other species from mammalian hosts in two or more of the following characters: irregularly alternating genital pores; absence of a receptaculum seminis; testes not occurring in front of the ovary; the ovary distinctly bilobed; length of the strobila; width of the scolex; diameter of the suckers; and the size of the cirrus pouch. Furthermore, *O. nyctophili* n. sp. appears to be the only species from a mammalian host in which a sphincter muscle surrounding the poral end of the vagina, and a distinct oocapt have been recorded. In the form and arrangement of the female reproductive system, *O. nyctophili* n. sp. resembles *O. vacuolata* n. sp. However, the marked differences between the cestode from the bat, *Nyctophilus geoffroyi*, and other species of the genus, seem to warrant the establishment of the new species, *O. nyctophili*.
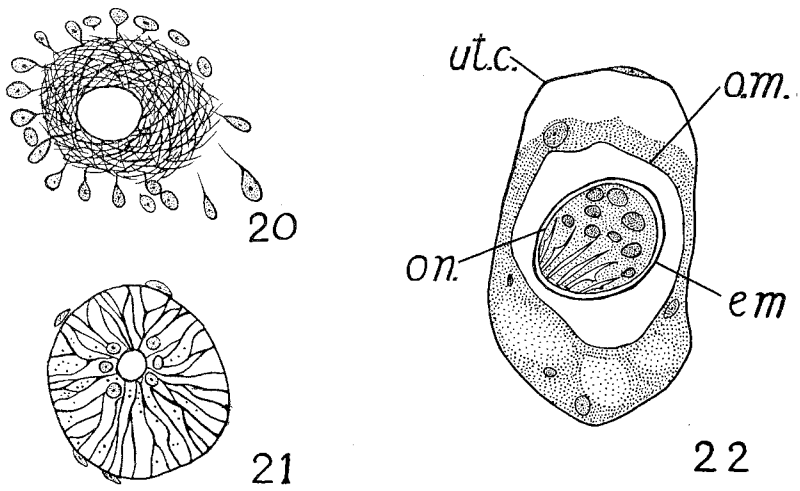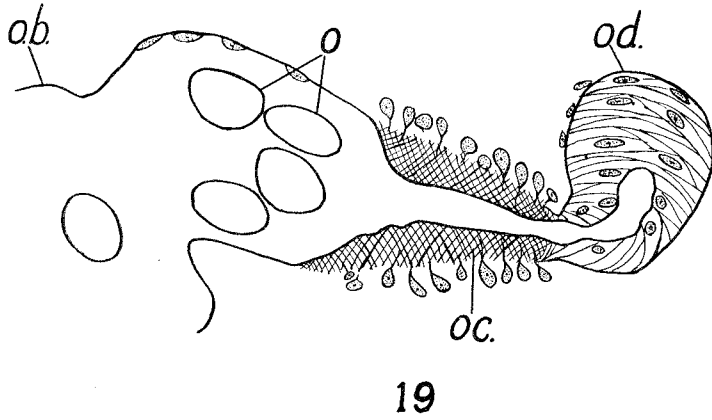
Oochoristica nyctophili n.sp.

Fig.   19.—Vertical longitudinal section through the oocapt.
Fig.   20.—Transverse section through the oocapt.
Fig.   21.—Transverse section through oviduct beyond oocapt.
Fig.   22.—Uniovulate uterine capsule.

Infestation of Host

Only one specimen of *Nyctophilus geoffroyi* was examined and three mature cestodes were found in its small intestine.

ACKNOWLEDGMENTS

The author expresses his appreciation to Dr. E. R. Guiler and Prof. V. V. Hickman for their interest and help. My thanks are also due to Mr. R. Wheeldon for collecting the specimen of *Nyctophilus geoffroyi* and to Mr. M. N. Maddock for the three specimens of *Egernia whitii* from Cooee.

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a.ut.—Anterior prolongation of uterus
c.—Cirrus
c.c.—Common canal
c.p.—Cirrus pouch
d.e.—Dorsal longitudinal excretory vessel
em.—Embryophore
f.d.—Fertilization canal
g.a.—Genital atrium
i.l.m.—Inner longitudinal muscles
M.g.—Mehlis's gland
n.—Lateral nerve
o.—Ova
o.b.—Ovarian bridge
oc.—Oocapt
od.—Oviduct
o.l.m.—Outer longitudinal muscles
o.m.—Outer membrane
on.—Onchosphere

ot.—Ootype
ov.—Ovary
p.a.ut.—Posterior aporal outgrowth of uterus
p.p.ut.—Posterior poral outgrowth of uterus
r.m.—Retractor muscles
r.s.—Receptaculum seminis
sp.—Sphincter
t.—Testes
ut.—Uterus
ut.c.—Uterine capsule
ut.d.—Uterine duct
vac.—Vacuoles of subcuticular cells
v.d.—Vas deferens
v.e.—Ventral longitudinal excretory vessel
vg.—Vagina
vt.g.—Vitelline gland