

Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

47193
244

TECHNICAL SERIES, No. 15.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ENTOMOLOGY.

L. O. HOWARD, Entomologist and Chief of Bureau.

A REVISION OF THE IXODOIDEA, OR TICKS,
OF THE UNITED STATES.

BY

NATHAN BANKS,

Assistant Entomologist.

ISSUED JUNE 6, 1908.



WASHINGTON:

GOVERNMENT PRINTING OFFICE.

1908.

TECHNICAL SERIES, No. 15.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ENTOMOLOGY.

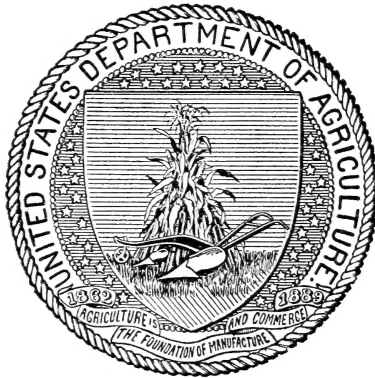
L. O. HOWARD, Entomologist and Chief of Bureau.

A REVISION OF THE IXODOIDEA, OR TICKS,
OF THE UNITED STATES.

BY

NATHAN BANKS,
Assistant Entomologist.

ISSUED JUNE 6, 1908.



WASHINGTON:
GOVERNMENT PRINTING OFFICE.

1908.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ENTOMOLOGY,
Washington, D. C., March 11, 1908.

SIR: I have the honor to transmit herewith the manuscript of a revision of the Ixodoidea, or ticks, of the United States, by Mr. Nathan Banks, assistant entomologist in this Bureau. In view of the importance which some of the ticks have assumed as the known transmitters of certain diseases it becomes very necessary that the different species be distinguished with certainty. This has hitherto been a matter of great difficulty, since there has been no work of a systematic character dealing with all the known species of ticks occurring in the United States. To supply this need and as a basis for the life history work undertaken by this Bureau on the cattle tick and other ticks, this bulletin has been prepared. I recommend its publication as Technical Series No. 15 of the Bureau of Entomology.

Respectfully,

L. O. HOWARD,
Entomologist and Chief of Bureau.

HON. JAMES WILSON,
Secretary of Agriculture.

CONTENTS.

	Page.
Structure	7
Life history	9
Geographical distribution.....	10
Abundance	11
Historical.....	11
Classification.....	12
Table of the families	14
Family Argasidæ.....	14
Table of the genera.....	14
Genus Argas	14
Genus Ornithodoros	16
Family Ixodidæ.....	20
Table of the genera.....	20
Genus Ceratixodes.....	20
Genus Ixodes	22
Genus Hæmaphysalis.....	32
Genus Rhipicephalus	34
Genus Margaropus.....	35
Genus Amblyomma	37
Genus Dermacentor	42
Unplaced species.....	51
Species erroneously accredited to the United States.....	52
Catalogue	52
Bibliography.....	56
Index	61

ILLUSTRATIONS.

PLATES.

		Page.
PLATE I. Fig.	1.— <i>Argas miniatus</i> : leg I.....	16
	2.— <i>Argas miniatus</i> : leg IV.....	16
	3.— <i>Argas brevipes</i> : leg I.....	16
	4.— <i>Argas brevipes</i> : leg IV.....	16
	5.— <i>Ornithodoros coriaceus</i> : leg I.....	16
	6.— <i>Ornithodoros coriaceus</i> : leg IV.....	16
	7.— <i>Ornithodoros talaje</i> : palpus.....	16
	8.— <i>Ornithodoros talaje</i> : leg IV.....	16
	9.— <i>Ornithodoros megnini</i> : palpus.....	16
	10.— <i>Ornithodoros megnini</i> : leg IV.....	16
	11.— <i>Ornithodoros megnini</i> : leg I.....	16
	12.— <i>Ornithodoros megnini</i> : tegument.....	16
	13.— <i>Ornithodoros turicata</i> : tegument.....	16
	14.— <i>Ornithodoros turicata</i> : palpus.....	16
	15.— <i>Ornithodoros turicata</i> : leg I.....	16
	16.— <i>Ornithodoros turicata</i> : leg IV.....	16
	II. Fig.	1.— <i>Ceratiixodes signatus</i> : female shield and coxæ.....
2.— <i>Ceratiixodes signatus</i> : tarsi I and IV.....		22
3.— <i>Ceratiixodes signatus</i> : capitulum of female.....		22
4.— <i>Ceratiixodes putus</i> : capitulum and palpus of female.....		22
5.— <i>Ceratiixodes putus</i> : tarsi I and IV.....		22
6.— <i>Ceratiixodes putus</i> : shield of female.....		22
7.— <i>Ceratiixodes putus</i> : palpus of male below.....		22
8.— <i>Ceratiixodes putus</i> : stigmal plate of female.....		22
9.— <i>Ixodes ricinus</i> : capitulum and tarsus I of female.....		22
10.— <i>Ixodes ricinus</i> : coxæ of female.....		22
11.— <i>Ixodes scapularis</i> ?: stigmal plate of nymph.....		22
12.— <i>Ixodes californicus</i> : female shield and capitulum.....		22
13.— <i>Ixodes ricinus</i> : female shield and stigmal plate.....		22
14.— <i>Ixodes scapularis</i> : mandible, and coxæ I and II.....		22
15.— <i>Ixodes scapularis</i> : capitulum, tarsi I and IV, and shield, of female; stigmal plate of male.....		22
III. Fig.	1.— <i>Ixodes cookei</i> : larva.....	28
	2.— <i>Ixodes cookei</i> : base of palpus of nymph from below.....	28
	3.— <i>Ixodes cookei</i> : tip of palpus of nymph.....	28
	4.— <i>Ixodes cookei</i> : capitulum of female.....	28
	5.— <i>Ixodes cookei</i> : tarsus I.....	28
	6.— <i>Ixodes cookei</i> : coxa I.....	28
	7.— <i>Ixodes cookei</i> : stigmal plate of female.....	28
	8.— <i>Ixodes cookei</i> : shield of female.....	28
	9.— <i>Ixodes brunneus</i> : capitulum and shield of female.....	28
	10.— <i>Ixodes marxi</i> : capitulum, coxæ, and shield, of female.....	28

	Page.
PLATE III. Fig. 11.— <i>Ixodes hexagonus</i> : coxæ of female.....	28
12.— <i>Ixodes diversifossus</i> : capitulum of female	28
13.— <i>Ixodes hexagonus</i> : capitulum and shield of female	28
14.— <i>Ixodes diversifossus</i> : shield, tarsus I, stigmal plate, coxæ I and II, and tooth beneath rostrum—all of female ...	28
IV. Fig. 1.— <i>Ixodes pratti</i> : shield of female, capitulum of female, tooth on rostrum, stigmal plate of female, and coxa I.....	32
2.— <i>Ixodes angustus</i> : coxæ, stigmal plate, capitulum, and shield, of female	32
3.— <i>Ixodes pratti</i> : stigmal plate of nymph.....	32
4.— <i>Ixodes pratti</i> : stigmal plate of male, and tarsus I.....	32
5.— <i>Ixodes pratti</i> : hypostome.....	32
6.— <i>Ixodes dentatus</i> : teeth below on rostrum, coxæ, capitu- lum, and shield, of female	32
7.— <i>Ixodes sculptus</i> : shield and capitulum of female.....	32
8.— <i>Hæmaphysalis leporis-palustris</i> : capitulum of male	32
9.— <i>Ixodes sculptus</i> : coxæ of female	32
10.— <i>Hæmaphysalis leporis-palustris</i> : tarsus I, capitulum and shield, stigmal plate, and coxa I, of female.....	32
11.— <i>Hæmaphysalis chordeilis</i> : shield and capitulum, coxæ I and IV, tarsus IV, and stigmal plate, of female.....	32
V. Fig. 1.— <i>Rhipicephalus texanus</i> : shield, capitulum, and mandible, of female; capitulum and stigmal plate of male.....	34
2.— <i>Rhipicephalus texanus</i> : palpus from beneath	34
3.— <i>Rhipicephalus texanus</i> : stigmal plate of female, anal plates of male, and coxa I.....	34
4.— <i>Rhipicephalus texanus</i> : tarsi I and IV	34
5.— <i>Margaropus annulatus</i> : stigmal plate of nymph, and coxa I of male	34
6.— <i>Margaropus annulatus</i> : shield, capitulum, and coxa I, of female.....	34
7.— <i>Margaropus annulatus</i> : tarsus IV of male, stigmal plate of female, and shield and capitulum of nymph.....	34
VI. Fig. 1.— <i>Amblyomma americanum</i> : male, and stigmal plate of female.	42
2.— <i>Amblyomma americanum</i> : stigmal plate of nymph, and tarsus IV	42
3.— <i>Amblyomma americanum</i> : hypostome, shield, and capitu- lum, of nymph; stigmal plate of male, and coxa I.....	42
4.— <i>Amblyomma americanum</i> : capitulum of female.....	42
5.— <i>Amblyomma maculatum</i> : tarsus IV, and coxæ I and IV..	42
6.— <i>Amblyomma cajennense</i> : tarsus IV, and mandible of male.	42
7.— <i>Amblyomma maculatum</i> : tarsus I, and stigmal plate of male.	42
8.— <i>Amblyomma tuberculatum</i> : capitulum of female, stigmal plate of male and of female.....	42
9.— <i>Amblyomma maculatum</i> : stigmal plate of female	42
10.— <i>Amblyomma maculatum</i> : capitulum of female.....	42
VII. Fig. 1.— <i>Amblyomma cajennense</i> : capitulum of female, and stigmal plate of male.....	42
2.— <i>Amblyomma cajennense</i> : stigmal plate and tarsus I of female; coxæ I and IV of male.....	42
3.— <i>Dermacentor variabilis</i> : capitulum and stigmal plate of female	42
4.— <i>Dermacentor variabilis</i> : capitulum of male	42
5.— <i>Dermacentor albipictus</i> : shield of female	42
6.— <i>Dermacentor variabilis</i> : leg I of larva.....	42

	Page.
PLATE VII. Fig. 7.— <i>Dermacentor nitens</i> : coxa I, leg IV of male, and shield and capitulum of nymph.....	42
8.— <i>Dermacentor variabilis</i> : tarsus I.....	42
9.— <i>Dermacentor albipictus</i> : stigmal plate of female, and capitulum of female and of male.....	42
10.— <i>Dermacentor nitens</i> : stigmal plates of male and female, capitulum, and shield of female.....	42
11.— <i>Dermacentor albipictus</i> : coxa IV, and stigmal plate of male.....	42
VIII. Fig. 1.— <i>Dermacentor occidentalis</i> : capitulum of male and female, shield of female, and tarsus IV of male.....	46
2.— <i>Dermacentor occidentalis</i> : coxæ I and IV of male, stigmal plates of male and female.....	46
3.— <i>Dermacentor nigrolineatus</i> : stigmal plate of female.....	46
4.— <i>Dermacentor venustus</i> : coxa IV of male.....	46
5.— <i>Dermacentor venustus</i> : capitulum and stigmal plates of male and female.....	46
6.— <i>Dermacentor parumapertus</i> var. <i>marginatus</i> : stigmal plate, capitulum, and shield, of female.....	46
7.— <i>Dermacentor venustus</i> : shield of female.....	46
8.— <i>Dermacentor parumapertus</i> : stigmal plate of female.....	46
9.— <i>Dermacentor nigrolineatus</i> : capitulum of female.....	46
10.— <i>Dermacentor parumapertus</i> : shield and capitulum of female, stigmal plate and capitulum of male.....	46
11.— <i>Dermacentor nigrolineatus</i> : stigmal plate and capitulum of male.....	46
IX. (By the late Dr. George Marx.)	
Fig. 1.— <i>Ixodes scapularis</i> : fresh female, and male attached to female.....	48
2.— <i>Ixodes scapularis</i> : female, coxa I, male, female stigmal plate, venter of female, and rostrum from beneath....	48
3.— <i>Ixodes dentatus</i> : engorged female, shield, and capitulum.....	48
4.— <i>Ixodes cookei</i> : male and female above and below, stigmal plate, and rostrum from beneath.....	48
5.— <i>Ixodes ricinus</i> : engorged female, above and below.....	48
6.— <i>Ceratixodes putus</i> : stigmal plate and capitulum.....	48
7.— <i>Ixodes dentatus</i> : rostrum from below.....	48
8.— <i>Ixodes marxi</i> : engorged female.....	48
X. (By the late Dr. George Marx.)	
Fig. 1.— <i>Dermacentor bifurcatus</i> : nymph, coxæ, shield, venter, palpus, stigmal plate, and capitulum.....	48
2.— <i>Hæmaphysalis leporis-palustris</i> : male, and rostrum of female beneath.....	48
3.— <i>Dermacentor variabilis</i> : engorged female, above and below.....	48
4.— <i>Dermacentor variabilis</i> : male, above and beneath, and stigmal plate of female.....	48
5.— <i>Amblyomma americanum</i> : nymph, above and below.....	48
6.— <i>Hæmaphysalis leporis-palustris</i> : fresh and engorged females.....	48
7.— <i>Margaropus annulatus</i> : capitulum of female, above and beneath.....	48
8.— <i>Margaropus annulatus</i> : capitulum of male, above and beneath.....	48
9.— <i>Dermacentor occidentalis</i> : male.....	48
10.— <i>Dermacentor reticulatus</i> : male.....	48
11.— <i>Dermacentor albipictus</i> : male.....	48

A REVISION OF THE IXODOIDEA, OR TICKS, OF THE UNITED STATES.

STRUCTURE.

The Ixodidæ, or ticks, are all mites of considerable size; even the young or "seed-ticks" are visible to the naked eye, while a full-grown engorged female may be half an inch long. Their abundance on many of the domestic animals and occasional occurrence on man have rendered them well-known objects of disgust in every clime.

The body is covered by a tough leathery skin, which in the female becomes greatly distended as she engorges herself with the blood of the host. Before distention the tick is of a somewhat triangular outline, flat, with prominent, slender legs and a beak-like rostrum in front. When the female becomes swollen these characters may be hardly noticeable and the whole creature may look like some large seed or bean. In most of the forms there is on the front part of the dorsum a corneous *shield* known as the *scutum*. In the male this scutum covers the greater part of the body, but in the female only a small part in front. Articulated to the anterior margin of this scutum, and usually within a slight emargination, is a small sub-triangular piece, called the *capitulum*, or head. This capitulum bears the palpi, the mandibles, the mandibular sheaths, and the hypostome. The last three organs together form the *proboscis*, or *haustellum*. The *hypostome* is a median piece beneath (really of two pieces) bearing many recurved teeth or denticles. The more basal of these denticles are in rows, and the number of these rows has been used in the differentiation of species, but is subject to some variation. At the tips of the mandibles are two or three processes, known as the *apophyses*; these have also been used in specific classification, but are now also known to be inconstant. The hypostome and mandibles are inserted into the host when the tick feeds, and so firmly do the recurved teeth of the hypostome hold that if one tries to remove a tick by force the body may be torn from the attached capitulum.

The *palpi* are inserted at the sides of the mouth parts and are of four segments, but commonly one sees only two, for the basal is short

and broad, and the apical is very small and often situated in a depression near the tip of the third. The palpi are usually somewhat concave on the side toward the mouth parts, so that they may sheath these parts. The comparative lengths of the second and third joints of the palpi give useful characters in separating the genera of ticks.

On the dorsum of the capitulum of adult female ticks there are two depressed pitted areas known as the *porose areas*. No one has as yet determined their function. All female ticks of the subfamily Ixodinæ which do not have these organs fully exposed are immature and should not be described as new species. Various species, and even genera, have been based on immature forms, owing to a failure to recognize this point. The genera *Phaulixodes*, *Herpetobia*, *Sarconyssus*, and *Gonixodes* fall in this class.

The shield is usually irregularly hexagonal in shape. On each lateral margin is a pale eye-like spot or ocellus; in some genera these eyes are wanting. The posterior margin of the body in most forms is marked by a number (8 to 10) of short impressed furrows, which outline a series of lobes or *festoons*; these are more distinct in the male than in the female, and when the latter is distended with blood they are barely visible. On the underside or *venter* of the body there are two median apertures; the anterior one not far from the beak is the *genital pore*; the posterior one is the *anus*. In many forms there is a curved groove behind the anus and from it a median furrow, while in other species there is a curved groove in front of the anus and reaching back each side toward the margin of the body. In all forms there is a more lateral groove each side reaching forward to the genital pore. In the males of several genera there are one or two corneous triangular plates each side of the anus, the *anal plates*. Occasionally the abdomen terminates in a median process, or tail.

The legs arise from each side of the anterior part of the venter; the coxæ are sometimes close together, sometimes more widely separate. The legs are usually slender, subequal in length, but the fourth pair is rather the longest, and sometimes larger than the others. Each is composed of at least six joints, as follows, from base outward: *Coxa*, *trochanter*, *femur*, *tibia*, *metatarsus*, and *tarsus*. The latter is commonly more or less definitely divided into two parts. At the tip of the tarsus is a pair of large claws situated on a rather long pedicel, and between them is usually a *pulvillum*. On the upper surface of tarsus I is a pit covered by a membrane; this is known as *Haller's organ*, from its discoverer, and is supposed to be an organ of audition. One or more of the coxæ are armed behind by spine-like processes or teeth. In the males of some species the hind coxæ are greatly enlarged. Above, and usually slightly behind the hind coxæ, are the *stigmal plates* containing near their center: the *stigmal orifice*

or *spiracle*. Each plate is a corneous piece, the surface of which is marked by granules of smaller or larger size. The shape and sculpture of the stigmal plate is quite constant in each species, but differs in the sexes.

In some genera there are on the dorsum, near the middle, a pair of small circular or oval plates, called by Doctor Stiles the *dorso-submedian porose plates*; no one has yet discovered their use.

Ticks are usually dull-colored, but some forms are brightly mottled with brown, white, yellow, or red. However, each species has a characteristic shade of color, which, when once known, helps in field identification; the colors accredited to the species in this paper are those shown by alcoholic materials. In life most of the colors are lighter or more vivid than after immersion in spirits.

LIFE HISTORY.

Ticks are parasitic during the greater period of their life; most of them, however, leave the host to moult, and all, to deposit eggs. Mammals are their ordinary hosts, but birds and reptiles are also infested, and two species of ticks have been taken from insects. Many of them show a decided preference for a certain animal, but a number of our common species have been found on a great variety of animals. Some ticks have apparently changed their host; for example, the Texas fever tick, now chiefly found on cattle, originally infested deer, and possibly bison.

In sucking the blood of their hosts the ticks, unless extremely numerous, do but slight harm, but several of them have been shown to transmit the germs of some disease, so that they become, in several cases, economic pests of prime importance.

The life history of ticks has been investigated by several authors, notably Curtice, Morgan, Lounsbury, and Hunter and Hooker. The female tick, as the result of her bloodthirsty nature, becomes enormously distended, and is then mature. The male mates with the female for some days, after which the latter drops to the ground to deposit eggs. These issue as elongate masses in front of the tick, and may be as many as 1,000 to 10,000 in number. During the operation the head is withdrawn into the body so that the surface of the capitulum is close to the genital pore. As the eggs issue they are coated with a viscous substance secreted from glands opening in the membrane between the shield and the head. These glands are partly eversible and enwrap each egg as it issues from the ovipositor. The eggs are usually placed upon the surface of the soil or just beneath it, and the larvæ hatch in a few days. The young ticks, known as "seed-ticks," ascend the nearest support of grass or herb and patiently await the coming of some animal. Delay and disappointment must often end in starvation and death. The seed ticks are, however, able

to endure long fasts, and many finally secure an attachment to some animal. In a few days the young tick is rapidly distended by blood, and drops to the ground. Here it seeks a hiding place and rests, during which time there are many changes in the internal anatomy. In three or four days the skin splits and from the six-legged larva there issues the octopod nymph. Climbing a plant it awaits the passing of some suitable animal, and, when attached, feeds and falls off again to moult, this time to the adult condition. It again waits for a host, and, finding one, feeds and starts the life cycle anew. The Texas fever tick and its allies do not drop off for moulting, but cast the skin while on the host. This enables a more rapid increase in the species. They drop to the ground, however, for the purpose of depositing eggs. Several other ticks pass the first moult while on the host, and some *Argasidæ* deposit eggs on posts above ground.

In the true ticks there is a considerable difference between the abdomen of the male and that of the female in the development of the dorsal shield. In several genera the male has plates near the anus, and in some cases the hind pair of legs is enlarged in the male; the porose areas are found only in the female; the sexes are, therefore, very easily distinguished.

The males and females feed side by side; but the younger stages are often restricted to a different part of the host; thus the larvæ of several species occur in the ears, while the adults are on the body of the host.

Ticks are able to live for long periods without food or moisture. Four to six months are common periods, and cases are recorded of female ticks fasting for eleven or twelve months. The argasids can live for a much longer time; specimens of *Argas* have remained alive in pill boxes for two years and three months without food, and Riley records one specimen living for five years in a corked vial without food. Even the young may live several months without food. This amazing vitality largely offsets the difficulty the tick may have in finding a host.

Ticks are also well fitted to withstand immersion in water; even the eggs and young stages live through long periods of submergence, so that rains have little effect upon tick life.

GEOGRAPHICAL DISTRIBUTION.

Africa is the home of ticks, all the known genera occurring there, and more species than on any other continent. Of the genera found in the United States, *Rhipicephalus*, *Margaropus*, and *Amblyomma* are tropical, and several of our species in these genera occur in Central and South America. *Dermacentor* is our most characteristic genus, and we have more species than any other country. *Ixodes* and *Hæmaphysalis* are northern genera, both as well represented in Europe

as in this country. Two common tropical genera, *Hyalomma* and *Aponomma*, have not yet been taken in this country. The two genera of Argasidæ favor warm countries. Two of the European species occur in our country, doubtless from importations. Several other European species have been accredited to the United States, but in all cases through erroneous determinations. In the United States the species of *Rhipicephalus* and *Margaropus* are restricted to the Southern States. Several species of *Amblyomma* spread northward along the coasts and up the great valleys. The species of *Dermacentor* are more restricted in distribution, and more abundant in the Northwest. In *Ixodes* the western species are quite unlike those of the East. One species of *Hæmaphysalis* is widely distributed in this country. Although a few species are as yet known from only one host, it is improbable that any are confined to one species of animal. *Dermacentor* is usually found on large mammals and *Ixodes* on small mammals.

ABUNDANCE.

Dermacentor is our most common tick, and the males are about as numerous as the females. *Rhipicephalus* and *Margaropus* are abundant locally, but the males of *Margaropus* are not so often seen. In *Amblyomma* the males are slightly less common than females. In *Ixodes* the males are comparatively rare, and in several species unknown to me. One species in the South is quite abundant, but of the other *Ixodes* only a few are taken at one time.

HISTORICAL.

Since the group is of such great economic importance, the need of a technical revision of the species is apparent. There has never been such a revision of our species. Say described a few species in 1821, Packard several more in 1869, and Fitch in 1871. Koch, in 1844, described a host of ticks from all over the world, naturally including a few from the United States. Each of the authors worked independently of the others. The late Dr. George Marx was much interested in this family of mites, and intended to monograph it, or at least our native species. To this end he had prepared many fine drawings and a considerable body of manuscript. I have had access to this material, and can testify to its high scientific character. In the genus *Dermacentor*, for example, he had the forms known to him separated out as I shall use them in this paper. Later writers confused several of these species, which he rightly held to be distinct. Doctor Marx's manuscript is not suitable for publication, being fragmentary and out of date, but many of his figures are so valuable that I have added two plates made up of them. These of course should be credited to him.

In 1896 Dr. George Neumann, of Toulouse, France, began the publication of a Revision of the Ixodidæ. Doctor Neumann attempted to monograph the ticks of the entire world, a task which in 1896 doubtless seemed quite possible, and the "Revision" was completed in four parts. Since then he has examined thousands of specimens, and his studies have appeared in five notes on the Ixodidæ supplementary to the "Revision." It is quite natural that in examining such a host of specimens from all parts of the world at varying intervals he should be inclined to unite forms which to the student of local fauna seem abundantly distinct. It is in this way that I differ from Doctor Neumann as to the species occurring in this country. I have seen practically all the material that he studied from the United States, including most of his types, and also collections from many colleges and other institutions in this country, together with larger collections made in the past few years. The types of Say and Fitch are lost, but through the kindness of Mr. Samuel Henshaw I have examined the types of Packard, now in the Museum of Comparative Zoology. This enables me to place correctly several species hitherto misplaced by authors. In 1899 Doctors Salmon and Stiles published a finely illustrated work on the cattle ticks of the United States. At that time their material was largely in Doctor Neumann's hands, and since then several species have been collected in this country, and Neumann himself has changed his opinions regarding several species.

During the past year Messrs. W. D. Hunter and W. A. Hooker, of this Bureau, have issued a bulletin (No. 72) on the cattle tick and other species, with much ethologic matter and valuable breeding notes. In this paper 38 species are recorded from this country, and 3 unplaced forms, doubtless identical with some of the known species. More species are to be expected in *Ixodes*, so that our tick fauna may yet have 50 species.

CLASSIFICATION.

Latreille, in 1795, made two genera for the ticks, *Argas* and *Ixodes*. The striking differences between the two were recognized by following acarologists, some of whom even placed *Argas* with the Gamasidæ. Koch, in 1844, divided these two genera into ten—just about as they stand to-day. He arranged these ten genera within three families—Argasidæ, Ixodidæ (long palpi), and Rhipistomidæ (short palpi). These three groups have been generally adopted by later authors. Neumann has modified it somewhat by using rostrum long or short to separate the last two families. But this will hardly distinguish some species of *Amblyomma* and *Dermacentor*. Doctor Marx, in 1892, made a somewhat different arrangement, dividing the group into two—Catastomata and Antistomata. The former is the Argasidæ of Koch, the later he separates into three families—Hæmalas-

toridæ, Ixodidæ, and Rhipistomidæ. The Hæmalastoridæ of Marx is based on a misconception; the type of *Hæmalastor* is a *Hyalomma*, while *Sarconyssus* belongs to *Eschatocephalus*.

These classifications have placed a great deal of prominence on the length of the palpi. Lahille, in 1905, in his tabular arrangement of the genera, has subordinated this character to others, and I fully agree with him. He places, and I believe correctly, *Amblyomma* near *Dermacentor* instead of near *Ixodes*. Lahille, however, bases his main divisions of the Ixodidæ on certain characters of the male; whether the male has five anal plates (Perissopli), or four anal plates (Artiopli), or no anal plates (Anopli). By this arrangement he separates *Hyalomma* from *Amblyomma*, while other authors—and here I agree with these latter—place these genera close together. Indeed, the character used to distinguish the females of these two genera is not always easy of verification, so that several writers have made mistakes in this matter.

