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A Search for Tick Parasites in South Africa.*

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WITH over 300 species of ticks (*Ixodidae*) known and with the increasing number of diseases of man, domestic animals, and wild animals, known to be carried by ticks, it is only natural that there should be a general interest in the possibility of biological control. This led to a visit to South Africa by the writer in 1928, to search for tick parasites, especially for such species as might be of value for the control of *Dermacentor andersoni* Stiles. This tick is a serious problem in the Rocky Mountain region of the United States where it transmits Rocky Mountain spotted fever and other infections to man, and is concerned in the transmission or causation of several diseases of animals.

Searching for tick parasites is relatively new in the experience of entomologists. In the field of agricultural entomology there are thousands of known parasites attacking insects that feed on plant life, and various workers have spent much time in looking for new species in other countries for use in their home lands. These entomologists have had the guidance of experience and the writings that have accumulated through many years. In the field of medical entomology, relatively few parasites of disease transmitting or disease causing insects, and only two parasites of ticks, are known. These are *Ixodiphagus texanus* Howard (17) and *Hunterellus hookeri* Howard (18) which are closely related phylogenetically and very similar in their biologies. *Ixodiphagus caucurtei* du Buysson (12) described from France has recently been determined to be synonymous with *H. hookeri*.

In the attempted biological control of *D. andersoni* Stiles in the United States, as carried on by the Montana State Board of Entomology from 1926 to July 1, 1931, and by the Bureau of the U.S. Public Health Service, since that time, the writer has had experience with the tick parasites referred to above and before leaving for Africa had assembled several trained assistants, who were on duty while he was away. They were thus in a position to receive and make use of any new parasites that might be found.

In view of the rather extensive and thorough faunal surveys of ticks that had been made by various workers in the United States, and particularly by the U.S. Bureau of Entomology of the Department of Agriculture, it was believed that we probably had discovered

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in America all the tick parasites present in the native fauna. In arriving at this opinion we were influenced by some knowledge of the methods that were used in the faunal surveys that had been made. In many instances the entomologists had kept the living ticks under observation and allowed the fed larvae and fed nymphs to develop and emerge into the next stage. An opportunity was thus afforded for detecting any tick parasites present, excepting latent ones. The latter could be found only by a further feeding of the immature ticks in the laboratory. Therefore it appeared to be more desirable to make search for parasites on some other continent rather than in the United States.

Africa was selected for the search for several reasons. There is present there an extensive tick fauna and most of the species are indigenous. G. A. H. Bedford (2) has recently listed 61 species in South Africa alone. It has been less disturbed by agriculture, industry, and commerce, than have the other continents, and the fauna has evidence of having gone through extensive and profound biological changes in the course of evolution. Ticks must have been present for ages and they must have afforded an opportunity for the adaptation of parasites in ticks with diverse habits. True, there are other regions where ticks have existed since very early times, but it seems clear that there are present on the continent concerned, many well adapted, or specialized ticks, which should afford opportunity for further specialization of parasites that attack them. This is illustrated by the discovery by Bedford (1) of the remarkable tick, *Nuttalliella namaqua* which appears to be intermediate between *Argasidae* and *Ixodidae*. It is his opinion that the finding of this tick " seems to indicate that the *Ixodidae* may have originated in Africa ".

Further, it was hoped that there might be found in South Africa, localities where some specialized tick could be discovered in relatively few numbers where parasites might be the cause for the lesser numbers. South Africa was chosen for the venture because it is remote from the equator, and the climate resembles more closely that found where *D. andersoni* is adapted in America.

The writer was pleased to be able to work under the auspices of the Government of the Union of South Africa at the Laboratories of Veterinary Services and Animal Industry at Onderstepoort which, in both accomplishment and facilities, stand very high among similar institutions of the world.

A thorough search for tick parasites in Africa, even in the southern part of the continent alone, would have required more time than was available and it was necessary to adopt a method that would lead directly to a maximum of results. The simple method employed was to secure numerous ticks from as many kinds of animals as possible. It was desirable also to get the ticks from many different localities. The ticks taken were kept alive under observation for parasitism. According to previous experience, about two-thirds engorgement is necessary either to permit the parasites to mature or to insure the development of the tick to the next stage. It was realized also that most of the different species of ticks available in the country could be obtained in the better settled agricultural regions, on domestic animals and the small wild mammals. It seemed to be

desirable also, to collect ticks from large wild animals and from the smaller mammals in the more remote regions where, it was believed, that in the more natural environment there might be a greater possibility of finding parasites.

The phenomenon of latency in *Hunterellus hookeri* had been discovered (9) just before departing for Africa, and its possible occurrence in any parasite was apparent. The method used as outlined above, would not bring to light any latent parasites that might be present, for in order to detect them it would be necessary to go through further procedure including the feeding of the ticks in the laboratory. This would have required not only more time, but trained helpers, further equipment, and a variety of laboratory animals.

RECORD OF TICKS COLLECTED IN SOUTH AFRICA.

It is not necessary to give in detail the various collecting trips that were taken. All of the collecting done is summarized in the following paragraph.

The Morning Market at Pretoria was visited for a few days beginning July 14, for the purpose of examining hares and some of the larger game animals. Later a man employed for the purpose, continued these observations. Brief collecting trips were made on roads leading out of Pretoria whenever there was opportunity. More extended trips were taken to Warmbaths, Pienaar's River, and to the vicinity of Hartebeestpoort Dam. Other trips were taken in the vicinity of Messina and along the Limpopo River and near the Kruger National Park Game Reserve, where collecting was done on lands owned by the Transvaal Consolidated Lands and Exploration Company. Mr. C. P. Lounsbury, a former college mate in Massachusetts, U.S.A., made an extended automobile tour through the southern Transvaal, Orange Free State and Cape Province, and secured for the writer, at no expense to him other than the petrol used, a large number of ticks.

Because of their nocturnal habits it was easier to secure certain of the small animals at night, such as hares, spring hares and gennets, etc. Most of the animals were shot. The desirability of capturing animals by traps in order to afford an opportunity to hold them in cages while any infesting ticks fed to repletion, was fully recognized. Only a small amount of trapping was possible, however. Mice were easily secured, but it was soon learned that they carried no ticks.

It should be realized that since the collecting was extended only from June 4 to October 17, the writer did not have the full opportunity to find any possible tick parasites. To be most effective such a survey should be continued through a full year in each general locality studied.

The locality of each tick lot taken in all of the collecting is given with dates in the tabulation below. The entire collection of ticks was examined by Dr. G. H. F. Nuttall and Mr. Cecil Warburton of Cambridge, England, and the writer desires to express his appreciation of their kindness in naming them.

SOUTH AFRICAN TICK RECORDS.

