

Zoological Survey of the Union of South Africa. Tick Survey—Part I.

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PREFACE.

IN 1937 a tick survey of the Union was started as part of a general zoological survey. The object was to gain more detailed information about the occurrence and distribution, both geographical and seasonal, of ticks in South Africa. The method was briefly the following: The Government Veterinary Officers (who are distributed over the length and breadth of the country) were instructed each to divide his area into three or four blocks according to altitude, vegetation, rainfall etc. and to select in each block three or four farms. On these farms ticks were to be collected from all species of domestic animals at definite times during the four seasons of the year, and forwarded to Onderstepoort with all the necessary details in regard to the local conditions. Where collections had been incomplete at first they were supplemented subsequently by material collected at the appropriate season; supplementary collections were also made to reflect annual variations in rainfall.

Several thousand tubes of ticks were collected in this way. The task of studying this material was commenced by Dr. R. du Toit and was then entrusted to Dr. Gertrud Theiler, who will publish the results of this study in a series of articles. The species of tick which required immediate and special attention was *Amblyomma hebraeum*, the transmitter of "heart-water", in view of the seriousness of this disease and the strictly localized occurrence of the transmitting tick.

Dr. Theiler's first article in this series deals with this species and should prove to be of special interest to veterinarians and others in South Africa. The other species of ticks will be dealt with in subsequent articles.

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INTRODUCTION.

Nature and Scope of the Survey.

Faunal surveys, planned essentially for the mere plotting of the distribution of a particular group of animals are always at best but ecologically incomplete. The very nature of the present survey, in which the collecting

was carried out by numerous individuals, not one of them a trained ecologist, stationed in different parts of a large tract of country shewing a great range and variety of climatological, physiographical, biotic and other conditions, leaves much to be desired from the strictly ecological point of view. The setbacks to a properly controlled sub-continental survey are numerous; thus an officer already stationed for some considerable time in an area of control would experience no difficulty in dividing up his district into representative blocks, whereas one but recently appointed to an area would not be familiar with its vegetative zones and his division of his territory into collecting blocks would be faulty. Apart from the above unevenness in the parcelling out of collecting blocks, the human element as a collector is an added inequality (for some individuals just do not make good collectors). Nor are all officers always in a position to make systematic collections at the quarterly intervals, due to the greater importance of routine or of extra routine matters. Thus, to obviate and eliminate some of the grosser unevennesses from the final plotting and to check up on the suitability or on the completeness of the collections which were being sent in, trial plottings of three of the more prevalent species of ticks were carried out early on in the Survey. According to the findings of this preliminary survey further collections were called for from some areas to fill in apparent gaps in the vegetational zones or to check up on the human element as a factor, as well as to counteract the attitude "Ticks are scarce now, so no collections have been made this winter, the collections will be resumed again after the first rains when tick life will be more abundant".

In spite of the shortcomings inherent in such a generalized survey, it has nevertheless been possible in many instances to draw definite conclusions as to the factors encouraging or discouraging the increase of various tick species, and hence as to their distribution in South Africa.

The survey is based solely and entirely on the survey material sent in during the period September 1937 to June 1944, supplemented by material sent in for identification by farmers. Verbal statements are given no credence, for but few persons have a species-sense and too frequently the identification is not only inadequate but also inaccurate; and in any case the popular name, in most instances, is generic rather than specific. In this way some "valuable records" may be missed, but this loss is counterbalanced by the fact that no "misleading records" have been introduced, and by the fact that each record as it stands can be authenticated. Remarks to the effect that *Amblyomma hebraeum*, the bont tick, occurs on the highveld have been made, but as yet these have not been substantiated when specimens were called for from the farms or from the localities mentioned. The blue tick, *Palpoboophilus decoloratus*, is well known and correctly identified by most farmers, but nevertheless for any record to be entered the tick must be produced; for even here, with this well-known tick, inaccuracies may creep in as not all individuals are to be trusted, to wit, the individual who maintained that he was familiar with the blue tick and then furnished an engorged female with banded legs!

The very inequality of the collections make it difficult to interpret the results consistently. The ideal collection aimed at was four collections from each block spread over four consecutive seasons; but this could not always be done and the collections varied from the ideal four down to one, or worse still, none at all. In one district the officer concerned was able to send in a monthly

collection spread over fifteen months. The four-times collections in conjunction with the fifteen-times collection, gave, as it were, some standard of reliability of the three-, two- or one-times collections. In those instances where any one given species appears four times in the quarterly collections it can safely be assumed that the collection as a whole was adequate and that not only was a given tick present, but that it was also safely established in the area; if it occurs three out of four times then the same conclusions can be drawn as to the adequacy of the collection and as to the establishment of the tick; here the tick may be absent due to the fact that it shows periods during which it does not feed. But if the tick is present less frequently, then the interpretation is not so straightforward, and several explanations are possible; either the tick is present and established on the farm but the collecting was not too good (for some collectors are bad), or that the collection was adequate and the tick was but recently introduced and was not established, or that the tick had a long non-feeding period; further if the tick is absent in the neighbouring collecting areas then it is concluded that the record is one of a recent introduction. Cases where only one batch of specimens is sent in present the most difficulties, and the conclusions drawn from these records are hence the least reliable, for the absence of e.g. *A. hebraeum* may not be a true absence for the reasons enumerated above; however though one-times collections are most unreliable for recording the absence of a species, they are yet valuable for their positive records of the presence of the tick, and hence serve the main purpose of the survey, namely the plotting of the areas in which the tick has been proved to occur.