Moreover, I fail to see the importance in secondary sexual characters that Lahille places upon them. They certainly are not of sufficient value to characterize groups higher than genera, and are better employed for groups of lesser rank.

Therefore I have made use of another character to divide the Ixodidæ into two groups, namely, the presence or absence of a curved groove in front of the anus and continued back each side. In *Ixodes* this groove is present, in other ticks it is absent, and in most forms there is a small groove behind the anus, not seen in *Ixodes*. *Ixodes* differs in various other ways from the other ticks, notably in lacking festoons to the posterior margin of the body. I have therefore placed *Ixodes* (and *Ceratiixodes*) in a subfamily, Ixodinæ, as opposed to the other ticks, Amblyomminæ. *Rhipicephalus* (and *Margaropus*), by the peculiar shape of the capitulum, have long been considered distinct from other ticks, and for them a tribe is established, the Rhipicephalini; likewise *Hæmaphysalis*, by its peculiar palpi, will warrant another tribe, the Hæmaphysalini. *Amblyomma*, *Hyalomma*, and *Aponomma* are more closely related to each other than to *Dermacentor*. Two more tribes will thus be requisite, the Dermacentorini and the Amblyommini, distinguished not only by the length of the palpi, but also by the lengths of the divisions of the tarsi. These characters will apply to both sexes and even to the nymphal forms. Other less important points aid in distinguishing the groups, as evidenced by the synoptic tables.

Long after the above was written, I received a paper by Mr. Cecil Warburton (Notes on Ticks, December, 1907), in which he proposes practically the same classification as I have proposed above. He uses the position of the anal groove to separate *Ixodes* from all other Ixodidæ, but for this group and all his groups uses new names,

instead of subfamily and tribal names based on the genus. He, however, keeps *Dermacentor* in the same group as *Rhipicephalus*, which I consider ill-advised and have placed them apart, *Dermacentor* closer to *Amblyomma*. Mr. Warburton has also put more value on the length of the palpi than I think justified, and also used, more than I, the secondary sexual characters of the male. A summary of my classification appeared in the Proceedings of the Entomological Society of Washington, Volume VIII, page 62, August, 1907.

Doctor Neumann has also lately (Sjöstedts Kili-mandjaro-Meru Expedition, page 20) given an arrangement of the genera in three sections. He, however, places, and I believe wrongly, *Hyalomma* near *Rhipicephalus*.

Our two families of ticks are very different, as seen from the following statement of characters:

TABLE OF THE FAMILIES.

No corneous shield on dorsum; head hidden beneath front of body; anus near middle of venter; skin roughened.....	<i>Argasidæ</i> .
A corneous shield present on dorsum; head distinct in front of body; anus behind the middle of venter; skin only finely striated.....	<i>Ixodidæ</i> .

Family ARGASIDÆ.

No dorsal shield; head hidden under front of body; anus near middle of venter; skin roughened; coxæ usually contiguous or nearly so; tarsi without apical pulvillum.

In the larvæ the head and mouth parts are distinct, in front of the body, as in the true ticks; there are also indications of a pulvillum at base of claws. However, there is not as much difference between the sexes as in the Ixodidæ; so it seems probable that each family has specialized along different lines. The argasids remain on their hosts for only a short time, and many of them are most active at night.

Our two genera are closely related, but may be distinguished as follows:

TABLE OF THE GENERA.

Margin of body thin and acute.....	<i>Argas</i> .
Margin of body rounded.....	<i>Ornithodoros</i> .

Genus ARGAS Latreille.

Body strongly depressed, elongate oval in shape, usually narrower in front, margins thin and acute; palpi hidden under front of body. Skin strongly wrinkled and with scattered smooth patches, most numerous near the margin. No eyes.

Type.—*A. reflexus* Fabricius.

The famous "Miana bug" of Persia (*Argas persicus* Fischer) belongs to this genus. The bite of this species was reputed to pro-

duce death, and the early travelers in that country give long and exaggerated accounts of the creature.

I have seen two species from our country, which may be tabulated as below:

TABLE OF THE SPECIES.

Anterior tibiæ and metatarsi each about three times as long as broad,	<i>miniatus.</i>
Anterior tibiæ and metatarsi each plainly less than three times as long as broad -----	<i>brevipes.</i>

Argas miniatus Koch.

Dark red-brown, legs pale yellowish, body nearly twice as long as broad, broader behind than in front, broadest behind the middle, tapering, and almost pointed in front, the margin often slightly upturned, except behind; surface densely and irregularly scarred and pitted, the smooth scars of varying sizes and more numerous on sides and behind, in latter part arranged somewhat in rows, a median row and two or more lateral less distinct; ventral surface scarred as above, most densely around the sides; palpi very short and lacking more than their length from reaching the anterior border; on rostrum at base of palpi is a transverse row of four bristles; the stigmal plate, which is scarcely distinct from the surrounding tissue, is a raised spot above the coxa IV and with a curved anterior rim. Legs (Pl. I, figs. 1, 2) rather slender; tarsi barely longer than preceding joints, and suddenly narrowed at tip; the legs have very few hairs; coxæ II, III, and IV are contiguous and radiate, coxa I is distinctly separate from the others, and at the sides of the beak.

The male differs but little from the female; it is usually smaller; the male genital pore is not nearly as broad as the vulva, and is situated farther back, and behind it is a short curved groove each side.

Length of swollen female, 8 to 10 mm.

This species is a common enemy of poultry in the Southwest, from southern Texas to California. It occurs, also, on other animals, rather rarely on cattle. Doctors Stiles and Salmon have described the hexapod larva of this species. I have followed Neumann in uniting *Argas sanchezi* Dugès to this species, as the slight difference in the structure of the mandibles is not constant.

I have seen specimens from Austin, Georgetown, El Paso, Patton, San Antonio, Brackettsville, and Colorado City, Tex.; from Merced and Riverside, Cal.; from Deming, N. Mex., and from Catalina Springs, Ariz.

Argas brevipes n. sp.

This species is similar in shape and general appearance to the common *A. miniatus*. It differs in the much shorter legs, as may be

seen by the figures (Pl. I, figs. 3, 4). The joints appear somewhat more roughened than in *A. miniatus*, and the tibia and metatarsus of leg I are distinctly swollen below before the tip. There are fewer smooth spots on the dorsum of the body, and they are wider apart; on the anterior part are three pairs of smooth spots, and a row each side of them of four; outside of these rows the spots are irregular.

The skin is as densely wrinkled as in *A. miniatus*.

Length of swollen female, 5 to 7 mm.

Three specimens from Tucson, Ariz.; two were from a cavity in *Cereus giganteus*, which was used, perhaps, by a bird.

Argas reflexus Fabricius.

This is the pigeon tick of Europe. I have not seen it from this country, but Prof. H. Osborn, in Bulletin No. 5, of this office, page 256, says: "It is common, I believe, as far north as St. Louis." Several pigeon raisers have informed me that they do not know it, but Thomas Wright, of Massachusetts, claims he has seen it in that State. The species is more ovate in form than our *A. miniatus*, and the color is grayer.

Genus **ORNITHODOROS** Koch.

Body depressed, oval or elongate, sides subparallel, margin of body rounded, not acute; palpi hidden under a median anterior process. Skin usually with many irregular tubercles or granules. Eyes sometimes present.

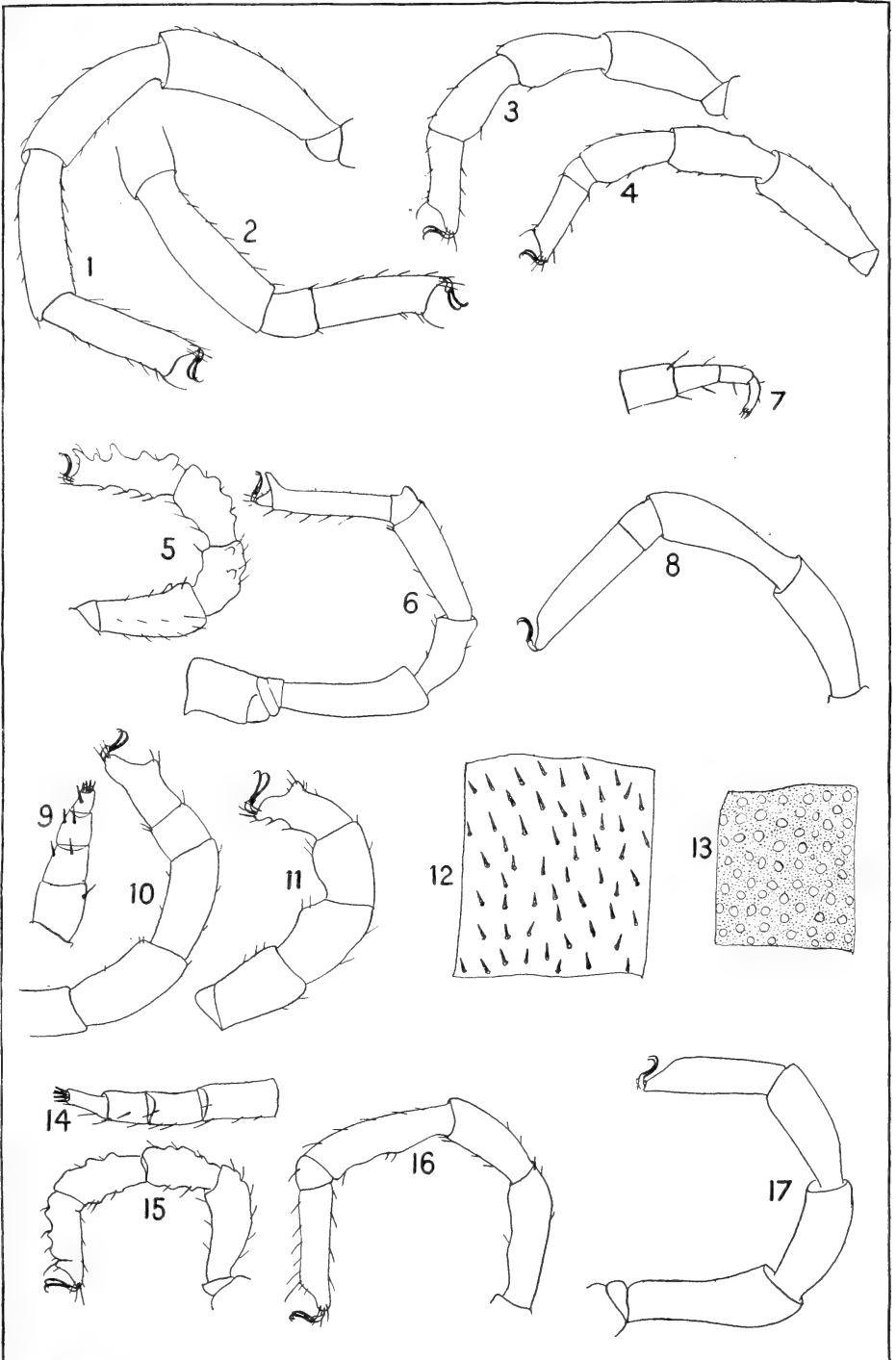
Type.—*O. savignyi* Audouin.

A few species of this genus occur in all tropical countries, four of them in the southern United States. Their bite is so very painful that wherever they occur the inhabitants have given them common names. Three of our species have received common names in Mexico. *O. megnini* is known as "garrapata," a term also applied to various other ticks; *O. turicata* as "turicata," and *O. talaje* as "talaxi." Dr. Jesus Aleman (quoted by Dugès and Mégnin) gives a long account of the inflammation and disorders consequent to the bite of *O. turicata*, and Sallé has written of the pain due to the bite of *O. talaje*.

Our four species may be separated as follows:

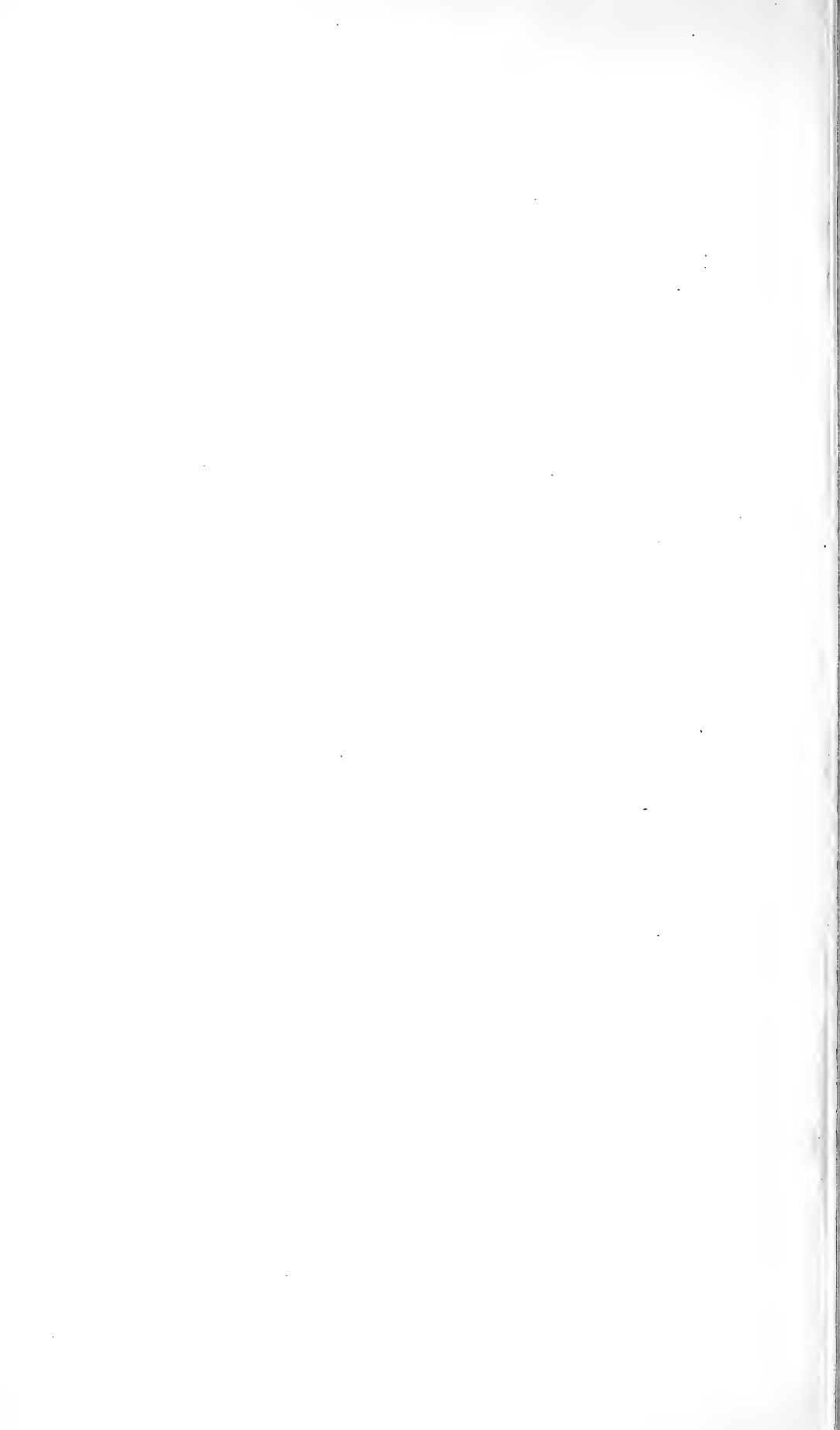
TABLE OF THE SPECIES.

1. Body provided with many short stiff bristles, hind tarsi scarcely three times as long as broad at base, with one subterminal hump above, anterior tarsi also with one subterminal hump; body rounded in front; no eyes.....*megnini*.
Body without bristles, but covered with rounded tubercles or granules; hind tarsi more slender..... 2



IXODOIDEA, OR TICKS, OF THE UNITED STATES.

Fig. 1.—*Argas miniatus*, leg I. Fig. 2.—*Argas miniatus*, leg IV. Fig. 3.—*Argas brevipetes*, leg I. Fig. 4.—*Argas brevipetes*, leg IV. Fig. 5.—*Ornithodoros coriaceus*, leg I. Fig. 6.—*Ornithodoros coriaceus*, leg IV. Fig. 7.—*Ornithodoros talaje*, palpus. Fig. 8.—*Ornithodoros talaje*, leg IV. Fig. 9.—*Ornithodoros megnini*, palpus. Fig. 10.—*Ornithodoros megnini*, leg IV. Fig. 11.—*Ornithodoros megnini*, leg I. Fig. 12.—*Ornithodoros megnini*, tegument. Fig. 13.—*Ornithodoros turicata*, tegument. Fig. 14.—*Ornithodoros turicata*, palpus. Fig. 15.—*Ornithodoros turicata*, leg I. Fig. 16.—*Ornithodoros turicata*, leg IV. Fig. 17.—*Ornithodoros talaje*, leg I. (Original.)



2. Two pairs of eyes present; tarsi IV with a prominent subterminal spur above; front of body conical in the middle; leg I strongly roughened ----- *coriaceus*.
 No eyes; no such spur on hind tarsi ----- 3
3. Front of body conical in middle; tarsi I without humps above ----- *talaje*.
 Body rounded in front; tarsi and metatarsi each with three humps ----- *turicata*.

Ornithodoros megnini Dugès.

Color red-brown to black, legs paler. Body broadly rounded in front and behind, a constriction much behind the middle. Body covered with many short, stiff, spine-like bristles (Pl. I, fig. 12), stouter in front than behind, and on venter mostly hair-like, skin only minutely roughened. Several broad depressions above, and on venter three elongate grooves behind and two in front. Rostrum and palpi (Pl. I, fig. 9) short. Legs (Pl. I, figs. 10, 11) short and stout; tibia and metatarsus of leg I not twice as long as broad, all tarsi with a subterminal hump, no other tubercles, hind tarsi not three times as long as broad at base; all legs with a few scattered hairs. No eyes.

Length of swollen female, 7 to 8 mm.

Male similar, but rather smaller and more slender. The nymphal stage (which is frequently observed) has a body about one and a half times as long as broad, broadest in front of leg III, much narrowed behind, broadly rounded in front and behind, the body covered with spine-like bristles, larger than on the adult, the legs more slender and more hairy. This nymph was first described and figured by Mégnin. Marx proposed for it the name *Rhynchoprion spinosum*.

This species is easily known from all other species of *Ornithodoros* by its bristly body, as well as by shape of tarsi. These, with the greater difference between the adult and nymphal instars, indicate that this species might well be the type of a subgenus. First found by Dugès in the ears of Mexican horses, it has been taken abundantly in the southwestern part of the United States, usually from the ears of cattle, but sometimes from other animals, including man.

Specimens have been examined from the following localities: Aycock, La.; Georgetown, San Antonio, and Victoria, Tex.; Albert, Santa Fé, and Mineral Hill, N. Mex.; Yuma, Ariz.; Los Angeles, Santa Rosa, Santa Clara County, and Humboldt County, Cal.; Ash Meadow, Nev.; Fremont County, Idaho; Davenport and Ames, Iowa, and Lexington, Ky.

Its frequent occurrence in ears has won it the common name of "ear tick" or "spinose ear-tick."

Ornithodoros turicata Dugès.

Color light brown, legs paler. Body broadly rounded in front and behind, only slightly constricted behind leg III, the sides being nearly parallel. Surface of body (Pl. I, fig. 13) covered with many small subequal, subconical granules. Impressions on dorsum small and indistinct, usually a curved one in front, subparallel to anterior margin, and some in pairs behind; on venter is a distinct median groove behind from anus, a curved transverse one half-way from anus to tip, and subcoxal ones extending obliquely outward behind hind coxæ. No eyes. Palpi (Pl. I, fig. 14) rather slender; legs (Pl. I, figs. 15, 16) moderately long, the hind legs about as long as width of body. Tibiæ, metatarsi, and tarsi I, II, and III with three tubercles above on each, those on the tarsi most distinct; hind legs without any definite tubercles, the tarsi being very slender; all legs with a few scattered hairs; all tibiæ and metatarsi more than twice as long as broad.

Length of swollen female, 6 to 7 mm.

I have seen specimens of this species from Keene, Kissimmee, and Crescent City, Fla. (in gopher holes); Burnet and Brownwood, Tex.; Las Cruces, N. Mex.; Phoenix, Ariz. (on cattle), and San Diego, Cal. (on cattle).

The first description of this species was by Dugès, in 1876, in the newspaper *El Repertorio del Guanajuato*, and later (1883) in *La Naturaleza*. Mégnin, in 1885, gave a fuller description with figures, based on specimens sent him by Dugès. One of his figures shows the hind tarsi with a subterminal hump, not found in my specimens. In the National collection is a vial from Doctor Dugès labeled "*O. turicata*, cotype." In this vial are 10 specimens, 7 of *O. megnini* and 3 of *O. turicata* as I have identified it, without a hump on the hind tarsus. I therefore suspect that Mégnin incorrectly delineated this appendage.

This species was taken from hogs in Mexico, and also in Texas, and, like the other species, will attack man.

Ornithodoros coriaceus Koch.

Color dark brown to black, legs paler. Anterior margin of the body rather cone-shaped in middle, broadly rounded behind, sides subparallel, only slightly constricted behind legs III. The body is covered by small, rather elongate granules, usually of a yellowish color, in striking contrast to the dark skin; venter with granules on the posterior part, less distinct in front. There are some fine hairs, at least near the margin of body. On the dorsum are several depressed areas where the granules are few or absent. Venter with a median groove from anus behind, and from in front of anus one extends obliquely down on the sides. Behind leg I is a smooth rounded spot or eye, and behind leg II is another, rather smaller, eye. The rostrum is usually depressed into a cavity, so as to be barely visible. The

palpi are short, the last joint cylindrical and deflected backward. The legs (Pl. I, figs. 5, 6) are long and slender, the fourth pair nearly as long as width of body; tibiæ, metatarsi, and tarsi I, II, III have several prominent tubercles above, and tarsi IV have a basal hump and a prominent subterminal spur above. All legs with a few hairs; the tibia and metatarsus are more than twice as long as broad.

Length of swollen female, 7 to 8 mm.

Described by Koch from Mexico. I have seen specimens from San Francisco and from Santa Clara County, California. It has been taken from cattle and from cattlemen. The spur on the hind tarsus is very characteristic and, with the eyes, will readily separate it from our other species.

Ornithodoros talaje Guérin.

Color light to dark brown, legs paler. Body cone-like in front, broadly rounded behind, a broad depressed groove each side, united in front. About four depressed smooth patches each side on dorsum, the hind pair more elongate. Venter with a groove each side running obliquely down on sides, a median groove from anus behind; a depressed area in front of anus, and toward tip a prominent transverse groove with recurved tips. Body thickly covered with large roughened and sculptured granules, smaller on the middle of the venter. No eyes. Rostrum usually sunk in a cavity, the thin edges of which may partially overlap it; these edges are roughened like the surrounding surface. The palpi (Pl. I, fig. 7) are short, and have the last joint slender and deflected backward. The entire rostrum is retractible, so that one may see only the tips of the palpi. The legs (Pl. I, figs. 8, 17) are short, but slender, and provided with many fine hairs; there are no humps nor tubercles on any of the tarsi, tibiæ, or metatarsi. All tarsi are very slender; the tibiæ and metatarsi more than twice as long as broad.

Length of swollen female, 5 to 6 mm.

This species was described by Guérin Méneville from Guatemala, and I have examined specimens from Gum Cave, Citrus County, Fla.; Brownsville, Tex., and San Clemente Island, California.

The figures by Nicolet in Guérin's article are quite detailed, and leave no doubt as to the identification of the species. It is readily known by the simple tarsi and by the sculptured tubercles of the body. It was not described until 1849 in spite of the fact that in the *Magasin de Zoologie*, Année 1845, it appears in the same form as in the *Revue et Magasin de Zoologie*, Année 1849. That volume of the *Magasin de Zoologie* was begun in 1845, but not finished until 1849; moreover, as shown by the article itself, the tick was not collected until May, 1847.

Family IXODIDÆ.

Dorsum of the body more or less covered by a corneous shield; head distinct in front of body; anus behind middle of venter; skin finely striated. Coxæ more or less separated; tarsi with a pulvillum. Stigmal plate behind coxæ IV. Male with dorsum almost entirely covered by the corneous shield; in the female the shield is restricted to the anterior part of dorsum, and there are on the capitulum a pair of porose areas, not seen in males or in immature stages.

The genera and higher groups known from our country may be separated by the following table:

TABLE OF THE GENERA.

- | | | |
|--|--------------------------------------|---|
| 1. Venter showing a curved groove a short distance in front of the anus and extending back each side to the hind margin; no posterior marginal festoons; stigmal plate nearly circular; no ocelli; hind coxæ of male not enlarged..... | (Ixodinæ.) | 2 |
| Venter showing more or less distinctly a curved groove behind the anus, but none in front of it; the male with distinct marginal festoons, more or less distinct in the female..... | (Amblyomminæ.) | 3 |
| 2. Capitulum slightly angulate on the sides; palpi with the third joint shorter than broad, and broadly rounded..... | <i>Ceratixodes.</i> | |
| Capitulum not angulate on sides; palpi with the third joint longer than broad, and slightly tapering toward the tip..... | <i>Ixodes.</i> | |
| 3. Sides of capitulum angulate; ocelli present; male with anal plates; palpi very short..... | (Rhipicephalini.) | 4 |
| Sides of capitulum not angulate..... | | 5 |
| 4. Palpi with acute transverse ridges; stigmal plate nearly circular; porose areas elliptical, distant; no distinct groove behind anus..... | <i>Margaropus.</i> | |
| Palpi without transverse ridges; stigmal plate comma shaped; porose areas triangular, approximate; a distinct groove behind anus, | <i>Rhipicephalus.</i> | |
| 5. Outer angle of the second joint of the short palpi acutely produced; no ocelli; male without anal plates..... | (Hæmaphysalini) <i>Hæmaphysalis.</i> | |
| Outer angle of second joint of palpi not acutely produced..... | | 6 |
| 6. Palpi longer, second joint about twice as long as broad; coxæ IV of male not enlarged; tarsi II, III, and IV plainly divided, the basal part much shorter than the apical part..... | (Amblyommini) <i>Amblyomma.</i> | |
| Palpi shorter, second joint barely longer than broad; coxæ IV of male enlarged; tarsi II, III, and IV indistinctly divided, the parts subequal in length..... | (Dermacentorini) <i>Dermacentor.</i> | |

Genus CERATIXODES Neumann.

Venter showing furrows as in *Ixodes*. Capitulum not produced anteriorly in the middle, but the sides somewhat angulate; porose areas oval, transverse. Palpi short, third joint no longer than broad, and broadly rounded. Shield unmarked, no ocelli. Coxa I close to rostrum, barely toothed behind; coxa IV of male not enlarged. Posterior margin of body without festoons. Stigmal plate circular.

Tarsi II, III, and IV divided, the parts of variable length, no tooth-like claw at apex.

Type.—*C. (Ixodes) putus* Cambridge.

