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ZOOLOGICAL SURVEY OF THE UNION OF SOUTH AFRICA.

TICK SURVEY, PART IX.

THE DISTRIBUTION OF THE THREE SOUTH AFRICAN HYALOMMAS OR BONTPOOTS.

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INTRODUCTION.

To the South African layman all species of Hyalomma are "Bontpoot", denoting variegated legs. Since the genus was not known to be a disease vector, it was not important to have specific popular names. More recently, however, the genus has been shewn to be implicated in disease transmission and much taxonomic activity has resulted. In due course, undoubtedly the three bontpoots will be given specific, popular names.

Neumann, 1911, reduced Koch's 13 species to four, with *H. aegyptium* as a Catchall, so that all South African records for a while were listed as *H. aegyptium*. Later Schulze 1919–28 and Chodziesner 1924 revised the genus. According to these classifications, Bedford and other South African workers listed the two species as:— *H. aegyptium aegyptium* or *H. aegyptium impressum transiens*, and *H. aegyptium impressum* or *H. aegyptium impressum rufipes* or combinations of these names. Delpy 1949 in his revision of the genus stabilized the names as *H. transiens* and *H. rufipes rufipes* and added the pale-legged species, *H. rufipes glabrum*. More recently Mühsam and Hoogstraal have ruled that *H. transiens* = *H. truncatum* Koch; *H. rufipes* remains *H. rufipes*; and *H. glabrum* = *H. turanicum*.

The genus Hyalomma is essentially a dry area genus, the different species having a different aridity/humidity tolerance range. Of the three species present in South Africa, *H. glabrum* is the most restricted in its distribution, its upper humidity limit being 12–15 inches per annum. For a hyalomma, *H. rufipes* shews an enormous humidity range, it can maintain itself in the humid mountain areas of Natal and Pondoland, but it does not extend into the warmer more tropically-humid coastal strip, nor into the cooler coastal belt from the Cape to Port Elizabeth. *H. truncatum* is more restricted in its range, being absent from the higher parts of the South African plateau, with its higher rainfall. However, it is present in the cooler winter rainfall areas of the Cape as also in the Southern Coastal strip reaching to Port Elizabeth.

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I. HYALOMMA TRUNCATUM KOCH 1844 (*syn. H. transiens* Schulze 1919).

General distribution in South Africa. (Map I).

Roughly *H. truncatum* occurs throughout the western and the northern parts of the Union of South Africa. It is absent from the higher lying and moister parts of the Cape Midlands, the Eastern Cape, Orange Free State, Transvaal, Natal and Swaziland; it is entirely absent from Basutoland. Along the eastern coastal strip it is absent from Bathurst to Zululand. In Zululand and the adjoining lower lying areas of Swaziland it occurs in the pockets of drier climatic conditions in the valleys of such rivers as the Usutu, Ingwavumu, M'Kuzi, Umfolosi and Umhlatuzi.

The Influence of Humidity and of Rainfall.

H. truncatum is a dry area tick, occurring in all the *desert* and *semi-desert* areas, and reaching into areas with a rainfall of 20 to 25 inches per annum. Above this, 25–30 inches, there are a few isolated records. It is questionable whether it will be able to maintain itself in these more humid areas. It occurs in winter rainfall areas as well as in the summer rainfall areas. In the marginal 25–30 inches it is the distribution of the rainfall in time rather than the actual amount that is important, thus 30 inches of thunderstorms in Pretoria is different from 30 inches at Port Elizabeth.

The Influence of Temperature and of Altitude.

Low temperatures and high altitudes in themselves do not play a rôle (see map 4, part I). *H. truncatum* is present in the Sutherland area at 4,700 feet, with 90–120 days of frost per annum. In the State Veterinary Areas of Middelburg, Beaufort West and Graaff-Reinet, all dry karoo regions, the tick tends to be absent from the farms situated on the mountain ranges having snow in winter.

Distribution in the Vegetational Types.

H. truncatum occurs in all vegetation types except in the short grass of the *Highveld*, a vegetation associated with high altitudes and relatively high rainfall. It is present in the *Middleveld* and the *Tall grassveld* only in those regions with a rainfall below 25 inches. Vegetation does not play a dominant rôle. In borderline areas the vegetation may be a deciding factor in maintaining micro-habitat conditions under which the tick is just able—or just not able—to exist.

The Influence of Dipping.

Dipping, as commonly practised, does not appear to play any rôle. On the farm 4 A, 3 where both *R. appendiculatus* and *B. decoloratus* have been eradicated and *R. evertsi* reduced, *H. truncatum* is as prevalent as on the neighbouring non-dipping farms.

It is just possible that dipping may have played a rôle in the valleys of the Bashee and Umzimvubu Rivers where conditions might otherwise just be favourable?

Distribution in Adjoining Countries and Africa generally.

H. truncatum is apparently present throughout SOUTH WEST AFRICA, according to Sigwart present all the year round. The scanty records for BECHUANALAND indicate that it may be present throughout the Protectorate. The infestations are usually very light and at most but a few animals in a herd are infected. The

collections sent in thus far are mainly from the eastern strip along the railway line and from NGAMILAND. These areas carry the more permanent and the heaviest cattle population. Whether the ticks are present in the more central areas, where watering for cattle is a problem, remains to be seen. That conditions here may be unsuitable is indicated by a remark by the Government Veterinary Officer at Maun, who states:—

> " The Rakops area (S. of S.E. from Maun) is free of ticks. I have introduced tick infested stock, but in no time the stock were clean and a tick has never been seen since."

The Southern Areas from which no collections have yet been made, abutting on Gordonia, Kuruman and Vryburg, can be expected to shew the presence of *H. truncatum*. It is recorded in ANGOLA, from *open savannah* and *acacia veld*. It may be pure coincidence that it is not recorded from *Isoberlinia-Brachystegia* or from *Mopane veld*, for it occurs in *Mopane veld* in the NORTHERN TRANSVAAL. It is absent from the higher lying, wetter regions of Angola.

It has been collected from some areas in the EASTERN CAPRIVI ZIPFEL (Onderstepoort records). The yearly inundations of the strip are countered by the reintroduction of cattle during the winter months from the surrounding dry areas, so that it is impossible to say whether the tick could maintain itself in the area.

The records from SOUTHERN RHODESIA (Onderstepoort and Jack 1945) are also somewhat scanty, but it would appear that it is present throughout except in the Eastern Mountainous Area. In the Plumtree area it is present but not nearly as consistently as is *H. rufipes*.

H. truncatum thus far has not been recorded often from MOÇAMBIQUE. Santos Dias' records for Chicualacuala and other localities in the Alto-Limpopo, Machanga and Mossurize join up with the Northern Transvaal dry areas along the Limpopo. The Guija record probably is the most easterly record for the tongue of *H. truncatum* passing through the Barberton district and Northern Swaziland. The records from Tete and Angonia (Theiler 1943) are in dry areas similar to those of Southern Rhodesia. Santos Dias 1951 also records it from Mutuali from the district of NIASSA. According to Onderstepoort and to Wilson's 1950 records *H. truncatum* seems to be limited to the dry plateau of Lilongwe-Msimba in SOUTHERN NYASALAND as also to the drier areas in the NORTHERN PROVINCE. For TANGANYIKA we have as yet but few records. In KENYA, according to Wiley 1953, "it is confined to the drier parts. It is abundant in some of the lower areas of the Rift Valley and the semi-arid parts of the Yatta and coastal hinterland. In many districts of the Northern Frontier province, which are little more than desert and wastes of lava rubble, these ticks predominate ".

In ANGOLA and NORTHERN RHODESIA *H. truncatum* is abundant in the *Rhodesian Highland* vegetation, it begins to die out in the Haut Katanga of the BELGIAN CONGO. Except for a few records it is *absent* from the *Southern Congo Savannah*, it is entirely absent from the *Eastern Highlands* and *Eastern Ubangi Savannah*. It occurs again in the UBANGI-SHARI of the FRENCH CONGO where it is associated with *H. impressum* of West Africa.

It is present (Wilson and Hoogstraal) in the drier areas of UGANDA; Hoogstraal records it from the following provinces in the ANGLO-EGYPTIAN SUDAN:—Equatoria Province, Bahr-el-Ghazal, Upper Nile, Blue Nile, Darfur and Kassala as also from

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Gebel Elba in South Eastern EGYPT. It is recorded as *H. savignyi* from the north-west zone of PORTUGUESE GUINEA by Tendeiro 1952; TOGOLAND, Schulze and Schlottke 1930; NIGERIA, Unsworth 1952; FRENCH WEST AFRICA Rousselot 1951 and 1953; CAMEROON, Rageau 1951 and Unsworth 1952; ETHIOPIA, Stella 1938; ITALIAN SOMALILAND and ERITREA, Rondelli 1926, Stella 1938 and Hoogstraal; FRENCH SOMALILAND, Hoogstraal 1953; BRITISH SOMALILAND, Hoogstraal 1953.

H. truncatum figures in Kartman's collection (identifications checked at Onderstepoort) from Dakar, SENEGAL. Onderstepoort also has some specimens from Tamatave, MADAGASCAR. This record represents a recent introduction from Africa, for *H. truncatum* does not figure in the lists of other workers. Aders 1917 records it from ZANZIBAR stating that " a number have been collected from camels. On other domesticated animals they seem to be rare. I am inclined to think that the species, like *R. pulchellus* has been unable to acclimatise itself ". Hoogstraal (private correspondence) records it from YEMEN, SAUDI ARABIA.

Whilst we have been able, within limits, to decide what factors influence the distribution of *H. truncatum* in SOUTH AFRICA, we have not yet sufficient information on the topographical and climatological factors of most of the other countries. It can be safely assumed, however, that the rainfall/humidity tolerance, i.e. up to the 20 inches to 25 inches range, will be the same, and that it will be present in most regions from *desert* through *semi-desert* to open *savannah*. It probably also exists elsewhere in areas above 25 inches, where the rainfall is precipitated in the form of heavy thunderstorms over a small period of time, rather than in softer showers over many months.

North of the SAHARA it is absent.

Remarks on the separate State Veterinary Control Areas.

These remarks must be read in conjunction with maps 1, 2 and 4, of Part I, and with map I of this article.

Since *H. truncatum* is so consistently either present or absent in some areas, it is not worthwhile discussing each *State Veterinarian's area* separately, but only to analyse in detail those areas in which it appears to be precariously established.

H. truncatum is consistently *absent* from the districts of:—

Transvaal: Belfast, Carolina, Bethal, Standerton, Wakkerstroom, Heidelberg, Johannesburg, Boksburg, Benoni, Springs and Brakpan.

Orange Free State: Heilbron, Frankfort, Vrede, Kroonstad, Lindley, Reitz, Ventersburg, Senekal, Bethlehem, Harrismith, Ficksburg, Fouriesburg, Thaba 'Nchu, Ladybrand, Edenburg, Trompsburg, Reddersburg, Dewetsdorp, Wepener, Bethulie, Smithfield, Rouxville, Zastron and Basutoland.

Cape Province: Albert, Aliwal North, Lady Grey, Herschel, Barkly East, Maraisburg, Molteno, Wodehouse, Sterkstroom, Glen Grey, Queenstown, Cathcart, Stockenstroom, Victoria East, Stutterheim, King William's Town, East London, Peddie and Bathurst, the whole of the Transkei and Pondoland.

Natal: The whole of Natal except certain areas in Emtonjaneni, Vryheid, Nongoma and Paulpietersburg, as discussed below.

H. truncatum is consistently *present* in the districts of:—

Cape: Mafeking, Vryburg, Hay, Gordonia, Hopetown, Prieska, Kenhardt, Namaqualand, Philipstown, Venterstad, Britstown, Carnarvon, Williston, Calvinia, Vanrhynsdorp, De Aar, Victoria West, Fraserburg, Sutherland, Ceres, Clanwilliam, Piquetberg, Hopefield, Wellington, Bellville, Wynberg, Paarl, Caledon, Worcester, Robertson, Montagu, Bredasdorp, Riversdale, Prince Albert, Uniondale, Humansdorp, Jansenville, Aberdeen, Pearston, Somerset East, Bedford.

Transvaal: Schweizer Reneke, Bloemhof, Potgietersrust.

Orange Free State: Hoopstad, Boshof, Jacobsdal, Bothaville.

Area 1, *State Veterinarian, Johannesburg.*

Collections poor. *H. truncatum* is absent from the *highveld areas* with a rainfall above 20 inches per annum. It is recorded but once from the drier farms in the Vereeniging area, it appears to be absent from the Heidelberg area, also with a rainfall below 20 inches; more complete collections may show the tick to be commoner than is indicated by the present collection. The record from IC. 5 in the higher rainfall area may represent a recent introduction which will not be able to maintain itself.

Area 2, *State Veterinarian, Potchefstroom.*

Present in the districts of Schweizer Reneke, Christiana, Wolmaransstad, rainfall 15–20 inches. Its absence from 2D.3 in the Wolmaransstad district, is possibly due to the fact that only one collection was made and that in November, when the tick's adult activity in the area appears to be at its lowest. In the Ventersdorp and Potchefstroom districts its absence may also be due to but one collection made in November. The rainfall figures given for the various farms in some instances fall in the 20–25 inches range, which appears to be the marginal range for the species in these areas.