Despite the failings of the survey collections an attempt will be made, in this series of articles, to establish the ecological habitat of each species. As the ticks under review are limited to those parasitic on domestic stock the food question will not enter into the discussion as a possible limiting factor; this latter is to be sought under the environmental conditions, mainly those which affect the tick at its least resistant stages; i.e. the free living and moulting stages. These factors would be: (a) The soil, its texture, its pH values, its humidity and temperature; (b) sunlight, its intensity and duration; (c) air temperature, high or low, and the intensity or length of the periods of frost; (d) rainfall, its amount and its spread taken in conjunction with the length of the intervening dry periods (maps or data for the relative humidity of the air are not available); (e) the type of vegetation, and its blanketing effect on soil moisture, on the humidity of the air more immediately above the soil, on the intensity of the sunlight, and on the temperature fluctuations. Whilst the vegetation can be taken to be a summation of the climatological and physiographical factors of any given locality, and whilst it undoubtedly plays a major rôle in the life of any tick, it is, however, not necessarily the limiting factor. The spread of a tick within a vegetational zone may be limited, for example, by frost, by increasing aridity, by the pH concentration of the soil, etc.

As yet but little is known as to the behaviour of ticks under field conditions. All that is known as to the length of their feeding times, their developmental and their survival periods has been obtained under laboratory conditions having a regulated even temperature and a constant humidity. These laboratory life-histories, averaging a rather higher humidity than is prevalent over most parts of the Union, will undoubtedly not reflect the true length of the developmental periods, for it is well known that with every rise in temperature there is a shortening of the developmental periods

in cold blooded animals, whereas at low humidities there may be a tendency towards a lengthening of the life-cycles. Despite the probable discrepancies between laboratory and out-of-doors life-histories, the laboratory life-histories are nevertheless useful as an indication of what could happen in nature when developmental conditions approach the ideal. These laboratory times will not be included in this article, but will be given in a later publication.

There is a tendency amongst modern systematists to look for and to create geographical subspecies and varieties. For the purposes of this survey, which in its essentials is an economic survey of disease carriers and of disease transmitters, the classification has been kept as simple as possible; thus anything that looks like *R. capensis*, is recorded as *R. capensis*, despite the fact that the *R. capensis* occurring in the arid regions of Namaqualand does shew slight differences from that found in the Eastern Province. The species dealt with in this article will be described in detail in a later work, when this question of subspecific and geographic variations will be discussed.

The accompanying maps give the average yearly rainfall; the major vegetational zones, and the average length of the yearly frost periods. Further it may be noted that the Union is on the whole a high lying country, as some 40 per cent. of the area is within the 4,000 ft. contour. The country is divided by a well marked escarpment into a great interior plateau, and a much diversified tract of country lying between the escarpment and the oceans on the east, on the south and on the west. Due largely to its structure the mean annual temperature over the greater part of the Union is extraordinarily uniform. The warmest parts in the Union are in the valleys of the Orange and the Olifants rivers on the West coast, and of the Komati, Tugela, Great Fish and other rivers on the East coast. The relative humidity of the air of the Union, for which charts are as yet not available, is highest towards the end of February and the beginning of March, after which it falls rapidly to the middle of September and then starts to rise.

PART I.

DISTRIBUTION OF *AMBLIOMMA HEBRAEUM*, THE HEARTWATER TICK.

General distribution.

To obtain a correct picture of the distribution of *A. hebraeum* it is perhaps best first to give a statement in general terms of political divisions and then to follow this up with an analysis of these generalizations.

Roughly *A. hebraeum* occurs throughout the Transvaal, north of a line drawn from Zeerust through Pretoria to Middelburg i.e. to the north of the Magaliesberg Range; to the west of the Transvaal it peters out in Bechuanaland, to the north of the Transvaal it is found in Southern Rhodesia, where it exists as an introduced tick [Jack, 1942, (Rhodesian Agric. Jnl. 39) lists it as present in certain parts of the following districts: Charter, Ndanga, Chibi, Victoria, Nyamadholvu, Bubi, Insiza, Mzingwane, Gwanda, Matobo, Gulalima-Mangwe, Bulawayo and Belingwe]; to the east of the Transvaal it is present in the *lowveld* regions of Portuguese East Africa, south of the tropic of Capricorn with an odd record or two from near Tete on the trade and cattle route across the Zambesi. From the north eastern Transvaal it extends southwards through the Barberton district and through Swaziland, along the coasts of Natal and of the Native

Territories into the Eastern Province, where it peters out in the strip of karroid veld at the level Port Elizabeth-Pearston. In these districts to the east of the Drakensberg range, it is present in what is locally referred to as the "lowveld" and in the "middleveld", but dies out in the "highveld". It appears to have established itself in the Mossel Bay area, especially along the little Brak River.