Our two species are separable as follows:

TABLE OF THE SPECIES.

1. Shield of female broadest on first third; divisions of tarsi II, III, and IV subequal in length; capitulum less angulate on side.-----*putus*.
Shield of female broadest on middle third; basal division of tarsi II, III, and IV much shorter than apical; capitulum more angulate on sides.-- *signatus*.

***Ceratixodes signatus* Birula.**

Female.—Shield reddish brown, legs paler, abdomen yellowish brown. Capitulum (Pl. II, fig. 3) very broad, lateral angles acute, hind angles not distinct, porose areas occupying nearly the whole of upper surface, palpi short and thick, with some scattered bristles, third joint but little swollen on inner side at base. Shield (Pl. II, fig. 1) much longer than broad, broadest on middle third, the lateral lobes only well separated in front, surface with many rather small punctures, abdomen with a few very short hairs; the abdomen, in swollen female, is very elongate; legs large and very slender; tarsi (Pl. II, fig. 2) tapering to tip; coxæ I, II, and III (Pl. II, fig. 1) with a small apical process behind. Stigmal plate circular, peritreme circular, surface with many minute granulations.

Length of female shield, 1.5 mm.

Several specimens from Pacific Grove, Cal., on a cormorant. It was described by Birula from Unalaska Island, and through the kindness of that gentleman I have examined one of his cotypes. Apparently the same species has been described by Neumann from Japan as *Ixodes parvirostris*.

***Ceratixodes putus* Cambridge.**

Female.—Shield and legs dull yellowish; abdomen pale brownish. Capitulum (Pl. II, fig. 4; Pl. IX, fig. 6) more than twice as broad as long, rather wider at outer base of palpi than elsewhere, hind angles not prominent, porose areas large, approximate, pointing outward. Palpi (Pl. II, fig. 4) rather large, second joint with four long bristles on the inner side below, third joint with a swelling on the inner side near base, the apical joint large, with a bristle each side. Shield (Pl. II, fig. 6) plainly longer than broad, broadest on anterior third, somewhat concave and tapering behind, tip rounded, the lateral lobes distinctly separated, surface with many irregularly placed deep punctures, not all of an even size; abdomen above and below with many long hairs. Legs large and slender, the tarsi (Pl. II, fig. 5) strongly humped above before tip; coxæ wholly unarmed.

Stigmal plate (Pl. II, fig. 8; Pl. IX, fig. 6) large, nearly circular, with a circular peritreme, surface minutely granulate.

Length of female shield, 1.7 mm.

Male.—Body subrectangular, narrowed in front of third pair of legs, broadly rounded behind. Shield not reaching to tip, with many subequal punctures, some hairs near hind margin of body; venter finely punctate; stigmal plate as in the female. Capitulum three times as broad as long, with a median depression; mandibles about one-half as long as palpi, hypostome still shorter, palpi (Pl. II, fig. 7) cylindrical, third joint prolonged in an acute point, the fourth joint projecting below from near the base. Legs rather slender; coxæ unarmed; the tarsi tapering, fourth with apical tooth and subterminal tubercle beneath.

Length of male, 3.8 mm.

Specimens come from St. Paul Island, Alaska, and Bering Island. Birula records it from Unalaska, and Kramer and Neuman from Bering Island. Cambridge described it from Kerguelen Island, Antarctic Ocean, and Evans and others have taken it from the western isles of Scotland. It is probable that the *Ixodes urivæ* of White (a manuscript name) from Arctic America is the same species. It occurs on several large migratory sea birds.

Genus IXODES Latreille.

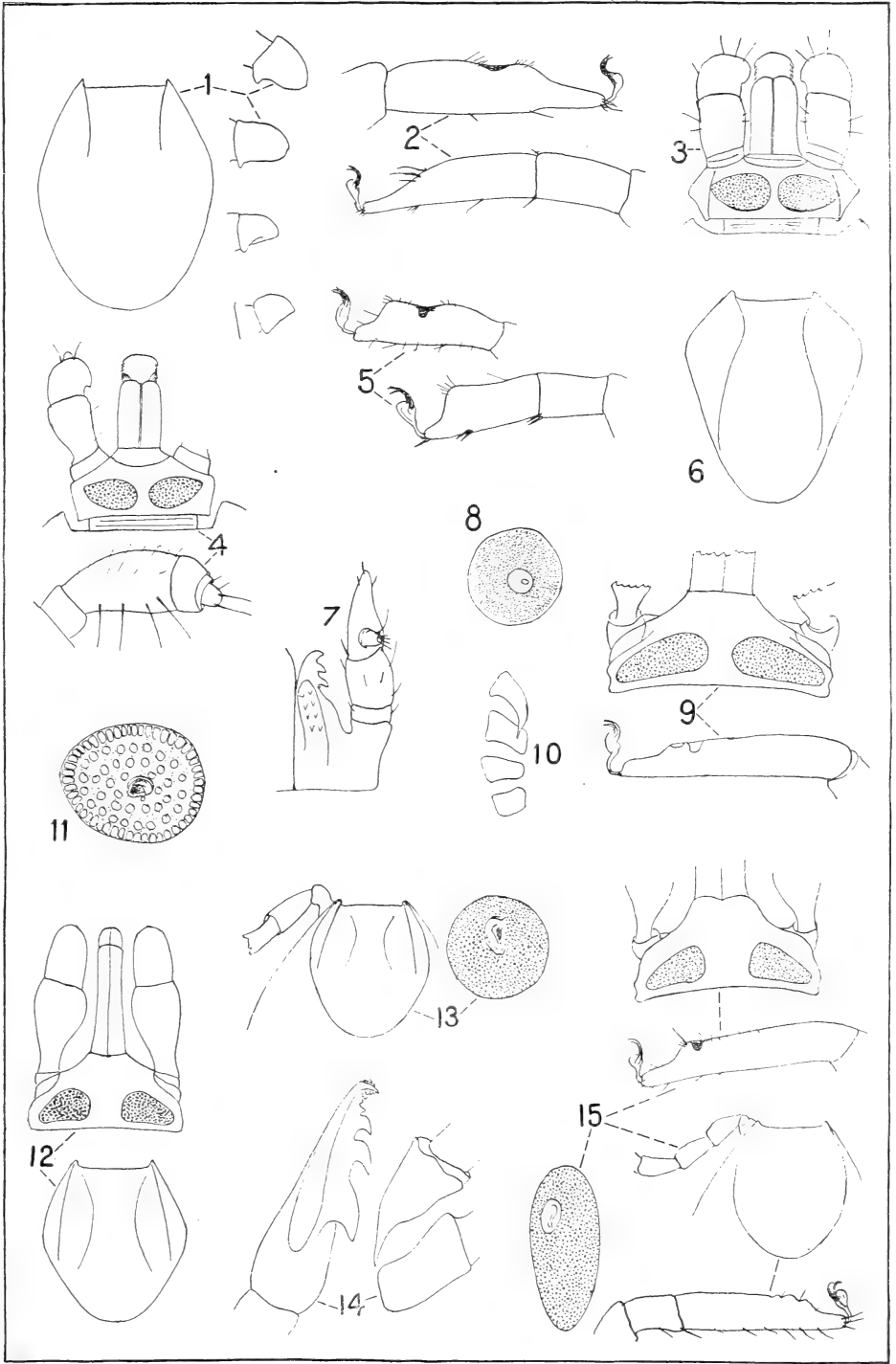
Venter showing a pair of submedian grooves reaching forward from hind margin of body and connected in front of anus; no groove behind anus. Capitulum produced anteriorly in the middle; porose areas subtriangular. Palpi rather slender, at least in female, the second joint usually twice as long as broad, the third not very much shorter, longer than broad and tapering toward tip. Shield without markings; no ocelli. Coxa I close to rostrum, with one or two teeth behind; coxa IV of male not enlarged. Posterior margin of body without festoons. Stigmal plate circular or elliptic. Tarsi II, III, and IV divided, the basal part shorter than the apical part, and no tooth-like claw at apex.

Type.—*Ixodes ricinus* Linnæus.

Our species are numerous, and probably there are several yet to be found by more thorough exploration.

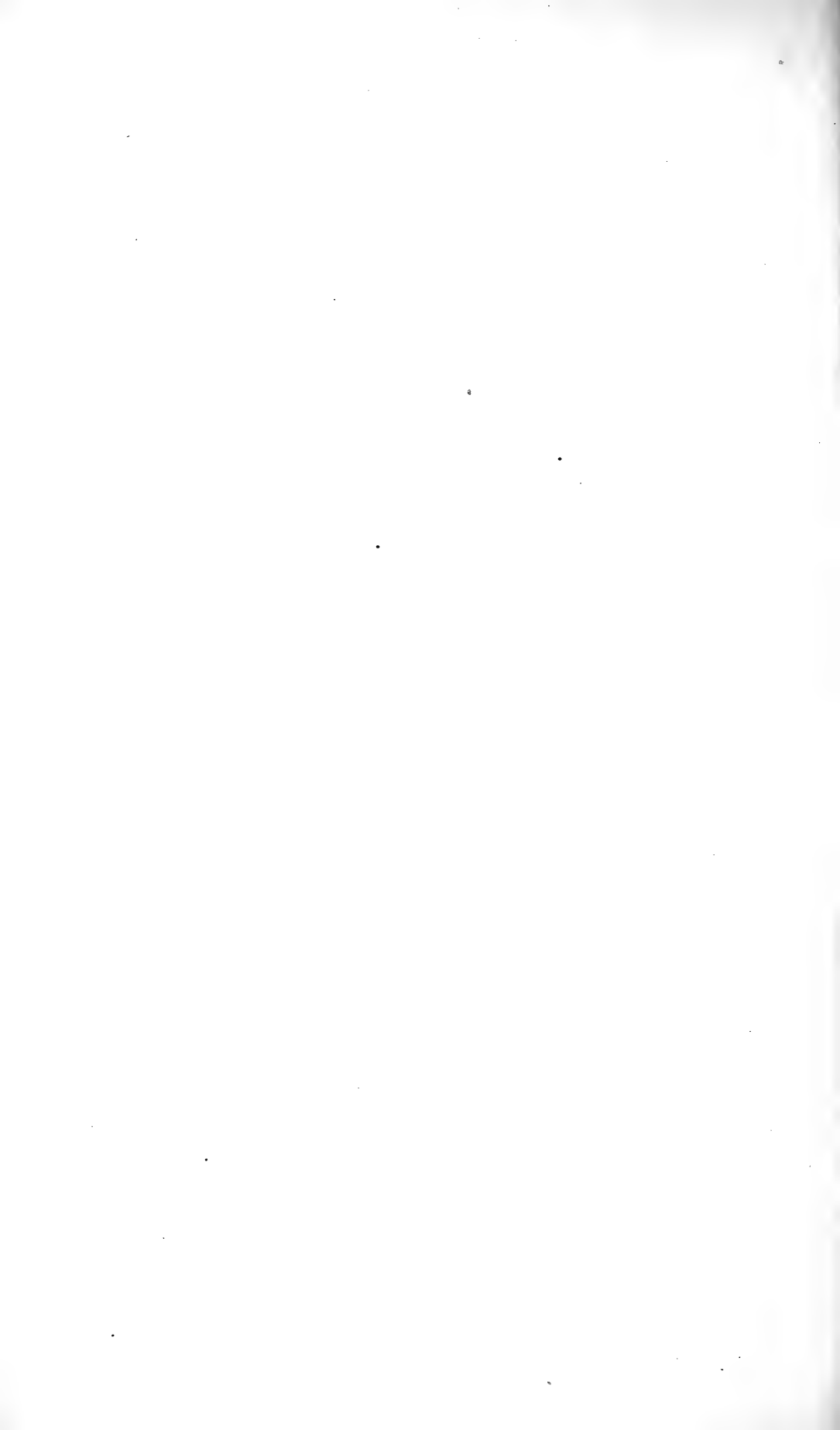
TABLE OF THE SPECIES.

1. Tarsus I fully one and one-half times as long as the metatarsus.....	2
Tarsus I barely more than one and one-fourth times as long as the metatarsus	6
2. A stout backward-directed tooth on under side of rostrum from near base of each palpus; shield fully twice as long as broad, with definite lateral carinæ; porose areas about as long as broad....	<i>diversifossus</i> .
No such teeth on rostrum below, at most only a tubercle; shield broader, and rarely with definite carinæ; porose areas plainly broader than long.....	3



IXODOIDEA, OR TICKS, OF THE UNITED STATES.

Fig. 1.—*Ceratixodes signatus*, female shield and coxæ. Fig. 2.—*Ceratixodes signatus*, tarsi I and IV. Fig. 3.—*Ceratixodes signatus*, capitulum of female. Fig. 4.—*Ceratixodes putus*, capitulum and palpus of female. Fig. 5.—*Ceratixodes putus*, tarsi I and IV. Fig. 6.—*Ceratixodes putus*, shield of female. Fig. 7.—*Ceratixodes putus*, palpus of male below. Fig. 8.—*Ceratixodes putus*, stigmal plate of female. Fig. 9.—*Ixodes ricinus*, capitulum and tarsus I of female. Fig. 10.—*Ixodes ricinus*, coxæ of female. Fig. 11.—*Ixodes scapularis*?, stigmal plate of nymph. Fig. 12.—*Ixodes californicus*, female shield and capitulum. Fig. 13.—*Ixodes ricinus*, female shield and stigmal plate. Fig. 14.—*Ixodes scapularis*, mandible, and coxæ I and II. Fig. 15.—*Ixodes scapularis*, capitulum, tarsi I and IV, and shield, of female; stigmal plate of male. (Original.)



3. Shield about one and one-half times longer than broad; all coxæ with spines; second joint of palpus about four times as long as broad; porose areas occupying greater part of capitulum; a small tooth at base of each palpus.....*brunneus*.
 Shield but little longer than broad; only coxa I spined (in female); second joint of palpus scarcely three times as long as broad; porose areas smaller 4
4. Shield not angulate on sides, no lateral carinæ; porose areas separated by fully their length; tarsus I rather shorter.....*scapularis*.
 Shield slightly angulate on sides, with traces of lateral carinæ..... 5
5. Porose areas large, separated by less than their length; coxa I with very long spine*ricinus*.
 Porose areas smaller, more widely separate; coxa I with shorter spine; shield more rhomboidal.....*californicus*.
6. Shield with definite lateral carinæ..... 7
 Shield without definite lateral carinæ; coxa I with a short spine..... 11
7. A large tooth each side under rostrum; coxa I with one long spine..... 10
 No such teeth under rostrum..... 8
8. Shield fully one and one-half times as long as broad; coxa I with rather short spine; porose areas triangular.....*angustus*.
 Shield not one and one-half times as long as broad; coxa I with long spine; porose areas not triangular..... 9
9. Porose areas as long as broad, the area separating them with a scar*sculptus*.
 Porose areas broader than long, no scar between them.....*cookei*.
10. Shield narrowed behind; hind angles of capitulum very prominent; porose areas broader than long, very small.....*pratti*.
 Shield very broad behind; hind angles of the capitulum barely distinct; porose areas nearly as long as broad.....*dentatus*.
11. Shield finely punctate, about one and one-half times as long as broad; third joint of palpus longer than broad; porose areas small, separated by their width*marxi*.
 Shield coarsely punctate, barely longer than broad; last joint of palpus about as broad as long; porose areas larger, not separated by width*hexagonus*.

Ixodes arcticus Osborn.

This was described from one specimen taken from a seal from the Pribilof Islands. It is recorded (No. 3500) in the type catalogue of the Division of Insects, U. S. National Museum, but diligent search on several occasions has failed to discover the specimen, therefore I am compelled to copy the description of Professor Osborn, which is not as specific as I could wish, yet indicates that the species is a good one:

"Elongate oboval, slightly contracted behind the middle, finely transversely striated; dorsal shield deep chestnut brown, oval except where truncated to join head; two divergent impressed lines or furrows from near the anterior margin to behind the middle, where they terminate abruptly, and external to which, near their ends, are short, impressed lighter marks, one on either side. Palpi rather short, blunt, truncate at apex, sharp edged, flat, and somewhat impressed

above; legs blackish except the joints, long, strong. The dorsum of the expanded abdomen has two deep parallel furrows anteriorly and three posteriorly, and the ventral surface has the ordinary furrows of the genus, much as in *ricinus*. The color of the alcoholic specimens is a testaceous yellow. Length of expanded female, 6 mm. Length of dorsal shield, 1.25 mm.; width, 0.92 mm."

***Ixodes californicus* Banks.**

Female.—Shield yellow-brown, legs darker brown, abdomen yellowish gray, unspotted. Capitulum (Pl. II, fig. 12) not nearly as broad as in *I. ricinus*, the posterior angles acute, the porose areas subtriangular, but plainly broader than long, and separated by about their length, inner edge oblique; palpi moderate, second joint plainly a little longer than the third, the latter not twice as long as broad. Shield (Pl. II, fig. 12) but little longer than broad, somewhat trapezoidal, the outer sides rather angulate before the middle, lateral carinæ not distinct, but traceable, punctuations numerous and fine. Abdomen striate, punctate, and hairy; ventral furrows divergent behind, legs rather slender, very hairy below, tarsus I fully one and one-half times longer than metatarsus, tapering to the tip, tarsus IV but little longer than metatarsus, tapering; coxa I with a long, sharp, basal spine, and a minute tooth at apex behind to all coxæ; stigmal plate rather small, nearly circular, and its surface finely granulate.

Length of female shield, 1.2 mm.

Male.—Similar to that of *I. scapularis*, but the shield has more nearly parallel sides, and the stigmal plate is nearly circular, the palpi are very short, and coxa I has a long, sharp spine behind.

Length of male, 2 mm.

Specimens from Claremont, Santa Clara County, Santa Cruz Mountains, and Redwood Creek, Humboldt County, all California. The hosts were gray fox and black-tail deer.

Separated from *I. ricinus* by shape of the porose areas, and from *I. scapularis* by more distinct lateral carinæ, and many minor points.

***Ixodes ricinus* Linnæus. (Pl. IX, fig. 5.)**

Female.—Shield reddish brown, body, legs, and palpi a paler brown, unspotted. Capitulum (Pl. II, fig. 9) very broad and short, porose areas twice as broad as long, not separated by their length, inner edge rounded, outer ends nearly reaching to basal angle of capitulum; palpi moderate, second joint barely longer than the last, the latter fully twice as long as broad. Shield (Pl. II, fig. 13) rather elliptical, plainly longer than broad, and the outer sides somewhat angulate much before the middle, lateral carinæ short and indistinct; many small, equal punctures, most numerous behind. Legs long, tarsus I (Pl. II, fig. 9) fully one and one-half times as long as

metatarsus, tapering to tip, tarsus IV also slender and tapering; coxa I with a long sharp spine at base and a minute one at tip, II with a small tooth at tip behind, others practically unarmed. (See Pl. II, fig. 10.) Abdomen above and below punctate and with many hairs; in female before engorgement there is a submarginal groove, incomplete behind; both ventral furrows divergent behind. Stigmal plate (Pl. II, fig. 13) rather large, circular, its surface minutely granulate.

Length of female shield, 1.1 mm.

Specimens in Marx collection from Kansas on sheep and from Texas on cattle. I have compared these with European specimens and they seem to be identical. Possibly they were introduced into this country with the hosts. I have not seen a male. Practically all of the previous records of this species in this country apply to *Ixodes scapularis* or to *I. cookei*.

***Ixodes scapularis* Say.** (Pl. IX, figs. 1, 2.)

Female.—Shield dark red-brown, almost black; legs and palpi paler; abdomen brown. Capitulum (Pl. II, fig. 15; Pl. IX, fig. 2) quite broad, hind angles acute, porose areas rather large, but plainly smaller than in *I. ricinus*, much broader than long and separated by fully their length, their inner edge somewhat truncate, and their outer angle not far from hind angle of capitulum; palpi elongate, second joint a little longer than the last, which is hardly twice as long as broad. Shield (Pl. II, fig. 15) broad in front, plainly longer than broad, broadly rounded behind, outer sides not angulate, and no lateral carinæ; punctuations fine and numerous all over surface. Legs long and slender; tarsus I fully one and one-half times as long as the metatarsus, and tapering to tip; tarsus IV plainly shorter than I, tapering to tip (see Pl. II, fig. 15); trochanters I and II swollen behind; all legs very hairy below; coxa I (Pl. IX, fig. 2) with a long sharp spine behind at base, and a small apical tooth, coxæ II and III with apical tooth, IV unarmed (see Pl. II, fig. 14). Abdomen finely striate, hairy, not prominently punctate; before engorgement there is a submarginal groove each side; stigmal plate (Pl. IX, fig. 2) circular, its surface finely and evenly granulate; ventral furrows divergent behind.

Length of female shield, 1.3 mm.

Male.—Dark colored as in female; the palpi are very short, second and third joints no longer than broad; shield with subparallel sides, densely punctate and very hairy; legs and coxæ as in the female; the stigmal plate (Pl. II, fig. 15) large, and elongate.

Length of male, 2 mm.

From many places in the South, especially abundant in Florida and southern Texas, where it occurs on dogs and man as well as on

various wild animals; from Norfolk, Va., on cattle; McGregor, Iowa; Texas (Belfrage Coll.); North Carolina, and Texas (Marx Coll.); Maryland, on sheep; Indiana.

This species is readily separated from *I. ricinus* by smaller porose areas and by the dark shield. It has been confused with *I. ricinus* by Neumann in the Marx collection; however, Neumann described the same species as new, *I. affinis*, from Costa Rica, and I have examined some of his type material.

***Ixodes brunneus* Koch.**

Female.—Shield brown, paler through the middle; palpi brown, pale on base; legs pale brownish yellow, tarsi paler, other joints marked with brown; abdomen brown, usually paler than the shield. Capitulum (Pl. III, fig. 9) small, hind angles not prominent; porose areas very large, angulate in front, separated by about one-half their length; palpi very slender, second joint plainly longer than last, latter fully twice as long as broad. Shield (Pl. III, fig. 9) about one and one-half times longer than broad, widest rather before the middle and tapering each way, no lateral carinae, but submedian grooves distinct, surface with many fine punctures, lateral lobes wrinkled. Legs slender, tarsus I very long, about twice as long as the preceding joint, tapering to tip, hind tarsus also tapering, but not so much longer than the metatarsus: coxæ I with a large, short spine at base and all coxæ with a distinct tooth at apex behind; trochanters II and III swollen behind. Body striate and punctate, with numerous hairs; anal furrows parallel behind; stigmal plate large, circular, and its surface with quite large granules.

Length of female shield, 1.5 mm.

Two females from a tufted tit, Raleigh, N. C. (Brimley Coll.); also one female from hermit thrush, Baltimore, Md. (Hassall Coll.). This is the specimen named by Neumann *Ixodes frontalis*. At that time, however, he had not seen the type of *I. brunneus*. Later, in a key, he separates them on the ground that *brunneus* has the tarsi attenuated gradually, while in *frontalis* they are narrowed suddenly before the tip. In this specimen the tarsi are certainly not attenuated suddenly, but are like the North Carolina specimens. There is another specimen, in the collection of the Massachusetts Agricultural College, which was taken from the neck of a "chipping bird," May 1, 1895, probably from Amherst, or near by; and the *Ixodes kelloggi*, recently described by Nuttall and Warburton, is evidently the same species, although the description is very brief. Their specimens came from Californian birds. Koch described the species from one female from *Fringilla albicollis*, from North America. I have not seen the male. Evidently the species is confined to birds.

***Ixodes diversifossus* Neumann.**

Female.—Shield, capitulum, and legs very dark red-brown; abdomen grayish yellow. Capitulum (Pl. III, fig. 12) rather triangular, long, hind angles very prominent; porose areas rather small, subtriangular, much more than width apart; palpi long and slender. Shield (Pl. III, fig. 14) plainly a little longer than broad, broadly rounded behind, broadest in front of middle, lateral carinæ distinct, reaching margin; surface with mostly small punctures, but those near the margin behind are very large. Abdomen striate and punctate; anal grooves subparallel; stigmal plate (Pl. III, fig. 14) large, nearly circular, coarsely granulate; coxæ I (Pl. III, fig. 14) with a large, sharp, basal spine, a small apical cone beyond it, and similar cone on coxæ II (Pl. III, fig. 14) and III, that on coxæ IV very indistinct; legs long and slender, tarsi slender, tarsus I (Pl. III, fig. 14) about twice as long as preceding joint; all tarsi taper to tip. Under the beak at base of palpi is a large backward-directed tooth each side (see Pl. III, fig. 14).

Length of female shield, 1.6 mm.

Two specimens (the types) from a raccoon, New Mexico, in the Hassall collection, and kindly loaned by Doctor Hassall.

Ixodes bicornis Neumann, described after the types of *I. diversifossus* were returned to the United States, comes extremely close to this species, and I think is identical. It is from Mexico, and I have specimens from Doctor Dugès agreeing closely with the description and also with the types of *I. diversifossus*. The male is still unknown.

***Ixodes pratti* n. sp.**

Female.—Dark reddish brown, legs and palpi paler. Capitulum (Pl. IV, fig. 1) broad, outer angles rather prominent, posterior angles distinctly prolonged; porose areas broader than long, and separated by one-half their width; palpi short, second joint about one and one-half times as long as broad, last joint scarcely as broad as long; below there is near the base of each palpus a distinct, stout, downward-projecting tooth (see Pl. IV, fig. 1). (Hypostome, Pl. IV, fig. 5.) Shield (Pl. IV, fig. 1) a trifle longer than broad, narrowed behind, lateral carinæ distinct and reaching to the margin, surface rather densely punctate, and many of the punctures quite large. Abdomen striate and punctate, with very fine hairs; anal grooves plainly divergent; stigmal plate (Pl. IV, fig. 1) small, almost circular, its surface with rather large granules. Coxæ with a minute tooth at apex behind; coxa I (Pl. IV, fig. 1) with a moderately long basal spine (not as long as in *I. cookei*). Legs short and slender, quite hairy, and the tarsi (Pl. IV, fig. 4) tapering to the tip.

Length of female shield, 0.9 mm.

Male.—Body very slender, more than twice as long as broad, dark brown, and very hairy; a deeply impressed lateral and posterior groove; surface densely punctate. Capitulum not broader behind than long in middle, sides parallel, posterior angles not prolonged; palpi short, but longer than width of capitulum, the third joint a little longer than broad, legs rather short, coxæ I with a very long, slender spine behind, II with two humps behind, and III with one hump; venter punctate; stigmal plate (Pl. IV, fig. 4) twice as long as broad, finely granulate.

Length, 2 mm.

A pair from Kerrville, Tex., May; one female from Sherwood, Tex., on a prairie dog (F. C. Pratt), and two females from Walker Pass, Death Valley, California, from *Thomomys* (Fisher).