Area 4, *State Veterinarian, Potgietersrust.*

It is present in the hills of Alma-Vaalwater in the Waterberg (20–24 inches) and the open flats of Swartwater and Tolwe (4–6 inches). The collections from the Nylstroom hills were not as good as those from the rest of the *State Veterinary area*, so that it is difficult to say whether the absence of the tick is due to this fact or due to the slightly higher rainfall—which is given as 22–24 inches. Dipping plays no rôle in the Nylstroom returns. In the Limburg–Gilead area it would seem that dipping associated with the 18–24 inches rainfall is keeping the tick in check, but few ticks being recorded in seven collections sent in.

Area 5, *State Veterinarian, Pietersburg.*

The absence of *H. truncatum* from these areas may be more apparent than real. From most farms only one collection, a November collection, was made. According to returns from neighbouring areas adult tick activity is very low in November. Dipping is usually at 14-day intervals. Many of the farms in the Haenertsburg district are in the 20–25 inches or even in the 25–40 inches rainfall area from which *H. truncatum* is not to be expected, yet there is one record from the Downs in the mist belt with a rainfall of 35 inches. A recent importation? The absence of the tick in this collection

from the " lowveld " is unexpected—the S.V.'s comment being " I am unable to account for the absence of bontlegged ticks during last summer ", (i.e. 1942 when the collection was made) the implication being that the tick is prevalent in the drier areas. The writer's personal experience is that bontlegged ticks are prevalent in the Letaba–Letsitele area.

Area 6, *State Veterinarian, Zoutpansberg.*

Like area 5, Zoutpansberg has a wide range of rainfall, decreasing from 35 inches in the mountains down to 10 inches on the flats. The absence or presence of *H. truncatum* one would expect to follow the rainfalls curves, allowing for slight local variations. Once again the expected distribution is not maintained, *H. truncatum* being present in the mountains, 35 inches, Pisanghoek, etc., in February collections, (rainy season November to April) and absent from June, October, December collections, with dipping at seven days in summer and 14 days in winter.

Its absence from the Sibasa flats area, as also from the dry flats of Messina, Evangelina, Vivo, Waterpoort and Mara areas is in all probability to be ascribed to but one collection having been made either in October or December when the tick was also " not present " in the " tick present " areas. Dipping seems to play no rôle in these areas.

Area 7, *State Veterinarian, Barberton.*

The area lies entirely in the high rainfall area in the mountains, sloping down towards the " lowveld " at its eastern border. Dipping is at 7–14 days intervals. Only two collections were sent in. *H. truncatum* was consistently absent from the December collections, except in one instance; when present it was always in the May collection.

There is a fair amount of stock movement in the area, which is often used for winter grazing, more especially for sheep. The fact that all records were in the May collections suggests that the tick is from introduced stock; the fact that there were no records from the summer collection suggests that the tick is unable to maintain itself in this high rainfall area. It is present in some " lowveld " farms on the eastern border.

Area 8, *State Veterinarian, Piet Retief.*

Absent throughout the high rainfall area, present in the lower lying drier areas of Sulphur Springs. Local movements of sheep do not seem to have confused the distribution picture in this area, as it has in area 7.

Area 9, *State Veterinarian, Lydenburg.*

H. truncatum is present in the drier " bushveld " areas of Lydenburg, Middelburg, and Pilgrims Rest. It is absent from the higher lying wetter regions of Sekukuniland, Belfast, Pilgrims Rest and Middelburg. Its record in the Graskop area, with a rainfall of 60 inches, in a February collection can only be explained as a recent importation.

Area 11, *State Veterinarian, Pretoria.*

The collections are poor, but the few records, taken in conjunction with those from adjoining areas indicate that the tick is absent from the " highveld " areas to the south of the Magaliesberg range, which has a slightly heavier rainfall than the

Bankenveld to the north of this range. The one record from the Witbank area is an introduction. The *Bankenveld* of the Springbok Flats, with a rainfall between 20–25 inches, offers marginal conditions in which the tick seems to maintain itself precariously.

Area 12, *State Veterinarian, Rustenburg.*

Collections poor. The collecting areas in the south fall in the marginal rainfall of 20–30 inches in which the tick maintains itself but precariously. In the central and northern areas it tends to be present in the flats and absent from the hills with a slightly higher rainfall. In these marginal regions, slight local differences undoubtedly play a rôle, encouraging or hindering the establishment of the species. More collections are needed to give a clear picture of the exact distribution of *H. truncatum*. Dipping is not practised, so plays no rôle.

Area 14, *State Veterinarian, Vryheid.*

The major portion of this area has an annual rainfall of over 25 inches, but in pockets, mainly along the larger rivers, e.g. Black and White Umfolozi, Mkuzi, Pongola and Umhlatuzi, it is much less. In these drier pockets *H. truncatum* is liable to be present.

Area 23, *State Veterinarian, Nongoma.*

As in area 14 *H. truncatum* occurs only in areas in the hotter, drier pockets along the larger rivers.

Area 31, *State Veterinarian, Aliwal North.*

Absent in the high rainfall *highveld* districts of Barkly East, Herschel, Lady Grey, Wodehouse, Molteno, Aliwal North and Albert; going westwards the country drops from the *highveld* to drier *Karoo*. *H. truncatum* occurs in the *Karooveld* of Albert and Venterstad, in areas ranging from 10 inches to 20 inches per annum.

Area 32, *State Veterinarian, Queenstown.*

H. truncatum is absent from the wetter *highveld* areas of the Stormberg, Elandsberg, Great Winterberg and adjoining mountain ranges. It occurs westwards as the country slopes down to the *Karoo* of Tarkastad, with a rainfall of 15–20 inches.

Area 36, *State Veterinarian, Swellendam.*

The rainfall shows a great range of variation in this area It is at its highest in the Langeberge, 30 to 40 inches, dropping very suddenly southwards to the dry coastal flats of Bredasdorp and northwards to the almost arid Karoo of Barrydale. *H. truncatum* dies out towards the mountain range. There is a certain amount of local trekking annually from the hills to the coastal strip, so that *H. truncatum* has been recorded once or twice from a high rainfall farm.

Area 37, *State Veterinarian, Oudtshoorn.*

This area is traversed by the parallel ranges of the Swartberg and the Langeberg-Outeniqua ranges. The semi-arid *Little Karoo* lies between these parallel ranges. To the south is the dry coastal strip of Heidelberg–Riversdale. Eastwards from

Mossel Bay in this strip the rainfall becomes higher, 30 inches upwards, and the *Western Province vegetation* is replaced by the *Temperate evergreen forests* of the Knysna and Tzitzikama forests.

Numerous single collections were sent in from many more farms than are plotted on the map. The records show that *H. truncatum* dies out in the wet mountain ranges and in the wet areas of Mossel Bay, George and Knysna. The odd record from George is undoubtedly a recent introduction which will not maintain itself. It is present in the Riversdale *coastal dune veld* and in the *Karoo veld* of the *Little Karoo.*

Area 39, *State Veterinarian, Port Elizabeth.*

The larger part of this area lies in the semi-arid *Karoo;* with a coastal strip of dry *Western Province vegetation* in the Humansdorp district, with also an outlier in the Groot Winterhoek-berge in the Uitenhage district. The high rainfall follows the mountain ranges as a broad belt into the sea at Port Elizabeth. The tick distribution is dominated by these alternating belts of high and low rainfall. The absence of the tick from a farm in the dry Karoo to the north of Steytlerville must be ascribed to inadequate collecting.

Area 40, *State Veterinarian, Grahamstown.*

This area falls into the transition between the southern coastal winter rainfall, to all the year round rainfall and the eastern and continental summer rainfall. Topographically in the east are the Zuurberg and to the north the larger higher Winterberg with its numerous sub-divisions. From these mountain ranges run the Sundays, the Bushmans, the Great Fish, the Koonop and the Keiskama Rivers, with their hot dry valleys, clothed in the peculiar *Karoid vegetation,* the *Fish River bush.* Not only is the rainfall picture confused by the broken nature of the country but also by the vegetation picture. It is the meeting place of *Western Province vegetation* and the *Eastern Grasslands* with incursions of *Karoo veld.*

H. truncatum is recorded from the dry strip between the Sundays and Bushmans Rivers stretching from the coast up to Alicedale; it occurs on farms in the Bushmans River valley, in the Salem–Sandflats region and on the farms in the dry belt to the North of Grahamstown sloping down to the Great Fish River. It is unexpectedly absent from the Koonop River, with a very low rainfall. *H. truncatum* is absent from the wetter coastal strip from the Bushmans River northwards, giving off two tongues, one reaching to Grahamstown and the other to Peddie.

Once again it must be stressed that the free hand plotting of points on a blank map, which then is superimposed on an " approximate " rainfall or vegetation map, may show a few apparent inaccuracies or contradictions. The maps can only be taken as approximations. Even so the approximations give a fairly clear picture of the tick distribution in this somewhat disturbed area.

Area 41, *State Veterinarian, Middelburg.*

It is difficult to account for the uneven distribution of *H. truncatum* in this area. The collections are but doubtfully adequate. The area may be considered as a high plateau averaging 4,000 feet, from which arise the mountain ranges of the Koudeberg, Sneeuberg, Rhenosterberg, Kikvorsberg, Bamboesberg and Tandjiesberg. Snow is liable to fall on these during the winter months. The main part of the area falls within the belt having from 90 to 120 days of frost per year. The

rainfall is mostly 10–15 inches; in a few localities on the eastern border it may go up to 20 inches. Rainfall is not the disturbing factor. Heavy frost is also not the disturbing factor, for the tick is consistently present in the Beaufort West–Fraserburg districts where conditions are even more severe.

The only extraneous factor is the snow, and until more information has been gained, the unequal distribution of the tick in this collecting area must be ascribed to localized climatic conditions set up by the presence of the snow during part of the winter months. The assumption is that the rainfall figures given in the survey returns are correct.

Area 43, *State Veterinarian, Beaufort West.*

Present on the flats, once again as in Area 41, tending to be absent on the farms on top of the Koudeberg and Nieuweveld Ranges. Conditions on these ranges appear to be marginal, for on some farms at 5–600 feet, *H. truncatum* is present, though apparently not firmly established; on others it is solidly absent.

Area 45, *State Veterinarian, Cape Town.*

H. truncatum is solidly present throughout. It is absent from one dairy herd on a farm which is purely agricultural and where control measures are conscientiously carried out.

Area 46, *State Veterinarian, Malmesbury.*

The presence or absence of *H. truncatum* on any farm in this essentially agricultural area—wheat and fruit—is mainly dependent on the grazing practised on the individual farms. On some farms there is next to no scrub left on the farm, on others fairly large tracts are set aside. Conditions would seem to be favourable for the tick to maintain itself, except in the forests and plantations of Tulbagh.

Area 47, *State Veterinarian, Bedford.*

The absence of *H. truncatum* from Cradock and Adelaide is mainly due to poor collecting; collections were mainly made at times when the tick was also absent in otherwise positive collections. Conditions throughout are suitable, the rainfall being between five and 15 inches per annum.

Area 50, *State Veterinarian, Kroonstad.*

This area passes from the higher rainfall of the *Highveld* to the *Middleveld* with its rather lower rainfall. The distribution of *H. truncatum* follows the rainfall, except for one odd record in the Winburg area which may represent a recent introduction.

Area 51, *State Veterinarian, Kimberley.*

The absence of *H. truncatum* from farms in the districts of Fauresmith, Herbert, Philippolis and Barkly West is undoubtedly due to inadequate collecting; from most farms only one collection was sent in.

Area 57, *State Veterinarian, Graaff-Reinet.*

As in Areas 41 and 43 the tick is present but tends to die out on the farms situated on the mountain ranges having snow in winter.

SUMMARY.

1. The distribution of *H. truncatum* (syn. *H. transiens*) is given in terms of political divisions.

2. The limiting factor to its distribution is seen to be increasing humidity. It is present up to 20 inches per annum. Above this the conditions are marginal and the presence of the tick is dependent on more localized climatic variations and micro-habitats. Where the high rainfall is due to heavy thunderstorms the tick can maintain itself precariously; where the high rainfall is due to a more even distribution in time the tick is unable to exist at the higher rainfall levels. In the Cape Midlands, with a low rainfall, the ticks tend to be absent from mountain farms having snow in winter.

3. Neither dipping nor vegetation types play a limiting rôle.

4. *H. truncatum* is shown to occur in all the drier areas throughout Africa, South of the Sahara.

LITERATURE REFERENCES.

Only the more recent and comprehensive references are given.

ANGLO EGYPTIAN SUDAN.

Hoogstraal, 1954. A preliminary annotated list of ticks of the Anglo Egyptian Sudan. *Jnl. Parasit.* 40, pp. 304–310.

BELGIAN CONGO, ANGOLA, NORTHERN RHODESIA, CAMEROONS, FRENCH EQUATORIAL AFRICA.