It must be stressed that the above is but a general statement and that the tick is not solidly present in all these districts; on the contrary in many regions in these districts it is absent; thus large tracts of Natal and of the native territories' "lowveld" and "middleveld" are quite free of *A. hebraeum*.

To aid in reading the distribution picture of the tick, the records are plotted on a vegetation map. (Botanical Survey Memoir 15, 1935) which is superimposed in outline on a topographical map, and on which the political districts are faintly outlined to assist in the orientation of the collecting areas, for it was clearly seen early on in the survey that individually temperature, altitude, rainfall, and soil did not affect the tick directly, but that they made themselves felt indirectly in so far as they influence the vegetation, and that it is the nature of the plant-covering which played the most important role in encouraging or inhibiting tick-survival; except possibly westwards where the increasing aridity of the *Bushveld* seems to be the deciding factor.

Distribution in Vegetational Types.

The vegetation map shows *A. hebraeum* to be present in:—

(1) All three types of South Africa's Parklands:

- (a) *The sub-tropical evergreen and deciduous tree and thorn forest* present in the Transvaal to the north of the Zoutpansberg and extending as the *lowveld*, through the Kruger National Park as an ever narrowing strip, to peter out at the level of the Tugela River in Zululand. This type of vegetation extends into Southern Rhodesia and into Portuguese East Africa.
- (b) *The evergreen and deciduous tree and bush veld* forming a narrow strip, known as the *Bankenveld*, stretching from Zeerust, through Pretoria to Middleburg, then swinging north and widening out in the westerly and north-easterly direction of the *Limpopo Highlands*.
- (c) *Thorn country* or "*mak bosveld*". Although it seems to be prevalent in this vegetational zone in the Transvaal, yet in the tracts of Bechuanaland immediately bordering on the Transvaal it seems to be very rare indeed, dying out completely westwards; in the southward extension of the "*mak bosveld*" into the Orange Free State and down to Kimberley it is entirely absent, except for one odd record from the Hoopstad district.

(2) But two of the three types of *Forest zones*:

- (a) *The evergreen deciduous bush, and sub-tropical forest* fringing the coast as far South as Port Elizabeth.

- (b) The patches of *temperate evergreen forest* scattered mainly in the eastern grasslands, with a large "outlier" forming the Knysna and the Zitzikama forests; in this latter "outlier" however, it is confined to the neighbourhood of the Little Brak River, where the *temperate forest* merges with the *Evergreen Sclerophyllous bush*, so characteristic of the Western Province.
- (3) The broad band of *tall-grass* lands lying to the east of the Drakensberg, and referred to as the *eastern grasslands*, extending from the Barberton district in the Eastern Transvaal to the Pearston-Port Elizabeth line. When present it is present in what is locally known as the "lowveld" and the "middleveld". Its distribution in this zone is very irregular as compared with that in any one of the Parkland zones. Nor is altitude the deciding factor. In the *Parklands A. hebraeum* survives up to 4-5,000 ft. or more, in the *tall grasslands* it tends to die out much sooner, the "middleveld" only going up to 3,000-3,500 ft. or frequently not even so high.

A careful comparison of the farms in these *eastern grasslands* shews the ticks to be liable to be present on those farms containing *scrub or bush* (*thorn bush* is rapidly encroaching in many regions of Natal, bringing *A. hebraeum* in this wake), and to be absent invariably on farms devoid of *scrub* and *bush*. Thus in the native territories which are bare of *trees* or *scrub* the tick is only recorded from localities situated on rivers, especially along the larger rivers which have bush in the kloofs along their banks.

The vegetation map, though accurate enough in its main divisions, is a bit misleading in some instances; thus, for example, not enough allowance is made for the extension inland of the typical *Karoooid scrub* of the Albany district, the *Fish River Bush* type of vegetation, along the Sundays River extending into and beyond the Lake Mentz depression into the Jansenville district, so that these records which, according to the map, occur on typical Karroo, are in actuality in the *Karoooid scrub* and are hence not out of their environment at all.

The same remark as to the extension inland of the rivers holds for the *highveld* in the Lydenburg and in the Barberton districts where the *Acacias* and other *trees* follow the rivers up on to the *Highlands*. In these *highveld* areas the distribution picture is further confused by the local practice, as carried out by many farmers, of trekking with their cattle into Swaziland or the *lowveld* for the winter grazing and of returning to the *highveld* for the summer months.

The vegetation map shews *A. hebraeum* to be absent from:—

1. The *desert shrub* areas.

- (a) The western, more *arid areas of the bushveld* extending through Bechuanaland into South-West Africa.
- (b) The *Desert shrub* areas of the *Karoo*.
- (c) *Desert succulents and desert grass* areas of Namaqualand, Bushmanland and South West Africa.

- (2) The *evergreen sclerophyllous bush* typical of the Western Province and extending along the coast line eastwards to the Gamtoos River mouth.

(3) The *grass lands*.

- (a) The *short grass* forming the *Highveld*, extending from the level Stormberg-Dordrecht-Barkly East through Basutoland and the eastern Orange Free State and the south-eastern Transvaal into the Sabie area where it gradually tapers away.
- (b) The *mixed grassveld* forming the *middleveld* of the central and of the northern Orange Free State and of the southern Transvaal, ending on the southern slopes of the Magaliesberg.

