

# Lice of the hyraxes, especially *Procavia capensis*.

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## Introduction.

The Procaviidae (hyraxes, dassies or rock-rabbits) are peculiarly interesting mammals because they have persisted with very little modification since the Upper Eocene period. This same conservatism has caused the modern members of the group to be exceedingly hard to classify satisfactorily, so that few mammalogists are agreed as to the number of genera which should be recognised, or as to which forms should be attributed to which species. But Bedford (1932), who was the first author to make a systematic study of the lice of the South African hyraxes, made a most interesting and significant discovery, namely, that certain of these lice are apparently more specific in their choice of host than are any other known lice, occurring each on one of the forms attributed to *Procavia capensis* or *Heterohyrax syriacus* and not on other forms of these same species. A single apparent exception to this rule will be discussed below; there are other apparent exceptions, but these need confirmation.

Our knowledge of the lice of hyraxes is fairly good so far as certain areas are concerned. Mr. G. A. H. Bedford made a large collection of lice from many specimens of South African hyraxes (mostly skins in the Transvaal Museum) and more recently I have been able, through the kindness of Dr. Austin Roberts of the Transvaal Museum, to examine further very large collections from the skins, some sent to me by Dr. Roberts and others collected from the skins by myself. In addition I owe to Dr. C. H. Curran and Dr. John E. Hill of the American Museum of Natural History the opportunity to examine many lice from skins in that museum, and to Dr. L. B. Leakey of the Coryndon Memorial Museum in Nairobi permission to examine all the hyrax-skins there. Various friends and myself have obtained many hyraxes in East Africa and the eastern Belgian Congo for the purpose of examining their lice. The Mallophaga or biting lice of hyraxes have recently been excellently monographed by Dr. Werneck, who had access to practically all the material I have mentioned and also to specimens belonging to the British Museum. The Anoplura or sucking lice found on this group of hosts still await a monographer, and it is evident that they comprise many

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more species than are at present recognised. Our knowledge is fairly adequate for South Africa and East Africa, but extremely inadequate for all other areas.

The fact that so high a proportion of the known material of hyrax-lice is from skins in museums carries the great advantage that it enables misdeterminations in this very difficult group of hosts to be checked and corrected, for most authors who have written about hyrax-lice have followed the excellent practice of recording the museum numbers of the skins from which their material was obtained. But it also has the great disadvantage that it is always possible for a few lice to be shaken off one skin onto another; for this reason, records in which the number of lice is very small need to be regarded with suspicion.

With regard to the names of the hosts I have followed Allen (1939) except that I have recognised several forms placed by him as synonyms.

#### **Forms of lice occurring on one host-form.**

The maximum number of species of Mallophaga known from any one form of hyrax is eight, on *Dendrohyrax arboreus adolfi-friederici*, of which the parasites are known from very large collections taken from many reliably-determined fresh specimens as well as from skins. These comprise a *Eurytrichodectes*, a *Dasyonyx*, two species of *Procaviphilus*, one species of the subgenus *Acondylocephalus* of *Procavicola*, two of the subgenus *Condylocephalus* of *Procavicola*, and one of *Procavicola s. str.* I have myself taken seven of the eight species on one individual host and all eight from freshly-killed specimens in the same locality. There is no room for doubt that some specimens must possess the entire set of lice.

Among hyraxes referred to *Heterohyrax* and *Procavia* the number of species of Mallophaga to be obtained from one host-form is smaller, but hyraxes of these groups are also infested with Anoplura. The maximum number of species known with certainty from any one form belonging to these groups is four Mallophaga and two Anoplura (of the genus *Prolinognathus*). The Mallophaga include a *Dasyonyx*, a *Procaviphilus*, a *Procavicola* of the subgenus *Condylocephalus* and a *Procavicola s. str.* In the following notes I shall generally refer to the subgenera of *Procavicola* by their subgeneric names only, so the "*Procavicola*" must be read as meaning "*Procavicola s. str.*"