Theiler and Robinson, 1954. Tick Survey VIII. *Onderstepoort Journal of Veterinary Research,* 26 pp. 447–461 (maps).

ITALIAN SOMALILAND, ERITREA, ABYSSINIA.

M. Rondelli, 1936. Alcuni Ixodidi della Somalia Italiana. *Res. biologicae* 1, 33–43.

Stella, 1948. Gli Ixodidi dell' Africa Orientale Italiana. *Rivisti di Biologia coloniale I,* pp. 135–153.

KENYA.

Wiley. Private communication. In the press.

MADAGASCAR.

Hoogstraal, 1953. Ticks of the Malagasy faunal region. *Bull. Mus. Comp. Zool. III* No. 2, pp. 38–113.

MOÇAMBIQUE.

Santos Dias, 1951. Açerca de alguns lotes de Carraças do Alto Limpopo. *Anais. Serv. Vet.* 3, pp. 207–233.

Santos Dias, 1954. Açerca de alguns ixodideos parasitas do javali africano. *An. Serv. Vet. Ind.*: *Anim.*: No. 4, pp. 103–112.

Theiler, 1943. Notes on the ticks off domestic stock from Portuguese East Africa. *Documentario Mocambique* 33, pp. 51–120. (Figs.)

NIGERIA AND CAMEROONS.

Unsworth, 1952. *Ann. Trop. Med. and Parasit.* 46, pp. 331–336.

NYASALAND.

Wilson, 1950. Check List Nyasaland. *Bull. Ent. Re*. 41, pp. 415–428.

PORTUGUESE GUINEA.

Tendeiro 1952. Ixodidae do Guiné Portuguesa. *Ann. Inst. Med. Trop. IX,* pp. 195–263.

SOUTHERN RHODESIA.

Jack 1942. Ticks infesting Domestic Animals in Southern Rhodesia. *Bull.* 1205. Minister Agriculture and Lands.

TAXONOMY.

Adler and Feldman-Mühsam, 1948. The differentiation of ticks of the Genus Hyalomma Koch in Palestine. *Refuah Veterinarith* III, pp. 91–94.

Adler and Feldman-Mühsam, 1948. A note on the Genus Hyalomma in Palestine. *Parasit.* XXXIX., pp. 95–101.

Chodziesner, 1924. *Zool. Jahrb.*, Jena, Syst. Abt. 47, pp. 505–572.

Delpy, 1949. Revision par des Voies experimentales du Genre Hyalomma Koch 1844. 2e partie. *Ann. Parasit.* XXIV, pp. 97–109.

Delpy, 1949. Essai critique de Synonymie du Genre Hyalomma C. L. Koch 1844 depuis Linné 1758. *Ann. Parasit.* XXIV. 464-494.

Delpy, 1949. Rôle des Hyalomma dans la transmission de la Theileriose Bovine. Biologie et Taxonomie des espèces en cause. *Internat. Vet. Conference*, London, 1949.

Feldman-Mühsam, 1954. Revision of the Genus Hyalomma. I. Description of Koch's types. *Bull. Res. Council Israel*, IV, pp. 150–170.

Hoogstraal, 1955. Correspondence

Kratz, 1940. Die Zeckengattung Hyalomma. *Z. Parasitenk.* XI, p. 510.

Pomeranzev, 1946. Tableaux Analytiques Faune U.R.S.S. *Publ. Inst. Zool. Acad. Science.*

Schulze, 1919. Bestimmungstabelle für das Zeckengenus Hyalomma Koch. *Sitzber. Naturf. Freunde.*, Berlin V, pp. 189–196.

Schulze and Schlottke 1927/28. Bestimmungstabellen für das Zeckengenus Hyalomma Koch. s.str. *Sitzber. Abhandl. Naturf. Ges.*, Rostock, II.

II. HYALOMMA RUFIPES KOCH, 1844.

General Distribution in South Africa. (Map 2).

Roughly *H. rufipes* occurs throughout the greater part of the Union. It is *absent* from the South West Cape from Piquetberg to Cape Town; from the Southern Coastal Strip, stretching from Cape Town to Port Elizabeth; with a few exceptions from the Coastal Strip from Port Elizabeth to the Portuguese East border; from Basutoland and the adjoining districts in the Orange Free State of Vrede, Harrismith, Reitz, Bethlehem, Fouriesburg, and in the Cape from the adjoining districts of Herschel, Barkly East, Elliott, Maclear, Matatiele and Mount Fletcher. In the Central Cape its *presence* is somewhat irregular depending on local changes in the environment.

The Influence of Humidity and of Rainfall.

H. rufipes is a dry area tick, occurring in all the *desert* and the *semi-desert* areas and reaching into areas with a rainfall of 20 to 25 inches per annum. Under certain conditions it will easily tolerate 25 to 30 inches, e.g. Pretoria and Rustenburg, but under other conditions it will not tolerate 30 inches, e.g. at higher altitudes or under semi-tropical conditions where the relative air humidity is higher.

It is solidly *absent* from all *winter rainfall* areas, i.e. from Piquetberg to Port Elizabeth; it is also absent from areas in which rain is liable to fall during most months of the year, i.e. Port Elizabeth to East London; it is absent from the Eastern Coastal Strip with its moist layer of air giving an increased relative humidity and a decreased range in daily temperature fluctuations. As for *H. truncatum* it is the distribution of the rainfall and of humidity in time, rather than the actual amount, that is important.

The Influence of Temperature and of Altitude.

H. rufipes can withstand a wide range of temperatures. It occurs in the cold areas of Sutherland and Belfast with up to 120 days of frost per annum as also in the dry hot areas of Gordonia and of the Northern Transvaal. Altitude alone does not seem to be a limiting factor, it is rather the increase in humidity, often associated with the increase in altitude, that plays a limiting rôle. Thus *H. rufipes* is present throughout the dry Central Karoo areas of Middelburg, Graaff-Reinet and Beaufort West but tends to be absent from farms having snow on the mountain ranges during part of the winter. It also tends to be absent from the high rainfall areas of the Drakensberg Escarpment in Lydenburg, whereas it is present in the adjoining dry *highveld.* It tends to be absent from the high rainfall areas of the Zoutpansberg and to a certain extent from the Waterberg with a somewhat lower rainfall.

Increase in temperature associated with a relative increase in humidity evidently also plays a limiting rôle. Thus the tick is present and firmly established in Vryburg, North-Western Cape, but is absent or but precariously established in the Letaba area in the Northern Transvaal, both with an average summer rainfall of 15 to 20 inches. Vryburg is considered " dry "—whereas Letaba borders on the " semi-tropical ". Vryburg has a mean absolute maximum of 89° F. and a mean absolute minimum of 38° F., Letaba has a mean absolute maximum of 91° F. and a mean absolute minimum of 51° F.

The Influence of Vegetation.

Other factors being equal *H. rufipes* occurs in all vegetational types, the *Western Province vegetation* associated with winter rainfall excluded.

The Influence of Dipping.

Dipping as commonly practised does not appear to play any rôle. It is just possible that it may play some rôle in borderline areas in Natal and in the Transkei and in Swaziland, or in areas where East Coast fever dipping intervals have recently been enforced.

Seasonal Activity.

H. rufipes is apparently an adaptable species. In dry areas, e.g. Potchefstroom, Mafeking, Aliwal North, De Aar, Namaqualand, it is *active at all times of the year.* As conditions become less suitable its activities are suspended during the early winter, e.g. Queenstown; or sometimes during late winter, e.g. Gordonia; or if conditions become more unfavourable then it may be inactive throughout the winter months. Its behaviour is undoubtedly influenced by the annual variations in local climates, for whereas in some collections it may have figured in early winter collections in one year, in another year it may be absent during the same period. In most areas it is present during early summer, but not invariably so, e.g. it may be absent at this time of year in Beaufort West, Gordonia, Kroonstad. Nor is it always present in late summer, e.g. Pietersburg, Eshowe, Transkei, Calvinia. However, despite these slight variations, as a broad general statement, one can say that it is more active in summer than in winter.

Distribution in Adjoining Countries and in Africa Generally.

Conditions in SWAZILAND are unfavourable in most areas. In the Drakensberg the rainfall is too high and the *lowveld* is semi-tropical. The survey shows the tick to be present in a few " more moderate " " middleveld " areas, lying in a line from

Mbabane, Mankaiana, Hlatikulu to Goedgegun. Farmers from Ermelo and Piet Retief trek to Swaziland for winter grazing; it is possible that this annual trekking may help to maintain *H. rufipes* in otherwise border line areas, practising 7–7 dipping. But few collections have been made in BASUTOLAND and no *H. rufipes* have been recorded as yet. Conditions in this mountainous area with winter snows are unfavourable.

The scanty Tick Survey records for BECHUANALAND indicate that *H. rufipes* may be present throughout the Protectorate. The infestations are usually very light and mostly but a few animals in a herd are infected. The collections sent to Onderstepoort are mainly from the Eastern Strip along the railway line, and from NGAMILAND. These areas carry the more permanent and the heaviest cattle population. Whether the ticks are present in the more central areas, where watering for cattle is a problem, remains to be seen. That conditions here may be unsuitable is indicated by a remark by the Government Veterinary Officer at Maun, who states " the Rakops area (S.E. of Maun) is free of ticks. I have introduced tick infested stock, but in no time the stock were clean and a tick has never been seen since." The Southern areas abutting on Gordonia, Kuruman and Vryburg, from which no collections have yet been made, can be expected to show *H. rufipes*. The material sent in from NGAMILAND has mainly been collected in April when the tick has been present in most areas, except in some Chobe localities and in some Nokanen areas where *H. transiens* is present. Some Nokanen collections were made in February. Collections along the eastern strip were sent in at different times of the year.

Despite the annual inundations by the Zambesi River, *H. rufipes* has been sent in from most collecting areas in the eastern section of the CAPRIVI STRIP. The presence of the tick in this area is undoubtedly due to the reintroduction of cattle from the surrounding tick infested regions during the dry months of the year.

Like the adjoining Kruger National Park on its western and Zululand on the southern boundary, the sub-tropical MOÇAMBIQUE including the northern Province of Niassa, appears to be unsuitable for *H. rufipes*. The tick has been recorded by Santos Dias in the region of the Alto Limpopo at Chicualacuala and neighbouring places, a region continuous with the dry region of the Limpopo of the Northern Transvaal. Santos Dias records one specimen from the district of Govuro, a dryish area near the coast in the district of Sul du Save. He also gives odd records for Maputo and Guija in the district of Lourenço Marques. The Onderstepoort records from Tete are from dry areas similar to those of Southern Rhodesia.

The Zoological Survey shows *H. rufipes* to be present in most of the cattle areas in SOUTH WEST AFRICA. The Mariental collections were poor, nevertheless the indications are that the tick is but poorly established in the very dry regions. We have records for Namib, Torrow and Keetmanshoop; but it appears to be absent at Aroab. The tick also dies out in the moister, more tropical extreme north of OVAMBOLAND. It is not present in ANGOLA either. (Sousa Dias 1950).

According to the somewhat scanty records (Onderstepoort and Jack 1942) it is probably present throughout SOUTHERN RHODESIA, but is apparently absent from the high rainfall area of Melsetter–Mount Selinda on the Drakensberg escarpment. According to the tick survey of NORTHERN RHODESIA it appears to be present throughout the drier south-western areas as also in some parts of the Luangwa Valley. It does not figure in collections from the wetter northern regions nor in collections from the adjoining KATANGA of the BELGIAN CONGO. It is entirely absent

from all types of vegetation in the BELGIAN CONGO. The tick survey has but one record from ARU near the Uganda border. Aru is in East African Highland vegetation and has a rainfall of 30 to 40 inches—these are wetter conditions than elsewhere where the tick occurs; possibly the record represents a recent introduction from drier areas further north or further east.

It would appear that *H. truncatum* (*transiens*) is the only *Hyalomma* definitely recorded from NYASALAND to date. Our data for TANGANYIKA are also but meagre. Miss Walker lists it for Lake Manyara (Allan Brook collection).

Some nymphae in the Onderstepoort collections have been doubtfully listed for the *Karamoja District of Uganda:* no adults have been recorded thus far. It can be expected in the drier northern areas, for it occurs across the borders in the SUDAN. Onderstepoort has but one record from Isiola in the semi-desert conditions north of Mount Kenya in KENYA. According to Lewis it is extremely common in all the drier areas of KENYA. J. R. Wiley (private correspondence) has drawn up a rough map of its distribution in Kenya. H. Hoogstraal, 1954, lists it for the SUDAN as present in all provinces, as scattered infestations on cattle and as common on giraffe and buffalo in the south. It has been listed by Paoli 1916 for ITALIAN SOMALILAND at El Ualae, Duddumai, Joc Doudou and Dafet, and by Tonelli Rondelli 1926 at Mogadiscio. Pocock 1900 lists it as *H. grossum* from BRITISH SOMALILAND. Onderstepoort has records from Segaz and Dagabur (Charters coll.) in ETHIOPIA; Stella 1938 records it as *H. aegyptium impressum* from Amhara, Lake Tana district; from Harrar and Galla Sedana. Stella 1938 also lists it from FRENCH SOMALILAND as well as from ITALIAN and BRITISH SOMALILAND. Tonelli Rondelli 1930 records it from ERITREA. Hoogstraal records it from EGYPT as " common on domestic animals in the Nile Valley only; it also arrives at the Cairo Abattoirs on cattle from the Sudan and East Africa."

