ECONOMIC SERIES No. 6

BRITISH MUSEUM (NATURAL HISTORY)

SPECIES OF
ARACHNIDA AND MYRIOPODA
(SCORPIONS, SPIDERS, MITES, TICKS AND CENTIPEDES)
INJURIOUS TO MAN

BY
STANLEY HIRST
ASSISTANT IN THE DEPARTMENT OF ZOOLOGY

WITH 26 TEXT-FIGURES AND 3 PLATES

LONDON
PRINTED BY ORDER OF THE TRUSTEES
OF THE BRITISH MUSEUM
1917

[PRICE SIXPENCE]

BRITISH MUSEUM (NATURAL HISTORY)
ECONOMIC SERIES No. 6

SPECIES OF ARACHNIDA AND MYRIOPODA

(SCORPIONS, SPIDERS, MITES, TICKS AND CENTIPEDES) INJURIOUS TO MAN

BY
STANLEY HIRST
ASSISTANT IN THE DEPARTMENT OF ZOOLOGY

WITH 26 TEXT-FIGURES AND 3 PLATES

LONDON
PRINTED BY ORDER OF THE TRUSTEES OF THE BRITISH MUSEUM
SOLD AT
THE BRITISH MUSEUM (NATURAL HISTORY), CROMWELL ROAD, S.W. 7.
AND BY
B. QUARITCH, 11, GRAFTON STREET, NEW BOND STREET, W. 1.
AND DULAU & CO., LTD., 37, SOHO SQUARE, W. 1.
1917

LONDON :
PRINTED BY WILLIAM CLOWES AND SONS, LIMITED,
DUKE STREET, STAMFORD STREET, S.E. 1, AND GREAT WINDMILL STREET, W. 1.

PREFACE.

The account which follows has been written by Mr. Stanley Hirst, and it deals with species of Arachnids and Myriopods which are in any way injurious to man. The Myriopods, including the animals known as Centipedes and Millipedes, are relatively unimportant in this respect. The greater part of the description accordingly deals with the Arachnids, animals which can usually, though not always, be distinguished from insects by having four pairs of ordinary walking legs instead of three pairs. This great division of the Arthropoda includes the Itch-mites, which are true parasites; the Scorpions, formidable by reason of the poisonous sting with which the hind end of the body is provided; the Spiders, a few of which are feared on account of their poisonous bite; and the Ticks and Harvest-bugs, one or two forms of which during the operation of sucking the blood of a human victim may introduce into his system the microscopic organisms which give rise to some serious disease, while others cause great irritation by their bites.

The animals here considered have thus a very practical interest, which fully justifies their inclusion in an economic series of publications. It is hoped that the present number will be followed, in due course, by others dealing with Arachnids which are injurious to domestic animals.

Plates I. and II. and text-figures 8, 13, 14, and 15 are reprinted from figures which have already been published elsewhere. The thanks of the Trustees are due to Mr. Walter E. Collinge, Dr. G. A. K. Marshall, and Dr. A. Castellani for permission to make use of these figures.

SIDNEY F. HARMER,

Keeper of Zoology.

British Museum (Natural History),
Cromwell Road, London, S.W. 7.

April 5th, 1917.

CONTENTS.

LIST OF ILLUSTRATIONS.

TEXT-FIGURES.

PLATES.

SPECIES OF
ARACHNIDA AND MYRIOPODA
(SCORPIONS, SPIDERS, MITES, TICKS AND CENTIPEDES)
INJURIOUS TO MAN

By STANLEY HIRST

Assistant in the Department of Zoology, British Museum (Natural History).

Class—ARACHNIDA.

The class Arachnida is one of the principal divisions of the Phylum Arthropoda,* and includes the Scorpions, Spiders, False Scorpions, Harvestmen, Mites, etc. A typical member of the group can be distinguished at a glance from an insect by the presence of four pairs of legs instead of three pairs.

Some of the Arachnida are of great economic importance, especially the large mites, popularly called ticks, which convey several diseases of man and domestic animals. Only the forms noxious to man are dealt with in the present pamphlet, but it is hoped to issue others at a later date on the Acarine parasites of domestic animals.

Order—Scorpiones.

The little black scorpions of the genus *Euscorpius* are common in Southern Europe; their sting is not followed by any very serious

* For the subdivisions of this group and for a general account of the Arachnida and Myriopoda, see the "Guide to the Crustacea, Arachnida, Onychophora and Myriopoda," published by the Museum (1910, price 1s.).

ill effects, being scarcely worse than that of a bee. The sting of the yellow European scorpion (*Buthus occitanus*, Amor.) is very painful, and may cause vomiting, faintness, muscular cramp, etc. Scorpion stings are rarely fatal to adults, but young children frequently succumb to their effects. Deaths due to scorpions have been reported from North and South Africa, West Indies, Mexico, etc. In the Mexican States of Durango and Guerrero many children under six years of age die after being stung by scorpions.

FIG. 1.

The Yellow European Scorpion (*Buthus occitanus*, Amor.).

On account of the number of fatal cases in the City of Durango, the authorities offered a reward for the tails of scorpions killed in that city. It is probable that the effects of the poison of different species differ considerably in virulence, but very little is known on this point. The largest species of scorpions occur in tropical Africa and Asia. The sting of a scorpion usually causes intense local pain, which gradually diminishes in intensity; in bad cases various general symptoms are also present, such as muscular

cramp, profuse perspiration, mental disturbances, fever, vomiting, convulsions, etc.

The poison-glands of a scorpion are paired, and are situated in the last (postanal) segment of the "tail." The latter is jointed and very flexible, and is curved forward over its body by the scorpion when striking. The poison is a clear, slightly acid fluid, apparently very like that of a cobra.

The best treatment for the sting of a scorpion is first to apply a proximal* ligature, and then to make an incision at the point of puncture and wash the wound well with a strong solution of permanganate of potash (or inject the solution).

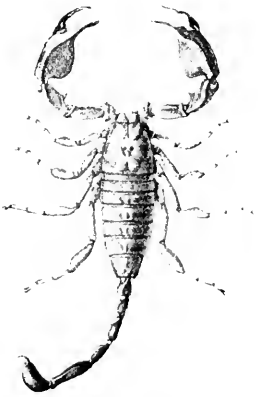


Fig. 2.

Little Black European Scorpion (*Euscorpius italicus*, Herbst). Natural size. After Simon.

Order—Araneae (Spiders).

The Venom of Spiders.

The poison-glands of spiders are paired, being situated in the cephalothorax, or anterior division of the body, in most spiders, but in the basal parts of the chelicerae, or poison-fangs (at the front end of the body), in the large tropical spiders commonly known as *Mygale*, and their allies. The venom flows from an orifice near the end of the fang of the chelicera. As is well known, the poison of spiders has a marked action on their prey, which generally consists of insects of various kinds, causing death or paralysis. Usually it seems to have but slight effect on vertebrate animals. The bite of certain species is reputed, however, to have serious consequences for vertebrate animals, including human beings; and these species are mentioned below. Anyone specially interested in the venom of spiders should consult the valuable works on this subject by Van Hasselt† and Kobert.‡

* *i.e.*, between the part stung and the heart of the patient.

† Tijdschr. Ent. 1896.

‡ Beiträge zur Kenntniss der Giftspinnen, Stuttgart, 1901.

FAMILY—*THERIDIIDAE*.

The members of the family Theridiidae are sedentary spiders, but the web which they construct is never orbicular. The presence of a comb of bristles on the tarsus of the last leg is a feature distinguishing them from the closely allied Argiopidae (Epeiridae).

GENUS—*Latrodectus*, Walckenaer.

Spiders belonging to the genus *Latrodectus* have the reputation in many countries of being dangerous to human beings and other animals; and there is so much independent testimony on this point that it seems highly probable that the bite of certain species of this genus is more venomous than that of other spiders.

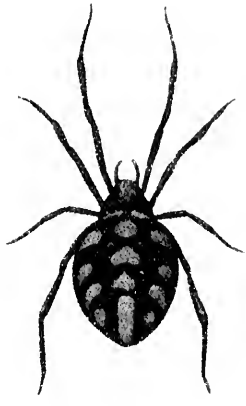


FIG. 3.

Latrodectus tredecimguttatus, Rossi. × 2.

In New Zealand the bite of the Katipo (*Latrodectus hasselti*, var. *katipo*, Powell) is believed to be very poisonous. *Latrodectus mactans*, Fabricius, a species occurring in North America and also in Central and South America, is another species with a bad reputation. The "Malmignatte" (*Latrodectus* 13-*guttatus*, Rossi), a spider which is very common in Southern Europe, has also been accused of being a dangerous species. Bordas states, however, that the effects of its bite are not very serious and cannot cause the death of a human being. He made specimens of the Malmignatte bite his wrist or the ball of his thumb on many occasions, and says that the bite causes redness and slight tumefaction of the skin over an area of about 2–3 centimetres, besides a certain amount of difficulty in moving the fingers, numbness of the palm, stiffness at the articulation of the wrist, violent itching in the region of the punctures, darting pains which disappear at the end of a few hours and return again at intervals, etc. After a few days these symptoms disappear almost completely, and at the end of a week all trace of inflammation has also gone. Dufour, Lucas,

and Eugène Simon state, on the other hand, that the bite of this spider does not produce any ill effects.

Family—*LYCOSIDAE, Etc.*

The Lycosidae or wolf-spiders are hunting spiders, and, with the exception of the Hippaseae, they do not make snares. In this family the eyes are arranged in three rows, an anterior row of four small eyes situated on the frontal slope of the cephalothorax and two posterior rows, each of two large eyes. (*Note.*—The arrangement of the eyes is very similar in the jumping spiders (Salticidae), but, in the latter, the eyes of the front row are large, especially the two middle ones.)

The name "Tarantula" is more correctly applied to *Lycosa tarentula* and its allies (family Lycosidae) than to the *Mygale*-like spiders. It was formerly supposed in Italy that the bite of this spider gave rise to a sickness called tarentism. The chief specific for the malady was music, which incited the victim to dance in a frenzied and violent manner, and to continue the exercise until the outbreak of a profuse perspiration effected the cure by getting rid of the poison.

Segestria perfida, Wlck. (Fam. Dysderidae) and *Chiracanthium nutrix*, Wlck. (Fam. Clubionidae), have also been accused of causing grave symptoms by their bite.

Family—*AVICULARIIDAE.*

The bite of some of the large "Mygale" spiders (the so-called "Tarantulas" which are found in tropical countries) is painful, and sometimes causes considerable inflammation.

An Egyptian species (*Chaetopelma olivacea*), called the "Aboushebat" by the Arabs, is said to be much feared by them owing to the fatal results supposed to be produced by its bite.

The "mygale," or "bird-eating spiders," as they are often called, are allied to the trap-door spiders, and, like them, can easily be recognized by the appearance of their mandibles (*chelicerae*), which project straight forwards, instead of being directed vertically or obliquely, so as to form an angle with the front of the cephalothorax, as is the case in other spiders.

Order Acari.

The Acari or mites are mostly of minute size, and their body is usually unsegmented. There is a great diversity of structure in this order, members belonging to different families often being very dissimilar in general appearance. Perhaps the most characteristic feature of the Acari is that they pass through a six-legged larval stage.

The Acari may be divided into eight principal divisions or orders, which are as follows:

Sub-Orders of Acari.

1. Vermiformia (Family—Demodicidae).
2. Tetrapoda (Family—Eriophyidae).
3. Astigmata (Families—Sarcoptidae, Tyroglyphidae, etc.).
4. Cryptostigmata (Family—Oribatidae).
5. Heterostigmata (Family—Tarsonemidae).
6. Prostigmata (Families—Trombidiidae, Tetranychidae, Cheletidae, Bdellidae, Hydrachnidae, etc.).
7. Mesostigmata (Families—Gamasidae, Spelaeorhynchidae, Holothyridae ?, Argasidae, and Ixodidae).
8. Notostigmata (Family—Opilioacaridae).

Acari and Man.

The species of Acari which are directly injurious to man are not very numerous, the following being the most important: the Rocky Mountain Fever Tick (*Dermacentor venustus*); *Ornithodoros moubata*, the tick transmitting human spirochaetosis in tropical Africa; the Japanese Harvest Bug, called Tsutsugamushi (*Microtrombidium akamushi*), carrier of the Kedani or River Fever of Japan; and the Itch-mite (*Sarcoptes scabiei*, var. *hominis*). A number of species of minor importance are also recorded below.