1928.	Ticks.	Parasites.	Hosts.	Localities.
4th June.....	*R. evertsi* Neum..... *B. decoloratus* Koch	—	Cattle.....	Capetown, C.P.
4th June.....	*B. decoloratus* Koch.....	—	Cow.....	Capetown, C.P.
14th June.....	*H. aegyptium* Linn..... *B. decoloratus* Koch	*	Hare, *Lepus zuluensis* Thos. and Schw.	Pretoria, Transvaal, Morning Market.
20th June.....	*B. decoloratus* Koch.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Morning Market.
20th June.....	*H. aegyptium* Linn..... *R. oculatus* Neum.	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Morning Market.
23rd June.....	*R. oculatus* Neum.....	—	Horses.....	Pretoria, Transvaal.
23rd June.....	*H. aegyptium* Linn.....	—	"Dikkop" *Burhinops capensis* Lcht. (a bird)	Pienaar's River, Transvaal.
25th June.....	*R. appendiculatus* Neum..... *R. evertsi* Neum. *A. hebraeum* Koch *H. aegyptium* Linn.	—	Cattle.....	Warmbaths, Transvaal.
26th June.....	*Hyalomma* sp..... *R. appendiculatus* Neum.	—	Horses.....	Pretoria, Transvaal.
30th June.....	*H. aegyptium* Linn.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Morning Market.
30th June.....	*R. oculatus* Neum..... *H. aegyptium* Linn.	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Morning Market.
4th July.....	*H. aegyptium* Linn.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Morning Market.
28th June.....	*R. evertsi* Neum.....	—	Kudu, *Strepsiceros strepsiceros* Pallas	Grahamstown, C.P.
7th July.....	*R. evertsi* Neum.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Morning Market.
6th July.....	*H. aegyptium* Linn..... *R. oculatus* Neum.	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Morning Market.
6th July.....	*R. evertsi* Neum.....	—	Sable antelope, *Ozanna nigra* Harris	Messina, Transvaal, Dongola Farm.
7th July.....	*R. evertsi* Neum..... *B. decoloratus* Koch	—	Kudu, *Strepsiceros strepsiceros* Pallas	Messina, Transvaal, Dongola Farm.
8th July.....	*Boophilus* sp.....	—	Hare, *L. zuluensis*.....	Messina, Transvaal, Dongola Farm.
7th July.....	*R. evertsi* Neum..... *H. aegyptium* Linn.	—	Roan antelope, *Equinus equinus* Desm.	Messina, Transvaal, Dongola Farm.

6th July.....	*H. aegyptium* Linn.....	—	Hare, *L. zuluensis*.....	Messina, Transvaal, Dongola Farm.
	B. decoloratus Koch			
8th July.....	*B. decoloratus* Koch.....	—	Duiker, *Sylvicapra grimmi* L....	Messina, Transvaal, Dongola Farm.
	R. evertsi Neum			
6th July.....	*R. evertsi* Neum.....	—	Impala, *Aepyceros melampus* Lcht.	Messina, Transvaal, Dongola Farm.
	B. decoloratus Koch			
10th July.....	*R. oculatus* Neum.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Morning Market.
11th July.....	*R. oculatus* Neum.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Morning Market.
12th July.....	*R. evertsi* Neum.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Morning Market.
15th July.....	*H. aegyptium* Linn.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Morning Market.
14th July.....	*H. aegyptium* Linn.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Morning Market.
14th July.....	*R. oculatus* Neum.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal.
17th July.....	*R. oculatus* Neum.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Morning Market.
	H. aegyptium Linn.			
21st July.....	*R. oculatus* Neum.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Morning Market.
26th July.....	*R. oculatus* Neum.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Morning Market.
26th July.....	*R. oculatus* Neum.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Morning Market.
28th July.....	*H. aegyptium* Linn.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Morning Market.
29th July.....	*Ixodes rasus* Neum.....	—	Impala, *Aepyceros melampus* Lcht.	Pretoria, Transvaal.
	Boophilus			
31st July.....	*B. decoloratus* Koch.....	—	Impala, *Aepyceros melampus* Lcht.	Pretoria, Transvaal, Morning Market.
3rd August.....	*R. oculatus* Neum.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Morning Market.
7th August.....	*R. appendiculatus* Neum.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Morning Market.
	B. decoloratus Koch			
8th August.....	*H. aegyptium* Linn.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Morning Market.
9th August.....	*R. oculatus* Neum.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Morning Market.
31st July.....	*R. appendiculatus* Neum.....	—	Sheep.....	Klasserie, Transvaal, Farm Scotia.
	A. hebraeum Koch			
31st July.....	*A. hebraeum* Koch.....	—	Goat.....	Klasserie, Transvaal, Farm Scotia.
1st August.....	*A. hebraeum* Koch.....	—	Dog.....	Klasserie, Transvaal, Farm Orinoco.
	H. leachii Audouin			
30th July.....	*H. aegyptium* Linn.....	—	Hare, *L. zuluensis*.....	Klasserie, Transvaal, Farm Fleur-de-Lys.
	R. evertsi			
	R. oculatus Neum.			
30th July.....	*R. evertsi* Neum.....	—	Hare, *L. zuluensis*.....	Klasserie, Transvaal, Farm Fleur-de-Lys.
	R. oculatus Neum.			
	H. aegyptium Linn.			
30th July.....	*R. oculatus* Neum.....	—	Hare, *L. zuluensis*.....	Klasserie, Transvaal, Farm Fleur-de-Lys.
	Hyalomma sp.			

SOUTH AFRICAN TICK RECORDS—(*continued*).