Whereas it appears to be present in most regions of East Africa, *H. rufipes* appears to be *absent* from WEST AFRICA. Thus far it has not been recorded from ANGOLA and CABINDA, BAS- AND MOYEN-BELGIAN CONGO (Theiler 1954); FRENCH MOYEN-CONGO, GABON of FRENCH EQUATORIAL AFRICA; RIO MUNI (Hoogstraal private correspondence); FRENCH CAMEROON (Rageau 1951); nor did it figure in Aellen's collection from the FRENCH CAMEROONS, which was sent to Onderstepoort for identification; SOUTHERN PROVINCE OF NIGERIA except for two records in the dry belt or Dahomey Gap, reaching the coast on the borders of Nigeria and Dahomey, i.e. from Badagiri on the coast, rainfall 20 to 30 inches, in a vegetation zone described as " Forest Belt to Parklands, water very scarce during the dry season " and Oyo in a vegetation zone given as " undulating grass lands, sparsely timbered " (Simpson 1912); according to Rosevear's map both localities lie in his Guinea Savannah; LIBERIA (Bequart 1930); SIERRA LEONE (Simpson 1913–14); PORTUGUESE GUINEA (Tendeiro 1952) and GAMBIA (Simpson 1911-12). It was absent from Dr. V. Aellen's collection from the IVORY COAST, which was sent to Onderstepoort for identification.

H. rufipes is *present* in SENEGAL, 30 inches rainfall, acacia, tall grass, and Savannah at Dakar (Kartman collection); in the NORTHERN PROVINCES OF NIGERIA on a strip of high grass low tree Savannah reaching southwards past Oyo to Badagiri at the Coast (Unsworth 1952, Simpson 1911–12). Rousselot 1951, records it from Bamako–Segou in the SUDAN of FRENCH WEST AFRICA, in the same strip of vegetation as at Dakar in Senegal; and from Bangui on the Congo River in Oubangui Chari. This record is somewhat unexpected, for Bangui although it is in the *High grass low tree savannah belt*, has a high rainfall of 50 to 60 inches. Possibly this record represents an introduction from some drier region of FRENCH EQUATORIAL AFRICA.

In North Africa it has been recorded from EGYPT and from LIBYA (Hoogstraal 1954). The Italian workers do not record it from Cyrenaica nor are there any records of it further west from Tunis, Algiers or Morocco.

Extra Africa. Hoogstraal records it from the YEMEN in Arabia. Bodenheimer, Adler and Feldman-Mühsam 1948 record it from Israel. If Delpy's synonymy is correct and if *H. aequipunctatum* Olenev 1931 = *H. rufipes* Koch 1844, then it is recorded from the desert regions of CENTRAL ASIA by Olenev 1932. " Soviet workers find *H. rufipes* in such small numbers and in such scattered localities that Pomerantzev (1930) believes its presence in Russia is due to small local populations established from nymphs from migrating birds. Schulze (1915) reported a Macedonian specimen (as *H. impressum*) which may have had a similar history". (Hoogstraal private correspondence). Hoogstraal quoting from literature lists it for Transcaucasia, Astrakhan and Kazakhstan in RUSSIA. Hoogstraal also lists it, according to material identified by him, as common in IRAQ—and rare in Eastern Anatolia in TURKEY. Neither Hyalomma is recorded from ZANZIBAR (Aders 1917); nor did either figure in a collection sent in for identification by Dr. Haddow from this island.

It is not listed for MADAGASCAR (Bück 1948). Both *H. truncatum* and *H. rufipes,* however, figured in a collection identified at Onderstepoort. This record from Tamatave is from stock imported from the Union. Other South African ticks in the same collection were *Rhipicephalus evertsi, R. capensis, Margaropus winthemi* and *Amblyomma hebraeum.* The *Hyalommas* are not likely to become established in this area lying in the high rainfall belt of the island.

Remarks on the Separate State Veterinary Control Areas.

These remarks must be read in conjunction with Maps 1, 2 and 4 of Part I and with Map 2 of this article.

Since *H. rufipes* is so consistently either present or absent in some areas, it is not worth while discussing each State Veterinary area separately, but only to analyse in detail those areas in which it appears to be unevenly distributed or but precariously established.

H. rufipes is consistently *present* in the districts of:—

Transvaal: Potchefstroom, Ventersdorp, Klerksdorp, Wolmaransstad, Bloemhof, Schweizer Reneke, Christiana, Pretoria, Middelburg, Witbank, Krugersdorp, Brits, Rustenburg, Marico, Lichtenburg, Bethal, Standerton, Belfast.

Orange Free State: Heilbron, Vredefort, Bothaville, Lindley, Kroonstad, Hoopstad, Winburg, Senekal, Ficksburg, Ladybrand, Bloemfontein, Jacobsdal, Fauresmith, Edenburg, Reddersburg, Dewetsdorp, Wepener, Zastron, Bethulie, Philippolis.

Cape: Mafeking, Vryburg, Kuruman, Taungs, Barkly West, Kimberley, Herbert, Hay, Gordonia, Kenhardt, Namaqualand, Hopetown, Philipstown, De Aar, Britstown, Carnarvon, Vanrhynsdorp, Victoria West, Aberdeen, Venterstad, Albert, Aliwal North, Sterkstroom, Tarka, Stockenstroom, Fort Beaufort, Jansenville.

Natal: Paulpietersburg, Newcastle, Dundee, Nqutu, Vryheid, Helpmekaar, Weenen, Richmond.

H. rufipes is consistently *absent* from the districts of:—

Orange Free State: Vrede, Reitz, Bethlehem, Fouriesburg.

Cape: Piquetberg, Hopefield, Malmesbury, Tulbagh, Wellington, Paarl, Bellville, Wynberg, Simonstown, Laingsburg, Montagu, Worcester, Stellenbosch, Somerset West, Caledon, Robertson, Mossel Bay, George, Knysna, Uniondale, Steytlerville, Bedford, Peddie, Willowvale, Elliotdale, Mqanduli, Idutywa, Nqamakwe, Umtata, Elliott, Maclear, Herschel, Qumbu, Libode, Port St. Johns, Lusikisiki, Tabankulu, Flagstaff, Bizana.

Natal: Alfred, Port Shepstone, Impendhle, Inanda, Mapumulo, Lower Tugela, Mtunzini, Eshowe, Lower Umfolosi, Hlabisa, Nongoma, Ubombo, Ingwavuma.

Area 1, *State Veterinarian, Johannesburg.*

Most of this area is situated in the *Middleveld* with mixed grass. It is possible that the poor collections from this area may explain the absence of *H. rufipes* from some farms in the district of Vereeniging. The rainfall for Vereeniging and Krugersdorp is below 30 inches per annum. In Benoni and Springs where the tick is absent the rainfall is above 30 inches. Most of the cattle in Area 1 are dairy herds, which possibly receive more regular deticking attention than is the general practice elsewhere.

Area 4, *State Veterinarian, Potgietersrus.*

Collections excellent. *H. rufipes* is solidly present in the *Bankenveld* of Alma–Vaalwater area of the Waterberg, as also in the open flats of the *Thornveld* of the Swartwater, Limburg–Gilead and Tolwe areas of Potgietersrust. It is entirely absent from the Nylstroom collections in the *Bankenveld* and *Thornveld,* with an average rainfall of 23 inches, farms mostly sourveld. The Nylstroom collections were not nearly as good as those from the other areas in the district. *H. rufipes,* however, is present in other collections for those months, mainly winter months, in which collections were made from Nylstroom. It is difficult to give an explanation as to why it should be absent from Nylstroom; it was absent from all four seasonal collections. Dipping plays no rôle.

Area 5, *State Veterinarian, Pietersburg.*

Present throughout the *Bankenveld* and *Thornveld* of Pietersburg, mostly absent from the mist belt of the Haenertsburg and Drakensberg, as also absent in three seasonal collections from the sourveld farms in their foothills. In the Letaba areas it seems to be but precariously established, it tends to die out eastwards in the *Lowveld* towards the Portuguese border. For these regions there was but one summer collection, but in other localities where it is present, it is present in early summer. Dipping is at 14 day intervals, so plays no rôle.

Area 6, *State Veterinarian, Zoutpansberg.*

Like area 5, Zoutpansberg has a wide range of rainfall, falling from 35 inches in the mountains down to 10 inches on the flats.

H. rufipes is present in the north and in the west in the " Bushveld " and the *evergreen* and *deciduous trees* and *thorn forest* with a rainfall of 15 to 20 inches. It is absent from the farms with a high rainfall in the Zoutpansberg and its foothills extending into the Kruger National Park in the north-east corner. It is present in the upper reaches of the Letaba River continuous with the belt in the Letaba area of Pietersburg. Dipping appears to play no rôle.

Area 7, *State Veterinarian, Barberton.*

The area lies entirely in the high rainfall area in the mountains sloping down towards the sub-tropical " lowveld " on its eastern border. It is consistently absent from the hot " middleveld " and " lowveld " of the Lebombo flats, of the Lomati and the Inkomati Rivers. It is also absent from the wet, high-lying Sabie Plateau, 45 to 50 inches, sourveld; as also from all the " middle " and " lowveld " bordering on the Kruger National Park. In the wet White River plateau, sourveld, it is unexpectedly present on some farms; this possibly represents introductions from the dry *Highveld* for winter grazing. It is present in the Nelspruit " lowveld ", 20 to 25 inches rainfall, as also in the upper reaches of the Crocodile, Elands, Kaap and Nelspruit Rivers. It is absent from the Sabie plateau, Kaapsche Hoop and Highlands, mostly within the mist belt of the Drakensberg.

Area 8, *State Veterinarian, Piet Retief.*

Uneven collections. *H. rufipes* is absent in the collections from Amersfoort, 6,000 feet, 38 inches rainfall; as also from one farm in the Pongola Valley, sub-tropical. It is present in Piet Retief, 3,800 to 4,500 feet, rainfall 36 to 38 inches. Its presence here may be due to the introduction of sheep from the drier *Highveld* for grazing. It is also present in the slightly drier strip between the Pongola River and the southern boundary of Swaziland. Dipping 7–14.

Area 9, *State Veterinarian, Lydenburg.*

The area, 6,000 feet at Belfast, is crossed by strips of *Highveld, Middleveld, Bankenveld* and *Bushveld. H. rufipes* is present in the *Highveld* areas of Belfast and Lydenburg, but absent from the wetter *Highveld* of Pilgrims Rest. It is present throughout the *Middleveld* and the *Bankenveld.* The recorded absence from Schoonoord and from the Branddraai area is either due to poor collecting, one collection only, or due to the fact that the farms are wetter than is indicated on the returns. The absence of the tick from the *Bankenveld* near Groblersdal is undoubtedly due to inadequate collecting, one collection only.

Area 10, *State Veterinarian, Ermelo.*

Three thousand to 5,000 feet, average rainfall 25 to 30 inches. *H. rufipes* is established in these *Highveld* areas though it is never present in any great numbers. Its absence from one farm in Ermelo, 5,000 feet, 31 inches rainfall and one in Carolina, 3,500 feet, 22 inches rainfall, is possibly due to its scarcity rather than to its complete absence, dipping is not practised on either of these two farms. In the adjoining lower-lying *Bankenveld,* with the same average rainfall the tick is more abundant.

Area 14, *State Veterinarian, Vryheid.*

Present in the higher lying areas of Vryheid, Paulpietersburg and Babanango (24 to 30 inches). It is absent from the more sub-tropical " lowveld " and the coastal farms. It is unexpectedly recorded from a 40-inch mist belt farm. Dipping 7: 7. If absent it is usually absent in January and February and sometimes in early winter.

Area 15, *State Veterinarian, Dundee.*

Two thousand to 4,500 feet; 20 to 30 inches rainfall. *H. rufipes* present throughout except for two " Highveld " farms at 6,000 feet on the *Grassveld* on the Utrecht–Wakkerstroom border, 40 inches rainfall. It is present in adjoining areas, also with 40 inches rainfall, but only at 4,000 feet. Mostly absent January–February.

Area 16, *State Veterinarian, Ladysmith.*

Present in areas 2,000 to 5,000 feet, rainfall 20 to 30 inches. Absent on four *highveld* farms on the Harrismith border, 5,000 feet, rainfall 21 to 30 inches.

Area 17, *State Veterinarian, Estcourt.*

Present throughout the *Grassveld* and *Thornscrub*, 3,000 to 4,000 feet, rainfal[1] 20 to 30 inches. Absent from two farms given as over 5,000 feet, " highveld " sourveld, 36 inches rainfall. It tends to be absent throughout the winter months.