These species of Acari causing injury to man may be divided into several different categories according to their habits:—

1. *Parasitic species.*—First of all there are two minute mites which are peculiar to man, viz., *Demodex folliculorum* (Fam. Demodicidae) and *Sarcoptes scabiei* (Fam. Sarcoptidae); it is possible that the latter is only a variety of a species occurring on several other animals as well as on man. *Ornithodoros moubata* is another human parasite, man being the principal host of this tick; and this is probably true also of *O. talaje*, but a variety is

found in birds' nests. Many other species of ticks have been recorded as attacking man, including species like *Dermacentor venustus* and *Ixodes ricinus*, which are found on many hosts, and others like *Argas persicus* (the fowl-tick) and *A. reflexus* (the pigeon-tick), which are more restricted in habit. Some of the little blood-sucking mites of the family Gamasidae also sometimes leave their proper hosts and bite human beings, viz., *Dermanyssus gallinae* (parasitic on the domestic fowl, cage-birds, etc.), *Liponyssus bursa* (parasitic on the domestic fowl), *L. bacoti* (parasitic on the brown rat), and a few others.

2. *Species parasitic during only part of their life* (the "harvest bugs").—It is only during the larval stage that the species of *Microtrombidium* and other similar forms suck blood. The adult mites are predatory, feeding on minute insects, etc.

3. *Predatory species which occasionally become parasitic.*—*Pediculoides ventricosus* can be placed here. Although normally feeding on the larvae of various insects, this species can transfer itself to man, causing serious trouble. The species might more properly be considered to be a parasite rather than a predaceous form, for it is very minute as compared with the bulk of the larva it feeds upon, and the latter only succumbs if attacked by a number of the mites.

4. *Species, normally feeding on detritus, which may become parasitic.*—The species belonging to the family Tyroglyphidae feed on decaying vegetable or animal matter, but a number of them are occasionally parasitic.

5. *Poisonous species.*—*Holothyrus coccinella*, a mite which secretes an irritant poisonous fluid.

The more important human parasites are given below in their proper systematic order.

Sub-Order—VERMIFORMIA.

Family—*DEMODICIDAE.*

Genus—*Demodex*, Owen.

Demodex folliculorum, G. Simon.

In general appearance the mites of the genus *Demodex* are rather like gall-mites (Eriophyidae), but have four pairs of very short legs, instead of only two pairs as in that family. They are

very minute (length of female of *D. folliculorum* 380 μ *), and the body is elongated, giving the mite a rather worm-like appearance, the posterior part of it being transversely striated (annulated). *Demodex folliculorum*, Simon, lives in the sebaceous glands of man, and is a very common parasite, being found in the skins of a large proportion of the human race. The anterior part of the dorsal surface is about a third of the total length of the body in this species of *Demodex* parasitic in human beings, and the egg is heart-shaped. The mite does not usually give rise to any skin-disease, and, owing to this fact and to its minute size, it is not noticed unless specially looked for. Hence many people harbour this parasite without being aware of it. Specimens can often be obtained by squeezing out the contents of black-heads (due to acne) on the face, and examining the material thus obtained under the microscope. Sometimes also they can be found in wax from the ear. According to Borrel, mites belonging to this species are especially abundant in cancerous lesions of the skin, and he also suggests that the germs of leprosy may perhaps be carried from a person suffering from this disease to a healthy individual by this mite. Lefebvre states, however, that the idea that *Demodex* is an active propagator of leprosy must be abandoned. Besides the human species, other species of *Demodex* occur in various animals; that of the dog is the cause of the serious disease called follicular or demodic mange.

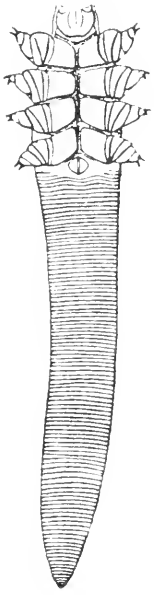


FIG. 4.

Demodex folliculorum, G. Simon. Greatly magnified. (After Berlese.)

Demodex caninus, Tulk.

A case of *Demodex caninus* affecting human beings has been recorded by Zürn, and another rather doubtful case by Babès in 1902. Lewandowsky has described a skin-eruption occurring in several patches on the face of an Italian workman in 1906. He found numerous examples of a *Demodex* in the affected parts of the skin; judging from the proportions of its body and the spindle-shaped eggs, he points out that it must be *D. caninus*.

* μ = one thousandth of a millimetre.

Instances of this kind are, however, very rare, and Neumann says that persons attending to dogs suffering from demodic mange do not contract the complaint even if no precautions are taken. Moreover, several experimenters have attempted to transmit this parasite from dogs to human beings, without result. It is exceedingly difficult, however, to transmit *Demodex caninus* from diseased to healthy dogs.

Demodex equi, Railliet.

Gaston Urbain has recently described a case in which *Demodex equi* is supposed to have been transmitted to a human being in Brazil, but the evidence which he gives on this point is far from conclusive.

Sub-Order—ASTIGMATA.

Minute whitish or pale mites, without tracheae or stigmata. The mandibles are chelate and the palpi short. These mites are mostly oval in shape and convex dorsally. The Sarcoptidae (Itch Mites) and Tyroglyphidae (Cheese Mites, etc.) are placed in this suborder, which also contains the Feather Mites (Analgesidae), and one or two other families.

Family—*SARCOPTIDAE*.

Sarcoptes scabiei, L.

The Itch-Mite.

Owing to the troublesome nature of the skin-complaint of which it is the cause, the Itch-mite has attracted a good deal of attention. The disease due to this parasite can be recognized by the presence of the gallery or furrow which it constructs in the skin. This gallery is rarely straight, being usually irregular and sinuous, and varies in length, but may measure up to half an inch or even more. It is sometimes very difficult to see in clean people, but if a little ink is applied to the skin it runs in and helps to show its track. Each of the galleries contains a single adult female mite, and usually also a number of eggs in various stages of development, as well as numerous little black points which are the excrement of the Acarus (Fig. 5). Conical pustules, which are another feature of this disease, are often present above the furrows, but the parasite is never found in them; these pustules are apparently caused by an irritant poison secreted by the *Sarcoptes*.

The mite is found at the extreme end of the burrow, and if this is slit open with a fine needle the parasite can often be extracted without any difficulty, owing to the fact that it is apt to cling to the point of the needle by the suckers of its feet.

The Itch-mite is very minute, appearing to the naked eye as a tiny whitish speck. The female is 330–450 μ in length. If

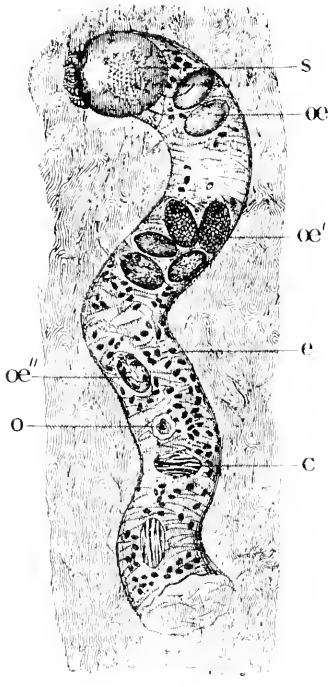


FIG. 5.

Sarcoptes scabiei. s. Adult female at end of gallery. œ, œ′, œ,″ Eggs in various stages of development. c, Empty egg shells. o, Opening through which a larva has escaped. e, Excrement. (From Railliet, partly after Gerlach.)

examined under a moderately high power of the microscope it is seen to be shaped rather like a tortoise, the upper surface being convex and the legs short, the posterior ones ending in long bristles. Numerous denticles and some symmetrically placed processes are present on the upper surface. The period of incubation of the egg seems to be from four to eight days. As is usual

in Acari, the larval stage has only six legs instead of eight when it leaves the egg. After undergoing several moults it changes into a nymphal form with eight legs, but differing from the adult in the absence of sexual organs, and finally it passes into the adult stage. The male is considerably smaller than the female and does not make a tunnel, but hides just beneath the skin. Itch * is especially troublesome at night, and may render sleep impossible. This complaint is easily cured by proper treatment. The parts affected should be well scrubbed with soap and hot water, and sulphur ointment applied at intervals for several days. Blankets and underclothes used by the patient should be well washed, and other garments baked in a hot oven.

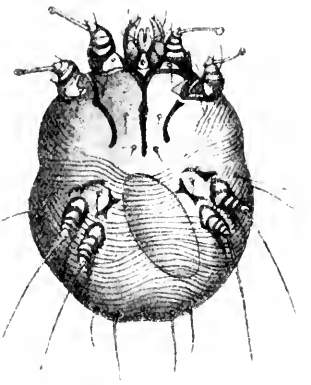


Fig. 6.

Sarcoptes scabiei, the itch mite. × 100. (After Canestrini.)

A remarkable case of skin-complaint caused by the Itch-mite in Indiana (United States) is described by Dr. Robert Hessler in the "American Naturalist" for April 1893. The patient was a middle-aged white man, and partly paralysed. "His entire body was covered with thick, yellowish-white, leathery scales, the largest measuring over one inch in diameter, and over one-tenth inch in thickness. He was literally covered with scales, like a fish. . . . (these scales were not crusts or scabs, they were epithelial proliferations)." Itch-mites and their eggs were found in extraordinary numbers in the scales; Dr. Hessler estimates the number

* Itch has been a source of considerable trouble in the present war amongst the British troops in France, sometimes occurring in a very tenacious form, with a tendency to relapse, even after very thorough sulphur treatment. It was thought that this trouble was due to the *Sarcoptes* of the horse, but specimens have every appearance of belonging to the human variety of the parasite, the dorsal scales being distinctly longer as compared with their breadth than in *Sarcoptes scabiei* var. *equi*.

of the parasites as about two millions, not including ova. Parasites are well known to attack sickly animals in larger numbers than usual, and this case seems to be merely an exaggerated instance of this kind.

A much more serious kind of itch, fortunately of rare occurrence, has been found in Norway and several other parts of Europe. It is characterised by the presence of white or yellowish crusts, which make their appearance on the hands and arms or on the feet, afterwards spreading to other parts of the body. Mites closely resembling those of ordinary itch occur in large numbers in these thick crusts. Norwegian itch, as it is called, is difficult to cure, vigorous and prolonged treatment being necessary in eradicating it. Fürstenberg considered the mite that causes it to be a sub-species or variety of the Itch-mite, and described it as *Sarcoptes scabiei crustosae*.

Varieties of *Sarcoptes scabiei* are found on various domestic and wild animals, and those of the horse, goat, pig, dog, and others sometimes transfer themselves to man when given the opportunity. The itch-parasite of cats belongs to the genus *Notoedrus* (*N. cati*, Hering), the species of which have the anal opening placed well on the upper surface of the body. Other species of the genus *Notoedrus* live in the skin of the rabbit (*N. cuniculi*, Gerl.), in the rat (*N. muris*, Mégnin), and in the mouse (*N. musculi*, Oudemans); those of the cat and rabbit are communicable to man, causing a transient eruption.

GENUS—*Cytoleichus*, Mégnin.

Whilst performing a postmortem on the body of a negro in Uganda, Castellani found two specimens of an Acarid parasite deeply imbedded in the fat of the omentum. They were dark yellowish in colour, the body being oval and furnished with six legs (his figure shows eight). This parasite is said by Castellani to bear a strong resemblance to *Cytoleichus sarcoptoides*, Mégn. (= *Cytodites nudus*, Vizioli), an internal parasite of the domestic fowl, and the drawing which he gives in his note certainly looks very like that species.

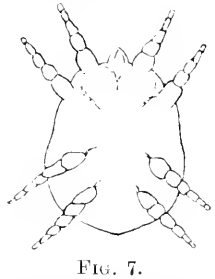


FIG. 7.

Cytoleichus hominis: an acarid parasite found by Castellani in the body of a negro in Uganda. (After Castellani.)

The palpi were very short; the

legs composed of five segments and apparently without hairs. The total length of the body was ·55 mm. I propose the name *hominis* for this species of *Cytoleichus*.

Another species (*C. banksi*) has recently been discovered by Wellman on squirrels in California.

GENUS—*Chorioptes*, Gerv.

Chorioptes bovis, Gerlach.

Chorioptes bovis is a parasite causing a localized skin-disease in cattle, but this complaint is not very grave and extends but slowly.

Most authorities are of opinion that this mite does not attack man, but Zürn states that he has found it on the head of a man affected with alopecia.

GENUS—*Psoroptes*, Gervais.

The mites of the genus *Psoroptes* can easily be recognized by the long three-jointed pedicel of the tarsi. They are the cause of Psoroptic Mange in cattle, horses, sheep, etc.

Leslie Linzell, of the Divisional Veterinary Hospital at St. Albans, who has spent much time in studying parasitic mange in horses and is well acquainted with the different species of Acari infesting these animals, informs me that he has been attacked more than once by the *Psoroptes* of the horse (*P. equi*, Hering) whilst attending to horses suffering from the mange caused by this species of mite. The irritation set up by the bite of *Psoroptes equi* was severe, but transient in nature, for all the ill effects had disappeared the day after the attack.

It is stated by most authorities, however, that *P. equi* only attacks the horse, ass and mule, and cannot be transmitted to other animals.

FAMILY—*TYROGLYPHIDAE*.

