The Nematode and Acanthocephalan Parasites of the Sheathbill, *Chionis alba* (Gmelin), at Signy Island, South Orkney Islands and a summary of host parasite relationships in the Sheathbill

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We have previously reported on the cestode and trematode parasites of the Sheathbill at Signy Island (Jones & Williams 1967, 1968, 1969) and conclude with an account of the nematodes and Acanthocephala. Our previous reports were based on specimens obtained from 13 Sheathbills collected at Signy Island in July and October, 1965 by Mr. Charles Howie, British Antarctic Survey. In addition to these we have examined a further 12 Sheathbills taken at Signy Island in March, 1967. We are greatly indebted to Mr. E. A. Smith, Senior Biologist, British Antarctic Survey, for arranging the collection and transport of the latter material.

ASCARIDIDEA Yamaguti, 1961
HETEROCHEILIDAE Railliet & Henry, 1915 *Phocanema decipiens* (Krabbe, 1878)
Synonymy : *vide* Myers (1959).
Incidence : 1 of 13 Sheathbills, 1965 ; 0 of 12 Sheathbills, 1967.
Intensity and habitat : 15 specimens, oesophagus ; 2 specimens, gizzard.

All 17 specimens were immature and corresponded closely to the pre-adult stage described by Grainger (1959). The worms measure 20-30 mm. in length by 0-8 mm. in diameter ; the oesophagus is 2-0-3-5 mm. in length and the intestinal caecum 1-0-1-8 mm., the ratio of caecum length to oesophageal length being 1/2. The mouth is surrounded by three large rounded lips each with a dentigerous ridge, while interlabia are absent. The dorsal lip has two papillae and each ventrolateral lip has a single papilla.

The genus *Phocanema* was proposed by Myers (1959) for *Por-rocaecmn decipiens* (Krabbe, 1878), a common and cosmopolitan parasite of seals, which differs from typical *Porrocaecum* species in lacking interlabia. She listed records of *P. decipiens* from seals in the Pacific and North Atlantic Oceans, but the list given of hosts in Antarctic and neighbouring waters is incomplete and these additional records are worth noting : New Zealand sea lion, *Neophoca hooken* (Gray) (Auckland and Campbell Islands, Johnston & Mawson 1953) ; New Zealand fur seal, *Arctocephalus forsteri* (Lesson) (Campbell Island, Johnston & Mawson 1953) ; leopard seal, *Hydrurga leptony*\ (Blainville) (Auckland and Campbell Islands, Johnston & Mawson 1953 ; Macquarie Island, Mawson 1953) and the elephant seal, *Mirounga leonina* (L.) (Auckland and Campbell Islands, Johnston & Mawson 1953).

Larvae of *Phocanema decipiens* have been reported, under the name *Porrocaecum decipiens*, from several species of marine fish in the general region of the South Orkneys (Baylis1, 1929), and it is probable that the present infection was acquired from such a source although, as the normal final hosts of *P. decipiens* are seals, it seems unlikely that the present specimens would have attained sexual maturity in the Sheathbill. In addition to our record from this host, immature *P. decipiens* have previously been reported from the penguin, *Eudyptes schlegeli* Tisch., at Macquarie Island by Mawson (1953), and from the Gentoo penguin, *Pygoscelis papua* Forster, also at Macquarie Island by Johnston & Mawson (1945), and in the cormorant, *Phalacrocorax albiventer* Brandt, at Macquarie Island by Johnston & Mawson (1945), in *P. colensoi* Buller, at Auckland Islands, New Zealand, by Johnston & Mawson (1953), and in *Phalacrocorax* sp. in Iceland by Kreis (1958). All these birds are habitual or occasional fish eaters which presumably led to infection with *Phocanema decipiens*.

Contracaecum sp.

Incidence : 1 of 13 Sheathbills, 1965 ; 0 of 12 Sheathbills, 1967.
Intensity and habitat : 3 immature specimens, hind third of the small intestine.
The present specimens are assigned to *Contracaecum* as they possess an intestinal caecum and a ventricular appendix. All three specimens are immature and measure 5.1-6.4 mm. in length and 0.12-0.13 mm. in diameter. The oesophagus is 0.64-0.72 mm. long and the oesophageal appendix 0.13-0.14 mm. ; the ratio of oesophagus length to body length is 1/7-1/9. The intestinal caecum is 0.33-0.35 mm. long, i.e. about half as long as the oesophagus. The lip region lacks interlabia, which are characteristic of adult *Contracaecum*, and lacks a boring tooth, which is characteristic of the third stage infective larva, thus suggesting that the worms are pre-adults.
It is possible that the present specimens are *C. spiculigerum* (Rud., 1809), a cosmopolitan and common parasite of marine fish eating birds, but hitherto unrecorded from the Sheathbill. This species was found by Baylis (1929) in the cormorant, *Phalacrocorax magellanicus* (Gmelin), from the neighbourhood of Cape Horn, and it has been found by one of us (ICW) in *P. verrucosus* (Cabanis) from lies Crozet in the southern Indian Ocean. The location of the specimens in the small intestine is unusual for *C. spiculigerum*, which normally lives in the oesophagus and stomach of its host, although the present specimens may have moved to the intestine after the death of their host.

