

NOTES ON
MANGE, AND ALLIED,
MITES

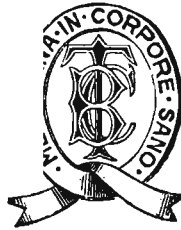
FOR VETERINARIANS.

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NOTES ON MANGE, AND ALLIED, MITES

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To

PROFESSOR ROBERT NEWSTEAD, F.R.S.

AS A SMALL TOKEN OF THE AUTHOR'S GRATITUDE,

THIS LITTLE WORK IS RESPECTFULLY

DEDICATED.

PREFATORY NOTE

THE contents of this small volume are an extensive amplification of a lantern lecture delivered before the members of the Yorkshire Veterinary Medical Association on April 30, 1920. The publication of it is chiefly due to the expression of that meeting that such a work would be of service to the profession. I have drawn extensively from the following works:

Megnin, P., "Les Parasites Articulés." Paris, 1895.—
Railliet, A., "Traité de Zoologie médicale et agricole." Deuxième Édition. Paris, 1895.—Canestrini, G., and Kramer, P., "Das Tierreich—Acarina—Demodecidae und Sarcoptidæ." Lieferung 7. Berlin, 1899.—
Michael, A. D., "British Tyroglyphidæ," vols. i. and ii. Ray Society. London, 1901 and 1903.—Gedoelst, L., "Synopsis de Parasitologie." Brussels, 1911.—Banks, N., "The Acarina or Mites Report No. 108, United States Department of Agriculture." Bureau of Entomology, 1915.—Newstead, R., and Morris, H. M., "Reports of the Grain Pests (War) Committee, No. 8," Royal Society of London, 1920.

Most of the photo-micrographs are from my own slides; some, however, have been taken from other works, due acknowledgment for which is given in the text.

I am indebted to Professor F. T. G. Hobday, C.M.G., F.R.C.V.S., F.R.S.E., for kindly revising the proof sheets as they were passing through the press, and my thanks are due to the publishers for their invariable courtesy over many points which needed their attention.

A. W. NOËL PILLERS.

LIVERPOOL,
August, 1921.

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MANGE AND ALLIED MITES

CHAPTER I

*INTRODUCTION**

THE ECONOMIC IMPORTANCE OF DISEASE-PRODUCING MITES.

ACARI are responsible for a great amount of disease amongst the lower animals. The conditions produced by them are spoken of as itch, scab, mange, scabies, and a number of local names. Some of them have been recognised from biblical times. The three forms of equine scabies give rise to serious annual loss. Two of them, psoroptic and sarcoptic, are subject to the Parasitic Mange Orders. In the United Kingdom during 1919 there were 5,003 outbreaks with 9,773 horses attacked. If all these animals recovered after a course of treatment lasting twenty-one working days, and the loss per day be estimated at ten shillings, this would represent £102,616 per annum. As a matter of fact a large number of animals are destroyed, and many are more than twenty-one days under treatment.

Whenever large numbers of animals are collected together mange is apt to appear, and it becomes aggravated if conditions of housing and management are unsatisfactory. This was the experience in the Crimean, Franco-Prussian, and South African Wars. When the veterinary history of the late war comes to be written, scabies will occupy one of the most important places. It must have cost the nation immense sums for treat-

ment alone, yet it was well controlled when compared with previous campaigns. In bovines mange is not quite so important, yet the sarcoptic form is one of the commonest skin diseases of housed animals. Sheep scab is subject to a number of official Orders; it occurred in sixty-two counties of the United Kingdom during 1919, and there were 438 outbreaks. In some countries rigid measures have exterminated this disease. Among swine, sarcoptic scabies is far from rare. In canine practice skin lesions and otorrhœa, of parasitic origin, occupy an importance which cannot be exaggerated an account of the proximity of canine pets to their owners. The cat, too, is not exempt from both skin and auditory lesions due to acari. Many of the domestic birds are liable to the attacks of mites. At times outbreaks of scabies amongst the laboratory animals have led to serious inconveniences, especially in the case of rabbits and small mammals. A number of wild animals suffer from mange, and ferret breeding has at times been menaced by it. Menageries, zoological collections, and travelling shows of wild exotic carnivora and ruminants, are sometimes seriously attacked by scabies.

The manufacture of parasiticides for the treatment and prevention of diseases caused by acari forms a large part of the work of some chemical companies.

A considerable part of the time of veterinarians and others both at home and abroad is devoted to the control of the ravages produced by mites.

Additional importance is added to scabies by the fact that in quite a number of cases the disease upon animals is communicable to man.

THE DISTRIBUTION OF MITES IN NATURE

Coming into close touch, as he usually does, with two or three genera of mites, the veterinarian is inclined to become a little cramped in his views with regard to this group, and to exhibit surprise when something not conforming with his mental picture is encountered upon a slide. A great number of mites are marine or aquatic, and others are found upon grasses, plants, shrubs, and trees, where they may or may not produce disease. Some are found upon dried crops, such as hay, straw, grain, and farinaceous materials, and many of these are brought into the closest contact with the domesticated animals either in transport, or as bedding and feeding materials. Certain genera prefer sugar-containing fruits, such as figs and dates; whilst others choose decaying vegetable substances. The soft fur of some species of mammals is the happy hunting-ground of some mites which do not appear to produce any inconvenience; and these are likely to be encountered when material from the skin of such an animal is subjected to microscopic examination for suspected scabies. A very large group of mites are found in the feathers of birds; a number of these rarely cause inconvenience, yet they may be confused in diagnosis with pathogenic ones, or even get upon animals when birds or their nests are near buildings in which animals are housed.

As unusual habitats, the following examples are noteworthy:

Certain species of *Halarachne* are found in the bronchial passages of seals, and *Pneumonyssus* *sp.* occur in the lungs of some monkeys. Numerous members of the chief groups of the Insecta are liable to have mites upon them. *Histiostoma berghi* lives parasitically in the egg-capsules of leeches in Denmark.

It is interesting to note that in each of the important genera of mange-producing mites there is at least one species which may be found in the auditory canal. Thus, *Psoroptes cuniculi* and *Psoroptes capræ* occur in the rabbit's and goat's ears respectively; *Otodectes sp.* have this organ for their special habitat; *Chorioptes cuniculi* has been found in the auditory canal of rabbits; *Notœdres muris* lives on the ears of rats and mice; and *Sarcoptes parvula* on ears of swine. A mite living in the fur as a commensal might easily, in the process of time, become adapted to the external auditory canal, and finally wander over the body as a disease-producing parasite. Henry has recently described as a distinct species a psoropt from the horse's ear; in some cases the rabbit's auricular psoropt produces a generalised mange.

Although one is constantly considering the effect of these mites upon their hosts, as one tries to overcome their ravages, it must not be forgotten that the host has undoubtedly some effect upon the parasite. Generation after generation of a species or variety living upon one kind of host would tend to specialisation in food and environment, and so lessen the chances of the parasite thriving upon several kinds of host.

Death of an affected animal is not conducive to the spread of the disease under natural conditions, but would lead to the death of most of the mites upon it, so that one can conceive that as ages pass, modifications in severity of attack are likely. *Notœdres muris* is often found in little wart-like growths of the rat's ears, and many animals so affected show little or no inconvenience.

MOUNTING MITES

The method of taking scrapings from the skin and of finding mange mites is discussed elsewhere (p. 28). If the specimen has passed through a boiling liquid it will be dead, others can be killed in a little hot water upon a slide. Having fixed the position of the desired acarus, it can be transferred by a fine camel-hair brush to fresh water for washing by gentle agitation. In some cases these steps have to be done under a microscope, and require a little practice. Staining is rarely necessary; the demodex shown in Fig. 2 was stained in red ink and then washed. Carbol fuchsin is a suitable stain. If canada balsam is going to be used as a mounting medium, the mite should have placed on it, and then removed, a drop or two of alcohol in the following percentages and order—viz., 20, 50, 70, 90—and finally “absolute,” to dehydrate it. If desired it can then be clarified in clove oil, and ultimately mounted in canada balsam.

If glycerin jelly, or Keilin's medium, is used, the acari, after washing, can be immediately mounted and the slides afterwards ringed.

The composition of the two media just mentioned is as follows:

<i>Glycerin Jelly.</i>				<i>Keilin's Medium for Dipterous Larvæ.</i>			
Gelatin	-	-	30 parts.	Gum acacia	-	-	30 grammes.
Glycerin	-	-	100 „	Glycerin	-	-	20 c.c.
Distilled water	-	-	120 „	Cocaine hydro-			
Carbolic acid	-	-	2 „	chloride	-	-	0.5 gramme.
				Distilled water	-	-	50 c.c.

For all practical purposes the last two media suffice—in fact, that of Keilin is much favoured by Professor R. Newstead.

The isolation of the members of the small-sized genera is somewhat tedious, and specimens are often lost in the

process. Much time can sometimes be saved by marking the slide underneath the mite, or by noting some larger object near it. When permanently mounted, a small ring of ink around the object saves time in searching for its position.

THE POSITION OF THE MITES IN THE ANIMAL KINGDOM

There still exists a great deal of confusion in the classification of the mites. As our knowledge of them increases, alterations in grouping and synonymy are inevitable, but these unfortunately are very confusing to the student and practitioner. In determining a species the veterinary student often hastily starts at the wrong end by taking "pot-shots" at its specific name. The surest, easiest, and most interesting way with all parasites is to start at the top of the classificatory scale and work down to the species. It is plain to see that mites possess animal life; they therefore belong to the **kingdom** ANIMALIA. They all have a body divided into segments with legs or jointed appendages on each side, and are thus included in the **sub-kingdom** ARTHROPODA. An acarus has eight legs and no antennæ; its place then is in the **class** ARACHNIDA. Arachnidans with bodies not showing distinct divisions into regions, with mouth parts adapted for piercing or sucking and which are parasitic, belong to the **natural order** ACARINA (ACARI). The final divisions of this natural order are interpreted differently by various authorities. An order may be split into divisions and these again into **sub-orders**. Of recent years a number of authors have split the sub-orders into **super-families**. Thus the mange mites fall into the DEMODICOIDEA and SARCOPTOIDEA. These are again

divided into **families**. Two of the chief are the Demodicidæ and Sarcoptidæ. The next recognised group is the **sub-family**, and this is split up into **genera**. The Sarcopt of the horse would be placed as follows:

Kingdom.	ANIMALIA.
Sub-kingdom.	ARTHROPODA.
Class.	ARACHNIDA.
Natural order.	ACARINA.
Sub-order.	ASTIGMATA.
Super-family.	SARCOPTOIDEA.
Family.	Sarcoptidæ.
Genus.	<i>Sarcoptes</i>
Species.	<i>scabiei</i>
Sub-species or variety.	<i>equi</i> .

Sarcoptes scabiei equi.

A kingdom is thus divided into sub-kingdoms, and so on down the scale until a species with several varieties is reached. The need of such divisions is essential to a proper understanding of the group.

There are several ways of classifying the order; the table on p. 8 shows the divisions into sub-orders, super-families, and families, which receive notice in this work.

The three other super-families of the order are the Hydrachnoidea, Oribatoidea, and Ixodoidea.

BRIEF STRUCTURAL OUTLINE

The following short account explains in a general way a number of the external structural details. The *cephalo-thorax* and *abdomen* are widely united and often there is no separating line between them: there may, however, be a distinct *transverse furrow*; possibly the abdomen of the mite represents more than the abdomen of spiders. In outline most mites are roughly rounded

<i>Natural Order.</i>	<i>Sub-Order.</i>	<i>Super-Family.</i>	<i>Family.</i>	
ACARINA.	VERMIFORMIA. Elongated bodies (somewhat worm-like).	Demoiicoidea.	Demodicidæ.	
	ASTIGMATA. Soft integument, no tracheæ, legs with epimera.	Sarcoptoidea. Body rounded, cephalo-thorax and abdomen often separated by a groove. Palps generally of three articles, often filiform; mandibles chelate. Legs of five articles, last armed with hooks; with caruncles or sometimes suckers on pedicles. Mainly parasitic upon mammals and birds.	Sarcoptoidea.	{ Sarcoptidæ. { Cytolêichidæ. { Tyroglyphidæ. { Listrophoridæ. { Analgesidæ.
	PROSTIGMATA. Soft integument. A pair of stigmata near the first pair of legs. Legs with epimera.	Eupodoidea. Palps with four or five articles, the last of which is never bent on last but one. Sparsely covered with hairs.	Eupodoidea.	{ Eupodidæ. { Tarsonemidæ.
	METASTIGMATA. Integument more or less coriaceous. Legs without epimera. A pair of stigmata near the coxæ of the third or fourth pair of	Trombidoidea. Last article of palp bent on the last but one, which generally has a hook. Body often very hairy. Gamasoidea. Hypostome small, without teeth. No eyes. No grooves on venter.	Trombidoidea.	{ Trombidiidæ. { Tetranychidæ. { Cheyletidæ. { Dermanyssidæ. { Gamasidæ.

or oval, and considerably flattened from above to below. A side view is rarely obtained when working with mange mites unless special steps are taken to secure it.

The *mouth parts* usually form a projection from the anterior extremity of the cephalo-thorax; the *mandibles* generally have two joints, and if the last is opposed to a projection on the first they are termed *chelate*. In some species they are adapted for piercing—*styliiform*. The *palpi*, externally placed to the mandibles, never have more than five segments, often three; the last is subject to a great number of modifications.

The *anal* aperture is usually at the posterior border of the ventral aspect, the genital opening of the female, the *ano-vulval slit*, is in front of it, and after fertilisation often becomes a conspicuous transverse opening, the *tocostome*, between the epimera of the second pair of legs. The structure of the *legs* varies considerably in the different families, but they are often composed of *coxa*, *trochanter*, *femur*, *patella*, *tibia*, and *tarsus*, some of which may be provided with distinctive *hairs* or *spines*. The tarsi terminate in different structures in the various groups. The anterior two pairs of legs are attached to the cephalo-thorax, and the posterior two arise from what appears to be the abdomen. In the soft-bodied forms, the junctions of the legs with the body are reinforced by horny rods—the *epimera*.

The male is usually smaller than the female, and may have *copulatory suckers* on the hinder portion of the venter; small lobes furnished with hairs may also project backwards from this region.

NOMENCLATURE

Veterinarians often appear, in the eyes of entomologists, a little careless with regard to specific names. The subject is governed by a set of rules adopted by the International Congress of Zoology. The two Latin names of a species are given in *italics*, the first, or generic, commencing with a capital letter, and the second, or specific, with a small one. Ex. *Sarcoptes scabiei*.

If it is desired to indicate a sub-species or variety, this is done by adding the sub-specific name alone, or by inserting the abbreviation "var." in front of it. Ex. *Sarcoptes scabiei equi* or *Sarcoptes scabiei* var. *equi*.

After the name of the species is placed the name of the author and the year in which it was described. Ex. *Demodex phylloides* Csokor 1879.

Some species have been given several names by workers in different countries at various dates. Starting from Linnæus' "Systema Naturæ" of 1758, the correct name is the oldest one, and all the others are synonyms. Some species have a great number of names, and become known by different ones according to the circulation of different authors' works.

Confusion has resulted from faulty descriptions, and this has been considerably added to when a worker, thinking he has before him, say, *Tyroglyphus longior*, has in reality been dealing with some other *Tyroglyphus*. The specific name does not change, but the generic one may. If an old genus is found to contain several well marked off groups, new genera will be made, and certain species will be carried into these. Thus, *Acarus scabiei* Linnæus 1758 became *Sarcoptes scabiei* (Linnæus 1758). In this case the author's name is put in brackets to indicate that it was not as a member of the present genus that he originally described the species. •

If a new generic name is created for a species, and later it is found that it has been applied to another group with which the author was not conversant, it falls, and a new one has to be given; the specific name, the author's title and date in parenthesis, however, remain.

Although the specific name does not change, and the most ancient title back to 1758 is the correct one, it is possible for a species to be known for a great number of years by one name, when some enthusiastic researcher turns up an older one nearer Linnæus' time, so that the familiar title has to go. If at about this time the genus be split up, it is quite possible to have a well-known species with two fresh names, and it so becomes completely unrecognisable. With the mange mites, there are a number of specific names in common use which are not the oldest, yet by replacing them great confusion has been caused.

CHAPTER II
FAMILY DEMODICIDÆ

VERMIFORMIA with no separation between cephalothorax and abdomen; palps composed of three articles, the last of which is hook-like. Four pairs of legs of three articles each. No eyes, anus or sexual dimorphism. Parasites of the hair follicles and sebaceous glands.

Genus *Demodex* Owen 1843.

Syn.: *Acarus* Simon 1843. *Macrogaster* Meischer 1843.
Simonea Gervais 1844. *Entozoon* Wilson 1844.
Steatozoon Wilson 1847.

It has been customary to regard the genus as possessing one species *Demodex folliculorum* of man, with a sub-species for each of the other numerous animals which may harbour the parasite. Hirst,¹ however, has recently revised the group, and brought a number of varieties up to specific rank. He figures new species and varieties from rodents and other mammals.

Demodex folliculorum Simon 1843 of man is usually thought to be unimportant. It is commonly found in "blackheads," sebaceous glands, hair follicles (especially of the nose and face), and Meibomian glands.

Measurements (Gmeiner):

		<i>Mm. Long.</i>		<i>Mm. Broad.</i>
Male .. ..		.3		.045
Female .. ..		.36		.05
Nymph .. ..		.36		.04
Larva .. ..		.12		.05
Egg .. ..		.08		.04

¹ Hirst, S., "Studies on Acari": No. 1, "The Genus *Demodex*." Owen, London, 1919.

Demodex canis Leydig 1859 (see Fig. 1) is found in follicular mange of the dog. The disease exhibits several forms, of which the pustular and squamous are the commonest. In the former case the best way of demonstrating the parasite is by pricking a pustule, collecting a little of the exuding material on a slide, applying a cover-glass and then examining under the

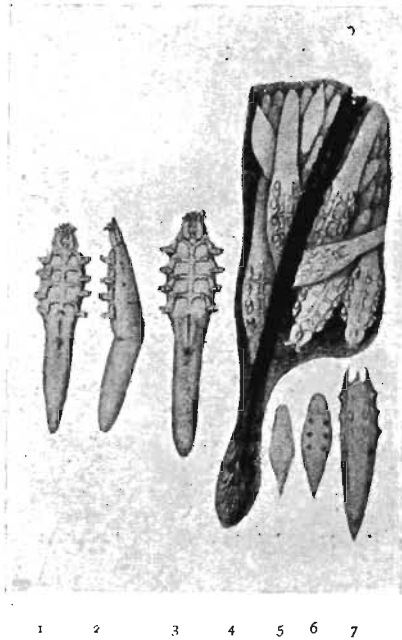


FIG. 1.—*DEMODEX CANIS*. $\times 130$ (AFTER MEGNIN).

1, Male, ventral aspect; 2, male, lateral aspect; 3, female, ventral aspect; 4, hair follicle containing acari in different stages of development; 5 and 6, larvæ; 7, nymph.

low power carefully, because the parasites are comparatively small. It should then be placed under the high power. In the squamous form, the parasite is to be searched for as described for *Sarcoptes* (see p. 28).

Affected animals usually have a distinct smell of mice,

and treatment is often extremely unsatisfactory, which indeed is not surprising when the position of the parasites is remembered.

Measurements (Gmeiner):

		Mm. Long.			Mm. Broad.
Male	.. ..	.25	.. ..		.045
Female	.. ..	.30	.. ..		.045
Nymph	.. ..	.23	.. ..		.05
Larva	.. ..	.14	.. ..		.035
Egg	.. ..	.05	.. ..		.025

Demodex phylloides Csokor 1879 causkos small bean-like pustules in the skin of swine.

Measurements (Gmeiner):

		Mm. Long.			Mm. Broad.
Male	.. ..	.22	.. ..		.057
Female	.. ..	.24	.. ..		.06
Nymph	.. ..	.26	.. ..		.06
Larva	.. ..	.14	.. ..		.04
Egg	.. ..	.05	.. ..		.023

Demodex canis var. *ovis* Railliet 1893 has been found in the glands of the eyelids of sheep.

Demodex cati Megnin 1877 from the ear and skin of the cat.

Demodex capræ Railliet 1893 occurs in pustules on the goat.

Demodex cuniculi Pfeiffer 1903 is recorded from the skin of the rabbit.

Demodex bovis Stiles 1892 of the ox. Quite an amount of literature has grown up on the follicular mite of the ox and its relation to other skin lesions. Especially has this been so in reports from hot countries. In Europe the lesion is nearly always a small pustular formation on the neck, shoulders and fore limbs.

Demodex equi Railliet 1893 (see Fig. 2) occurs in the Meibomian glands and the skin of the horse. Walther¹ and Schenzle² described the skin lesion stated to be due to it.