The Tyroglyphid mites are minute soft-bodied species; the cheese-mite (*Tyroglyphus siro*, Linnaeus) and the flour-mite (*Aleurobius farinae*, De Geer) are familiar examples of this family. These mites are closely allied to the Sarcoptidae, and, like the Acari of that family, they are without tracheae or stigmata.

Mites of the genus *Glycyphagus* sometimes swarm in raw sugar, and formerly grocers and others handling this product used to be troubled by a slight irritation of the skin caused by the mites.

This complaint is called "Grocers' Itch" by Murray in his text-book on Economic Entomology. Mr. C. E. Sage, consulting chemist, assures me that he has examined and mounted as microscopical preparations specimens of Tyroglyphid mites found causing skin-trouble in persons handling raw sugar in London. This complaint seems to have disappeared now that only refined sugar is dealt with by grocers. Copra Itch is the name given by Castellani to a very similar complaint which he discovered amongst workers in copra mills in Ceylon, and it has been subsequently

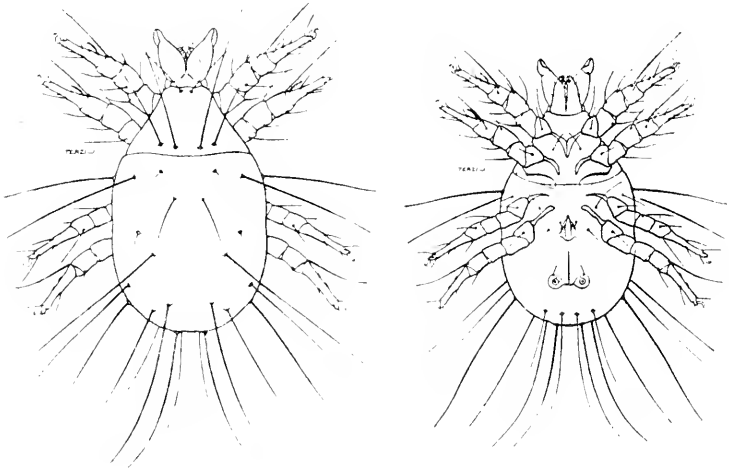


FIG. 8.

Tyroglyphus longior var. *castellanii* Hirst. ♂, dorsal and ventral aspects; the Acarus causing "Copra Itch," much enlarged.

met with in London. A minute mite (*Tyroglyphus longior*, var. *castellanii*, Hirst) is very abundant in copra dust, and it has been proved by experiment that it originates this itch.

Galli-Valerio has found mites of the genus *Glycyphagus* in hay and straw from Aigle, Switzerland, causing itch in soldiers who came in contact with it. Cases of this kind of itch have also been observed by this author amongst alpine climbers who slept on hay infested with *Glycyphagus*.

A species of *Tyroglyphus* has been observed by Lefebvre to cause suppurative dermatitis in lepers at Manila, in the Philippines. He

says that mites of this genus often make their appearance in cases of sores of long standing, ulcers, etc., especially in lepers, but do not convey the disease.

One or more species of *Tyroglyphus* are occasionally found in vanilla, and are said to set up a skin-complaint called "Vanillisme" in persons coming in contact with this substance.

Rhizoglyphus parasiticus, Dalgetty, is stated by that author to be the causative agent of a superficial vesicular dermatitis known under the name "Water Itch," occurring during the wet seasons of the year amongst coolies employed in tea-gardens in Assam. Coolies who are already in a state of ill-health are the persons chiefly affected by this disease, and it only attacks the feet. The disease does not appear in tea-plantations until they are several years old and have become thoroughly contaminated with human excrement and other refuse. According to Dalgetty, both ova and mites are found in the pustules characteristic of the disease. The best means of preventing this disease is for the coolies to wear shoes. It should be noted that the European species of *Rhizoglyphus* are vegetable feeders, attacking bulbs, the roots of plants, etc.

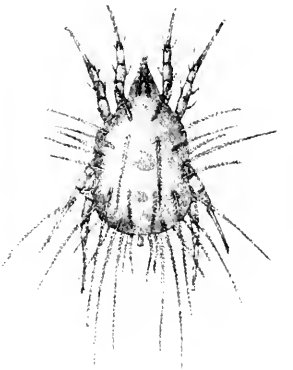


FIG. 9.

House-mite, *Glycyphagus domesticus*, × 50. (After Michael.)

In 1864 Bogdanoff described and figured a mite under the name *Dermatophagoides scheremetewskyi*. He says that this Acarus was found by Schérémétewsky more than twenty times on the skin of persons suffering from itch at Moscow. In his well-known treatise on Medical and Agricultural Zoology, Railliet regards this mite as being the same as *Chorioptes bovis*, Gerl., but it is more probable that it is a Tyroglyphid mite.

According to Brumpt, Ludwig found numerous specimens of *Histiogaster entomophagus*, Laboulbène, in a digital tumour.

Specimens of a Tyroglyphid mite were also discovered by Moriggia, in 1866, in a large horny growth on the hand of an old

woman who died in a hospital at Turin. The material examined by him had been preserved for about three months, and it is quite probable that the mites made their way into the preserved material.

Sub-Order—HETEROSTIGMATA.

Family—*TARSONEMIDAE.*

This isolated family contains a few genera of minute soft-bodied mites, and its exact systematic position is still uncertain. They are placed by Berlese in a sub-order by themselves. The body of these mites often shows traces of segmentation, and there is a clavate organ between the first two pairs of legs. Sexual dimorphism is well pronounced.

Genus—*Pediculoides*, Targioni-Tozzetti.

Pediculoides ventricosus, Newport.

The Mite Causing Grain-Itch.

The curious mite called *Pediculoides ventricosus* is carnivorous, feeding on various soft-bodied larvae, and more rarely on adult insects. This mite readily transfers itself to human beings, and causes a serious eruption of the skin. It has been reported as attacking porters and others handling grain infested by the Wheat Joint Worm or other insect pests in many parts of Europe. In December 1913 the cargoes of several steamers which had brought consignments of cotton-seed from Alexandria to London were found to be infested with large numbers of *Pediculoides ventricosus* feeding on the pink boll-worm. The dock labourers unloading this cotton-seed were much troubled by the bites of the mite, which caused a red rash to appear on their bodies. It was necessary to pay them 50 per cent. more than the usual wage for discharging these cargoes. I remember Colonel Alcock telling me at the time of this outbreak that some of the dockers going home infected their wives and children, who were also badly bitten by the mites. According to Willcocks, who has written an account of this particular case, workers at the Colchester Oil Mill handling cotton-seed received from Alexandria at much the same date were

also annoyed by the *Pediculoides*. Willcocks records this mite as occurring at several localities in Egypt. It has also been found attacking soldiers handling stored barley in Algeria. There are specimens in the British Museum from Nyasaland.

In Philadelphia many cases of dermatitis due to this mite have occurred over a period of several years, usually during the months of May and October. The disease in this locality was carefully studied by Schamberg and Golberger, who detected the presence of the mite in straw mattresses slept upon by the patients.

Webster states that there was an epidemic of dermatitis due

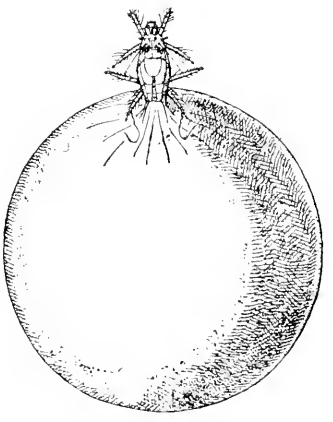


FIG. 10.

Pediculoides ventricosus (Newport), gravid female; the mite causing Grain-Itch, much enlarged. (After Banks.)

to *Pediculoides* in Ohio and other Western States of America in the year 1908, persons engaged in threshing grain or using the straw for mattresses or packing having been badly affected.

GENUS—*Tarsonemus*, Canestrini and Fanzago.

Specimens of *Tarsonemus* have been found in cancerous tissues taken from man and several domestic animals and preserved in alcohol. Dahl and Saul, believing them to be the cause of cancer, described these specimens of *Tarsonemus* under several specific

names (*T. hominis*, Dahl, *T. canis*, Saul, etc.). Probably these mites were introduced into the preserved tissues by accident.

Nephrophagus sanguinarius, Miyake and Scriba, is the name given to a mite found dead day after day for a week or more in the urine of a Japanese. Judging from the published figure of the male it is very closely allied to *Pediculoides* or *Tarsonemus*.

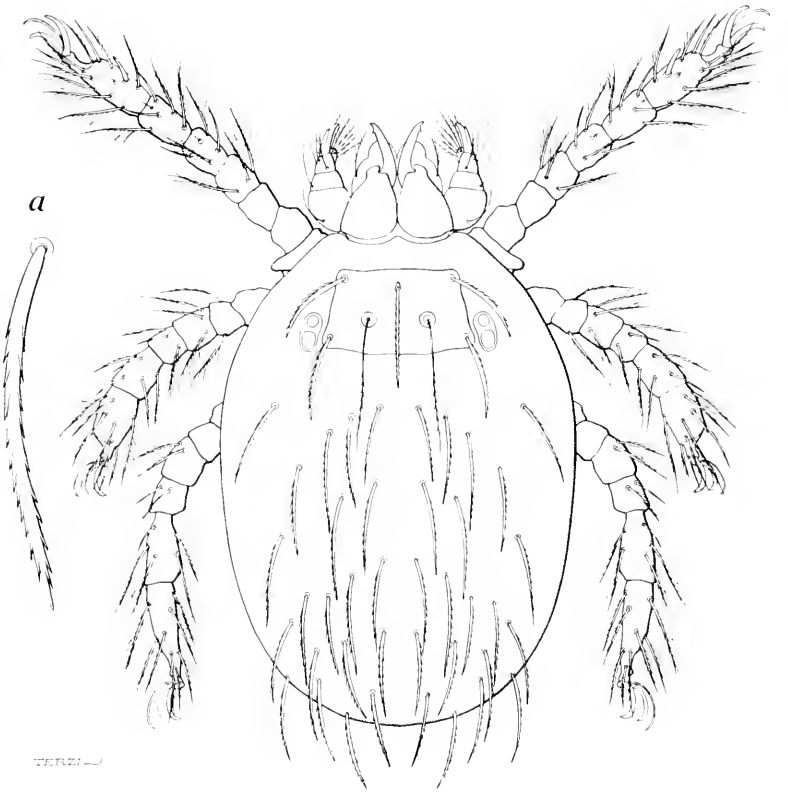
Sub-Order—PROSTIGMATA.

In these mites the stigmata are situated at the anterior end of the body near the mandibles, hence the name Prostigmata. The mites belonging to this sub-order present great diversity both of structure and habits. They include the Spinning Mites (Tetranychidae), the Snouted Mites (Bdellidae), the Velvet or Harvest Mites (Trombidiidae), etc.

Family *TROMBIDIIDAE*.

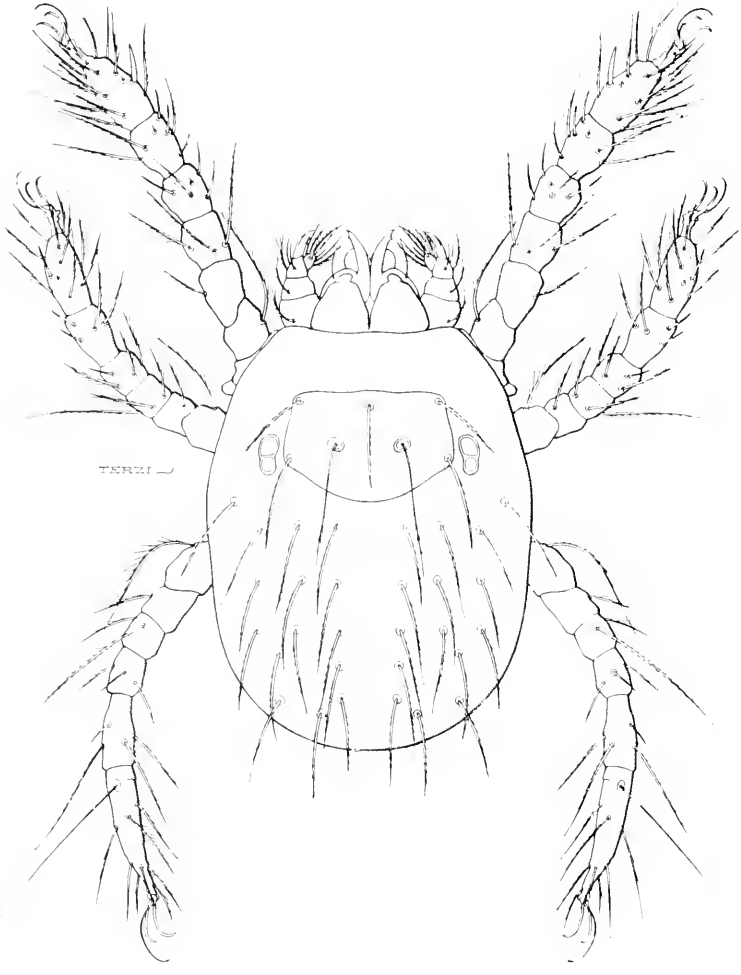
When adult, the Velvet Mites—or Harvest Mites, as they are often called—are predaceous, feeding on various insects, etc. The last joint of the palp is in the form of a thumb or appendage, being usually club-shaped. Eyes are present in this family.