Recent Introduction.

The two odd records, the one from the Oudtshoorn district and the other from near Vrededorp in the Northern Orange Free State must be looked upon as recent introductions which in all probability will not survive more than one summer season.

Remarks on the separate Government Veterinary Officer-control areas.

These remarks must be read in conjunction with maps 1, 2 and 3.

Area 1, G.V.O., Johannesburg.

This area lies mostly in the *mixed grass zone or middleveld*, with the S.E. corner of Heidelberg in the *short grass* of the *highveld*, and the N.W. corner of Krugersdorp in the *evergreen and deciduous tree and bush* of the Bankenveld.

A. hebraeum is present in the N.W. corner of Krugersdorp, but absent everywhere else. It has been reported near Benoni, but repeated requests for specimens have so far been without results, so there is no confirmation that it is established at Benoni. It would seem that the tick, if introduced, does not survive.

Area 2, G.V.O., Potchefstroom.

This area lies mostly in the *mixed grass zone or middleveld*, with the northern corner of Schweizer Reneke, the southern corner of Bloemhof and southern Christiana in the *thornveld or makbos veld*.

A. hebraeum is absent throughout, but if introduced into the dry *bushveld* areas it might become established.

Area 3, G.V.O., Mafeking.

The eastern portions are mainly *mixed grass or middleveld*, the western portion *thornveld* with a strip of *Bankenveld* in the south of the Marico district. *A. hebraeum* is present throughout the Marico district except in one collecting area where a 14-day summer-dipping practice is carried out. It is absent in the south Lichtenburg *bushveld*; and present or absent in the Mafeking *bushveld*. It seems to be but precariously established in these *Bushveld areas*; thus at B2 it is present despite dipping, and absent at B1, where there is no dipping. The specimens sent in from Digatlong, the farmer reported to be the first he had seen for twenty years. Further to the west it is quite safe to assume that it is absent in the *Kalahari Bushveld*. Judicious dipping should easily prevent the tick from becoming established in the areas under the control of the G.V.O. of Mafeking.

Area 4, G.V.O., Potgietersrust.

Mainly *thorn country* or *makbosveld* with incursions of *evergreen deciduous tree and bush* or *Bankenveld*. *A. hebraeum* is solidly present throughout. The dipping is irregular or not carried out at all; even on farms where dipping is carried out the tick is still present. The collections from this area were carried out monthly over a period of 15 months and hence they give reliable information as to possible seasonal variations.

Area 5, G.V.O., Pietersburg.

Ranging from *Bankenveld* through *makbosveld* to *subtropical evergreen and deciduous tree and thorn forest*, including *Mopani* in the north towards the dry Limpopo regions. *A. hebraeum* is solidly present throughout except (a) on two farms at the foot of the Magoebas Kloof Mountain in the Tzaneen district i.e. Dieplaagte and Runnymede; (b) on a farm near Letsitele in the *lowveld*. Only one collection, however, has been sent in from these farms, so that the chances are that the tick is present.

Area 6, G.V.O., Zoutpansberg.

Mainly *subtropical evergreen and deciduous tree and thorn forest* with the *evergreen and deciduous tree and bush* in the mountains. *A. hebraeum* is solid throughout; despite regular dipping it has not been dipped out. Its numbers in the Sibasa area, at the foot of the mountains, however, seem to have been considerably reduced. The rainfall in this area ranges from 75 in. in the Zoutpansberg to 10 in. on the Limpopo.

Area 7, G.V.O., Barberton.

Three vegetational zones meet in this district namely the *subtropical evergreen and deciduous tree and thorn forest* of the *lowveld*, the *tall grass of the eastern grasslands*, and the *short grass* of the *highveld*, with incursions of the *lowveld* along the rivers into the "middleveld" *grass lands*, which contain *thorn bush*, and with similar incursions along river beds of the *thorn trees* on to the *highveld*. Though the distribution picture of *A. hebraeum* is here somewhat confused one can nevertheless state roughly that it is present in the *Lowveld* and in the "middleveld" *tall grass* and absent in the *highveld*. It is unexpectedly absent on some farms in the "Middleveld" *tall grass* on the White River plateau, 3,000-3,500 ft. with a 7-14 day dipping interval; as also in the Sabie ward, 2,800-3,800 ft., and in the Schoemanskloof area, 3,500-3,800 ft., and in the Elands River valley area, 3,000-3,600 ft., with a 7-14 day dipping interval. Some of these farms are *grass veld* and have bush only in the kloofs, whilst others have bush, though rare, on the veld. If the cattle do not have access to the kloofs then these farms could be considered as pure *grass veld* in which case *A. hebraeum* would not be expected. In some instances the presence of the tick on one or two *highveld* farms is undoubtedly due to the practice of trekking to the *lowveld* for winter grazing. That the tick, when introduced on these *highveld* farms, can maintain itself is questionable.

Area 8, G.V.O., Piet Retief.