1928.	Ticks.	Parasites.	Hosts.	Localities.
30th July.....	*R. evertsi* Neum..... *R. oculatus* Neum. *Hyalomma* sp.	—	Hare, *L. zuluensis*.....	Klasserie, Transvaal, Farm Scotia.
30th July.....	*R. appendiculatus* Neum.....	—	Goat.....	Klasserie, Transvaal, Farm Scotia.
31st July.....	*H. aegyptium* Linn.....	—	Hare, *L. zuluensis*.....	Klasserie, Transvaal, Farm Scotia.
30th July.....	*R. appendiculatus* Neum.....	—	Goats.....	Klasserie, Transvaal, Farm Scotia.
31st July.....	*R. appendiculatus* Neum.....	—	Calves.....	Klasserie, Transvaal, Farm Scotia.
31st July.....	*R. appendiculatus* Neum.....	—	Calves.....	Klasserie, Transvaal, Farm Scotia.
31st July.....	*R. appendiculatus* Neum.....	—	Calves.....	Klasserie, Transvaal, Farm Scotia.
30th July.....	*Rhipicephalus* (nymphs).....	—	Hare, *L. zuluensis*.....	Klasserie, Transvaal, Farm Fleur-de-Lys.
1st August.....	*R. appendiculatus* Neum..... *R. evertsi* Neum. *A. hebraeum* Koch	—	Hare, *L. zuluensis*.....	Klasserie, Transvaal, Farm Scotia.
1st August.....	*A. hebraeum* Koch..... *H. leachii* Audouin	—	Dog.....	Klasserie, Transvaal, Farm Orinoco.
21st July.....	*H. leachii* Audouin.....	—	Dog.....	Klasserie, Transvaal.
27th July.....	*R. appendiculatus* Neum..... *A. variegatum* Fabr. *Ixodes* (nymphs) *A. hebraeum* Koch	—	Dog.....	Klasserie, Transvaal.
27th July.....	*Rhipicephalus* (nymphs).....	—	Dogs.....	Klasserie, Transvaal.
27th July.....	*R. appendiculatus* Neum..... *A. hebraeum* Koch *Ixodes pilosus* Koch	—	Dogs.....	Klasserie, Transvaal.
27th July.....	*R. evertsi* Neum..... *H. aegyptium* Linn.	—	Hare, *L. zuluensis*.....	Klasserie, Transvaal.
28th July.....	*R. appendiculatus* Neum.....	—	Dog.....	Sand River, Transvaal.
28th July.....	*A. hebraeum* Koch..... *H. leachii* Audouin	—	Dog.....	Klasserie, Transvaal.
27th July.....	*A. hebraeum* Koch.....	—	Dog.....	Klasserie, Transvaal.
28th July.....	*R. appendiculatus* Neum..... *A. hebraeum* Koch	—	Dog.....	Klasserie, Transvaal.

26th July.....	*R. appendiculatus* Neum.....	—	Yellow-footed squirrel, *Paraxerus cepapi* A. Smith	Klasserie, Transvaal, Farm Scotia.
27th July.....	*A. hebraeum* Koch.....	—	Dog.....	Klasserie, Transvaal.
	Ixodes sp. (nymphs)			
28th July.....	*R. appendiculatus* Neum.....	—	Dog.....	Sand River, Transvaal.
27th July.....	*A. hebraeum* Koch.....	—	Dog.....	Klasserie, Transvaal.
6th August.....	*B. decoloratus* Koch.....	—	Sable antelope, *Ozanna nigra* Harris	Acorn Hoek, Transvaal, Spring Valley.
6th August.....	*H. leachii* Audouin.....	—	Dog.....	Acorn Hoek, Transvaal, Spring Valley.
7th August.....	*R. evertsi* Neum.....	—	Goat.....	Acorn Hoek, Transvaal, Spring Valley.
	R. appendiculatus Neum.			
	A. variegatum Fabr.			
	A. hebraeum Koch			
	B. decoloratus Koch			
	Boophilus			
8th August.....	*R. appendiculatus* Neum.....	—	Bull.....	Satara, Transvaal, Kruger Park.
	A. hebraeum Koch			
7th August.....	*A. hebraeum* Koch.....	—	Bull.....	Acorn Hoek, Transvaal, Spring Valley.
	B. decoloratus Koch			
	R. appendiculatus Neum.			
	H. aegyptium Linn.			
28th July.....	*R. oculatus* Neum.....	—	No host given.....	Messina, Transvaal.
11th August.....	*R. oculatus* Neum.....	—	Impala, *Aepyceros melampus* Lcht.	Moea Maru (?).
22nd August.....	*R. distinctus* Bedf.....	—	Dassie, *Procavia coombsi* Rbts...	Onderstepoort, Stock Farm.
	H. cooleyi Bedf.			
	Rhipicentor bicornis			
29th August.....	*R. oculatus* Neum.....	—	Hare, *L. ochropus* Wagn.....	Bloemfontein, O.F.S.
	H. aegyptium Linn.			
28th August.....	*R. oculatus* Neum.....	—	Hare, *L. ochropus* Wagn.....	Glen, O.F.S.
	H. aegyptium Linn.			
29th August.....	*H. aegyptium* Linn.....	*	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Morning Market.
26th August.....	*R. evertsi* Neum.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Pretorius Farm.
	H. aegyptium Linn.			
28th August.....	*R. evertsi* Neum.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Pretorius Farm.
	Hyalomma sp.			
30th August.....	*H. aegyptium* Linn.....	*	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Pretorius Farm.
30th August.....	*H. aegyptium* Linn. (nymphs).....	*	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Nefdt Farm.

SOUTH AFRICAN TICK RECORDS—(*continued*).

1928.	Ticks.	Parasites.	Hosts.	Localities.
30th August.....	*R. evertsi* Neum.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Nefdt Farm.
	H. aegyptium Linn.			
31st August.....	*R. evertsi* Neum.....	*	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Nefdt Farm.
31st August.....	*R. oculatus* Neum.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Nefdt Farm.
30th August.....	*Rhipicephalus* (nymphs).....	*	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Nefdt Farm.
31st August.....	*R. evertsi* Neum.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Nefdt Farm.
31st August.....	*R. evertsi* Neum.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Nefdt Farm.
1st September...	*H. aegyptium* Linn.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Nefdt Farm.
31st August.....	*R. evertsi* Neum.....	*	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Nefdt Farm.
31st August.....	*R. evertsi* Neum.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Nefdt Farm.
30th August.....	*Hyalomma* sp. (nymphs).....	*	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Nefdt Farm.
31st August.....	*Rhipicephalus* sp.....	—	Hare, *L. capensis*.....	Grootfontein, O.F.S.
	R. oculatus Neum.			
30th August.....	*R. oculatus* Neum.....	—	Hare, *L. capensis*.....	Middelburg, C.P.
31st August.....	*R. oculatus* Neum.....	—	Hare, *L. capensis*.....	Grootfontein, O.F.S.
28th August.....	*H. leachii* Audouin.....	—	Dog.....	Grootfontein, O.F.S.
7th September...	*H. aegyptium* Linn.....	*	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Nefdt Farm.
3rd September...	*R. evertsi* Neum.....	—	Cattle.....	Fort Beaufort, C.P.
5th September...	*R. evertsi* Neum. (nymphs).....	—	Cattle.....	Fort Beaufort, C.P.
6th September...	*R. evertsi* Neum.....	—	—	Fort Beaufort, C.P.
	R. appendiculatus Neum.			
3rd September...	*R. evertsi* Neum.....		Sheep.....	Fort Beaufort, C.P.
4th September...	*R. evertsi* Neum.....	—	Hares, *L. capensis*.....	Fort Beaufort, C.P.
	H. aegyptium Linn.	—		
13th September...	*R. evertsi* Neum.....		Calf.....	Hartebeestpoort Dam, near Pretoria, Transvaal, Smith's Farm.
	H. aegyptium Linn.	—		
	R. appendiculatus Neum.			
5th September...	*Argas persicus* Oken.....		Fowls.....	Fort Beaufort, C.P.
5th September...	*Boophilus*.....	—	Cattle.....	Fort Beaufort, C.P.
5th September...	*R. evertsi* Neum.....	—	Cattle.....	Fort Beaufort, C.P.
	A. hebraeum Koch	—		

