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**The Fleas of Sea Birds in the
Southern Ocean**

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The Ticks of Sea Birds

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THE FLEAS OF SEA BIRDS IN THE SOUTHERN OCEAN

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The arrival recently of a small parcel of fleas from the Australian National Antarctic Research Expedition gives me the opportunity of briefly reviewing what is known about these ectoparasites of birds in the Southern Ocean. I include in this review some hitherto unpublished records of specimens collected for me by Mr. R. W. Rand, biologist of the South African Government, Guano Islands, and Mrs. M. K. Rowan, formerly resident on Tristan da Cunha.

Systematics needs no apologist, but it is when it provides evidence for use in other scientific fields that the imagination and interests of workers in the allied sciences are aroused. As much as they would like to, very few systematists have the time or facilities for collecting over the large areas in which their particular interests lie, and they are largely dependent for specimens on brother scientists in the field of natural history and ecology. If some story can be woven round these specimens, then they become more than mere collectors' items. I therefore propose to draw attention to the fact that fleas may provide evidence on such controversial matters as the evolution and place of origin of penguins with the hope that biologists will become interested in the Southern Ocean region and that collecting by them will really be undertaken in earnest.

The matters to be discussed here are not all original. They were first announced by Dr. Karl Jordan (1942) in a paper which is not readily accessible and which seems to be unknown to most antarctic biologists.

It will be realized at the outset that much remains to be done. The conclusions arrived at here are no more than tentative and may have to be drastically changed when more is known about the ectoparasites of sea birds.

Fleas are usually found in the nests of penguins and other sea birds. As penguins spend so much of their time in the open sea far from land during the non-breeding season, fleas can only breed in the nests of these birds and not on their bodies. This tendency for the fleas to remain in the nests on the island breeding ground naturally leads to isolation and accounts for the evolution of subspecies such as occurs in the genus *Parapsyllus*. Some sea birds, other than penguins, are known to range far and wide over southern seas and one might expect them to distribute

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fleas over their range. Present evidence, inadequate as it is, points against the wide distribution of fleas by flying sea birds and provides further evidence that *Parapsyllus*, at least, is essentially a nest flea and is not easily carried over long distances. An exception to the stay-at-home habit is shown by *Notiopsylla kerguelensis* which shows no subspecific differentiation over its very wide range. This flea has not been found in penguin nests (See Table) but only on the bodies and in the nests of flying birds. Its occurrence on a bird with such a wide breeding range as *Larus dominicanus* probably means that island communities are constantly being supplied from other regions, leading to intermixing of populations and hence no subspecific differentiation.

The fleas dealt with here are restricted to Southern Ocean regions and even a presumed body flea like *N. kerguelensis* hardly extends further north than the limits of the Subantarctic Zone. An entirely different picture is presented by ticks, of which some species are common to both antarctic and arctic regions (See F. Zumpt—"Ticks of Sea Birds"). This is no doubt due to the fact that ticks, in order to feed to repletion, remain firmly attached to their hosts for much longer periods than fleas. It also means, of course, that there must be considerable overlapping of the territories of northern and southern flying sea birds.

Before discussing these matters any further it is necessary to describe two new subspecies of *Parapsyllus*.

Parapsyllus longicornis dacunhai subsp. nov. (Figs. 1 to 4).

This flea is somewhat intermediate between *taylori* J. of the South Pacific and *longicornis humboldti* J. of the west coast of Peru and the islands off the South African Coast. It is immediately recognizable by its tarsal chaetotaxy. In the male, tarsus V of the mid and fore legs has three stout apical plantar bristles thus differing from *longicornis australiacus* Roths. and *taylori* J. and resembling the other subspecies of *longicornis*. It differs markedly from the latter group in having the subapical plantar bristles very stout and more strongly developed than in any other subspecies or in *taylori* itself. In the female there are two apical plantar bristles and one stout subapical one. The male terminalia show characters which are intermediate between *taylori* on the one hand and *longicornis humboldti* and *longicornis alginus* on the other. The male has the short clasper manubrium of *taylori* and the loboid of the paramere as in *humboldti* and the hood as in *l. alginus*. The spermatheca of the female has a squat, almost square, head as in *magellanicus* J. and in this respect differs from other species in my collection (*l. alginus*, *l. humboldti*, *l. australiacus*) in which the head is more oval in shape. Sternite VII of the female has a large sinus which is wider at its mouth than in any other subspecies (this sex in *taylori* is unknown).