Area 18, *State Veterinarian, Pietermaritzburg.*

Present throughout, 2,000 to 3,500 feet, 18 to 30 inches rainfall, with sweet grassveld and thornveld. Absent from 5,500 to 6,000 feet, 30 to 35 inches rainfall, " highveld " with sourveld and mostly lying in the mist belt. One farm, given as in the mist belt at 4,000 feet, 47 inches rainfall, shows the tick present in one collection out of four.

Its occurrence is quite irregular, it is present or absent quite irregularly.

Area 19, *State Veterinarian, Greytown.*

Collections unsatisfactory. No collections from Msinga or Kranskop, only one collection from other areas. It is recorded only from two farms in New Hanover, 2,800 to 3,000 feet, 25 to 30 inches rainfall with *semi-thornveld* vegetation. It is present on one farm at 3,500 feet, 35 inches rainfall, in the wattle mist belt, seven-day dipping. It is possible that its absence from the Umvoti and the other four New Hanover farms may be real. These farms are given as 3,000 to 4,700 feet, 20 to 35 inches rainfall, with semi-sour-to sourveld, lying in the mist belt; one farm at 4,700 feet has a rainfall of 54 inches. On these farms the dipping is the usual for Natal 7–7 or 7–14; three farms also handdress.

Area 20, *State Veterinarian, Richmond.*

In the lower-lying sweetveld, 1,500 feet, 27 inches rainfall, the tick occurs in all collections. With increase in altitude it tends to be absent during the mid-winter months at altitudes up to 3,500 feet, rainfall 20 to 30 inches. At altitudes above 4,500 feet, rainfall 35 inches, sour-sweetveld to sourveld, it is mainly absent, e.g. the Underberg area. It is unexpectedly present in the Bulwer area above 4,500 feet, rainfall 35 to 42 inches. It never seems to be very abundant in the area.

Area 21, *State Veterinarian, Port Shepstone.*

H. rufipes is absent throughout the *Grasslands* of Harding, 2,000 to 2,500 feet, 30 inches rainfall, the coastal sour grass and scrub of Port Shepstone, and the sugar belt of Umzinto. It is imperfectly established in the grassland and shrub and the sub-tropical bush of Umzinto adjoining the Ixopo boundary.

Area 22, *State Veterinarian, Eshowe.*

Absent throughout, as in the adjoining areas 24 State Veterinarian, Durban, and 23 State Veterinarian, Nongoma, except for three records in the wattle belt with a rainfall of only 32 to 35 inches as opposed to 30 to 60 inches in most other areas. It is possible that the tick is present along the Lower Umfolozi River, rainfall 25 inches, but that it has not yet been collected. Absent during mid-winter.

Area 24, *State Veterinarian, Durban.*

Definitely absent from the higher rainfall areas. Present, though occurring only once in four seasonal collections, on two farms in the 30 to 35 inches belt which reaches to the coast south of Durban.

Area 27, *State Veterinarian, Umtata.*

The rainfall is 25 to 30 inches except along a 40-mile coastal strip where it is 30 to 45 inches per annum. As in Natal, the country rises in successive stages till it reaches the Drakensberg, which in the Transkei is slightly further from the coast than it is in Natal. The country is mainly undulating sour-grassveld, practically devoid of bush, over-grazed in most areas, and broken up by river gorges. The mountain slopes and river gorges are still well wooded.

There is a tendency for the ticks to be absent from the 30 to 35 inches sourveld areas and to be but precariously established in the 25 to 30 inches areas. When present, it occurs during the last two to three months of the year, it shows a tendency to disappear in January and February; there are but few records of it during the winter months. Dipping 7–14.

Area 28, *State Veterinarian, Butterworth.*

The country is much the same as in the State Veterinarian, Umtata areas. *H. rufipes* is generally absent throughout, rain 30 inches or more. It is present in but two localities, one in the Valley of the Great Kei and the other of the Quolora. In both instances it is recorded for the summer months only. Dipping 7–14.

Area 29, *State Veterinarian, Flagstaff.*

Average 4,500 to 6,000 feet, rainfall 25 inches or more, with frost and snow in the winter. *H. rufipes* is absent from most localities. Its presence on three farms above 4,000 feet, rainfall 25 inches or more in the mist belt, is unexpected. Its presence, during summer might be ascribed to local stock movements except that the surrounding areas are free. The A3 Umzimkulu record connects up with the adjoining records for Ixopo, State Veterinarian, 20. Areas below 4,000, dipping 7–14; above 4,000, dipping 14–0.

Area 31, *State Veterinarian, Aliwal North.*

Present throughout the *Karooveld* and the *Highveld* up to 5,000 to 5,200 feet. Above this it does not seem able to maintain itself even at 20 to 25 inches rainfall. Possibly winter snows play a limiting rôle?

Area 32, *State Veterinarian, Queenstown.*

Absent from the higher-lying farms of Indwe, Elliott and Maclear; rainfall 25 inches and over. Present in Queenstown, Sterkstroom, Tarka and Cathcart at all times of the year, although sometimes absent during the winter months, rainfall up to 25 inches.

Area 36, *State Veterinarian, Swellendam.*

Absent throughout the winter rainfall areas except for two summer records in the coastal sandy strip of Heidelberg and one summer record for the strandveld of Bredasdorp. Also absent from the dry Karooveld off Barrydale to the north of the Langeberg.

Area 37, *State Veterinarian, Oudtshoorn.*

Absent from the high winter rainfall areas south of the Langeberge–Outeniqua ranges, as also from the dry Karooveld of the Little Karoo of Ladismith, Oudtshoorn and Uniondale. There are two summer records from farms under irrigation in the district of Oudtshoorn and one summer record from the strandveld of Heidelberg.

Area 39, *State Veterinarian, Port Elizabeth.*

Absent from the coastal belt with summer-winter rainfall. Present in the " Middlebush " *Karoo* of Uitenhage and Humansdorp as also in the *Karooveld* of Jansenville. Its absence from the dry Steytlerville Karoo may be more apparent than real, as but two collections were made, viz. late summer and mid-winter when *H. rufipes* is not very active.

Area 40, *State Veterinarian, Grahamstown.*

Absent from the coastal strip of Alexandria, Bathurst and Peddie, with an annual rainfall of 25 inches and over, all the year round rainfall. Mostly present throughout the rest of the area with summer rains; more prevalent during summer than during the winter months. Absent from the Hogsback with a rainfall over 35 inches. Dipping somewhat irregular.

Area 41, *State Veterinarian, Middelburg.*

The distribution picture is somewhat confused, only one summer collection having been made in the districts of Richmond, Hanover and Colesberg. The collections for Middelburg, Steynsburg and Hofmeyr are uneven; from some collecting areas three collections were sent in, from some two, but mostly only one collection was sent in. It is thus difficult to evaluate the records. According to the records from adjoining areas, lying in the same 90 to 120 days frost belt one would expect *H. rufipes* to be present throughout the flats of Richmond and Hanover and to be absent only from the higher lying farms with snow during some of the winter months as in the mountains of Middelburg and Graaff-Reinet. When present, present in summer and in some of the few winter collections made.

Area 42, *State Veterinarian, Calvinia.*

Absent from the Cold and Warm Bokkeveld of Ceres, with *Western Province vegetation* and definite winter rains; also absent from the escarpment of the Bokkeveld of Nieuwoudtville, winter rainfall; as also probably from the Cedarberg with *Western Province vegetation.*

It is present in the Ceres and Sutherland Karoo. It was sent in from all Roggeveld areas except from two farms which seem to differ in no way from the other Roggeveld farms. It was sent in from three of the four collecting areas from the Bushmanland of Northern Calvinia; and two of three farms from Williston. The collections are good. *H. rufipes* is mainly active in summer, four collections also gave it as active in winter. This winter activity is probably only confined to males?

The records for this area may be incorrect to a certain extent, in that many of the identifications were made before *H. glabrum* was differentiated from the other two Hyalommas. In a collection sent in May 1943, no *H. rufipes* was present. Both *H. transiens* and *H. glabrum* are present throughout the area.

Area 43, *State Veterinarian, Beaufort West.*

Collections good, but, as for Calvinia, the records may be somewhat incorrect as the identifications were made before *H. rufipes* was differentiated from *H. glabrum. H. glabrum* present throughout, no collections sent in from Fraserburg. The distribution of *H. rufipes* seems to be somewhat uneven, suggesting that in some areas it is but precariously established. When present *H. rufipes* occurs in mid-summer; there are three winter records (probably males only?).

Area 44, *State Veterinarian, Gordonia.*

Present throughout with but three exceptions. *H. rufipes* never seems to be very abundant. In most areas it is active through spring to late autumn, being absent only during late winter. Summer rainfall, 5 to 10 inches. *Mixed Karooveld* in the south passing through " Driedoringveld " to " Kalahari " in the north. Further collections may show the tick to be present in the three areas from which it has not been recorded thus far and which in no way differ from the adjoining areas in which it is present. No dipping.

Area 47, *State Veterinarian, Adelaide.*

Collections poor, the records are possibly inaccurate, as some of the identifications were made before *H. glabrum* was differentiated from the other two *Hyalommas*. *H. rufipes* is apparently not firmly established, though present in most localities in Somerset East, Adelaide and Fort Beaufort. It is mainly absent from Pearston and Cradock. It shows a tendency to be absent from prickly pear veld.

Area 49, *State Veterinarian, Bethlehem.*

Collections inadequate. The available records seem to indicate that the tick tends to die out above 5,500 feet. The vegetation throughout the area is the *short grass* of the *highveld.* Rainfall, 20 to 25 inches or 25 to 30 inches, but the presence or absence of the tick does not seem to be clearly linked to the rainfall.

Area 57, *State Veterinarian, Graaff-Reinet.*

Collections inadequate. *H. rufipes* is apparently present in the flats of southern Graaff-Reinet, Aberdeen and Willowmore. It is absent from some sourveld farms in Willowmore. Absent in mid-winter.

SUMMARY.

1. The distribution of *H. rufipes* is given in terms of political divisions.

2. The limiting factor to its distribution in South Africa is seen to be increasing humidity. It is present in areas up to 20 to 25 inches per annum. Above this it can maintain itself in areas with up to 30 inches per annum, where the atmosphere is dry; but in moist semi-tropical areas at 25 to 30 inches it is either absent or but precariously established. Also in dry areas it is not able to maintain itself in winter rainfall areas or in areas with winter snow.

3. Neither dipping nor vegetation types play a limiting rôle.

4. Data for central Africa are meagre, but its distribution is possibly limited not only to the lower rainfall regions but possibly also to areas with but one rainy season per annum.

LITERATURE REFERENCES.

Only the more recent and comprehensive references are given.

ANGLO EGYPTIAN SUDAN.

Hoogstraal, H., 1954. A preliminary annotated list of ticks of the Anglo Egyptian Sudan. *Jnl. Parasit.* 40, pp. 304–310.

BELGIAN CONGO, ANGOLA, NORTHERN RHODESIA, FRENCH CAMEROONS, FRENCH EQUATORIAL AFRICA, LIBERIA.

Theiler and Robinson, 1954. Tick Survey VIII. *Onderstepoort Jnl. of Vet. Res.* 26, pp. 447–461 (maps).

GAMBIA.

Simpson, 1911–12. *Bull. Ent. Res.* 1, pp. 187–240 (map).

KENYA.

Wiley. Private communication. In the press.

MADAGASCAR.

Buck, 1948. Tiques des Animaux Domestiques a Madagascar. *Ann. Rep. Arch. Inst. Pasteur Tananarive*, pp. 60–63.

MOÇAMBIQUE.

Santos Dias, 1950. Contribuição para o conheciminte da Fauna Ixodologica de Moçambique. *Documentario Moçambique* 61, pp. 113–170.

Santos Dias, 1951. Açerca de alguns lotes de Carraças do Alto Limpopo. *Anais. Serv. Vet.* 3, pp. 207–233.

Theiler, 1943. Notes on the ticks off domestic stock from Portuguese East Africa. *Documentario Moçambique*, 33. pp. 51–120 (figs.)

NIGERIA AND CAMEROONS.

Simpson, 1911–12. Northern Nigeria. *Bull. Ent. Res.* 2, pp. 301–346 (maps).
Simpson, 1912. Southern Nigeria. *Bull. Ent. Res.* 3, pp. 137–193.
Unsworth, 1952. *Ann. Trop. Med. Parasit.* 46, pp. 331–336.
Rosevear, 1953. Check list and Atlas of Nigerian Mammals. Govt. Printer, Lagos.

NYASALAND.

Wilson, 1950. Check List Nyasaland. *Bull. Ent. Res.* 41, pp. 415–428.

PORTUGUESE GUINEA.

Tendeiro, 1952. Ixodidae do Guiné Portuguesa. *Ann. Inst. Med. Trop.* IX, pp. 195–263.

SIERRA LEONE.

Simpson, 1913–14. *Bull. Ent. Res.* 4, pp. 151–190 (map).

SOMALILAND: BRITISH, FRENCH, ITALIAN, ERITREA, ETHIOPIA.