Owing to the fact that the Kedani Fever of Japan is conveyed by one of their number, the larval mites of the family Trombidiidae, commonly called harvest bugs, are of special interest. Only in a very few cases is their parentage known with certainty, hence it is necessary to give separate specific names to these larval stages in order to distinguish them from one another. A great many of the larval forms have been fully described and figured by the celebrated acarologist Dr. A. C. Oudemans, of Arnhem. They attack insects and other arthropods, and also birds, small mammals, etc. The Kedani or River Fever of Japan is a complaint induced by the bite of the harvest bug known under the names Tsutsugamushi or Akamushi (*Microtrombidium akamushi*, Brumpt). This disease is peculiar to certain areas along the banks of rivers in the Echigo and Akita Provinces of the main island of Hondo (Nippon), and is very fatal, the mortality averaging about 27 per cent. of the persons affected. The Tsutsugamushi are found in the ears of field-mice, and evidently transfer themselves to human beings, thus transmitting the disease. Dr. Miyajima has shown that Kedani Fever can be transmitted to monkeys by the bite of the



The Japanese "Harvest Bug," called Tsutsugamushi or Akamushi (*Microtrombidium akamushi*, Brumpt), carrier of the Kedani or River Fever. *a*—one of the dorsal hairs. Greatly enlarged.

[*To face p.* 24.]



The "Harvest Bug" (*Microtrombidium autumnale*, Shaw).
Greatly enlarged.

[*To face p.* 25.]

mite and also by inoculation. The causative organism is not yet known with certainty. Larval forms closely resembling the one which conveys the disease are parasitic on small mammals in other uninfected districts in Japan, but their bite does not give rise to any fever. It has been suggested by Ashburn and Craig that this disease exists in the Philippines, and according to Dr. Schüffner a very similar complaint occurs at Deli, Sumatra; he gives photographs of a larval Trombidiid which may perhaps transmit the disease, but it is possible that it is conveyed by a true tick (Ixodidae).

In France two or even three different larval forms belonging to this group (*Microtrombidium autumnale*, Shaw; *Metatrombidium poriceps*, Oudemans; and perhaps also *Trombidium striaticeps*, Oudemans) attack human beings during the hot and dry months of the year. So far, only one of these species, *Microtrombidium autumnale*, Shaw, popularly known as the "harvest bug," has been found in Great Britain. It fixes itself at the base of a hair on the limbs or body, and its bite gives rise to great irritation, which may last for days if not attended to, sometimes even causing insomnia. If a little ammonia is applied to the wound it soon alleviates the pain, however. Gilbert White gives the following graphic account of this Acarus in his "Natural History of Selborne":—"There is an insect with us, especially on chalky districts, which is very troublesome and teasing all the latter end of the summer, getting into people's skins, especially those of women and children, and raising tumours which itch intolerably. This animal (which we call an harvest bug) is very minute, scarce discernible to the naked eye: of a bright scarlet colour, and of the genus of acarus. They are met with in gardens on kidneybeans, or any legumens: but prevail only in the hot months of summer. Warreners, as some have assured me, are much infested by them on chalky downs; where these insects swarm sometimes to so infinite a degree as to discolour their nets, and to give them a reddish cast, while the men are so bitten as to be thrown into fevers."

In North America these larval Trombidiid mites are called Jiggers or Red Bugs (*Leptus* = *Microtrombidium? americanus*, Riley, and *L. irritans*, Riley); Mr. Nathan Banks states that they are a source of great annoyance in parts of the Southern States.

Theobald recommends oil of citronnelle applied to the limbs before walking as a preventive against harvest bugs.

Another preventive is flowers of sulphur rubbed over the legs

and ankles, or into the underclothes and stockings from the knees downwards. A bath in hot water, or water containing salt or strong soap, should be taken within a few hours after walking in places likely to be infested with the mites. Chittenden, from whose pamphlet the advice given above is taken, has pointed out that sheep grazing in infested tracts of land destroy the harvest bugs.

The earliest known of these harvest bugs attacking man is the *Acarus hatatus* of Linnaeus, the habitat of which is Surinam, Dutch Guiana. Dr. Oudemans has given the name *Microtrombidium wichmanni* to the larval form assailing human beings in New Guinea and Celebes, and he has described another form with similar habits also occurring in New Guinea under the name *Schöngastia vandersandei*. Harvest bugs occur in practically every part of the world, and the more annoying kinds have been given popular names; for instance, the "Bête Rouge" of some parts of South America, the "Bicho Colorado" (*Microtrombidium ? molestissimum*, Weyenberg) of the Argentine Republic, the Mexican "Tlalzahuatl," the "Gonone" of Celebes and neighbouring islands, and others. The following extracts from various sources will serve to give an idea of the trouble caused by these Acari in tropical regions.

In their well-known Introduction to Entomology Kirby and Spence quote the following observation by Lindley: "A similar insect is found in Brazil, abounding in the rainy season, particularly during the gleams of sunshine, or fine days that intervene, as small as a point, and moving very fast. These animals get upon the linen and cover it in a moment; afterwards they insinuate themselves into the skin and occasion a most intolerable itching. They are with difficulty extracted, and leave behind them large livid tumours, which subside in a day or two. An insect very tormenting to the wood-cutters and the settlers on the Mosquito shore and the bay of Honduras, and called by them *the doctor*, is thought to be synonymous with this."

Alfred Russel Wallace makes the following remarks about one of these harvest bugs in his work on the Malay Archipelago: "All the time I had been in Ceram I had suffered much from the irritating bites of an invisible acarus, which is worse than mosquitoes, ants, and every other pest, because it is impossible to guard against them. This last journey in the forest left me covered from head to foot with inflamed lumps, which, after my return to Amboyna, produced a serious disease, confining me to

the house for nearly two months—a not very pleasant memento of my first visit to Ceram . . ."

The following details are selected from an account by Mr. S. W. Jackson of the attacks of these Acarids in the Tinaroo shrubs near Atherton, North Queensland, 1908: "October 31. In patient silence we waited, enduring absolute torture from the bites of the red scrub animalcule (*Leptus* sp.), irritating parasites that can give points to all ticks, sand-flies and mosquitoes in the world." "November 2.—The scrub-itch mites, tiny red parasites hardly visible to the naked eye, punished me severely again to-day; they mostly attack the legs below the knees, and quickly reduce them to a raw state of intense irritation, which was bad enough to make sleep quite impossible, and I found on enquiry that the aboriginals suffer to a similar degree."

And in his "Wanderings in South America" Waterton says, in explaining the word Bête Rouge: "This horrible little pest much resembles our harvest bug in colour, size and habits. It is a minute species of tick belonging to the genus *Leptus*, and causes the most violent irritation when it attacks a human being . . ."

Family—*CHELETIDAE.*

Three specimens of a Cheletid mite (*Acaropsis mericourti*, Laboulbène) were found by Leroy de Mérieourt in pus from the ear of a sailor. It is probable that the occurrence of this mite in the pus was only accidental, for the mites of the genera *Acaropsis* and *Cheletus* are predatory forms, feeding on other minute mites, etc. The typical members of this family have greatly enlarged subchelate palps, which are used for seizing their prey.

Family—*TETRANYCHIDAE.*

It is to this family that the forms called "red spider" by horticulturists belong. The Tetranychidae or spinning mites are very injurious to cultivated plants. The mandibles are styliform in the Acari of this family.

Genus—*Tetranychus*, Dufour.

A mite of the genus *Tetranychus* (*T. telarius*, var. *russeolus*, Koch) found on Plane Trees in Paris is accused by Artault of being troublesome to human beings. Workers trimming the

Plane Tree or gathering up the branches which have been lopped off and children playing with the latter are said to complain of itching places on the arms and neck, apparently caused by the mite. It is possible that Artault is mistaken in thinking that this trouble is due to the mite, for the species of *Tetranychus* normally only attack vegetation.

FAMILY—*BDELLIDAE*.

GENUS—*Tydeus*, Koch.

The mites of the genus *Tydeus* are small soft-bodied forms, and are predatory in habit.

Tydeus molestus, Moniez (Fig. 11), was reported as occurring during many years in the gardens of a large farm in Belgium, not far from Ath. It is alleged that this mite was imported in guano from Peru. At first it was met with only in one spot, but afterwards increased greatly in numbers and invaded the entire garden of the farm. Human beings were attacked by this species, its bites causing insupportable itching, and it was also found on dogs, cats, poultry, etc.

FIG. 11.
Tydeus molestus, Moniez.
(After Moniez.)

SUB-ORDER—MESOSTIGMATA.

FAMILY—*PARASITIDAE* (Gamasidae).

The mites of the family Parasitidae (Gamasidae) are closely allied to the ticks, but are usually very much smaller in size. Their body is furnished with tough chitinous plates. The majority of these Acari are free-living forms, but some of them are true parasites. A large number of species are found on rodents and in their nests, others on birds, and a few on reptiles.

The mandibles of the predatory species are in the form of

pincers, both fingers being well developed and armed with teeth. In the genus *Liponyssus*, most of the species of which are parasitic on small mammals, and a few on birds and reptiles, the fingers are usually devoid of teeth, and they have become attenuated and sharply pointed, being much more suitable for cutting through the skin of the host. The species of *Dermanyssus* are few in number, and are parasitic on birds and mammals; in this genus the mandibles are still further transformed, the two fingers being fused together to form a very long fine style for piercing the skin.

Some of the Gamasid mites belonging to the genera *Dermanyssus* and *Liponyssus* occasionally become temporary parasites

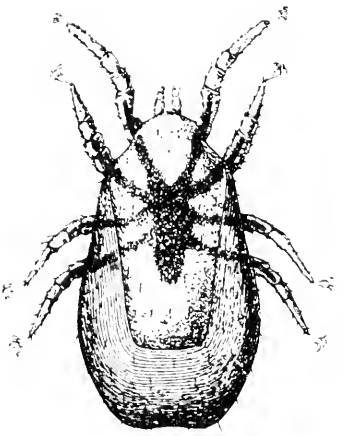


Fig. 12.

Dermanyssus gallinae, Redi. Parasitic on poultry, cage birds, etc., and sometimes attacking human beings. Female, much enlarged. (After Berlese.)

of man. The well-known red mite of birds (*Dermanyssus gallinae*, Redi), which is nocturnal, sucking the blood of fowls, cage-birds, swallows, and other birds, is perhaps the principal offender, sometimes attacking persons looking after poultry, and others, and may set up strong pruritus by its bites.

Dermanyssus hirundinis, which is also accused of attacking human beings, is at most only a variety of *D. gallinae*.

Three species of *Dermanyssus* occur on the rodents found in human habitations in Egypt, and one of them (*D. muris*, Hirst),

a parasite of the black rat (*Rattus rattus*), is also widely distributed in the East. These species of *Dermanyssus* found on rodents have only recently been discovered, and are not yet known to bite human beings, but the possibility of their doing so should be borne in mind.

Bird-mites (presumably *D. gallinae*) have been proved by Mayer to transmit spirochaetosis (*Spirochaeta gallinarum*) in canaries, but it is not certain whether infection is due to the bites of the Acari or to their being swallowed by the birds.

Andrew Balfour found blood-parasites (*Haemogregarina jaculi*) in blood from the alimentary canal of mites of the genus

FIG. 13.

Dermanyssus aegyptius, Hirst. Sketch of the front end of the body of the female, showing the mandibles in situ. Greatly enlarged.

Dermanyssus occurring on jerboas at Khartoum. He suggests that the mite may be found to serve as an intermediate host for this blood-parasite. Dr. Balfour thought that the mite in question was *D. gallinae*, but it is more likely to be one of the species peculiar to rodents.

Another species of fowl-mite (*Liponyssus bursa*, Berlese) occurs in many tropical countries, and has been discovered on human beings at Zanzibar. A specimen of this fowl-mite was found by Dr. H. L. Howell, R.A.M.C., at Ahmednagar, Deccan, India, on a lady suffering from "very bad irritation of the skin" alleged to be caused by the mite. "It raised small red lumps with white tops,

and looked as if the insects burrowed; irritation was intense even for days after the bite."

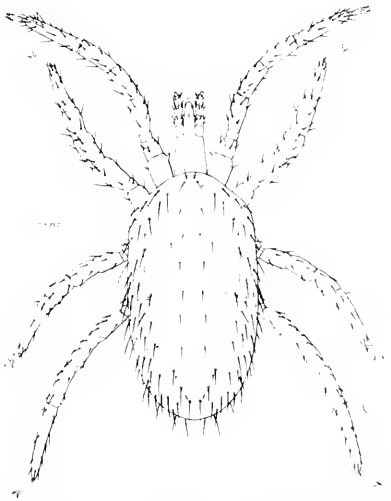


FIG. 14.—A tropical fowl mite (*Liponyssus bursa*, Berlese), occasionally biting human beings. Much enlarged.