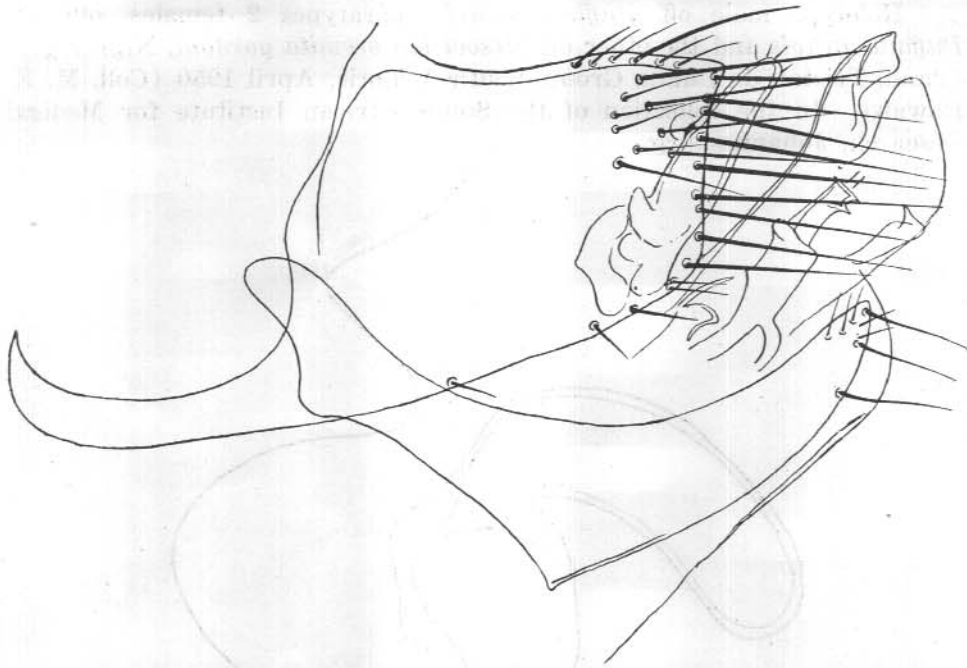


Fig. 1.—*Parapsyllus longicornis dacunhae* subsp. nov., male terminalia

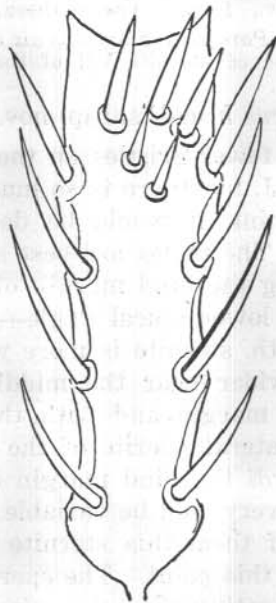
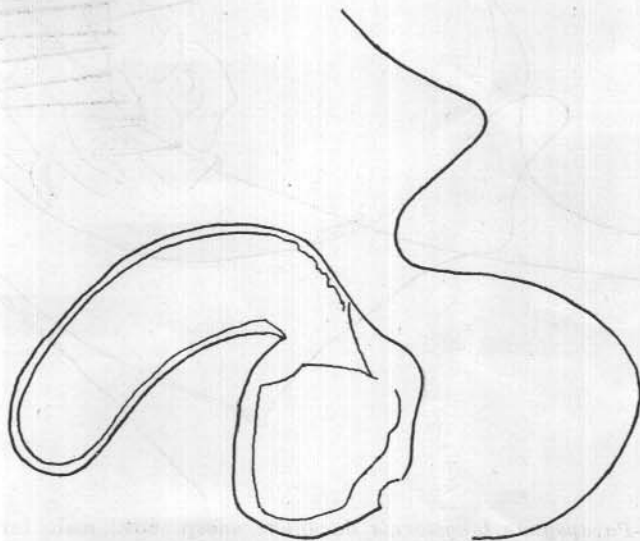


Fig. 2.—*Parapsyllus longicornis dacunhae*,
subsp. nov., fifth tarsal segment of the
midleg of the male.

Holotype male off *Puffinus gravis*, paratypes 2 females, one off *Puffinus gravis* and the other off *Nesocichla eremita gordonii*, Nightingale Island, Tristan da Cunha Group, South Atlantic, April 1950 (Coll. M. K. Rowan). In the collection of the South African Institute for Medical Research, Johannesburg.



(Left): Fig. 3.—*Parapsyllus longicornis dacunhae* subsp. nov., female spermatheca.

(Right): Fig. 4.—*Parapsyllus longicornis dacunhae* subsp. nov., outline of sternite VII of the female.

Parapsyllus magellanicus heardi subsp. nov. (Figs. 5 and 6).

This subspecies bears fewer bristles on the different segments than *magellanicus magellanicus* J. but there is so much variation in the specimens before me that I think it would be dangerous to rely on this character at the moment. The males are best separated as follows:—In *m. heardi* the bristles along the hind margin of the clasper—except the two very long ones at the lower apical angle—are shorter; the apex of the vertical arm of the IXth. sternite is more widened; the ventral arm of the IXth. sternite is wider near the middle, without any subbasal bristles along the ventral margin and with the apical bristles shorter and more spiniform; the lateral sclerite of the paramere is broader.

In the female *m. heardi* the hind margin of sternite VII is nearly straight, though this may very well be variable as it is difficult to see in my specimens. In most of them this sternite is broken along its free edge, being very fragile at this point. The spermatheca appears to offer the best character for separating the subspecies. In *m. heardi* the head is elongate, being widest across the middle whereas in *m. magellanicus* it is almost square in shape.

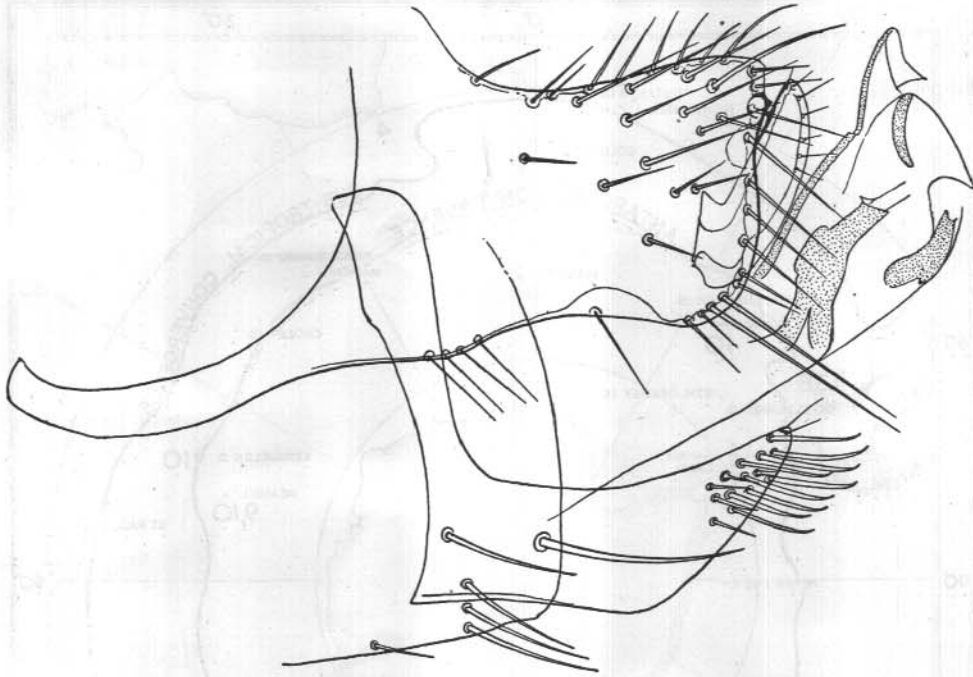


Fig. 5.—*Parapsyllus magellanicus heardi* subsp. nov., male terminalia.