Paoli, 1916. Ixodidi raccolte nella Somalia Italiana Meridionale. *Redia* 11, *Fasc.* 1.
Rondelli, 1926. Alcuni Ixodidi della Somalia Italiana. *Res. biol.* 1, pp. 33–43.
Rondelli, 1932. Hyalomma nuovi della colonie Italiana. *Atti. della Soc. Ital. di Scienze naturali* LXXI.
Stella, 1938. Gli Ixodidi dell Africa Orientale Italiana. *Rivisti di biol. coloniale* I, pp. 135–153

SOUTHERN RHODESIA.

Jack, 1942. Ticks infesting domestic animals in Southern Rhodesia. *Bull.* 1205: Minister Agriculture and Lands.

ZANZIBAR.

Aders, 1917. Insects injurious to man and stock in Zanzibar. *Bull. Ent. Res.* 9, pp. 391–401.

III. HYALOMMA GLABRUM. DELPY, 1949.

(= H. TURANICUM. POMERANTZEV, 1946?)

General Distribution in South Africa (*Map* 3).

Absent throughout the Transvaal, Swaziland, Northern Orange Free State, Basutoland, Natal, East Griqualand, Transkei and Coastal Regions of the Eastern Province, North-western Cape (except for one record from Barkly West), Namaqualand, Bushmanland, Bechuanaland and South West Africa.

Present in the Karoo areas of the Eastern Cape, Western and South-western Cape, and the Cape Midlands as also in the Brokenveld of the Southern Orange Free State.

The Influence of Humidity and of Rainfall.

It does not occur in areas with a rainfall over 15 inches per annum and can exist in areas receiving 5 to 10 inches per annum, in areas 0 to 5 inches it is but precariously established. It tends to be absent from winter rainfall areas, as also from areas with rainfall all the year round; it is, however, established at Little Brak.

The Influence of Temperature and of Altitude.

It is present in the coldest areas, having up to 150 days of frost per year, as also in areas having little or no frost. (See Map 4, Pt. I). The high temperatures of the dry areas also are easily tolerated. The tendency to be absent from mountains having some snow in the winter is not as pronounced as in the other two hyalommas.

The Influence of Vegetation.

H. glabrum appears to be confined to pure karoo and karooid areas. This type of vegetation itself is confined to lower rainfall areas of the Central Cape Plateau, with extensions to the coast in the Robertson–Worcester–Bredasdorp areas, in the Francis Bay–Cape Recife strip and a few strips into the Albany District.

Quite unexpectedly it is absent from the Little Karoo stretching from Montagu to Uniondale. In Karoo areas mixed with mesembrianthemums, with sourveld grass, it appears to be well established, but where it becomes mixed with sweetveld grass it is but precariously established and tends to disappear. It is maintaining itself in the coastal sand strip of Clanwilliam and Vanrhynsdorp.

It would seem that like the other two hyalommas it is following the incursion of karooveld into the southern Orange Free State.

It is absent from all the forest, parklands and grasslands, thorn country deser succulents, and desert grass areas.

The Influence of Dipping.

Regular dipping is not carried out in the areas in which *H. glabrum* occurs. Dipping for the Karoo paralysis ticks, *I. rubicundus*, is carried out on some Karoo farms, but this once to three times a year dipping does not appear to influence this bontpoot.

Seasonal Activity.

The adult is active during the summer months in all areas. In some areas, e.g. Calvinia and Vanrhynsdorp it appears to be active all the year round. In some areas the odd winter records may represent collections of male ticks only, either late droppers or early arrivals.

Distribution in Adjoining Territories and Elsewhere.

Since this tick is confined to karooid vegetations it is not likely to be present in other parts of Africa; or if introduced, it is not likely to become established.

For some time it was suspected that this tick was introduced with the Blackhead sheep from Persia. The taxonomic conclusions arrived at by Delpy and Hoogstraal seem to support this conclusion. As yet we do not know much of the life history of this tick in the Karoo and are still hesitant to accept this synonymy.

If Delpy's and Hoogstraal's synonymy is correct and *H. glabrum* = *H. turanicum* then its distribution outside Africa is given as Middle Asia, Southern Khazakstan and Iran.

To quote from Hoogstraal (private correspondence) where it occurs in the Soviet area *H. turanicum* ranges through a number of altitudinal zones. It lives in " tugai meadows " in semi-desert and in low areas of fields at the base of hills and up the slopes of mountains to the wooded belts. Adult hosts are " large and small horn-bearing animals " especially cattle and also horses. The immature stages attack birds.

Remarks on the separate State Veterinary Control Areas.

These remarks must be read in conjunction with maps 1, 2 and 4, of Part I, and with map 3 of this article.

H. glabrum is consistently *absent* from:—

Transvaal.....	All areas.
Natal.....	All areas.
Orange Free State	Northern areas.
Cape Province....	The Eastern Province; the Transkei; Border and Albany districts; the southern coastal districts from Uniondale–Knysna to Ladismith–Riversdale; the western districts from Bredasdorp to Clanwilliam; the north-western districts from Namaqualand to Taungs–Vryburg–Mafeking.

It is solidly or partially *present* in:—

Area 31, *State Veterinarian, Aliwal North.*

It is absent from all farms in the *Highveld* areas of Barkly East, Wodehouse, Aliwal North, Lady Grey and Herschel, as also in the foothills having *mixed karoo-bush* and *grassveld* of Albert, and from most collecting areas of Venterstad. The one record from E. 1 on the Orange Free State border is from a farm which in no way differs from the others, the record may be a recent importation.

The altitude varies from 3,600 to 7,000 feet—and the rainfall from 12 to 25 inches. The collections are adequate.

Area 32, *State Veterinarian, Queenstown.*

It is absent from the *tall grassveld* areas of Cathcart, Glen Grey, Sterkstroom, Elliott and Maclear. Altitude 3,000 to 6,000 feet, rainfall 20 to 40 inches.

It occurs on one farm in the Queenstown district and on one in Tarkastad district, with *Karooveld* and a 12-inch rainfall. Dipping in these areas is not compulsory.

Area 35, *State Veterinarian, Worcester.*

It is absent from all areas having the Western Province *sclerophyllous bush* vegetation of Caledon, Robertson, Worcester and Montagu; it appears also to be absent from the incursions of Karooveld of Robertson and Montagu, but is present on the *karoo vegetation* of the Matroosberg and on the Karoo of Laingsburg, with under 10 inches rainfall.

Area 36, *State Veterinarian, Swellendam.*

Most of this area has the *Western Province* vegetation with heavy rainfall, 30 to 45 inches in the Langeberg Range, the rainfall decreasing to 10 to 15 inches on the coastal dunes. To the north of the range is the *Barrydale-Karoo,* with but eight inches per annum. The only two records are from a farm in the Heidelberg Ruggens, 20 inches, and from a farm in the coastal belt, 15 inches. In each case they were only recorded once, a summer record, and hence each may represent but a recent introduction which is not likely to maintain itself.

Area 37, *State Veterinarian, Oudtshoorn.*

Vegetation varies according to the position relative to the mountain ranges, the rainfall throughout is fairly heavy, decreasing sharply to the north of the Ranges where the vegetation is *Karooveld,* with a rainfall between 5 and 10 inches. Despite the apparently favourable conditions in the Little Karoo and the fairly adequate collections, no ticks were sent in. There is but one record, a winter record, from the Willowmore Karoo; and one a summer record from the drier coastal region of the Little Brak River, having *grassveld* and *rhenosterbush,* 14 inches of rainfall. This may represent an importation of sheep from the Karoo, to feed summer holiday visitors.

Area 38, *State Veterinarian, De Aar.*

All of this area is Karoo, with a low rainfall below 15 inches per annum. The tick is present throughout De Aar, and Britstown and the southern part of Philipstown and Hopetown, where the vegetation is *pure karoo.* Going northwards as the pure stand of *karoo bush* is gradually invaded by *sweet grass,* the tick appears to be but precariously established and tends to disappear. But few winter collections were made; it was taken in many summer collections.

Area 39, *State Veterinarian, Port Elizabeth.*

In this area there is a general intermingling of *tall grassveld, karooveld* and the *evergreen sclerophyllous* bush of the *Western Province vegetation* with the higher rainfall areas at the coast and in the mountain ranges, with a dry strip along the Gamtoos Valley and in the Karoo to the north of the mountains. *H. glabrum* is absent from the coastal belt (except for one record in the hills of Humansdorp, 27 inches rainfall), it is present in the dry Karoo areas of Jansenville and Steytlerville. Its absence from two Karoo areas may be due to the fact that only summer collections were made. From the returns sent in *R. glabrum* is frequently absent from summer collections.

The odd Humansdorp summer record may be a recent introduction.

Area 41, *State Veterinarian, Middelburg.*

The collections from this area are of uneven value and the plotted records difficult to read. The veld varies from *karoo,* an almost pure stand, to *karoo bush with sourveld* or *karoo with sweet grass.* The altitude varies from the plateau at 4,000 to over 5,700 feet.

H. glabrum is present throughout the *Karoo* of Hanover and Richmond, high lying areas up to 5,700 feet, having over 90 days of frost per annum, and about 12 inches of rainfall. It is present throughout Hofmeyr and Schoombie in the district of Maraisburg, except from one farm in Schoombie, which is described as *Karoo*. The farms in these areas are described as *Karoo* or *Karoo* with but little *grass*. The Steynsburg farms are also listed as *Karoo and little grass*. Possibly due to the poor collection the tick is not recorded from one farm given as *Karoo*. The Middelburg records also are somewhat confusing, the tick appearing somewhat haphazardly in *Karoo* and *Karoo and grass*. It is absent from two farms at 5,000 feet listed as *rhenosterbos*, *Karoo* and *grass*, 12 inches rainfall. In the district of Colesberg where the vegetation changes from *Karoo and little grass* to *grass and little Karoo* the tick is absent or but precariously established, rainfall 12 inches, height 4,000 to 5,500 feet, over 90 days of frost.

It would seen that more extensive collections in the veterinary area would confirm the provisional finding that *H. glabrum* is unable to maintain itself in the absence of an adequate covering of *Karoo scrub*, within the range of its rainfall tolerance. Winter collections were but few; when present it occurred in the summer collections.

Area 42, *State Veterinarian, Calvinia.*

Throughout the greater part of this area the *Karoo* predominates, varying from a pure stand, with *mesembrianthemum* or *rhenosterbush* to the gradual infiltration of the *bushman grass* in Bushmanland. The tick is present throughout. Rainfall varies from three inches in Sutherland and Ceres Karoo to 10 inches in most regions. The altitude varies from 1,500 to 6,000 feet in Sutherland. Sutherland is the coldest region of the Union with over 150 days of frost per annum.

The tick is absent from one collecting area of northern Calvinia where *grass* begins to predominate; across the border in Kenhardt where the *bushman grass* is dominant it is solidly absent. It is also absent from two *Western Province* vegetation farms in the Cold Bokkeveld. Its presence in the other *Western Province flora* farms in the Cold and Warm Bokkeveld, having a rainfall from 15 to 20 inches per annum, can only be accounted for by the local custom of the yearly trek of the herds to the *karooveld* for summer grazing. In the adjoining districts with pure *Western Province flora*, where yearly trekking is not practised, the tick is absent.

Area 43, *State Veterinarian, Beaufort West.*

Present in the Karoo of the Koup Prince Albert, three to five inches, 2,000 to 3,000 feet; in the flats of Beaufort West, *short mixed Karoo*, eight to nine inches, 3,000 feet, in the Merweville region, *Karoo with some grass*, eight inches, 3,000 to 4,000 feet; on one farm in the rugged mountainous area of the Nieuweveld Berge, 10 to 15 inches, 6,000 feet; on all farms from the Murraysberg " Highveld " short *Karoo with thorn trees* along the rivers, 10 inches rainfall, 3,500 feet, as also in the *mixed Karoo* of the Koudeveld berge, 15 inches, 4,000 to 5,000 feet; on all farms of the *short Karooveld* of Victoria West and Carnarvon and the *kriedoringveld* of Carnarvon, eight inches, 4,000 feet; the record from the *Pan-sandveld* area of Van Wyksvlei is unexpected and possibly represents a recent introduction from adjoining *Karoo* areas. As in Middelburg veterinary area, in those areas where the *grass* tends to dominate, the tick is but precariously established or is absent, e.g. L. 1 van Wyksvlei in Carnarvon, D. 4 in the Merweville area, eight inches; and the farms in the Swartberg of Prince Albert, nine inches. In the Nieuweveldberg of Williston, at 6,000 feet, with a rainfall of 15 inches, the tick is absent on two farms and present on the third. The latter may represent a recent introduction or a precarious existence. More frequently present in summer than in winter.

Area 47, *State Veterinarian, Bedford.*

Collections poor and of uneven value. Present throughout the *mixed Karoo* veld, and prickly pear of Pearston, eight to 15 inches, 3,000 feet; throughout the *mixed Karoo, sour grassveld,* the *noorsveld* and *prickly pear veld* of Somerset East, 10 to 15 inches, 3,000 feet; present in the western half of Cradock but absent in the Tarka area east of the Fish River. It is consistently absent from the *tall grassveld* of Bedford, Adelaide and Fort Beaufort, as also in the adjoining areas, 40 State Veterinarian, Grahamstown and 32 State Veterinarian, Queenstown. When present it tends to be present during the summer months and absent during early winter.