Liponyssus bursa has also been found biting human beings at Cremorne, Sydney. Dr. Burton Cleland gives the following

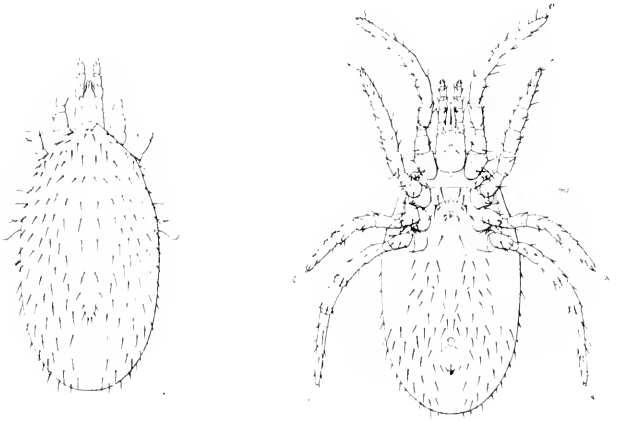


FIG. 15.—*Liponyssus bacoti*, Hirst. An acarine parasite of the brown rat, biting human beings in Australia. Dorsal and ventral aspects.

account of this species:—"In Sydney, it has been reported that in some cases where English starlings have built in the roof the dwellers in the house have suffered much irritation from mites introduced by the birds. In one case, in a church, it is said that the roof had to be renovated on account of the annoyance caused by these creatures." Specimens of *Liponyssus bursa* found biting human beings at Sydney and the other two localities recorded above are preserved in the collection of the British Museum (Natural History).

A species of *Liponyssus* (*L. bacoti*, Hirst) is parasitic on the brown rat (*Rattus norvegicus*), and, as might be expected, this mite has a very wide distribution. It has been recorded as attacking human beings at Sydney, Adelaide, Perth, and Fremantle in Australia.

Family *HOLOTHYRIDAE*.

The mites belonging to the genus *Holothyrus* are globular or ovate in shape and hard-skinned. They are red in colour and of rather large size, the body measuring up to 6½mm. in length. Very little is known about their habits, and their precise systematic position is still in dispute. These Acari are found in Ceylon, Mauritius, the Seychelles and other islands of the Indian Ocean, and also in New Guinea. Several cases of poisoning due to these mites have occurred in the island of Mauritius, the principal symptoms being grave inflammation of the mucous membrane of the mouth and pharynx. These cases are chiefly found amongst children, who are affected by touching the mouth with their hands after having meddled with these mites. Apparently the Acarus secretes an irritant fluid, which is the source of the trouble. It is said to be impossible to keep ducks or geese in certain parts of Mauritius, where the *Holothyrus* occurs in great numbers. Mr. Green, the well-known Ceylon entomologist, accidentally touched his tongue with a finger about five hours after handling one of these mites. He says: "Immediately an extraordinarily pungent, galvanic sensation or taste commenced rapidly to spread over my mouth, quickly reaching my throat. Rinsing my mouth and gargling with hot water failed to arrest the progress of the sensation, which was accompanied with excessive salivation. The unpleasantness lasted for several hours, and then died away without any further conse-

quences. . . . . I afterwards tested the insect [the mite], and found it to be the real agent. The experiment was repeated at my suggestion by a medical friend—Dr. R. J. Drummond—who can testify to the result. He described the sensation as somewhat like that produced by the strongest menthol. We both noticed that it had a numbing effect upon the mucous membrane of the mouth. It is evident that this property must be a very efficient protection to the insect. The rapidity with which the secretion acts would cause it to be very quickly ejected if picked up by either a bird or a lizard—the only enemies that would be likely to attack it." Possibly the red colour of these mites is a case of warning coloration.

Super-Family—IXODOIDEA.

Key to the Genera of Ticks (Ixodoidea).

1	No dorsal shield. Capitulum ventral in adults	Family Argasidae... 2
	Dorsal shield present. Capitulum terminal	Family Ixodidae ... 3
2	Body flattened, and with a distinct narrow border or margin, composed of striations or cells. Eyes never present	*Argas*.
	Body, stout when distended, its margins thick and without any distinct border. Eyes sometimes present	*Ornithodoros*.
3	Capitulum usually long	4
	Capitulum short	6
4	Eyes absent. Anal groove curved so as to surround anus anteriorly, but open posteriorly	*Ixodes*.
	Eyes usually distinct. Anal groove curved so as to surround anus posteriorly, but open anteriorly	5
5	Anal plates absent	*Amblyomma*.
	Anal plates present in male ...	*Hyalomma*.

6	Eyes absent. Coxa of first leg never bifid. Trochanter of first leg with a distinct retrograde spur. Anal plates absent	*Haemaphysalis.*
	Eyes present	7
7	Anal plates present in male (sometimes fused to form a single plate)	8
	Anal plates absent	9
8	Scutum of male, with distinct festoons posteriorly. Stigmata usually comma-shape	*Rhipicephalus.*
	Festoons absent. Scutum of female small. Anal groove obsolete. Stigmata rounded or oval ...	*Margaropus.*
9	Base of capitulum hexagonal dorsally, the sides projecting in angles. Scutum not ornamented	*Rhipicentor.*
	Base of capitulum rectangular dorsally. Scutum usually ornamented with designs	*Dermacentor.*

The Ixodoidea are mostly Acari of large size, and are popularly known as ticks. They are closely allied to the mites of the family Parasitidae (Gamasidae). There are two principal divisions or families of ticks, viz., the Argasidae and the Ixodidae.

Family—*ARGASIDAE.*

The ticks of the family Argasidae are not furnished with any dorsal shield (scutum); while the capitulum (rostrum) is ventral in position, and cannot be seen from above, being hidden by the front end of the body. There is no marked difference between the sexes, but the male is usually smaller than the female. This family consists of two genera (*Argas* and *Ornithodoros*), but they are very closely allied, and perhaps should be united to form a single genus.

Genus—*Argas*, Latr.

Argas reflexus, Fischer.

The Pigeon-Tick.

Numerous instances of *Argas reflexus* biting human beings have been recorded. These cases always occur in rooms or attics situated near places where pigeons are kept, and are due either to the destruction of the pigeons, depriving the ticks of the proper nourishment, thus causing them to seek it elsewhere, or to the ticks increasing so greatly in numbers that it is necessary for them to migrate in all directions. Sometimes the bite has slight effect on the victim or only causes a swelling or papule at the point bitten. Often, however, its sets up itching and oedematous swelling of a limb, or even of the whole body, and an urticarious eruption may also break out. The accounts given below will serve as examples of the mischief caused by the pigeon-tick.

For several years pigeons were kept in one of the wings of the Château du Vernet, near Brout-Vernet (Allier), France. Owing to the appearance of *Argas reflexus* in large numbers in the nests and to the consequent deterioration of the young birds through loss of blood, it was decided to get rid of the pigeons. This was done, and every effort was made to destroy the Acari as well. In spite of every care, however, specimens were met with from time to time at night walking on the walls of the pigeon-house, which was situated on the second floor of the château. The ticks found their way into the neighbouring bedrooms occupied by the servants, and annoyed them to such a degree that they asked for their rooms to be changed. Members of the family, including H. du Buysson himself, from whose narrative these details are taken, were badly bitten by the parasite. Du Buysson states that if his arm was bitten it became numbed and stiffened as if affected by cramp, and various general symptoms also developed, such as fever, swelling of the lips and eyelids, itching eruption on the body, etc. In 1908 it was found necessary to close a school at La Chapelle, near Vichy, in France, which was infested by this tick. Pigeons had been kept above the school-room by a former master, but were killed and eaten before he left. The new master (M. Blètry) was greatly troubled by the ticks, their bites setting up large phlegmons, and he became seriously ill. Pupils also were attacked by the ticks, even in the daytime, and they suffered from abscesses. Finally it became necessary to

abandon the premises. A still more serious case is that reported by Dr. Tonnel at La Madeleine in 1906, and it is important because it shows that *Argas reflexus* is capable of transmitting disease (furunculosis). A house, formerly occupied by a person dealing in fowls, who had kept both fowls and pigeons in the upper part of the building, remained completely empty for four years. At the end of this period a workman suffering from general furunculosis took the house and lived there with his wife and two children. Numerous ulcers and oedematous places set up by the bites of the ticks made their appearance on the bodies of the children, and it was necessary to vacate the building. Shortly afterwards the same rooms were occupied by another workman, together with his wife and three children, and all five of them were affected with the complaint in the same way. A thorough disinfection of the rooms then took place, and the ticks were destroyed, after which the boils and other symptoms disappeared.

Although widely distributed in Europe, this tick is a rare species, apparently being very local. It has also been found in North Africa and China; and a variety occurs in South America. For many years the pigeon-tick has been known to occur in Canterbury Cathedral, but this seems to be the only British locality for it. This species is very tenacious of life; specimens have been kept alive for more than five years without being fed. It is very difficult to exterminate by chemical means.

Argas persicus, Oken.

This species, the fowl-tick, can be distinguished from the pigeon-tick (*Argas reflexus*) by the presence of quadrangular areas or cells, instead of striations, along the margins of the dorsal surface.

In Persia the fowl-tick has long had the reputation of being injurious to man. Its bites are said to have serious consequences for strangers, whilst natives are comparatively immune from the ill effects. It is probable that some of the earlier accounts of the deadly nature of the bite of *Argas persicus* are exaggerated. Still, it seems clear from the evidence of various observers that the bites of this tick, although usually comparatively innocuous, may give rise to feverish symptoms. It is chiefly at Miana and one or two other localities in Persia that sickness caused by this tick has been observed. This supposed complaint is so local that it seems more probable that it is due to the transmission of some

specific organism than to a virus secreted by the parasite. According to Kotzebue and also Oken, villages in Persia may become so infested with the tick that the inhabitants are obliged to burn or abandon them. In Persia the fowl-tick is called the "Miana Bug" (Mialleh de Mianeh), "Shebgaz," and "Guérib-Guez"; in Mexico, the "Chinche" or "Adobe-tick," but the latter name possibly refers to *Ornithodoros turicata*.

Argas persicus is very widely distributed in the warmer, temperate, and in the tropical regions of the world. In North

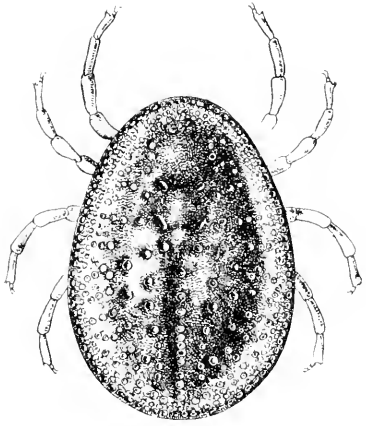


FIG. 16.

The fowl tick (*Argas persicus*, Fischer). Female. (After Brumpt.)

America it is usually referred to under the scientific name *A. miniatus*. It transmits the spirochaetosis of fowls.

GENUS—*Ornithodoros*, Koch.

Ornithodoros moubata, Murray.

THE TICK WHICH TRANSMITS THE RELAPSING FEVER OF TROPICAL AFRICA.

This tick is widely distributed in Africa, living in native huts, where it conceals itself during the daytime in the crevices of the walls or in the dust on the floor. It is in localities on the trade-routes that this tick is usually found. The absence of eyes is a

feature by which it can be distinguished from the closely allied species *O. savignyi*, Audouin. The disease called African Relapsing Fever or Tick Fever, which occurs in East and Central Africa, the Belgian Congo, Angola, and Madagascar, is conveyed by *O. moubata*. This fever is caused by a minute spiral protozoon, a *Spirochaeta*, which makes its way into the blood of the person bitten.

The spirochaetes are chiefly found in the gut of the tick, and it is supposed by Leishman and also by Hindle that infection takes place through contamination of the wound from the excreta voided by the tick whilst biting.

The principal symptoms of African Tick Fever are headache, vomiting, pain in the abdomen and purging, high temperature, etc. The first attack lasts from two to four days, then the temperature of the patient falls, but there are usually four or five more attacks of fever at short intervals before the disease has run its course, hence the name relapsing fever. Death takes place in about 6 per cent. of those affected by the disease.

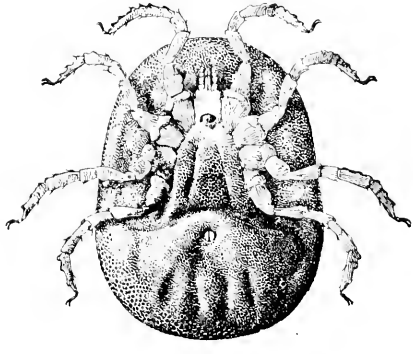


FIG. 17.