SPIRURIDEA Diesing, 1861
ACUARIIDAE Seurat, 1913
Paracuaria tridentata (von Linstow 1877)

Synonymy : *Filaria tridentata* von Linstow, 1877 ; *Spiroptera tridentata* (von Linstow 1877) Newman, 1900 ; *Streptocara tridentata* (von Linstow 1877) Skrjabin, 1916 ; *S. transcaucasica* (Solonitsin 1932) ; *S. rissae* Kreis, 1958 ; *Paracuaria macdonaldi* Rao, 1951.
Incidence : 2 of 13 Sheathbills, both adult males, July and October, 1965 ; 0 of 13 Sheathbills, March, 1967.
Intensity and habitat : 5 gravid females, oesophagus ; 1 adult male, lumen of the gizzard.
The present specimens agree morphologically with the descriptions of *P. tridentata* given by Rao (1951), Chabaud & Czaplinski (1961), Leonov et al. (1963), Maksimova (1964) and Barus (1967), and with specimens found by one of us (ICW) in the Herring Gull, *Larus argentatus* Pont., and the Great Black-backed Gull, *L. marinus* L., in Britain. The females measure 7.3-11.5 mm. in length and are cylindrical in shape with a maximum diameter of 0.08-0.12 mm. The vulva is situated two thirds of the way along the body and the ovejector is directed backwards. The eggs are 0.035-0.037 mm. by 0.017-0.02 mm., the remarkably thick walls being 0.004 mm. across. The anus opens 0.15-0.2 mm. from the posterior end. The cephalic structures are identical with those described by Leonov et al. (1963) : the vestibule is 0.12-0.15 mm. long and the two trifid cephalic spines are 0.17-0.19 mm. behind the head end. Each trifid spine is 0.016-0.017 mm. long by 0.013 mm. across the tip, the middle spine-being shorter than the two laterial spines. The male is 7.6 mm, long with a maximum diameter of 0.12 mm. The length of the vestibule is 0.13 mm. that of the muscular oesophagus 0-64 mm. and of the glandular oesophagus 1.6 mm. Owing to the tightly coiled condition of the tail, measurements of the spicules could not be made but four preanal papillae are clearly visible.
Paracuaria tridentata is a common parasite of lariform birds in northern latitudes but does not seem to have been recorded previously in the southern hemisphere ; the life cycle is unknown. When the Sheathbill harbouring the female worms was examined its oesophageal wall was found to be markedly inflamed, possibly due to the burrowing activities of these parasites.

ACANTHOCEPHALA
PALAEACANTHOCEPHALA Meyer, 1931
POLYMORPHIDAE Meyer, 1931
Corynosoma hammani (von Linstow, 1892)

Synonymy : *Echinorhynchus hammani* von Linstow, 1892 ; *E. antarcticus* Rennie, 1906 ; *E. sipho* Railliet & Henry, 1907 ; *Corynosoma antarcticum* (Rennie) Johnston & Best, 1937.
Incidence : 6 of 13 Sheathbills, 1965 ; 1 of 12 Sheathbills, 1967.
Intensity : range 1-22, mean 4.1.
Habitat : embedded in the mucosa of the middle third of the small intestine.
All 29 specimens of *C. hammani* seem to be fully formed but all are sexually immature, suggesting that the Sheathbill is an abnormal host. The body of most specimens is partially contracted, measuring up to 2 mm. in length, and comprises a bulbous, disclike, forebody attaining 1.5 mm. in diameter, and a tapering, pipelike, hindbody. The forebody and ventral surface of the hindbody are covered with spines measuring up to 0.055 mm. in length, whereas the dorsal and lateral aspects of the hindbody are devoid of spines. The cylindrical proboscis is situated in the centre of the forebody and measures 0.8-1.0 mm. in length by 0.25-0.3 mm. in diameter. It is armed with 18-20 longitudinal rows of hooks, each row comprising 12-14 hooks. The proximal two or three hooks