Holotype ♂, in nest of *Macronectes giganteus*, Cape Gazert, Heard I., 20.12.49; paratypes 5 ♂♂, 11 ♀♀, in the same nest, locality and date, and 1 ♂, 1 ♀ in nest of *Phoebetria palpebrata*, Rogers Head, Heard I., 20.1.50. The latter pair presented to the British Museum, the rest in

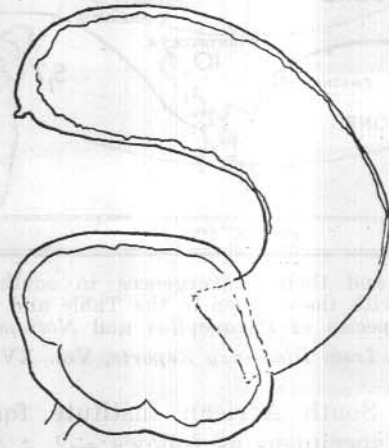
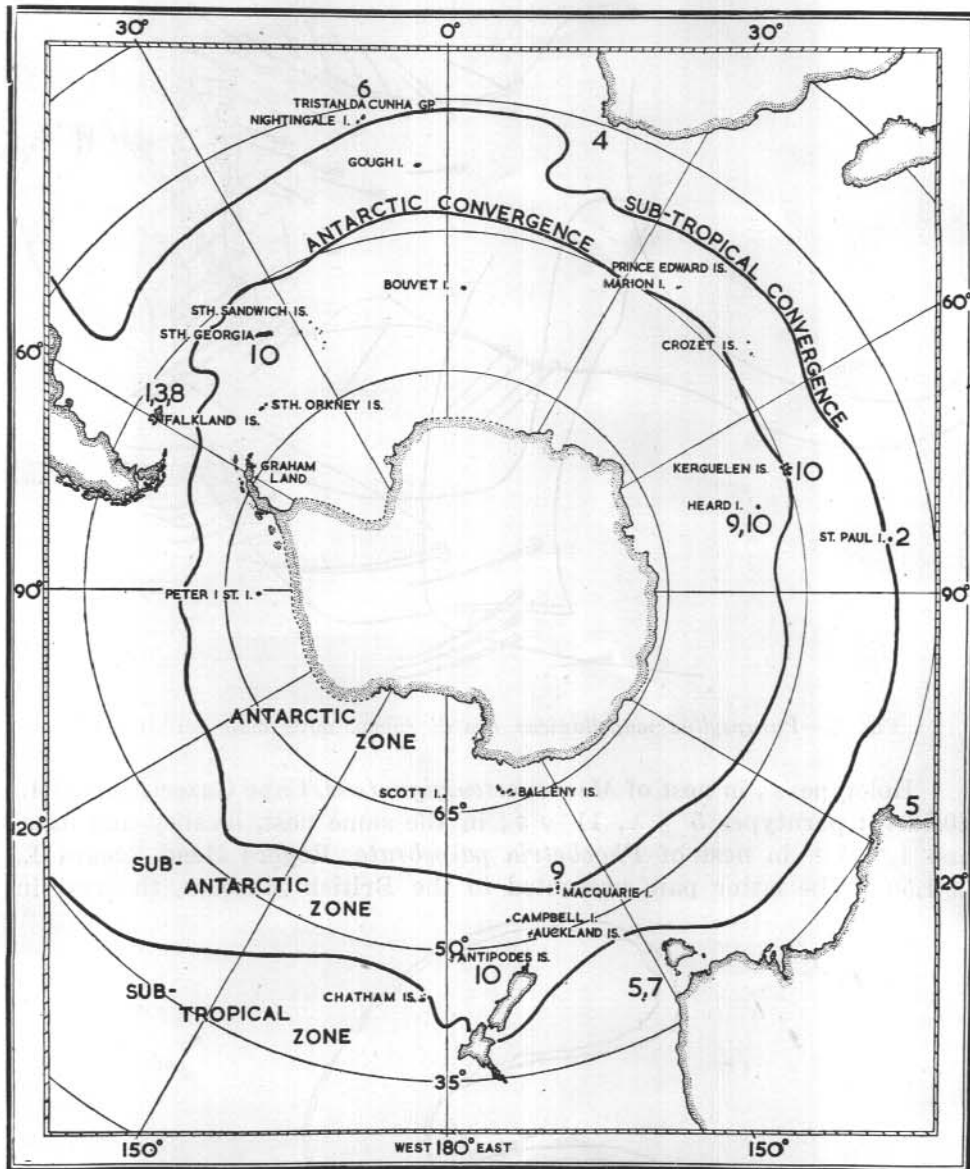


Fig. 6.—*Parapsyllus magellanicus heardi* subsp. nov., female spermatheca.



Zones of surface water and their convergences in south-polar projection. The numbers 1-10 correspond with those given in the Table and indicate the distribution of species and subspecies of *Parapsyllus* and *Notiopsylla kerguelensis*.

(Redrawn from *Discovery Reports*, Vol. XV, 1937)

the collection of the South African Institute for Medical Research, Johannesburg. Other specimens as follows:—2 ♂♂, 7 ♀♀ in burrows of *Pachyptila desolata*, Atlas Cove, Heard I., 17.12.49; 4 ♀♀ in nest of *Stercorarius skua lonnbergi*, Atlas Cove, Heard I., 26.12.49; 1 ♂, 2 ♀♀ in