Ornithodoros moubata, Murray.
(After Castellani and Chalmers.)

Very similar diseases are found in Europe, North Africa, Asia, and Central America, but it is not known with certainty how they are spread; possibly by lice, however.

The bite, even of uninfected specimens of this tick, is very painful, causing itching and raised wheals on the skin. Like other members of the family, *Ornithodoros moubata* is very tenacious of life. A number of specimens received from Uganda were kept alive in a glass jar at the Natural History Museum, South Kensington, and although kept without nourishment or fluid of any kind, one of the specimens was still alive and vigorous after fourteen months. The larval stage is inert in this species, being poorly developed, and it is as a nymph that the tick emerges from the egg-shell. After getting rid of its larval skin, this nymph is ready to feed. It casts its skin several times before becoming fully developed, a moult taking place after each meal of blood. The female tick does

not lay eggs until it has fed. The spirochaetes are taken up by the tick whilst sucking blood, and make their way into its ovaries, penetrating into the undeveloped eggs. The nymphal which develops from these eggs is capable of conveying the disease. The spirochaetes can be transmitted to the third generation of ticks, and they can thus convey the disease, although their immediate parents have fed only on blood free from spirochaetes. An affected tick may harbour the disease for months and still be capable of transmitting it.

The following precautions are advisable in localities in which this tick occurs. Beds should not be placed on the ground, but should be well raised and not allowed to touch the walls; hammocks are preferable for sleeping purposes. Native houses or other buildings which have become infested with the tick should be thoroughly disinfected, and huts or other premises of little value destroyed by fire. Old camping sites likely to harbour the tick should be avoided whenever possible. Native quarters should be established at some distance from those of Europeans (at least twenty to thirty yards away), and servants and others coming from them compelled to change their clothes before entering sleeping apartments used by white people. The preventive methods given above are principally taken from those recommended by Wellman; see also Drake-Brockman's advice as to the best method of destroying *O. savignyi* (see below).

Ornithodoros savignyi, Audouin.

Ornithodoros savignyi is very like *O. moubata* in general appearance; the granules of the integument are rounded as in that species, but there are two well-developed eyes on each side of the body, one being placed opposite the first coxa, the other between the coxae of the second and third legs. Although scarcer than *O. moubata*, this tick has a very wide distribution in Africa, occurring also at Aden and in Southern India. Its habits are apparently very similar to those of *O. moubata*. Brumpt has succeeded in transmitting tick fever by means of *O. savignyi*.

In the Bulletin of Entomological Research for September, 1915, Mr. Drake-Brockman gives an interesting account of the habits of *Ornithodoros savignyi* in Somaliland. He says: "This tick is found in the soil in or around the huts on the outskirts of the coastal towns, showing a predilection for the more squalid and insanitary areas where the indigent Somalis reside. In the

interior it frequents most camps of long-standing which are inhabited by human beings and their domestic animals. They are extremely common in the dusty soil surrounding the wells and water-holes. In the waterless Haud and Nogal Valley they are most frequently found under large trees, especially when these are in isolated positions, as at Ged Aboukir on the Arori Plain, and afford the only shade for miles to the shepherd and his flock during the heat of the day. *Ornithodoros savignyi* is capable of living for months without a fill of blood in the soil, into which it burrows to a depth of half to one inch, lying dormant there until the ground is disturbed by the foot of man or beast. In captivity it will live for six months or more in a tightly stoppered bottle half-filled with dry earth, without food or water. It will attack human beings, camels, cattle, mules, donkeys, sheep and goats with equal vigour. It seldom climbs much higher than the ankle in human beings and the hocks in animals." Drake-Brockman remarks that the best and cheapest method of destroying these ticks when they swarm in confined areas, such as the immediate vicinity of wells, is to cover the whole infested area with dry grass and brushwood, after harrowing or disturbing the surface, and then set fire to the grass all round simultaneously, so that the fire will gradually burn its way towards the centre. Native soldiers should rub their feet and ankles with turpentine when entering localities where the tick is known to occur and to be infected with the spirochaet of relapsing fever.

Relapsing fever is known to occur in Persia; Wosnissensky's and Dschunkowsky's observations seem to make it clear that the spirochaet causing the disease in that country is conveyed by a tick of the genus *Ornithodoros*. The identity of the tick concerned is still uncertain; it is either *Ornithodoros tholozani*, *O. canestrinii*, or *O. lahorensis*.

Ornithodoros pavimentosus, Neumann.

A third African species of *Ornithodoros* (*O. pavimentosus*) has also been found in South Africa (Namaqualand). There are two distinct eyes on each side of the body of this tick as in *O. savignyi*, but it differs from that species in having the granules contiguous and flattened, instead of rounded (hence the name *pavimentosus*). It is possible, however, that this tick is only a variety of *O. savignyi*. According to Schultze, the habits of *O. pavimentosus* are very like those of *O. moubata*. He says it is common at resting-places,

where it hides in the sand, biting travellers whilst they are lying on the ground.

Ornithodoros turicata, Dugès.

Ornithodoros turicata attacks pigs, cattle, horses, and man. The bite of this tick causes troublesome itching and an inflamed papule, which usually soon subsides, however, if the patient refrains from scratching the affected spot. Moreover, this species is suspected of being the carrier of relapsing fever in Colombia. Besides the hosts recorded above, it has been found in the holes of gophers and in the burrows of a tortoise (*Xerobates polyphemus*).

This species occurs in the southern parts of the United States (California, Florida, Texas, and Arizona), Mexico, Colombia, and Venezuela.

Ornithodoros talaje, Guér.-Mén.

This species inhabits old houses, concealing itself in crevices and coming out at night to suck the blood of the inmates. Its bite is very painful, causing much swelling and itching. It is quite probable that this species transmits relapsing fever. A pair of movable flaps or cheeks are present near the palps in this tick, a feature distinguishing it from other species of the genus. This tick is very abundant on the brown rat (*Rattus norvegicus*) at Panama, and also occurs more sparingly in that locality on the black rat (*Rattus rattus*) and Alexandrine rat (*R. alexandrinus*). About three thousand specimens of *O. talaje* were found by Jennings on rats at Panama, and all of them, with the exception of two nymphs, were larvae. It has also been found on the llama, and Aragao states that he has seen examples from the paca (*Coelogenys paca*) and from *Dicotyles* sp.

Ornithodoros talaje occurs in Mexico, Guatemala, Panama, Venezuela, Brazil, and Chili.

A variety of this species (*O. talaje*, var. *capensis*, Neum.) is found in the nests of birds in the islands off the coast of Cape Colony, also on St. Paul's Rocks, and on Cargados Carajos (Siren Islands) in the Indian Ocean.

Ornithodoros megnini, Dugès.

The Spinose Ear-Tick.

This tick lives in the ears of cattle, horses, and, more rarely, in those of other animals. Numerous short, bristly hairs are present

on the integument of the nymph of this species, those on the front part of the upper surface being spine-like. The adult is almost smooth, however. Mexico and the south-western part of the United States are the habitat of this species. Specimens have been found in the ears of children on several occasions. Two nymphs of this tick were extracted by Dr. J. Christian Simpson from the ears of an American visitor to Cambridge, England. It is

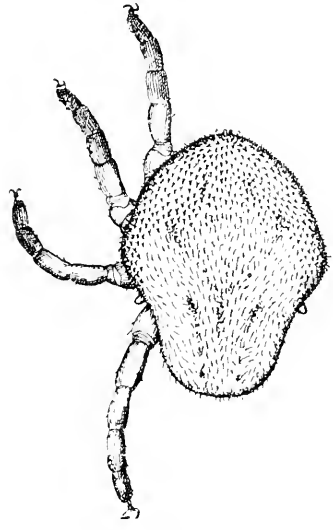


FIG. 18.

The Spinose Ear Tick (*Ornithodoros megnini*, Duges). Nymph, enlarged. (After Marx.)

supposed that they made their way into his ears when camping out in Arizona.

Ornithodoros coriaceus, Koch.

A species furnished with eyes and with the anterior margin of the body rather cone-shaped in the middle. According to Banks it occurs on cattle in California, and attacks the cattlemen, causing large swellings which are very painful and remain for a week or more. It is also found in Mexico and Paraguay.

Ornithodoros tholozani, Laboulbène and Mégnin.

This *Ornithodoros* is a Persian species, and is called Kéné (sheep-bug) by the inhabitants of that country. It is a parasite of sheep, and has also been found on camels and domestic fowls. Mégnin fed some specimens of this tick, which had been forwarded to him alive, on his own person.

FAMILY—*IXODIDAE.*

The ticks belonging to the family Ixodidae are provided with a distinct dorsal shield (scutum), which covers practically the whole upper surface of the male, but is usually small in the female, leaving much of the upper surface unprotected, and the body is capable of great distension. The capitulum (rostrum) is situated at the anterior end of the body and is visible from above. This family is divided into a number of genera. Many of the species are known to attack man occasionally, but only the principal ones so doing are mentioned below.

GENUS—*Amblyomma*, Koch.

Amblyomma variegatum, Fabricius.

According to Joyeux the larvae of *Amblyomma variegatum* are very abundant in French Upper Guinea at the beginning of the dry season, from early November to February, and they attack both man and other animals. The nymphs of this tick also attack human beings, but less frequently, and Joyeux only observed a single case of the adult attacking man. Larvae and nymphs of this species are said by Neumann to have been found on human beings in the French Sudan, and an adult specimen on a sailor at Nossi-Bé Island, near Madagascar. *Amblyomma variegatum* differs from nearly all the other species of the genus in having the eyes distinctly rounded, instead of flat.

Amblyomma hebraeum, Koch.

Larvae of *Amblyomma hebraeum*, and sometimes also larvae of *Rhipicephalus*, are said by Sant' Anna to be so numerous in the neighbourhood of Lourenço Marques as to be a veritable scourge, especially in the localities frequented by cattle. They set up great

itching, and larval ticks are found in little vesicles which make their appearance on the skin of the person attacked. In a few individuals general symptoms were also observed, including weakness, muscular pains, enlargement of glands in axilla, groin, and other places. Occipital headache and stiffness of the neck and limbs are also given as symptoms of this disease. Somewhat similar cases are reported by Nuttall as occurring on the veldt of the east coast of Natal and Cape Colony. Hindle and Breinl suffered from a rather similar complaint caused by the bites of larvae of *Amblyomma hebraeum* whilst experimenting with these ticks at the Runcorn Research Laboratories near Liverpool.

Amblyomma hebraeum transmits a definite disease (Heartwater) in sheep, goats, and occasionally in cattle. Enlarged coloured models of the male, female, and larval form of this tick are exhibited in the Central Hall of the Museum.

Amblyomma cajennense, Fabricius.

Amblyomma cajennense has a wide distribution in Central and South America, where it bites man and also various domestic and wild animals.

Stoll says of this species, in his volume in the "Biologia Centrali-Americana": ". . . . The female, which abounds in the woods and savanas [in Guatemala] on grass and bushes, is occasionally rubbed off by horses, cattle, or dogs, and even by man. It adheres tenaciously to the skin, fixing itself by perforating the cutis with its sucking apparatus; and remains, when undisturbed, for several days, till filled with blood, and then probably falls off spontaneously by its own weight. If forcibly removed, the sucking apparatus breaks off and remains in the wound, causing a disagreeable and sometimes painful inflammation for a considerable time, but I never saw any serious consequence result from it. Even in its young stage the garrapata is of parasitic habits. The young, which are distinguished by the inhabitants of Guatemala by the name of "Mostacilla" (derived from "mostaza," mustard), hang to the grass in clusters of thousands, especially during the dry season; and by their creeping on the bare skin and frequent biting they form one of the greatest plagues to the European traveller, who is sometimes kept awake for hours during the night by them. . . ."

Newstead states of this tick: "To man it is the greatest pest of the island [of Jamaica], attacking him in all its stages from the larval to the sexually mature males and females. It is a most vicious biter, and when it has gained access to the skin inserts its mouth-parts (capitulum), the adults producing an irritating wound followed often by intense itching. . . ."

Amblyomma americanum, Linnaeus.

Owing to its habits this tick is of considerable economic importance, for it readily attacks domestic animals and man.

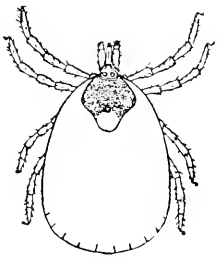


FIG. 19.

The Lone Star Tick (*Amblyomma americanum*, L.). Female, enlarged. (After Banks.)

According to Hooker, Bishopp, and Wood, in the Eastern and Southern States of North America human beings are more frequently attacked by this tick than by any other species. It is troublesome to milkers at dairies and also to people who keep poultry. This species is called the lone star tick, because of the conspicuous silvery spot on the shield of the female.

The hosts of *Amblyomma americanum* are very numerous; it is said to bite almost any mammal, and also birds (poultry, etc.). This species occurs in Labrador and Southern Manitoba, in nearly all the States bordering on the Atlantic and Gulf of Mexico, and also in several inland States. It is also found in Guatemala, Guiana, and Brazil.