¹ Walther, *Berliner Tierärztlicher Wochenschrift*, September, 1908.

² Schenzle, *Berliner Tierärztlicher Wochenschrift*, December, 1909.

During the late war it was often found. It is sometimes demonstrated upon the skin in early cases of sarcoptic mange, but the lesion caused by it is described by some Army veterinarians¹ as a definite pustular condition, most commonly situated upon the lower half of the neck, where it is termed Demodetic and sometimes Demodectic scabies.

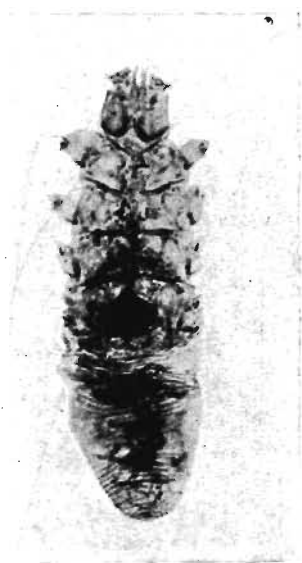


FIG. 2.—*DEMODEX EQUI*. × 250.

From a sarcoptic positive skin-scraping of a horse.

Follicular mites pass their lives in the skin, all stages of the life-cycle being often found in the same pustule. Usually the heads point towards the bottom of the gland or follicle. The eggs vary in shape. The stages in the life-history are: (1) egg, (2) larva, (3) protonymph, (4) deutonymph, and (5) adult.

¹ Williamson and Oxspring, "Demodectic Scabies in the Horse," *Veterinary Journal*, London, vol. lxxvi., p. 376, 1920.

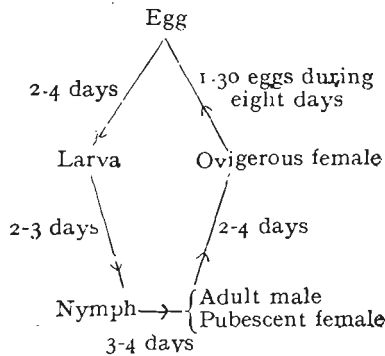
The male has a dorsal penis, and is smaller than the female. Hirst¹ believes that he has seen stigmata and tracheæ.

FAMILY SARCOPTIDÆ

Palpi simple, filiform, and composed of three articles; there may be anal suckers in the male; suckers of the tarsi when present carried on a jointed or unjointed pedicle. When there are no suckers the tarsi terminate in hairs; the anus is terminal save in one genus, and the tocostome is transverse.

Obligatory parasites of mammals and birds, causing scabies.

Most important genera, *Sarcoptes*, *Notædres*, *Cnemidocoptes*, *Psoroptes*, *Chorioptes* and *Otodectes*. Others of lesser interest to the veterinarian are *Prosopodectes*, *Psoralgæ*, *Caparinia*. Mostly oviparous, some are ovo-viviparous. The duration of the life-cycle varies according to season, temperature, food supply, and mite concerned. Roughly it is from two to three weeks. The number of moults in each stage varies.



¹ *Loc. cit.*, p. 12.

As many as fifty-one eggs have been seen in a sarcoptid gallery. The length of time that the different stages in the life-cycle can remain apart from the host and then regain complete vitality has not been accurately determined in all cases. Eggs appear incapable of hatching out after leaving the warm body for a short period, and about thirty days would seem to see an end to the activity of adults. In some cases it is much less.

Genus *Sarcoptes* Latrielle 1806.

Syn.: *Eusarcoptes* Railliet 1893.

Ambulacral sucker on a long unjointed pedicle on the first and second pairs of legs in the female, and the first, second, and fourth in the male; anus terminal.

Important characters in specific differences are size, host, the disposition and size of the dorsal scales, and the same points in connection with the sternites and epimera of the ventral surface.

It has been customary to describe one species with a number of sub-species, but the genus may be regarded as containing about eighteen distinct species, the following of which are the chief:

Sarcoptes scabiei (Geer 1778).

Syn.: *Acarus psoricus* Pallas 1760. *S. exulcerans* Nitzsch 1818. *S. hominis* Raspail 1834. *S. galei* Owen 1853. *S. communis* Delafond and Bourguignon 1862. *S. scabiei* var. *hominis* Megnin 1880.

The cause of itch or scabies of man. The fecundated female burrows in the epidermis; the galleries so made vary from a few millimetres to a centimetre in length, and contain eggs, larvæ and fæces. The egg (Fig. 3) measures 0.15 mm. long by 0.10 mm. broad, and in about four to eight days, after being laid, hatches into a *hexapod larva*. This stage is characterised by having only

three pairs of legs, the first and second pair of which terminate in a sucker on the end of an unjointed pedicle, whilst the third has a hair (Fig. 5). The next stage—viz., the *nymph* or *octopod*—has an additional pair of legs also furnished with a hair; the first, second and third pairs are as in the larva (Fig. 6). Some nymphæ are larger than others, and these after moulting turn into females whilst the smaller ones become males. The *male* is $\cdot 20$ mm. long and $\cdot 16$ mm. broad; suckers are



FIG. 3.—SARCOPTES SUIS.
X APPROXIMATELY 160.
Ovum.



FIG. 4.—SARCOPTES SUIS.
X APPROXIMATELY 150.
Ovum, just prior to hatching.

present on the first, second, and fourth pairs of legs, and the third is provided with a long hair (Fig. 7). The *pubescent female* measures $\cdot 28$ mm. long and $\cdot 23$ mm. broad. The genital orifice is in the form of an ano-vulval slit. The first and second pairs of legs terminate in suckers, and the third and fourth by hairs. After fecundation and moulting, the final stage or *ovigerous female* is reached. This measures $\cdot 30$ mm. long and $\cdot 26$ mm. broad. The features of the legs are the same as the previous stage, but there is a transverse

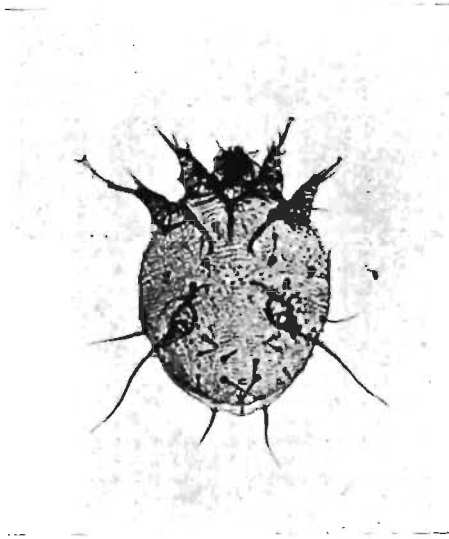


FIG. 5.—SARCOPTES SUIS. X APPROXIMATELY 140.
Hexapod larva, ventral aspect.

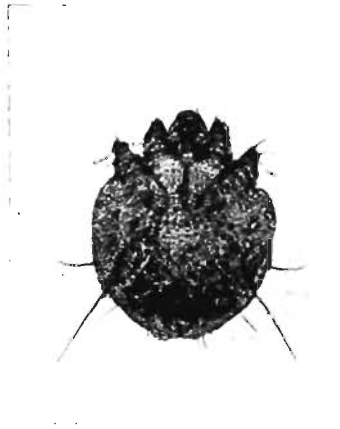


FIG. 6.—SARCOPTES EQUI. X 150.
Nymph, ventral aspect.

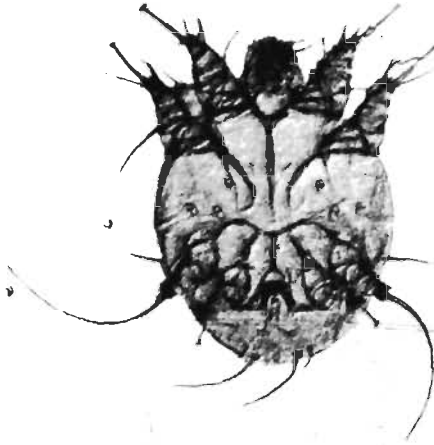


FIG. 7.—*SARCOPTES SUIS*. × APPROXIMATELY 135.
Male, ventral aspect.

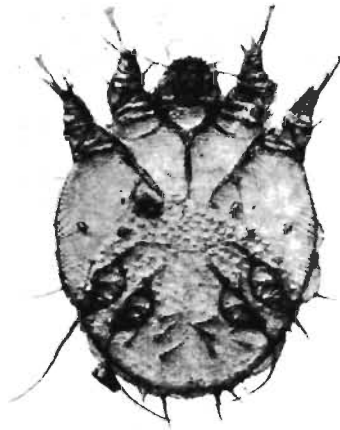


FIG. 8.—*SARCOPTES SUIS*. × APPROXIMATELY 90.

to costome just below the epimera of the second pair of legs (see Fig. 8).

The pedicle and sucker characteristic of this genus are shown in Fig. 9.



FIG. 9.—SARCOPTES EQUI. $\times 550$.

Leg II. right side, ventral aspect. Note the sucker on the unjointed pedicle.

It is stated that the human sarcopt does not produce disease upon other animals. Unlike some other mange mites *Sarcoptes* are not found in *copula*, and this has apparently never been witnessed.

Sarcoptes scabiei-crustosæ Furstenberg 1861.

Syn.: *S. scabiei* var. *lupi* Megnin 1880.

This appears to be a rarer but yet distinct species of man, upon whom it produces Norway, or Norwegian, itch (*Scabies norvegica*).

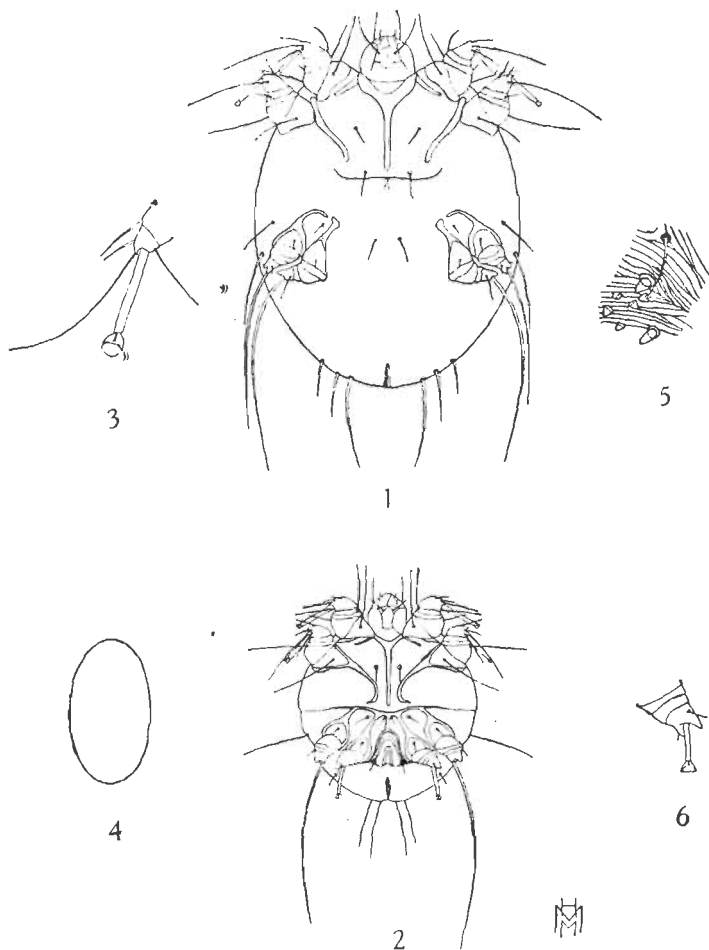


FIG. 10.—*SARCOPTES EQUI*. (After Newstead and Morris.)

1. Female, ventral aspect. $\times 117$.
2. Male, ventral aspect. $\times 117$.
3. Tarsus of leg II. of female, side view. $\times 250$.
4. Egg. $\times 117$.
5. Dorsal cuticle. $\times 167$.
6. Tarsus of leg IV. of male, ventral aspect. $\times 250$.

Reproduced, by permission, from Report No. 8 of the Grain Pest (War) Committee of the Royal Society.

Sarcoptes equi Gerlach 1857.

Syn.: *S. scabiei* var. *equi* Railliet 1893.

Figs. 6, 9, and 10. Found upon the horse, mule, and ass. At the moment a prevalent form, causing generalised mange.

Measurements (Megnin):

	<i>Mm. Long.</i>	<i>Mm. Broad.</i>
Egg	·16 ..	·10
Larva	·16 to ·25 ..	·10 to ·17
Nymph	·30 ..	·20
Pubescent female	·35 to ·40 ..	·25 to ·30
Ovigerous female	·45 ,, ·47 ..	·35
Male	·26 ,, ·28 ..	·18 to ·20

Sarcoptes bovis.

Although a bovine sarcopt was described by Robin in 1860, it has often been stated that the ox readily takes sarcopt mange of other animals. It is, however, so prevalent in housed animals in winter and spreads so rapidly that one cannot but conclude that the parasite is proper to the ox. The disease is often found on the udder, croup, hind quarters and sides of the neck.

Sarcoptes ovis Megnin 1880.

Syn.: *S. scabiei* var. *ovis* Megnin 1880.

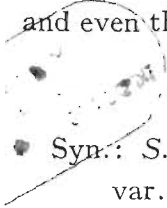
This species is the cause of blackhead, black muzzle, or sarcoptic mange of the sheep's head and face. It is not common in this country. I have seen a reference in a Dutch journal on the finding of a normally non-parasitic mite in crusts from a sheep's face; the lesion produced was said to closely resemble blackhead.

Sarcoptes capræ Furstenberg 1861.

Syn.: *S. scabiei* var. *capræ* Megnin 1880.

The lesions produced by this species upon the goat

commence on the head and ears, and later gain the neck and even the trunk and limbs.



Sarcoptes suis Gerlach 1857.

• Syn.: *S. squamiferus* Furstenberg 1861. *S. scabiei* var. *suis* Megnin 1880.

The pig sarcopt is one of the largest of the genus. It is fairly widely distributed and is far from rare at present. The male is .32 mm. long and .29 mm. broad, and the egg-bearing female .47 to .50 mm. long and .36 mm. broad (see Figs. 3, 4, 5, 7 and 8).

If crusts containing this acarus are placed in a tube in the warm pocket for an hour or so, they may often be seen moving to and fro on the inside of the glass.

Sarcoptes parvula Canestrini 1894.

This is a much smaller species than the last, from the ear of the pig. Male .168 mm. long and .128 mm. broad; female, .288 mm. long and .216 mm. broad.

Sarcoptes dromedarii Gervais 1841.

Syn.: *S. scabiei* var. *cameli* Megnin 1880.

This species is the cause of serious mange on the dromedary and camel.

Sarcoptes canis Gerlach 1857.

Syn.: *S. scabiei* var. *canis* Railliet 1893.

The male is from .19 mm. to .23 mm. long and .14 to .17 mm. broad, and the fecundated female .29 to .38 mm. long and .23 to .28 mm. broad. I have found it to be very difficult of detection in scrapings from the dog's skin.

Sarcoptes cuniculi Neumann 1892.

Syn.: *S. scabiei* var. *cuniculi* Railliet 1893. *S. precox* Canestrini 1894.

Rabbit sarcoptic mange is not common in this country. It is usually the psoroptic or notœdric form which one encounters.

Sarcoptes hydrochæri Megnin 1880.

Syn.: *S. scabiei* var. *furonis* Railliet 1893.

This is the cause of rot or foot rot in ferrets.

Other species are *Sarcoptes aucheniæ* Railliet 1893 of the llama, *Sarcoptes vulpis* Furstenberg 1861 of the fox, *Sarcoptes leonis* Canestrini 1894 of the lion, *Sarcoptes wombati* Railliet 1893 of the wombat, and *Sarcoptes lupi* Megnin 1880 of the wolf.

When upon an unusual host, the lesion produced by a sarcopt is often slight and transient, but in some cases serious disease may result. The following table shows the possible cross infections:

<i>Species.</i>	<i>Normal Host.</i>	<i>Occasional Host.</i>
<i>Sarcoptes equi</i>	Horse	Man, ox.
„ <i>bovis</i>	Ox	Man.
„ <i>ovis</i>	Sheep	Man, goat, pig.
„ <i>capræ</i>	Goat	Man, sheep, ox, horse, pig.
„ <i>suis</i>	Pig	Man.
„ <i>dromedarii</i>	Camels	Man.
„ <i>canis</i>	Dog	Man.
„ <i>cuniculi</i>	Rabbit	Ferret, guinea-pig.
„ <i>vulpis</i>	Fox	Man.
„ <i>leonis</i>	Lion	Man.
„ <i>aucheniæ</i>	Llama	Man, sheep, horse, alpaca.
„ <i>wombati</i>	Wombat	Man.
„ <i>lupi</i>	Wolf	Horse.

In moderately advanced cases, sarcoptic scabies can be recognised and distinguished clinically from other

types of mange with a fair degree of accuracy. The lesion prefers the thinner skinned areas; in addition to encrustation the skin itself is thickened, the lesion is diffuse, with intermixing of areas containing hair, and there are here and there numerous blood points. Early cases are difficult to diagnose as there are then only a number of pimples, diffusely scattered without loss of hair and which give a positive labial reflex when the part is rubbed. The following remarks apply more particularly to equine sarcoptic mange, but the general principles involved are practically the same in the other animals, apart from differences of an anatomical or physiological nature. There is a marked seasonal prevalence; the disease is usually at its lowest in warm weather and when there is plenty of sweating of the skin. During October, November, and the following months there is a gradual increase, until in March it usually reaches its height. In the ensuing months it falls slowly and from June to September is at its lowest. It may justly be said to be a disease of winter and long and dirty coats.

Several explanations of the seasonal prevalence of the various manges have been offered. Unfortunately a number of them have had in view one mite or one species of host. Seasonal occurrence, however, applies to several genera of mange-producing mites, and the conditions of management of sheep, cattle, horses, and camels are often very different. The collection of numbers of animals together at certain periods might be put forward as an explanation of the increased prevalence of scab in sheep if they both occurred at the same time, but horses in towns are not subjected to any such movement, and yet there is a periodic increase of equine mange cases in cold weather. If an affected animal be kept under observation for the four seasons of the year, it

will be found that there is a much less aggravated state of affairs during the hot months; it is well known too that in summer mange is much easier to cure, and that spontaneous or open-air recoveries are from time to time recorded during this season. The explanation would therefore seem to lie between the parasite and its host on the one hand and reduced climatic temperature on the other, rather than altered conditions of management in different seasons. The parasites of mange are very sensitive to temperature; in summer, when removed from the lesion, *Psoroptes* will run about the hand in a very active manner and is consequently easily seen, but in winter the acari hardly move, and the unaided eye distinguishes them from masses of cells with difficulty. In cold weather, too, clipping is a very valuable means of preventing the disease, yet in unclipped affected animals it makes marked progress. These points, coupled with spontaneous cure and the better therapeutic results which are obtainable in summer, suggest that the seasonal prevalence during cold weather can be explained by the efforts of the mites to obtain the necessary degree of warmth suitable for their activities. Many animals which develop the disease in winter have been infected some while previously, but the advent of cold weather limits the mites' wanderings over the body, breeding becomes localised, and lesions result. If the actual surface of the skin be of the proper temperature, rapid breeding takes place. The reason why a closely clipped and recently infected in-contact animal does not develop the disease so quickly or seriously is because the skin does not furnish the necessary heat as when clothed in hair. In summer, the mange mite population is subjected to a number of conditions which tend to mitigate against the production of lesions, whilst in winter their natural enemies, sweating and cleanliness

of the skin, are rarer. Often if an affected horse dies in winter the acari climb up the long hairs when the body has cooled with the intention of seeking warmer situations, but their activity soon ceases and many may be found more or less quiescent only a little way up the hair. The whole question of seasonal occurrence of mange seems to be bound up with the bionomics of the causal parasite.

The ease or difficulty with which a microscopical diagnosis is made depends chiefly upon the duration of the disease and the manner in which the scraping from the skin is taken. Usually the older the case the easier it is to find the parasite. There are several ways of taking a scraping from the skin and of rendering the parasite visible on the slide. It is a matter of thoroughness in each case. The following are simple and efficacious:

The suspicious or desired area having been located either by the eye or the fact that when scratched marked irritation is shown, the hair is removed by the clippers for a length of about 4 inches and a width of the clipper blade. Any extra amount of dirt can be taken off by means of a stiff brush or even a little caustic potash solution. It is then advisable to restrain the animal so that the material can be taken. A suitable article is a safety razor blade one edge of which is enclosed in a leather or metal guard. Holding a flat piece of paper about 4 inches square or an envelope below the lesion, and at such an angle so that material will fall into it, a number of scrapings are made with the blade in the direction towards the paper until moisture adheres to the knife; this is continued for a few strokes and a little blood may become visible. A small amount of sulphur ointment should then be applied to the area. The last material taken will stick to the blade, and must

be removed on to the paper. The scraped material should be placed in a small vessel, covered with a little 10 per cent. caustic potash solution, which is then raised just to the boil. This breaks up a great deal of the short hair and masses of cells which are present. Often if some of the material is examined at this stage between two slides or in a thin layer in a Petri dish the parasites will be discovered. It is, however, better to place the boiled material in a centrifuge tube, give it a few turns in the machine, then decant and examine a small quantity of the deposit between two slides under the $\frac{2}{3}$ inch lens.