A. hebraeum is absent on the *highveld* of Wakkerstroom and on *grass veld* of the "middleveld" to the west of the Swaziland border, most of which farms are *grass veld*, with but scattered thorn trees, carrying sheep;

and with dipping intervals of 7-14 days, and extensive veld-burning (phosphorus and protein deficient vegetation). The tick is also absent in the adjoining tank areas in Swaziland. Otherwise it is solidly present in the *grassland* areas to the south of Swaziland and where bush is not so rare. In some instances the movement of stock en route to Piet Retief may introduce *A. hebraeum* on to the *tall grass* farms and thus confuse the distribution picture slightly.

Area 9, G.V.O., Lydenburg.

Nearly all types of vegetational zones are represented ranging from the *lowveld*, through the three types of *grass lands*, through the *Bankenveld* to the *thorn country* or *makbosveld*.

A. hebraeum is absent on the *highveld* of Belfast; it is present on the *lowveld* areas of Pilgrims Rest, in the *Bankenveld* areas of Middelburg and of Lydenburg and in the *makbosveld* of Lydenburg. It is present on two farms, both lying at an altitude of over 5,000 ft., in the Lydenburg district. One farm 9.A.7 sends stock to the *lowveld* for winter grazing, dipping periods 7-0days; the other 9.A.2 apparently only has local trekking, and probably has become infected as a result from some neighbour who sends his cattle to the *lowveld*. Whether the tick has become established or not on either of these farms, it is difficult to say, it is reported twice, in both a summer and a winter collection, in each instance.

Area 10, G.V.O., Ermelo.

The area consists of *tall grass* along the strip of country edging the Swaziland border rising to the *highveld*, the altitude of which is mostly over 5,000 ft.

A. hebraeum is absent in the *highveld* of both Carolina and Ermelo; it is also absent in the "middleveld" *grass veld* stretch which apparently is devoid of bush. In this it agrees with the adjoining tank areas in Swaziland and with the strip of Piet Retief also bordering upon Swaziland. If *thorn bush* were to encroach into these areas, *A. hebraeum* would doubtlessly be able to establish itself.

Swaziland.

The vegetation ranges from *subtropical evergreen and deciduous tree and thorn forest* of the *lowveld proper*, through the "middleveld" *tall grass lands* with *thorn bush*, to the higher lying mountainous parts (3,000-3,500 ft.) of the "middleveld" of *open grass lands*.

A. hebraeum is present in the Eastern two thirds of the territory i.e. *lowveld* and *thornveld plus tall grass veld*, and absent in the western third which is mountainous, with more open grass lands and some bush (the line of demarcation is even and clear cut between the presence and the absence of the tick). The adjoining regions of areas 8 and 10 also shew this absence of *A. hebraeum*.

Portuguese East Africa.

The tick is very common in the districts of Lourenço Marques and of Inhambane i.e. roughly south of the *Tropic of Capricorn*. Northwards its place is taken by *Amblyomma variegatum*, except for two records, one at Teie and at the Porte-deMassinga at the mouth of the Zambesi, both localities on well established trade and cattle routes.

Area 11, G.V.O., Pretoria.

In the Southern portions, i.e. to the South of the Magaliesberg, the vegetation is *mixed grass* or the *botanical middleveld*; the northern portions are *evergreen and deciduous tree and bush* of the *Bankenveld*.

Though the collections from this area of control are but poor, it was nevertheless possible to conclude that *A. hebraeum* is absent from the *mixed grassveld* and present in the *Bankenveld*.

Area 12, G.V.O., Rustenburg.

The southernmost borders lie in the *mixed grass lands* or the *middleveld*, this is followed by a band of the *Bankenveld*, *evergreen and deciduous tree bush*; the rest to the north is *thorn country* or *dry bushveld*, with a slight incursion to the east of Thabazimbi of the *evergreen and deciduous tree and bush* of the Zoutpansberg range.

In most instances only one collection was sent in, so that the absence of *A. hebraeum* from any given farm is not significant. It is assumed that it is absent from the southernmost *middleveld* strip, but present throughout *Bankenveld* and the *bushveld*. Dipping?

Area 14, G.V.O., Vryheid.

Mainly *tall grass* of the *eastern grass lands*, rising in Paulpietersburg to the true *highveld*. *A. hebraeum* is present in the "lowveld" and "middleveld" with *thornbush* of Vryheid, Babanango and Ngotshe. It is absent in the *open grassveld* of Paulpietersburg, with its wattle plantations. 7-Day dipping is practised throughout, but there is no evidence that the tick has been dipped out on any one farm.

Area 15, G.V.O., Dundee.

It is situated mainly in the *tall grass* areas of the "middleveld", rising to true *highveld* in the Utrecht and Newcastle districts.

A. hebraeum is absent in the *highveld* areas, except in one instance where its presence can definitely be attributed to trekking from other regions. It tends to be absent in the *open grass lands* and present in the *thornveld*. The evidence seems to point to its having been dipped out in some *thornveld* areas, e.g. in Utrecht and Dundee.

Area 16, G.V.O., Ladysmith.

A. hebraeum is present in the "middleveld" *thornveld* of Weenen; and absent in the *grass veld* of Klipriver and of Bergville which districts are higher "middle veld" rising to *highveld*.