12th September...	*R. oculatus* Neum..... *R. evertsi* Neum. *R. appendiculatus* Neum.	—	Cattle.....	Bathurst, C.P.
12th September...	*R. appendiculatus* Neum..... *R. evertsi* Neum. *A. hebraeum* Koch	—	Cattle.....	Bathurst, C.P.
12th September...	*R. evertsi* Neum..... *R. appendiculatus* Neum.	—	Cattle.....	Bathurst, C.P.
12th September...	*R. appendiculatus* Neum..... *Ixodes* sp. (nymphs)	—	Cattle.....	—
14th September...	*R. evertsi* Neum..... *R. appendiculatus* Neum.	—	Cattle.....	Klemmond.
14th September...	*Boophilus*.....	—	Cattle.....	Klemmond.
21st September...	*H. aegyptium* Linn.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Nefdt Farm.
18th September...	*Boophilus*.....	—	Cattle.....	Queenstown, C.P.
18th September...	*Boophilus*.....	—	Cattle.....	Queenstown, C.P.
18th September...	*R. evertsi* Neum.....	—	Cattle.....	Queenstown, C.P.
18th September...	*R. evertsi* Neum.....	—	Cattle.....	Queenstown, C.P.
18th September...	*R. evertsi* Neum.....	—	Cattle.....	Queenstown, C.P.
18th September...	*R. evertsi* Neum.....	—	Cattle.....	Queenstown, C.P.
22nd September..	*R. oculatus* Neum..... *H. aegyptium* Linn.	—	African bulls.....	Bloemfontein, O.F.S.
27th September...	*R. evertsi* Neum..... *B. decoloratus* Koch *H. aegyptium* Linn.	—	Cattle.....	Pretoria, Transvaal, Nefdt Farm.
27th September...	*H. aegyptium* Linn..... *Boophilus*	—	Cattle.....	Pretoria, Transvaal, Nefdt Farm.
27th September...	*R. evertsi* Neum.....	—	Cattle.....	Pretoria, Transvaal, Nefdt Farm.
1st October.....	*Ixodes* sp.....	—	Hare, *L. zuluensis*.....	Wolfenada.
1st October.....	*R. oculatus* Neum.....	*	Hare, *L. zuluensis*.....	Pienaar's River, Transvaal.
1st October.....	*R. oculatus* Neum.....	—	Hare, *L. zuluensis*.....	Pienaar's River, Transvaal.
1st October.....	*R. oculatus* Neum.....	—	Hare, *L. zuluensis*.....	Pienaar's River, Transvaal.
2nd October.....	*R. evertsi* Neum.....	—	Impala, *Aepyceros melampus* Lcht.	Pienaar's River, Transvaal.
1st October.....	*R. oculatus* Neum.....	—	Hare, *L. zuluensis*.....	Pienaar's River, Transvaal.
1st October.....	*H. numidiana* Neum.....	—	Spring hare, *Pedetes caffer satinea* Wr.	Pienaar's River, Transvaal.
1st October.....	*H. aegyptium* (nymphs) Linn.....	—	Hare, *L. zuluensis*.....	Pienaar's River, Transvaal.

SOUTH AFRICAN TICK RECORDS—(*continued*).

1928.	Ticks.	Parasites.	Hosts.	Localities.
30th September...	*H. aegyptium* Linn.....	—	Hare, *L. zuluensis*.....	Pienaar's River, Transvaal.
30th September...	*R. appendiculatus* Neum.....	*	Hare, *L. zuluensis*.....	Pienaar's River, Transvaal.
30th September...	*R. oculatus* Neum.....	—	Hare, *L. zuluensis*.....	Pienaar's River, Transvaal.
30th September...	*R. oculatus* Neum.....	*	Hare, *L. zuluensis*.....	Pienaar's River, Transvaal.
30th September...	*H. aegyptium* Linn.....	*	Hare, *L. zuluensis*.....	Pienaar's River, Transvaal.
1st October.....	*H. aegyptium* Linn.....	—	Hare, *L. zuluensis*.....	Pienaar's River, Transvaal.
1st October.....	*H. leachii* Audouin.....	—	Spotted gennet, *Genetta ludia* Thos. & Schw.	Pienaar's River, Transvaal.
12th October.....	*R. sanguineus* Latr.....	—	Dog.....	Onderstepoort, Transvaal.
12th October.....	*B. decoloratus* Koch.....	—	Cattle.....	Pretoria, Transvaal, Nefdt Farm.
7th August.....	*R. evertsi* Neum.....	—	Bull.....	Acorn Hoek, Transvaal, Spring Valley.
30th August.....	*R. oculatus* Neum.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Nefdt Farm.
22nd September..	*R. oculatus* Neum.....	—	Hare, *L. ochropus* Wagn.....	Glen, O.F.S.
1st October.....	*R. oculatus* Neum.....	—	Hare, *L. zuluensis*.....	Pienaar's River, Transvaal.
25th September...	*R. evertsi* Neum.....	—	Cattle.....	Middelburg, C.P.
1st October.....	*R. oculatus* Neum.....	—	Hare, *L. zuluensis*.....	Pienaar's River, Transvaal.
28th July.....	*R. sanguineus* Latr.....	—	Dog.....	Klasserie, Transvaal.
	A. variegatum Fabr.			
1st October.....	*R. oculatus* Neum.....	—	Hare, *L. zuluensis*.....	Pienaar's River, Transvaal.
3rd September...	*R. evertsi* Neum.....	—	Sheep.....	—
20th September...	*R. evertsi* Neum.....	—	Cattle.....	Middelburg, C.P.
9th August.....	*R. evertsi* Neum.....	—	Duiker, *Sylvicapra grimmi* L....	Acorn Hoek, Transvaal, Spring Valley.
18th September...	*R. evertsi* Neum.....	—	Cattle.....	Queenstown, C.P.
	H. aegyptium Linn.			
7th October.....	*R. evertsi* Neum.....	—	Cattle.....	Pretoria, Transvaal, Nefdt Farm.
	B. decoloratus Koch			
	A. variegatum Fabr.			
28th August.....	*H. leachii* Audouin.....	—	Meerkat.....	Ventersburg, O.F.S.
7th August.....	*R. evertsi* Neum.....	—	Goat.....	Acorn Hoek, Transvaal.
7th October.....	*R. evertsi* Neum.....	—	Cattle.....	Nefdt Farm, Pretoria, Transvaal.
1st October.....	*R. oculatus* Neum.....	—	Hare, *L. zuluensis*.....	Pienaar's River, Transvaal.
28th September...	*R. sulcatus* Neum.....	—	*Pronolagus randensus*.....	Pretoria, Transvaal, Silverton Farm.
7th August.....	*R. sanguineus* Latr.....	—	Hare, *L. zuluensis*.....	Acorn Hoek, Transvaal, Spring Valley.