There is possibly no other disease where success in treatment depends so much upon the personal element, more so probably in the case of the attendant than the veterinary surgeon. Where great numbers of animals have to be treated, dips for liquid dressings or plants for generating sulphur dioxide are economical and successful. There are a great number of dressings suitable for general practice, and these fall roughly into two classes—viz., watery and oily or fatty; the latter is to be preferred.

The desiderata of a dressing are that (1) it will remain active and moist on the skin for some days; (2) it kills the parasites; (3) it is non-toxic; (4) it is fairly foolproof; (5) it is not prohibitive in price, and (6) does not mat, blister, or cake upon the skin. Probably a mixture of the following answers most of the above qualifications:

Strong calcium polysulphide solution ..	1 part = 8 ounces
Water	2 parts = 16 ..
Horse fat	2 parts = 16 ..
	2 pints

The strong solution of calcium polysulphide can be prepared in small quantities by mixing $2\frac{1}{4}$ pounds of

sulphur with 1 pound of good quicklime in a bucket, make into a paste, and boil in 2 gallons of water until a dark red-brown solution is formed. Boiling will take about three hours; the whole must be kept well stirred during the process, and made up to 2 gallons at the end. About 2 pints of the oily mixture will dress a properly prepared ordinary case.

With care the following preparation may be used :

Sulphur sub.	..	..	..	2½ pounds
Ol. cetacei	..	..	..	1 gallon

The following emulsion is very valuable in reliable hands, but careless use may lead to blistering :

Soap (potash)	..	..	..	1 pound
Water	..	..	..	1 gallon
Kerosene	..	..	..	1 pint

When properly made by well mixing the oil into the hot soap solution a cream-like emulsion results.

Each of the above formulæ should be applied when at a temperature of about 110° F. The following routine may be followed :

First Day.—Clip closely all over, even the mane and tail in some cases. No hair must be left long; if it is, matting and blistering will result later.

Second Day.—Soak in warm water; incorporate soft soap. Wash and remove all epidermal accumulations by scraping. This is a most important operation; the water must not be above 120° F. or cracking of the skin occurs at a later date. Dry and exercise.

Third Day.—Apply dressing all over, care being taken not to miss the submaxillary, axillary, and inguinal regions. The animal should not, however, be saturated. No bedding, no rugs.

Fourth, Fifth, Sixth, Seventh, and Eighth Days.—Move the dressing daily by firm rubbing with an oily rag,

and re-apply a very little dressing to dry affected areas. Exercise.

Ninth Day.—Wash, removing every vestige of dressing. Dry and exercise. Whilst this is being done the stall and head collar must be disinfected.

Tenth Day.—Groom hard; if necessary, re-clip and commence as from the third day. Three courses usually effect a cure, but it is a question of scrupulous attention to detail. Daily or every-other-day dressing often causes serious dermatitis, worse than the disease itself.

A great number of apparently cured cases recur; many of these are due to a small mange mite population being left upon the patient, and the disease breaks out again when they have become sufficiently numerous; others are due to re-infection from harness, brushes, or the stable. The "following up" of apparently cured mange cases by clipping and dressing with watery and less active parasiticides are important items in consecutive treatment. Although bland oils are often discarded in favour of watery dressings on account of the cost, their use would often be economically justified owing to the greatly reduced loss of working time resulting thereby.

CHAPTER III

FAMILY SARCOPTIDÆ (continued)

Genus *Notœdres* Railliet 1893.

This genus closely resembles *Sarcoptes*, but differs from it by the important fact that the anus is on the dorsum. The species are generally much smaller than those of *Sarcoptes*. As a result of having long been included in genus *Sarcoptes* some confusion arises as to whether an animal is or is not liable to sarcoptic or notœdric mange.

Notœdres cati (Hering 1838).

Syn.: *Sarcoptes cati* Hering 1838. *S. minor* Furstenberg 1861. *S. notœdres* Megnin 1876. *S. notœdres* var. *cati* Megnin 1880.

Body rounded in both sexes, no lateral depressions. Habitat, the head of the cat; the common cause of mange in this animal. It can often be easily found by soaking crusts in 10 per cent. caustic potash solution and pressing between two slides. The eggs are deposited in groups or nests. See Figs. 11 and 12.

Measurements (Megnin):

	<i>Mm. Long.</i>		<i>Mm. Broad.</i>	
Egg	·08	..	·05	..
Larva	·09	..	·07	..
Nymph	·12	..	·10	..
Male	·12	..	·09	..
Ovigerous female ..	·16	..	·13	..

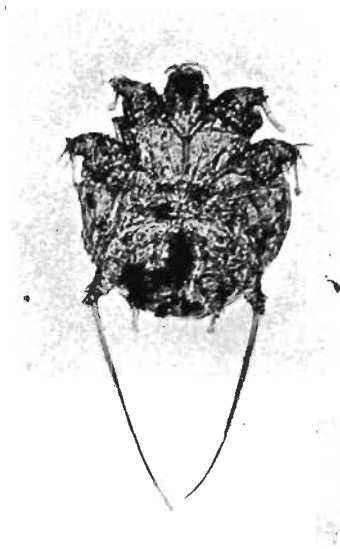


FIG. 11.—NOTŒDRES CATI. $\times 200$.
Male, ventral aspect.

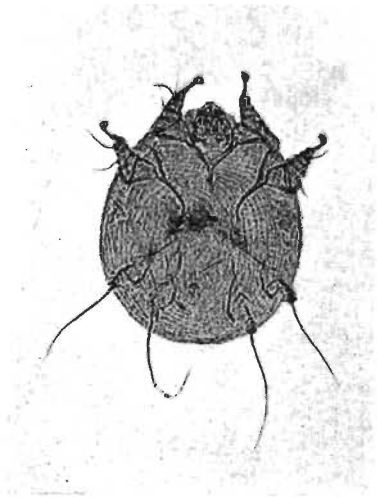


FIG. 12.—NOTŒDRES CATI. $\times 140$.
Female, ventral aspect (cleared in clove oil).

Notœdres notœdres (Megnin 1880).

Syn.: *Sarcoptes notœdres* var. *muris*. Megnin 1880.
S. alepis Railliet and Lucet 1893. *N. muris*
 Canestrini 1894.

There are no scales on the dorsal surface; comparatively a large species. Habitat, the ears of rats and certain other rodents. Sometimes appears to be ovo-viviparous.

Measurements (Megnin):

	Mm. Long.	Mm. Broad.
Egg	·15	·08
Larva	·15	·11
Male	·18	·15
Pubescent female	·20	·16
Ovigerous female	·30	·24

Notœdres cuniculi (Gerlach 1857).

Syn.: *Sarcoptes cuniculi* Gerlach 1857. *S. minor* var.
cuniculi Railliet 1895.

The common cause of mange in the rabbit, and intermediate in size between that of the cat and rat.

Notœdric mange of the cat has been transmitted to man and the horse, but the explanation that an equine outbreak is due to this species rarely stands the test of microscopic examination, and the same may be said when smaller rodents are blamed.

Home treatment of notœdric mange is often unsatisfactory, whereas by placing the animal under proper restraint, carrying out detailed clipping of the head, removing all the epidermal products, and applying a non-toxic oleaginous sulphur preparation, good results can be obtained.

Genus *Cnemidocoptes* Furstenberg 1870.

Syn.: *Knemidokoptes* Furstenberg 1870. *Dermatortyctes* Ehlers 1873.

Ovigerous females without ambulacral suckers. Males with suckers on an unjointed pedicle on all legs. The

epimera of the first pair of legs have a dorsal prolongation each, and these join upon the dorsum. Anus terminal. Parasites of birds.



FIG. 13.—CNEMIDOCOPTES MUTANS. × 120.
Female, ventral aspect.

Cnemidocoptes mutans (Robin and Languetin 1859).

Syn.: *C. viviparous* Furstenberg 1870. *Dermatoryctes mutans* Ehlers 1873.

This species is ovo-viviparous.

Measurements (Megnin):

		<i>Mm. Long.</i>		<i>Mm. Broad.</i>
Larva	.. ..	·14 to ·20	..	.. ·10 to ·14
Nymph	.. ..	·26	..	.. ·18
Male	.. ..	·25	..	.. ·15
Pubescent female	..	·38	..	.. ·33
Ovigerous female	..	·47	..	.. ·39

Fig. 13 shows a female, the dorsal prolongations of the epimera being distinctly visible through the cuticle;

all the legs are without suckers. The male closely resembles the larva (Fig. 14), but has an additional pair of legs with similar suckers.

It is the cause of scaly leg in poultry, and is easily found by soaking clean crusts in 10 per cent. caustic potash solution and pressing them between two slides.

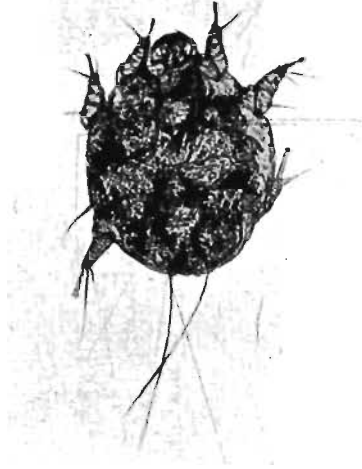


FIG. 14.—CNEMIDOCOPTES MUTANS. $\times 170$.

Hexapod larva.

It has been recorded from the legs of turkeys, guinea-fowl, and pheasants.

Treatment is easy if at first as many scales as possible are removed by soaking the legs and then an ointment of 1 part of creosote to 20 of lard is applied. As much sulphur as can be incorporated into some vaseline (about equal parts), so that it can be rubbed in, is also a dressing to be recommended.

Cnemidocoptes gallinæ (Railliet 1886).

See Fig. 15. The cause of depluming scabies of the fowl; chiefly found upon the head, neck, and rump; affected birds often pluck out their feathers. The parasites live at the base of the quills. It occurs in this country.

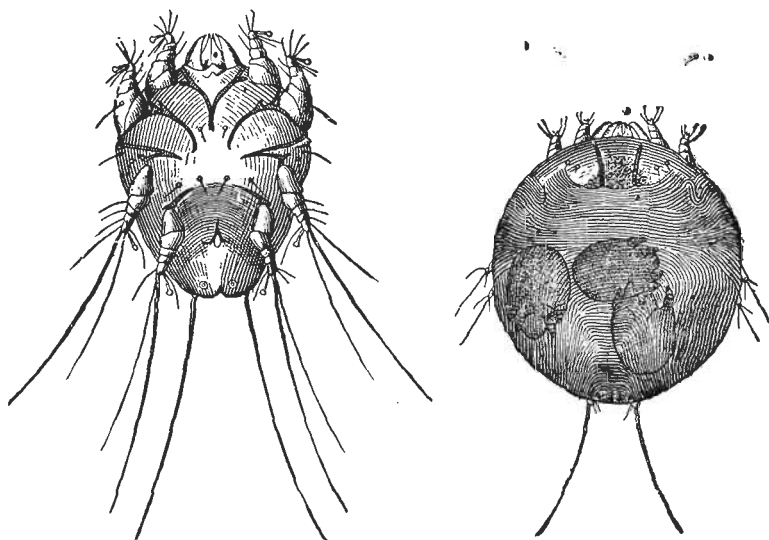


FIG. 15.—CNEMIDOCOPTES GALLINÆ (AFTER RAILLIET).

Left: Male, ventral surface. $\times 200$.

Right: Female, dorsal surface. $\times 100$.

(From Neumann's "Parasites.")

Measurements (Railliet):

	<i>Mm. Long.</i>	<i>Mm. Broad.</i>
Male	·17 to ·18	·12 to ·13
Ovigerous female ..	·31 ,, ·35	·27 ,, ·30

Other species are *Cnemidocoptes lævis* of the pigeon which is not rare here and *Cnemidocoptes phasiani* of the pheasant. Railliet discovered the parasite of the pigeon in 1885 and named it *Sarcoptes lævis*; the next year, having found an allied form on the fowl, he called

his first find var. *columbæ*, the second var. *gallinæ*, and a third var. *phasiani*. They are now regarded as species.

Cnemidocoptes prolificus Railliet and Henry 1908 occurs on French geese. The female only has been described, and measures .58 mm. long and .40 mm. broad.

Slight cases of depluming scabies yield to treatment with creosote 1 part and vaseline 20 applied to the cleaned-up areas. The part can be moistened with soapy water, and then pyrethrum or sulphur blown in. Cocks are often affected, and they spread the disease quickly by contact. Slaughtering out is often most economical.

Genus *Psoroptes* Gervais 1841.

Syn.: *Dermatodectes* Gerlach 1857. *Dermatocopte* Furstenberg 1861.

Male with anal suckers, females with copulator; tubercles; ambulacral sucker carried on a long and jointed pedicle on the first, second, and fourth pairs of legs in the ovigerous female and on the first, second, and third pair of legs in the male; fourth pair of legs rudimentary in the male (see Figs. 16 to 19). The characteristic sucker and pedicle are shown in Fig. 20.

Many authors still regard the genus as containing one species and a number of varieties.

The *larva* has suckers on the first and second pairs of legs, the third is provided with two hairs, and the fourth pair is wanting.

The *nymph* is larger than the preceding, with no tubercles projecting from the hinder portion of the abdomen as there are in the pubescent female. The two pairs of anterior legs have suckers, but on the third and fourth they are wanting. The *male* (Fig. 16) has suckers on all but the diminutive fourth pair of legs, and also two abdominal lobes with hairs. The *pubescent female*

(Fig. 19), smaller than the final female, has two copulatory tubercles projecting from the posterior of the abdomen, and there is a posterior ano-vulval slit. Suckers are present on the first, second, and fourth pairs of legs, but on the latter they may not be completely developed. In the *ovigerous female* (Fig. 17) there is a distinct anterior tocostome, increased size, and suckers are present on the first, second, and fourth pairs of legs.

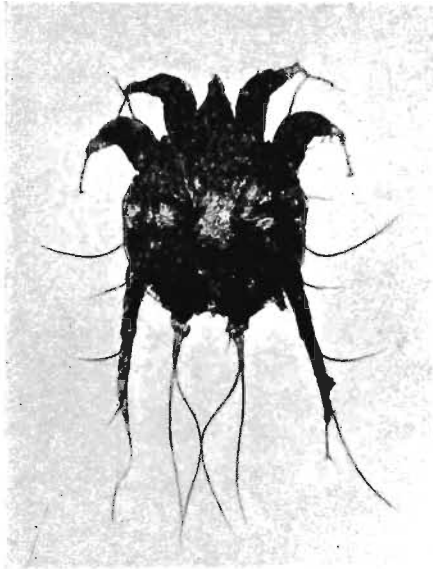


FIG. 16.—*PSOROPTES EQUI*. × 70.
Male. The fourth pair of legs are indistinct.

Psoroptes equi (Hering 1838).

Syn.: *Sarcoptes equi* Hering 1838. *Dermatodectes equi* Gerlach 1857. *Dermatocoptes communis* Furstenberg 1861. *P. longirostris* var. *equi* Megnin 1880. *P. communis* var. *equi* Railliet 1893.

(See Figs. 16 to 21.) The cause of psoroptic mange of equines.

Measurements (Megnin):

	Mm. Long.			Mm. Broad.		
Egg20	..	..	.12	
Larva20 to .35	..	..	.12 to .24	
Nymph35	..	..	.25	
Male50	..	..	.30	
Pubescent female40	..	..	.30	
Ovigerous female80	..	..	.50	

Psoroptes hippotis Railliet and Henry 1920.

This species, from the ears of the horse, ass and mule is slightly larger than the preceding, and the abdominal lobes have a different number of bristles upon them.

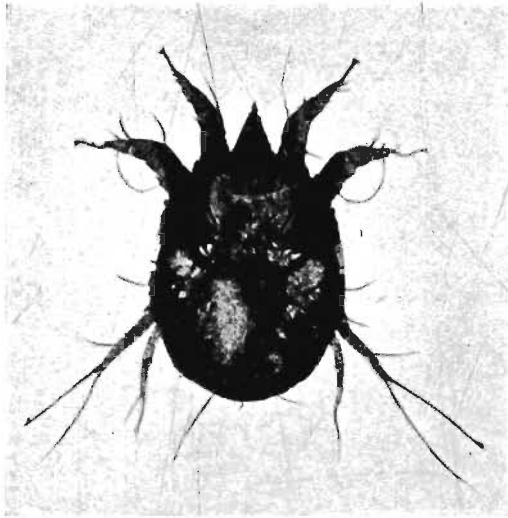


FIG. 17.—*PSOROPTES EQUI*. × 50.
Ovigerous female.

Psoroptes bovis (Gerlach 1857).

Syn.: *Dermatodectes bovis* Gerlach 1857. *P. longirostris* var. *bovis* Megnin 1880. *P. communis* var. *bovis* Railliet 1893.

The cause of psoroptic mange of bovines.

Measurements (Railliet):

	<i>Mm. Long.</i>	<i>Mm. Broad.</i>
Male	·43 to ·44 ..	·30 to ·32
Ovigerous female ..	·53 „ ·60 ..	·36 „ ·41

Psoroptes ovis (Hering 1838).

Syn.: *Sarcoptes ovis* Hering 1838. *Dermatodectes ovis* Gerlach 1857. *P. longirostris* var. *ovis* Megnin 1880. *P. communis* var. *ovis* Railliet 1893.

The cause of sheep scab.

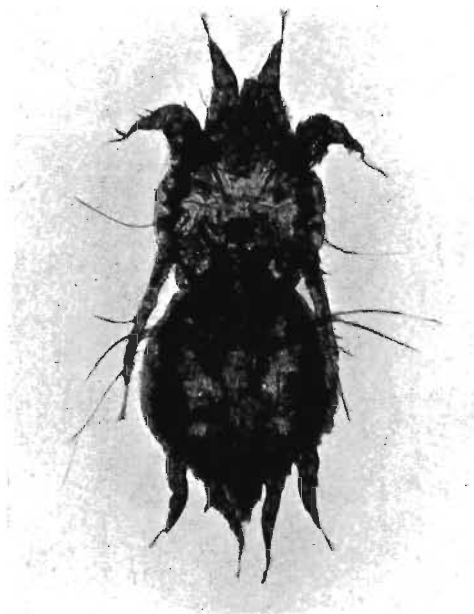


FIG. 18.—PSOROPTES EQUI. × 70.
Male and female (pubescent) in copula.

Measurements (Railliet):

	<i>Mm. Long.</i>	<i>Mm. Broad.</i>
Male	·50 to ·60 ..	·34 to ·37
Ovigerous female ..	·67 „ ·74 ..	·45

Psoroptes capræ Railliet 1893.Syn.: *P. communis* var. *capræ* Railliet 1893.

The cause of psoroptic otacariasis of the goat.

Measurements (Railliet):

	Mm. Long.	Mm. Broad.
Male .. .. .	.50 to .60 .. ..	.34 to .37
Ovigerous female .. .. .	.67 „ .74 .. ..	.45 „ .46

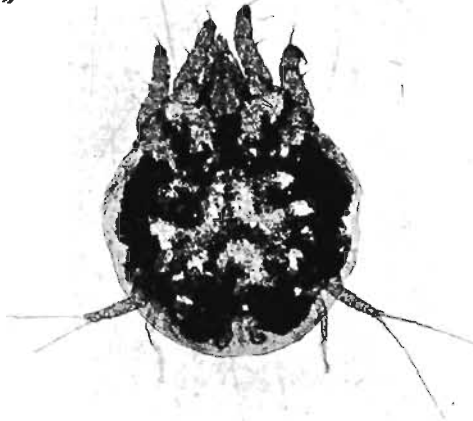


FIG. 19.—PSOROPTES EQUI. × 110.
Pubescent female.

Psoroptes cuniculi (Delafond 1859).

Syn.: *Dermatodectes cuniculi* Delafond 1859. *P. longirostris* var. *cuniculi* Megnin 1880. *P. communis* var. *cuniculi* Railliet 1893.

A comparatively large species, the male being .52 to .62 mm. long and .31 to .40 mm. broad, and the ovigerous female .67 to .78 mm. long and .4 to .48 mm. broad.

A common cause of otorrhœa of the domestic rabbit it is stated to have been found upon the horse and dog

Psoroptes gazellæ Canestrini 1894 has been found in the ears of various species of gazelle.