Area 51, *State Veterinarian, Kimberley.*

Absent from the *sandveld* of Hay, Barkly West, Kimberley, Herbert, Jacobsdal and northern Fauresmith, rainfall ranging from nine to 15 inches. In southern Fauresmith and Philippolis it is established precariously; in these areas there is a steady encroachment of *Karoo* into the *grassveld,* the rainfall ranges from five to 15 inches. The odd record from Barkly West is probably a recent introduction.

Area 57, *State Veterinarian, Graaff-Reinet.*

Since the collections from this area are very poor the absence from some collecting areas is probably more apparent than real. Conditions would appear to be favourable, *Karooveld,* five to eight inches rainfall. Except the farm B.2 in Aberdeen district, which is described as mainly *grass and little Karoo.* If present, it is recorded for the summer months and spring.

Area 58, *State Veterinarian Vanrhynsdorp.*

Collections good, showing the tick to be present in most *marginal types of Karooveld,* with *mesembrianthemum, taaibos, skilpadbos* and *some grass* and early *spring compositae,* also in the coastal belt of *sandveld.* In one collecting area where the *grass* is dominant the tick is absent. Rainfall four to five inches; little or no frost. The tick was collected at all seasons of the year, but most frequently in summer.

Area 59, *State Veterinarian, Clanwilliam.*

Collections good. Rainfall five to seven inches; vegetation mainly *Western Province sclerophyllous bush* with an intermixture of *mesembrianthemums* and some *Karoo* bush, more especially in the mountains. *H. glabrum* seems to be firmly established in these dry, no frost areas, including the sandy coastal belt as in 58. It is absent from two collecting areas in the Citrusdal district, which are described as *small bush and quick grass.* Recorded for the summer months, with but one or two present in winter.

South West Africa.

H. glabrum is absent from South West Africa. If introduced it is not likely to become established, since it is absent from the adjoining districts with comparable climatic and floral conditions.

SUMMARY.

1. The distribution of *H. glabrum* is given in terms of political divisions and is seen to be confined to a very restricted area of South Africa.

2. The limiting factor is seen to be a humidity/vegetational one. It is tied to *Karoo*, which itself is limited by humidity/aridity. Ten to twelve inches rainfall seems to be the critical range; in a few areas it is present at 15 inches, possibly areas with long intervening droughts. It can exist in *marginal vegetational Karooid areas*, provided these areas have a low annual rainfall; at higher rainfalls it does not exist in marginal vegetation areas.

3. For record purposes, since we are not quite convinced that *H. glabrum* is synonymous with *H. turanicum*, it has been decided to retain Delpy's name.

LITERATURE REFERENCES.

Delpy, 1949. Rôle des Hyalomma dans la transmission de la Theileriose Bovine. Biologie et Taxonomie des espèces en cause. *Internat. Vet. Conference.* London, 1949.

Hoogstraal. Correspondence.

CLIMATE ZONES OF SOUTH AFRICA.

Explanatory Notes to the Maps.

M. *Mediterranean Zone.*

Winter rains and hot dry summer.

Temperature.

Average daily max.....	Jan. 28° C (82° F)	July. 17° C (63° F).
Extreme max.....	Jan. 43° C (109° F)	July. 30° C (86° F).
Average daily min.....	Jan. 15° C (59° F)	July. 6° C (43° F).
Extreme min.....	Jan. 4° C (39° F)	July. –5° C (23° F).
	depending on altitude and situation.	

Rainfall.

Varies from 250 mm (10″) on flats to over 2,500 mm (100″) against mountains; Max. June and July.

A. *Temperate Belt.*

Temperate and humid; occasional warm and dry " bergwinds ".

Temperature.

Average daily max.....	Jan. 26° C (79° F)	July. 19° C (66° F).
Extreme max.....	Jan. 42° C (108° F)	July. 32° C (90° F).
Average daily min.....	Jan. 15° C (59° F)	July. 7° C (45° F).
Extreme min.....	Jan. 4° C (39° F)	July. –4° C (25° F).

Rainfall.

Varies from 380 mm (15″) on the Western flats to 1,140 mm (45″) against the mountain ranges. Rains throughout the year; max. in March and October.

K. *Great- and Little-Karoo Zone.*

Poor steppe and desert. Transition Zone from summer to Winter rains; occasional hot " bergwinds ".

Temperature.

Average daily max.....	Jan. 32° C (90° F)	July. 18° C (64° F).
Extreme max.....	Jan. 45° C (113° F)	July. 31° C (88° F).
Average daily min.....	Jan. 15° C (59° F)	July. 5° C (41° F).
Extreme min.....	Jan. 5° C (41° F)	July. –3° C (27° F).

Rainfall.

Annual rainfall varies from about 125 mm (5″) on the flats to 760 mm (30″) on the Swartberg. Rain in all seasons, max. in March and November.

SE. *South Eastern Coastal Belt.*

Temperate and moist.

Temperature.

Average daily max.....	Jan. 28° C (82° F)	July. 21° C (70° F).
Extreme max.....	Jan. 43° C (109° F)	July. 34° C (93° F).
Average daily min.....	Jan. 17° C (63° F)	July. 8° C (46° F).
Extreme min.—Inland.....	Jan. 5° C (41° F)	July. –5° C (23° F).
Coastal....	Jan. 12° C (54° F)	July. 3° C (37° F).

Rainfall.

Annual rainfall varies from 500 mm (20″) (Fishriver Valley) to 1,260 mm (50″). Rainy season mainly October to March; winter rains (July 25 mm) not exceptional.

E. *Eastern Coastal Belt.*

Warm and moist.

Temperature.

Average daily max.....	Jan. 28° C (82° F)	July. 22° C (72° F).
Extreme max.....	Jan. 43° C (109° F)	July. 34° C (93° F).
Average daily min.....	Jan. 19° C (66° F)	July. 9° C (48° F).
Extreme min.....	Jan. 7° C (45° F)	July. –1° C (30° F).

Rainfall.

Annual rainfall varies from 760 to 1,260 mm (30″ to 50″). Rainy season mainly October to March, though 250 mm (10″) can be expected in mid-winter.

D. *Drakensberg Zone.*

Warm, temperate monsoon type of climate.

Temperature.

Average daily max.....	Jan. 27° C (81° F)	July. 19° C (66° F).
Extreme max.....	Jan. 40° C (104° F)	July. 30° C (86° F).
Average daily min.....	Jan. 15° C (59° F)	July. 3° C (37° F).
Extreme min.....	Jan. 3° C (37° F)	July. –10° C (14° F).

Rainfall.

Annual rainfall varies from 690 mm (27″) in the Tugela valley to 1,900 mm (75″) against the Drakensberg. Rainy season November to March; though 12 mm p.m. may fall in winter.

L. *Sub-tropical Savannah Zone.*

Warm and muggy except in midwinter; cooler against the escarpment.

Temperature.

Average daily max.....	Jan 30° C (86° F)	July 23° C (73° F)
Extreme max.....	Jan. 43° C (109° F)	July. 35° C (95° F).
Average daily min.....	Jan. 18° C (64° F)	July. 8° C (46° F).
Extreme min.....	Jan. 7° C (45° F)	July. –2° C (28° F).

Rainfall.

Annual rainfall varies from 500 mm (20″) in the North East to over 1,900 mm (75″) against the escarpment; rainy season from November to March; max. in January. Frequent mist and drizzle against escarpment.

W. *Desert Zone.*

Irregular and little rain; large annual and diurnal temperature variation; West coast misty due to cold ocean currents.

Temperature.

Average daily max.....	Jan. 35° C (95° F)	July. 18° C (64° F).
Extreme max.....	Jan. 46° C (115° F)	July. 32° C (90° F).
Average daily min.....	Jan. 17° C (63° F)	July. 3° C (37° F).
Extreme min.....	Jan. 5° C (41° F)	July. –10° C (14° F).

Rainfall.

Varies from 25 mm (1″) along the westcoast to 250 mm (10″) inland. The coastal strip has winter rains, inland mainly autumn and summer rains

Sn. *Northern Steppe Zone.*

Semi-arid; large annual and diurnal temperature variation; summer rains.

Temperature.

Average daily max.....	Jan. 32° C (90° F)	July. 18° C (64° F).
Extreme max.....	Jan. 41° C (106° F)	July. 29° C (84° F).
Average daily min.....	Jan. 16° C (61° F)	July. 0° C (32° F).
Extreme min.....	Jan. 4° C (39° F)	July. –10° C (14° F).

Rainfall.

Average annual rainfall varies from 254 mm (10″) in the West to 500 mm (20″) in the east. The rainy season is at its height during late summer (Feb. and March).

Ss. *Southern Steppe Zone.*

Semi-arid. Large annual and diurnal temperature variation. Summer rains.

Temperature.

Average daily max.....	Jan. 31° C (88° F)	July. 16° C (61° F).
Extreme max.....	Jan. 41° C (106° F)	July. 27° C (81° F).
Average daily min.....	Jan. 14° C (57° F)	July. 1° C (34° F).
Extreme min.....	Jan. 2° C (36° F)	July. –11° C (12° F).

Rainfall.

Average annual rainfall varies from 250 mm (10″) in the west to 635 mm (25″) in the East; snow on the southern mountain ranges in winter. Rainy season mainly in summer; max. in March.

H. *Highveld Zone.*

Warm temperate monsoonal type of climate; dry winter.

Temperature.

Average daily max.....	Jan. 27° C (81° F)	July. 16° C (61° F).
Extreme max.....	Jan. 38° C (100° F)	July. 26° C (79° F).
Average daily min.....	Jan. 13° C (55° F)	July. 0° C (32° F).
Extreme min.....	Jan. 1° C (34° F)	July. –13° C (9° F).

Rainfall.

Annual rainfall varies from 635 mm (25″) in the West to 890 mm (35″) in the East. Snow in Winter on the Drakensberg, occasionally as far north as Lydenburg. Rain occurs mainly from October to March.

NT. *Sub-tropical semi-arid Savannah Zone.*

Sub-tropical semi-arid.

Temperature.

Average daily max.....	Jan. 31° C (88° F)	July. 22° C (72° F).
Extreme max.....	Jan. 42° C (108° F)	July. 31° C (88° F).
Average daily min.....	Jan. 18° C (64° F)	July. 4° C (39° F).
Extreme min.....	Jan. 8° C (46° F)	July. –7° C (19° F).

Rainfall.

Annual rainfall varies from 380 mm (15″) in the Limpopo-Sandriver valley to 710 mm (28″) against the Waterberg. Summer rainfall, November to March; max. in January.

S.W.A. & B.P. *South West Africa and Bechuanaland Zone.*

The Climate merges with that of the (Sn) Northern steppe and the (NT) Subtropical semi-arid savannah Zones; low irregular summer rains; and large annual and diurnal temperature variation.

Temperature.