THE FLEAS OF SEA BIRDS RECORDED FROM SOUTHERN OCEANS

SPECIES	DISTRIBUTION	HOSTS	REFERENCES
1. <i>Liastronius robertsonianus</i> J.	Falkland Islands	<i>Spheniscus magellanicus</i> ; <i>Procellaria aequinoctialis</i> .	Jordan, 1938, Nov. Zool. 41, 137.
2. <i>Parapsyllus longicornis longicornis</i> End.	St. Paul I.	<i>Eudypetes chrysocome</i> ; <i>Eudypetes chrysolophus</i> ; <i>Eudypetula</i> ; <i>Pygocelis</i> ; * <i>Spheniscus magellanicus</i> .	Enderlein, 1901, Zool. Jahrb. Abt. Syst. 14, 553; Jordan, 1942, Eos, 18, 17; Costa Lima & Hathaway, 1946, Mon. Inst. Oswalda Cruz, 4, 147.
3. <i>Parapsyllus longicornis alginus</i> J.	Falkland Islands	<i>Eudypetes chrysocome</i> ; <i>Pygocelis papua</i> ; <i>Spheniscus magellanicus</i> .	Jordan, 1942, Eos, 18, 18.
4. <i>Parapsyllus longicornis humboldti</i> J.	Zapallar, Chile; ***Sinclair's I.; ***Dassen I.; ***Ichaboe I.; South African Coast	** <i>Eudypetes humboldti</i> ; *** <i>Spheniscus demersus</i> .	Jordan, 1942, Eos, 18, 18.
5. <i>Parapsyllus longicornis australiacus</i> Roths.	Bird I., near Perth; Victoria; Tasmania; Furneaux I.; Lady Julia Percy I.; Flinders I.	<i>Eudypetula minor</i> ; <i>Puffinus tenuirostris</i> .	Rothschild, 1909, Nov. Zool., 16, 62; Jordan, 1942, Eos, 18, 19.
6. <i>Parapsyllus longicornis dacunhai</i> subsp. nov.	Nightingale I., Tristan da Cunha	<i>Puffinus gravis</i> ; <i>Nesocichla eremita gordonii</i> .	(Coll. M. K. Rowan).
7. <i>Parapsyllus taylori</i> J.	Lady Julia Percy I.	<i>Puffinus tenuirostris</i> .	Jordan, 1942, Eos, 18, 22.
8. <i>Parapsyllus magellanicus magellanicus</i> J.	Falkland I.	<i>Spheniscus magellanicus</i> .	Jordan, 1938, Nov. Zool., 41, 135.
9. <i>Parapsyllus magellanicus heardi</i> subsp. nov.	Heard I.; Macquarie I.	<i>Pachyptila desolata</i> ; <i>Stercorarius skua lonnbergi</i> ; <i>Phoebastria palpebrata</i> ; <i>Diomedea melanophris</i> ; <i>Daption capensis</i> .	(Coll. Australian National Antarctic Research Expedition)
10. <i>Notiopsylla kerguelensis</i> (Tasch)	Kerguelen; S. Georgia; Antipodes I.; ****Heard I.	<i>Attaprion desolatus banksi</i> ; <i>A. desolatus desolatus</i> ; <i>Pelecanoides urinatrix</i> ; <i>Larus dominicanus</i> ; **** <i>Macronectes giganteus</i> .	Taschenberg, 1880, Die Föhle, 62; Jordan & Rothschild, 1908, Parasit. 1, 93; Jordan & Rothschild, 1914, Nov. Zool., 21, 220.

* This is probably erroneous. I cannot find on what authority Lima & Hathaway quote this host.

** Murphy (1936) uses the generic name *Spheniscus* for this penguin.

*** New host and locality records (Coll. R. W. Rand).

**** New host and locality record (Coll. A.N.A.R.E.).

nest of *Daption capensis*, Jacka Valley, Heard I., 21.5.50; 2 ♂ ♂, 2 ♀ ♀, host and date not recorded, Macquarie I. All these specimens collected by the Australian National Antarctic Research Expedition.

In the Table are all the records that I have been able to trace of fleas recorded from sea birds of the Southern Ocean. I have used host names as given by authors and collectors. Some of the early publications, notably by Enderlein, are not available to me and I have quoted freely from Jordan (1942) and Da Costa Lima and Hathaway (1946). Only the principal references are given. Included in this list are the records of the specimens sent to me by the Australian National Antarctic Research Expedition (ANARE), Heard and Macquarie Islands; Mr. R. W. Rand, South African Islands; and Mrs. M. K. Rowan, Nightingale Island.

It is quite evident from the map that many antarctic and subantarctic islands still remain to be surveyed for bird fleas. Quite apart from this, most of the records relate to a few specimens only and it can be truly said that no single rookery has been adequately searched.

One of the most interesting features revealed by the map is the occurrence of *Parapsyllus longicornis humboldti* on the Chilean Coast and the South African coastal islands, and its absence from Tristan da Cunha and the Falkland Islands. I have experienced great difficulty in finding an explanation for this apparent anomaly. Murphy (1936), however, in his discussion of the genus *Spheniscus* throws some light on the problem. In the first place it seems that the four species of this genus—*mendiculus*, Galapagos Islands; *humboldti*, west coast of South America; *magellanicus*, southern South America; and *demersus*, South Africa—are very closely related. Some systematists indeed do not regard all as distinct species. Murphy allows them specific status and points out that fundamentally, superficial resemblances notwithstanding, the Galapagos and South African penguins occupy the extreme ends of a taxonomic and geographical series. Murphy writes, "It seems highly probable that the ancestors of the African *Spheniscus demersus* followed the currents of the west-wind zone from a South American source into the present range of the species. Tristan da Cunha, which lies close to the counter-clockwise warm-water circulation of the South Atlantic, was barred to these birds either by chance, by physical characteristics of the sea-water, or perhaps the small islands had already been fully appropriated by the aggressive rockhopper penguins. But the cool, rich waters of the Benguela Current, to which the African penguin is still restricted, offered substantially the same life conditions that the far-wandering penguins had left behind in Fuegia". It would seem then that the African penguin brought its flea with it from South America where it had been in contact with the Peruvian penguin (*S. humboldti*). The fact that this flea (*P. longicornis humboldti*) is not found at Tristan

is explicable in terms of Murphy's statement above. It would indeed be of very great interest to know what subspecies occurs in the nests of the Magellan penguin on the east coast of South America.

The occurrence of the same flea on the South African and Peruvian penguins, which at first sight appears so strange, may therefore have a relatively simple explanation were it not for the fact that it is difficult to understand how the flea could have withstood this great trek across the Atlantic. One may well ask, however, how the penguins withstood it themselves? Perhaps the intervening land masses or islands, which have now disappeared, were in existence at that time.