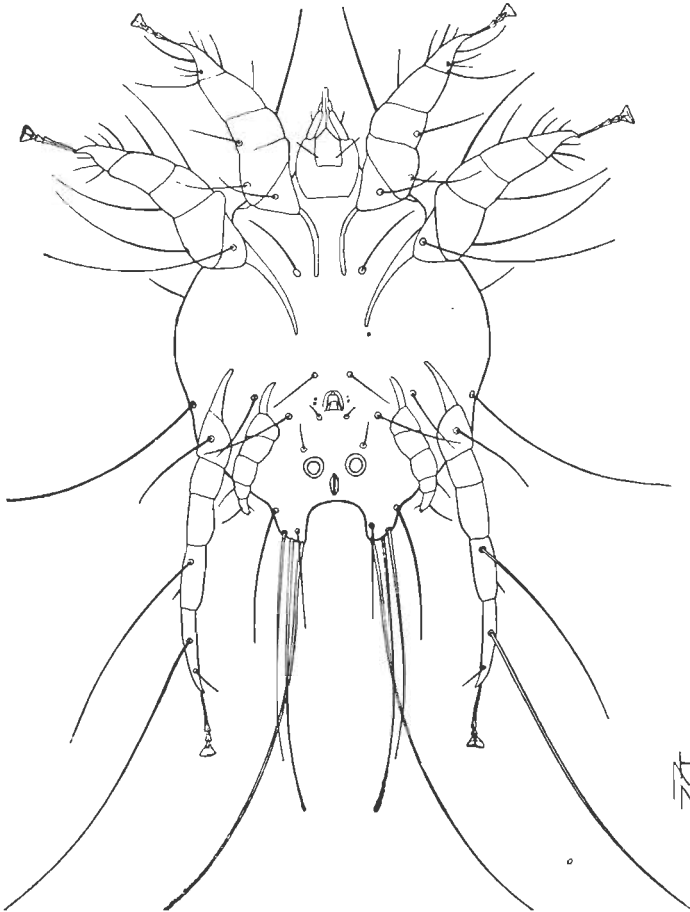
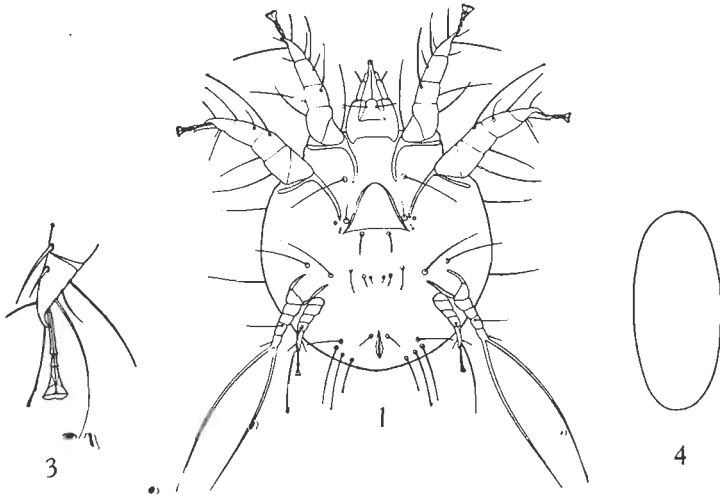
Psoroptes live upon the skin or in the external ear. In the horse the lesion can be recognised with a fair degree of accuracy. At first it is localised, well defined, and, although there is a heaping-up of epithelium, the hair may not be lost at once, so that there is a raised circular patch. The parts affected are often situated



FIG. 20.—*PSOROPTES EQUI*. × 204.

Leg II. on right side, ventral aspect. Note the sucker on the long and jointed pedicle.

near the dorsal median line, the withers, back, and croup being favourite places. As the disease advances, the areas become larger, and they are usually barer and not so intermixed with hair as in sarcoptic mange. The response to the labial reflex is usually most marked. The seasonal prevalence is similar to sarcoptic mange. It also often recurs at spring and autumn in the same



MT

animal. It is possible to find the parasites in the mane and tail of apparently healthy animals during summer. It is these animals which break out with the disease if clipping is not done or there is neglect in grooming in the winter. The disease, being easier to cure than the sarcoptic form, has decreased in prevalence under legislative control.

In cattle it often starts at the base of the tail, spreads slowly, and frequently disappears when warm weather sets in. This fact has been noted in a number of manges, and explains the different results obtained with various treatments at different seasons of the year.

In sheep scab the early lesion is masked by the fleece, but clinical symptoms are soon shown. The delicate skin, when inspected, has clear lesions with parasites at work. What has been said with regard to finding *Sarcoptes equi* applies also to the psoropt. In early cases, with the aid of a lens, the parasite can often be seen at work at the edges of the lesion; and if a little of the accumulated "scab" from the edge of an affected part be warmed in the closed hand, the mites can usually be discovered running about with the unaided eye. Warmth makes them very active, and a piece of blackened glass may be heated over the spirit-lamp and the suspected material placed upon it. After soaking in a 10 per cent. solution of caustic potash and then being examined between two slides under the $\frac{2}{3}$ -inch lens material from the edge of an active lesion should reveal the parasites. Failing these methods, boiling in 10 per cent. caustic potash solution and centrifuging will have to be carried out.

FIG. 21.—PSOROPTES EQUI. (After Newstead and Morris.)

1. Female, ventral aspect. × 117.
2. Male, ventral aspect. × 117.
3. Tarsus of leg II. of female, side view. × 250.
4. Egg. × 117.

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In general terms the treatment of psoroptic mange in equines is the same as for sarcoptic scabies. Minute attention to (1) complete close clipping, (2) whole and thorough washing to remove all crusts, and (3) completely dressing all over are essential. Properly done, two complete courses of treatment are often sufficient because the parasite is on the surface of the skin. Reclipping and following up are important. A number of watery preparations used for, and at the same intervals as for, sheep scab are satisfactory, although the coat may be left somewhat harsh in appearance. The ear forms of psoroptic mange are usually amenable to careful cleansing and dressing in an oleo-sulphur liniment, but the sequelæ, such as damage to the lining of the canal, may have to have glycerin of iodine applied. Damage to the internal ear is very intractable.

Sheep-dipping is carried out in a great number of ways. It may be by a simple hand bath with a proprietary dip or by means of an elaborate plant for the preparation of the material and heating the dip. The commonest type of bath is the swim bath. It may be 33 feet long at the top, 20 feet 6 inches long at the bottom. The entrance end is vertically 3 feet 6 inches to 5 feet deep; the exit end thus slopes from top to bottom and is provided with footholds. The sides slope inwards, the width at the top being about 2 feet and at the bottom 9 inches.

The chief requirements of a dipping material are that it will kill the parasite, be non-toxic to animals and men, shall not damage the skin or fleece, shall not cause "set back," shall be easily prepared, and shall be as fool-proof as possible. Two dippings at an interval of from seven to twelve days should effect a cure; shearing should if possible be carried out a fortnight before dipping. Care must be exercised with rams and pregnant ewes.

After dipping animals should drain on a bare lot; warm dips are better than cold ones.

One has only to ask the question, Where does the arsenic go when the dip is drained? to see the wisdom of using non-toxic substances, let alone the chances of the immediate dangers of poisoning. The following are three dips approved of by the Ministry of Agriculture and Fisheries for 100 gallons of solution:

(a) *Lime and Sulphur*.—Mix 25 pounds of flowers of sulphur with $12\frac{1}{2}$ pounds of good quicklime. Triturate the mixture with water until a smooth cream without lumps is obtained. Transfer this to a boiler capable of boiling 20 gallons, bring the volume of the cream to 20 gallons by the addition of water, boil and stir during half an hour. The liquid should now be of a dark red colour; if yellowish, continue the boiling until the dark red colour is obtained, keeping the volume at 20 gallons. After the liquid has cooled, decant it from any small quantity of insoluble residue, and make up the volume to 100 gallons with water.

(b) *Carbolic Acid and Soft Soap*.—Dissolve 5 pounds of good soft soap with gentle warming in 3 quarts of liquid carbolic acid (containing not less than 97 per cent. of real tar acid). Mix the liquid with enough water to make 100 gallons.

(c) *Tobacco and Sulphur*.—Steep 35 pounds of finely ground tobacco (offal tobacco) in 21 gallons of water for four days. Strain off the liquid, and remove the last portions of the extract by pressing the residual tobacco. Mix the whole extract, and to it add 10 pounds of flowers of sulphur. Stir the mixture well to secure an even admixture, and make up the total bulk to 100 gallons with water.

The period of immersion in these dips should not be less than half a minute.

CHAPTER IV

SARCOPTIDÆ (concluded)

Genus *Chorioptes* Gervais 1859.

Syn.: *Symbiotes* Gerlach 1857. *Dermatophagus* Furstenberg 1861.

ANAL suckers in the male; copulatory tubercles in the female; ambulacral suckers carried on a very short pedicle on all legs of the male, and on the first, second,

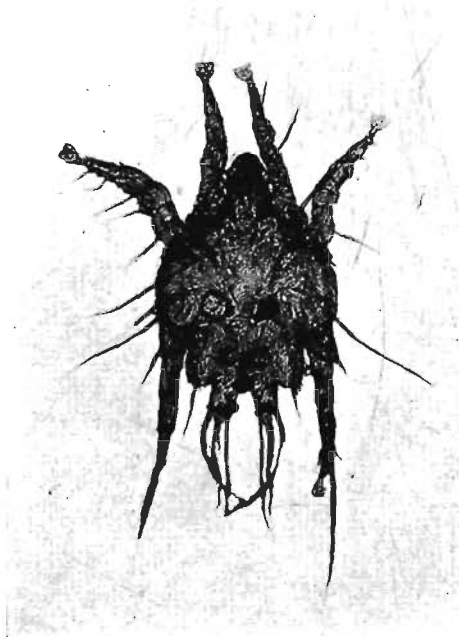


FIG. 22.—*CHORIOPTES EQUI*. × 120.

Male, ventral aspect. (The fourth pair of legs and their suckers are indistinct, and the sucker of one third leg is not visible.)

and fourth pairs of the female. The fourth pair of legs of the male is rudimentary. (See Figs. 22 to 25.) The characteristic pedicle and sucker are shown in Fig. 24. Like the preceding genus, this group is often stated to contain one species and several varieties.

The *larva* has suckers on the first and second pairs of legs, two hairs on the third pair and the fourth are wanting; the *nymph* is larger, with an additional pair of legs

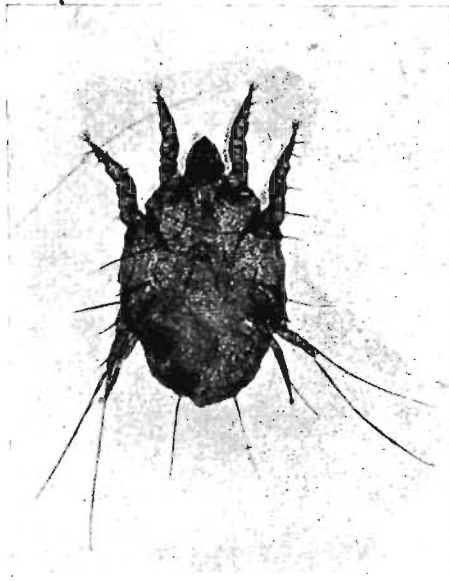


FIG. 23.—CHORIOPTES EQUI. × 90.
Ovigerous female, ventral aspect.

having a hair. The *male* (Fig. 22) has suckers on the first, second, and third pairs of legs and two abdominal lobes with hairs; the *pubescent female* has suckers on the first and second pairs of legs only, an ano-vulval slit and two copulatory tubercles on the posterior of the abdomen. The *ovigerous female* (Fig. 23) has suckers on the first, second, and fourth pairs of legs, and a transverse tocostome.

Chorioptes equi (Gerlach 1857).

Syn.: *Symbiotes equi* Gerlach 1857. *C. spathiferus*
Megnin 1880. *C. symbiotes* var. *equi* Railliet 1893.

(See Figs. 22 to 25.)

Measurements (Megnin):

		Mm. Long.		Mm. Broad.
Egg	.. ..	.15	.. ..	.09
Larva	.. ..	.16 to .20	.. ..	.10 to .12
Nymph	.. ..	.25	.. ..	.15
Male	.. ..	.28	.. ..	.18
Pubescent female	.. ..	.27	.. ..	.18
Ovigerous female	.. ..	.40	.. ..	.25



FIG. 24.—CHORIOPTES EQUI. $\times 350$.
Male, leg II., ventral aspect.

The cause of symbiotic, chorioptic, or leg mange of the horse; and a predisposing factor in a number of diseases and injuries of the feet and legs.

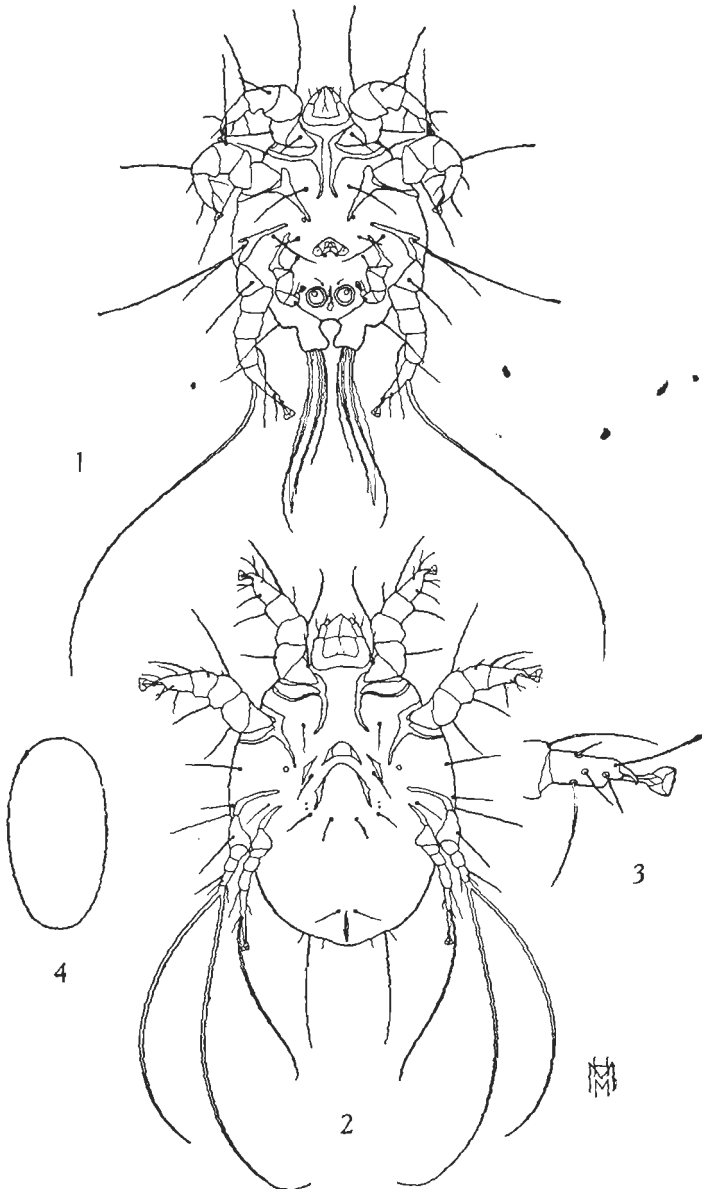


FIG. 25.—CHORIOPTES EQUI (AFTER NEWSTEAD AND MORRIS).

1. Male, ventral aspect. $\times 117$.
2. Female, ventral aspect. $\times 117$.
3. Tarsus of leg II. of female, side view. $\times 250$.
4. Egg. $\times 117$.

(Note: The fourth pair of legs in the male is shown curled up.)

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Chorioptes bovis (Gerlach 1857).

Syn.: *Symbiotes bovis* Gerlach 1857. *Dermatophagus bovis* Furstenberg 1861.

Measurements (Railliet):

	<i>Mm. Long.</i>	<i>Mm. Broad.</i>
Male .. .. .	.27 to .30 ..	.21 to .22
Ovigerous female ..	.38 ,, .39 ..	.23 ,, .25

Although this species has been found upon man (Zurn, Sheremetevsky), it probably has no clinical importance for the human subject. Habitat: bovines.

Chorioptes capræ Gervais and Beneden 1859.

Syn.: *C. symbiotes* var. *capræ* Railliet 1893.

The male measures .29 to .30 mm. long and .18 to .21 mm. broad, and the ovigerous female .31 to .36 mm. long and .21 to .23 mm. broad. Habitat: the goat.

Chorioptes ovis Railliet 1893.

Syn.: *C. symbiotes* var. *ovis* Railliet 1893.

Measurements (Zurn):

	<i>Mm. Long.</i>	<i>Mm. Broad.</i>
Male .. .. .	.31 ..	.25
Ovigerous female ..	.37 to .40 ..	.26

Found upon the pasterns of sheep.

Chorioptes cuniculi (Zurn 1874).

Syn.: *Dermatophagus cuniculi* Zurn 1874. *C. symbiotes* var. *cuniculi* Railliet 1893.

Comparatively rare in rabbits' ears.

Although not always regarded as such, chorioptic or symbiotic mange of the horse is important on account of the number of diseases and accidents with which it is associated in starting. It is most common at the moment, usually being confined to the legs below the knees and hocks, although it may reach to the axilla

and groin. In the ox it is found on the pasterns and anal fossæ; the sheep also harbours its choriopt on the hairy portions of the legs.

The microscopic detection of the parasite is usually easy if the material is taken from the edge of an active lesion, then soaked in a 10 per cent. caustic potash solution, and finally examined between two slides under the $\frac{2}{3}$ -inch lens. The mites are often very numerous in a scraping from the lesions of an untreated case. If care is taken to thoroughly wash and dry, then to apply the paraffin emulsion mentioned on p. 30, and follow by careful sawdusting, the hair of Shire horses can be left on. As in most forms of mange, it is a question of detail, and if oily dressings are used, they must be warm, in order to get down to the actual skin; if repeated in four or five days, there is no need to previously wash, provided the animal has been kept out of the dirt. It is, however, always advisable to remove the hair from the inside of the hocks and thighs. The remarks concerning not clipping apply to the feather, or long hair of the legs, in the Shire or Clydesdale breeds.

Genus *Otodectes* Canestrini 1894.

Anal suckers in the male; copulatory tubercles in the female; ambulacral suckers on a very short pedicle on all legs of the male and the first and second pairs of the female. The fourth pair of legs of the female is feebly developed. (See Figs. 26 and 27.)

Habitat: the external ear of carnivora.

Otodectes cynotis (Hering 1838).

Syn.: *Sarcoptes cynotis* Hering 1838. *S. auricularum* Lucas and Nicolet 1849. *Symbiotes canis* Bendz 1859. *Chorioptes ecaudatus* Megnin 1880. *C. auricularum* var. *canis* Railliet 1893.

(See Figs. 26 and 27.) Habitat: dogs' ears.

Measurements (Megnin):

	<i>Mm. Long.</i>		<i>Mm. Broad.</i>	
Egg	·18	..	·08
Larva	·18 to ·28	..	·12 to ·15
Nymph	·28	..	·18
Male	·30	..	·23
Pubescent female	·28	..	·18
Ovigerous female	·45	..	·25

The characteristics of the different stages—*egg, larva, nymph, male, pubescent female* and *ovigerous female*—

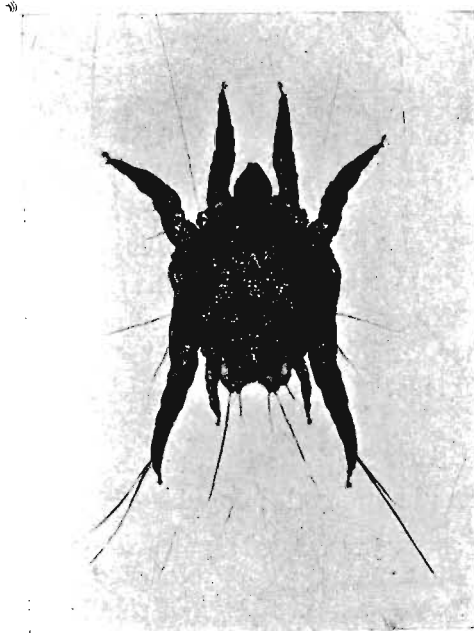


FIG. 26.—*OTODECTES CYNOTIS*. × 110.
Male, ventral aspect.

are somewhat similar to *Chorioptes*, save that at no time are there suckers on the fourth pair of legs in the female.

The male differs from the choriopt male by the absence of the prominent abdominal lobes and long hairs upon them, and by the presence of a much larger fourth leg.

The female is distinguished from the female choriopt by the possession of a diminutive fourth pair of legs without suckers.