GENUS—*Hyalomma*, Koch.

Hyalomma aegyptium, Linnaeus.

Hyalomma aegyptium, L., is a very abundant tick in Africa, and occurs also in Southern Europe and Asia. Its hosts are very numerous, and include camels, cattle, and horses. This species sometimes attacks human beings, and Ronsisvalle says its bite produces morbid phenomena in man.

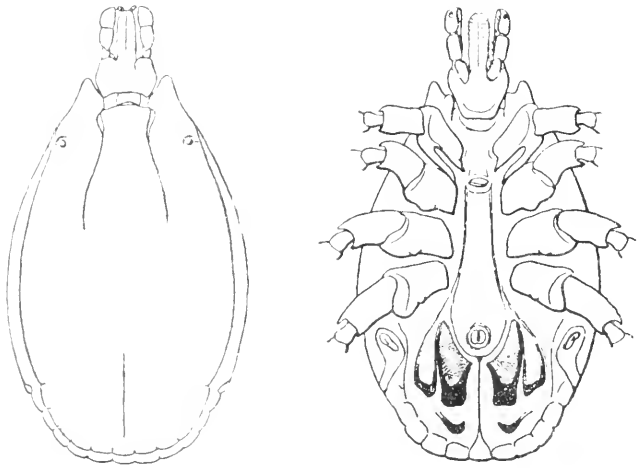


FIG. 20.

Hyalomma aegyptium, L. Dorsal and Ventral aspects of male, × 10. (After Neumann.)

GENUS—*Margaropus*, Karsch.

Margaropus annulatus australis, Fuller.

This cattle-tick has a very wide distribution in Central and South America, and is the carrier of Texas Cattle Fever. In his paper on the blood-sucking ticks and other arthropods of Jamaica, Newstead states of this tick: "It is generally believed that the

larval or 'grass lice' stage will attack any vertebrate animal that comes its way. It is in this stage that it is such a great pest to

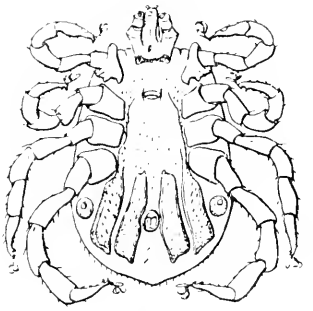


FIG. 21.

Margaropus annulatus, Say. Ventral view of male. Enlarged. (After Neumann.)

man." Neumann and other authorities do not, however, record this tick as biting human beings.

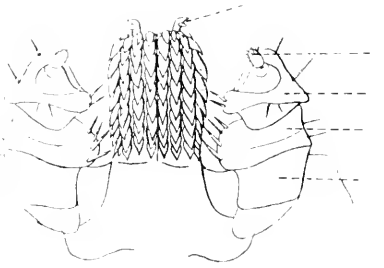


FIG. 22.

Margaropus annulatus, Say. ♀, Ventral view of Capitulum, greatly enlarged. (After Neumann.)

The larval stage of *Margaropus annulatus decoloratus*, Koch, a very widely distributed cattle-tick in Africa, is also said to attack man.

GENUS—*Rhipicephalus*, Koch.

Rhipicephalus sanguineus, Latreille.

This common dog-tick is almost cosmopolitan in distribution, being found in all the warmer, temperate, and tropical countries of the world. It attacks many other animals besides its principal host, sometimes biting human beings. Malignant jaundice in dogs is transmitted by this species.

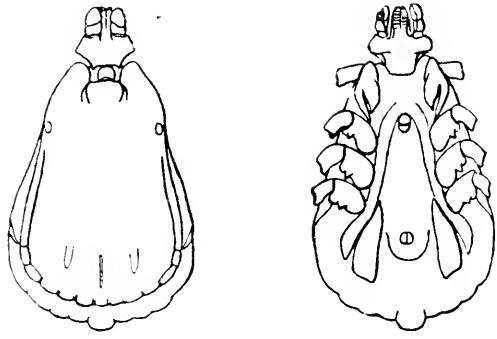


FIG. 23.

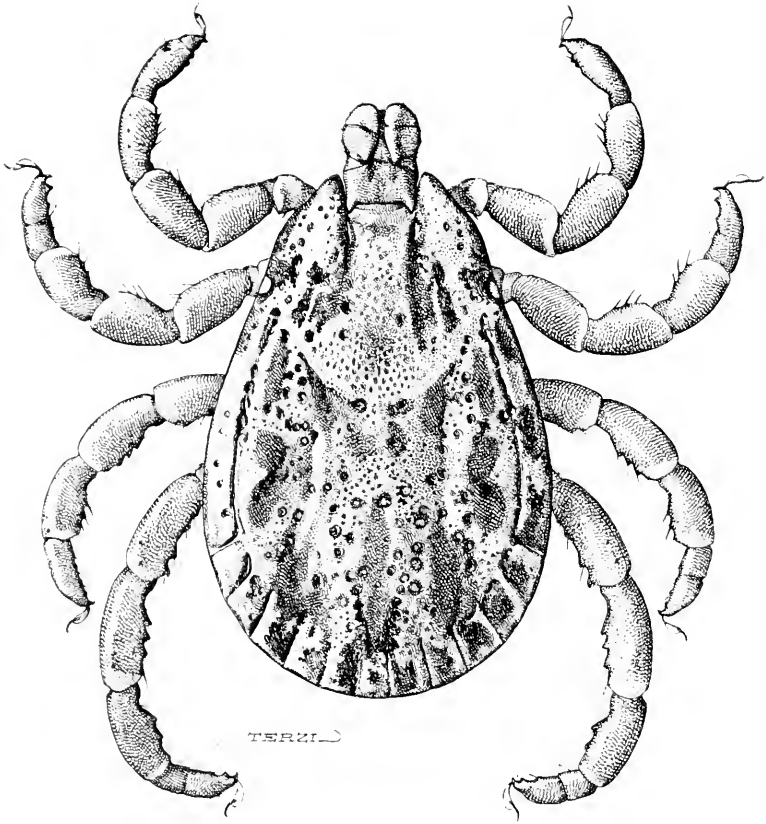
Rhipicephalus sanguineus, Latreille. Dorsal and Ventral aspects of the male, × 13. (After Neumann.)

GENUS—*Dermacentor*, Koch.

Dermacentor reticulatus, Fabricius.

Dermacentor reticulatus is a widely distributed tick, being found both in Europe and in Northern Asia. It transmits Biliary Fever (due to *Piroplasma caballi*) in horses in Southern Russia. In England it is a rare species, chiefly occurring on sheep in Devonshire, but it has also been discovered in Wales.

This tick is parasitic on sheep, cattle, deer, horses, goats, etc., sometimes attacking man. Wheler states that it has been troublesome to human beings at Revelstoke.



The Rocky Mountain Spotted Fever Tick (*Dermacentor venustus*, Banks).
Male. Enlarged.

To face p. 49.

Dermacentor venustus, Banks.

THE ROCKY MOUNTAIN SPOTTED FEVER TICK.

(PLATE III.)

Dermacentor venustus is the carrier of the human tick-fever occurring in Montana, Idaho, and several other States in the Rocky Mountain region of the United States. The virulence of this disease varies in different localities, the death-rate being from 5 to 7 per cent. in Idaho, whereas it is about 70 per cent. in the Bitter Root Valley of Montana. This fever has been known for many years in the localities in which it occurs, and it is probable that it already existed there before the settlement of the country by Europeans. It is not yet known with certainty whether Rocky Mountain Spotted Fever is caused by a virus secreted by the tick or by the transmission of some minute blood-parasite by its bite. *Dermacentor venustus* is known to occur from British Columbia southward to northern New Mexico, and from the foothills of the Rocky Mountains in Colorado to the base of the Cascade Range in Oregon and California. The immature stages of the tick are generally found on various small mammals, such as ground-squirrels, chipmunks, etc. The adults are usually found on the larger domestic animals, especially on cattle and horses, but also on hogs, sheep, and more rarely on dogs. Human beings are bitten by the adult ticks and thus contract the complaint. It is possible that the wild mountain goats may act as a reservoir of infection. Gophers, rock-squirrels, woodchucks, chipmunks, and mountain rats are also susceptible to Spotted Fever, and may perhaps be sources of infection.

Dr. C. Wardell Stiles has described the tick which causes the disease under a new name (*Dermacentor andersoni*, Stiles), and is of opinion that *D. venustus* is a different tick.

Dermacentor occidentalis, Neumann.

This species, which has been confused with *D. venustus*, also frequently attacks man, and often occurs in great numbers on domestic live-stock. It is not known to spread disease, however. Hooker, Bishopp, and Wood state that in Western California and Western Oregon it is the most common tick which attacks man. A number of cases were brought to their attention where the bite of this species had caused considerable local inflammation, which in some instances required a physician's attention. They say it is quite common for the rostrum to be broken off when the ticks are

removed, and in such cases the irritation and itching persist for several weeks.

Dermacentor occidentalis is called the Pacific Coast Tick or Wood Tick. The habitat of this species is the Pacific coast-region of the United States (Coast Range and Sierra Nevada Mountains in California and Oregon, and the smaller mountain-ranges in south-western California). It is found on cattle, horses, human beings, deer, dogs, etc.

Dermacentor variabilis, Say.

This North American dog-tick sometimes attacks human beings, but apparently without causing ill effects of any consequence.

It is usually found on the dog, but occasionally on other animals.

Genus—*Ixodes*, Latreille.

Ixodes ricinus, Linnaeus.

Inflammation and other ill effects are said to result sometimes from the bite of *Ixodes ricinus*, L., but such cases are rare; the bite of this tick usually only sets up a certain amount of irritation, and there are no serious consequences.

Specimens of *Ixodes*, usually *I. ricinus*, sometimes, however, occur in tumours under the skin of human beings, and similar cysts, each containing a tick belonging to this genus, have also been found in the skin of horses, cattle, dogs, and foxes. Cases of this kind are, however, of quite an exceptional nature. It is supposed that the irritation caused by the hypostome of the *Ixodes* sets up inflammation and swelling of the tissues, which gradually envelop the parasite. The external wound may heal, leaving only the internal cyst enclosing the tick.

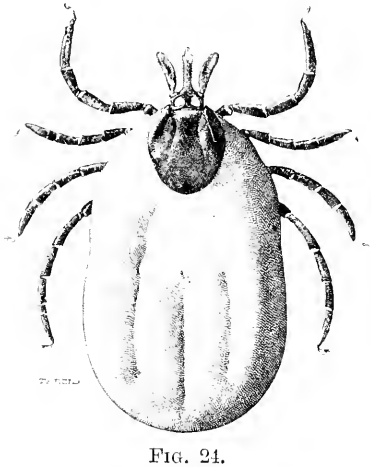


Fig. 24.

Ixodes ricinus, L. Female. Enlarged.

The bite of *Ixodes ricinus* is reported by Dubreuilh to have caused a gangrenous pustule,

perhaps due to the anthrax bacillus. Kunjaëff also gives an account of a case of a carbuncle on the thigh of a man, probably caused by a tick (*I. ricinus*), the mouth-parts of which could still be seen in the ulcer.

Tick-Paralysis.

The Australian cases of tick-paralysis given below are taken from Dr. J. Burton Cleland's paper. Speaking of human infestation by ticks, this author says: "Along the Eastern Coast of Australia, in parts where there are dense scrubs and tropical jungle, it is not at all uncommon at certain times of the year to find that ticks (*Ixodes holocyclus*) attach themselves to the human subject. As a rule, beyond some irritation they produce no particular ill effects, but every now and again a case is reported, usually in children, in which severe symptoms have followed, and sometimes even death."

In Australia dogs and cats frequently perish from tick-paralysis or poisoning. According to Bancroft, after the tick has been attached to a full-grown dog for two or three days the animal begins to look weary. Puppies travel away and are rarely found alive again. Weakness in the hind limbs is first observed, and in about five days from the attachment of the tick the dog becomes unable to walk. Native animals in Queensland usually endure the attacks of Ixodidae without ill effects of this kind, and animals in infected districts are said to become tick-proof, for a single attack confers immunity.

A woman of forty living in Australia, on whom a tick was found attached, is said by Bancroft to have become very weak and to have developed ocular trouble.

At Eden, on the south coast of New South Wales, a little girl aged thirteen died from paralysis especially affecting the respiratory tract, induced by the bite of a tick (almost certainly *Ixodes holocyclus*).