#### **Lice as specific or subspecific criteria in hyraxes.**

We have just seen that it is fully established that two species of *Procaviphilus* and two species of *Condylocephalus* may occur on the same host-form. In addition, there is one apparently authentic case of the occurrence of two species of *Acondylocephalus* on one form of host, while *Dasyonyx* is rather sporadic in its distribution. Bearing in mind that so much of our material is from skins in

museums, and that therefore the specimens are often very few in number, it is clear that the presence of different species of any of these groups on two hosts cannot be regarded as certain evidence of any difference in their parasitic fauna, since it may mean that the two hosts have the same pair of species in each instance and that in one instance we have collected one member of the pair and in the other case we have obtained the other member. Nor are the Anoplura more useful to us in this connection, largely because their systematics have not yet been sufficiently clarified.

But the position with regard to *Procavicola s. str.* is entirely different, for there is no established example of the occurrence of two species of this subgenus on the same host-form. To this rule there is one exception, in which the species of *Procavicola* found on two forms of *Procavia capensis* seems to be governed by geography rather than by host-form: the *Procavicola* characteristic of *Procavia c. coombi* is *P. pretoriensis*, while *Procavia c. letabae* is infested by *Procavicola mokeetsi*; but the latter louse was obtained from certain skins determined by Dr. Roberts as *P. capensis coombi* (T.M. nos. 1547, 1548 and 1805 from Rustenburg, Transvaal, and 3568 and 3569 from near Wylies Poort, Zoutpansberg, Transvaal), whereas skins of *letabae* from the type locality of the form (also in the Zoutpansberg district) were also infested with *mokeetsi*. We are therefore apparently faced with the extraordinary situation that *Procavia c. coombi* over the greater part of its range is infested by *Procavicola pretoriensis*, but in the Rustenburg and Zoutpansberg areas (in the latter of which it is a very short distance from the type locality of *letabae*) it bears *Procavicola mokeetsi*, as *letabae* also does in its type locality. Since all the known louse-material from *Procavia c. letabae* and from the Rustenburg and Zoutpansberg specimens of *coombi* is from skins in the Transvaal Museum, there remains the possibility that the apparent anomaly is accounted for by lice from one skin being shaken off on to another; but the number of specimens obtained from some of the skins is sufficient to render this explanation extremely unlikely. I must admit my inability to find a wholly satisfactory explanation for the apparent facts in this unique case. Is it conceivable that a form of *Procavia capensis* may sometimes acquire the physiological characteristics of a different subspecies before acquiring the external characters of the other form?

A second apparent exception is easily explained: *Procavicola (P.) natalensis* Bedford and *P. (P.) sternatus* (Bedford) have both been recorded from *Procavia capensis natalensis*. But the hyrax from which *sternatus* was obtained was never (so far as I am aware) identified by a mammalogist and the locality was an unlikely one for *P. c. natalensis*; furthermore, I have had material from many skins of authentic *P. c. natalensis* through my hands and have never encountered *Procavicola sternatus*, so there seems to be a very strong probability that this hyrax was not *natalensis*.

Since two forms of *Procavicola* do not normally occur on the same form of the host we can accept the possession of different species of this group by two hosts as strong evidence that the hosts are distinct forms, and the possession of a *Procavicola* in common by two forms as an indication that these forms are at least very closely related. In the present state of our knowledge the other genera and subgenera of lice are of less value except as generic criteria for the hyraxes.

### The genera of the hyraxes.

Any mammalogist who reads this paper is certain to ask: "Do the lice throw any light on the vexed question as to whether we should recognise three genera of hyraxes or only one?" Before attempting to answer this question, I must remind readers once again of the inadequacy of our knowledge of hyrax-lice, the unsatisfactory nature of some of the records, and the fact that probably no mammalogist would claim that (if we are to recognise three genera of hyraxes) every one of the forms of hyrax from which we have parasites stands in its correct generic position in even the most modern classification of the group. Bearing in mind these limitations, I claim that the parasites provide rather strong evidence in favour of the generic distinctness of *Procavia* and *Dendrohyrax*, with *Heterohyrax* apparently constituting a miscellany of heterogeneous forms which should be divided between the other two genera. But the evidence could also be read as meaning that certain forms of *Procavia* and certain forms of *Dendrohyrax* have diverged so widely that they would certainly be regarded as generically distinct if the annectant forms which constitute *Heterohyrax* had become extinct, but that the persistence (as "living fossils") of these annectants obviates the possibility of erecting any generic boundary between the two extremes. On present evidence I prefer the former interpretation.