of each longitudinal row are 0.038-0.055 mm. long and lack recurved roots, which all other hooks of each row possess. The hooks toward the distal end of the proboscis are larger, attaining 0.071-0.077 mm. in length, the re¬curved root having about the same length as the blade. Apart from the absence of recurved roots in the two or three proximal hooks of each row, all hooks are similar in general shape and there are no differences in shape or size of hooks at the same level on the proboscis which occurs in some species of the genus, for example *C. strumosum* (Rud., 1802). The proboscis receptacle is a double walled sac, 0.8-0.9 mm. long by 0.15-0.18 mm. in diameter.

The present specimens agree most closely with the description of *C. hammani* given by Edmonds (1957), who had the opportunity of studying specimens collected from Weddell seals, *Leptonychotes weddelli* Lesson, from Enderby Land, as well as re-examining the specimens of Rennie (1906), Leiper & Atkinson (1915) and Johnston & Best (1937). The present specimens however, represent the first record of *C. hammani* being found in a bird, all previously reported hosts being seals. Larval forms of *C. hammani* were found by Baylis (1929) encysted on the outside of the intestine of the fish *Notothenia rossi*, from the South Shetlands, and *Parachaenichthys georgianus* off South Georgia. Presumably it was from similarly infected hosts that the Sheathbills at Signy Island became parasitized.

Some uncertainty exists about the suitability of birds as final hosts of those species of *Corynosoma* which usually parasitize marine mammals, and Van Cleave (1953) and Golvan (1959) maintain that sexual maturity is never attained in birds if the normal host is a mammal. Yet some species are known in which gravid females have been reported from both birds and mammals, for example, *C. strumosum* by Dollfus (1964) and Williams (1961). On the other hand the presence of eggs in the female worm does not demonstrate that these would be viable in the intermediate host.

Among species of *Corynosoma* from hosts in southern waters, *C. clavatum* Goss, 1941 has been reported on a number of occasions from cormorants in New Zealand and Australian waters; and at Heard, Macquarie and the Kerguelen Islands, while *C. australe* Johnston, 1937, the normal hosts of which are various species of seal in Australian waters, has been found in the cormorant, *Phala-crocorax colensoi* Buller, in New Zealand waters by Johnston & Edmonds (1953). These specimens were immature forms and seem, therefore, to be similar to the present infection of Sheathbills with *C. hammani*.

DISCUSSION

From the twenty-five Sheathbills available for examination nine species of helminths were identified, all nine being present in adult birds and three in juveniles (Table I). As all these species gain entry to the avian host through its food their acquisition depends on twc main factors : first, the feeding habits of the Sheathbill; second, the presence of infected intermediate hosts.

The Sheathbill is a shore feeder and during the breeding season, a scavenger on penguin colonies ; inevitably its diet is varied. However, the physical environment of the South Orkneys is harsh, being characterized especially by ice scour of the marine littoral and freezing of the land and fresh water pools during the winter. There are no terrestrial or fresh water molluscs on Signy Island and the marine littoral molluscan fauna is limited to the limpet *Patinigera polaris* (Hombron & Jacquinot, 1841), on which the Sheathbill is known to feed regularly. The sublittoral fauna is more extensive, including several gastropod and lamellibranch species and several species of Crustacea, but these are only periodically available to the Sheathbill, either at very low tide or as storm strewn debris. Con¬firmation that Sheathbills take these animals is shown by the presence of a specimen of *Laevilittorina* sp. in the duodenum of a juvenile and of unidentified amphipods in the stomach of two adult birds. Apart from invertebrates, occasionally dead fish and other vertebrate offal are available to Sheathbills. Thus in the South Orkneys the number of species of potential and readily available intermediate hosts of helminth parasites is limited. It may be expected, therefore, that the helminth fauna of juvenile Sheathbills would be poor in comparison to that of adults ; this appears to be so (Table I).

From our examinations of juvenile Sheathbills collected at Signy Island in March, 1967, at the end of the southern breeding season before the birds had an opportunity to leave the South Orkneys, we conclude that there are local sources of infection with *Paramonosto-mum signiensis*, *Lateriporus australis* and *Corynosoma hammani*.