Otodectes felis (Huber 1860).

Syn.: *Symbiotes felis* Huber 1860. *Chorioptes auricularum* var. *cati* Railliet 1893.

Habitat: the cat's ears.

Measurements:

	Mm. Long.	Mm. Broad.
Male .. .. .	.32 to .35 ..	.23 to .25
Ovigerous female ..	.43 ,, .48 ..	.20 ,, .29

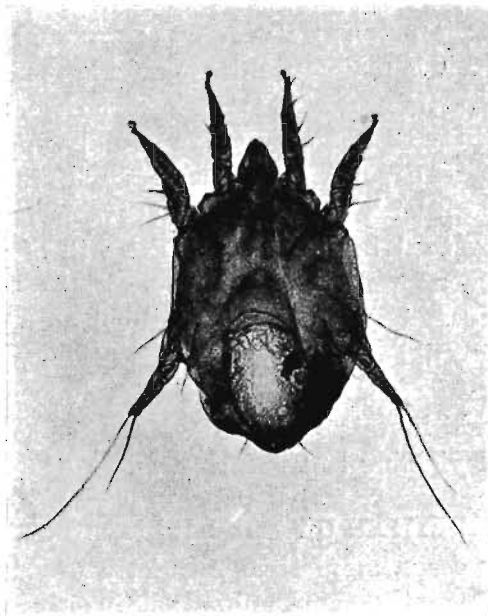


FIG. 27.—OTODECTES CYNOTIS. × 100.
Ovigerous female, ventral aspect.

Otodectes furonis Railliet 1893.

Syn.: *Chorioptes auricularum* var. *furonis* Railliet 1893.

Habitat: the ferret's ears.

Measurements :

	<i>Mm. Long.</i>	<i>Mm. Broad.</i>
Male .. .. .	.27 to .34 ..	.21 to .25
Ovigerous female ..	.38 ,, .45 ..	.24 ,, .28

It is generally stated that the size of the above three species decreases in the order in which they are here given.

Ear mites found upon the hyæna, wolf, and hedgehog belong to the genus *Caparinia* and are named *C. setifera* (Megnin 1880), *C. vulpis* (Megnin 1880), and *C. tripilis* (Michæel 1889) respectively. By their discoverers the first two were regarded as *Chorioptes* and the last as a *Symbiotes*.

Otodects produce irritation of the external auditory canal, and this is manifested by scratching and shaking of the head. In neglected cases otorrhœa occurs, and later there may be disturbances in equilibrium.

The parasites can often be seen *in situ* with the unaided eye or, better, with a lens. Moist deposit taken on a probe and placed between two slides will often reveal eggs and other forms.

With care and attention to the hygiene of the ear, followed by mild acaricides, the mites can usually be exterminated (see p. 46). The injuries and effects of a long-neglected invasion are, however, often serious and stubborn in yielding to treatment.

MULTIPLE OR POLY INFECTIONS.

In many cases, more than one form of mange may be found upon the same animal; lice, either *Hæmatopinus* or *Trichodectes*, and even vegetable parasites giving rise to ringworm, may also be present. Having once become the prey of ectozoa the diseased skin appears to offer little resistance to the attacks of other enemies. Such a state of affairs becomes important in diagnosis especially in cases with a legal aspect. The coexistence of lice which have been seen is often put forward a

a defence against prosecutions for the existence of un-notified parasitic mange. I have heard of one plea that the condition was due to mites derived from the forage, and that these mites were very difficult to distinguish from mange acari. In horses chorioptic mange is very common, and often occurs on an animal, as well as one or other of the scheduled forms—viz., psoroptic and sarcoptic. Less often all three forms may coexist. In cattle coming for the first time into town dairies which contain animals with mange the presence of *Trichodectes* may be blamed for the eruption, which really results from the sarcopt. It has been pointed out elsewhere (p. 15) that the demodex may often be found in sarcopt positive equine skin-scrapings. Otodectic mites are common in the ears of cats, and they may often be seen in cases where the animals are also suffering from notædric mange. The same applies to the presence of the ear mite in dogs which may be affected with either demodetic or sarcoptic mange.

In other animals multiple infections may at times be encountered.

Summary of varieties of mange and their respective hosts:

	<i>Demodetic.</i>	<i>Sarcoptic.</i>	<i>Notædric.</i>	<i>Cnemidocoptic.</i>	<i>Psoroptic.</i>	<i>Chorioptic.</i>	<i>Otodectic.</i>
Horse	+	+	-	-	+	+	-
Ox	+	+	-	-	+	+	-
Sheep	+	+	-	-	+	+	-
Goat	+	+	-	-	+	+	-
Pig	+	+	-	-	-	-	-
Dog	+	+	-	-	-	-	+
Cat	-	-	+	-	-	-	+
Camel	-	+	-	-	-	-	-
Dromedary ..	-	+	-	-	-	-	-
Rabbit	-	+	+	-	+	+	-
Ferret	-	+	-	-	-	-	+
Rat	-	-	+	-	-	-	-
Fowl	-	-	-	+	-	-	-

FAMILY CYTOLEICHIDÆ.

Mandibles, palps, and lip fused for aspiration. The terminal article of the legs, or at least those of the last two pairs, end in a sucker on a pedicle; tocostome longitudinal. Parasitic upon birds.

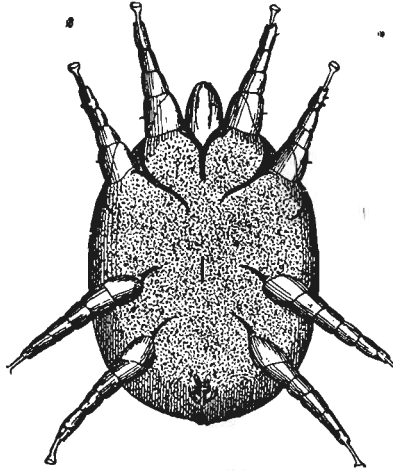


FIG. 28.—CYTOLEICHUS NUDUS (AFTER RAILLIET). × 100.
Male, ventral aspect.

Genus *Cytoleichus* Megnin 1879.

Cytoleichus nudus (Vizioli 1870).

Syn.: *Sarcoptes nudus* Vizioli 1870. *C. sarcoptoides* Megnin 1879. *C. nudus* Megnin 1879. *Cytodites nudus* Railliet 1893.

(See Figs. 28, 29, and 30.)

Measurements (Megnin):

	Mm. Long.		Mm. Broad.	
Larva (hexapod) ..	·20	..	..	·12
Larva (octopod) ..	·30	..	..	·18
Nymph ..	·50	..	..	·32
Male ..	·50	..	..	·28
Pubescent female ..	·45	..	..	·38
Ovigerous female ..	·57	..	..	·44

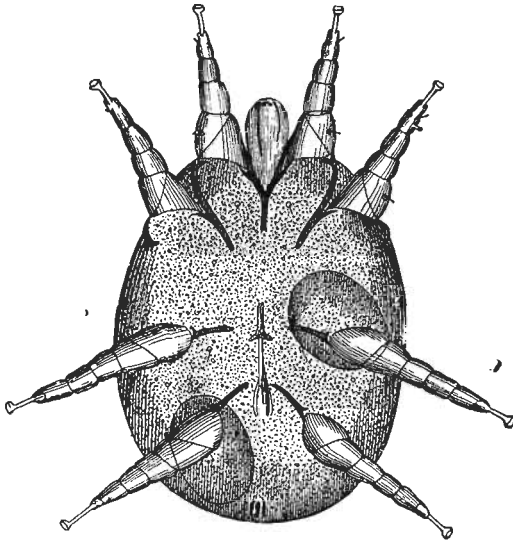


FIG. 29.—CYTOLEICHUS NUDUS (AFTER RAILLIET). × 100.
Female, ventral aspect.

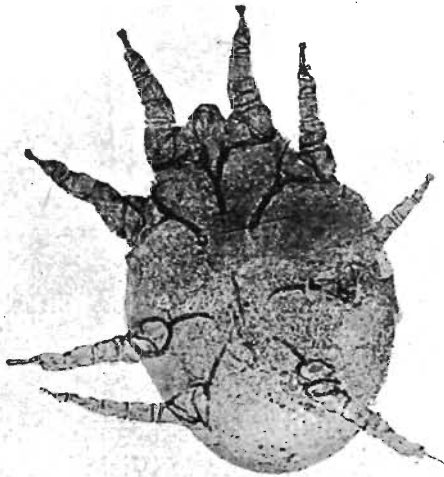


FIG. 30.—CYTOLEICHUS NUDUS. × 100.
Female, ventral aspect.

The female may lay eggs, or these may hatch within her. The longitudinal tocostome is placed between the third and fourth pairs of legs (Fig. 29). This mite is found in the air sacs of fowls and pheasants. It may occur within the bones, bronchi, lungs, and peritoneal cavity. As a fatal disease lesions due to it are rare in this country; a number of writers have, however, blamed it for causing enteritis, œdema of the

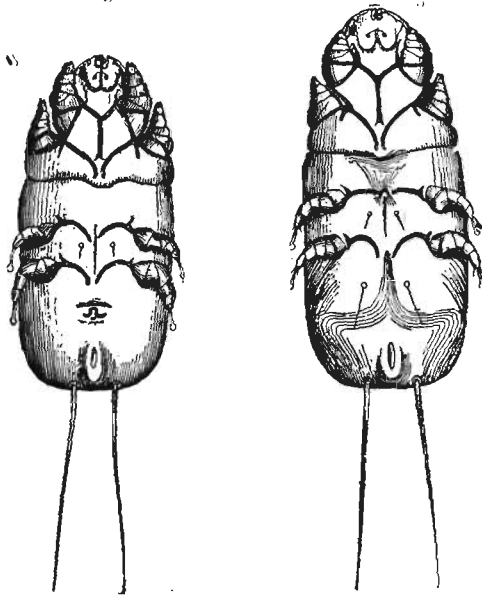


FIG. 31.—LAMINOSIOPTES CYSTICOLA (AFTER RAILLIET).

Left: male, ventral aspect. $\times 200$.

Right: female, ventral aspect. $\times 200$.

lungs, and broncho-pneumonia. The parasites may be so numerous that affected organs appear as if sprinkled with fine sand.

Genus *Laminosioptes* Megnin 1880.

Laminosioptes cysticola (Vizioli 1870).

Syn.: *Sarcoptes cysticola* Vizioli 1870. *L. gallinarum* Megnin 1880. *Epidermoptes cysticola* Rivolta 1880. *Symplectoptes cysticola* Railliet 1885.

FAMILY CYTOLEICHIDÆ

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Measurements (Megnin):

			<i>Mm. Long.</i>			<i>Mm. Broad.</i>
Larva	·12	·07
Nymph	·18	·09
Male	·20	·09
Pubescent female	·20	·09
Ovigerous female	..	..	·26	..	..	·11

The genital armature of the male lies midway between the fourth pair of legs and the anus. The third and fourth pairs of legs in each sex will be seen to be the only legs with suckers (Fig. 31). The female is ovoviviparous.

It is found in and sometimes under the skin of fowls and turkeys. The parasites do not seem to affect the health when in small numbers. After death they act as a foreign body, and ultimately become calcified.

CHAPTER V

NON-PARASITIC MITES

It has long been known that mites which are usually free-living may at times be found upon the skin of man and the domesticated animals. So long ago as 1875 Fleming,¹ in discussing the diagnosis of mange, said: "It is necessary to remember that in the epidermis detritus of all horses, no matter whether the skin be healthy or diseased, there are to be found the bodies of acari derived from the dust of forage, such as *Glyciphagæ*, *Cheyletæ*, *Tyroglyphæ*, etc., which might be mistaken for the sarcopt, although they are perfectly harmless."

The truth of these words was fully proved during the late war, but the same interpretation was not placed upon their harmlessness. Megnin (1895) in discussing the habitat of *Glyciphagus domesticus* in stable-dust, forage, etc., says (p. 140) it is found "accidentally upon animals with these dusts, but it is perfectly inoffensive with regard to the latter." Again, in listing the haunts of *Tyroglyphus siro*, he says (p. 142): "The hypopial nymph is found exclusively on animals and often in considerable quantity." On p. 147 we read: "The so-called *Symbiotes elephantis* of Gerlach, which became the *Homopus elephantis* of Furstenberg, is nothing other than the hypopial nymph of *Tyroglyphus siro* which we have re-found on cattle, birds, and lizards."

After having a tilt at the medical profession for their lack of knowledge on mites in general and their errors

¹ Fleming G., "A Manual of Veterinary Sanitary Science and Police," vol. ii., p. 47.

in blaming them as the cause of disease, he returns to the veterinary aspect. His remarks (p. 345) would be spoiled by translation.

“ Affections attribuées à tort à des acariens. Le cheval est un des animaux sur lesquels il est le plus facile de rencontrer des Acariens vagabonds, et, dans ce cas, pour peu qu'il présente une affection quelconque de la peau, on serait tenté de l'attribuer aux Acariens en question. C'est ce qui est arrivé même à l'éminent professeur vétérinaire de Stuttgart, Hering, qui, trouvant un jour sur le pied malade d'un cheval abattu pour cause de maladie incurable—il était affecté de cet *eczéma* des pieds connu sous le nom vulgaire de *crapaud*—un Acarien de genre *Glyciphagus*, le prit pour une espèce particulière qu'il nomma *Glyciphagus hippopodos*. Or c'était simplement le Glyciphage coureur (*Glyciphagus cursor* Gervais) (= *Glyciphagus domesticus*), qui abonde dans les poussières des fourrages, dans les écuries, dans les salles de dissection, etc., on compagnie de Tyroglyphes, de Cheylètes et de Gamases.

“ Nous avons aussi rencontré sur le cheval, aussi bien que sur le bœuf et même sur des animaux de classes très différentes, Reptiles, Insectes et Myriapodes, une nymphe hypopiale de Tyroglyphe très abondante, le même que Gerlach avait trouvée sur l'Eléphant et qu'il avait nommée *Symbiotes elephantis*, croyant avoir affaire à une nouvelle espèce d'Acarien psorique. Ce qui trompe, c'est qu'elle reste parfaitement vivante sur les animaux auxquels elle s'attache et qui ne sont pour elle qu'un véhicule, qu'un omnibus, car elle n'a aucun organe propre à déchirer ou à piquer; elle n'a même pas de bouche, car elle n'absorbe rien pendant cette période de sa vie.”

Raillict (1895), in describing *Aleurobius farinae*, mentions several instances of this species being found upon man, and quotes Burke as having discovered it in a disease of horses which he called *stomatitis pustulosa acarosa*; the bran also contained the acari. Hering is

stated to have found *Aleurobius* upon a cat which had a diseased skin.

In 1902 Garnett¹ recorded the finding of *Glyciphagus domesticus* in a case of sheep scab.

Butler² (1914) in an article on sarcoptic mange, when pointing out possible sources of error in microscopical diagnosis, says: "Acari other than those of scabies are to be found on the skin of the horse, and at least two varieties cause great irritation." Concerning the illustrations of his paper, Newstead and Morris state that they recognise *Aleurobius farinae*, *Cheyletus eruditus*, and two hypopi.

There are a number of other records of a similar nature. The more recent are considered under the individual species mentioned later; some of them have attached too much weight to the disease-producing power of non-parasitic mites. They all, however, show how important it is to have such a knowledge of acari as to be able to distinguish pathogenic from non-pathogenic forms. This raises the point as to what a parasite really is and what are the different degrees of parasitism.

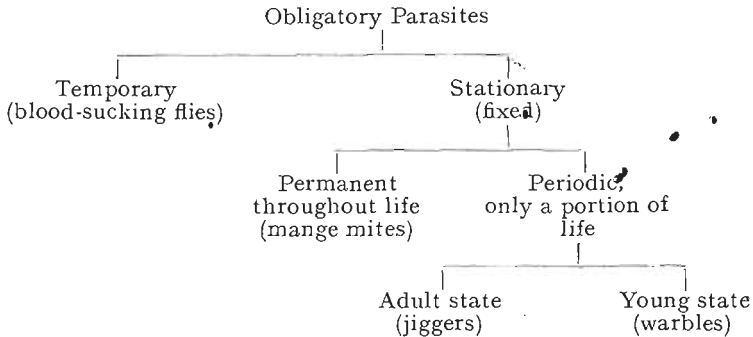
In general terms a true *parasite* may be said to be a living organism which, during the whole or a part of its existence, must, to maintain itself and reproduce, live in or upon some other living organism at whose expense it flourishes.

Whether it produces visible disease or not depends upon many conditions, such as numbers present and the state of resistance of the attached tissues. Such a degree, as outlined above, is *obligatory parasitism*,

¹ Garnett, F. W., "*Glyciphagus domesticus*: A Non-pathogenic Acarus Accidentally Present in a Case of Sheep Scab." *Journal of Comparative Pathology and Therapeutics*, 1902, vol. xv., p. 357.

² Butler, E. R. C., "Sarcoptic Scabies of the Horse." *Proceedings of the Tenth International Veterinary Congress*, London, 1914.

but there are organisms which can live and maintain themselves apart from their hosts; such are therefore *facultative parasites*, and a third class, which are usually free-living, are termed *accidental parasites*. Obligatory parasites may be classified as follows:



At present the most that can be said about some of the free-living acari which have been found upon animals is that they are accidental; in some cases, however, they are no more parasites than a man is when on horseback.

During the late war acari of a normally free-living habit came prominently before veterinary officers, and Wadley,¹ in 1918, quoting a record compiled by Pallin of the results obtained from the microscopical examination of scrapings taken from a very large number of animals evacuated for mange and contagious skin disease or as close-in-contacts, gave the following figures:—

	<i>Per Cent.</i>		<i>Per Cent.</i>
Sarcoptic	46·15	Forage acari ..	14·72
Psoroptic	4·57	Lice	1·71
Symbiotic	·83	Ringworm	1·81
Dermatodectic ² ..	4·52	Negative	24·71

¹ Wadley, E. J., "The Control and Treatment of Mange and other Contagious Skin Diseases." *Veterinary Journal*, 1918, vol. lxxiv., p. 161.

² This is manifestly an error, because dermatodectic is derived from *Dermatodectes*, synonymous with *Psoroptes*; demodectic is no doubt meant.

These figures do not claim to represent the incidence of the above diseases throughout the war in the British Expeditionary Force. The period over which the investigation was carried out is not given; further, it is not stated whether all evacuations for mange from the front were examined; or whether the examined animals were clinical cases or those which responded to the labial reflex. It is to be regretted that up to the present the 14.72 per cent. of forage acari from such a very large number of animals has not been more fully amplified in the veterinary press with regard to the different species making up the total.

This brings one to a consideration of the labial reflex, a reaction of considerable interest both with regard to accidentally parasitic acari and also the mange mites.

The control of mange would be rendered comparatively easy if (i.) the disease could be diagnosed within a day or so of its onset; (ii.) we knew how long after definite infection it would take for symptoms to appear; and (iii.) we could say with absolute certainty when an animal was cured. In each of these cases, as our clinical knowledge at present stands, the labial reflex plays an important part.

In answer to the question concerning early diagnosis, it is held that if rubbed upon the suggested site of infection with a piece of stick, a penny, a horse nail, a teaspoon, or the finger-tip, the first positive symptom in equine mange is a response by moving the lips or teeth in a characteristic manner. Possibly this is so, but there are a number of other diseases where there is a like result.

With regard to the period of incubation some horses will show marked irritation in winter in a few days, but in other cases animals may harbour only a few

parasites, and so not show clinical symptoms for several months; this actually may only happen when the coat becomes heavy and dirty, is badly groomed, or when the horse is at rest for long periods. In other words, a few mites upon a host may not give rise to visible symptoms.

As to "when" a horse is cured of mange depends upon what one understands by the words "cured" and "mange." If "mange" means clinical symptoms and lesions, an animal may be said to be cured when it has no visible lesion and a whole coat; many would add, "and does not respond to the labial reflex," but this last proviso wants to be used with extreme care. If "cured" means has not a single mange mite or living egg left upon the host, then one can never definitely say, because there are carriers, and upon these the disease recurs. These are three of the most important questions in mange control, and are all closely associated with the labial reflex and stray acarids which live in food and bedding. Nearly all the surroundings of a horse may have these acari upon them in the dust derived from hay, forage, and other materials. *Cheyletus* was very common in hay in the British Expeditionary Force; *Aleurobius* I found often in bran and rice; hypopi of *Tyroglyphus* were frequently encountered in oats; and all of these were detected on horses which responded to the labial reflex. The longer one searches an apparently mange-negative slide the more likely is one to come across some form of usually non-parasitic acarus. Such have been very often found in groomings from healthy animals. In addition to mange and acarus irritation there are several conditions which give a positive labial reflex. The most important of these are—(i.) dirty skins; (ii.) acne, especially when fibrosis is taking place; (iii.) lousiness due to *Hæmatopinus*; (iv.) burns, in the

final stages and after recovery; (v.) certain blood-sucking fly bites; and (vi.) old scar tissue in special situations. Sometimes there is no reaction after a dose of physic in horses which before such medication showed marked signs of pleasing irritation. The normal labial reflex is seen in the sucking foal when the dam places her mouth on the foal's croup; and in young stock biting each other's manes just in front of the withers. It is possible to make an animal move its lips and even its teeth, as in the labial reflex, without touching it. Animals can be taught that they must not do it, and atmospheric conditions influence the degree to which it is shown. For the pruritus of accidental infections close clipping all over, complete washing in soap and water, followed by exercise and one application of a sulphur-oil or calcium polysulphide-horse-fat preparation, when warm, is to be recommended.