The map shows very plainly how populations of *Parapsyllus* have become isolated on the various islands with the consequent evolution of subspecies. It will also be seen that these bird fleas occur largely within the confines of the subtropical convergence which approximately marks the northern limits of penguin distribution. *Notiopsylla kerguelensis* is principally a flea of the Antarctic Zone where it appears to be freely carried about by flying birds and hence has not shown a tendency towards subspecific differentiation. Its distribution is consistent with the idea that it is not primarily a penguin flea.

FLEAS AND THE PLACE OF ORIGIN OF PENGUINS

The place of origin of penguins is apparently a matter for dispute. The most recent publication dealing with this subject that I have been able to consult is by Simpson (1946), in which he says, "The place in which penguins arose is still more speculative . . ." and further, "Penguins are most abundant and varied in the south temperate zone, and the center of their distribution may be considered not as a point but as a ring following the cooler part of the zone round the world". Again, "It seems most likely that protopenguins were sea birds ranging widely over the cooler south temperate zone seas, and that they evolved into penguins somewhere among the islands and waters of that zone, perhaps over a large area and quite surely not in a single, definite center that can ever be identified".

Simpson's opinions are not easily dismissed but it is pertinent to point out that penguin fleas do provide some vital information on this very subject. The only fleas that have been found associated with penguins belong to two genera of South American rodent fleas, namely *Parapsyllus* and *Listronius* of the subfamily *Parapsyllinae*. This subfamily contains some eight genera and it is entirely confined to South America with the exception, of course, of the species occurring on penguins. They are not found on any land animals anywhere else in the world. It is quite obvious from this that the penguins over their whole range from the Chilean coast round Terra del Fuegia to the

Falklands, Tristan da Cunha, the southern coast of South Africa, Iles de Kerguelen, Heard Island, Macquarie Island and the islands south of Australia and New Zealand must have originally got their fleas from South America. It is quite inconceivable that two fleas so alike as that of the South American and that of the Australian penguins could have arisen independently. They must have originated in South America.

Since the fleas undoubtedly belong to South America and are now associated with penguins over their whole range it seems inevitable to conclude that the penguins themselves must have arisen in South America. One may well ask that, if penguins carried the fleas over so wide an area in the past, why don't they do so to-day? Why do we find *longicornis* dividing into subspecies in isolated areas? The answer may well be that when the penguins first migrated from their original home the present-day land masses were not so widely dispersed. After all, it is very well known that Australia, South Africa and southern South America have many botanical, zoological and geological links which can only be explained on the supposition that land bridges, now sunk under the sea, once connected these continents or that Continental Drift did indeed take place.

It would seem, therefore, that the ancestors of the present-day penguins, at least, did arise in a "definite center", namely the South American Subantarctic which is so rich in their fossil remains.

FLEAS AND THE EVOLUTION OF PENGUINS

Three theories of penguin evolution are at present in vogue. They may be briefly summarized as follows:—(1) that protopenguins were non-flying land animals which took to the sea, (2) that protopenguins were flying birds which lost the power of flight on land and then took to the sea, and (3) that protopenguins were flying birds which took to the sea and lost their power of flight there.

Now both *Parapsyllus* and *Listronius* are rodent fleas and the penguins must have got their parasites from them. There must therefore have been close contact between rodents and penguins in the past and this could only have happened on land. The most likely place was on the ground itself. Is it not reasonable to suppose that this penguin, which came into such close contact with other land animals, was a ground-breeding, non-flying bird? Had it been a flying land bird it would surely have avoided the rodents by nesting in trees or inaccessible islands. But then it would hardly have acquired a rodent flea as a parasite!

The evidence, meagre as it is, supports theories (1) and (2) above. One visualizes the protopenguins as non-flying continental birds living in contact with rodents on the ground, acquiring their fleas and eventually taking to the sea, the depredations of the rodents themselves perhaps

playing some part in the "flight" from the continental shores. At first these early penguins would seek safety on nearby rodent-free islands. The distance would be small enough for fleas to be carried with them. In this manner penguins and their parasites could have become widely dispersed.

Though outside the scope of this paper it is interesting to record that there is another ectoparasite which supports the evidence provided by fleas. I refer to the *Argasid* tick *Ornithodoros talaje* which is a parasite of American rodents and occurs in penguin nests round the South African coast as the subspecies *O. talaje capensis*.

I wish to thank the Australian National Antarctic Research Expedition and Mrs. M. K. Rowan for sending me specimens. Mrs. Rowan further gave me the benefit of her extensive knowledge of sea birds. It is a pleasure to acknowledge the help and advice received from Dr. K. Jordan and Mr. G. H. E. Hopkins of Tring.

REFERENCES

- JORDAN, K., 1942. *Eos*, 18, 7-29.
DA COSTA LIMA, A., and HATHAWAY, C. R., 1946. *Mon. Inst. Oswaldo Cruz*, 4.
MURPHY, R. C., 1936. *Oceanic Birds of South America*.
SIMPSON, G. G., 1946. *Fossil Penguins*, *Bull. Amer. Mus. Nat. Hist.*, 87, 7-99.

THE TICKS OF SEA BIRDS

By F. ZUMPT*

The ticks collected by the Australian National Antarctic Research Expedition during 1949/50 comprise 3 species, namely *Ceratixodes uriae* White, *Ixodes auritulus* Neumann and *Ixodes kerguelensis* André & Colas-Belcour. The exact localities are given below.

The ticks of sea birds represent a very interesting ecological group. They are very widely distributed and some species occur in both the southern and northern hemispheres. It has been considered advisable therefore to give in this paper a survey of all ticks of sea birds so far recorded. These comprise 9 species which belong to the genera *Ceratixodes* and *Ixodes* of the *Ixodinae*, and to *Ornithodoros* of the *Argasidae*. It is important to note first, that none of the higher *Ixodidae* which belong to the subfamily of *Rhipicephalinae* is adapted to sea birds. All ticks of sea birds belong to genera with pronounced primitive features as especially represented in *Ceratixodes* Neumann. Secondly, it is only in two of the *Ixodinae* species, *Ceratixodes uriae* and *Ixodes kerguelensis*, that the male sex is known, the remaining species being represented only by the female sex or nymphal stage. It is thought that the males are not blood-sucking, that they are more or less dwarfish and that they remain hidden in the nests of their hosts where they are difficult to find. Another possibility is that these species are parthenogenetic like *Amblyomma rotundatum* Koch, a toad-infesting tick of South America (Schulze 1938).