Species of lice are obviously useless for any discussion of this question and we must look to genera or subgenera. *Eurytrichodectes* and *Procaviphilus* will certainly not help us, for the former is too rare for its apparent absence to have any significance and the latter occurs on all three groups of the hyraxes. In *Dasyonyx* we come to something slightly more suggestive: *Dasyonyx s. str.* appears to occur on all three groups of hyraxes, but *Neodasyonyx* apparently does not occur on *Dendrohyrax*. In *Procavicola* we find that *Procavicola s. str.* and *Condylocephalus* occur on all three groups, but *Acondylocephalus* occurs on all forms of *Dendrohyrax* and is strictly confined to this genus if we regard *bocagei* (included by Allen in *Heterohyrax*) as a *Dendrohyrax*. Anoplura of the genus *Prolinognathus* are very wide-spread on *Procavia* and *Heterohyrax*, but do not occur on *Dendrohyrax*.

The case of *bocagei* may reasonably be regarded as a test, for Dr. Jordan collected from hyraxes which were later determined at

the British Museum as this form two species of *Acondylocephalus*—a group which, as I have just stated, is strictly confined to *Dendrohyrax*. It is, therefore, most interesting to note that there is evidence, entirely independent of the parasites, which suggests either that the true position of *bocagei* is in *Dendrohyrax* or that two species (one a *Dendrohyrax*) have been confused under the name *bocagei*. Thomas (1892, p. 52) writes of *Dendrohyrax grayi* Bocage, which Allen lists as a synonym of *bocagei*, that it differs from *bocagei* only by the possession of complete orbits — the most conspicuous difference between *Dendrohyrax* and *Heterohyrax*. I am not concerned with the systematic position of *bocagei* in itself, nor am I competent to decide the question, but from the evidence of the parasites collected by Dr. Jordan from *bocagei* I am convinced that either *bocagei* is a *Dendrohyrax* or *grayi* and *bocagei* are not synonymous and Dr. Jordan's specimens were *Dendrohyrax grayi*.

On present evidence derived solely from the parasites, therefore, I regard the hyraxes as divisible into *Procavia* (characterized, so far as its parasites are concerned, by the presence of *Neodasyonyx* and *Prolinognathus* and the absence of *Acondylocephalus*), and *Dendrohyrax* (characterized by the presence of *Acondylocephalus* and absence of *Neodasyonyx* and *Prolinognathus*). I regard *Heterohyrax* as having no real existence, most of the species being referable to *Procavia*, and *bocagei* (or possibly *grayi*) to *Dendrohyrax*.

### Lice and the species of hyraxes.

Bedford (1932) found that, in *Procavia capensis* and in the two forms of *Heterohyrax* found in South Africa, every local form has its own species of *Procavicola*, this even applying to certain forms not yet distinguished. In *Dendrohyrax*, and in *Procavia* and *Heterohyrax* in other parts of Africa, conditions are not quite the same.

We know the *Procavicola* found on seven subspecies of *Dendrohyrax arboreus* in Kenya, Uganda, Tanganyika, the eastern part of the Belgian Congo, and South Africa. Every one of these subspecies bears precisely the same *Procavicola* (*P. eichleri*). The only other *Dendrohyrax* from which this subgenus of lice has been recorded is *D. dorsalis marmota*, which bears a quite different species.

In *Heterohyrax* we get the first hint of a difference between conditions in East Africa and South Africa. Each of the two South African forms (*granti* and *ruddi*) has a quite different species of *Procavicola*, whereas a form from Uganda (identified as *brucei*, but perhaps more probably *thomasi*) and a form (*hindei*) from a locality more than 500 miles away in Kenya both bear the same *Procavicola*.