Strickland records the case of a boy in Australia who had the misfortune to get a tick in his ear whilst in the bush. Four days afterwards he became very sick and giddy, and after being put to bed got much worse, all his muscles apparently being affected; one side of his face became quite crooked, and he could not walk without assistance. The child was carefully fed and given medicine, and was well again ten days after the tick was removed. Dr. E. M. Eaton gives an instance of a tick biting a little girl in Australia and

causing transitory muscular paralysis. Dr. Temple, of Oregon in the United States, has published observations on a number of cases of paralysis in that State caused by ticks. In all he mentions thirteen instances of this kind, all the victims being children. The paralysis is of an ascending nature, affecting the motor nervous system, and it is apparently quite rapid, becoming complete from three to five days from commencement, and often ending in death. The legs are generally first affected, the patient being unable to walk or even stand. Patients usually recover if the tick is removed before the heart or respiratory organs become affected, and proper treatment is given. Tick-paralysis is also found in British Columbia, human beings, sheep, and probably other animals as well contracting this complaint. The tick causing it is said by Hadwen to be *Dermacentor venustus*, Banks. Seven cases of tick-paralysis in British Columbia are recorded by Dr. John L. Todd; six of the patients were children. A number of experiments with *Dermacentor venustus* were performed at Cambridge by Hadwen and Nuttall, and one of them gave interesting results. A female tick of this species was placed on a dog, and paralytic symptoms very like those occurring in the Australian and other cases appeared. A curious feature in this experimental case is that the dog recovered before the tick was removed.

Dermal Leishmaniasis.

In several parts of South America there occurs a skin-complaint which is very like Oriental Sore (Aleppo Boil) in appearance. Both Flu and Migone have suggested that this complaint is probably spread by the bites of Ixodidae. Other authors are of opinion that it is conveyed by some species of insect, possibly by a fly.

The causative organism is a parasitic protozoon of the class Flagellata called *Leishmania americana* (possibly a variety of *L. tropica*).

Plague.

The following instance suggests that ticks may perhaps play a part in the dissemination of plague. Whilst investigating the circumstances relating to the case of a native who died at Nowshera, India, apparently from plague, Skinner found a gorged tick imbedded in the ear of a black rat affected with bubonic plague. The lymphatic glands in connection with this ear were broken

down, and had clearly been the first to be infected with the disease. Fleas and numerous ticks of another species were, however, also found on this rat.

MYRIOPODA.

Class CHILOPODA (Centipedes).

In tropical regions some of the Scolopendridae reach a large size, and their bite is much feared, for it is very painful. Sometimes the person bitten also suffers from symptoms such as dizziness and headache. The bite of *Scolopendra cingulata*, Latreille, a centipede common in the south of Europe, is also said to be painful and to cause local swelling. The part bitten should be bathed in a solution of ammonia (about 1 in 5).

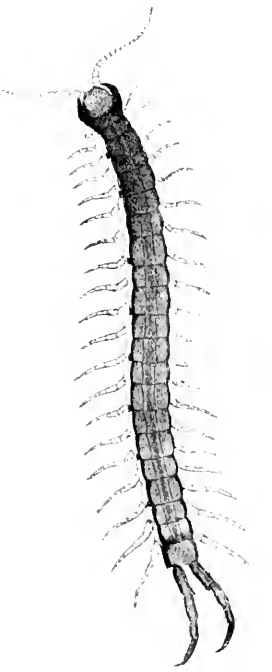


Fig. 25.
Scolopendra morsitans.
(After Koch.)

The Pseudoparasitism of Myriopoda in Man.

Including the new case mentioned below, there are now fifty-one recorded instances of the pseudoparasitism of Myriopoda in human beings, which seem to be well authenticated. Prof. Raphael Blanchard has made a special study of this subject and gives references to a large number of the earlier cases, besides placing several new ones on record. Other cases of this kind are recorded by Huber, Neveu-Lemaire, Verdun and Bruyant, Shipley, Laveran, Laurens, and Galli Valerio. Myriopods have been described as occurring thirty-three times in the nasal cavities

and adjoining sinuses, once in the ear, and seventeen times in the alimentary canal.

The myriopods pseudoparasitic in the nasal cavities always belong to the class Chilopoda (centipedes) and nearly all of them belong to the long attenuated forms with many legs of the family Geophilidae; Blanchard records, however, three cases in which Lithobiid centipedes were found in this situation. The following species are said to have been found in the nasal cavities:—*Geophilus carpophagus*, Leach; *G. electricus*, Linnaeus; *G. longicornis*, Leach (=*G. similis*, Newport); *G. cephalicus*, Wood; *Chaetechelyne vesuviana*, Newp.; *Lithobius forficatus*, L.; *L. melanops*, Newp. The presence of the centipede sets up various symptoms such as fixed pain in the forehead, headache, irritation in the nostrils, violent attacks of sneezing and coughing, etc.

FIG. 26.

Geophilus longicornis.
(Slightly enlarged.)

The myriopoda which are believed to have lived in the alimentary canal include both centipedes and millipedes; the names of the species are as follows:—*Geophilus electricus*, L.; *G. longicornis*, Leach; *Chaetechelyne vesuviana*, Newp.; *Stigmatogaster subterraneus*, Leach; *Himantarium gervaisi* (these five species all belong to the family Geophilidae); *Scutigera coleoptrata*, L. (FAM. Scutigeridae); and three species of millipedes: *Julus terrestris*, L.; *J. londinensis*, Leach; and *Polydesmus complanatus*, L.

A specimen of *Geophilus* passed in the faeces of a patient suffering from chronic colitis was sent to the British Museum (Nat. Hist.) in September 1914 by Dr. H. Lyon Smith. The patient, a man 61 years of age, had been abroad for many years in Egypt and South Africa. He suffered frequently from uncontrollable (and inexplicable) attacks of vomiting. The symptoms of irritation are said to have disappeared since the evacuation of the "worm," as the myriopod was called by the patient. It should be mentioned that minute ova, resembling those of *Ascaris*, were also found in the intestinal mucus after irrigation of the colon. They were about 20 μ in length.

In some of the cases in which myriopoda are supposed to have

occurred in the alimentary canal, it is probable that the arthropod was already present in the receptacle into which the faeces (or in some cases the matter vomited) were deposited. These myriopods which occur in the alimentary canal are reported as causing colic and other intestinal troubles, together with nervous and general symptoms.

LITERATURE.

Owing to considerations of space, only works dealing with the subject in a comprehensive manner are given below.

Banks, N. — The Acarina or Mites. A Review of the group for the use of Economic Entomologists. 1915. U.S. Dept. Agriculture, Rep. no. 108. 153 pp., 294 text-figs.

Banks, N. — A Revision of the Ixodoidea, or Ticks, of the United States. U.S. Dept. Agr., Tech. Ser., Bur. Ent., Bull. 15. 1908. 61 pp., 10 pls.

Berlese, A. — Gli Insetti. Loro organizzazione, sviluppo, abitudini e rapporti coll' uomo. Milan. 1912.
[Volume 2 of this work contains a good account of the Arachnida and Myriopoda, especially of the Acari.]

Brumpt, E. — Précis de Parasitologie. Paris. 1910. 915 pp., 4 pls., and 683 text-figs.

Canestrini, G., and Kramer, P. — Das Tierreich. Demodicidae and Sarcoptidae. 1899. 193 pp., 31 text-figs.

Canestrini, G. — Prospetto dell Acarofauna Italiana. Padua. 1885–1899. In 8 parts.

Hooker, W. A., Bishopp, F. C., and Wood, H. P. — The Life History and Bionomics of some North American Ticks. U.S. Dept. Agr. Bur. Ent., Bull. 106. 239 pp., 15 pls., 17 text-figs.

Huber, J. C. — Bibliograph. der Klin. Ent. (Hexapoden, Acarinen). Jena. 1899–1900. In 4 parts.

Mégnin, P. — Les Parasites et les Maladies Parasitaires. Paris. 1880. 478 pp., 26 pls., and 63 text-figs.

Murray, A. — Economic Entomology. Aptera. South Kensington Museum Science Handbook. 1877. 433 pp., numerous text-figs.

Nuttall, G. H. F., and Warburton, C. — Ticks, a Monograph of the Ixodoidea. Parts 1–3, and 2 vols. Bibliography. (1908–1915, still in progress.)

Neumann, L. G. — Das Tierreich. Ixodidae. 1911. 169 pp., 76 text-figs.

Oudemans, A. C. — Die bis jetzt bekannten Larven von Thrombidiidae und Erythraeidae. Zool. Jahrb. Syst. 1912. Suppl. Vol. 14. pp. 1–230, 57 text-figs.

Railliet, A. — Traité de Zoologie Médicale et Agricole. 2nd edition. Paris. 1895. 1303 pp., 892 text-figs.

INDEX.

NATURAL HISTORY MUSEUM.

Economic Pamphlets.

No. 1.—**The House-Fly as a Danger to Health.** Its Life-history, and how to deal with it. By Ernest E. Austen. Second Edition. Pp. 12: 2 plates (containing 4 figures), and 3 figures in text. 1913, 8vo. 1*d.* (*postage* ½*d.*).

No. 2.—**The Louse and its Relation to Disease.** Its Life-history and Habits, and how to deal with it. By Bruce F. Cummings. Pp. 16: 1 plate (containing 2 figures), and 2 figures in text. 1915, 8vo. 1*d.* (*postage* ½*d.*).

No. 3.—**Fleas as a Menace to Man and Domestic Animals.** Their Life-history, Habits, and Control. By James Waterston, B.D., B.Sc. Pp. 21: 1 plate and 6 text-figures. 1916, 8vo. 1*d.* (*postage* ½*d.*).

No. 4.—**Mosquitoes and their Relation to Disease.** Their Life-history, Habits, and Control. By F. W. Edwards, B.A. Pp. 20: 6 text-figures. 1916, 8vo. 1*d.* (*postage* ½*d.*).

No. 5.—**The Bed-Bug.** Its Habits and Life-history, and how to deal with it. By Bruce F. Cummings. Pp. 20: 7 text-figures. 1917, 8vo. 1*d.* (*postage* ½*d.*).

No. 6.—**Species of Arachnida and Myriopoda** (Scorpions, Spiders, Mites, Ticks, and Centipedes) injurious to Man. By S. Hirst. Pp. 60: 26 text-figures and 3 plates. 1917, 8vo. 6*d.* (*postage* 1*d.*).

Pamphlets on "**The Biology of Waterworks**" and "**The Furniture Beetle**" *are in preparation.*

Economic Leaflets.

No. 1.—**The Danger of Disease from Flies and Lice.** Pp. 4. 1915, 8vo. Price: 1*d.* for 6 copies (*postage* ½*d.*), 1*s.* for 100 (*postage* 5*d.*).

A leaflet on "**The Danger of Disease from Fleas and Bugs**" *is in preparation.*

Applications to the Museum direct for any of these pamphlets should be accompanied by a remittance, including postage.

Written communications respecting them should be addressed to the Director, British Museum (Natural History), Cromwell Road, London, S.W. **7.**

BRITISH MUSEUM

(NATURAL HISTORY).

DAYS AND HOURS OF ADMISSION.

The EXHIBITION GALLERIES are open to the PUBLIC, free, as follows:—

WEEK-DAYS.

Daily.—Central Hall (Special Exhibits), North Hall (Domesticated Animals, etc.), Bird Gallery, Upper and Lower Mammal Galleries, Shell Gallery, and Botanical Gallery.

On *Mondays*, *Wednesdays*, and *Fridays*.—Fossil Mammal Gallery, Fossil Reptile Gallery, and Mineral Gallery. (Eastern side.)

On *Tuesdays*, *Thursdays*, and *Saturdays*.—Coral Gallery, Starfish Gallery, Reptile Gallery, Insect Gallery, Fish Gallery, and Whale Room. (Western side.)

SUNDAYS.

Central Hall, North Hall, Bird Gallery, Mammal Galleries (including Whale Room), Fossil Mammal Gallery, Fossil Reptile Gallery, and Mineral Gallery.

The Hours of Admission are:—

On WEEK-DAYS, throughout the year from 10 a.m., in

January	to	4	p.m.
February 1 to 14	,,	4.30	,,
,, 15 to end	,,	5	,,
March	,,	5.30	,,
April to August (inclusive)	,,	6	,,
September	,,	5.30	,,
October	,,	5	,,
November and December	,,	4	,,

On SUNDAYS, in

January	from	2	to 4	p.m.
February 1 to 14	,,	2	,, 4.30	,,
,, 15 to end	,,	2	,, 5	,,
March	,,	2	,, 5.30	,,
April	,,	2	,, 6	,,
May to August (inclusive)	,,	2.30	,, 7	,,
September	,,	2	,, 5.30	,,
October	,,	2	,, 5	,,
November and December	,,	2	,, 4	,,

The following Galleries are closed continuously for the duration of the War, viz.—Fossil Fishes; Fossil Cephalopods; other Fossil Shells, etc.; Fossil Corals and Sponges, and Fossil Plants; Stratigraphical and Special Palæontological Collections.

The Museum is closed on Good Friday and Christmas Day.

BY ORDER OF THE TRUSTEES,

L. FLETCHER, *Director*.

LONDON: PRINTED BY WILLIAM CLOWES AND SONS, LTD., DUKE STREET, STAMFORD STREET, S.E. 1.