FAMILY TYROGLYPHIDÆ

Integument smooth, mammillated, or spiny; fourth pair of legs armed with hooks and often with a sessile caruncle. Adults usually free-living, but one stage—viz., the hypopial nymph—is found attached to insects and mammals. Unlike the Sarcoptidæ, all the legs of the members of this family are approximately the same length.

Genus *Aleurobius* Canestrini 1888.

Syn.: *Acarus* (part) Linnæus 1758. *Tyroglyphus* Gervais 1844.

Aleurobius farinæ (de Geer 1778).

Syn : *Acarus siro* (part) Linnæus 1758. *A. farinæ* de Geer 1778. *Tyroglyphus farinæ* Gervais 1844.

(See Figs. 32 to 36.) The first pair of legs in the male are considerably the thickest, and each has a large tooth-like projection from the outside of the femur or second joint. In the female, the first pair of legs are not thicker than the rest. The vulva is placed between the third and fourth pair of legs.

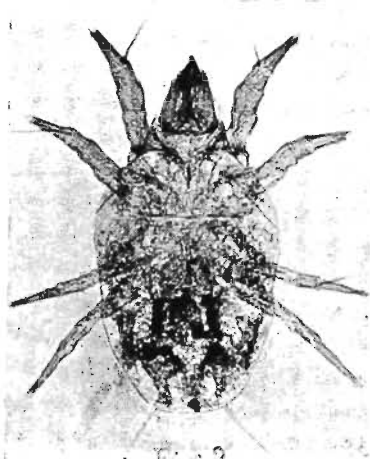
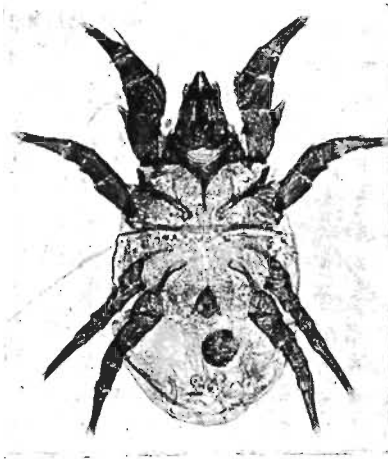


FIG. 32.—ALEUROBIUS FARINÆ.
x 80.

Male, ventral aspect.
(*Veterinary Journal.*)

FIG. 33.—ALEUROBIUS FARINÆ.
x 80.

Female, ventral aspect.
(*Veterinary Journal.*)

Measurements (Michael):

	Mm. Long.		Mm. Broad.	
Male
Female
Egg

The life-cycle consists of *egg* (Fig. 36), *larva* (Fig. 34), *nymph* (*hypopial nymph*), *male* (Fig. 32), and *female* (Fig. 33).

It has a wide distribution, being found in flour, bran, rice, oatmeal, farinaceous material, and cheese. It is a serious pest, and causes a great amount of damage, especially to flour. As previously remarked, it has been found upon man by Moniez, upon the cat by Hering, and upon horses by Butler. I have found it

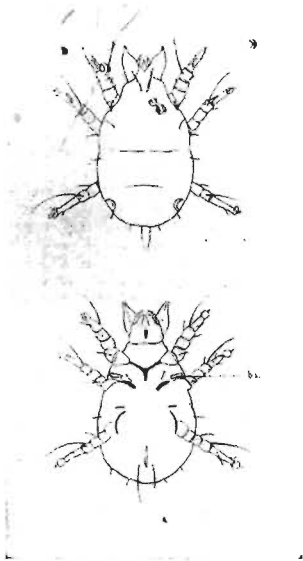


FIG. 34.—ALEUROBIUS FARINÆ (AFTER NEWSTAD AND DUVAL).
Larva. $\times 165$.
Top, dorsal aspect. Bottom, ventral aspect.



FIG. 35.—ALEUROBIUS FARINÆ.
 $\times 100$.
Damaged specimen from skin of horse, ventral aspect.

several times in skin-scrapings of horses¹ and in guinea-pigs' ears.² This acarus was a very frequent find upon horses in France during the late war, and some slides labelled Mark XIII. contained it. Fig. 35 represents a damaged specimen from a horse's skin.

¹ *Veterinary Record*, 1919, vol. xxxii., p. 22.

² *Veterinary Journal*, 1920, vol. lxxvi., p. 332.

The egg is not likely to be mistaken for that of a mange mite, as it is not smooth, but has a granular appearance (Fig. 36).

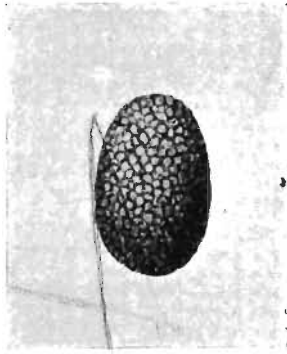


FIG. 36.—*ALEUROBIUS FARINÆ* (AFTER MICHAEL).
Ovum. $\times 45$.

Genus *Tyroglyphus* Latreille 1796.

The ambulacra of all the legs are sessile; mandibles chelate; female without a projecting tubular bursa

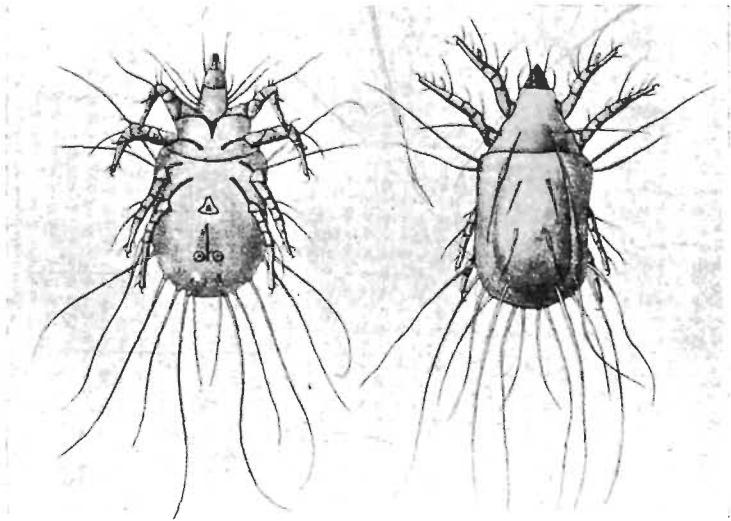


FIG. 37.—*TYROGLYPHUS LONGIOR* (AFTER MICHAEL).
Left: Male, ventral aspect. $\times 80$.
Right: Male, dorsal aspect. $\times 80$.

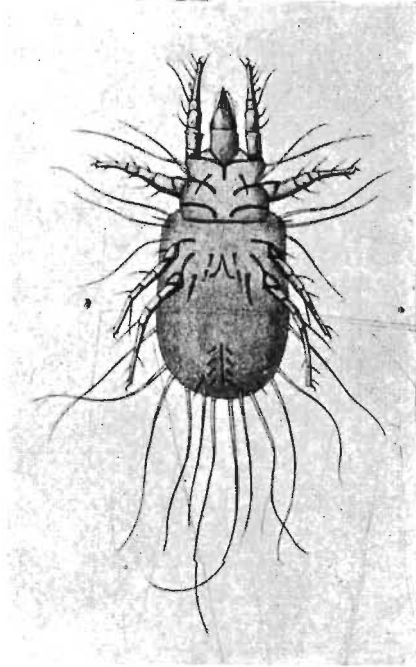


FIG. 38.—*TYROGLYPHUS LONGIOR* (AFTER MICHAEL).
Female, ventral aspect. $\times 80$.

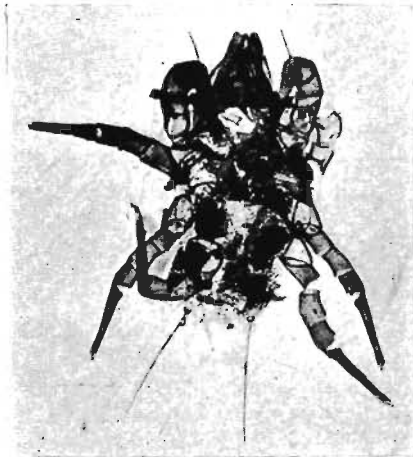


FIG. 39.—*TYROGLYPHUS LONGIOR*.
Damaged specimen from skin of horse. $\times 80$.

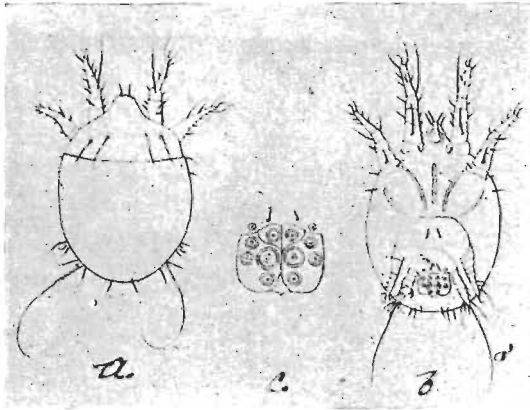


FIG. 40.—TYROGLYPHUS LONGIOR (AFTER MICHAEL).
a, Hypopial nymph, dorsal aspect. $\times 120$.
b, Hypopial nymph, ventral aspect. $\times 120$.
c, Sucker plate. $\times 300$.

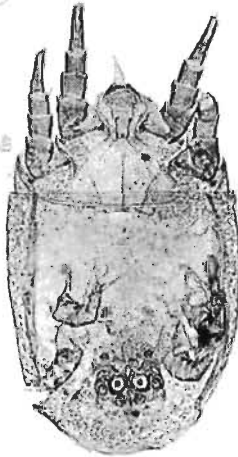


FIG. 41.—HYPOPIAL NYMPH.
 $\times 100$.
 From skin of a horse.
 (*Veterinary Record.*)

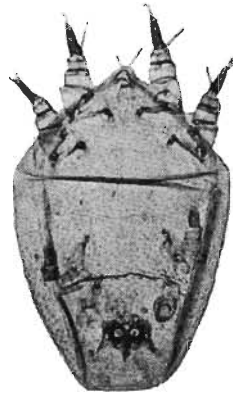


FIG. 42.—HYPOPIAL NYMPH.
 $\times 200$.
 From skin of a horse.
 (*Veterinary Record.*)

copulatrix; cephalothorax and abdomen distinctly divided by a line; the first leg of the male is not conspicuously thicker than the other legs, and its femur has no spur; genital suckers present in both sexes.

Tyroglyphus longior Gervais 1844.

Syn.: *T. infestans* Berlese 1884.

(See Figs. 37 to 40.)



FIG. 43.—TYROGLYPHUS LONGIOR (AFTER MICHAEL).
Ovum. × 400.

Measurements (Michael):

				<i>Mm. Long.</i>			<i>Mm. Broad.</i>
Male	..	..	..	.28	..	..	.21
Female	..	..	..	.36	..	..	.24
Egg	..	..	..	.15	..	..	.09

Tyroglyphus siro (Linnæus 1758).

(See Fig. 44.)

Measurements (Michael):

				<i>Mm. Long.</i>			<i>Mm. Broad.</i>
Male	..	..	..	.52	..	..	.28
Female	..	..	..	.65	..	..	.32

Both of the above species are termed "cheese mites." They are found in materials similar to those frequented by *Aleurobius farinæ* (see p. 70).

T. siro has also been found upon powdered drugs, such as ergot. They are extremely difficult to differentiate. Newstead and Morris, after closely examining the dis-

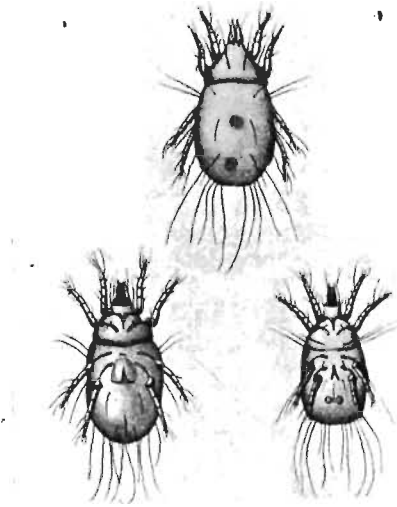


FIG. 44.—TYROGLYPHUS SIRO (AFTER MICHAEL).
× 30 (approximately).

Top: Female, dorsal aspect.

Bottom, left: Female, ventral aspect.

Bottom, right: Male, ventral aspect.

tinguishing features given by Michael, point out that they are not reliable, and say that a possible difference between the two species is the presence in *T. siro* of a chitinous bar posterior to the vulva of the female, which is absent in *T. longior*. They record the finding of both species in skin-scrapings of horses in France and Flanders. I have found *T. longior*¹ several times

¹ *Veterinary Record*, 1920, vol. xxxii., p. 475.

under similar circumstances, and it was often seen in skin-scrapings of horses in the British Expeditionary Force. Several years ago I examined a sample of hay very heavily infested with *T. longior*. Cattle feeding from the rick which furnished it were said to have been affected with an irritating skin lesion on the head and neck. The symptoms gradually disappeared when access to the mow was stopped. Oudemans found *T. siro* upon a linnet in Holland.

Hypopi.

One of the commonest finds in skin-scrapings of army horses in France was some form of hypopus or hypopial nymph. Mark 1., figured by Kirk,¹ is a hypopus. Most species, if not all, of the family Tyroglyphidæ pass through this stage under special conditions. It appears to be for purposes of distribution. Reference to Figs. 40, 41, and 42 will show their chief characteristics—viz., no mouth parts, and a ventral sucker plate by which they attach themselves to beetles and other objects.

The sucker plate in the hypopial nymph of *T. longior* is oblong, being broader than long. It is divided by a median line so as to form an equal part on each side. Near the anterior edge and on the plate are four suckers; behind these are four more, the central pair being much the larger; behind these, again, are two more small ones close to the median line. There are also two more anterior to the front edge of the plate at each corner with two small spines between them (Fig. 40). The arrangement of the details of the sucker plates is different in the various species.

¹ Kirk, H., "Skin Diseases of the Horse," *Veterinary News*, 1917, vol. xiv., p. 320.

At one time these hypopi were regarded as species of the so-called genus *Hypopus*.

Reference has already been made to one found upon the elephant (see p. 62). They are very common in hay and oats. Butler's paper with illustrations of hypopi has previously been mentioned (see p. 64). Newstead and Morris say that they have examined a number of hypopi from healthy army horses in France and Flanders, representing several species, but, owing to the more or less imperfect condition of the material, it was not possible to determine the species with exactitude. I have figured two types commonly seen in equine skin-scrapings.¹

The diagnosis of a clinical condition of the skin of horses requiring treatment by the finding of a mouthless hypopus upon the skin is, to say the least, hiding the real cause of the lesion.

Genus *Glyciphagus* (Hering 1838).

Ambulacra of all legs sessile, chelate mandibles, bursa copulatrix of female forming a tubular projection from the centre of the posterior end of the abdomen; with or without a groove between cephalothorax and abdomen; cuticle rough and never polished; considerable sexual dimorphism. Dorsal hairs pectinated or plumose, or modified into foliaceous scales or spines. No anal suckers.

Glyciphagus domesticus (de Geer 1778).

Syn.: *G. cursor* Gervais 1841.

(Figs. 45 to 48.)

Measurements (Michael):

				<i>Mm. Long.</i>			<i>Mm. Broad.</i>
Male	..	..	..	.48	..	..	.25
Female	..	..	..	.50	..	..	.27

¹ *Veterinary Record*, 1920, vol. xxxii., p. 522.

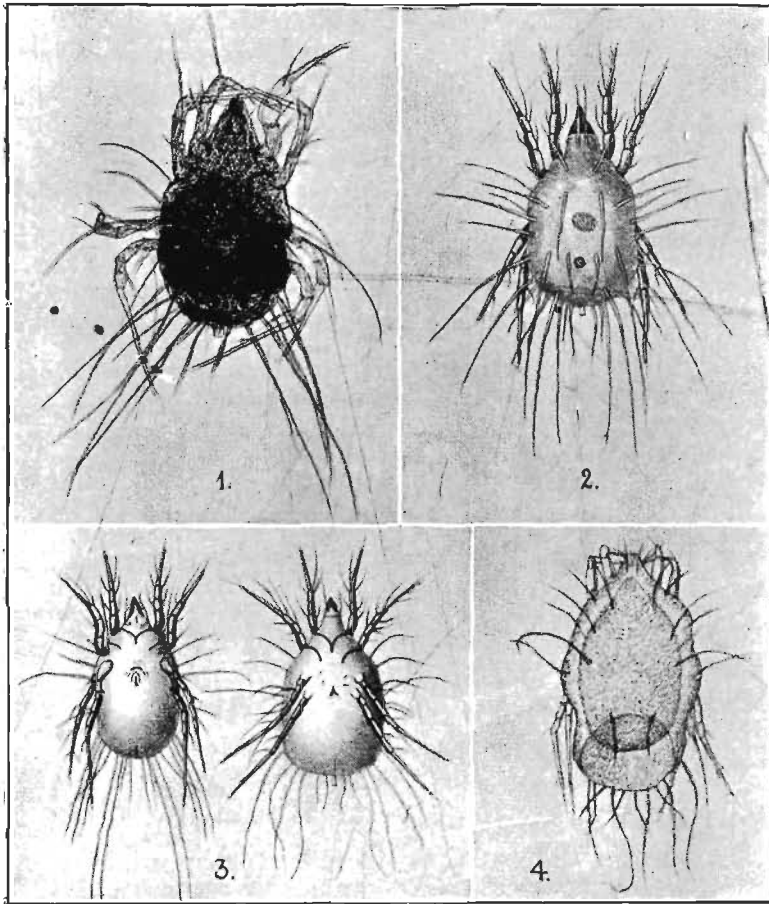


FIG. 45.—(1) GLYCIPHAGUS DOMESTICUS. $\times 72$.
Female, dorsal aspect. From ear of rabbit.

FIG. 46.—(2) GLYCIPHAGUS DOMESTICUS (AFTER MICHAEL). $\times 68$.
Female, dorsal aspect.

FIG. 47.—(3) GLYCIPHAGUS DOMESTICUS (AFTER MICHAEL).
Left: Male, ventral aspect. $\times 62$.
Right: Female, ventral aspect. $\times 62$.

FIG. 48.—(4) GLYCIPHAGUS DOMESTICUS (AFTER MICHAEL). $\times 125$.
Hypopial nymph, dorsal aspect.
(*Veterinary Journal*.)

This species is extremely common upon all sorts of dead animal and vegetable matter. In some districts it is prevalent in hay dust and farinaceous material. Megnin says that it was probably this species which Hering found upon the foot of a horse affected with canker, and which he regarded as proper to this affection; he termed it *Sarcoptes hippopodus*. Megnin's remarks upon its being found upon animals have already been quoted (p. 62). Garnett found it upon a sheep in a case of sheep scab (p. 64). I have recorded it from the ears of rabbits¹ and guinea pigs.² It is the cause of grocer's itch.

The small hairs upon the longer dorsal ones do not show up very clearly in the diagrams, but they are easily seen under the microscope. The apparent thickness of the longer hairs in the figures is due to their pectinated condition. The bursa copulatrix is plainly shown in Fig. 45. The hypopial nymph is not an active stage, being quite rudimentary, and never leaving the skin of the previous nymph (Fig. 48).

In some species of *Glyciphagus* the hypopus is homopial—that is, it resembles in structure the immature form which was once regarded as a distinct genus—viz., *Homopus*. It is chiefly in those forms which inhabit the nests of small mammals that the homopus is seen. Instead of the typical sucker plate, the ventral surface, in the same region, is furnished with a structure suitable for grasping the hair of its carrier. It consists of a median furrow with a lip or wing-like piece on each side. These can be raised or depressed by pressure, from a roughened portion on each lip near the median furrow, upon a hair in it, a secure hold being thus obtained.

¹ *Veterinary Journal*, London, 1920, vol. lxxvi., p. 126.

² *Ibid.*, p. 331.

Glyciphagus cadaverum Schrank.