Turning to *Procavia*, this hint of an important difference between conditions in East and South Africa becomes certainty. East African conditions apparently extend as far south as Nyasaland and perhaps further. There is a record of *Procavicola* (*P. shoanus* Maltbaek from *P. habessinica sciona* from Abyssinia, but this animal had been in Copenhagen Zoo and the record is therefore

unreliable. *Procavia habessinica zelotes* from Kenya and *P. johnstoni lopesi* from Uganda both possess *Procavicola* (*P.*) *lopesi* Bedford, whereas *P. johnstoni matschiei* from the southern shores of Lake Victoria and *P. johnstoni johnstoni* from Nyasaland are both infested by *Procavicola* (*P.*) *thorntoni* Hopkins, which is very distinct from *lopesi*. These facts are at first sight very startling, for (ignoring the doubtful record) we appear to have the same parasite on forms of two different species (*habessinica zelotes* and *johnstoni lopesi*) and a different parasite on two other forms of one of these species (*johnstoni matschiei* and *j. johnstoni*). The explanation almost certainly lies in the unsatisfactory state of the systematics of the hyraxes. I believe that, in East Africa, possession of a *Procavicola* in common by two subspecies of *Procavia* indicates that they are conspecific (not, of course, that they are synonyms), whereas the possession of different species of *Procavicola* by two forms indicates that they belong to different species. Accordingly, I consider *matschiei* to be correctly placed as a subspecies of *johnstoni*, whereas *lopesi* and *zelotes* are forms of one species which is not *johnstoni*.

Conditions in South Africa are so different as to demand separate treatment.

#### Lice and the forms of *Procavia capensis*.

Omitting forms from Southwest Africa, of whose parasitic fauna we know too little for discussion to be profitable at present (though we may note that the *Procavicola* from the only form from which this subgenus is known is different from any of the South African species), there are seven described forms of *Procavia capensis*. We know, with some approach to certainty, the species of *Procavicola* which occur on four of these forms and, with a greater or less degree of probability, the species occurring on the remaining three. Every one of these species of *Procavicola* is distinct.\* This most remarkable fact was first noted by Bedford (1932), who regarded it as evidence that the forms ascribed to *Procavia capensis* are full species, and who was led by the fact that other distinct species of *Procavicola* were collected from skins labelled *Procavia capensis* to prophesy that other forms of *Procavia* in South Africa awaited description. His prophesy has been fulfilled in at least one instance, and further evidence collected since he wrote has tended to establish more firmly the facts he brought forward, though it now appears that there may be certain exceptions.

If Bedford's belief that every form of *Procavia capensis* is infested by a different species of *Procavicola* is correct, it should be possible to identify forms of the hyrax by means of their lice of this subgenus. Let us examine a few examples. Bedford stated

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\* I have discussed above the apparent anomaly exhibited by *Procavia capensis coombi* and *P. c. letabae*, and this instance is left out of consideration here.

his belief that a skin (T.M. no. 4861), from which he obtained the types of *Procavicola* (*P.*) *subparvus*, must therefore be a new species. Examination of this skin by Dr. Roberts showed it to be "quite distinct from other specimens in the museum" and it is now the type of *Procavia capensis chiversi*. Dr. Roberts, in describing *Procavia capensis orangiae*, wrote (1937, p. 102): "In three specimens from Kastrol Nek . . . two somewhat resemble the type of *orangiae* in colour . . . but the third is greyer and both in colour and teeth is a *natalensis*. It seems likely, therefore, that the one form has come to the top of the escarpment from the east and the other form from the west. There is a wooded kloof at this place where the animals occur amongst the shady rocks, and at a higher level there are exposed kranses more like those of the Orange Free State, and it is possible, therefore, that the two forms keep much to their own territory, though evidence of this is lacking." In the Bedford collection, at that time in my care, I found specimens of *Procavicola* s. str. from two of the skins from Kastrol Nek referred to by Dr. Roberts, T.M. skin no. 4324 having produced the type-series of *P. (P.) furca* Bedford and no. 2919 producing two males of *P. (P.) natalensis* Bedford. In reply to my enquiry as to the identity of these two skins, Dr. Roberts kindly informed me that, as I had already deduced from the parasites, no. 2919 is the specimen resembling *P. c. natalensis* to which he had referred in his paper and no. 4324 is one of those which resembled *P. c. orangiae*.