This species differs from *Ixodes diversifossus* by the shorter tarsi I, by the absence of large pits on posterior part of the shield, by shorter spine on coxa I, by shorter palpi, and has several minor differences. Nymphs, probably of this species, are from Kerrville on skunk, and from Del Rio on rock squirrel; the stigmal plate is elliptical, and of peculiar sculpture, as figured (Pl. IV, fig. 3).

***Ixodes dentatus* Neumann.** (Pl. IX, fig. 3.)

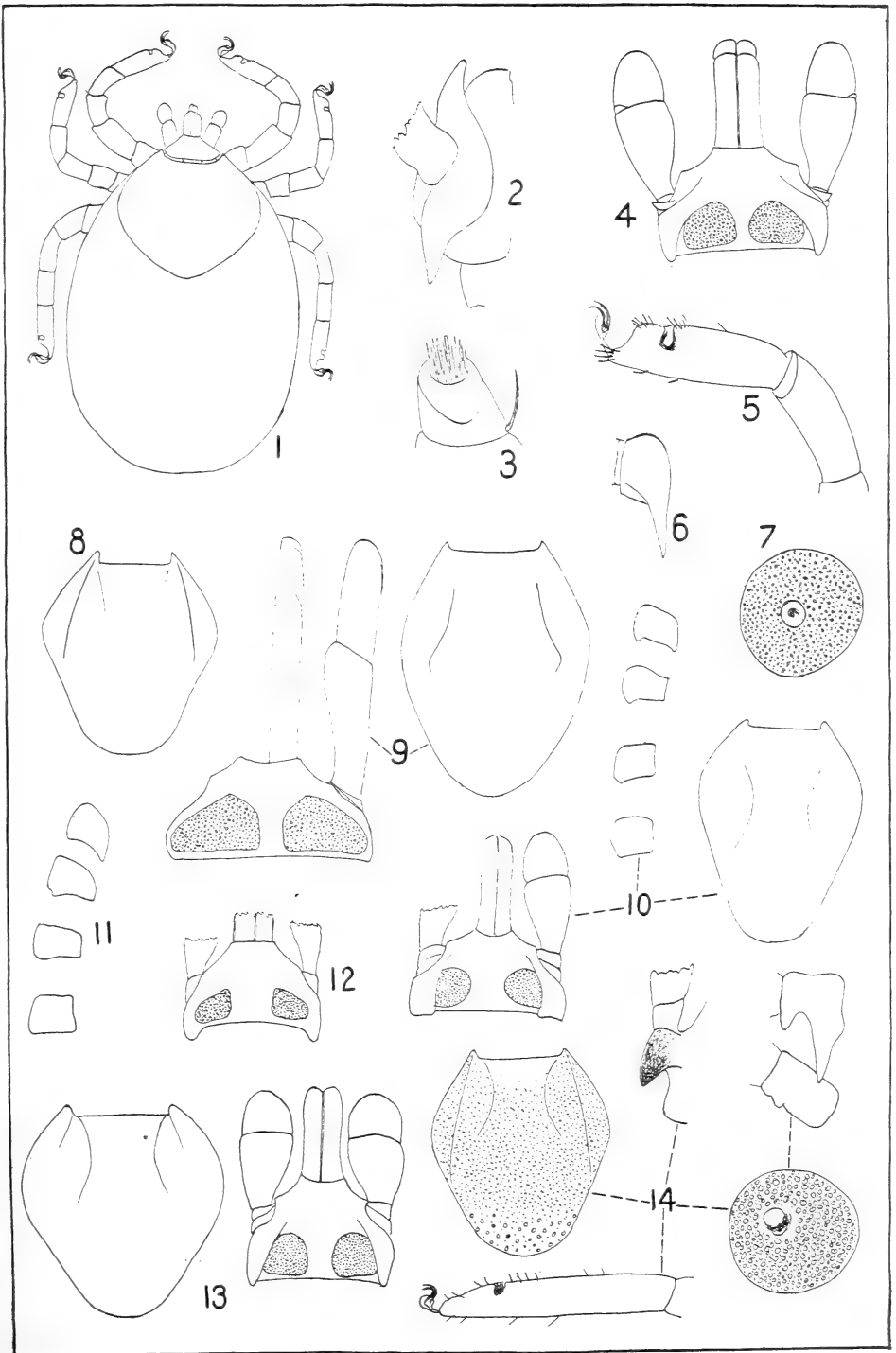
Female.—Shield, capitulum, and legs dark red-brown; abdomen nearly black. Capitulum (Pl. IV, fig. 6; Pl. IX, fig. 3) small, hind angles rather prominent; porose areas broader than long, nearly their width apart; shield (Pl. IV, fig. 6; Pl. IX, fig. 3) only a little longer than broad, broad behind, lateral carinæ distinct, reaching the hind margin, the middle area behind densely, finely punctate, elsewhere with few punctures. Abdomen (engorged female) elongate, striate and punctate, with many very short hairs; stigmal plate circular, its surface minutely granulate, the stigma nearly central. The under side of the rostrum shows a stout recurved tooth each side, just behind the bases of palpi (Pl. IV, fig. 6; Pl. IX, fig. 7). Coxæ I with a long basal spine behind, and a small apical tubercle, and similar one on coxæ II, others unarmed (Pl. IV, fig. 6); legs short, finely haired.

Length of female shield, 1 mm.

Described from the type specimen in the Marx collection, taken from a rabbit in Maryland; the palpi are broken off. This is the only specimen I have seen; it is very distinct, not only by the teeth on the rostrum, but also by the shape of the shield.

***Ixodes cookei* Packard.** (Pl. IX, fig. 4.)

Female.—Shield yellow-brown, legs and palpi somewhat paler, abdomen gray-brown. Capitulum (Pl. III, fig. 4; Pl. IX, fig. 4) rather broad, triangular, the hind angles moderately prominent, the



IXODOIDEA, OR TICKS, OF THE UNITED STATES.

Fig. 1.—*Ixodes cookei*, larva. Fig. 2.—*Ixodes cookei*, base of palpus of nymph from below. Fig. 3.—*Ixodes cookei*, tip of palpus of nymph. Fig. 4.—*Ixodes cookei*, capitulum of female. Fig. 5.—*Ixodes cookei*, tarsus I. Fig. 6.—*Ixodes cookei*, coxa I. Fig. 7.—*Ixodes cookei*, stigmatal plate of female. Fig. 8.—*Ixodes cookei*, shield of female. Fig. 9.—*Ixodes brunneus*, capitulum and shield of female. Fig. 10.—*Ixodes marzi*, capitulum, coxæ, and shield, of female. Fig. 11.—*Ixodes hexagonus*, coxæ of female. Fig. 12.—*Ixodes diversifossus*, capitulum of female. Fig. 13.—*Ixodes hexagonus*, capitulum and shield of female. Fig. 14.—*Ixodes diversifossus*, shield, tarsus I, stigmatal plate, coxæ I and II, and tooth beneath rostrum—all of female. (Original.)



porose areas about one-fourth broader than long, one-half their diameter apart; palpi short and broad, the last joint barely, if any, longer than broad, and plainly shorter than second joint. Shield (Pl. III, fig. 8) only a trifle longer than broad, somewhat narrowed behind, widest part plainly in front of the middle, its surface densely and rather coarsely punctate, the lateral carinæ moderately distinct, running out slightly behind the widest part. Abdomen punctate and with extremely short hairs; in engorged specimens elongate; the anal furrows subparallel behind; the stigmal plate (Pl. III, fig. 7; Pl. IX, fig. 4) large, elliptical, the surface granulate and the stigma situated before the middle; coxæ with a small apical tooth behind, and coxa I (Pl. III, fig. 6) with a long stout spine at base; legs rather long and large, tarsi suddenly narrowed before tip, tarsus I (Pl. III, fig. 5) but little longer than the metatarsus.

Length of female shield, 1.5 mm.

Male.—Yellow-brown, the palpi very short, the apical joint fully as long as second; shield nearly one and two-thirds times longer than broad, broadly rounded behind, rather densely and evenly punctate, showing three shallow furrows, the median one not reaching as far forward as the sublateral pair; stigmal plate large and like that of the female; the coxæ armed the same, but the basal spine on coxa I has a more slender point.

Length of male, 3.3 mm.

This species is common on small mammals in the Eastern States, as far west as the Rockies. I have seen it from Norway, Me.; Salem, Amherst, and Sherborne, Mass.; Washington Hollow, Manlius, Albany, Catskills, Crane Point, and Rensselaer and Greene counties, New York; Pine County, New Jersey; Plummers Island, Maryland; Washington, D. C.; Agricultural College, Michigan; Iowa; St. Anthony Park, Minn.; Brookings, S. Dak.; Denver, Colo.; Kansas; Kerrville, Tex., and Guelph, Ontario, Canada. The known hosts include fox, mink, weasel, skunk, pocket gopher, striped gopher, porcupine, woodchuck, raccoon, dog, cat, and robin. I have examined Packard's type of this species, now in the Museum of Comparative Zoology, and typical specimens of *Ixodes hexagonus* var. *longispinosus* of Neumann which are identical with Packard's form. I consider Fitch's *I. cruciarius* to be the same; Fitch gave three descriptions of this species—two from specimens from human beings, the other from a specimen from mink; they evidently apply to this species; all were from New York. In both cases on human beings the bite was very severe, and medical attention was necessary in one case.

***Ixodes angustus* Neumann.**

Female.—Shield pale brownish yellow; legs very pale yellowish; abdomen yellowish gray. Capitulum (Pl. IV, fig. 2) small, triangu-

lar, posterior angles acute, the porose areas long, triangular, nearly as long as broad; palpi with the second joint plainly a little longer than the last, the latter about one and one-half times as long as broad. Shield (Pl. IV, fig. 2) elongate, fully one and one-half times as long as broad, broadest near middle, broadly rounded behind, lateral carinæ distinct, but running out before the posterior third, surface minutely punctate. Abdomen (engorged) very elongate, with very short hairs, the anal grooves slightly approximating behind; stigmal plate (Pl. IV, fig. 2) transversely elliptical, its surface minutely granulate. Legs short, tarsus I suddenly narrowing before tip, other tarsi tapering to tip, tarsus I but little longer than metatarsus; coxæ I with a rather short, stout spine at base behind, and a tooth near apex, a similar tooth on coxæ II and III, coxæ IV unarmed (see Pl. IV, fig. 2).

Length of female shield, 1 mm.

Male.—The only one seen is very small; elliptical; the capitulum subtriangular, the palpi extremely short, barely longer than width of capitulum; the shield elliptical, about one and three-fourths times as long as broad, and but little broader in middle.

Length of male, 1.5 mm.

The type is a female taken from *Neotoma occidentalis* at Shoshone Falls, Idaho, collected by Dr. Cooper Curtice, and now in the collection of the Bureau of Animal Industry, this Department. Other specimens come from various rodents of the Northwest; Glacier Bay, Alaska; Portland, Oregon; Massett, British Columbia; Walker Pass and Siskiyou County, California. In the Fourth Memoire of his Revision Neumann gives a second description based on two specimens from Argentina, of what he thinks is this species; it differs in several points of structure, and evidently is not the same species, since the many specimens of *I. angustus* examined by me agree closely with the type.

***Ixodes sculptus* Neumann.**

Female.—Shield yellow-brown; legs and palpi paler; abdomen yellow-brown. Capitulum (Pl. IV, fig. 7) elongate-triangular, posterior angles scarcely prominent; porose areas large, much longer than broad, and only about one-half their breadth apart, this space containing an elongate depression or scar. Last joint of palpus one and one-half times as long as broad, second joint plainly a little longer. Shield (Pl. IV, fig. 7) one and one-fourth times as long as broad, broadly rounded behind, lateral carinæ strong, somewhat incurved, almost reaching the margin, the surface densely and very minutely punctate. Abdomen punctate and with many longitudinal rows of short yellowish hairs; anal furrows subparallel; stigmal plate

rather large, elliptical, its surface minutely granulate; all coxæ (Pl. IV, fig. 9) with a small apical tooth behind, and coxa I with a long basal spine; legs rather long, not very hairy, and the tarsi abruptly narrowed near tip, tarsus I but little longer than the metatarsus.

Length of female shield, 1.4 mm.

The type, in the Marx collection, is from the Santa Cruz Mountains, California. I have also seen two females from Del Rio, Tex., on rock squirrel (Bishopp), which agree closely with the type, except that the color is darker, the shield being dark red-brown, and the abdomen nearly black. They are engorged, and the abdomen is elongate.

Ixodes hexagonus Leach.

Female.—Capitulum and shield yellowish brown; legs and palpi paler; abdomen grayish yellow. Capitulum (Pl. III, fig. 13) rather elongate, hind angles slightly produced, porose areas large, subtriangular, as long as broad, and scarcely half their diameter apart; palpi short, second joint only a little longer than broad, last not as long as broad. Shield (Pl. III, fig. 13) about as broad as long, tapering behind, the anterior sides quite long, no trace of lateral carinæ, surface rather evenly and densely strewn with quite large punctures. Abdomen striate, when engorged elongate; punctures and hairs very weak; anal grooves subparallel; stigmal plate moderately large, nearly oval, the stigma in front of middle, its surface strongly granulate. Coxæ (Pl. III, fig. 11) with a minute black tooth at apex behind, and coxa I with a very short spine at base. Legs moderately large, hairy; tarsi tapering to tip, tarsus I but little longer than the preceding joint.

Length of female shield, 1.2 mm.

Two specimens in the Marx collection from sheep, Kansas, and labeled by Neumann as typical *I. hexagonus*. Possibly they were introduced with the sheep. Also two specimens in the Hassall collection from rabbit, Baltimore, Md., labeled by Neumann as typical *I. hexagonus*. The specimens in the same collection from spermophile, District of Columbia, and pocket gopher, Iowa, also labeled by Neumann as *I. hexagonus*, are not that species, but the *I. cookei* Packard (*longispinosus* Neum.) The four females from the United States agree quite closely with a German specimen in the Marx collection, labeled by Neumann *I. hexagonus*; but the porose areas in the European specimen are more pointed in front, and the shield is rather more coarsely punctate and wrinkled.

I have not seen a male from the United States, and both cases of the species' occurrence may be importations. Nearly all the previous records of this species in this country refer to *I. cookei*.

Ixodes marxi n. sp. (Pl. IX, fig. 8.)

Female.—Shield, capitulum, and legs pale yellowish gray. Capitulum (Pl. III, fig. 10) rather broad, the posterior angles hardly projecting; porose areas somewhat circular, far from sides, and nearly their diameter apart; palpi with last joint fully as long as broad, plainly shorter than the second. Shield (Pl. III, fig. 10) about one and one-half times as long as broad, broadest much before middle, narrowed behind, with concave sides, tip broadly rounded, lateral carinæ practically invisible, surface very finely and rather sparsely punctate. Abdomen with fine punctures and very short hairs; stigmal plate very small, nearly circular, surface granulate; coxæ (Pl. III, fig. 10) almost unarmed, but a small tooth behind on coxæ I and II and a short spine at base of coxa I; legs rather short, tarsi suddenly narrowed before tip.

Length of female shield, 1 mm.

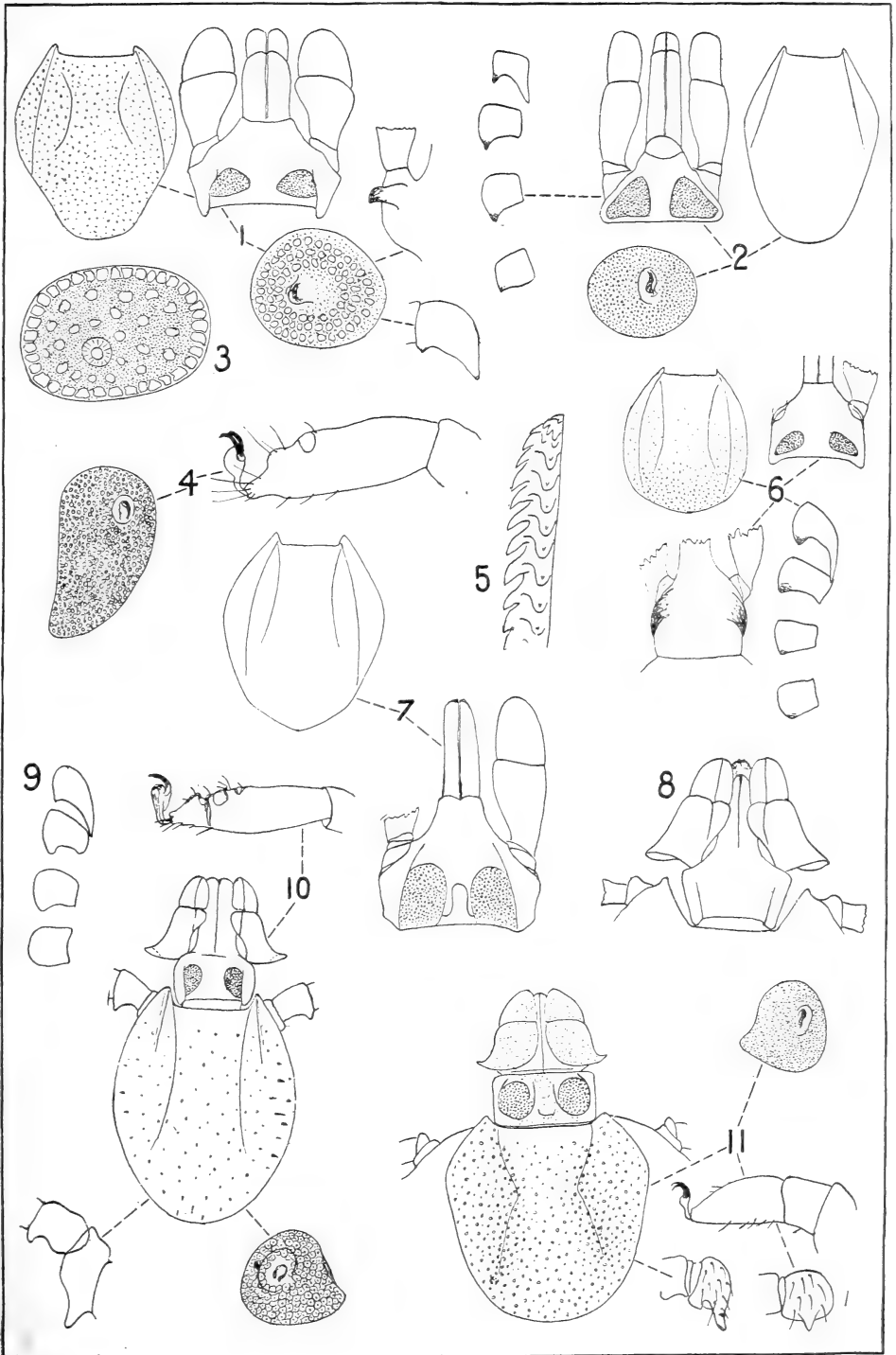
I have seen this species from Washington, D. C.; Salineville and Wauseon, Ohio; Ithaca, N. Y.; Portland, Mich.; Guelph, Ontario, Canada; and Denver, Colo. It has usually been taken on red squirrels, but the specimen from the last locality was from fox. Two of these specimens were referred doubtfully by Neumann to his variety *inchoatus* of *Ixodes hexagonus*, which, however, has an earlier name in *I. canisuga* Johnston, 1849, a common dog tick in Scotland. Through the kindness of Dr. William Evans I have obtained specimens of *I. canisuga* and find that it has a more coarsely punctate shield than our species, and the porose areas are larger, while the legs are larger and there is no trace of a spine at base of coxa I. I have not seen the male of *I. marxi*. I name it in honor of Dr. George Marx, who had recognized its distinctness and given it a manuscript name.

Genus HÆMAPHYSALIS Koch.

Venter showing a curved groove behind the anus, and from this a median furrow back to margin of body. Capitulum not angulate on sides; porose areas large, longitudinal, distant. Palpi short, second joint with an acute basal prolongation outward. Shield without markings; no ocelli. Abdomen showing festoons behind; coxa I with one tooth behind; coxa IV of male not enlarged. No anal plates in male. Stigmal plate broad, with a small outer point. Tarsi II, III, and IV indistinctly divided, the basal part shorter than the apical part, and no tooth-like claw at apex.

Type.—*H. concinna* Koch.

I have seen but two species from our territory; the record of *H. concinna* is due to wrong synonymy.



IXODOIDEA, OR TICKS, OF THE UNITED STATES.

Fig. 1.—*Ixodes pratti*, shield of female, capitulum of female, tooth on rostrum, sternal plate of female, and coxa I. Fig. 2.—*Ixodes angustus*, coxæ, sternal plate, capitulum, and shield, of female. Fig. 3.—*Ixodes pratti*, sternal plate of nymph. Fig. 4.—*Ixodes pratti*, sternal plate of male and tarsus I. Fig. 5.—*Ixodes pratti*, hypostome. Fig. 6.—*Ixodes dentatus*, teeth below on rostrum, coxæ, capitulum, and shield, of female. Fig. 7.—*Ixodes sculptus*, shield and capitulum of female. Fig. 8.—*Hæmaphysalis leporis-palustris*, capitulum of male. Fig. 9.—*Ixodes sculptus*, coxæ of female. Fig. 10.—*Hæmaphysalis leporis-palustris*, tarsus I, capitulum and shield, sternal plate, and coxa I, of female. Fig. 11.—*Hæmaphysalis chordellis*, shield and capitulum, coxæ I and IV, tarsus IV, and sternal plate, of female. (Original.)



TABLE OF THE SPECIES.

Shield of female as broad as long; palpi very heavy and short----- *chordeilis*.

Shield of female longer than broad; palpi more slender----- *leporis-palustris*.

Hæmaphysalis leporis-palustris Packard. (Pl. X, figs. 2, 6.)

Female.—Red-brown to black; shield, mouth parts, and legs red-brown, without markings. Capitulum (Pl. IV, fig. 10) not twice as broad as long, hind angles slightly prominent, porose areas elongate, separated by much more than their width, a ridge on the outer side of each; palpi rather elongate, second joint with a sharp projection on the outer side at base; the inner tip is inflated above, or rather its upper edge; the third joint also has a lamellar edge above projecting over the hypostome, and below there is a row of hairs on the second joint (Pl. X, fig. 2); the rostrum below has a distinct spine at each hind angle. Shield (Pl. IV, fig. 10) plainly longer than broad, with many large punctures above, and the submedian grooves very large and deep. Legs rather slender, the tibiæ and metatarsi I (Pl. IV, fig. 10) and II are convex below; trochanter I has a large projection above, and II and III have projections behind, when seen from below; coxa I (Pl. IV, fig. 10) is bifid behind, the basal projection the longer; other coxæ each with a very small projection; all coxæ have a number of long hairs. Abdomen striate, and with many deep punctures. The stigmal plate (Pl. IV, fig. 10) is as broad as long, with many rather large granules.

Length of female shield, 0.9 mm.

Male.—Paler red-brown; capitulum (Pl. IV, fig. 8) rather narrow, its posterior angles very distinctly prolonged; palpi shorter than in the female, but the inner sides inflated above as in the female; body nearly twice as long as broad, lateral grooves distinct, but no basal furrow to the eleven festoons; dorsal surface rather densely and evenly punctate. The legs are as in the female, and the coxæ armed the same, coxa I being rather more strongly bifid behind; the rostrum shows below the two small teeth behind as in the female. The stigmal plate is subtriangular, as broad behind as long, its surface rather coarsely granulate.

Length of male, 1.6 mm.

The nymph has the shield fully as long as broad, and broadly rounded behind.

Specimens come from Virginia: Shreveport, La.; Columbus and Victoria, Tex., Grand Canyon, Ariz.; Kern County, Cal.; Maverick, Tex.; Keene Valley and Dannemora, N. Y. Packard's types were from North Carolina. It is usually found on rabbits, but the young are often taken from birds, as quail, lark, etc.

Hæmaphysalis chordeilis Packard.

Female.—Shield, legs, and palpi rather uniform reddish brown, abdomen more yellowish brown. Capitulum (Pl. IV, fig. 11) nearly twice as broad as long, hind angles barely prominent; porose areas large, and limited by a ridge each side; palpi broad, second joint with a prominent sharp tooth on outer side at base, the two palpi together broader than long. Shield (Pl. IV, fig. 11) about as broad as long, strongly and densely punctate, the punctures most numerous at the submedian grooves. Legs rather short, tarsi (Pl. IV, fig. 11) shorter than in *H. leporis-palustris*, coxæ (Pl. IV, fig. 11) with distinct projections behind; that on coxa I is fully one-half the width of that joint. Body striate, and with scattered, broad, deep punctures. Stigmal plate (Pl. IV, fig. 11) longer than broad, with a short but distinct dorsal prolongation, its surface finely granulated.

Length of shield, 1 mm.; whole specimen, 5.5 mm.

The types, two engorged females from a nighthawk at Milton, Mass., are in the Museum of Comparative Zoology, where I have studied them. I have also seen a female from Taftsville, Vt., from a turkey.

Neumann, in his "Revision," had placed this species as a synonym of *H. leporis-palustris*, but it is plainly distinct. I have not seen the male, but a nymph from the killdeer, taken at Fort Collins, Colo., may belong to this species.

Genus RHIPICEPHALUS Koch.