Area 17, G.V.O., Estcourt.

It is situated mainly in the *tall grass* and higher regions of "middleveld" rising to *highveld*.

A. hebraeum is absent in the *highveld* and in the *open grass lands*; it is present on the *scrubveld* of the Tugela river; 7-14 days dipping period.

Area 18, Pietermaritzburg.

The area ranges through the *tall grass* lands of the "middleveld" to the *highveld* in Impendhle.

A. hebraeum is absent not only in the *Highveld* and the *grass lands* of the "middleveld" but also absent from the lower lying *thornveld* areas.

The collections from this area are very good, so that the absence of *A. hebraeum* can be assumed to be a true absence, and further it could be assumed that in the *thornveld* area the 7-14 day dipping played a role in the elimination of the tick.

Area 19, G.V.O., Greytown.

The collections were inadequate; *A. hebraeum* is apparently absent even in the lower lying "middleveld" (as is actually the case in area 18). It is recorded but once from a *thornveld* farm. Dipping 7-14 day period.

Area 20, G.V.O., Ixopo.

The vegetation ranges from the lower lying *tall grass* of the "middleveld" of Ixopo through the higher "middleveld" of Polela to the *Highveld* of Underberg.

A. hebraeum is present in the "middleveld" *thornveld* of Ixopo, though absent on few of these *thornveld* farms. It is absent on the open *tall grasslands* and on the *highveld* of Polela and of Underberg. The 7-14 day dipping practice may be responsible for the elimination of *A. hebraeum* from some of the *thornveld* farms.

Area 21, G.V.O., Port Shepstone.

A. hebraeum is present in the coastal and in the Sugarcane belts. It is absent from the *tall grass* lands of the Harding district and from the open *tall-grasslands* of "middleveld" generally.

Area 22, Eshowe.

Vegetation ranges from the coastal strip of *evergreen and deciduous bush and sub-tropical forest* through the true *lowveld* or *sub-tropical evergreen and deciduous tree and thorn forest* to *tall grass*.

A. hebraeum is present in the *coastal strip* and in the *lowveld* and in the *scrub veld* of the "middleveld" grasslands. It is absent in the *open grasslands* of the "middleveld". It is also absent on a few *scrub-veld* farms, where it can be assumed that the 7-14 days dipping plays a role.

Area 23, G.V.O., Nongoma.

The area lies mainly in *subtropical evergreen and deciduous tree and thorn forest* with some parts in *tall grass*, and with a narrow strip along the coast in *subtropical forest*.

A. hebraeum is present throughout both in the *lowveld* and in the *thornveld* of the *grasslands*. Dipping is carried out at the 7-14 day intervals, and though the stock is stated to be remarkably tick-free, yet *A. hebraeum* has not been dipped out on any one farm.

Area 24, G.V.O., Durban.

It consists of a narrow coastal strip of *sub-tropical forest*, for the rest the vegetation is of the *tall grass* type.

A. hebraeum is present in the *coastal strip* of forest but absent in the *tall grass lands*; it is also absent from some farms on the *scrubveld* of the coastal strip. Dipping is carried out at the seven day interval. This extraordinary absence of *A. hebraeum* is shared with the adjoining area 18, G.V.O. Pietermaritzburg and area, 19, G.V.O. Greytown.

Areas 26 and 27, G.V.O., Umtata.

They range from the coastal strip of *subtropical forest* through the "lowveld" and "middleveld" *tall grasslands* almost into the *highveld*. The district consists mostly of grassy planes, in some places with thorn bush, intersected by rivers running from the escarpment to the sea. These river banks are usually well-wooded or carry a fair amount of scrub.

A. hebraeum is absent throughout the *grasslands* and the few *thornveld* areas and it is even absent from the *coastal strip*. It is recorded from some farms along rivers e.g. the Kei- and the Bashee-Rivers.

Dipping is mostly carried out at the 7 day interval, in some instances at the 14 day interval. It is unquestionable but that dipping is assisting in eliminating the tick in this area. Added to the fact that conditions are apparently very favourable for the survival of *A. hebraeum* in the thickets along the river beds, is the fact that on dipping days some cattle may be overlooked and hence help to keep the tick alive in these kloofs.

One of the best organised collections was sent from here.

Area 28, G.V.O., Butterworth.

The area consists mainly of *tall grasslands* with a narrow coastal strip of *subtropical forest*.

Compared with the above two native territories i.e. Areas 26-27, tick life is abundant. *A. hebraeum* tends to be absent in the *open grasslands*, and is present wherever *bush* or *scrub* is reported. It is most abundant along the river courses. The dipping interval of 14-28 days would seem to be totally inadequate.

Area 29, G.V.O., Flagstaff.

It is mainly *tall grasslands* with a narrow coastal strip of *subtropical forest*. The *grasslands* are mostly open grass lands, some of the collections, however, are from *grasslands* with *thornbush*, or *scrub*.

A. hebraeum is absent throughout, except for one record 29 A.2 which is *open grassveld*. The regular dipping has undoubtedly assisted in the disappearance of the tick.

Area 30, G.V.O. Kokstad.