Bedford's principle appears to be firmly established by the evidence, and it may now be of interest to list the South African forms of *Procavia*, with their distribution as shown by the lice obtained from skins or fresh specimens. It must be borne in mind that many skins have been examined without *Procavicola* being found and that females of this subgenus are not determinable, so that my list is necessarily restricted to those specimens from which male lice of this group have been obtained — a relatively small number.

*Procavia capensis capensis* (Pallas). Type locality Cape of Good Hope, which should be interpreted as meaning the neighbourhood of Cape Town. *Procavicola (P.) vicinus* Werneck has been obtained in quantity from several topotypes from Leeukoppie, Hout Bay, about 15 miles southwest of Cape Town (South African Museum skins 18899, 19448 and 19449). This louse is not known to occur in any other locality.

*Procavia capensis chiversi* Roberts. Type locality Mount Fletcher, East Griqualand. *Procavicola (P.) subparvus* Bedford was collected from the holotype of this form (T.M. skin 4861), but only two males were obtained so that confirmation that *chiversi* is the true host of the species is required. *P. subparvus* has also been obtained in small numbers from an undetermined skin collected at Lambert's Bay, near Clanwilliam, Cape Province (T.M. skin 2150) which Dr. Roberts considers is not *chiversi*.

*Procavia capensis coombi* Roberts. Type locality Hennops River, Pretoria. Characterized by *Procavicola* (*P.*) *pretoriensis* Bedford. The distribution of this form, as shown by the lice, includes Schurveberg, Pretoria (T.M. skin 4344); Onderstepoort, near Pretoria; Weltevreden, Parys, Orange Free State (T.M. skin 3507); and Mochudi, Bechuanaland (T.M. skin 7575).

*Procavia capensis letabae* Roberts. Type locality Mokeetsi, Zoutpansberg, northern Transvaal. Characterized by *Procavicola* (*P.*) *mokeetsi* Bedford, which has been obtained from a paratype of *letabae* (T.M. skin 3275); from several other skins collected in the Zoutpansberg area (Mokeetsi, T.M. skin 3981); near Wylies Poort (T.M. skins 3568 and 3569); from Koperfontein, Rustenburg, Transvaal (T.M. skins 1547 and 1548) and Rooikrans, Rustenburg (T.M. skin 1805); and from Gwanda, Southern Rhodesia (American Mus. Nat. Hist. skin 42038). It is to be noted that Dr. Roberts considers the skins from Wylies Poort and the Rustenburg area to be *coombi* and not *letabae*.

*Procavia capensis marlothi* Brauer. Types from Krankshoek and Nieuwveld Mts., near Beaufort West, Cape Province. The evidence with regard to the characteristic *Procavicola* of this form is deplorably weak. Among material from T.M. skin 9607, from Campbell, Cape Province, I found four males of a new species of *Procavicola* s. str. which I hope shortly to describe; a further male was obtained from T.M. skin 2147, from Klaver. In the absence of topotypes, Dr. Roberts is unable to determine these skins with certainty, but he thinks the specimen from Campbell is not *marlothi*.

*Procavia capensis natalensis* Roberts. Type locality Pigg's Peak, Swaziland. *Procavicola* (*P.*) *natalensis* Bedford has been obtained from the holotype and a topotype of this form (T.M. skins 2005, 2006) and from many other skins. The distribution of the form, as shown by the parasites, also includes Kastrol Nek, Wakkerstroom district, Transvaal (T.M. skin 2919); Deepdale, Natal; Knysna, Cape Province (T.M. skin 1168); Fir Glen and Kleinpoort, Grahamstown, Cape Province (T.M. skins 6749, 6752, 6757, 6758 and 6759); Still Bay, Riversdale district, Cape Province (T.M. skin 9325, two males only); and Jonkersberg Forest Station, George district, Cape Province (T.M. skin 9330). A single male of *Procavicola* (*P.*) *natalensis* was obtained from T.M. skin 9323, collected at Cape Agulhas, Cape Province, but I attach no importance to this because a single specimen could so easily have been derived from some other skin. Dr. Roberts thinks this specimen, and also that from Still Bay (no. 9325) nearer to *c. capensis* than to *c. natalensis*. The number of specimens of *Procavicola natalensis* obtained from each of these skins is so small that no great weight should be attached to the louse-evidence. He also considers that the Grahamstown specimens represent an undescribed form.