2nd October.....	*R. evertsi* Neum.....	—	Sheep.....	Wintershoek, Rounderbult.
1st October.....	*R. oculatus* Neum.....	—	Hare, *L. zuluensis*.....	Wolfenada.
13th September...	*R. simus* Koch.....	—	Cattle.....	—
	R. oculatus Neum.			
17th October.....	*R. evertsi* Neum.....	—	Horse.....	—
30th July.....	*R. oculatus* Neum.....	—	Hare, *L. zuluensis*.....	Acorn Hoek, Transvaal, Fleur-de-Lys Farm.
12th September...	*R. simus* Koch.....	—	Cattle.....	—
	B. decoloratus Koch			
	H. silacea Rob.			
	H. vriegatum Fabr.			
	R. evertsi Neum.			
22nd September..	*R. evertsi* Neum.....	—	Africander bull.....	Middleburg.
14th September...	*R. evertsi* Neum.....	—	Cattle.....	Klemmond.
	B. decoloratus Koch			
5th September...	*R. oculatus* Neum.....	—	Ox.....	Fort Beaufort, C.P.
1st October.....	*R. oculatus* Neum.....	—	Hare, *L. zuluensis*.....	Pienaar's River, Transvaal.
2nd September..	*R. oculatus* Neum.....	—	Africander bulls.....	Bloemfontein, O.F.S.
5th September...	*R. simus* Koch.....	—	—	Fort Beaufort.
30th July.....	*R. evertsi* Neum.....	—	Steenbok, *Raphiceros campestris*..	Klasserie, Transvaal.
1st October.....	*R. oculatus* Neum.....	—	Hare, *L. zuluensis*.....	Pienaar's River, Transvaal.
25th July.....	*R. sanguineus* Latr.....	—	Dog.....	Klasserie, Transvaal, Scotia Farm.
31st July.....	*R. evertsi* Neum.....	—	Sheep.....	Klasserie, Transvaal, Scotia Farm.
1st September...	*H. aegyptium* Linn.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Nefdt Farm.
	R. evertsi Neum.			
31st August.....	*R. evertsi* Neum.....	—	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Nefdt Farm.
27th July.....	*R. simus* Koch.....	—	Dog.....	Klasserie, Transvaal.
	R. sanguineus Latr.			
18th September...	*R. evertsi* Neum.....	—	Cattle.....	Queenstown, C.P.
31st July.....	*R. evertsi* Neum.....	—	Sheep.....	Klasserie, Transvaal, Scotia Farm.
	A. hebraeum Koch			
31st July.....	*R. evertsi* Neum.....	—	Goat.....	Klasserie, Transvaal, Scotia Farm.
1st October.....	*H. aegyptium* Linn.....	—	Off the ground.....	Wolfenada.
31st July.....	*H. aegyptium* Linn.....	—	Horse.....	Klasserie, Transvaal, Scotia Farm.
13th September...	*B. decoloratus* Koch.....	—	Cattle.....	—
7th August.....	*B. decoloratus* Koch.....	—	Bull.....	Acorn Hoek, Transvaal, Spring Valley.
4th August.....	*R. evertsi* Neum.....	—	Sable antelope, *Ozanna nigra* Harris	Acorn Hoek, Transvaal, Spring Valley.
	B. decoloratus Koch			

SOUTH AFRICAN TICK RECORDS—(*continued*).

1928.	Ticks.	Parasites.	Hosts.	Localities.
6th July.....	*B. decoloratus* Koch.....	—	Hare, *L. zuluensis*.....	Messina, Transvaal, Dongola Farm.
8th August.....	*B. australis* Fuller.....	- -	Bull.....	Satara, Transvaal, Kruger Park.
12th October.....	*B. decoloratus* Koch.....	—	Cattle.....	Pretoria, Transvaal, Nefdt Farm.
14th September...	*B. decoloratus* Koch.....	- -	Cattle.....	Bathurst, C.P.
	R. evertsi Neum.			
	H. silacea Rob.			
6th August.....	*B. decoloratus* Koch.....	- -	Sable antelope, *Ozanna nigra* Harris	Acorn Hoek, Transvaal, Spring Valley.
12th October.....	*B. decoloratus* Koch.....	—	Cattle.....	Pretoria, Transvaal, Nefdt Farm.
27th September...	*B. decoloratus* Koch.....	- -	Cow.....	Pretoria, Transvaal, Nefdt Farm.
12th September...	*Boophilus*.....	—	Calf.....	—
20th September...	*B. decoloratus* Koch.....	—	Cattle.....	Middelburg, C.P.
5th September...	*H. aegyptium* Linn.....	—	Cattle.....	Fort Beaufort, C.P.
12th October.....	*H. aegyptium* Linn.....	—	Cattle.....	Pretoria, Transvaal, Nefdt Farm.
20th September...	*H. aegyptium* Linn.....	- -	Cattle.....	Middelburg, C.P.
31st July.....	*H. aegyptium* Linn.....	—	Hog.....	Klasserie, Transvaal, Scotia Farm.
30th August.....	*Rhipicephalus* sp. (nymphs).....	- -	Calf.....	Pretoria, Transvaal, Nefdt Farm.
7th October.....	*H. aegyptium* Linn.....	—	Cattle.....	Pretoria, Transvaal, Nefdt Farm.
22nd September..	*H. aegyptium* Linn.....	- -	Africander bull.....	Winburg District, O.F.S.
12th October.....	*H. aegyptium* Linn.....	—	Cattle.....	Pretoria, Transvaal, Nefdt Farm.
	A. hebraeum Koch			
31st August.....	*Hyalomma* (nymphs).....	- -	Hare, *L. zuluensis*.....	Pretoria, Transvaal, Nefdt Farm.
20th September...	*H. aegyptium* Linn.....	—	Cattle.....	Middelburg, C.P.
4th August.....	*H. aegyptium* Linn.....	- -	Sable antelope, *Ozanna nigra* Harris	Acorn Hoek, Transvaal, Spring Valley.
	B. decoloratus Koch			
25th July.....	*H. aegyptium* Linn.....	—	Horse.....	Klasserie, Transvaal, Scotia Farm.
18th September...	*H. aegyptium* Linn.....	—	Cattle.....	Queenstown, C.P.
17th September...	*Argas persicus* Oken.....	- -	—	Queenstown, C.P.
17th September...	*Argas persicus* Fis.....	—	Pettertrees.....	Queenstown, C.P.
15th September...	*Argas persicus* Fis.....	- -	Domestic fowl.....	Fort Beaufort, C.P.
18th September...	*Ornithodoros megnini* Dugès.....	—	Cattle.....	Queenstown, C.P.
9th September...	*A. hebraeum* Koch.....	—	Cattle.....	—
20th September...	*A. hebraeum* Koch.....	—	Cattle.....	Middelburg, C.P.
	R. evertsi Neum.			