The area lies mainly above 3,500 ft., with the more open *tall grassveld* of the higher "middleveld" rising up to the *highveld*. Along the rivers scrub thickets or even natural forests may be present.

A. hebraeum is absent throughout, even along the river beds. In the lower lying Umzimkulu district dipping is at the 7-14 day interval; over the rest of the area the dipping interval is 14 days during summer, but is suspended during winter when frost and snow are registered.

Area 32, G.V.O., Queenstown.

The area lies mostly above 3,500 ft., the vegetation varying from the *tall grassveld* of Cathcart through the hilly regions to the *Highveld* of the Stormberg, and to the *Karoo* areas in the Tarkastad district.

A. hebraeum is present in the "middleveld" *thornveld* of Cathcart and along the Kei River up to an altitude of 3,500-4,000 ft. It is absent from the *tall grassveld* of the mountainous areas, and from the *Karoo* farms of Tarkastad.

It is *absent* also from a few "middleveld" *thornveld* farms, all however lying fairly high. Dipping is carried out at 14 day intervals.

Area 33, G.V.O., East London.

This is a narrow coastal band of *evergreen and deciduous bush* and *sub-tropical forest*, but mainly *tall grasslands*, and some large rivers with thickets along their banks.

A. hebraeum is present throughout, the vegetation being largely "middleveld" with *thorn or scrub*: it is even present on farms which are described as *open grassveld* (the local G.V.O. states that *A. hebraeum* is not seen on those farms which maintain a 7 day dipping interval).

The dipping, as carried out in this area, is quite inadequate, for, as stated above, *A. hebraeum* has been able to maintain itself on open *grassveld*.

Area 37, G.V.O., Oudtshoorn.

The area consists of a narrow strip of *temperate evergreen forest* along the coast, including the Knysna and the Zitzikama forests, followed by a band of *evergreen sclerophyllous bush* or *Western Province flora* and, beyond the Langeberg and the Outeniqua range, *desert shrub* or *karoo veld*, with *sclerophyllous bush* once again in the Groot Swarteberge range.

A. hebraeum is absent throughout all three vegetational zones. It has, however, succeeded in establishing itself along the Little Brak River and in the Brandwacht and the Gonna Kraal areas of the Mossel Bay district. These localities lie in the transition area where the *Western Province flora* merges into the *temperate evergreen forest*. The odd record from Lategan's Vlei in the Oudtshoorn district, is from a farm described as a *Karoo Gwarrie* and *thornveld* farm in the foothills of the Groote Swarte Berg. This is in all probability an introduction which will not be able to maintain itself.

Area 39, G.V.O., Port Elizabeth.

In this area the coastal strip of *subtropical forest* peters out and there is a general meeting and intermingling of *tall grassveld*, *desert shrub* or *Karoo veld* and of the *Western Province sclerophyllous bush*.

The *Karrooid scrub*, so characteristic of the Great Fish River and which is usually referred to as *Fish River bush*, is to be found along most of the Rivers in this area, where it often extends far inland e.g. up the Sundays river, well beyond Lake Mentz in the Jansenville district. The distribution as plotted on the vegetation map thus appears somewhat more confused than it actually is.

A. hebraeum is present wherever this *Karrooid scrub* invades the other vegetational zones. It appears, however, to be present in *sclerophyllous bush* in the Humansdorp district independently of a river; the records for the Jansenville district and which on the map appear to be in typical *Karoo veld*, are to be looked upon rather as being in an area where the *Fish River bush* has made a deep incursion into *Karoo veld*. It is absent in the typical *Karoo veld* of Steytlerville and of the Northern parts of Jansenville. It is present in the *Zuurveld* or *Western Province vegetation*, of Port Elizabeth and of Humansdorp. There is one odd record from a farm on the northern side of the Baviaanskloof Mountains which is in typical *Karoo veld*, this may represent a recent introduction and the tick in all probability will not be able to maintain itself here.

Area 40, G.V.O., Grahamstown.

This is a narrow coastal strip of *subtropical forest*, mainly *tall grass veld*. The area is very broken up by numerous larger or smaller rivers. The banks of all of these rivers are clothed with thickets of a *Karrooid-like scrub*, which is generally referred to as the *Fish River Bush*; these rivers reach far back into the surrounding mountainous areas, taking their scrub vegetation with them.

A. hebraeum shows its densest distribution of all the *Eastern grasslands* in this area of control. It is present throughout, even appearing in the incursions of *Karoo veld* into the Albany district, and reaching right up to the top of the Hogsback. The dipping as carried out (14 day period), is anything but conscientious and is quite inadequate.

The collections from this area of control were excellent, so that any conclusions drawn from them are reliable.

Area 41, G.V.O., Middelburg.

The area consists mainly of *desert shrub* or *Karoo veld*. The one odd record from near Hofmeyr is in all probability but a recent introduction, or has come up one of the tributaries of the Great Fish River.

Area 47, G.V.O., Bedford.

This lies partly in the *tall grass* area, rising to the highlands of the Great Winterberg to the north and merging into the *Karoo* plateau to the west, with incursions of the *Karrooid scrub* of the Fish River and its tributaries well up into the mountainous areas and way back into the *Karoo* plateau.