Syn.: *G. spinipes* Koch 1841. *G. destructor* Schrank.
(Figs. 49 and 50.)

Measurements (Michael):

	<i>Mm. Long.</i>	<i>Mm. Broad.</i>
Male	·45	·24
Female	·70	·45
Egg	·14 to ·18	·07 to ·1

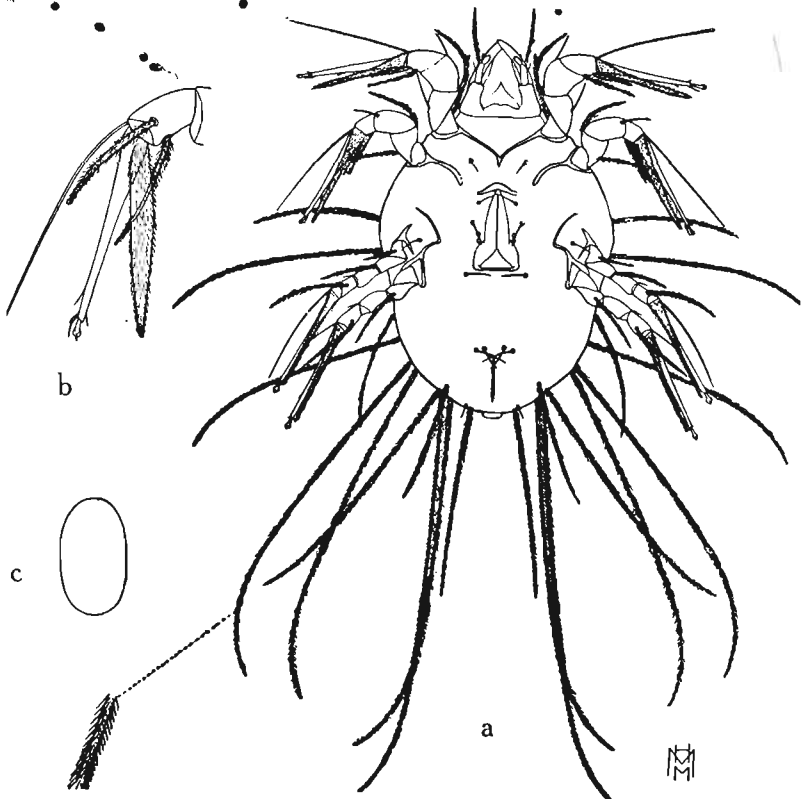


FIG. 49.—GLYPHAGUS CADAVERUM (AFTER NEWSTEAD AND MORRIS).

a, Female, ventral aspect. × 117.

b, Tibia and tarsus of leg II. × 250.

c, Egg. × 117.

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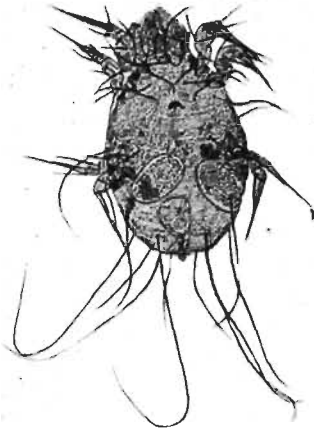


FIG. 50.—GLYCIPHAGUS CADAVERUM. × 170.
Female, ventral aspect.

This species occurs in situations similar to *G. domesticus*, and is often mistaken for it. It commonly goes by the name *spinipes*. Michael gives the following points of distinction:

	<i>G. domesticus.</i>	<i>G. spinipes.</i>
1. Tarsi ..	Smooth with 4 to 6 setiform hairs.	Densely clothed in very short fine hairs.
2. Tarsi ..	As long as whole leg.	Not so long.
3. Third joint of third leg.	Has no scale.	Scale, like a husk of corn, clothed on the outside by fine hairs.
4. Bursa copulatrix.	Twice as long as in <i>G. spinipes</i> .	
5. Body ..	Body not so constricted.	When alive, body constricted between the second and third pairs of legs.

It has often been found upon horses by Baudét¹ in Holland. In that country it occurs in hay. Megnin applied to it remarks similar to those he made upon *G. domesticus* (p. 62). Professor R. Newstead, F.R.S., has shown me slides labelled Mark VI. containing mites from the horse's skin which belonged to this species.

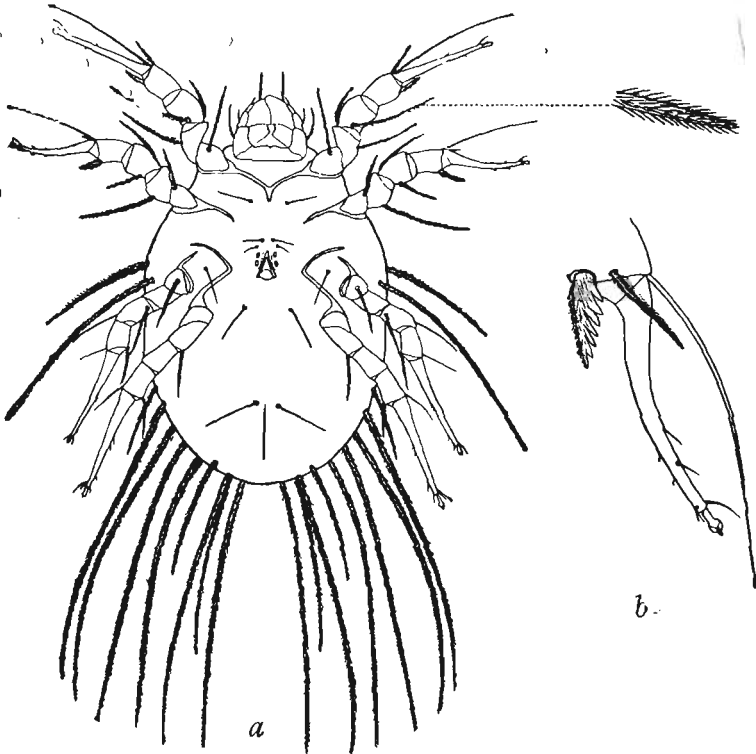


FIG. 51.—GLYPHAGUS ORNATUS (AFTER NEWSTEAD AND MORRIS).

(a) Male, ventral aspect. $\times 87$.

(b) Tibia and tarsus of leg II. $\times 260$.

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¹ Baudét, E. A. R. F., "Komen chorioptes—schurftmijten in hooi of stroo voor" (*Tijdschrift voor Vergelijkende Geneeskunde Gezondheidsleer en Parasitaire en Infectieuze Dierziekten*, Leiden, vol. i, p. 187).

Glyphagus ornatus Kramer 1881.

(Fig. 51.)

This appears to be a continental species. It has been found in hay dust and moss. Newstead and Morris, in recording it from skin-scrapings from horses in France, point out that it is readily distinguished by the large comb-like appendages at the distal end of the fourth segment or tibia of legs' i. and ii. of the male.

CHAPTER VI

FAMILY LISTROPHORIDÆ

THIS family of hair-clasping mites is regarded by some as an unnatural one. As the clasping apparatus is different in the few genera which comprise the family, they are sometimes thought to be modified members of other families, such as the Analgesidæ, Tyroglyphidæ, or Sarcoptidæ.

The lip, or posterior legs, are modified for hair-clasping. The mandibles are small and often chelate. The palpi are simple, filiform, and composed of three segments. The males are often different in shape to the females, and have copulatory suckers. The front two pairs of legs, at least, are furnished with ambulacral suckers.

Genus *Listrophorus* Pagenstecher 1861.

Listrophorus gibbus Pagenstecher 1861.

The male is .47 mm. long, and the posterior portion of the abdomen has a flattened, bifid prolongation. Female .45 mm. long. (See Figs. 52 and 53.)

This species is common in the depths of the fur of rabbits, where it appears to produce no lesions or inconvenience. Mr. C. J. Davies, of Haywards Heath, informs me that he has found it in the auditory canal of rabbits. It is stated that *Cheyletus* (see p. 92) may feed upon this mite.

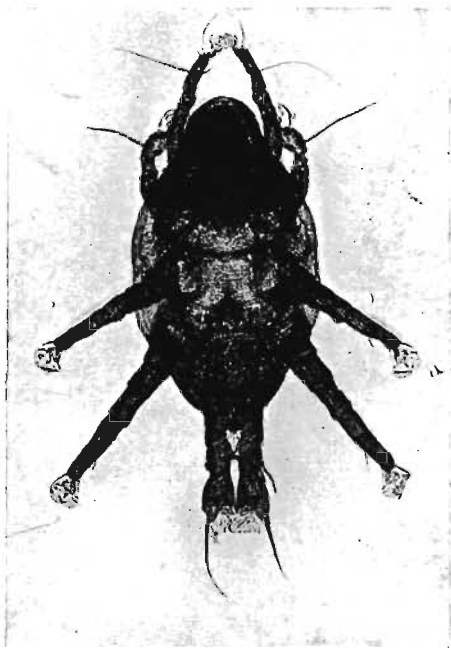


FIG. 52.—LISTROPHORUS GIBBUS. $\times 110$.
Male, ventral aspect.

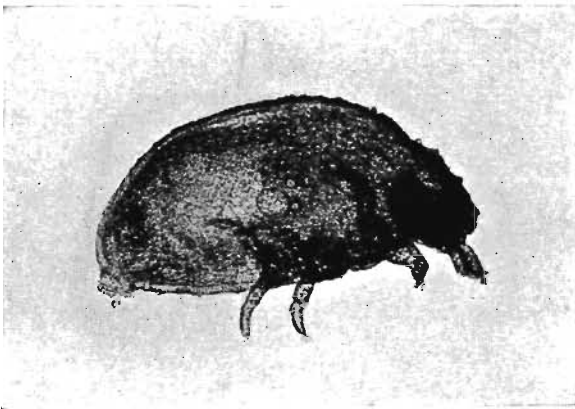


FIG. 53.—LISTROPHORUS GIBBUS. $\times 110$.
Female, lateral aspect.

An allied form is found on ferrets, and others occur on rodents.

FAMILY ANALGESIDÆ

The mites of this family are found in the plumage of birds, where they rarely give rise to parasitism, but are rather mutualists. They are a large group.

Anal suckers present, no genital suckers; the vulva is transversè. Sexual dimorphism more or less apparent, often very marked.

Genus *Pteronyssus* Robin 1868.

Pteronyssus striatus Robin 1877.

Bulter¹ states that *Pteronyssus* occurs on the sparrow and linnæ, and that he found it on the horse on three occasions. He figures *P. striatus* (?) of the sparrow. Canestrini and Kramer do not mention any member of this genus as having been found upon sparrows or linnæ. They list the above species from the chaffinch (*Fringilla cœlebs*). Allied species, *Proctophylloides truncatus* Robin 1877 and *P. glandarinus* Koch 1840, occur on sparrows and finches respectively.

FAMILY EUPODIDÆ

Cephalothorax furnished with hairs diversely situated; eyes, when present, near posterior border of cephalothorax; last segment of first leg shorter than or only as long as the preceding one. Mostly free-living.

¹ Bulter, E. R. C., "Sarcoptic Scabies of the Horse," Tenth International Veterinary Congress, London, 1914.

Genus *Tydeus* Koch 1842.

Tydeus molestus Moniez 1889.

Male $\cdot 2$ mm. long and $\cdot 125$ mm. broad; female $\cdot 225$ mm. long and $\cdot 135$ mm. broad. Gravid female longer and broader. Colour, pink. (See Fig. 54.) Found by Moniez in Belgium; imported previously

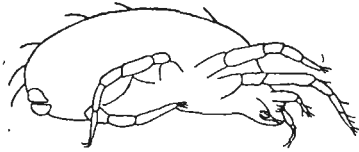


FIG. 54.—TYDEUS MOLESTUS (AFTER MONIEZ). $\times 175$.
Lateral aspct.

on guano. Common on trees and grass. Caused great irritation on dogs, cats, and poultry around the joints, eyes, and anus. They appeared regularly with the warm weather, and ceased their activities with the advent of the first frosts.

FAMILY TARSONEMIDÆ

Cephalothorax and abdomen distinct; palpi simple and small; mandibles small and styliform; with tracheæ; the legs have five segments; the terminal ones of the first pair have a claw both in the male and female. There is a claviform appendix between the first and second pair of legs on each side of the female; complete sexual dimorphism. Parasites of plants.

Genus *Pediculoides* Targioni-Tozzetti 1878.

Pediculoides ventricosus (Newport 1850).

Syn.: *Heteropus ventricosus* Newport 1850. *Acarus tritici* Lagreze-Fossot 1851. *Physogaster larvarum* Lichenstein 1868. *Sphærogyna ventricosa* Laboulbère and Megnin 1885.

Male, oval, $\cdot 12$ mm. long and $\cdot 08$ mm. broad; female $\cdot 2$ mm. long and $\cdot 07$ mm. broad. When gravid the posterior portion of the abdomen becomes greatly distended into a globe-like structure, which may be more than 1 mm. in diameter. The eggs hatch within the abdomen; the young have four pairs of legs on

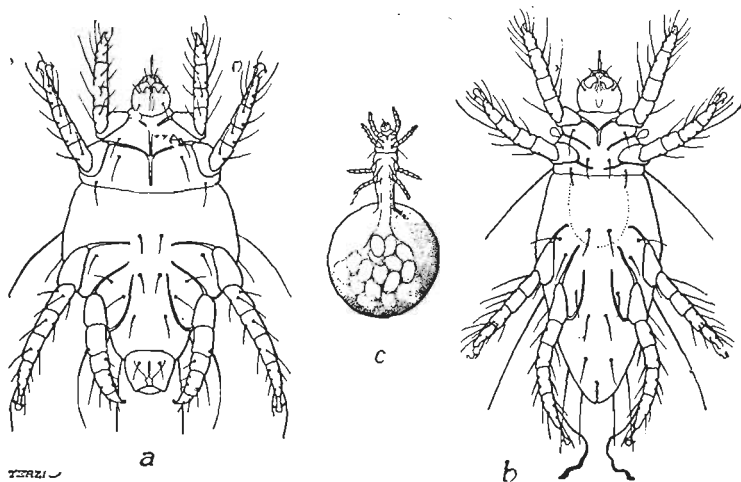


FIG. 55.—*PEDICULOIDES VENTRICOSUS*.

(a) Male, ventral aspect. $\times 350$.

(b) Female, ventral aspect. $\times 220$.

(c) Gravid female. $\times 60$.

(Castellani and Chalmers.)

emerging from the parent, and are practically adult (see Fig. 55). It occurs in this country, and lives on growing cereals. It may be harvested with them. The mite described as a *Tyroglyphus* by Carpano¹ in Italy from a horse's skin really belongs to the above species.

¹ Carpano, "On a Mite of the Genus *Tyroglyphus*, an Accidental Parasite of the Horse," *Clinica Veterinaria*, 1918, vol. xli., No. 7. Milan.

It is a common species in grain, cereals, hay, clover, and other feeding-stuffs, where it lives upon other soft-skinned forage-loving mites. It was very common

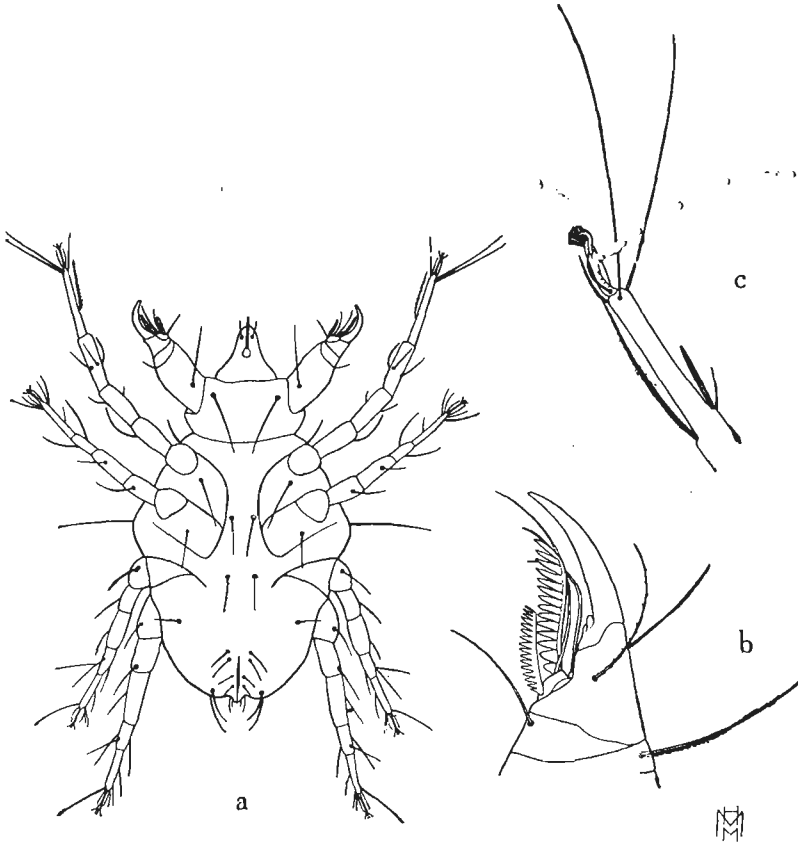


FIG. 58.—CHEYLETUS ERUDITUS. (AFTER NEWSTEAD AND MORRIS).

(a) Female, ventral aspect. $\times 87$.

(b) Palp, ventral aspect. $\times 325$.

(c) Tarsus of leg I., lateral aspect. $\times 325$.

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in bales of hay and bran used in the British Expeditionary Force. I have examined specimens labelled Mark VIII., and taken from the horse's skin, which

belonged to this species. It has been obtained from the ear of the guinea-pig,¹ and is stated to hunt *Listrophorus gibbus* (see p. 86) in the depths of the rabbit's fur.

Picaglia² blamed this form for causing a dermatosis of a horse. Megnin stated that he often found it upon horses, together with other acari which had tumbled from the rack.

Newstead and Morris state that it has been found by them in groomings from healthy army horses in France and Flanders.

I have seen veterinarians find this species in stable dust and blame it for causing a skin eruption for which they had failed to find the real cause—viz., the sarcopt.

Genus *Cheyletiella* Canestrini 1886.

Cheyletiella parasitivorax (Megnin 1878).

This species differs from the last in that the palpi are not so large and have no combs on the last article but a bifid cirrus with three small hairs; the anterior two pairs of legs are shorter than the posterior; the tarsi end in a leaf-like cirrus with pectinate borders. Male .27 mm. long; female .420 mm. long (Fig. 59).

It does not produce disease, but is found in the depth of the rabbit's fur, where it is said to prey upon *Listrophorus gibbus* (see p. 85). I have detected it once in the dusty deposit from the skin of a cat which had strayed whilst severely affected with pneumonia.

FAMILY TETRANYCHIDÆ

Soft mites with tracheæ and two pairs of eyes; palpi composed of four segments, the last but one of which

¹ *Veterinary Journal*, 1920, vol. lxxvi., p. 331.

² Picaglia quoted by Railliet, *Traité de Zoologie Médicale et Agricole*, Paris, 1895, p. 696.

has a powerful claw; the legs have six segments, with sucker discs between the claws of the tarsus. Parasitic upon plants.

Genus *Tetranychus* Dufour 1832.

Tetranychus molestissimus Weyenbergh 1886.

"Bicho colorda" of the Argentine and Uruguay. It is found on the under-side of the leaves of South American plants, and from December to February

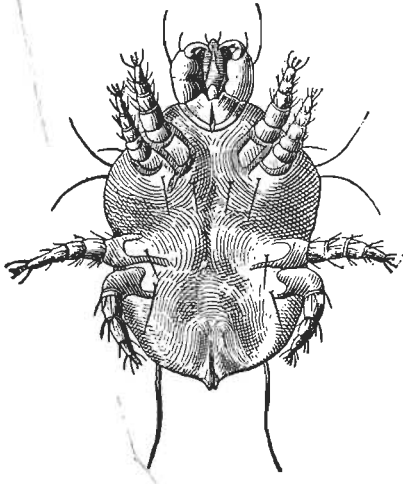


FIG. 59.—CHEYLETIELLA PARASITIVORAX. $\times 100$.
Ovigerous female, ventral surface.
(Neumann's "Parasites.")

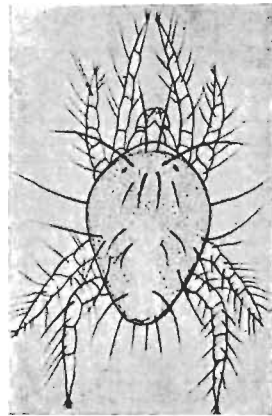


FIG. 60.—TETRANYCHUS TELARIUS (AFTER ARTAULT).
Dorsal aspect, greatly enlarged.

attacks warm-blooded animals. Commonly called Red spiders.

An allied species, *T. telarius*, causes "red disease" of the vine, and has been recorded from man in France. (See Fig. 60.)