The following ticks have been recorded from sea birds:—

I. CERATIXODES URIAE WHITE, 1852.

- 1852. *Ixodes uriae* White, J. voyage Baffin's Bay 2 App. p. 210.
- 1878. *Hyalomma puta* Pickard-Cambridge, Philos. Trans. Roy. Soc. Lond. 168, p. 222.
- 1883. *Ixodes borealis* Kramer & Neumann, Vetenskap. Jakttagelser 3 p. 518.
- 1883. *Ixodes fimbriatus* Kramer & Neumann, id. ibid. p. 518.
- 1885. *Ixodes eudyptidis* Maskell, Trans. Proc. New Zeal. Inst. 17, p. 19.
- 1899. *Ixodes putus* Neumann, Mem. Soc. Zool. France 12 p. 125.
- 1902. *Ceratixodes putus* Neumann, Arch. Parasitol. 6 p. 115.

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1904. *Ixodes (Ceraticoxodes) putus* Neumann, Arch. Parasitol. 8, p. 444.
1911. *Ixodes putus* Nuttall & Warburton, Mon. Ixodidea 2, p. 256.
1930. *Ixodes (Ceraticoxodes) putus procellariae* P. Schulze, Sitzber. naturf. Ges. Rostock (3) 2, p. 123 (Nov. syn.)
1936. *Ixodes uriae* Oudemans, Krit. Hist. Overz. Acarologie 3 B, p. 796.
1938. *Ceratoxides uriae* Schulze, Zool. Anz. 123, p. 12.
1941. *Ceratoxides uriae* Schulze, Ztschr. Morph. Okologie 37, p. 505.
1945. *Ixodes uriae* Cooley & Kohls, Nat. Inst. Health Bull. no. 184, p. 223.
1947. *Ceratoxides uriae* Andre, Mem. Mus. Paris (N.S.) 20, p. 76.

Neumann (1902) created for the so-called "puffin-tick" the new genus *Ceratoxides* which he later (1904) degraded to a subgenus of *Ixodes*. Nuttall and Warburton (1911) in their monograph then suppressed the subgenus, regarding it as a simple synonym of *Ixodes*. Schulze (1938), restored the genus on account of the outstanding and primitively constructed capitulum and the peculiar structure of Haller's organ, but subsequently Cooley and Kohls (1945) again suppressed the genus. The writer considers that Schulze is right and that several features of this species are outstanding enough to justify a generic separation from *Ixodes*.

The distribution of *C. uriae* is a very interesting one, its territory comprising the surroundings of both poles. Schulze, therefore, called it a "bipolarly distributed" tick. In the northern hemisphere, it has been recorded from North America (Alaska, Canada, Newfoundland), Greenland, Iceland, North Europe (Faeroes, Hebrides, Scotland, England, Norway, Finland, Kola Pen.) and the most eastern parts of Russian Asia (Kamchatka, Bering Isl.).

In the southern hemisphere, *C. uriae* shows a circumpolar distribution as well. It is recorded from Patagonia, Iles de Kerguelen, Ile St. Paul, King Island, Campbell Island, Nightingale Island (of the Tristan da Cunha group) and South Africa. Host specificity is not pronounced. Climate and the characteristics of the nesting places seem to be more important in influencing distribution than the physiological condition of the hosts.

The male ticks do not suck blood and are, therefore, only found in or near the nests of the birds, whereas the females, nymphs and larvae naturally live on the hosts as well. The most frequently recorded hosts of *C. uriae* are gulls, albatrosses, petrels, shearwaters and penguins. All they have in common is that they are sea birds, and they show no phylogenetic relationship. The recorded localities and hosts are given by

Nuttall and Warburton (1911), Schulze (1938) and Cooley and Kohls (1945).

The material received from the A.N.A.R.E. contained the following specimens:

- 1 N., from *Pachyptila desolata*—nest, Atlas Cove, Heard Island, 17.12.1949.
- 2 ♂, 1 ♀, from *Pachyptila* and *Pelecanoides* nests, West Bay, Heard Island, 12.1.1950.
- 1 N, from *Phalacrocorax atriceps*, Heard Island, 8.1.1950.
- 5 N, 1 L, from *Phoebetria palpebrata*, Heard Island, 2.1.1950.
- 7 N, 1 L, from *Eudyptes chrysolophus*, Heard Island, 26.12.1949.
- 14 L, from *Phoebetria palpebrata*, Heard Island, 19.2.1950.
- 2 N, from *Eudyptes chrysocome*, Heard Island, 12.1.1950.
- 1 N, from *Eudyptes chrysocome*, Heard Island, 30.11.1949.
- 11 N, from *Eudyptes chrysocome*, Macquarie Island.
- 2 ♀, 1 N, from *Diomedea melanophris*, Macquarie Island, 17.3.1950.
- 4 N, from *Eudyptes chrysocome*, Macquarie Island, 23.3.1950.
- 14 ♂, 11 ♀, 5 N, 3 L, from *Penguin rookery*, Macquarie Island, December 1949.
- 13 ♀, from *Aptenodytes patagonica*, Macquarie Island, January 1950.

There is no adequate explanation for this wide distribution. Schulze (1938) has discussed this problem at some length without finding a satisfactory answer. There is Pfeffer's hypothesis that species with such a bipolar distribution are relics of a tertiary fauna. I do not think that such an explanation is very satisfactory. Schulze also mentions the possibility that the attached ticks may be transported by the wandering sea bird from one place to another. It is, for instance, known that Wilson's storm petrel (*Oceanites oceanicus*) breeds in the Antarctic but migrates northwards to Labrador, Greenland, and Great Britain. The arctic tern breeds in the circumpolar region during the northern summer, but is not uncommon thereafter on the coasts of South Africa. More examples are easily to be found showing that the transportation of this tick may take place without difficulty. Unfortunately, our knowledge of the biology of *C. uriae* is very poor. It is said to be a three-host tick and that the males do not feed. In such cases the males fertilize the females after they have dropped from the host. It is not known if a parthenogenetic development of the eggs is possible. Larvae and nymphs give rise to both sexes but we do not know if they stay long enough on the host to explain the huge distribution area. A last possibility is that the eggs being sticky may be transported from one place to another on birds' feet. They normally have a long incubation

period and may easily be transferred from the northern to the southern hemisphere and vice versa. This problem remains unsettled but I believe the explanation is more likely to be an ecological than a historical one.