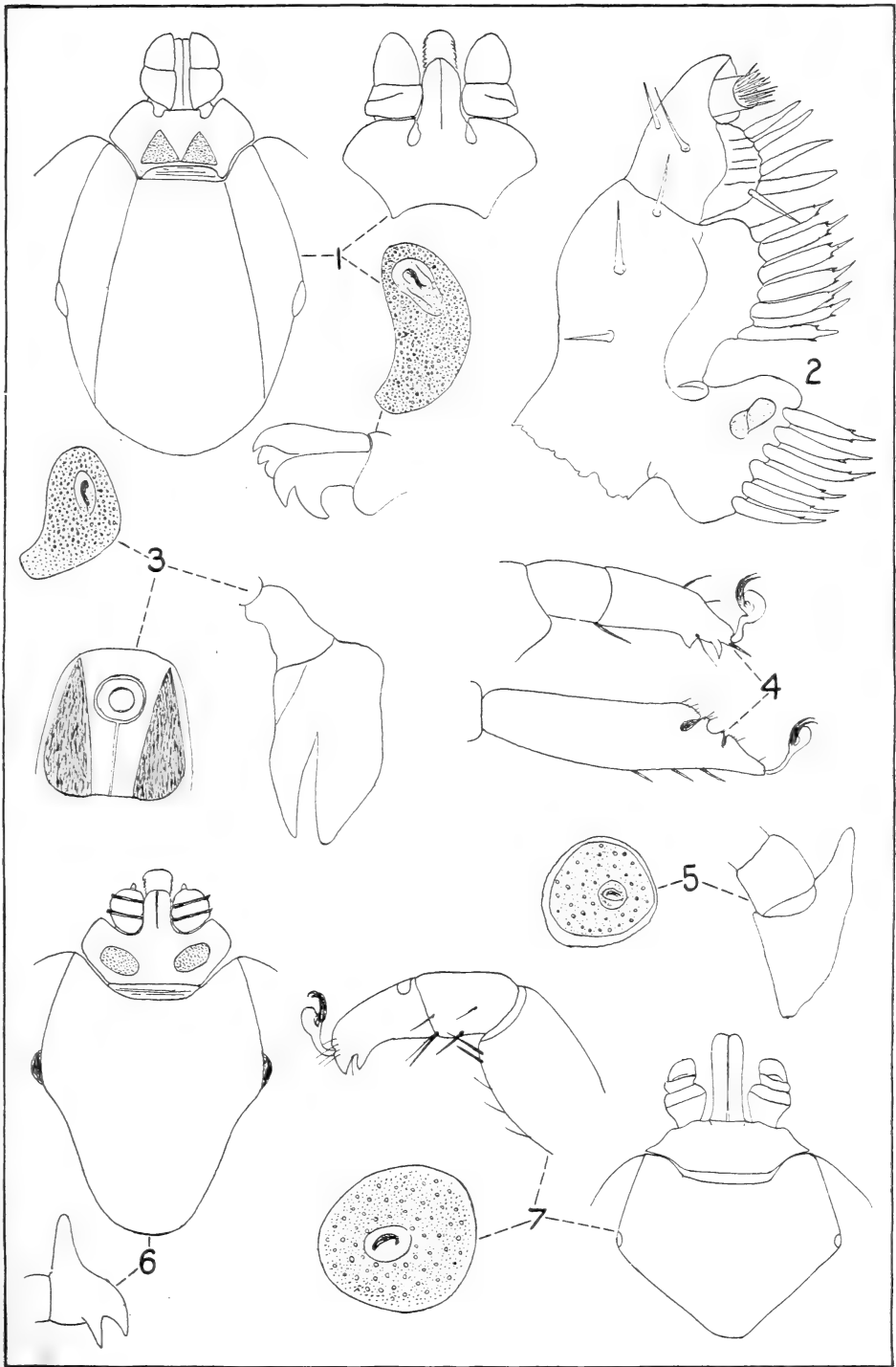
Venter showing a curved groove behind anus and a median line to the posterior margin of body. Capitulum angulate on sides; porose areas triangular, approximate. Palpi short and broad, no transverse ridges. Shield without markings; ocelli present. Abdomen showing festoons behind. Coxa I strongly bidentate behind; hind coxa not enlarged in male. Stigmal plate subcrescentic or reniform. Male with distinct anal plates. Tarsi II, III, and IV indistinctly divided, the basal part shorter than the apical part; no distinct tooth-like claw at apex. The palpi have on the lower edge a series of long flattened teeth, as represented in the figure.

Type.—*R. sanguineus* Latreille.

We have but one species of this genus, a form very similar to the type species.

Rhipicephalus texanus n. sp.

Male.—Red-brown, without markings; legs paler. Capitulum (Pl. V, fig. 1) broad, lateral angles acute, hind angles barely prolonged; palpi (Pl. V, fig. 2) very short, not as long as half the width of the capitulum, but as long as the hypostome, their tips acute. Dor-



IXODOIDEA, OR TICKS, OF THE UNITED STATES.

Fig. 1.—*Rhipicephalus texanus*, shield, capitulum, and mandible, of female; capitulum and stigmal plate of male. Fig. 2.—*Rhipicephalus texanus*, palpus from beneath. Fig. 3.—*Rhipicephalus texanus*, stigmal plate of female, anal plates of male, and coxa I. Fig. 4.—*Rhipicephalus texanus*, tarsi I and IV. Fig. 5.—*Margaropus annulatus*, stigmal plate of nymph and coxa I of male. Fig. 6.—*Margaropus annulatus*, shield, capitulum, and coxa I, of female. Fig. 7.—*Margaropus annulatus*, tarsus IV of male, stigmal plate of female, and shield and capitulum of nymph. (Original.)

sum one and one-half times as long as broad, the shield still more narrow, and with subparallel sides, leaving broad lateral and apical margins, the latter with twelve impressed lines; the shield with a definite lateral groove reaching back from the eyes, and behind are seven festoons, without basal groove; also two submedian impressions, and three in the apical part, the median one the longest; surface with many subequal punctures. Legs rather long, the fourth pair thickened, anterior tarsi (Pl. V, fig. 4) rather slender; coxæ I (Pl. V, fig. 3) with two processes behind on the style of *Dermacentor*, the inner one much the thicker, other coxæ unarmed. Each side of the anus is an elongate triangular plate (Pl. V, fig. 3); the apex of the abdomen is somewhat pointed; the stigmal plate (Pl. V, fig. 1) is elongate, barely tapering behind and the tip upcurved, its surface with many small granules.

Length of male, 2.7 mm.

Female.—Red-brown; legs pale; no markings. Capitulum (Pl. V, fig. 1) broad, lateral angles acute, hind angles distinct, but little produced; porose areas triangular, situated on posterior part of capitulum, and touching on basal inner angle; palpi short, apex subacute. Shield (Pl. V, fig. 1) plainly longer than broad, broadly rounded behind, eyes farther back than in most ticks, surface with many large punctures, furrows separating the lateral lobes very distinct and reaching to the hind margin. Legs slender, all tarsi long, coxæ I (Pl. V, fig. 3) armed with two spines as in the male, other coxæ unarmed, but with transverse ridges. Stigmal plate (Pl. V, fig. 3) not very much longer than broad, with a prominent dorsal prolongation, its surface with many distinct granules.

Length of female shield, 1.3 mm.

Specimens have been taken at several places in Texas—San Antonio, Victoria, Brownwood, Brownsville, Green Lake—and from Albuquerque, N. Mex. It also occurs in Mexico. It has been taken from dogs and horses.

Genus MARGAROPUS Karsch.

Venter without distinct curved groove behind anus, but no submedian furrows. Capitulum angulate on sides; porose areas elliptic, distant. Palpi short and broad, second and third joints with transverse ridges. Shield without markings; ocelli present. Abdomen showing more or less distinct festoons behind. Coxa I bidentate behind, coxa IV of male slightly larger than the others. Four anal plates in male. Stigmal plate subcircular. Coxæ I more distant from the rostrum than in most ticks. Tarsi II, III, and IV indistinctly divided, the parts subequal in length; and a distinct tooth-like claw at tip.

Type.—*M. winthemi* Karsch.

The replacement of the familiar *Boophilus* by this almost unknown name is a case where the inflexible application of the law of priority is greatly to be deplored, especially since there is no resulting benefit whatever to science.

But one species has as yet been found in the United States, but an allied form is known from the West Indies, and will, perhaps, some day occur in our country.

Margaropus annulatus Say.

Male.—Small, brownish yellow, legs paler, no markings. Capitulum (Pl. X, fig. 8) rather crescentic, acute on lateral angles, hind angles prolonged into short spines; palpi extremely short, shorter than the hypostome, the joints with transverse acute ridges. Dorsum one and one-half times longer than broad, broadest near hind end; surface usually indicating two furrows in front, sublateral, and three furrows behind, with many rather small subequal punctures; festoons indistinct, but usually nine of them indicated. Legs slender, the first pair short, fourth pair much larger than the others; tarsi (Pl. V, fig. 7) short; all with scattered hairs. Coxæ I (Pl. V, fig. 5) with two spines behind, the inner one very short, the outer one more slender and sometimes very long, and in front a long spine-like process; other coxæ mutic. Two prominent long adanal plates, and each side a smaller, shorter, curved plate; the tips of these four plates are seen, in a dorsal view of the tick, projecting behind the posterior margin. Stigmal plate small, subelliptical, with about twenty-five or thirty large granules and many smaller ones.

Length of female, 2.2 mm.

Female.—Shield red-brown, often very dark, abdomen brighter red-brown; legs pale; no markings. Capitulum (Pl. V, fig. 6; Pl. X, fig. 7) broad, hind angles barely distinct, lateral angles acute; palpi extremely short, much shorter than the hypostome, and with ridges, as in male; porose areas elliptical, widely separated, and pointing outward. Shield (Pl. V, fig. 6) plainly longer than broad, broadest at eyes, quite suddenly narrowed behind the eyes; surface wrinkled, but the middle of front is smooth; a few punctures, mostly lost in the wrinkles. Abdomen with fine hairs; legs small and slender, hairy; coxæ unarmed; stigmal plate (Pl. V, fig. 7) small, only a little longer than broad, with a number of scattered visible granules, and many very minute ones.

Length of female shield, 1.1 mm.

Specimens may be taken from cattle in many parts of the country, but are native only to the Southern States, where they occur on deer and other animals. This is "the cattle tick" and the proven dis-

seminator of southern cattle or splenetic fever. Much has been written upon it, and its life history is fairly well known.

It was described by Say from deer from Florida; described by Koch, and later by Packard, and by Riley as *Ixodes bovis*. Under this name it was long known, until Curtice proposed for it the genus *Boophilus*. Neumann has recently shown that the type of *Margaropus* is a true *Boophilus*, therefore it is necessary to drop the familiar cognomen, under which it had become of prime economic importance. Neumann at first considered *M. annulatus* to be of world-wide distribution; but in 1899 Fuller separated the South African and the Australian forms, and now it is believed that *M. annulatus* occurs only in North America.

Biological and economic accounts of this species can be found in Bulletin No. 72 of this Bureau. This tick is rarely recorded from any animal other than cattle; however, Mr. J. D. Mitchell has found it on sheep, and I have seen specimens taken from ponies in Michigan.

Genus **AMBLYOMMA** Koch.

Venter with a distinct curved groove behind the anus and a more or less distinct median furrow behind. Capitulum rather small; porose areas longitudinal. Palpi long and slender, second joint about twice as long as broad, third very much shorter than the second. Shield usually with some markings; ocelli present, and on margin of the shield. Abdomen showing festoons behind (except in distended female). Coxa I with one or two teeth behind; coxa IV of male not enlarged, usually with a spine behind. No anal plates in male. Stigmal plate subtriangular or elongate. Tarsi II, III, and IV plainly divided, the basal part much shorter than the apical part, and a distinct tooth-like claw at apex.

Type.—*A. cajennense* Fabricius.

TABLE OF THE SPECIES.

- | | |
|--|---|
| 1. Coxa I with but one spine, metatarsi (except I) with two thickened spurs at tips; second joint of palpus not twice as long as third; porose areas elongate; shield brown, with silvery marks----- | |
| Coxa I with two spines; metatarsi without stout spurs at tips, only slender hairs----- | 2 |
| 2. Projections of coxa I blunt and short; porose areas elongate; second joint of palpus not twice as long as third; coxa IV of male with only a tubercle behind; large species----- | |
| Projections of coxa I longer, and at least one of them sharp-pointed; second joint of palpus twice as long as third; coxa IV of male with a long spine; smaller species----- | 3 |
| 3. Porose areas nearly circular; shield of both sexes pale yellowish, with some silvery streaks and marks, and some reddish spots; shield of female as broad as long ----- | |
| Porose areas elongate; shield brown, in female with an apical silvery mark, in male with two small apical and two or four other silvery spots; shield of female longer than broad----- | |

-----*maculatum*.
-----*tuberculatum*.
-----*cajennense*.
-----*americanum*.

Amblyomma tuberculatum Marx.

Male.—Shield red-brown, with a narrow silvery stripe each side, slightly above the margin, and connected behind to the silvery spots on the festoons; from behind extend forward a pair of rather broad silvery stripes which unite somewhat behind the middle and are here connected to the lateral silvery stripes. In some specimens these markings are much less extensive, but the spots on the festoons are always distinct. Capitulum pale in middle of front, and also a pale spot on the shield just behind the capitulum; palpi pale; legs reddish brown, with tips of joints white; venter pale yellowish brown. The capitulum is large and long, the hind angles rounded; palpi short, the second joint not twice as long as the last. Dorsum very broad in front, hardly one and one-fourth times longer than broad, with many very small punctures, some larger ones near the anterior angles; surface generally smooth; no lateral grooves, nor any before the festoons, which are not very strongly marked. Legs large and long, hairs and tubercles below, but no spurs at tips of metatarsi; the tarsi are very short; coxæ with two flattened tubercles, except IV, which has only one. Stigmal plate (Pl. VI, fig. 8) elongate, end tapering and upturned, with extremely minute granules.

Length of male, 5.5 to 6 mm.

Female.—Reddish brown, shield with a large silvery mark each side, containing one or two dark spots, and two divaricate silvery stripes extending forward from the hind margin, and sometimes connected to the lateral spots; capitulum paler in front and middle than on the sides and behind; palpi pale; legs red-brown, tips of joints whitish; abdomen brownish, sometimes showing black lines. Capitulum (Pl. VI, fig. 8) large and long, hind angles rounded; porose areas rather small, elongate, well separated, and directed forward; palpi short, second joint not twice as long as last; shield pentagonal, sides rounded, plainly broader than long, and broadest in front of middle, with many minute punctures, but some larger ones on the anterior lateral lobes; body without hairs, usually shining. Legs large and long, no spurs at tips of metatarsi, but most joints with hair-bearing tubercles below; coxæ armed like the male, and just as strongly. Stigmal plates (Pl. VI, fig. 8) elongate, of peculiar shape, being longer on inner than on outer side, an elevated smooth boss occupying the outer concave side, the surface with very minute granulations.

Length of female shield, 3.6 mm.

Specimens come from various parts of Florida, and are associated with the gopher tortoise. The nymphs have, on the shield, a large silvery spot each side, united behind at tips, and in front much broken by the large punctures.

This is our largest tick, and a very distinct species, allies of which occur in tropical countries.

Amblyomma maculatum Koch.

Male.—Shield brown, lineate with silvery white, lines more or less connected; a submedian pair in front, and a similar pair behind, uniting in the middle; two lateral streaks connected near front, and the inner one connected to submedian at middle; usually a few isolated white spots on the festoons, but there is variation in the amount of the white; legs more or less brownish, usually showing white at tips of joints. Capitulum long, its posterior angles acute; palpi short, the second joint about one and one-fourth times longer than the last joint. Dorsum nearly twice as long as broad, with many prominent punctures, most numerous in the middle region and in furrows; several elevated smooth streaks; lateral furrows very prominent, arising in front of eyes; festoons strongly marked. Legs rather heavy, IV (Pl. VI, fig. 5) pair much the largest; all, except I (Pl. VI, fig. 7), with a pair of stout spurs at tip of metatarsus. Coxa I (Pl. VI, fig. 5) with one very long, sharp spine, only a trace of the basal spine; coxæ II and III with a flattened tubercle, IV (Pl. VI, fig. 5) with a slender sharp spine, fully as long as width of joint. Stigmal plate (Pl. VI, fig. 7) long, slender, its tip tapering and upturned, surface with minute granules.

Length of male, 4 mm.

Female.—Shield silvery white behind, on front brown, the white of sides usually showing an elongate brown spot behind, and the white of middle extending forward in two streaks, sometimes wholly divided by a brown median stripe; legs pale brown; abdomen dark. Capitulum (Pl. VI, fig. 10) long, hind angles scarcely acute; porose areas elliptical, widely separated, and directed forward; palpi short second joint but little longer than the last. Shield pentagonal, fully as long as broad, broadest before middle, its lateral lobes strongly punctured, very few punctures behind; abdomen without hairs. Legs large, tarsi slender, metatarsi (except I) with a pair of spurs at tip; coxæ armed as in male, except that the hind coxa bears only a tubercle. Stigmal plate (Pl. VI, fig. 9) longer than usual, with a much smaller dorsal prolongation, its surface furnished with minute granules.

Length of female shield, 2 mm.

Specimens have been examined from various places in Texas—Brazos County, Esperanza Ranch, Brownsville, Victoria, Harlingen, and Columbus. Other localities are Cameron Parish, La.; Virginia (Niles); Orlando, Fla.; Memphis, Tenn.; and Tulare County, California. It was described from "Carolina." The recorded hosts are

cattle, horses, dogs, fox, and man. It apparently is not common except in certain localities near the Gulf coast. It is very readily known by the spurs at apex of metatarsi, a character not previously noted by writers.

Amblyomma americanum Linnæus. (Pl. VI, fig. 1.)

Male.—Body usually a pale brown, or yellowish brown, with several small yellow spots—two on the posterior border of shield rather close together, one on each side margin in front of the former, and a pair in front of middle of shield, behind and rather inward from the eyes. Sometimes the anterior of these spots are indistinct, but the posterior pair are nearly always distinct. Legs slightly paler than the body. Capitulum broad, its posterior angles acute; palpi not very long, second joint about one and one-half times as long as last joint. Dorsum elongate, broadest in middle, surface rather evenly, densely, and minutely punctate; lateral furrows not reaching to eyes; festoons distinctly limited. Legs short, IV (Pl. VI, fig. 2) pair but little if any larger than I, all hairy beneath; coxa I (Pl. VI, fig. 3) with two spines, the outer the longer, a flattened tubercle on coxæ II and III, IV with a slender spine behind about as long as width of the joint; stigmal plate (Pl. VI, fig. 3) long, semielliptical, its tip slightly turned up, surface with many minute granulations.

Length of male, 2.4 mm.

Female.—The shield is brown, reddish brown, or almost black, often paler in front, on the posterior lobe a large prominent yellowish spot; legs more or less brownish yellow. Capitulum (Pl. VI, fig. 4) rather narrow, hind angles rounded, porose areas elliptic, divergent, and well separated; palpi slender, second joint twice as long as last. Shield pentagonal, about as broad as long, broadest much in front of the middle, apex nearly truncate, its surface densely punctate; body without hairs; legs very slender, no spurs at tips of any metatarsi; coxæ armed as in the male, except that the spine on coxa IV is barely longer than the tubercles on coxæ II and III. Stigmal plate (Pl. VI, fig. 1) subtriangular, its surface minutely granulate.

Length of female shield, 1.7 mm.

Specimens come from various places in the Eastern States—Washington, D. C.; Falls Church, Va.; Cape Charles, Va.; Chapel Hill, N. C.; Bee Spring and Smiths Grove, Ky.; Springfield, Willow Springs, and St. Louis (Packard's type), Mo.; Florida; Agricultural College, Mich.; Shreveport, La.; Austin, Kerrville, Llano, Dallas, Mountain Home, and Hockley, Tex. Marx recorded it from Labrador and Sanborn from Massachusetts. Fitch recorded it from New York, and it was described by Linnæus from Pennsylvania and New Jersey.

It is now rather uncommon in the Eastern States, never as common as *Dermacentor variabilis*. Fitch wrote in 1870 that although formerly abundant it had then become nearly extinct, he having seen only one specimen from New York, and that taken forty years before he wrote. He says that it occurs in the Southwest in woodlands, and not in cleared sections. It is often taken from cattle, occasionally from horses, hogs, dogs, and goats, once from panther and wolf, sometimes from man, and rarely from any of the small mammals. It is commonly known as the "lone star tick," because of the single yellow spot on shield of female.

The *Acarus americanus* of Linnæus was taken by the traveler Peter Kalm, in 1754, in Pennsylvania and New Jersey. Its description will fit only to that species later described by Packard as *Ixodes unipunctata*. Koch correctly identified and figured the species, but Neumann in his "Revision" considered *americanus* to apply to the *Dermacentor electus* Koch. Later he changed, and used *americanus* for this species. Fitch correctly identified the species.

Amblyomma cajennense Fabricius.

Male.—Pale yellowish or brownish yellow, with several irregular silvery white marks and streaks each side, and a number of brown, often reddish brown, spots, all arranged to form a definite, but complex, pattern; some of the pale spots behind are bordered with brown. Legs and palpi wholly pale yellowish, or greenish yellow, tarsi sometimes darker. Capitulum subtriangular, hind angles rounded; palpi longer than width of the capitulum, the middle joint more than twice as long as the last; body broad, oval, broadest behind middle, with many rather small, subequal punctures, but with four convex smooth spots each side, and a smooth median streak behind; lateral furrows very distinct, reaching fully up to the eyes; behind are twelve deeply impressed lines, the festoons fully twice as long as broad. Legs rather slender, tarsi long, hind tarsus (Pl. VI, fig. 6) with three consecutive teeth below, one at apex; no spurs at tip of any metatarsi, but long hairs below on all joints; coxæ I (Pl. VII, fig. 2) with two spines, the outer one much the longer, coxæ II and III each with a mere tubercle, coxa IV (Pl. VII, fig. 2) with a spine about as long as width of the joint. Stigmal plate (Pl. VII, fig. 1) very long and slender, its surface with many minute granulations. Length of male, 2.7 mm.

Female.—Yellowish; capitulum with some dark on the margin, shield mostly silvery, with a brown line on each margin reaching back from the eyes; legs pale greenish yellow, tarsi often dark, especially of legs I and II. Capitulum (Pl. VII, fig. 1) much broader than long, hind angles acute; porose areas nearly circular, and widely

separated; palpi slender, longer than width of the capitulum, middle joint about twice as long as last. Shield pentagonal, a little broader than long, anterior sides slightly convex, posterior sides straight, tip rounded; surface densely punctate; body with scattered white hairs. Legs slender, tarsi (Pl. VII, fig. 2) long, coxæ armed as in the male, except that the spine on coxa IV is barely larger than that on coxæ II and III. Stigmal plate (Pl. VII, fig. 2) subtriangular, as broad behind as long, concave on upper outer edge, its surface covered with minute granules.

Length of female shield, 1.8 mm.

Specimens come from various places in the South and Southwest. It is abundant in southern Texas—San Antonio, Victoria, Brownsville, Uvalde, Rocks Resaca, Weets Ranch, Live Oak County, San Tomas, etc. I have it also from Biscayne Bay, Florida; Fort Bowie, Ariz., and San Diego County, California. The species occurs also in Mexico, Central America, the West Indies, and South America. It infests a great variety of animals, but is not common on cattle or horses. This species was described from Surinam, and later, by Koch, from Brazil under several names. To this species also belongs, I believe, the *Ixodes crenatum* of Say, for none of our other species so aptly fits his description.

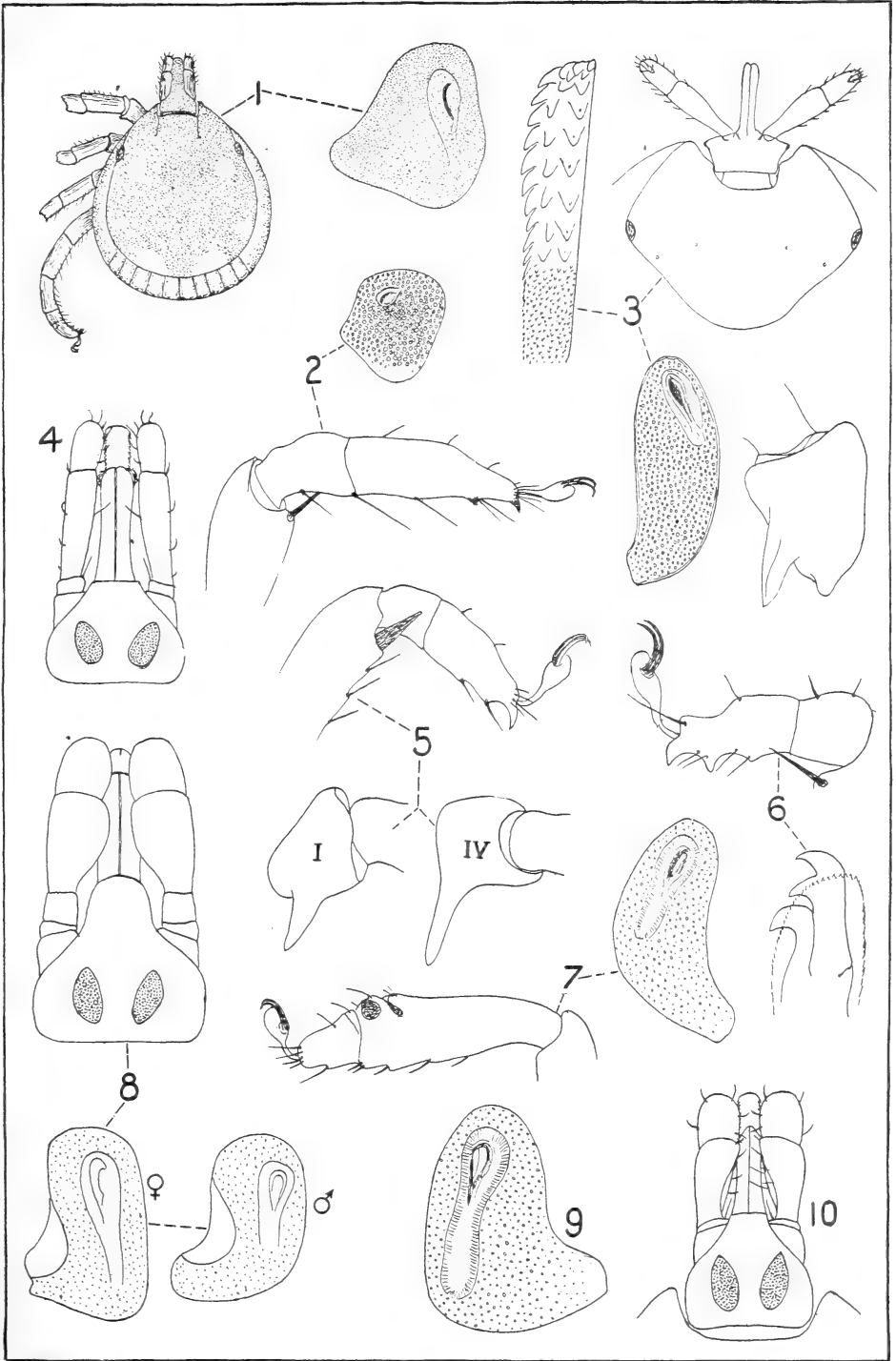
Genus **DERMACENTOR** Koch.

Venter showing indistinctly a curved groove behind the anus, from which a median line extends to margin of body. Capitulum not angulate on sides; porose areas elliptic and transverse. Palpi short and broad, the second joint barely longer than broad and with a basal projection above, but not outward. Shield usually marked with white; ocelli present. Coxa I strongly bidentate behind; coxa IV of male much larger than other coxæ, and leg IV larger than other legs. Abdomen shows festoons behind (except in distended female). No anal plates to male. Stigmal plate large, usually reniform in female, more elongate in male. Tarsi II, III, and IV indistinctly divided, the parts subequal in length, and a minute tooth-like claw at apex.

Type.—*D. reticulatus* Fabricius.