The larval stages of species of *Paramonostomum* are usually found in fresh water and brackish water gastropods, which do not occur on Signy Island. However, Graefe (1968) has found redia and cercaria of a *notocotylid trematode* in *Laevilittorina caliginosa* at Hope Bay, Antarctic Peninsula. He believes these to be the larval stages of *P. antarcticum* Graefe, 1968 from the Sheathbill at the same locality. The species of *Laevilittorina* found on Signy Island is *L. coriacea*, and it may be found to be the intermediate host of *P. signiensis*. The latter species differs from *P. antarcticum* mainly in the structure of the intestine, and the relative distribution of the vitellaria, uterine loops and cirrus sac. In addition to these two a third species, P. ionorne Travassos is known from the Sheathbill and now that larval stages attributed to one of them have been found, experimental infection of captive Sheathbills may show the extent of variation in *P. antarcticum* and thus the systematic relationships of these three species.

It is possible that the cestode *Lateriporus australis* utilizes a species of marine crustacean as an intermediate host, possibly an imphipod of which there are large sublittoral populations at Signy Island. The nematodes *Phocanema decibiens* and *Contracaecum* sp., and the acanthocephalan *Corynosoma hammani*, probably employ species of Crustacea as first intermediate hosts and marine fish as second intermediate hosts. The life cycle of *Paracuaria tridentata* is unknown, but from what is known of the life cycle of related genera it seems possible that a species of crustacean may serve as an intermediate host. During shore scavenging adult Sheathbills may eat a variety of

small Crustacea and dead fish, but the young birds are fed largely on krill, *Euphausia* sp., stolen from penguins. As *Euphausia* is planktonic, it seems less likely than littoral crustaceans to serve as an intermediate host for nematodes and acanthocephalans parasitizing Sheathbills.

TABLE I

The presence of helminth parasites in 9 juvenile and 16 adult Sheathbills, *Chionis alba,* (Gmelin), at Signy Island, South Orkney Islands, in 1965 and 1967.

Age group	juvenile		adult	
Year	1965	1967	1965	1967
No. examined	0	9	13	3
No. infected with :				
Trematoda				
Gymnophallus deliciosus			4	1
Notocotylus chionis			4	1
Paramonostomum signiensis		4		1
Cestoda				
Noiotaenia fileri			1	
Lateriporus australis		1	2	1
Nematoda				
Phocanema decipiens			1	
Contracaecum sp.			1	
Paracuaria tridentata			2	
Acanthocephala				
Corynosoma hammani		1	6	

If *Phocanema decipiens* does not achieve sexual maturity in the Sheathbill, only *Paracuaria tridentata*, and possibly *Contracaecum* sp., can be regarded as normal nematode parasites of these birds. It thus seems reasonable to conclude that Sheathbills are not infected to any great extent with nematodes. This view is supported by the observations of Johnston & Mawson (1945) who examined 11 *Chionis minor* (Hartlaub) at Iles Crozet and Iles de Kerguelen without finding a single nematode. These authors also commented on the apparent paucity of nematode infections of Antarctic and sub Antarctic birds, which is in marked contrast to the usual high incidence of infection with nematodes met with among sea birds in northern latitudes. A notable exception are the cormorants which usually seem to be parasitized with ascaroids, often as heavily in Antarctic cormorants as their more northerly relatives.

The presence of Acanthocephala in 7 of 25 Sheathbills, including one juvenile which had not left the vicinity of the South Orkneys, indicates a local source of infection. The first intermediate host of *C. hammani* is unknown, but the first intermediate host of the related *C. strumosum* is believed to be an amphipod (Golvan, 1959). Large populations of sublittoral amphipods occur in the South Orkneys and we have found amphipods in the gizzard of adult Sheathbills. It seems possible that infected amphipods, or fish infected by eating the amphipods, may serve as intermediate hosts of *C. hammani* at Signy Island, and we have previously referred tc Baylis' (1929) record of larval *C. hammani* from fish at South Georgia and the South Shetland Islands.

From our studies it seems that three elements in the helminth fauna of the Sheathbill at Signy Island can be recognized. First, those species for which the Sheathbill is an abnormal host where the parasite either dies or fails to achieve sexual maturity, for example the nematode *Phocanema decipiens* and the acanthocephalan *Corynosoma hammani*. Second, those species which are acquired in the South Orkneys by juveniles as well as by adults, such as *Lateri-porus australis* and *Paramonostomum signiensis*. Third, those species which have not been found in juvenile Sheathbills and may, therefore, be acquired outside the South Orkneys, such as *Gymno-phallus deliciosus*, *Notocotylus chionis* and *Nototaenia fileri*. Only further study can lead to a clarification of the tentative interpretation suggested here.

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