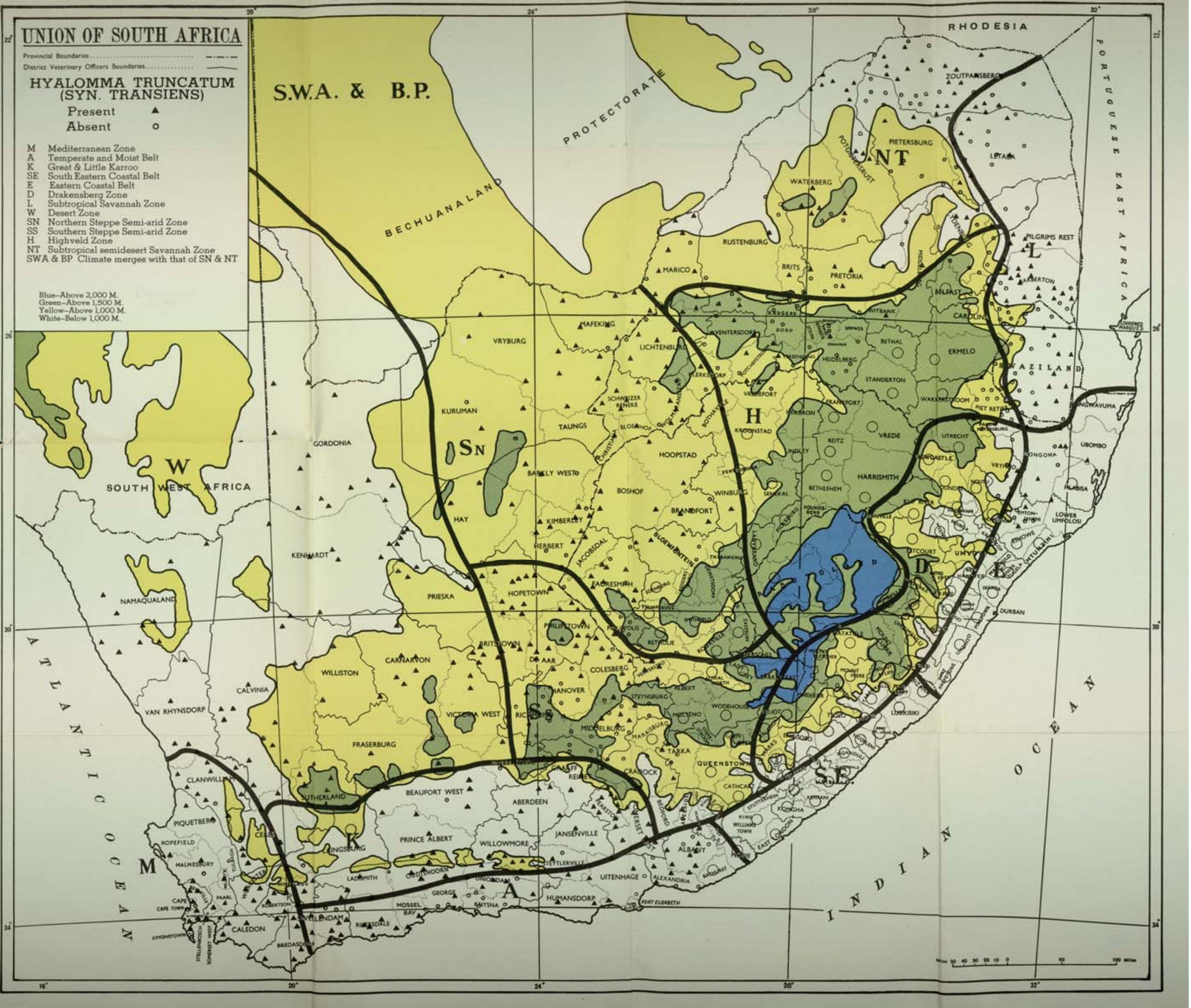
Average daily max	Jan. 31° C (88° F)	July. 24° C (75° F).
Extreme max.....	Jan. 42° C (108° F)	July. 32° C (90° F).
Average daily min.....	Jan. 18° C (64° F)	July. 5° C (41° F).
Extreme min.....	Jan. 7° C (45° F)	July. –9° C (16° F)

Rainfall.

Annual rainfall varies from 250 mm (10″) in the South West to 610 mm (24″) in the North. Rainy season mainly from December to March.

Southern S.W.A. falls under (W) Desert Zone.

Information taken from a *Weather Bureau Chart* issued as a Christmas Calendar, 1955.


UNION OF SOUTH AFRICA
Provincial Boundaries
District Veterinary Officers Boundaries
HYALOMMA TRUNCATUM (SYN. TRANSIENS)
Present ▲
Absent ○
M Mediterranean Zone
A Temperate and Moist Belt
K Great & Little Karroo
SE South Eastern Coastal Belt
E Eastern Coastal Belt
D Drakensberg Zone
L Subtropical Savannah Zone
W Desert Zone
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SS Southern Steppe Semi-arid Zone
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Blue–Above 2,000 M.
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S.W.A. & B.P.
BECHUANALAND
PROTECTORATE
RHODESIA
PORTUGUESE EAST AFRICA
SOUTH WEST AFRICA
SWAZILAND
ATLANTIC OCEAN
INDIAN OCEAN
W
SN
H
NT
L
D
E
SE
K
M
A
ZOUTPANSBERG
PIETERSBURG
LETABA
WATERBERG
RUSTENBURG
PILGRIMS REST
MARICO
BRITS
PRETORIA
MAFEKING
VRYBURG
LICHTENBURG
BETHAL
ERMELO
STANDERTON
KURUMAN
TAUNGS
SCHWEIZER RENEKE
HEIDELBERG
FRANKFORT
VREDE
WAKKERSTROOM
PIET RETIEF
UTRECHT
UBOMBO
GORDONIA
HOOPSTAD
KROONSTAD
REITZ
HARRISMITH
BARKLY WEST
BOSHOF
WINBURG
BETHLEHEM
BRANDFORT
HAY
KIMBERLEY
HERBERT
JACOBSDAL
KENHARDT
LOWER UMFOLOSI
PRIESKA
HOPETOWN
NAMAQUALAND
DURBAN
PHILIPSTOWN
BRITSTOWN
DE AAR
COLESBERG
WILLISTON
CARNARVON
CALVINIA
VAN RHYNSDORP
HANOVER
VICTORIA WEST
STEYNSBURG
WODEHOUSE
LUSIKISIKI
FRASERBURG
MIDDELBURG
TARKA
QUEENSTOWN
CATHCART
CLANWILLIAM
BEAUFORT WEST
ABERDEEN
SUTHERLAND
PIQUETBERG
PRINCE ALBERT
JANSENVILLE
WILLOWMORE
HOPEFIELD
MALMESBURY
LADISMITH
OUDTSHOORN
UITENHAGE
ALEXANDRIA
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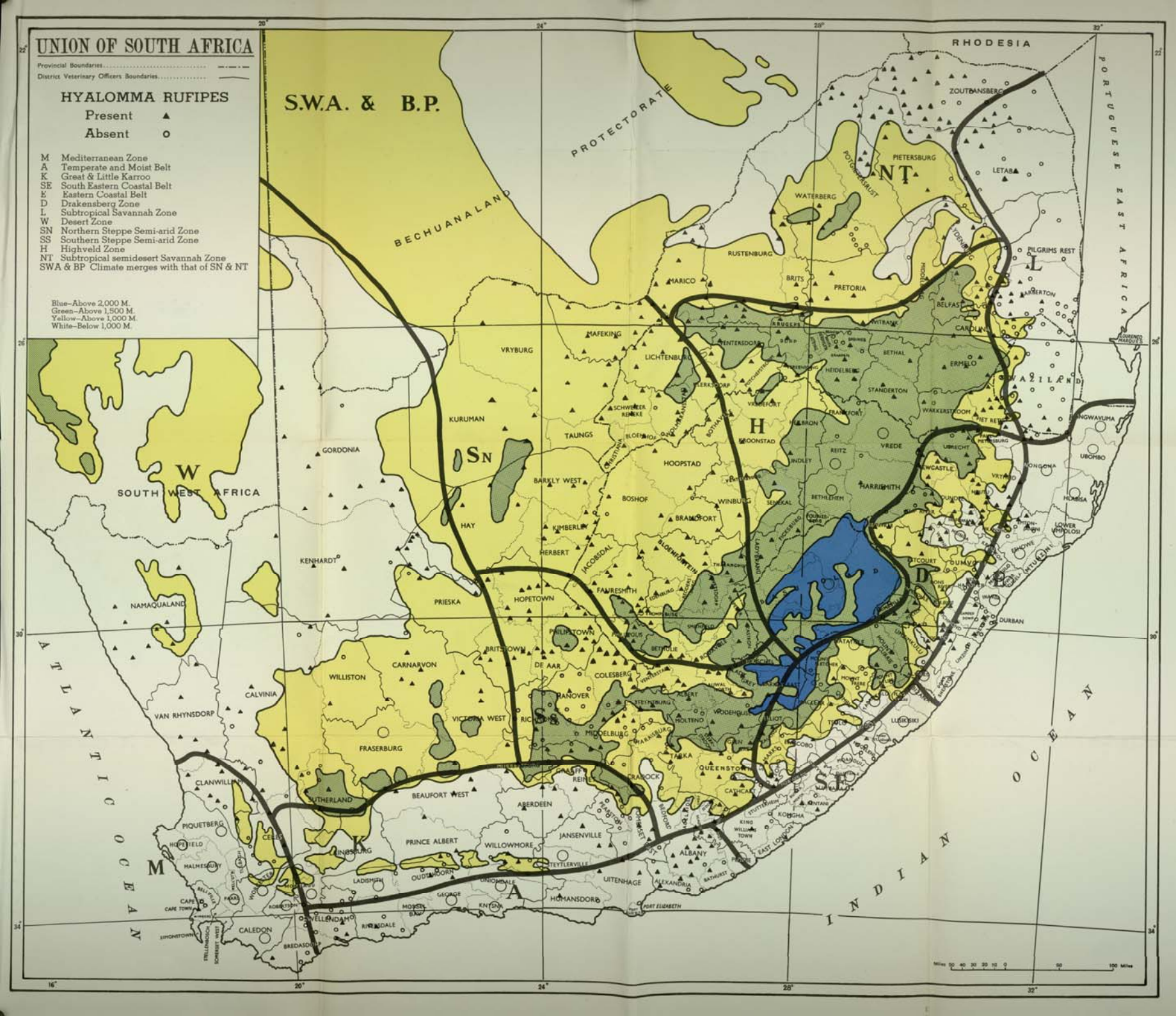
EAST LONDON
GEORGE
KNYSNA
HUMANSDORP
PORT ELIZABETH
CAPE
CAPE TOWN
ROBERTSON
SWELLENDAM
MOSSEL BAY
RIVERSDALE
CALEDON
BREDASDORP
SIMONSTOWN
STELLENBOSCH
SOMERSET WEST
PAARL
20°
24°
28°
32°
22°
26°
30°
34°
16°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KNYSNA
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LADISMITH
STRUISBAAI
MOSSEL BAY
DURBAN
PIETERMARITZBURG
LADYSMITH
NEWCASTLE
UMTATA
KOKSTAD
KING WILLIAMSTOWN
EAST LONDON
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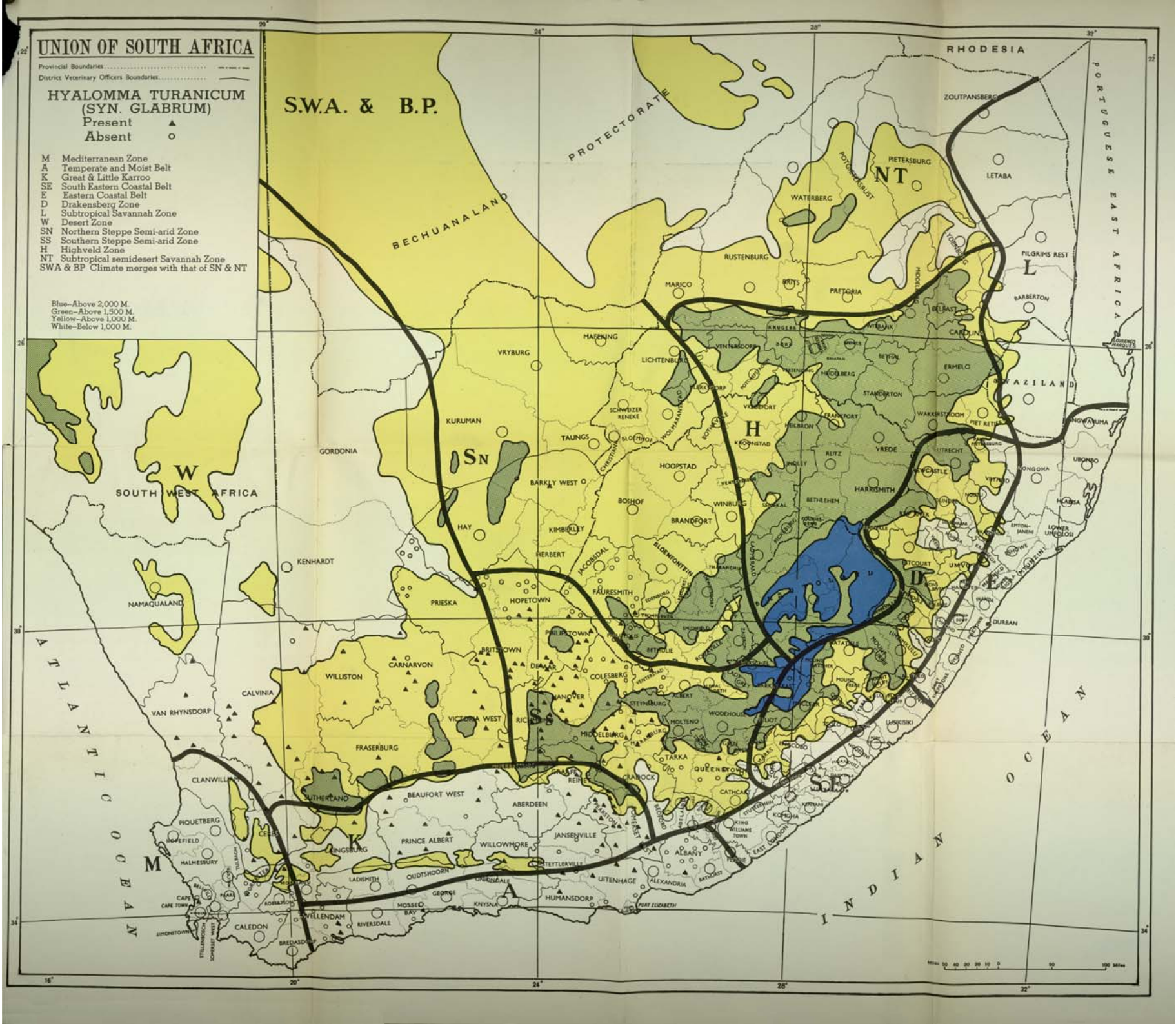
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