27th July.....	*A. hebraeum* Koch (nymphs).....	—	Dog.....	Klasserie, Transvaal.
7th August.....	*A. hebraeum* Koch.....	—	Goat.....	Acorn Hoek, Transvaal, Spring Valley.
20th September...	*A. hebraeum* Koch.....	—	Cattle.....	Middelburg, C.P.
27th September...	*A. hebraeum* Koch.....	—	Cow.....	Pretoria, Transvaal, Nefdt Farm.
25th July.....	*A. hebraeum* Koch.....	—	Horse.....	Klasserie, Transvaal, Scotia Farm.
9th September...	*A. hebraeum* Koch.....	—	Cattle.....	Bathurst, C.P.
7th August.....	*A. hebraeum* Koch.....	—	Bull.....	Acorn Hoek, Transvaal, Spring Valley.
	R. evertsi Neum.			
12th October.....	*H. aegyptium* Linn.....	—	Cattle.....	Pretoria, Transvaal, Nefdt Farm.
	R. evertsi Neum.			
5th September...	*R. evertsi* Neum.....	—	Cattle.....	Fort Beaufort, C.P.
7th October.....	*A. hebraeum* Koch.....	—	Cattle.....	Pretoria, Transvaal, Nefdt Farm.
12th October.....	*A. hebraeum* Koch.....	—	Cattle.....	Pretoria, Transvaal, Nefdt Farm.
31st July.....	*A. hebraeum* Koch.....	—	Pig.....	Klasserie, Transvaal, Scotia Farm.
31st July.....	*A. hebraeum* Koch.....	—	Sheep.....	Klasserie, Transvaal, Scotia Farm.
25th July.....	*A. hebraeum* Koch.....	—	Dog.....	Acorn Hoek, Transvaal, Spring Valley.
7th October.....	*A. hebraeum* Koch.....	—	Cattle.....	Pretoria, Transvaal Nefdt Farm.
	R. evertsi Neum.			
5th September...	*A. hebraeum* Koch.....	—	Cattle.....	Fort Beaufort, C.P.
8th August.....	*A. hebraeum* Koch.....	—	Bull.....	Satara, Transvaal, Kruger Park.
8th August.....	*A. hebraeum* Koch.....	—	Horse.....	Satara, Transvaal, Kruger Park.
	R. evertsi Neum.			
31st July.....	*A. hebraeum* Koch.....	—	Goat.....	Klasserie, Transvaal, Scotia Farm.
	R. evertsi Neum.			
28th July.....	*A. hebraeum* Koch.....	—	Dog.....	Klasserie, Transvaal.
27th July.....	*A. hebraeum* Koch.....	—	Dog.....	Klasserie, Transvaal.
19th July.....	*A. vespertilionis* Latr.....	—	In a house.....	Barberton, Transvaal.
6th September...	*R. evertsi* Neum.....	—	No host given.....	Fort Beaufort, C.P.
10th October.....	*R. evertsi* Neum.....	—	Sheep, horses.....	Harding, Natal.
28th July.....	*R. appendiculatus* Neum.....	—	Dog.....	Klasserie, Transvaal.
27th July.....	*R. appendiculatus* Neum.....	—	Dog.....	Klasserie, Transvaal.
10th August.....	*O. moubata* Mur.....	—	Kaffir hut.....	Acorn Hoek, Transvaal.
18th September...	*O. megnini* A. Dugès.....	—	Cattle.....	Queenstown, C.P.
18th September...	*O. megnini* A. Dugès.....	—	Cattle.....	Queenstown, C.P.
27th September...	*O. megnini* A. Dugès.....	—	Horses.....	Petrusburg, O.F.S.
18th September...	*O. megnini* A. Dugès.....	—	Cattle.....	Queenstown, C.P.
15th September...	*O. megnini* A. Dugès.....	—	Cattle.....	Queenstown, C.P.

SOUTH AFRICAN TICK RECORDS—*(continued)*.

1928.	Ticks.	Parasites.	Hosts.	Localities.
27th July.....	*H. leachii* Audouin.....	—	Dog.....	Klasserie, Transvaal.
8th August.....	*H. leachii* Audouin.....	—	Leopard, *Panthera suahelica* Neum.	Satara, Transvaal, Kruger Park.
7th August.....	*H. leachii* Audouin.....	—	Lion, *Leo leo krugeri* Rbts.....	Acorn Hoek, Transvaal, Blyde River.
18th September...	*H. leachii* Audouin.....	—	Mongoose.....	Pretoria, Transvaal.
27th July.....	*H. leachii* Audouin.....	—	Dog.....	Klasserie, Transvaal.
28th July.....	*H. leachii* Audouin.....	—	Dog.....	Klasserie, Transvaal.
27th July.....	*H. leachii* Audouin.....	—	Dog.....	Klasserie, Transvaal.
12th September...	*R. appendiculatus* Neum.....	—	Cattle.....	Bathurst, C.P.
20th July.....	*H. leachii* Audouin.....	—	Hare, *L. zuluensis*.....	Zululand.
2nd August.....	*H. leachii* Audouin.....	—	Dog.....	Klasserie, Transvaal, Orinocco.
27th July.....	*Ixodes pilosus* Koch.....	—	Dog.....	Klasserie, Transvaal.
5th September...	*Ixodes pilosus* Koch.....	—	No host given.....	Fort Beaufort, C.P.
15th July.....	*Aponomma* sp. (larvae).....	—	Mamba snake, *Dendraspis angusticeps* Sm.	Barberton, Transvaal.

TICK PARASITES FOUND.

Of the two hundred and sixty lots of ticks collected, thirteen were parasitized with *H. hookeri*. In all cases parasites were found only in nymphal ticks, in fact in all countries, and with all ticks that have been attacked by this parasite, the nymphal stage only is parasitized, so far as is known. It is shown also that the following tick species were parasitized:—

Hyalomma aegyptium, six lots.
Rhipicephalus oculatus, two lots.
Rhipicephalus evertsi, two lots.
Rhipicephalus appendiculatus, one lot.
Rhipicephalus sp., one lot.
Hyalomma sp., one lot.

Further examination of this tabulated information shows that in every case the parasitized ticks were feeding on the hare, *Lepus zuluensis*.