Ceratixodes uriae shows a considerable variability especially in the strength of the legs. But it is not yet possible to distinguish well-founded subspecies restricted to a certain locality or group of hosts. Perhaps, if in the future more material from different places and hosts is available, a subspecific splitting up may be possible, but at present it cannot be done.

II. IXODES KERGUELENENSIS ANDRÉ AND COLAS-BELCOUR, 1942.

1942. *Ixodes canisuga* var. *kerquelenensis* Andre & Colas-Belcour, Bull. Mus. Nat. Hist. Nat. (2), 14, p. 261.

1947. *Ixodes canisuga* var. *kerquelenensis* Andre, Mem. Mus. Paris (N.S.) 20, p. 72.

The authors based their variety on one male specimen from Kerguelen and regarded it as a variety of the European *I. canisuga* Johnston. In the collection received from A.N.A.R.E. 15 males were present, taken from nests of *Pachyptila desolata* and *Pelecanoides spec.* at West Bay, Heard Island, 12th January 1950.

Only the male of this species is known, and it is curious that neither the female nor the nymph have been found up to date. Normally, these stages are more commonly collected than the males. One could, perhaps, believe that this male belongs to a female species already described. This is unlikely because of its outstanding morphological features.

André and Colas-Belcour described this tick as a variety of *I. canisuga* Johnston. I do not think that its status as a species can be questioned. Compared with the mentioned species, *I. kerguelenensis* has a large jugular plate on each side of the pregenital plate. In *I. canisuga* these jugular plates are present but they are very small and indistinct. Furthermore, the pregenital plate is pentagonal in *I. kerguelenensis*, but more or less quadrangular in *I. canisuga*. The specimen on which the authors based *kerquelenensis* was probably fully engorged, so the ventral plates would be widely separated from each other. This is not the case in my specimens, and the anal groove is slightly, but distinctly, converging posteriorly. The single male from Kerguelen is drawn as having the anal groove diverging but this is certainly due to a distortion of the engorged tick.

This species runs down to *I. pilosus* Koch in Nuttall and Warburton's monograph (1911) and to *I. rugosus* Bishopp or *I. sculptus* Neumann in Cooley and Kohl's paper on the North American *Ixodes* (1945).

III. IXODES AURITULUS NEUMANN, 1904.

1899. *Ixodes thoracicus* Neumann (nec Koch), Mem. Soc. Zool. France 12, p. 149.
1904. *Ixodes auritulus* Neumann, Arch. Parasitol. 6, p. 450.
1906. *Ixodes percavatus* Neumann, arch. Parasitol. 10, p. 200.
1911. *Ixodes auritulus* Nuttall & Warburton, Mon. Ixodoidea 2, p. 187.
1911. *Ixodes percavatus* Nuttall & Warburton, Mon. Ixodoidea 2, p. 220.
1938. *Ixodes auritulus* Johnston, Austr. Antarct. Exp. 1911-14 C 2 (3), p. 11.
1939. *Ixodes auritulus* Aragao, Mem. Inst. Oswaldo Cruz 33, p. 324.
1945. *Ixodes auritulus* Cooley & Kohls, Nat. Inst. Health Bull. no. 184, p. 195.
1947. *Ixodes percavatus* André, Mem. Mus. Paris (N.S.) 20, p. 76.

I. auritulus is a fairly common tick of sea birds and is widely distributed in the southern hemisphere. Its area of distribution nearly equals that of *C. uriae* but though it reaches the northern parts of North America, it has not yet been found in northern Europe and Asia. Originally, it may have been an element of the South American fauna from which it spread out on the one hand, like the penguins, to the antarctic and subantarctic islands, or on the other hand along the American coasts up to the arctic regions of Canada.

Neumann (1911) based his *Ixodes percavatus* on 4 slightly mutilated females from Nightingale Island. I received several nymphs and females from this locality, collected by Mrs. Rowan off *Diomedea chlororhynchus*. This batch comprises all transitions from typical *I. auritulus* to *I. percavatus* as figured by Neumann or Nuttall and Warburton. The internal spur of coxa I may be distinct or not. Nuttall and Warburton describe the first joint of the palpus as having an anterior point internally which in the type specimens is perhaps not as big or clearly visible as in unengorged specimens of *I. auritulus*, so that this feature would not be against the synonymising of these two species. I have not seen the type specimens of *I. percavatus*, but I think that the proposed synonymy will prove to be correct.

The A.N.A.R.E. collection contains 3 females from the nests of *Pachyptila desolata* and *Pelecanoides spec.*, West Bay, Heard Island, 12th January 1950.

Ixodes auritulus has also been recorded from Macquarie Island, off *Aptenodytes patagonica*, and I received 2 females from the British Museum which were collected on Stephens Island from a dove petrel. Most of the unrecorded localities refer to both Americas where this tick

species not only lives on sea birds, but also on numerous and not closely related species of land birds. (cf. Cooley and Kohls, 1945.)

IV. IXODES ROTHSCHILDI NUTTALL & WARBURTON, 1911.

1911. *Ixodes percavatus* var. *rothschildi* Nuttall & Warburton, Mon. Ixodoidea 2, p. 221.

This species, originally described as a variety of *Ixodes percavatus*, differs from it by stronger and dorsally recurved cornua and smaller porose areas, the interval between the pores being equal to half their width, and by the lack of a retrograde spur on trochanter IV. The authors based this form on 2 females and 3 nymphs, taken from a puffin, but the locality was not known. I received one female and one nymph from Nightingale Island taken by Mrs. M. K. Rowan off *Diomedea chlororhynchus*, 31.3.50. Both specimens fit the description very well so that there is, I believe, no doubt about the identification. But the differences from *I. auritulus* (*percavatus*?) are so great, that it is better to regard *I. rothschildi* as a distinct species.