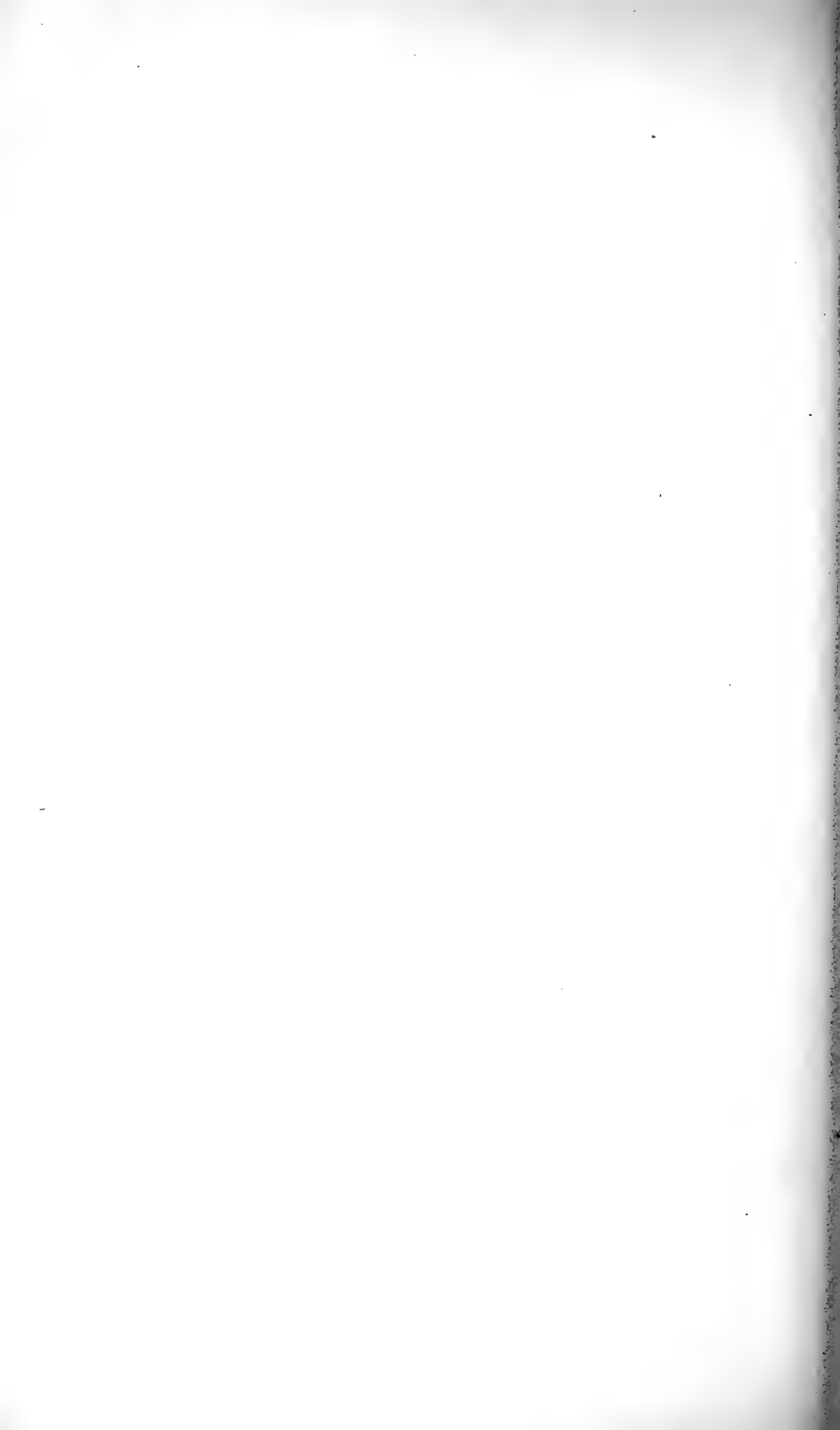
TABLE OF THE SPECIES.

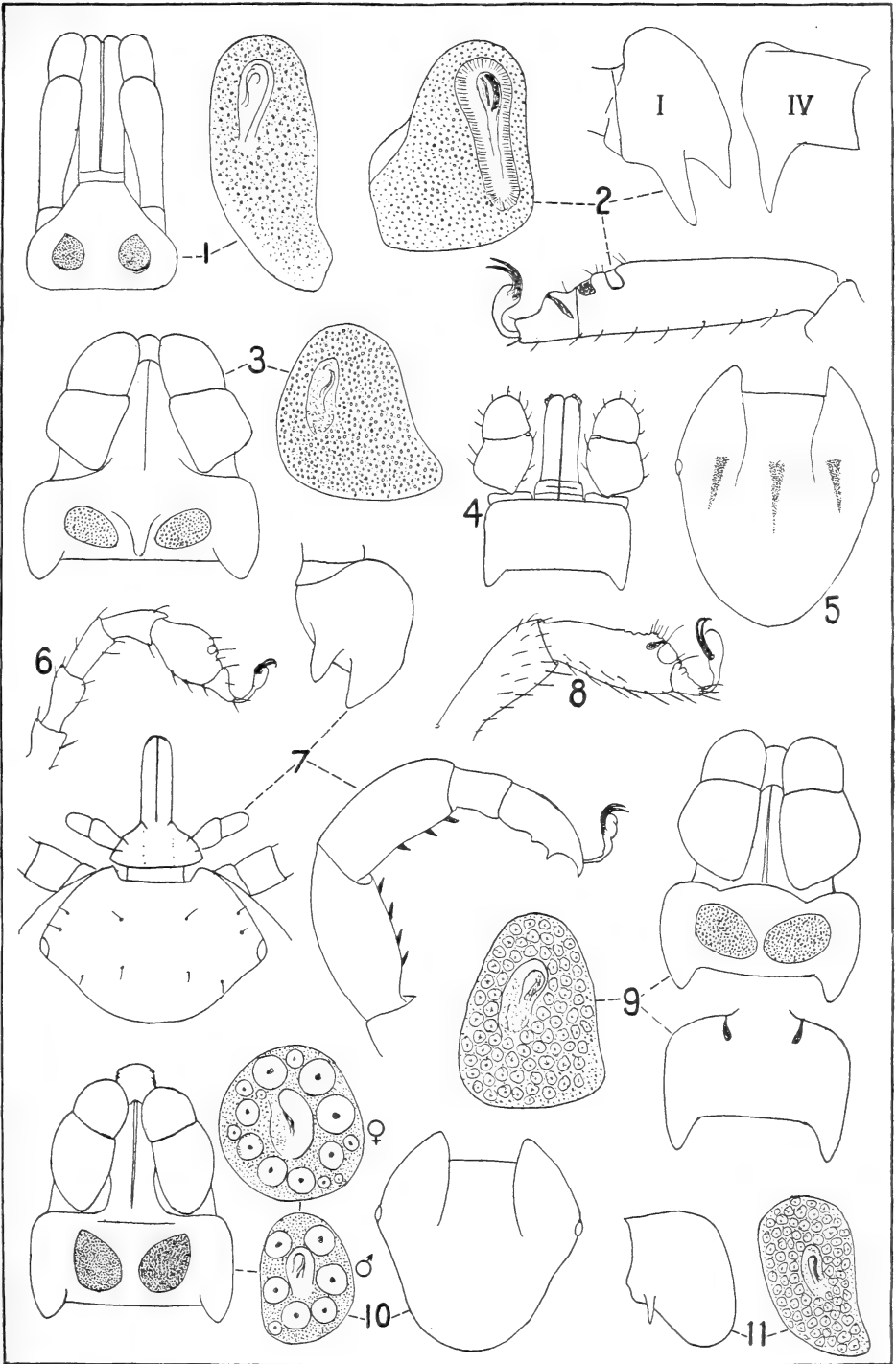
1. Females -----	2
Males -----	8
2. Stigmal plate nearly circular, with from ten to twenty very large more or less isolated granulations; shield without distinct punctures; color dark red-brown, without markings-----	<i>nitens</i> .
Stigmal plate with many much smaller, more crowded granulations; shield distinctly punctured, and usually with some pale markings--	3



IXODOIDEA, OR TICKS, OF THE UNITED STATES.

Fig. 1.—*Amblyomma americanum*, male, and stigmal plate of female. Fig. 2.—*Amblyomma americanum*, stigmal plate of nymph and tarsus IV. Fig. 3.—*Amblyomma americanum*, hypostome, shield, and capitulum of nymph, stigmal plate of male, and coxa I. Fig. 4.—*Amblyomma americanum*, capitulum of female. Fig. 5.—*Amblyomma maculatum*, tarsus IV, and coxæ I and IV. Fig. 6.—*Amblyomma cajennense*, tarsus IV and mandible of male. Fig. 7.—*Amblyomma maculatum*, tarsus I, and stigmal plate of male. Fig. 8.—*Amblyomma tuberculatum*, capitulum of female, stigmal plate of male and of female. Fig. 9.—*Amblyomma maculatum*, stigmal plate of female. Fig. 10.—*Amblyomma maculatum*, capitulum of female. (Original.)





IXODOIDEA, OR TICKS, OF THE UNITED STATES.

Fig. 1.—*Amblyomma cajennense*, capitulum of female and stigmatal plate of male. Fig. 2.—*Amblyomma cajennense*, stigmatal plate and tarsus I of female, coxae I and IV of male. Fig. 3.—*Dermacentor variabilis*, capitulum and stigmatal plate of female. Fig. 4.—*Dermacentor variabilis*, capitulum and shield of female. Fig. 5.—*Dermacentor albipictus*, shield of female. Fig. 6.—*Dermacentor variabilis*, leg I of larva. Fig. 7.—*Dermacentor nitens*, coxa I, leg IV of male, and shield and capitulum of nymph. Fig. 8.—*Dermacentor variabilis*, tarsus I. Fig. 9.—*Dermacentor albipictus*, stigmatal plate of female and capitulum of female and of male. Fig. 10.—*Dermacentor nitens*, stigmatal plates of male and female, capitulum and shield of female. Fig. 11.—*Dermacentor albipictus*, coxa IV and stigmatal plate of male. (Original.)



3. Stigmal plate about as broad as long, with short and broad dorsal prolongation, and covered with many very minute granules, scarcely visible as such; shield plainly longer than broad, and much streaked with white ----- *variabilis*.
 Stigmal plate with much larger granules, at least near the peritreme --- 4
4. Stigmal plate without distinct dorsal prolongation; shield plainly longer than broad ----- 5
 Stigmal plate with a more or less distinct dorsal prolongation ----- 6
5. Shield mostly white, with brown streaks and spots; porose areas close together ----- *albipictus*.
 Shield dark red-brown, with very little white; porose areas rather widely separate ----- *nigrolineatus*.
6. Shield mostly white, about as broad as long ----- 7
 Shield without white, or but little, plainly a little longer than broad; porose areas but little longer than broad, and well separated.
parumapertus.
7. Porose areas very small; stigmal plate with rather wide dorsal prolongation ----- *occidentalis*.
 Porose areas larger; stigmal plate with a more narrow dorsal prolongation ----- *venustus*.
8. Stigmal plate with from four to ten very large isolated granules; dorsum without white marks; only eight impressed lines behind -- *nitens*.
 Stigmal plate with many smaller, more crowded granules; twelve impressed lines behind ----- 9
9. Stigmal plate about as broad behind as long, with dorsal prolongation, the granulations extremely minute; dorsum marked with white streaks and spots ----- *variabilis*.
 Stigmal plate usually plainly longer than broad; the granulations much larger ----- 10
10. Stigmal plate without distinct apical prolongation; the sides of body more nearly parallel ----- 11
 Stigmal plate with distinct apical prolongation; sides of body more divergent ----- 12
11. Dorsum mostly white, with brown streaks and spots in a pattern; hind angles of the capitulum but little produced; coxa IV about one-half as long as broad on base; large species ----- *albipictus*.
 Dorsum red-brown, with black lines, no white; hind angles of capitulum much prolonged; coxa IV not twice as broad on base as long; species of moderate size ----- *nigrolineatus*.
12. Dorsum with few, if any, white spots; coxa IV about as long as broad at base; hind angles of capitulum moderately produced --- *parumapertus*.
 Dorsum largely white, or much spotted with white ----- 13
13. Stigmal plate more attenuate behind; coxa IV about one-half as long as broad at base; hind angles of capitulum moderately produced -- *venustus*.
 Stigmal plate less attenuate behind; coxa IV not twice as broad on base as long; hind angles of capitulum much produced ----- *occidentalis*.

Dermacentor bifurcatus Neumann.

This species was described as an *Ixodes*, and based on a young female from a wild cat, from Texas. Later Neumann placed it as a synonym of *Ixodes brunneus* Koch, then still later stated that it was a *Dermacentor*. It is, therefore, evidently a nymph of some

of the previously described *Dermacentors*; the shape of the stigmal plate would indicate *D. variabilis*, but the lack of markings would indicate *D. parumapertus*. Among Doctor Marx's drawings are several figures of this specimen, and they are presented on the plates (See Pl. X, fig. 1) so that when the life histories of all of our *Dermacentors* are known it will be possible to place this name under the species to which it belongs.

I have not been able to locate the specimen which, according to Doctor Neumann (*in litt.*), should be in the National Museum collection, but it was not in the material returned, nor indicated on the list of material returned to the Museum.

***Dermacentor albipictus* Packard. (Pl. X, fig. 11.)**

Male.—White above, with brown spots and streaks in a definite pattern; capitulum, palpi, and legs white above, rest reddish brown. Capitulum (Pl. VII, fig. 9) quite broad, hind angles produced, but not as long as in *D. occidentalis*; palpi short, not nearly as long as width of capitulum. Dorsum more slender than in most species, fully one and three-fourths times as long as broad, with a great many rather small punctures, lateral grooves not very distinct, posterior margin with twelve impressed lines. Legs rather large and long, fourth pair much larger than others, teeth below large and distinct. Coxæ armed as usual; coxæ IV (Pl. VII, fig. 11) plainly wider on base than long. Stigmal plate (Pl. VII, fig. 11) elliptical, without distinct dorsal prolongation, its surface provided with many large granules.

Length of male, 4 mm.

Female.—Capitulum, palpi, and legs white above, reddish or yellowish brown beneath; shield mostly white, a long median streak, not reaching apex, a narrower stripe each side, and some spots near eyes, red-brown; elsewhere the white is rarely broken by small brown spots; abdomen dark red-brown. Capitulum (Pl. VII, fig. 9) quite broad, its hind angles only slightly produced, the porose areas very large, and not far apart, the palpi very short and broad, the shield (Pl. VII, fig. 5) plainly longer than broad, usually much longer, and broadest much before the middle, the punctures few and not prominent. Abdomen rather more elongate, the sides more nearly parallel than in allied forms. Legs long, the coxæ armed as usual; stigmal plate (Pl. VII, fig. 9) large, semielliptical, without distinct dorsal prolongation, and covered with many large granules.

Length of female shield, 2–2.2 mm.

This tick occurs throughout the northern parts of the United States and in Canada. I have seen specimens from Adirondack Mountains, New York; Michigan; Nebraska; Montana; Bear, Idaho; Nevada, and Pullman, Wash. It has usually been taken from moose

and wapiti, but also recorded from the beaver. Packard first used the name *albipictus* for this moose tick, as shown in the appended catalogue, but later placed under this name a specimen of *D. variabilis*. The types from the moose are still in the Museum of Comparative Zoology, where I have examined them. Neumann, using Marx's manuscript name, described it as *D. variegatus*.

The species is distinguished by its elongate form, especially the long shield, the shape and sculpture of the stigmal plate, and by its large size. This latter character, however, is variable, and specimens are found that are not much larger than the ordinary *D. variabilis*.

Dermacentor parumapertus Neumann.

Male.—Dark red-brown, legs a trifle paler, no white markings, except sometimes a few small spots, and a minute white spot at tips of some joints of the legs. Capitulum (Pl. VIII, fig. 10) moderately broad, hind angles only very slightly produced; palpi very short, not as long as width of capitulum; dorsum one and two-thirds times as long as broad, with many scattered, deep, but not very large punctures, submarginal furrow very distinct on the sides, less so behind; twelve impressed lines near posterior margin. Coxæ spined as usual, hind coxæ barely wider on base than long, legs rather short, hind pair not so much larger than the others, and the teeth below small and indistinct. Stigmal plate (Pl. VIII, fig. 10) elongate, attenuate behind, the fore part around peritreme with large granules, a few down on the narrow portion, which is covered with smaller granules.

Length of male, 2.8 mm.

Female.—Shield and capitulum dark red-brown or almost black, without marks; abdomen blackish; legs red-brown, a faint white mark at tips of some of the joints. Capitulum (Pl. VIII, fig. 10) moderately broad, hind angles distinctly prolonged behind, porose areas rather small, nearly circular, and well separated; palpi as long as width of capitulum. Shield (Pl. VIII, fig. 10) plainly a little longer than broad, with many deep punctures, those in the depressed area each side especially large and numerous, almost confluent. Legs rather small and short; coxæ armed as usual. Stigmal plate (Pl. VIII, fig. 8) small, with a distinct, although short and broad, dorsal prolongation, most of the surface with rather large granules, but those on the prolongation very small.

Length of female shield, 1.1 mm.

Specimens are from Lakeside, Cal. (also Neumann's type in the Marx Coll.), taken on man, and in a chicken house.

Distinguished from other forms most readily by lack of white on shield, by porose areas, and stigmal plate. After describing this

species, Neumann later made it a variety of *D. electus* (*variabilis*), but it differs in many important characters from that species, and the granulations of the stigmatal plate are much larger.

***Dermacentor parumapertus* var. *marginatus* n. var.**

This form agrees in general with the true *D. parumapertus*, but differs in several minor points. The posterior border of the female shield (Pl. VIII, fig. 6) is margined with white; the porose areas are larger and rather closer together; the lateral lobes of the shield have fewer punctures, and the shield is more contracted behind the eyes; the stigmatal plate of the female (Pl. VIII, fig. 6) has a narrower dorsal prolongation, and the inner margin is more convex; the posterior angles of the capitulum (Pl. VIII, fig. 6) are less prominent. Otherwise it is very similar to the type.

Several specimens from Mesa City, Ariz., from a jack rabbit (Cordley).

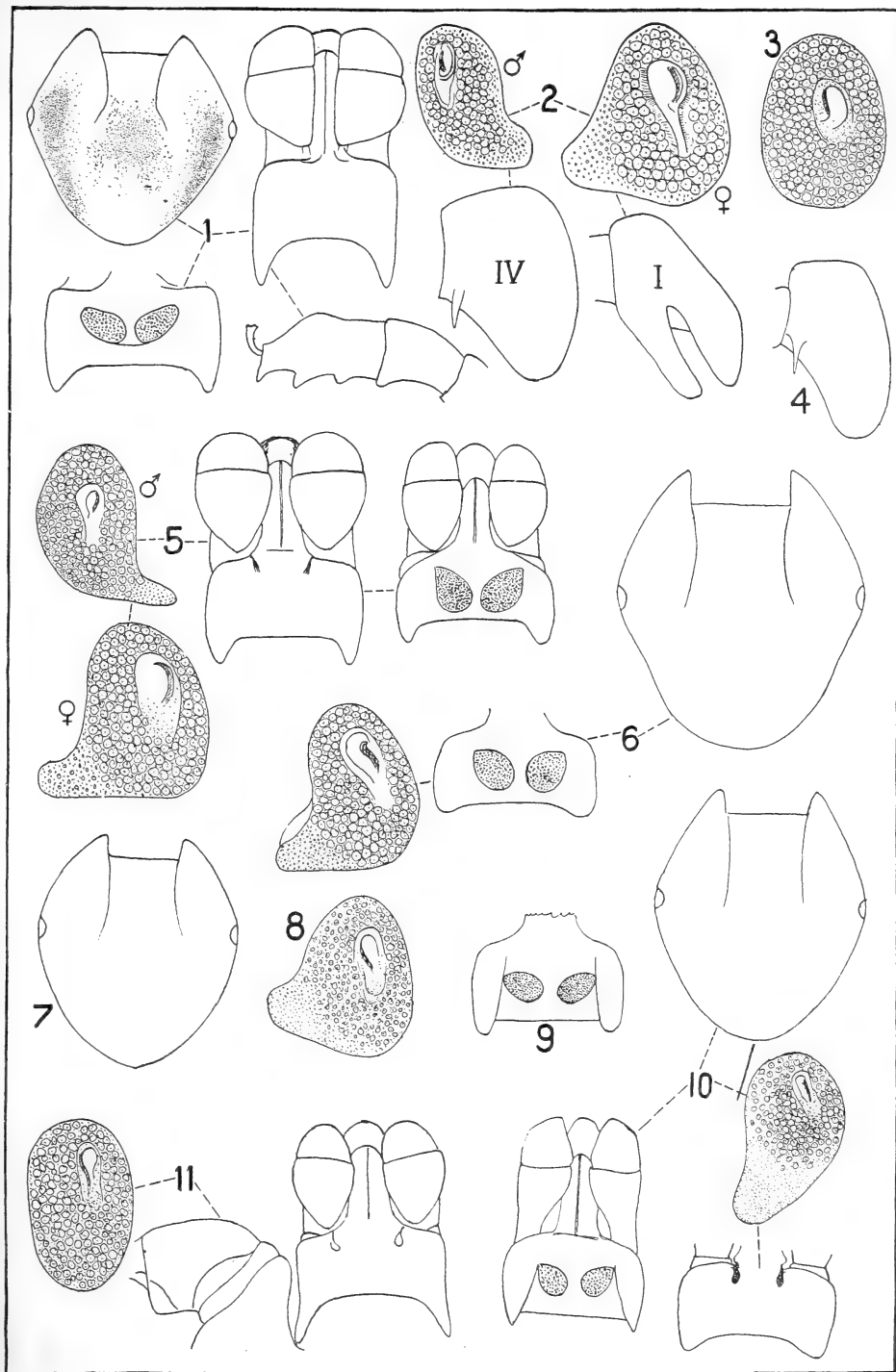
***Dermacentor venustus* n. sp.**

Male.—Red-brown, marked with white, but not so extensively as in *D. occidentalis*, usually but little white on the middle posterior region; legs paler red-brown, tips of joints whitish. Capitulum (Pl. VIII, fig. 5) quite broad, its posterior angles only slightly produced; palpi very short and broad, not as long as width of capitulum. Dorsum about one and two-thirds or one and three-fourths times as long as broad, with many, not very large, punctures; lateral furrows distinct. Legs of moderate size, hind pair plainly larger and heavier, and with the teeth below distinct. Coxæ armed as usual, the coxa IV (Pl. VIII, fig. 4) nearly twice as wide at base as long. Stigmatal plate (Pl. VIII, fig. 5) with a rather narrow dorsal prolongation, with large granules on the main part and minute ones on the prolongation.

Length of male, 3.5 to 5 mm.

Female.—Capitulum and legs reddish brown, the latter with tips of joints whitish; shield mostly covered with white—this white not so much broken up by the brown dots as in *D. occidentalis*; abdomen red-brown. Capitulum (Pl. VIII, fig. 5) rather broad, posterior angles but little produced, the porose areas rather large, egg-shaped, and quite close together; palpi shorter than width of capitulum. Shield (Pl. VIII, fig. 7) as broad as long, broadest slightly before the middle, and rather pointed behind, with numerous, not very large punctures. Legs of moderate size, the coxæ armed as usual. The stigmatal plate (Pl. VIII, fig. 5) has a rather narrow dorsal prolongation, with large granules on the main part, and small ones on the prolongation.

Length of female shield, 2 mm.



IXODOIDEA, OR TICKS, OF THE UNITED STATES.

Fig. 1.—*Dermacentor occidentalis*, capitulum of male and female, shield of female, and tarsus IV of male. Fig. 2.—*Dermacentor occidentalis*, coxæ I and IV of male, stigmatal plates of male and female. Fig. 3.—*Dermacentor nigrolineatus*, stigmatal plate of female. Fig. 4.—*Dermacentor venustus*, coxa IV of male. Fig. 5.—*Dermacentor venustus*, capitulum and stigmatal plates of male and female. Fig. 6.—*Dermacentor parumapertus* var. *marginatus*, stigmatal plate, capitulum, and shield of female. Fig. 7.—*Dermacentor venustus*, shield of female. Fig. 8.—*Dermacentor parumapertus*, stigmatal plate of female. Fig. 9.—*Dermacentor nigrolineatus*, capitulum of female. Fig. 10.—*Dermacentor parumapertus*, shield and capitulum of female, stigmatal plate and capitulum of male. Fig. 11.—*Dermacentor nigrolineatus*, stigmatal plate and capitulum of male. (Original.)

Specimens come from various places in the West; Olympia, Yakima, Klikitat Valley, and Grand Coulee, Wash.; Fort Collins and Boulder, Colo.; Pecos and Las Cruces, N. Mex.; Bozeman, Mont.; Bridger Basin, Utah; Soldier, Idaho, and Texas (on sheep).

This species is quite common in the Northwest. It has been included in *D. occidentalis* by Neumann, but was separated out by Doctor Marx in manuscript under the name I have adopted. It is larger than *D. occidentalis*, with more red and less white in the coloring, and differs in many minor points of structure, as size of porose areas, size of hind coxæ in male, etc. This is the species supposed to be concerned in the transmission of spotted fever in Montana.

***Dermacentor occidentalis* Neumann. (Pl. X, fig. 9.)**

Male.—Red-brown, with many waxy-white markings, often with a waxy bloom, sometimes almost wholly white, but there is red-brown near the eyes, on the festoons, and several submedian spots; moreover, the white is broken by the many red-brown punctures; legs pale reddish brown, marked with white above. Capitulum (Pl. VIII, fig. 1) rather narrow, and the hind angles prolonged into very prominent spines; palpi very short, not as long as the width of the capitulum; dorsum not much more than one and one-half times as long as broad, with many punctures, but mostly small; lateral furrows distinct and long, twelve indented lines behind. Legs of moderate size, tarsus IV (Pl. VIII, fig. 1) with two very distinct teeth below and one less prominent, teeth on other joints distinct; coxæ (Pl. VIII, fig. 2) armed as usual; coxæ IV about one and one-half times as wide at base as long. Stigmal plate (Pl. VIII, fig. 2) elongate, with a broad turned-up tip, almost truncate; large granulations on the main part, small ones on the tip.

Length of male, 3 to 3.5 mm.

Female.—Shield red-brown, mostly covered with white, red-brown near eyes and in the middle region, and the white broken up by the many brown dots at punctures; capitulum and legs red-brown, latter white at tips of joints, and generally paler above than below; abdomen dark red-brown. Capitulum (Pl. VIII, fig. 1) rather small, the hind angles prominent, and the porose areas very small and rather close together. Shield (Pl. VIII, fig. 1) about as broad as long, broadest before middle, and rather pointed behind, with many small punctures and some larger, but not nearly as many large ones as in *D. parumapertus*. Legs rather small, coxæ armed as usual. Stigmal plate (Pl. VIII, fig. 2) with a broad dorsal prolongation, with large granulations in the main part, and minute ones on the prolongation.

Length of female shield, 1.5 mm.

Nearly all specimens come from California—Occidental, San Diego, Goose Lake, Siskiyou County, Santa Clara County, Humboldt County; some taken from deer.

Closely related to *D. venustus*, but with a more narrow capitulum, and with a broader prolongation to stigmal plate, in the male by shorter hind coxæ, and in the female by smaller porose areas. Taken together, I think these characters indicate its distinctness from *D. venustus*.