FAMILY TROMBIDIIDÆ

Soft integuments; mandibles adapted for biting; larvæ parasitic; adults free-living.

Fig. 61 shows a damaged specimen of a trombidiid taken from the skin of a horse suspected

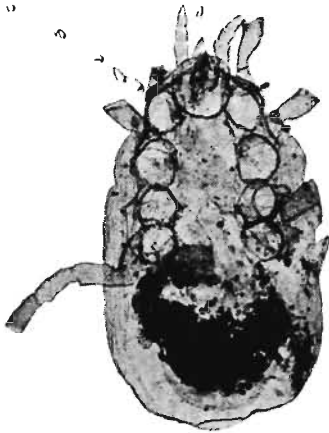


FIG. 61.—TROMBIDIID. $\times 100$.
Damaged specimen from the
skin of a horse.

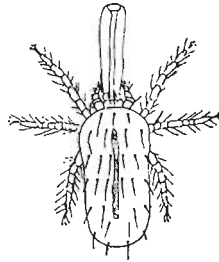


FIG. 62.—LARVA OF TROM-
BIDIUM SP. (AFTER GUD-
DEN). $\times 65$ approximately.
Harvest bug, with the so-
called sucking proboscis.

of mange. It is not possible to accurately determine its name. I have encountered very similar specimens on three occasions.

Genus *Trombidium* Fabricius 1775.

Trombidium sp.

Fig. 62 is a larval form—leptus—which attacks numerous animals—man, the horse, ox, sheep, dog, rabbit, cat, and fowl. There are several species

of *Trombidium*, and the harvest bug, long known as *Leptus autumnalis*, probably represents the larval form of several of them. They are common in barley-fields in autumn, and are often prevalent in gardens and upon nut bushes. It is stated that cavalry horses after autumn manœuvres may show eruptions on the legs up to the knees and hocks due to the harvest bug. It is sometimes termed the heel bug.

In some areas in France adult mites of this genus were very numerous.

In certain training districts race-horses are attacked on the heels, fetlocks, and legs by mites which are said to belong to this genus. Washing the parts likely to be affected with weak solutions of coal-tar preparations before exercise is stated to be a deterrent.

FAMILY DERMANYSSIDÆ

Mandibles adapted for piercing; stigmata on the dorsum; legs in both sexes similar. Parasitic upon birds.

Genus *Dermanyssus* Duges 1834.

Dermanyssus gallinæ (de Geer 1778).

Syn.: *D. avium* Duges 1834.

The colour varies from pink to dark red, according to the amount of blood contained in the internal organs. (See Fig. 63.)

			Length, Mm.		Width, Mm.		
Male	·60	..	..	·32
Female	·75	..	..	·4
Nymph	·40	..	..	·15
Egg	·25	..	..	·15

This species is nocturnal in its perambulations, and is common in cracks, nests, and other situations in

fowl-houses and pigeon lofts. It is known as the red mite, and may cause important loss by disturbing sitting birds. The acari may wander to attack other animals at night. Man, horses, oxen, goats, rabbits, dogs, and cats are stated to have been infested. The mite appears to be able to fast for long periods. Megnin

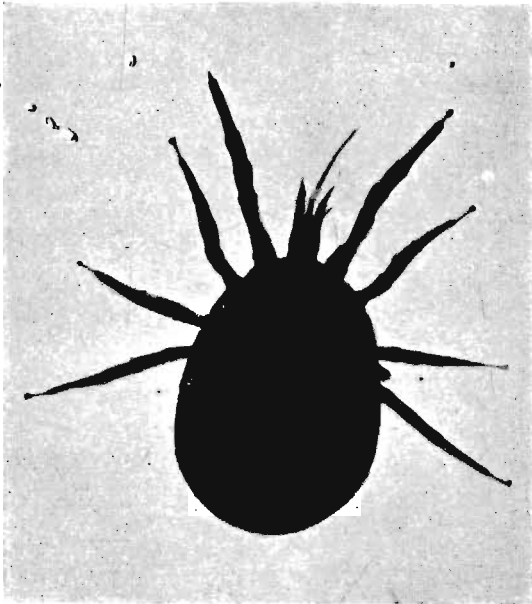


FIG. 63.—*DERMANYSSUS GALLINÆ*. × 40.
Female, ventral aspect.

gave an account of an equine dermatosis due to this species caused by the use of an old rug in which the acari sheltered during the day.

D. hirundinis, an allied species found in swallows' nests, has been blamed for causing an eruption on cows.

As the parasitism is not permanent, thorough disinfection of fowl-houses, pigeon lofts, and other haunts,

together with the burning of nesting materials, will often bring about a very satisfactory reduction in the number of parasites present.

Genus *Sternostomum* Berlese and Trouessart 1889.

Sternostomum rhinolethrum Trouessart.

The rostrum in this species is inferior and completely hidden by the epistome when viewed from the dorsum. (See Fig. 64.) It occurs in the nasal fossæ of ducks and other birds, where it may produce serious disease.

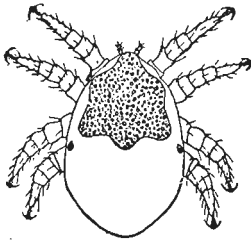


FIG. 64.—*STERNOSTOMUM RHINOLETHRUM* (AFTER BANKS).

Dorsal aspect. Greatly enlarged.

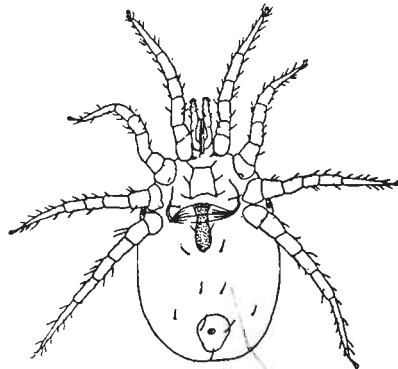


FIG. 65.—*RAILLIETIA AURIS* (AFTER FREUND). × 35.

Ventral aspect.

FAMILY GAMASIDÆ

The first pair of legs are inserted into the sides of the buccal orifice; the dorsal surface does not project over the origin of the mouth-parts. Predaceous on small insects and mites. Some species are parasitic upon insects.

Genus *Raillietia* Trouessart 1902.

Raillietia auris (Leidy 1872).

Syn.: *Gamasus auris* Leidy. *Sejus auris* Leidy.

An ovoid mite, with brown legs, covered with hairs the tarsi terminate in a pair of hooks and a caruncle palpi with six articles. Length 1 mm., width .8 mm. (See Fig. 65.)

This species was found by Turnbull in the ears of American cattle, and was regarded by him as being capable of causing disease.



FIG. 66.—PARASITINÆ ? *Hyletastes*. × 140.

From ear of rabbit.

(*Veterinary Journal*.)

Genus *Hyletastes*.

Fig. 66 shows an acarid which was found on several occasions in the ears of domesticated rabbits. Professor R. Newstead, F.R.S., placed the specimens which were

damaged in the subfamily Parasitinæ? *Hyletastes*. The members of this genus are found upon certain beetles, and some occur in moss.

Ewing¹ has recorded *H. missouriensis* Ewing, as causing irritation of the skin of man in the vicinity of Washington, U.S.A.

¹ Ewing, H. E., U.S. Bur. Entom., "A Gamasid Mite annoying to Man," *Journal of Parasit. Urbana*, June, 1920, No. 4, vol. vi., p. 195.

APPENDIX

A.—MILITARY MITES

DURING the early part of 1917 veterinary officers in the British Expeditionary Force began to refer to acari, other than reputed mange mites which had been found on the horse's skin, as members of a military series. In this way one heard specimens spoken of as Mark I., and so on up to Mark XIII. It was stated that the idea of so naming them arose from the fact that upon the ventral surface of one of them there was a structure which closely resembled the broad arrow, then in common use upon military stores. The following short account is given, in order, where possible, to associate war-time experience with the actual names of these acari. The determinations offered are, unfortunately, not very exact. They have been made from labelled slides, from drawings which have appeared in the veterinary press, and from odd diagrams. In some cases, slides bearing the same Mark number have been found to have mounted upon them different species of acari. This can possibly be explained by imagining that in the original series exact specific characters were lacking, whilst the generic points were emphasised. Kirk's¹ Mark I. appears to be a hypopial nymph of one of the species of the family Tyroglyphidæ. It has been stated that these "finds" were numbered in order of the frequency with which they were encountered. Hypopi were very common in skin-scrapings of horses in the British Expeditionary Force, and a short account of them is given on p. 76. His Mark II. shows a

¹ Kirk, H., "Skin Diseases of the Horse," *Veterinary News*, 1917, vol. xiv., p. 320.

distinct rounded body between the first and second pairs of legs, which may represent the pseudo-stigmatic organ of the family Oribatidæ. These mites feed upon vegetable matter, and are commonly found in lichens, fungi, decaying wood, and under the bark of trees. On the other hand, the structure as depicted does not appear to arise from the dorsum, a point which makes it resemble the clavate organ of the females of the family Tarsonemidæ. The conformation of the third and fourth pairs of legs is in keeping with that of the females of this group. On the whole, and apart from the mouth structures, this Mark somewhat resembles the female of *Tarsonemus spiripex*, which is found upon growing oats. Mark III. possibly represented an allied form. From the structure of the fourth pair of legs, Mark IV. appeared to represent a male of the family Tarsonemidæ (see p. 87). Mark V. apparently belonged to the Tyroglyphidæ; probably it was a female *Aleurobius farinæ* or *Tyroglyphus* (see pp. 69 and 71).

In my experience, adult *Tyroglyphus* was not very prevalent, so that, as it was the fifth commonest find, most likely the former was intended. Mark VI. was, I think, a *Glyciphagus*, possibly *spinipes* (see p. 80). A slide bearing this mark and which I examined contained a mite of this species, and Professor R. Newstead, F.R.S., informs me that his slide with *Glyciphagus ornatus* upon it bore this number also (see p. 83). Mark VII. represented a second type of hypopus of the family Tyroglyphidæ. Mark VIII. was almost certainly *Cheyletus eruditus* (see p. 89); a slide so labelled, examined by myself, turned out to contain this mite, and Kirk¹ says of this number that "it most abounds in forage." It was one of the easiest found acari in mixed forage in France. Mark IX. was stated to be parasitic upon the house-fly, and therefore need not be considered. Mark X. represented a third form of hypopial nymph (Tyroglyphidæ); indeed, the figures examined were very similar to the hypopus of *Tyro-*

¹ *Loc. cit.*, p. 100.

glyphus longior (see p. 73). Mark XI. was stated to be parasitic upon the stable-fly (*Stomoxys calcitrans*) and humble-bee. Mark XII. was from forage dust. Neither of these, therefore, needs further consideration. I have examined a slide bearing *Aleurobius farinæ* which was labelled Mark XIII.

Reference must be made to an unnumbered mite which was said to have been found several times upon the horse's skin, and which was stated to rather resemble the advertisement for Michelin tyres. In the diagrams of this acarus the oval-shaped and annulated body, with only four legs, and these directed forwards at the anterior extremity, showed clearly that it belonged to the second family of the Demodicioidea—viz., the Eriophyidæ (Phytoptidæ) or gall mites. Nalepa¹ states that the typical genus *Eriophyes* contains over 144 certain species and many doubtful ones. They are found in great numbers in the growing buds of numerous trees and plants, where they cause important diseases. Many measure only .2 mm. in length. Their presence upon the horse's skin must, therefore, be due to dissemination from infected trees or plants. It has been said that in the ordinary process of migration the mite assumes a vertical position, and waits till some passing insect or other animal allows it to attach itself for purposes of transportation.

It seems likely that "finds" of mites similar to these are included in the remarks concerning *Achorutes* on p. 104. The poplar-tree, so common in France, harbours *E. populi*. Other prevalent species are *E. ribis* (the black-currant gall mite), *E. piri* (on the pear-tree), and *E. tenuis* (on growing oats).

Apart from the "inflated motor-tyre mite," most of the "Mark" series which have been recorded from the horse have previously received some mention in these notes.

¹ Nalepa, A., "Eriophyidæ (Phytoptidæ)," *Das Tierreich*, Lieferung 4. Berlin, 1898.

B.—INSECTA

Two species of insecta are illustrated in Figs. 67 and 68, chiefly because they may be found during microscopical diagnosis when mange mites are suspected.

Genus *Achorutes* Templeton 1835.

Natural order Collembola.

In material from the ear of a doe rabbit taken for microscopical examination several specimens similar to Fig. 65 and belonging to this genus were found. They were undoubtedly accidental, as they occur



FIG. 67.—ACHORUTES SP. × 140.

From ear of rabbit. Natural order Collembola. Class Insecta.

(*Veterinary Journal.*)

on grass, decaying wood, and in similar situations. Allied species may be found in numerous places where they are likely to become transferred to the skins of horses.

Several members of the profession in France spoke to me of finding organisms of a somewhat similar structure in skin-scrapings of horses affected with mange, but I did not actually come across such an one.



FIG. 68.—LIMOTHRIPS CEREALIMUM. $\times 30$.

Damaged female from the skin of a horse. Natural order
Thysanoptera. Class Insecta.

(*Veterinary Journal*.)

A. viaticus has been found on the dog, and other Collembola insufficiently characterised have been described from the horse as *Podurhippus pityriasicus*.

Limothrips cerealium (Haliday).

Syn.: *Thrips cerealium* Haliday. *T. physapus* Kirby.
Family Thripidae; natural order Thysanoptera
(Fig. 67).

I have encountered parts of this insect several times in skin-scrapings of horses both here and in France. It is rarely one finds a complete specimen—the head and antennæ, portion of a wing, or the last segments of the abdomen are the usual finds. The photograph shows a female which has lost parts of its antennæ, three legs, and a wing in the processes of taking the scraping and boiling in caustic potash solution.

There are a number of Thripidæ which attack our crops. The one under consideration is common in summer and autumn on growing grain, and is thus likely to be found in the sweat and exudations of diseased skins of horses in the proximity of ripening corn. A correspondent informs me that this was noticeably so in the Calais district in the autumn of 1918. It is this species which is seen as a little black line on the perspiring hands and face, where it causes marked irritation by means of the great activity of its legs. Other species which are found in flowers often cause violent sneezing if they enter the nostrils in the inspiratory act of strong sniffing.

C.—TABULAR SUMMARY

Super-families.	Families.	Genera.	Species.	Hosts and Habitats.	
Demodicoidea.	Demodicidæ.	<i>Demodex</i> .	<i>D. folliculorum</i> .	Man.	
			<i>D. canis</i> .	Dog.	
			<i>D. phylloides</i> .	Pig.	
			<i>D. canis</i> var. <i>ovis</i> .	Sheep.	
			<i>D. cati</i> .	Cat.	
	Eriophyidæ.	<i>Eriophyes</i> .	<i>D. capræ</i> .	Goat.	
			<i>D. bovis</i> .	Ox.	
			<i>D. equi</i> .	Horse.	
			<i>E. populi</i> .	Poplar-tree (? horse).	
			<i>S. scabiei</i> .	Man.	
Sarcoptoidea.	Sarcoptidæ.	<i>Sarcoptes</i> .	<i>S. scabiei</i>	Man.	
			<i>S. scabiei crustosæ</i> .	Man.	
			<i>S. equi</i> .	Horse (man, ox).	
			<i>S. bovis</i> .	Ox (man).	
			<i>S. ovis</i> .	Sheep (man, goat, pig).	
			<i>S. capræ</i> .	Goat (man, sheep, ox, pig).	
			<i>S. suis</i> .	Pig (man).	
			<i>S. parvula</i> .	Pig.	
			<i>S. dromedarii</i> .	Camels (man).	
			<i>S. canis</i> .	Dog (man).	
	<i>S. cuniculi</i> .	Rabbit (ferret, guinea-pig).			
				<i>S. hydrochæri</i> .	Ferret.
				<i>S. vulpis</i> .	Fox (man).
				<i>S. leonis</i> .	Lion (man).
				<i>S. aucheniæ</i> .	Llama (man, sheep, horse, alpaca).
<i>S. wombati</i> .				Wombat (man).	
		<i>Notædres</i> .	<i>S. lupi</i> .	Wolf (horse).	
			<i>N. cati</i> .	Cat.	
			<i>N. notædres</i> .	Rat, mouse.	
			<i>N. cuniculi</i> .	Rabbit.	
			<i>C. mutans</i> .	Fowl, pheasant, turkey, guinea-fowl.	
		<i>Cnemidocoptes</i> .	<i>C. gallinæ</i> .	Fowl.	
			<i>C. lavis</i> .	Pigeon.	
			<i>C. phasiani</i> .	Pheasant.	
			<i>C. prolificus</i> .	Goose.	

<i>Super-families.</i>	<i>Families.</i>	<i>Genera.</i>	<i>Species.</i>	<i>Hosts and Habitats.</i>	
Sarcop- toidea. (<i>contd.</i>)	Sarcop- tidæ. (<i>contd.</i>)	} Psoroptes.	<i>P. equi.</i>	Horse, ass, mule.	
			<i>P. hippotis.</i>	Horse, ass, mule.	
			<i>P. bovis.</i>	Ox.	
			<i>P. ovis.</i>	Sheep.	
			<i>P. capræ.</i>	Goat.	
			<i>P. cuniculi.</i>	Rabbit.	
			<i>P. gazellæ.</i>	Gazelle.	
			<i>C. equi.</i>	Horse, ass, mule.	
			<i>C. bovis.</i>	Ox.	
			} Chori- optes.	<i>C. capræ.</i>	Goat.
				<i>C. ovis.</i>	Sheep. ^u
				<i>C. cuniculi.</i>	Rabbit.
			} Otodectes.	<i>O. cynotis.</i>	Dog.
				<i>O. felis.</i>	Cat.
				<i>O. furonis.</i>	Ferret.
} Capa- rimia.	<i>C. setifera.</i>	Hyæna.			
	<i>C. vulpis.</i>	Wolf.			
	<i>C. tripilis.</i>	Hedgehog.			
} Cyto- leichus.	<i>C. nudus.</i>	Fowl, pheasant.			
	} Lamino- sioples.	<i>L. cysticola.</i>	Fowl, turkey.		
		<i>Aleuro- bius.</i>	<i>A. farinæ.</i>	Farinaceous mater- ial, cheese (man, horse, cat, guinea- pig).	
Tyro- glyphidæ.	} Tyro- glyphus.	<i>T. longior.</i>	Farinaceous mater- ial, cheese (man, horse, ox).		
		<i>T. siro.</i>	Farinaceous mater- ial, cheese (man, horse, ox, linnet).		
	} Glyci- phagus.	<i>G. domesticus.</i>	Dead animal and vegetable matter (man, horse, ox, sheep, rabbit, guinea-pig).		
		<i>G. spinipes.</i>	Dead animal and vegetable matter (horse).		
		<i>G. ornatus.</i>	Hay-dust, moss (horse).		
		<i>L. gibbus.</i>	Rabbit.		
} Listro- phoridæ.	<i>Listro- phorus.</i>	<i>L. gibbus.</i>	Rabbit.		
	} Eupo- didæ.	<i>Tydeus.</i>	<i>T. molestus.</i>	Trees, grass (man, dog, cat, poul- try).	
} Tarso- nemidæ.		} <i>Pedicu- loides.</i>	<i>P. ventricosus.</i>	Growing cereals (man, horse).	
	<i>Tarso- nemus.</i>		<i>T. sauli.</i>	Ox, dog, mouse.	
Eupo- doidea.					

MANGE AND ALLIED MITES

<i>Super-families.</i>	<i>Families.</i>	<i>Genera.</i>	<i>Species.</i>	<i>Hosts and Habitats.</i>
Trombidoidca.	Cheyletidæ.	<i>Cheyletus.</i>	<i>C. eruditus.</i>	Hay and farinaceous materials (man, horse, ox, guinea-pig).
		<i>Cheyletiella.</i>	<i>C. parasitivorax.</i>	Rabbit, cat.
	Tetranychidæ.	<i>Tetranychus.</i>	<i>T. molestissimus.</i>	Trees (man, animals).
		<i>Trombidium.</i>	<i>T. telarius.</i> <i>T. sp.</i>	Vine (man). Growing cereals (man, animals).
	Trombididæ.			
Gamasoidea.	Dermanyssidæ.	<i>Dermanyssus.</i>	<i>D. gallinæ.</i>	Fowl, pigeon (horse, man).
		<i>Sternostomum.</i>	<i>D. hirundinis.</i> <i>S. rhinolethrum.</i>	Swallow (ox). Duck.
	Gamasidæ.	<i>Raillietia.</i>	<i>R. auris.</i> <i>? H. sp.</i>	Ox. Beetles and moss (guinea-pig).
		<i>Hyletastes.</i>	<i>H. missouriensis.</i>	(Man).

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