*Procavia capensis orangiae* Roberts. Type locality Meadows, Orange Free State. *Procavicola* (*P.*) *furca* Bedford was described from two



males obtained from T.M. skin 4324. This skin is from Kastrol Nek, Wakkerstroom, Transvaal, and is determined by Dr. Roberts as "near *orangiae*."

*Procavia capensis* ssp. *nondescript*. Bedford obtained from T.M. skin 2148, collected at Lambert's Bay, Cape Province, the type series of *Procavicola* (*P.*) *parvus* Bedford, comprising three males, besides females. He regarded this fact as evidence that the skin is that of an undescribed form of *Procavia* and I agree that this belief is probably correct, though the number of specimens of the louse is not sufficient to rule out the possibility of contamination.

*Procavia capensis* ssp. *nondescript*. Hill (1922, p. 65) described two species of Mallophaga "taken from a Cape Hyrax (*Procavia capensis*) shot at Mtabamhlope, Estcourt District, Natal, by Mr. P. Barnes." There is no indication that this hyrax was ever seen by a mammalogist, and on geographical and ecological grounds it cannot have been *capensis capensis*. Subsequently Bedford (1928, p. 845) found among Hill's material from this hyrax the types of *Procavicola* (*P.*) *sternatus* (Bedford). Bedford recorded the host as *Procavia capensis natalensis*, presumably because of its locality, but in later papers (1932, p. 718; 1936, p. 58) he expressed the view, with which I entirely agree, that it was probably an undescribed form.

#### **Are the South African forms of *Procavia* species or subspecies?**

Bedford considered that the fact that each form of *Procavia capensis* has its own species of *Procavicola* showed that "they are probably distinct species" (Bedford, 1932, p. 709). He wrote (*l.c.*, p. 710) that these animals "live only on mountains and hills, and never wander far from their rocky homes. As many of the mountains and hills in this country are isolated by large stretches of intervening country, numerous colonies of dassies have probably been isolated for a great many years, and no doubt in some cases thousands of years. It is possible, therefore, that one or more species may eventually be found to be restricted in its distribution to a single locality."

Considering the East African hyraxes, I regard the fact that *zelotes* and *lopesi* in Kenya and Uganda, and *matschiei* and *johnstoni* in Tanganyika and Nyasaland, are infested by the same *Procavicola* as evidence that *zelotes* and *lopesi* are forms of one species and that *matschiei* and *johnstoni* are also forms of one species and are at least much more closely related to one another than to the other pair. But why should conditions alter so suddenly between Nyasaland and the Union of South Africa, where most of the forms of *capensis* each has its own specific louse? I do not think that the conditions of isolation in which colonies of *Procavia* live are appreciably more extreme in South Africa than in Kenya and Uganda, and can only assume that in some instances isolation of the South African forms has persisted for a much longer period than

is the case in East Africa. This assumption might explain some of the apparent anomalies if we make the further assumption that in some instances isolation has gone on for a shorter period and that in such cases "East African conditions" prevail. It seems very probable that many of the various forms of *Procavia capensis* are at least more distantly related to one another than are *lopesi* and *zelotes* or *matschiei* and *johnstoni*.