Neumann first considered *D. occidentalis* and *D. venustus* of Marx as identical with the European *D. reticulatus*. There are, however, many differences, as he later recognized, and *D. reticulatus* (Pl. X, fig. 10) does not, as far as now known, occur in our country. When he described *D. occidentalis*, Neumann included with it *D. venustus* of Marx manuscript. However, I have restricted the name to the form to which Marx applied it. *D. occidentalis* may perhaps be credited to Curtice, for in a paper^a on ticks in general he refers to this species under this name and with a few words of description; hardly, however, sufficient to identify it, and evidently not intended to be a description of a new species.

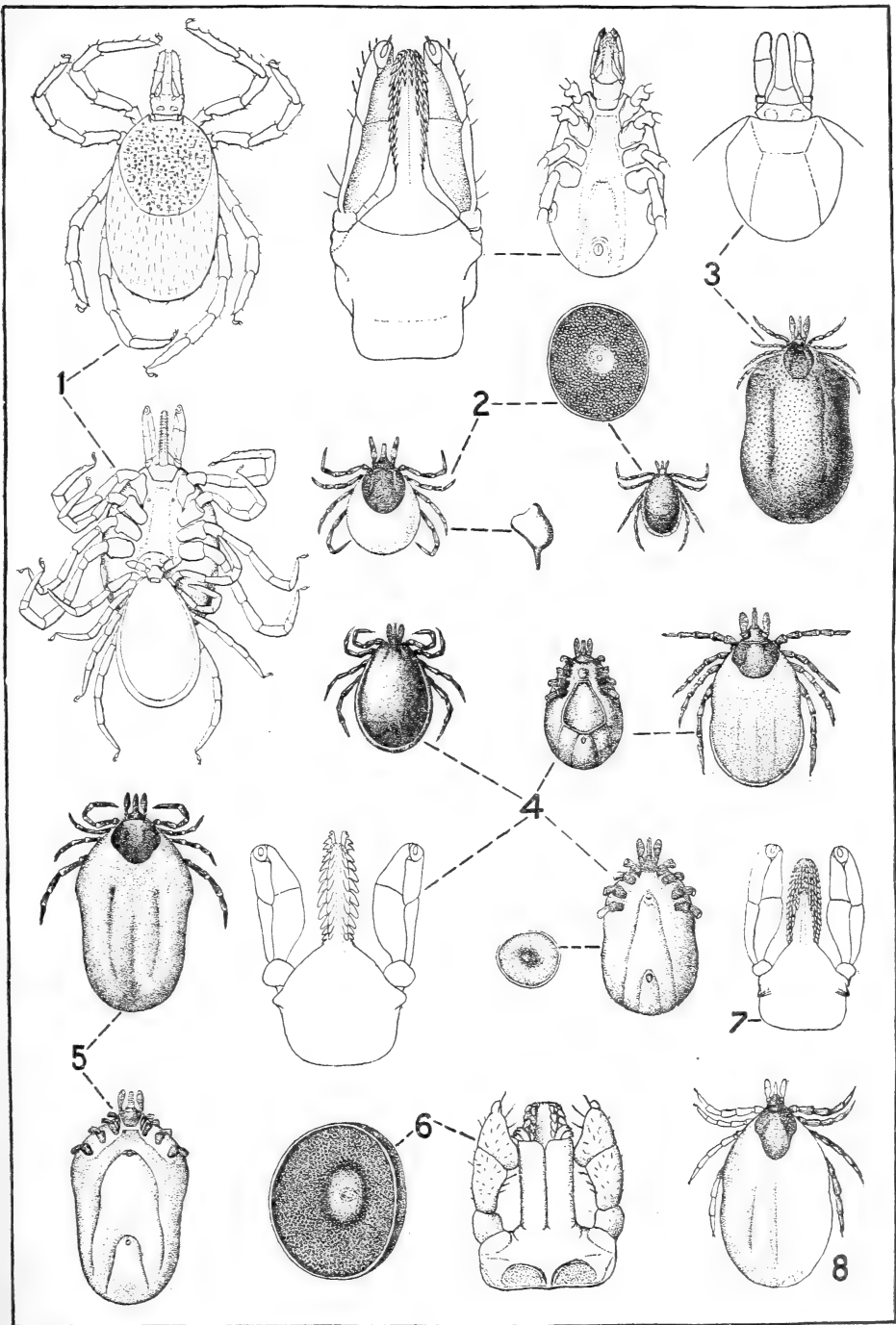
***Dermacentor nigrolineatus* Packard.**

Male.—Rather pale red-brown, no white markings, but the black cæcal marks show through in most specimens as several irregular lines behind; legs more yellow-brown. Capitulum (Pl. VIII, fig. 11) small and narrow, its posterior angles produced into long spines; palpi very small and stout. Dorsum slender, about one and two-thirds times as long as broad; middle anterior region smooth and shining, sides and behind densely punctured, and with many short hairs; lateral furrows not very distinct, twelve impressed lines behind, but the festoons are not as obvious as usual. Legs rather short, coxæ with usual spines, coxa IV but little wider at base than long; stigmal plate (Pl. VIII, fig. 11) large, elliptical, without dorsal prolongation, and covered with many large granules.

Length of male, 3.5 mm.

Female.—Shield red-brown, without marks; legs similar; abdomen dark red-brown. Capitulum (Pl. VIII, fig. 9) scarcely twice as broad as long; hind angles distinctly prolonged behind; porose areas large, oval, and distinctly separated; palpi small and short, not as long as width of capitulum. Shield plainly longer than broad, broadest much before the middle, tapering and almost pointed behind, with very few punctures. Legs small and short, the tarsi very short; coxæ with the usual spines, that on IV no longer than on III. Stig-

^a About cattle ticks. Journ. Comp. Med. Vet. Archives, January, 1892.

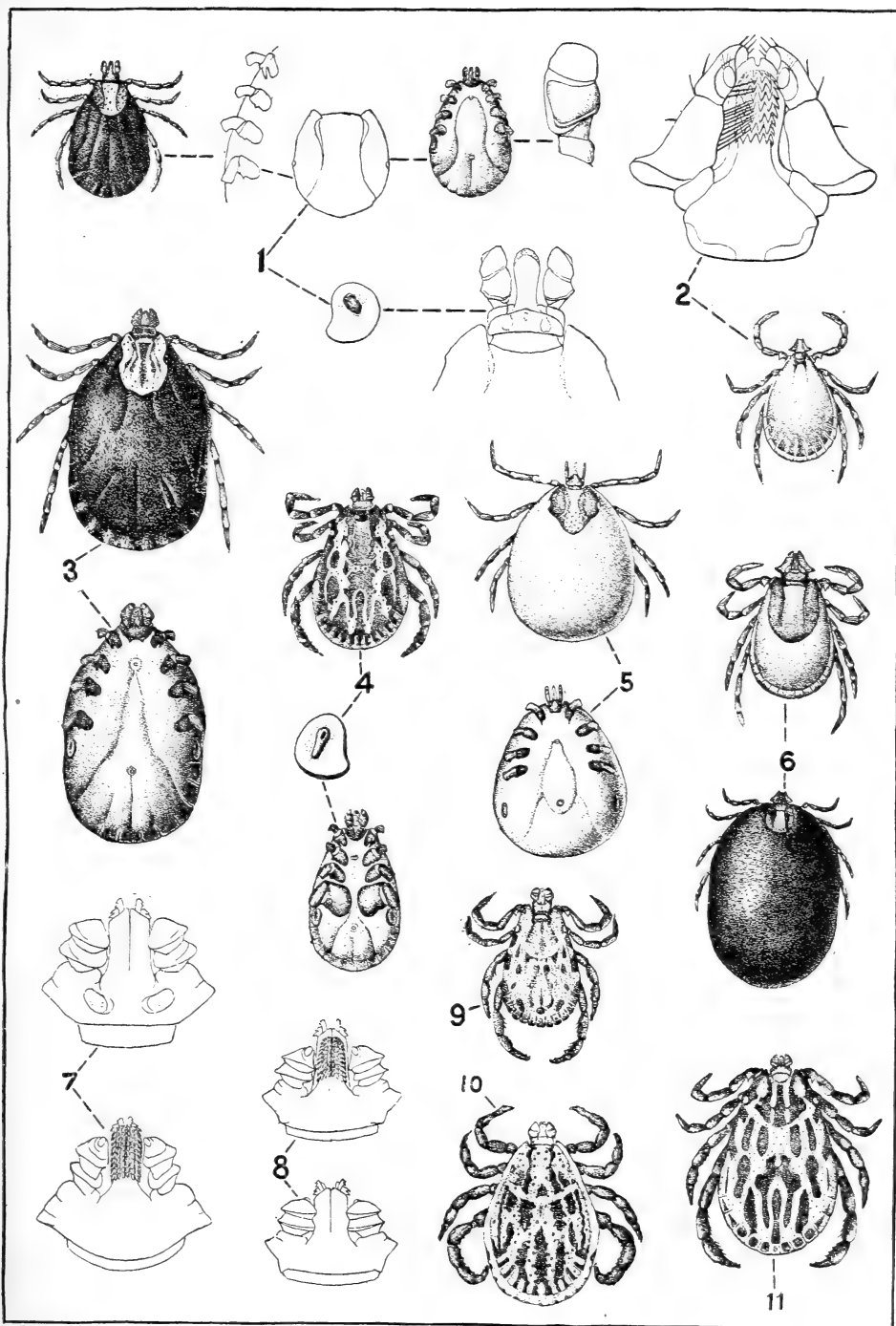


S. Marx, del.

IXODOIDEA, OR TICKS, OF THE UNITED STATES.

Fig. 1.—*Ixodes scapularis*, fresh female, and male attached to female. Fig. 2.—*Ixodes scapularis*, female, coxa I, male, female stigmatal plate, venter of female, and rostrum from beneath. Fig. 3.—*Ixodes dentatus*, engorged female, shield, and capitulum. Fig. 4.—*Ixodes cooki*, male and female above and below, stigmatal plate, and rostrum from beneath. Fig. 5.—*Ixodes ricinus*, engorged female, above and below. Fig. 6.—*Ceratiixodes putus*, stigmatal plate and capitulum. Fig. 7.—*Ixodes dentatus*, rostrum from below. Fig. 8.—*Ixodes marxi*, engorged female. (Drawings by the late Dr. George Marx.) (Original.)





G. Marx, del.

IXODOIDEA, OR TICKS, OF THE UNITED STATES.

Fig. 1.—*Dermacentor bifurcatus*, nymph, coxæ, shield, venter, palpus, sternal plate, and capitulum. Fig. 2.—*Hemaphysalis leporis-palustris*, male, and rostrum of female beneath. Fig. 3.—*Dermacentor variabilis*, engorged female, above and below. Fig. 4.—*Dermacentor variabilis*, male, above and beneath, and sternal plate of female. Fig. 5.—*Amblyomma americanum*, nymph, above and below. Fig. 6.—*Hemaphysalis leporis-palustris*, fresh and engorged females. Fig. 7.—*Margaropus annulatus*, capitulum of female, above and beneath. Fig. 8.—*Margaropus annulatus*, capitulum of male, above and beneath. Fig. 9.—*Dermacentor occidentalis*, male. Fig. 10.—*Dermacentor reticulatus*, male. Fig. 11.—*Dermacentor albipictus*, male. (Drawings by the late Dr. George Marx.) (Original.)

mal plate (Pl. VIII, fig. 3) elliptical, of same shape as in male, no dorsal prolongation, and covered with many large granules.

Length of female shield, 1.2 mm.

Specimens in the New York State collection at Albany, probably from Adirondack Mountains; Packard's type, which I have seen, was from deer from this region; I have some from Catskill Mountains, New York, in June. Recently Mr. W. D. Hunter has received several specimens taken by Mr. Rumsey from deer at Laredo, Tex., and Mr. H. S. Barber took one from deer at Crab Lake, Vilas County, Wis. Neumann placed this species in *Hæmaphysalis* as a synonym of the European *H. concinna*, a species which now seems not to occur in our country. It is allied to *D. albipictus*, but differs in shape of stigmal plate, more distinctly separated porose areas, sharper hind angles to the capitulum, shield more pointed behind, and in shorter tarsi. Quite possibly it is the *Ixodes erraticus* of Say.

Dermacentor variabilis Say. (Pl. X, figs. 3, 4.)

Male.—Red-brown, dorsum with irregular white marks, the usual pattern being a submarginal stripe each side, starting from the anterior angles and reaching straight back to beyond the middle, where they unite, or nearly so, and thence giving off branches straight backward and obliquely outward to the side margin; along the sides and on the festoons are scattered white spots. Specimens from Texas and Florida often have these markings more extensive and more connected together, and some white on the median anterior part of dorsum. Legs red-brown, the tips of the joints white. Capitulum (Pl. VII, fig. 4) about twice as broad as long, its posterior angles slightly produced; palpi nearly as long as width of the capitulum. Dorsum fully one and one-half times as long as broad, with many deep and prominent punctures, but the anterior median region nearly free of them; lateral grooves distinct; twelve impressed lines behind; legs rather long and stout, hind pair much heavier than the others, and the teeth below distinct. Coxæ armed as usual for the genus, the hind coxæ but little broader than long. Stigmal plate large and broad, with a short dorsal prolongation, surface densely covered with minute granules.

Length of male, 4 mm.

Female.—Red-brown, shield with white on the sides, and broadly around the tip; a brown marginal stripe near eye, and sometimes two white streaks in the middle area. Legs red-brown, tips of the joints white. Capitulum (Pl. VII, fig. 3) fully twice as broad as long, its posterior angles only slightly produced, the porose areas oval, of moderate size, and well separated; palpi short and very broad. Shield plainly a little longer than broad, broadest at middle, and

posteriorly almost angulate; punctures large, but not very numerous, and few in middle area, usually four forming a trapezium behind the middle. Legs (Pl. VII, fig. 8) rather large and long, the hind pairs with distinct teeth beneath; coxæ armed as usual. Stigmal plate (Pl. VII, fig. 3; Pl. X, fig. 4) large and very broad, in fact as broad behind as long, and covered with many minute granules.

Length of female shield, 2 mm.

Specimens come from many places in the eastern United States, from Labrador to Florida and Texas. West of the Mississippi it is not common, and perhaps only introduced with stock.

This species, described by Say, is probably identical with the *Ixodes cinctus* of Fabricius from North America. Koch's *D. electus* is the same species. It was considered by Neumann at first to be the *Ixodes americanus* of Linnæus, but later he accepted Koch's identification of *I. americanus* as an *Amblyomma*, and used *D. electus* for this *Dermacentor*. Fitch's descriptions of *I. robertsoni* and *I. 5-striatus* offer nothing contrary to this form. Although the western specimens might have been another species, the specimens from Virginia must have been *D. variabilis*.

The pattern of the white markings is practically constant, but the amount of white present is variable. The species is readily known by the broad stigmal plate and the minute granulation thereon. It has been taken from a great variety of animals, including man, but seems to prefer dogs and cattle to smaller animals, doubtless due to the fact that the freshly moulted individuals climb up several feet from the ground in wait for a host. In the larva tarsus I is much enlarged.

***Dermacentor nitens* Neumann.**

Male.—Red-brown, without markings; legs rather yellowish brown. Capitulum rather narrow, hind angles acute, but scarcely prolonged; palpi very short and small, shorter than the hypostome and no longer than the length of the capitulum. Dorsum one and two-thirds as long as broad, broadest slightly behind the middle, shiny, with some punctures in front and on the sides, and behind are seven or eight impressed lines; the lateral furrows are not very distinct, usually three impressed grooves or furrows on the posterior half of dorsum; some scattered hairs, mostly on the sides behind. Legs rather long, fourth pair (Pl. VII, fig. 7) plainly larger than others, and the teeth below very evident; coxa I (Pl. VII, fig. 7) with the usual two teeth, neither very long; coxa II with two equal projections; coxa III with two tubercles, and coxa IV, which is no broader than long, with the usual tooth. Stigmal plate (Pl. VII, fig. 10) but little longer than broad, with from four to ten large, isolated granules.

Length of male, 2.5 to 2.7 mm.

Female.—Wholly red-brown, legs paler, and abdomen darker, no white markings. Capitulum (Pl. VII, fig. 10) of moderate width, with the hind angles only slightly prolonged; porose areas rather large, well separated, and directed more forward than in other species; palpi very short, not reaching to tip of hypostome. Shield (Pl. VII, fig. 10) a trifle longer than broad, broadest in front of middle, very finely punctured; in middle region in front, and on the sides, are irregular wrinkles. Legs rather long, teeth on coxæ shorter than usual; stigmal plate (Pl. VII, fig. 10) nearly circular, provided with ten to twenty more or less isolated granules, all of large size.

Length of female shield, 1.4 mm.

This species was described from Jamaica and Santo Domingo. Recently it has been taken at Brownsville and Harlingen, Tex., and I have some from Fort Bowie, Ariz. In the Museum of Comparative Zoology there are specimens from Grand Anse, Hayti, taken about forty years ago. It appears to prefer horses, and usually occurs in the ears.

D. nitens is strongly separated from all our other species of the genus. Especially noticeable is the sculpture of the stigmal plate; the few impressed lines behind with the male are also peculiar. Likewise the very short palpi, shorter than the hypostome, constitute a peculiar character again seen in the cattle tick, and, as in that species, may indicate some habit connected with the dissemination of disease.

UNPLACED SPECIES.

Ixodes erraticus Say.

“Body oblong-ovate, gradually narrowed before, sides hardly arquated, with distant punctures, those behind more deeply impressed, posterior margin with ten or twelve impressed lines which are abbreviated by a submarginal impressed line, two abbreviated lines before; head, posterior edge transversely rectilinear, angles extended backward abruptly, and subacute; rostrum rather short; palpi oval-orbicular. Found in the Southern States; the color is reddish or ferruginous, with acute black lines.” [It may be *Dermacentor nigrolineatus* Pack.]

Ixodes fuscus Say.

“Body fuscous, ovate, punctured; tergum with a few black, obsolete lines, and a profoundly indented submarginal line, posterior marginal impressed line none; no distinct thorax; edge rounded; head, posterior edge rectilinear, angles not prominent beyond the rectilinear edge; eyes not visible; palpi suboval, terminal joint rather longer than the preceding one. A common species.” [A true *Ixodes*, and probably the male of *I. scapularis* Say.]

***Ixodes cinctus* Fabricius.**

“Reliquis magis oblongus. Caput ferrugineum. Scutellum triangulum, ferrugineum, margine albo. Thorax et abdomen ferruginea, antice cerea, scutellum late alba. Pedes ferruginei. Habitat in America boreali Dom. v. Rohr. Mus. Dom. de Schestedt.” [Either *Dermacentor variabilis* Say or *Amblyomma maculatum* Koch, and probably the former.]

SPECIES ERRONEOUSLY ACCREDITED TO THE UNITED STATES.***Dermacentor reticulatus* Fabricius. (Pl. X, fig. 10.)**

Neumann at first identified the forms now called *D. occidentalis* and *D. venustus* as this European species. As shown above, these species are quite distinct, and there is no evidence that the true *D. reticulatus* occurs in this country.

***Ixodes frontalis* Panzer.**

As I have stated under *Ixodes brunneus*, Neumann's identification of *I. frontalis* was based on specimens of *I. brunneus*.

***Ixodes inchoatus* Neumann.**

Neumann questionably recorded this from the United States, but the specimens, as I have stated under *I. marxi*, differ greatly from the European *I. inchoatus*, and with more material I have described them as a new species—*I. marxi*.

***Hæmaphysalis concinna* Koch.**

As explained under *Dermacentor nigrolineatus*, the record of *H. concinna* is based on a misidentification of Packard's species.

CATALOGUE.**IXODOIDEA.****ARGASIDÆ.****ARGAS.**

Latreille, Précis Caract. Ins., p. 178, 1796.

MINIATUS Koch, Arch. f. Naturg., X, p. 219, 1844; Salmon and Stiles, 17th Ann. Rept. Bur. Anim. Ind., U. S. Dept. Agric., p. 402, 1902.

americana Packard, Rept. U. S. Geol. Surv. Mont., Idaho, Wyom., Utah, p. 740, 1872; Neumann, Mém. Soc. Zool. France, 1896, p. 9.

radiatus Railliet, Traité Zool. Méd., p. 718, 1893.

persicus Neumann, Arch. Parasitol., IX, p. 240, 1905 (not of Fischer).

sanchezi Dugès, La Natureza (2), I, p. 20, 1891; Neumann, Mém. Soc. Zool. France, 1896, p. 16; *ibid.*, 1901, p. 255.

BREVIPES Banks, *supra*, p. 15, 1908.

REFLEXUS Fabricius, Entom. Syst., IV, p. 426, 1794; Neumann, Mém. Soc. Zool. France, 1896, p. 4. [Doubtful in U. S.]

ORNITHODOROS.

Koch, Arch. f. Naturg., X, p. 219, 1844.

- MEGNINI Dugès, La Natureza Mexicana, VI, p. 197, 1883; Mégnin, Journ. Anat. Physiol., XXI, p. 472, 1885; Neumann, Mém. Soc. Zool. France, 1896, p. 42; Salmon and Stiles, 17th Ann. Rept. Bur. Anim. Ind., U. S. Dept. Agric., p. 408, 1902.
- spinorum* Marx, Proc. Ent. Soc. Wash., III, p. 199, 1895 (*Rhynchoprion*).
- TURICATA Dugès, La Natureza Mexicana, VI, p. 196, 1883; Mégnin, Journ. Anat. Physiol., XXI, p. 466, 1885; Neumann, Mém. Soc. Zool. France, 1896, p. 31.
- americanus* Marx, Proc. Ent. Soc. Wash., III, p. 199, 1895.
- CORIACEUS Koch, Arch. f. Naturg., X, p. 219, 1844; Übersicht Archn. Syst., IV, p. 31, 1847; Neumann, Mém. Soc. Zool. France, 1896, p. 31; *ibid.*, 1901, p. 258.
- TALAJE Guérin, Rev. et Mag. de Zool., 1849, p. 342; Mégnin, Journ. Anat. Physiol., XXI, p. 470, 1885; Neumann, Mém. Soc. Zool. France, 1896, p. 34.

IXODIDÆ.

Ixodinæ.

IXODES.

Latreille, Précis Caract. Ins., p. 179, 1796.

- ANGUSTUS Neumann, Mém. Soc. Zool. France, 1899, p. 136; *ibid.*, 1901, p. 284.
- ARCTICUS Osborn, Fur Seals and Fur Seal Islands of the North Pacific Ocean, III, p. 553, 1899.
- BRUNNEUS Koch, Arch. f. Naturg., X, p. 232, 1844; Übersicht Archn. Syst., IV, p. 101, 1847; Neumann, Arch. Parasitol., VIII, p. 454, 1904.
- kelloggi* Nuttall and Warburton, Proc. Camb. Philos. Soc., XIV, p. 396, 1908.
- CALIFORNICUS Banks, Proc. Cal. Acad. Sci. (3), III, p. 369, 1904.
- COOKEI Packard, 1st Ann. Rept. Peabody Acad. Sci., p. 67, 1869.
- cruciaris* Fitch, 14th Rept. Ins. N. Y., p. 366, 1871.
- hexagonus* var. *longispinosus* Neumann, Mém. Soc. Zool. France, 1901, p. 283.
- hexagonus* Salmon and Stiles, 17th Ann. Rept. Bur. Anim. Ind., U. S. Dept. Agric., p. 467, 1902 (not of Leach).
- DENTATUS Neumann, Mém. Soc. Zool. France, 1899, p. 119.
- DIVERSIFOSSUS Neumann, Mém. Soc. Zool. France, 1899, p. 136.
- bicornis* Neumann, Arch. Parasitol., X, p. 196, 1906.
- HEXAGONUS Leach, Trans. Linn. Soc. London, XI, p. 397, 1815; Neumann, Mém. Soc. Zool. France, 1899, p. 129.
- MARXI Banks, *supra*, p. 32, 1908.
- PRATTI Banks, *supra*, p. 27, 1908.
- RICINUS Linnæus, Syst. Nat., X, p. 615, 1758; Neumann, Mém. Soc. Zool. France, 1899, p. 112; Salmon and Stiles, 17th Ann. Rept. Bur. Anim. Ind., U. S. Dept. Agric., p. 463, 1902.
- SCAPULARIS Say, Journ. Acad. Phil., II, p. 78, 1821; Compl. Writ., II, p. 21, 1859.
- affinis* Neumann, Mém. Soc. Zool. France, 1899, p. 120.
- SCULPTUS Neumann, Arch. Parasitol., VIII, p. 462, 1904.

CERATIXODES.

Neumann, Arch. Parasitol., VI, p. 115, 1902.

PUTUS Cambridge, Proc. Zool. Soc. London, 1876, p. 260; Neumann, Mém. Soc. Zool. France, 1899, p. 125; Arch. Parasitol., VI, p. 115, 1902; *ibid.* XI, p. 229, 1907.

borealis Kramer and Neuman, Acariden während der Vega Exped., p. 526, 1883.

fimbriatus Kramer and Neuman, *ibid.* (male).

hirsutus Birula, Bul. Acad. Imp. St. Pétersbourg, 1895, p. 356.

SIGNATUS Birula, Bul. Acad. Imp. St. Pétersbourg, 1895, p. 357.

parvirostris Neumann, Mém. Soc. Zool. France, 1901, p. 284.

Amblyomminæ.

HÆMAPHYSALIS.

Koch, Arch. Naturg., X, p. 237, 1844.

CHORDEILIS Packard, 1st Ann. Rept. Peabody Acad. Sci., p. 67, 1869.

LEPORIS-PALUSTRIS Packard, 1st Ann. Rept. Peabody Acad. Sci., p. 67, 1869; Neumann, Mém. Soc. Zool. France, 1897, p. 343.

rostralis Dugès, Bul. Soc. Zool. France, 1888, p. 129.

AMBLIOMMA.

Koch, Arch. Naturg., X, p. 223, 1844. *Euthesius* Gistel, Naturg., p. 158, 1848.

AMERICANUM Linnæus, Syst. Nat., X, p. 615, 1758; Fitch, 14th Rept. Ins. New York, p. 364, 1871; Neumann, Mém. Soc. Zool. France, 1899, p. 209; Salmon and Stiles, 17th Ann. Rept. Bur. Anim. Ind., U. S. Dept. Agric., p. 475, 1902.

orbiculatus Say, Journ. Phil. Acad., II, p. 76, 1821.

unipunctata Packard, 1st Ann. Rept. Peabody Acad. Sci., p. 66, 1869.

CAJENNENSE Fabricius, Entom. Syst., IV, p. 427, 1794; Koch, Übersicht Arachn. Syst., IV, p. 73, 1847; Neumann, Mém. Soc. Zool. France, p. 205, 1899.

crenatum Say, Journ. Phil. Acad., II, p. 76, 1821; Compl. Writ., II, p. 20, 1859.

mixtum Koch, Arch. Naturg., X, p. 227, 1844.