The parasitized ticks were found only in the Transvaal. They were found on the farms of Andries W. J. Pretorius and T. S. Nefdt, on the shore of the Hartebeestpoort Dam, and on the stock farm of Pretorius at Pienaar's River known as "Bushfeld" farm. No attempt was made to determine the limits of the areas where the parasites were present. The dates of the recovery of parasites were scattered from 9th June to 30th September. Bearing in mind that the collecting period was from 4th June to 17th October and that few ticks were taken after 1st October, it is seen that the records indicate that parasites were present through most of the colder months, and suggests that they would likely be even more active during the warmer part of the year.

Further comments on the biology of this tick parasite will be of some interest. A very considerable portion of the ticks recorded in the table were adults, but nearly all those taken from rabbits and other small animals were nymphs or larvae. It has been pointed out on an earlier page, that in collecting nymphs and larvae we cannot expect them to develop recognizable parasitism, unless they are at least two-thirds engorged. It is quite probable, therefore, that more parasitism was present than is shown. In similar work done by the writer in America, it was found that if the animals are taken alive by trapping and held in cages enclosed in bags, all of the ticks can be recovered fully fed. The trap method is of particular value in recovering parasitized ticks when checking on the effectiveness of attempted colonization of parasites in nature.

The writer attaches no particular significance to the taking of *H. hookeri* in ticks found only on hares, for it was taken on deer in France, by Brumpt, and has been found in ticks from dogs several times, as well as from ticks on other host animals. It appears to be true that this insect will attack larval or nymphal ticks on either large or small animals. In the South African material here concerned, the immature ticks of the parasitized species listed above were not often found on the larger animals.

H. hookeri has been taken from a wide variety of ticks. It has been recorded elsewhere in the literature as parasitizing the following: *Haemaphysalis leporis-palustris*, *R. evertsi*, *R. sanguineus*, *Ixodes ricinus* and *Dermacentor parumapertus marginatus*. It has been recovered in nature in America in *D. andersoni* and *Dermacentor variabilis*, in areas where parasites have been liberated in attempted biological control. In the tabulation here presented are added three species, and two instances in *Rhipicephalus* and *Hyalomma* when the species was not determined. It is apparent, therefore, that this parasite attacks species of five genera of ticks which show some range of habits. We do not know of any case in which it has attacked a tick which remains on one host for feeding in its three stages. It would be of particular interest to attempt to establish this insect as a parasite of *Boophilus decoloratus*. In the case of this tick the parasites would have opportunity to lay eggs in both larvae and in nymphs, both while unfed and while feeding, and the ticks might remain attached to the host animal while the parasites were maturing, thus insuring that the adult parasites would be in the presence of ticks on the host when they emerge.

SPECIALIZATION IN *HUNTERELLUS HOOKERI*.

In an evolutionary sense we must recognize that this tick parasite is highly specialized. It is a parasite of ticks only, so far as we know. It would be difficult to imagine any way in which these insects could become injurious to man's interests unless it were to become a secondary parasite with another species of tick parasite as primary, in which case it might tend to destroy the primary by feeding on it within the host tick. We know of no such instance. Numerous points, both morphological and biological, could be cited to show that there is specialization in this insect's attack on ticks, but apparently this specialization has not gone far enough to make these insects of particular value in the control of any ticks or type of tick that we know of, unless possibly in the case of *B. decoloratus* and other species of the one host type.

A parasite to be of maximum value should be characterized by a high degree of host specificity. It is perhaps not going too far to say that we can imagine a type and degree of specialization that would characterize a parasite of such special value. One example, though hypothetical, may serve to show what it is intended to mean. There might be found some parasite with these or similar further specialized points, namely, ability to recognize as food only one species of tick, or a very few species, and able by especially developed senses to locate these ticks, or their haunts. Such a parasite might be of particular value. The writer does not intend to say that *H. hookeri* cannot be of considerable value in the control of such ticks as *H. aegyptium*, *R. oculatus*, and *R. evertsi*, in the climate of South Africa.

Percentage of Parasitized Ticks.

It is of interest to note that a large proportion, or about 80 per cent. of the nymphs collected near Hartebeestpoort Dam, and at the location on Pienaar's River, were parasitized. In figuring this percentage only those living nymphs which had been sufficiently fed

to produce parasites were counted. It is possible that a higher percentage of parasitism might have been found if all of the nymphs had been fully fed or if latent parasitism had been taken into account.

Adult Parasites Found in Fur of Rabbits.

Previous to the writer's visit to Transvaal, in all of the published records of the finding of *H. hookeri*, the insects had been recovered only in immature stages in nymphs of the several species. It was of interest therefore that, while working on the Nefdt farm on 7th September, a rabbit was shot at about 11 o'clock a.m., and in examining it, eight adult parasites, all females, were found in the fur of the animal. It was a bright, hot day and the estimated temperature was 90° F. There had always been the question as to whether the female parasites lay eggs in ticks, on the ground, in nests of the host animals, or in the ticks while they are feeding, or about to feed, on the host. This observation appears to show that the parasite eggs are laid on the animals, although we still do not know whether they also laid eggs in the ticks on the ground, or in the nests.

There has since been published by Doctor C. B. Philip (25) an account of the discovery of *H. hookeri* in the hair of dogs at Lagos, Nigeria. The same author also states that at least 90 per cent. of the ticks (*Rhipicephalus sanguineus*) were parasitized, but the ticks were still very abundant. In this connection it would be of interest if we might know if the parasites had been recently introduced at Lagos, and further to know if the parasites were approaching one of the probable periods of maximum abundance.

A POSSIBLE NEW PARASITE SEEN.

While stationed on the Nefdt farm, one living specimen of an insect was seen that may have been a parasite of ticks. Knowledge of the incident may be of some interest to future workers.

In the morning of 1st September, there were for examination six rabbits which had been shot late in the previous evening. When shot, they were dropped into two collecting bags of cloth, four in one bag and two in another, and the ends of the bags were tied. In examining the last rabbit, one of the two in one bag, a living insect was seen on one of the rabbits. When the ear was opened with the fingers, the insect ran to the margin of the ear and flew away. It would have been interesting to capture the insect and put it in a vial, but the writer had not over a second or two in which to examine it. It was clearly a hymenopterous insect and it was thought to belong to the Chalcididae or Proctotrupidae. The thorax was relatively large, showing strong muscular development and the hind femora were thickened. Thinking that this insect might be recovered again, an experiment was made with caged animals placed out in the immediate vicinity where the insect was seen. Wire cages, laboratory rabbits, and nymphal ticks (*Rhipicephalus appendiculatus*) were obtained through the courtesy of the laboratory at Onderstepoort. The cages, six in number, containing rabbits and ticks, were placed in the field, hoping that some of the insects would reach the ticks through the mesh of the cages. They were left out as long as possible,

being brought in just before the ticks had completed feeding. The ticks were recovered and held under observation. No parasites developed. If the procedure had included the finding of the adult ticks that emerged from the fed nymphs, it is just possible that we might have discovered parasitism due to latency.