I must interpolate here a note as to what I mean by "species" and "subspecies": I regard a species as a permanently interbreeding community incapable of producing normally fertile offspring with any other community, while a subspecies is capable of producing normally fertile offspring with other such communities and usually does interbreed with them and produce intermediates where their areas of distribution meet. It is extremely rare to find subspecies of one species, thus defined, infested by different species of Mallophaga of the family (Trichodectidae) to which *Procavicola* belongs, and in some of the few known instances of this phenomenon there is considerable room for doubt as to whether the host-forms in question would not be better regarded as species. Thus far the evidence is in favour of the forms of *Procavia capensis* being full species. But it is also extremely rare to find the same species of Trichodectidae on different species of hosts, though such cases are known. Yet on all the South African forms of *Procavia capensis* of which the Mallophaga are at all adequately known we get at least two species of Trichodectidae (a *Procaviphilus* and a *Condylocephalus*) which are precisely the same on all the forms, and on some of them we get the same *Dasyonyx* as well. This evidence is in favour of the forms of *Procavia capensis* being merely subspecies.

Direct evidence on this point is almost entirely lacking, but the fact that a *Procavia capensis natalensis* (T.M. skin 2919) and a *P. c. orangiae* (T.M. skin 4324), both taken at Kastrol Nek, each bore its own species of *Procavicola* without admixture of that of the other form, and that the same is true of T.M. skins 2148 and 2150, both from Lambert's Bay, suggests that at each of these two places two forms of *Procavia capensis* meet without the interbreeding which would be certain to result in exchange of parasites.

The evidence is, I think, inconclusive, and it would be premature to attempt to decide the question without much more adequate collections of lice (failing direct evidence of successful or unsuccessful interbreeding) from each of the forms. A particularly valuable contribution would be collections of Mallophaga from many individual hosts at some point, such as Kastrol Nek, where two forms meet.

**An appeal.**

It will have been evident many times in this paper that there are very large gaps in our knowledge of the parasites of hyraxes. I hope I have shown that it may be possible to draw deductions of the greatest interest and importance with regard to this most interesting and difficult group of mammals from a study of their parasites when our knowledge of the species and host-distribution of these latter is more complete. In particular we very badly need material from specimens which have never been in contact with any other hyraxes after death and therefore have not been exposed to contamination.

The collection of lice from freshly-killed hyraxes is a very simple matter. The host, as soon as it is killed, should be placed in a calico bag (even wrapping it in newspaper will do at a pinch) to avoid the possibility of the lice from another specimen coming into contact with it. If only one specimen has been collected it is not absolutely essential to wrap it up, but it is as well to do so to prevent the escape of any lice. No nervousness need be felt in the unlikely event of a few lice getting on to the collector, for hyrax-lice will not live on man. The specimen is put into any moderately airtight container (a large biscuit tin is excellent) and the lice are killed by exposure for half an hour to the fumes of chloroform, ether, petrol, carbon bisulphide, carbon tetrachloride, or cyanogas. None of these substances should be allowed to come into direct contact with the specimen, the liquids being placed on a wad of cotton-wool in a corner of the box. The animal is then removed and the fur rubbed violently and repeatedly with one's hand over a large sheet of white paper until no more dust and debris falls on to the paper. The whole of the debris (among which the parasites will be found) is then placed in a tube of alcohol (70% or even undiluted methylated spirit will do) and sent to the specialist, to whom it is best to leave the sorting out of lice from debris.

In the case of dry skins the lice are dead, so that treatment with chloroform or a substitute is unnecessary, but the dead parasites mostly remain on the skin and they can be obtained in the manner described and can be restored by appropriate treatment to their original form. Precisely the same methods can be used for obtaining the lice from other small mammals or from birds, but the lice of most mammals much larger than a hyrax are not easily obtained by these methods and it is best merely to sun-dry the skin and send it to the specialist without attempting to collect the lice.

In many parts of Africa, hyraxes of several species are abundant and in some parts of South Africa they are even a pest. I appeal to anyone who has the opportunity to obtain even a single specimen to collect the lice, skin the specimen, dry the skin and skull, and send the lice to me and the skin and skull to Dr. Roberts at the Transvaal Museum. The types of any parasites new to science will

be given to the British Museum unless the collector desires otherwise. If any reader who is interested desires further particulars I will be most pleased to enter into a correspondence on the subject. I have little doubt that Dr. Roberts would gladly provide instructions for skinning the hyraxes.

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