MACULATUM Koch, Arch. Naturg., X, p. 227, 1844; Neumann, Mém. Soc. Zool. France, 1899, p. 249.

tigrinum Koch, Arch. Naturg., X, p. 227, 1844.

tenellum Koch, *ibid.*

rubripes Koch, *ibid.*, p. 228.

ovatum Koch, *ibid.*

triste Koch, *ibid.*, p. 229.

TUBERCULATUM Marx, Insect Life, VI, p. 314; Neumann, Mém. Soc. Zool. France, 1899, p. 235.

DERMACENTOR.

Koch, Arch. Naturg., X, p. 235, 1844.

ALBIPICTUS Packard, Amer. Nat., II, p. 559, 1868; Guide Study Insects (part 9), p. 662, 1869 (Aug.); Amer. Nat., III, p. 365, 1869.

variegatus Neumann, Mém. Soc. Zool. France, 1897, p. 367; Salmon and Stiles, 17th Ann. Rept. Bur. Anim. Ind., U. S. Dept. Agric., p. 452, 1902.

reticulatus Salmon and Stiles, 17th Ann. Rept. Bur. Anim. Ind., U. S. Dept. Agric., p. 448, 1902 (not of Fabricius).

BIFURCATUS Neumann, Mém. Soc. Zool. France, 1899, p. 122 (sub. *Ixodes*); Arch. Parasitol., VIII, p. 453, 1904.

NIGROLINEATUS Packard, 1st Ann. Rept. Peabody Acad. Science, p. 66, 1869.

NITENS Neumann, Mém. Soc. Zool. France, 1897, p. 376; Salmon and Stiles, 17th Ann. Rept. Bur. Anim. Ind., U. S. Dept. Agric., p. 455, 1902.

OCCIDENTALIS Neumann, Arch. Parasitol., IX, p. 235, 1905.

reticulatus Neumann, Mém. Soc. Zool. France, 1897, p. 360 (part).

PARUMAPERTUS Neumann, Mém. Soc. Zool. France, 1901, p. 267; Arch. Parasitol., IX, p. 236, 1905.

PARUMAPERTUS var. MARGINATUS Banks, supra, p. 46, 1908.

VARIABILIS Say, Journ. Phil. Acad., II, p. 77, 1821; Compl. Writ., II, p. 21, 1859. *americanus* of various authors (not of Linnaeus).

electus Koch, Arch. Naturg., X, p. 235, 1844; Neumann, Mém. Soc. Zool. France, 1901, p. 265; Salmon and Stiles, 17th Ann. Rept. Bur. Anim. Ind., U. S. Dept. Agric., p. 455, 1902.

Dept. Agric., p. 455, 1902.

albipictus Packard, 1st Ann. Rept. Peabody Acad. Sci., p. 66, 1869 (not of Guide Study Insects).

5-striatus Fitch, 14th Rept. Ins. N. Y., p. 366, 1871.

robertsoni Fitch, *ibid.*

? *punctulatus* Say, Journ. Phil. Acad., II, p. 78, 1821; Compl. Writ., II, p. 21, 1859.

VENUSTUS Banks, supra, p. 46, 1908.

MARGAROPUS.

Karsch, Mitt. Münch. Ent. Ver., 1879, p. 96. *Boophilus* Curtice, Journ. Comp. Med. Vet. Arch., XII, p. 313, 1891.

ANNULATUS Say, Journ. Phil. Acad., II, p. 75, 1821; Compl. Writ., II, p. 19, 1859; Neumann, Mém. Soc. Zool. France, 1897, p. 407; Salmon and Stiles, 17th Ann. Rept. Bur. Anim. Ind., U. S. Dept. Agric., p. 420, 1902; Hunter and Hooker, Bul. 72, Bur. Ent., U. S. Dept. Agric., p. 30, 1907.

bovis Packard, 1st Ann. Rept. Peabody Acad. Sci., p. 68, 1869.

bovis Riley, Gamgee's Rept. Diseases of Cattle, p. 121, 1869.

indentatus Gamgee, Rept. Diseases of Cattle, p. 121, 1869.

dugesi Mégnin, Les Parasites, p. 126, 1880.

RHIPICEPHALUS.

Koch, Arch. Naturg., X, p. 238, 1844.

TEXANUS Banks, supra, p. 34, 1908.

UNPLACED.

IXODES CINCTUS Fabricius, Syst. Antliatorum, p. 356, 1805.

IXODES ERRATICUS Say, Journ. Phil. Acad., II, p. 77, 1821; Compl. Writ., II, p. 20, 1859.

IXODES FUSCUS Say, Journ. Phil. Acad., II, p. 79, 1821; Compl. Writ., II, p. 22, 1859.

BIBLIOGRAPHY.

ALLEN, W. E.—Internal morphology of the American cattle tick. <Studies Zool. Lab. Univ. Nebraska, No. 67, 1905, pp. 245-278, 3 pls.

BANKS, N.—Some arachnida from California. <Proc. Cal. Acad. Sci., III, (3), pp. 331-369, 1904.

BANKS, N.—A treatise on the Acarina or mites. <Proc. U. S. Nat. Mus., XXVIII, pp. 42-49, 1904.

BANKS, N.—A catalogue of the Acarina, or mites, of the United States. <Proc. U. S. Nat. Mus., XXXII, pp. 595-625, 1907.

BEARDSLEE, H. C.—Cattle tick on human body. <Bul. 4, n. s., Div. Ent., U. S. Dept. Agric., pp. 84-85, 1884.

BEHR, H. H.—A Californian tick. <Can. Entom., 1899, pp. 229-231.

RIRULA, A.—Ixodidae novae vel parum cognitae Musei Zoologici Academiae Caesareae Scientiarum Petropolitanae. <Bul. Acad. Imp. Sci. St. Petersburg., (5) II, pp. 353-364, 2 pls., 1895.

BUTLER, T.—The cattle tick and the quarantine restrictions. <Bul. No. 24, N. Car. State Bd. Agric., pp. 30-37, 1903.

BUTLER, T.—Progress made in exterminating the fever tick (*Boophilus annulatus*) in North Carolina. <Cir. N. Car. Dept. Agric., Jan. 1, 1906, 4 pp.

CONNAWAY, J. W.—Texas fever, or acclimation fever. <Bul. 37, Mo. Agric. Exp. Sta., pp. 81-139, 11 figs., 1897.

CURTICE, C. The biology of the cattle tick. <Journ. Comp. Med., XII, pp. 313-319, 1891.

CURTICE, C.—About cattle ticks. <Journ. Comp. Med., XIII, pp. 1-7, 1892.

CURTICE, C.—Parasites, being a list of those infesting the domesticated animals and man in the United States. <Journ. Comp. Med., XIII, pp. 223, 236, 1892.

CURTICE, C.—Cattle tick (*Boophilus bovis* Riley sp.) Biology. <Bul. 24, Tex. Agric. Exp. Sta., pp. 237-252, 2 pls., 1892.

CURTICE, C.—On the extermination of the cattle tick and the disease spread by it. <Journ. Comp. Med., XVII, pp. 649-655, 1896.

DALRYMPLE, W. H., H. A. MORGAN, and W. R. DODSON.—Cattle tick and Texas fever. <Bul. 51, La. Agric. Exp. Sta., pp. 230-282, 6 pls., 1898.

- DUGÈS, A.—Turicata y garrapata de Guanajuato. <La Naturaleza Mexicana, VI, pp. 195-198, 1883.
- DUGÈS, A.—Los Garrapatas de Mexico. <Mem. Soc. Antonio Alzate, XVIII, pp. 187-194, 1904.
- FITCH, A.—Fourteenth Report on the noxious, beneficial, and other insects of the State of New York. <Ann. Rept. N. Y. State Agric. Soc. (1870), pp. 355-381, 1872.
- FRANCIS, M.—The cattle tick, preventive measures for farm and range use. <Bul. 24, Tex. Agric. Exp. Sta., pp. 253-256, 1892.
- FRANCIS, M.—Veterinary Science. <Bul. 30, Tex. Agric. Exp. Sta., pp. 436-458, 3 pls., 1894.
- FRANCIS, M., and J. W. CONNAWAY.—Texas fever. <Bul. 53, Tex. Agric. Exp. Sta., pp. 53-106, 1899.
- GUÉRIN-MÈNEVILLE, F. E.—Genus *Argas*, A. *talaje* Guérin Mèneville. <Mag. de Zoologie, Année 1845, Arachn., pl. 6 (2 pp.) (Issued 1849.)
- GUÉRIN-MÈNEVILLE, F. E.—*Argas talaje* n. sp. <Revue et Mag. de Zool., (2) I, pp. 342-344, 1849.
- HASSALL, A.—Note on the chicken tick (*Argas americanus*). <16th Ann. Rept. Bur. Anim. Ind., U. S. Dept. Agric., pp. 496-500, 1 pls., 1900.
- HAYS, W. J.—The moose tick. <Amer. Nat., II, p. 559, 1869.
- HAZEN, E. H.—Cattle tick in the human ear. <Amer. Nat., V, pp. 176-177, 1871.
- HOEHR, F.—Further concerning the new chicken plague in Texas. <Insect Life, V, p. 348, 1893.
- HOLLAND, W. J.—Concerning ticks. <Can. Entom., 1898, pp. 96-97.
- HOWARD, L. O.—Note on the chicken tick. <Insect Life, VII, pp. 417-418, 1895.
- HUNTER, W. D.—Note on the occurrence of the North American fever tick on sheep. <Cir. 91, Bur. Ent., U. S. Dept. Agric., July, 1907, 3 pp.
- HUNTER, W. D., and W. A. HOOKER.—Information concerning the North American fever tick, with notes on other species. <Bul. 72, Bur. Ent., U. S. Dept. Agric., pp. 87, 1907.
- KALM, P.—Nachricht von einer Art Insecten in Nordamerika Waldlaus genannt (*Acarus nigra* De Geer). <Abh. Schw. Akad. f. 1754, pp. 20-31.
- KOCH, C. L.—Systematische Uebersicht ueber die Ordnung der Zecken. <Arch. f. Naturg., X, pp. 217-239, 1844.
- KOCH, C. L.—Übersicht des Arachniden-systems. <Nürnberg, part IV, pp. 136, pls. 30, 1847.
- LEIDY, J.—Remarks on ticks. <Proc. Acad. Nat. Sci. Phil., 1890, pp. 278-280.
- LEWIS, L. L.—Texas fever. <Buls. 27 and 39, Okla. Agric. Exp. Sta., 1897, 1898.
- LUGGER, O.—Insects injurious in 1896. <Bul. 48, Minn. Agric. Exp. Sta., pp. 31-270, 1896.
- MARX, G.—Note on the classification of the Ixodidæ. <Proc. Ent. Soc. Wash., II, pp. 232-236, 1892.
- MARX, G.—On the morphology of the ticks. <Proc. Ent. Soc. Wash., II, pp. 271-288, 1892.

- MARX, G.—[In Hubbard's "The insect guests of the Florida land tortoise."] <Insect Life, VI, pp. 302-315, 1894.
- MARX, G.—[Plate illustrating ticks, published by the Entomological Society of Washington in connection with obituary of Doctor Marx.] <Proc. Ent. Soc. Wash., III, pp. 195-201, 1895.
- MAYER, A.—The cattle tick in its relation to southern agriculture. <Farmers' Bul. 261, U. S. Dept. Agric., pp. 22, 1906.
- MAYO, N. S.—Texas fever. <Bul. 69, Kans. Agric. Exp. Station, pp. 124-134, 1897.
- MÉGNIN, P. A.—Les Argas du Mexique. <Journ. Anat. Physiol., XXI, pp. 460-476, 1885, 2 pls.
- MELVIN, A. D.—How to get rid of cattle ticks. <Cir. 97, Bur. Anim. Ind., U. S. Dept. Agric., pp. 4, 1906.
- MILLER, W. McN.—Texas cattle fever. <Bul. 31, Nevada Agric. Exp. Sta., 11 pp., 1895.
- MOHLER, J. R.—Texas fever, with methods for its prevention. <Bul. 78, Bur. Anim. Ind., U. S. Dept. Agric., pp. 48, 1906.
- MOHLER, J. R.—Texas or tick fever and its prevention. <Farmers' Bul. No. 258, U. S. Dept. Agric., pp. 45, 6 figs., 1906.
- MORGAN, H. A.—Report of the entomologist. <Bul. No. 28 (2d ser.), La. Agric. Exp. Sta., pp. 982-1005, 8 figs., 1894.
- MORGAN, H. A.—Ticks and Texas fever. <Bul. 56, La. Agric. Exp. Station, pp. 14, 9 pls., 1899.
- NEUMANN, G.—Révision de la famille des Ixodidés. <Mém. Soc. Zool. France, 1896, pp. 1-44; 1897, pp. 324-420; 1899, pp. 107-294; 1901, pp. 249-372.
- NEUMANN, G.—Notes sur les Ixodidés. <I. Arch. Parasit., VI, pp. 109-128, 1902; II, Arch. Parasit., VIII, pp. 444-464, 1904; III, Arch. Parasit., IX, pp. 225-241, 1905; IV, Arch. Parasit., pp. 195-219, 1906; V, Arch. Parasit., XI, pp. 215-232, 1907.
- NEWELL, W., and M. S. DOUGHERTY.—The cattle tick. Studies of the egg and seed-tick stages. A simple method of eradicating the tick. <La. Crop Pest Comm., Cir. No. 10, pp. 32, 1906.
- NILES, E. P.—The cattle tick in Virginia. <Bul. 76, Va. Agric. Exp. Sta., pp. 45-50, 1898.
- NILES, E. P.—A preliminary study of ticks. <Bul. 86, Va. Agric. Exp. Sta., pp. 25-30, 4 pls., 1898.
- NILES, E. P.—Animal Parasites, VII. <Bul. 114, Va. Agric. Exp. Sta., pp. 84-89, 1901.
- NUTTALL, G. H. F., and C. WARBURTON.—On a new genus of Ixodoidea, together with a description of eleven new species of ticks. <Proc. Cambr. Philos. Soc., XIV, pp. 392-416, 1908.
- OSBORN, H.—Insects affecting domestic animals. <Bul. 5, n. s., Div. Ent., U. S. Dept. Agric., pp. 255-262, 3 pls., 1896.
- PACKARD, A. S.—Report of the curator of articulata. <First Ann. Rept. Trustees Peabody Acad. Science, pp. 52-69, 1869.

- PACKARD, A. S.—Description of new insects. <Sixth Ann. Rept. U. S. Geol. Survey Terr. f. 1872, pp. 739-741, 1873.
- RANSOM, B. H.—Some unusual host-relations of the Texas fever tick. <Bur. Anim. Ind., U. S. Dept. Agric., Cir. 98, pp. 8, 1906.
- REDDING, R. J.—Cattle ticks and Texas fever. <Bul. 49, Ga. Agric. Exp. Sta., pp. 228-229, 1889.
- RILEY, C. V.—Remarks on the *Ixodes bovis*. <Reports, Diseases of cattle in U. S., p. 168, 1869.
- RILEY, C. V.—Poisonous insects. <Reference Handb. Med. Sci., V, pp. 741-760, 1887.
- RILEY, C. V., and L. O. HOWARD.—The Texas cattle tick. <Insect Life, II, p. 20, 1889.
- RILEY, C. V., and L. O. HOWARD.—The new chicken plague in Texas. <Insect Life, V, p. 267, 1893.
- ROBERT, J. C.—Texas fever. <Bul. 69, Miss. Agric. Exp. Sta., pp. 16, 1901.
- ROBERT, J. C.—Tick fever or murrain in Southern cattle (commonly termed Texas fever). <Bul. 73, Miss. Agric. Exp. Sta., p. 24, 1902.
- SALMON, D. E., and CH. W. STILES.—Cattle ticks (Ixodoidea) of the United States. <Ann. Rept. Bur. Anim. Ind., U. S. Dept. Agric., pp. 380-491, 25 pls., 1902.
- SAY, T.—An account of the Arachnides of the United States. <Jour. Acad. Nat. Sci. Philad. II, (1), pp. 59-82, 1821; Complete Writings, Le Conte Ed., II, pp. 19-22, 1859.
- SCHROEDER, E. C.—A note on the vitality of the Southern cattle tick. <16th Ann. Rept. Bur. Anim. Ind., U. S. Dept. Agric., pp. 41-42, 1900.
- SCHROEDER, E. C., and W. E. COTTON.—Growing noninfected ticks and afterwards infecting them. <16th Ann. Rept. Bur. Anim. Ind., U. S. Dept. Agric., pp. 33-41, 1900.
- SMITH, T., and F. L. KILBORNE.—Investigations into the nature, causation, and prevention of Texas or Southern cattle fever. <Bul. 1, Bur. Anim. Ind., U. S. Dept. Agric., pp. 301, 1893.
- SMITH, T., F. L. KILBORNE, and E. C. SCHROEDER.—Additional observations on Texas cattle fever. <Bul. 3, Bur. Anim. Ind., U. S. Dept. Agric., pp. 67-72.
- STILES, CH. W.—A zoological investigation into the cause, transmission, and source of the Rocky Mountain spotted fever. <Bul. 20, Hygienic Laboratory, 1905.
- STILES, CH. W., and A. HASSALL.—Notes on Parasites, 55: A pupa-like stage in the development of the spinose ear tick (*Ornithodoros mcgini*) of cattle. <Cir. 34, Bur. Anim. Ind., U. S. Dept. Agric., 2 pp., 1901.
- STILES, C. W., and A. HASSALL.—Notes on Parasites, 56: *Boophilus australis* present in Cuba, Porto Rico, Venezuela, and India. <Cir. 34, Bur. Anim. Ind., U. S. Dept. Agric., pp. 2-3, 1901.
- TOWNSEND, C. H. T.—Note on a tick from ear of a coyote. <Ent. News, 1893, p. 246.

- TOWNSEND, C. H. T.—Ticks in the ears of horses. <Journ. N. Y. Entom. Soc., I, pp. 49-52, 1893.
- VINCENHELLER, W. G.—The cattle tick in Washington and Benton counties. <Bul. 90, Ark. Agric. Exp. Sta., pp. 131-141, 1906.
- WALSH, B. D., and C. V. RILEY.—Ticks and Texas fever. <Amer. Entomologist, I, p. 28, 1868.
- WARD, H. B.—The ticks of Nebraska. <Ann. Rept. Nebraska State Bd. Agric. (1899), pp. 193-205, 6 figs., 1900.
- WILLIAMS, S. R.—Anatomy of *Boophilus annulatus*. <Proc. Bost. Soc. Nat. Hist., XXXII, pp. 313-334, 5 pls., 1905.
- WILLOUGHBY, C. L.—Cattle ticks and Texas fever; immunizing experiments in Georgia. <Bul. 64, Ga. Agric. Exp. Sta., pp. 143-182, 1904.
- WRIGHT, C.—The cattle tick. <Amer. Nat., III, pp. 51-52, 1869.

INDEX.

	Page.		Page.
Abundance.....	11	Life-history.....	9
<i>affinis</i> , <i>Ixodes</i> . (See <i>scapularis</i> .)		<i>longispinosus</i> , <i>Ixodes</i> . (See <i>cookei</i> .)	
<i>albipictus</i> , <i>Dermacentor</i>	43, 44	<i>maculatum</i> , <i>Amblyomma</i>	37, 39
<i>Amblyomma</i>	20, 37	<i>Margaropus</i>	20, 35
AMBLYOMMINÆ.....	20	<i>marginatus</i> , var. of <i>parumapertus</i>	46
AMBLYOMMINI.....	20	<i>marxi</i> , <i>Ixodes</i>	23, 32
<i>americana</i> , <i>Argas</i> . (See <i>miniatus</i> .)		<i>megnini</i> , <i>Ornithodoros</i>	16, 17
<i>americanus</i> , <i>Ornithodoros</i> . (See <i>turicata</i> .)		<i>miniatus</i> , <i>Argas</i>	15
<i>americanum</i> , <i>Amblyomma</i>	37, 40	<i>mixtum</i> , <i>Amblyomma</i> . (See <i>cajennense</i> .)	
<i>angustus</i> , <i>Ixodes</i>	23, 29	<i>nigrolineatus</i> , <i>Dermacentor</i>	43, 48
<i>annulatus</i> , <i>Margaropus</i>	36	<i>nitens</i> , <i>Dermacentor</i>	42, 43, 50
<i>arcticus</i> , <i>Ixodes</i>	23	<i>occidentalis</i> , <i>Dermacentor</i>	43, 47
<i>Argas</i>	14	<i>orbiculatus</i> , <i>Ixodes</i> . (See <i>americanum</i> , <i>Amblyomma</i> .)	
ARGASIDÆ.....	14	<i>Ornithodoros</i>	14, 16
<i>bicornis</i> , <i>Ixodes</i> . (See <i>diversifossus</i> .)		<i>ovatum</i> , <i>Amblyomma</i> . (See <i>maculatum</i> .)	
<i>bifurcatus</i> , <i>Dermacentor</i>	43	<i>parumapertus</i> , <i>Dermacentor</i>	43, 45
<i>Boophilus</i> . (See <i>Margaropus</i> .)		<i>parvirostris</i> , <i>Ixodes</i> . (See <i>signatus</i> , <i>Ceratixodes</i> .)	
<i>borealis</i> , <i>Ceratixodes</i> . (See <i>putus</i> .)		<i>persicus</i> , <i>Argas</i> . (See <i>miniatus</i> .)	
<i>bovis</i> , <i>Boophilus</i> . (See <i>annulatus</i> , <i>Margaropus</i> .)		<i>pratti</i> , <i>Ixodes</i>	23, 27
<i>brevipes</i> , <i>Argas</i>	15	<i>punctulatus</i> , <i>Ixodes</i> . (See <i>variabilis</i> , <i>Dermacentor</i> .)	
<i>brunneus</i> , <i>Ixodes</i>	23, 26	<i>putus</i> , <i>Ceratixodes</i>	21
<i>cajennense</i> , <i>Amblyomma</i>	37, 41	<i>quinqvestriatus</i> , <i>Ixodes</i> . (See <i>variabilis</i> , <i>Dermacentor</i> .)	
<i>californicus</i> , <i>Ixodes</i>	23, 24	<i>radiatus</i> , <i>Argas</i> . (See <i>miniatus</i> .)	
<i>canisuga</i> , <i>Ixodes</i>	32	<i>reflexus</i> , <i>Argas</i>	14, 16
<i>Ceratixodes</i>	20	<i>reticulatus</i> , <i>Dermacentor</i>	42, 52
<i>chordeilis</i> , <i>Hæmaphysalis</i>	33, 34	RHIPICEPHALINI.....	20
<i>cinctus</i> , <i>Ixodes</i>	50, 52	<i>Rhipicephalus</i>	20, 34
Classification.....	12	<i>ricinus</i> , <i>Ixodes</i>	22, 23, 24
<i>concinna</i> , <i>Hæmaphysalis</i>	32, 52	<i>robertsoni</i> , <i>Ixodes</i> . (See <i>variabilis</i> , <i>Dermacentor</i> .)	
<i>cookei</i> , <i>Ixodes</i>	23, 28	<i>rostralis</i> , <i>Gonixodes</i> . (See <i>leporis-palustris</i> , <i>Hæmaphysalis</i> .)	
<i>coriaceus</i> , <i>Ornithodoros</i>	17, 18	<i>rubripes</i> , <i>Amblyomma</i> . (See <i>maculatum</i> .)	
<i>crenatum</i> , <i>Ixodes</i> . (See <i>cajennense</i> , <i>Amblyomma</i> .)		<i>sanchezi</i> , <i>Argas</i> . (See <i>miniatus</i> .)	
<i>cruciaris</i> , <i>Ixodes</i> . (See <i>cookei</i> .)		<i>sanguineus</i> , <i>Rhipicephalus</i>	34
<i>dentatus</i> , <i>Ixodes</i>	23, 28	<i>savignyi</i> , <i>Ornithodoros</i>	16
<i>Dermacentor</i>	20, 42	<i>scapularis</i> , <i>Ixodes</i>	23, 25
DERMACENTORINI.....	20	<i>sculptus</i> , <i>Ixodes</i>	23, 30
<i>diversifossus</i> , <i>Ixodes</i> . (See <i>putus</i> .)	22, 27	<i>signatus</i> , <i>Ceratixodes</i>	21
<i>dugesi</i> , <i>Ixodes</i> . (See <i>annulatus</i> , <i>Margaropus</i> .)		<i>spinusum</i> , <i>Rhynchoprion</i> . (See <i>megnini</i> , <i>Ornithodoros</i> .)	
<i>electus</i> , <i>Dermacentor</i> . (See <i>variabilis</i> .)		Structure.....	7
<i>erraticus</i> , <i>Ixodes</i>	49, 51	<i>talaje</i> , <i>Ornithodoros</i>	17, 19
<i>fimbriatus</i> , <i>Ceratixodes</i> . (See <i>putus</i> .)		<i>tenellum</i> , <i>Amblyomma</i> . (See <i>maculatum</i> .)	
<i>frontalis</i> , <i>Ixodes</i>	26, 52	<i>texanus</i> , <i>Rhipicephalus</i>	34
<i>fuscus</i> , <i>Ixodes</i>	51	<i>tigrinum</i> , <i>Amblyomma</i> . (See <i>maculatum</i> .)	
Geographical distribution.....	10	<i>triste</i> , <i>Amblyomma</i> . (See <i>maculatum</i> .)	
HÆMAPHYSALINI.....	20	<i>tuberculatum</i> , <i>Amblyomma</i>	37, 38
<i>Hæmaphysalis</i>	20, 32	<i>turicata</i> , <i>Ornithodoros</i>	17, 18
<i>hexagonus</i> , <i>Ixodes</i>	23, 31	<i>unipunctata</i> , <i>Amblyomma</i> . (See <i>americanum</i> .)	
<i>hirsutus</i> , <i>Ceratixodes</i> . (See <i>putus</i> .)		<i>uriae</i> , <i>Ixodes</i> . (See <i>putus</i> , <i>Ceratixodes</i> .)	
Historical.....	11	<i>variabilis</i> , <i>Dermacentor</i>	43, 49
<i>inchoatus</i> , <i>Ixodes</i>	32, 52	<i>variegatus</i> . (See <i>albipictus</i> , <i>Dermacentor</i> .)	
<i>indentatus</i> , <i>Ixodes</i> . (See <i>annulatus</i> , <i>Margaropus</i> .)		<i>venustus</i> , <i>Dermacentor</i>	43, 46
<i>Ixodes</i>	20, 22	<i>winthemi</i> , <i>Margaropus</i>	36
IXODIDÆ.....	14, 20		
IXODINÆ.....	20		
IXODOIDEA.....	7		
<i>kelloggi</i> , <i>Ixodes</i> . (See <i>brunneus</i> .)			
<i>leporis-palustris</i> , <i>Hæmaphysalis</i>	33		