SUMMARY OF THE PRESENT STATUS OF OUR KNOWLEDGE OF THE FAMILY *ENCRYTIDAE*.

There have been described three species of tick parasites all closely related and classified in the *Encrytidae*. They are: *Ixodiphagus texanus* Howard (17), *Hunterellus hookeri* Howard (18), *Ixodiphagus caucurtei* du Buysson (16). Dr. A. B. Gahan and Dr. C. F. W. Mueseback, of the U.S. National Museum, have recently concluded and will soon publish that *H. hookeri* and *I. caucurtei* are one and the same insects, and the name *H. hookeri* will be retained as having priority. *I. texanus*, described in 1907, was not seen again until taken by Mr. Carl Larson and Mr. Roger Cooley, two assistants in the U.S. Public Health Service, working in the field near Mayfield, Idaho (U.S.A.). Two parasitized nymphs were found in a considerable number of ticks, *Ixodes hexagonus* var. *cookei* Packard, taken on a woodchuck, on 28th June, 1932. Several generations were reared at the laboratory, and while we know that it is very similar in habits to *H. hookeri*, we lack sufficient information to be able to express a view on the possible value of the insect in biological control.

I. texanus has been found only in the United States, but *H. hookeri* has been found in France, India, Indo-China, Cuba, Brazil, Union of South Africa, Nigeria, South West Africa, and the United States.

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REFERENCES.

In the list below are included all of the known references on tick parasites.

BEDFORD, G. A. H.

(1) 1931. *Nuttalliella namaqua*, a New Genus and Species of Tick. *Parasitology*, Vol. XXIII, No. 2.

(2) 1932. A Synoptic Check-list and Host-list of the Ectoparasites found on South African Mammalia, Aves, and Reptilia. *18th Report of the Director of Veterinary Services and Animal Industry, Union of South Africa.*

BRUMPT, E.

(3) 1913. Utilisation des insectes auxiliares entomophages dans la lutte contre les insectes pathogenes. La presse Medicole, No. 36, du Mai.

(4) 1930. Parasitisme latent de *l'Ixodiphagus caucurtei* chez les larves gorgees et les nymphs a' jeun de divers ixodines (*Ixodes ricinus* et *Rhipicephalus sanguineus*). Compte. rend. l'academie des Sciences, t. 191, p. 1085, seance du 1 er decembre.

COOLEY, R. A.

(5) 1926. A Parasite of Ticks. Sixth Biennial Rep., Montana St. Bd. of Entomology, 15-17.

(6) 1927. Tick Parasites. *Medical Sentinel*, Portland, Oregon, Vol. 35, No. 12, December.

(7) 1928. Tick Parasites. Executive Report. Seventh Biennial Rep., Montana St. Bd. of Entomol., 10-16.

(8) 1928. Preliminary Report on the Tick Parasite *Ixodiphagus caucurtei* du B. Seventh Biennial Rep., Montana St. Bd. of Entomol., 17-31.

COOLEY, R. A., AND GLEN M. KOHLS.

(9) 1928. Egg-laying of *Ixodiphagus caucurtei* in Fed Larval Ticks. *Science*, 67, No. 1748, 656.

(10) 1929. A Summary of Tick Parasites. *South African Jour. of Natural History*, Vol. 6, 266-272, 1.

(11) 1930. Review of Tick Parasite Work for 1929 and 1930. Eighth Biennial Rep., Montana St. Bd. of Entomol., 16-25.

(12) 1930. The Possibility of Controlling the Wood Tick by Parasites. *Western Hospital News*, Portland, Oregon, Vol. 2, No. 1, 8.

(13) 1933. Observations sur *Ixodiphagus caucurtei* du Buysson dans l'ouest des etats-unis. Annales de Parasitologie, Humaine et Comparee, Tome XI, No. 1, Janvier 1933.

(14) 1934. Occurrence of Tick Parasites in Nature in Southern Idaho. Public Health Reports, Vol. 49, No. 4, January 26, 1934.

DA COSTA LIMA, A.
(15) 1915. O chalcideo *Hunterellus hookeri* Howard, parasite de carrapato *Rhipicephalus sanguineus* Latrielle, observado no Rio de Janeiro. Rev. Vet. Zootechnia, V, 201-203.

DU BUYSSON, R.
(16) 1912. Un hymenoptere parasite des Ixodes. Archives de parasitologie, t. XV, 246.

HOWARD, L. O.
(17) A Chalcidid Parasite of a Tick. *Entomol. News*, Vol. 18, 375-378, November.
(18) 1908. Another Chalcidoid Parasite of a Tick. *The Can. Entomol.*, Vol. 40, 239-241, July.

KOHLS, GLEN M.
(19) 1930. A Summary of Parasite Liberations. Eighth Biennial Rep., Montana St. Bd. of Entomol., 26-34.

LARROUSSE, F., A. G. KING, AND S. B. WOLBACH.
(20) 1928. The Overwintering in Massachusetts of *Ixodiphagus caucurtei*. *Science*, 67, 351-353.

MACLEOD, J.
(21) 1933. Control of the Sheep Tick on Hill Pastures. Reprint "Transactions of the Highland and Agricultural Society of Scotland".

MORTON, FRED. A.
(22) 1928. Quantity Production of Tick Parasites. Seventh Biennial Rep., Montana St. Bd. of Entomol., 32-35.

NUTTALL, G. H. F., CECIL WARBURTON, W. F. COOPER, AND L. E. ROBINSON.
(23) 1915. Ticks, a Monograph of the Ixodoidea, Part III, p. 547.

PARKER, J. R., AND W. J. BUTLER.
(24) 1928. Tick Parasite Liberation in Montana during 1928. Seventh Biennial Rep., Montana St. Bd. of Entomol., 35-38.

PHILIP, C. B.
(25) 1931. Occurrence of a Colony of the Tick Parasite *Hunterellus hookeri*, Howard, in West Africa. Pub. Health Rep., Vol. 46, No. 37, September 11.
(26) 1931. Decouverte en Afrique Occidentale *D'Hunterellus hookeri*, Howard, parasite des Ixodides. Annales de Parasitologie, Humaine et Comparee, Tome IX, No. 3, 1931.

WOOD, H. P.
(27) 1911. Notes on the Life History of the Tick Parasite. *Hunterellus hookeri*, Howard, *Journ. Econ. Entomol.*, Vol. 4, 425-431, October.

NOTE.—There are also now in manuscript the following:—

COOLEY, R. A., AND GLEN M. KOHLS.
1933. A Summary on Tick Parasites. To appear in the near future in the Proceedings of the Fifth Pacific Science Congress, 1933.

COOLEY, R. A.
1934. A Report on Tick Parasites to Kenya, Africa.