V. IXODES MURRELETI COOLEY & KOHLS, 1945.

1945. *Ixodes murreleti* Cooley and Kohls, Nat. Inst. Health Bull. No. 184, p. 213.

The authors based this species on one partly engorged female taken from "the sea bird, Scripps murrelet, Los Coronados Island, Lower California, Mexico".

VI. IXODES UNICAVATUS NEUMANN.

1908. *Ixodes unicavatus* Neumann, Arch. Parasitol. 12, p. 1.
1911. *Ixodes unicavatus* Nuttall and Warburton, Mon. Ixodoidea 2, p. 264.

This is a species which is only known from a few females, nymphs and larvae from Great Britain. The only recorded host is the European cormorant, *Phalacrocorax carbo* L.

VII. IXODES SIGNATUS BIRULA, 1895.

1895. *Ixodes signatus* Birula, Bull. Acad. Imp. Sc. Petersburg (5) 2, p. 357.
1899. *Ixodes arcticus* Osborn, Fur Seals 3, p. 553.
1901. *Ixodes parvirostris* Neumann, Mem. Soc. Zool. France, 14, p. 284.
1904. *Ixodes eudyptidis* var. *signatus* Neumann, Arch. Parasitol. 8, p. 451.
1908. *Ceratixodes signatus* Banks, U.S. Dept. Agric. Tech. Ser. No. 15, p. 21.

1911. *Ixodes signatus* Nuttall & Warburton, Mon. Ixodoidea 2, p. 261.

1945. *Ixodes signatus* Cooley & Kohls, Nat. Inst. Health Bull. no. 184, p. 201.

This is a rare species which has been collected a few times from cormorants (*Phalacrocorax penicillatus* and *Ph. pelagicus*) on the Aleutian Islands, Castle Rock and Pacific Grove, California, and Yezo, Japan.

VIII. IXODES NEUMANNI NUTTALL & WARBURTON, 1911.

1911. *Ixodes neumanni* Nuttall & Warburton, Mon. Ixodoidea 2, p. 217.

This species is doubtful. (See reference.) The authors based it on several females and nymphs from New Zealand. The host was unknown but is probably a sea bird.

The females of the known ticks of sea birds may be distinguished as follows:

1. Coxae practically unarmed; scutum broadest anteriorly.
.....*Ceratixodes uriae* White.

2. Some of the coxae with distinct spurs; scutum broadest near middle posteriorly.

A. All, or at least 3 of the trochanters with distinct spurs.

1. Article 1 of palp with an anteriorly directed spur; scutum about as broad as long.

(a) Collare with slight cornua which are not or only weakly recurved dorsally; all trochanters with a retrograde ventral spur on the distal border.....
.....*Ixodes auritulus* Neum.

(b) Collare with strong comms which are distinctly recurved dorsally; only trochanters I-III with a retrograde ventral spur.

.....*I. rothschildi* Nutt. & Warb.

2. Article 1 of palps with anteriorly directed spur; scutum distinctly longer than broad.

.....*I. murreleti* Cool. & Kohls

B. Trochanters without spurs.

1. Collare broadest in front; confluent porose areas almost covering the whole dorsum of the collare; palps strikingly curved inwards.

.....*Ixodes unicavatus* Neum.

2. Collare broadest at base or near middle; porose areas normally not confluent and never covering the whole dorsum; palps not strikingly curved inwards.

(a) Collare with strongly developed auriculae near the middle.

.....*Ixodes signatus* Birula

(b) Collare without auriculae, broadest at the base and from here slightly converging to the front margin.

I. neumanni Nutt. & Warb.

The *Argasidae* have contributed two forms to the fauna of sea birds, namely *Ornithodoros talaje capensis* Neumann on penguins and *O. talaje sancti-pauli* Schulze on terns. Whether these forms are really to be regarded as subspecies of *O. talaje* Guerin-Meneville is still an open question. I have no South American material and can, therefore, not touch this problem. But the relationship between *O. talaje* in South America and the two mentioned subspecies is without doubt very close. We can, therefore, accept the hypothesis that the sea bird infesting *talaje* forms have evolved from the continental *talaje talaje* which infests a wide range of animals, especially rodents. This is an interesting parallel to the penguin-infesting fleas which are closely related to South American fleas parasitising rodents (See B. de Meillon—"Fleas of Sea Birds in the Southern Ocean").

IX. ORNITHODORUS TALAJE CAPENSIS NEUMANN, 1901.

1901. *Ornithodoros talaje* var. *capensis* Neumann, Mem. Soc. Zool. France 14, p. 258.
 1908. *Ornithodoros talaje* var. *capensis* Nuttall & Warburton, Mon. Ixodoidea 1, p. 61.
 1941. *Alectorobius talaje capensis* Schulze, Ztschr. Morph. Okol. 37, p. 542.

This tick is common in the nests of the South African jackass penguin, *Spheniscus demersus*, on islands off the Cape Province coast. Apart from some morphological features already stated by Neumann, Schulze also found that Haller's organ in this form is strikingly different from that of *talaje talaje*.

X. ORNITHODORUS TALAJE SANCTI-PAULI SCHULZE, 1941

1941. *Alectorobius talaje sancti-pauli* Schulze, Ztschr. Morph. Okol. 37, p. 544.

Schulze separated the *talaje* form from St. Paul Rocks as a further subspecies. The translation of his description is as follows:

"*A. talaje sancti-pauli* may be taken as a small *talaje capensis* with Haller's organ as in *talaje talaje*. In contrast to *talaje talaje* and *talaje capensis*, which reach a total body-length of 6 mm, the biggest female before me from St. Paul measures only 4 mm. The colour is light yellow,

the sclerotisation is probably still weaker than in *capensis* being especially distinct on the margin of the capsula which is yellow in *capensis*, but colourless in *sancti-pauli*. Other morphological features of *sancti-pauli* are quite similar to the South African form."

O. talaje sancti-pauli was collected from the nests of the Atlantic noddy, *Anous stolidus*. I have two nymphs from Ascension Island, but no host is recorded.

I wish to express my thanks to the Director of the Australian National Antarctic Research Expedition for entrusting me with the tick specimens collected from Heard Island and Macquarie Island, and Mrs. M. K. Rowan for sending me additional material from Tristan da Cunha.