A. hebraeum is liable to be present on the mountain *grass veld* and throughout the lower lying areas south of the Great Winterberg and of Bruintjieshoogte. It is absent in the *Karoo* areas of Somerset East, Pearston and Cradock. Here it may be present where the *Karrooid scrub*-covered rivers stretch back into the *Karoo veld*.

UNION OF SOUTH AFRICA

- Provincial Boundaries: - - - - -
- District Veterinary Officers Boundaries: ———
- VEGETATION —
- FOREST.**
- Evergreen and deciduous bush and sub-tropical forest: ———
 - Temperate evergreen forest: ·····
 - Evergreen sclerophyllous bush: 1000000000
- PARKLAND.**
- Evergreen and deciduous tree and bush: - - - - -
 - Sub-tropical evergreen and deciduous tree and thorn forest: ———
 - Thorn country: ·····
- GRASSLAND.**
- Tall grass: ~~~~~
 - Short grass: ———
 - Mixed grass: ———
- DESERT SHRUB.**
- Thorn country and desert shrub: ·····
 - Desert shrub: ———
 - Desert succulents and desert grass: - - - - -

Average duration of the sharp frost period 27° F. in days.

80

90



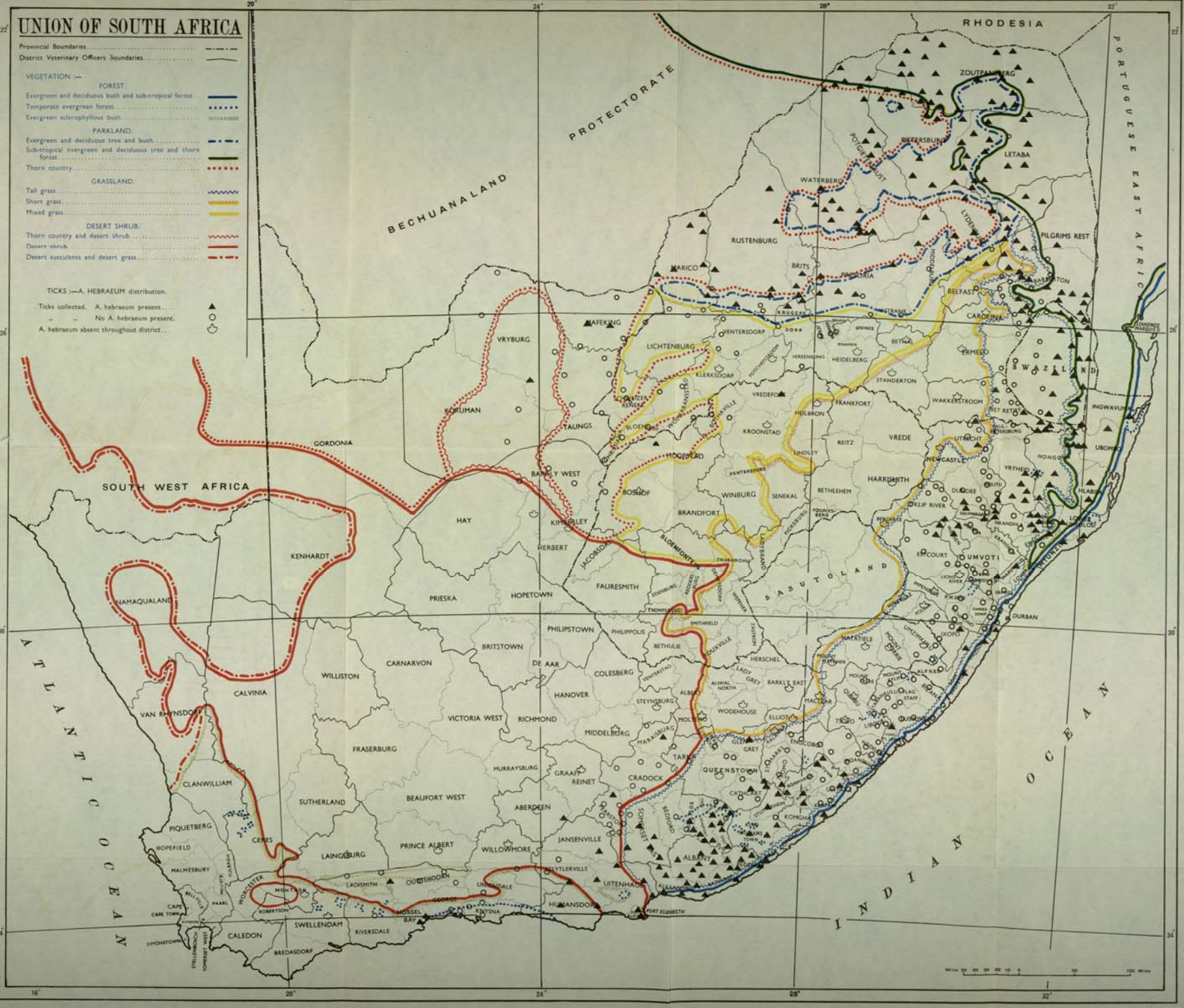
Miles 100 40 30 20 10 0 10 100

UNION OF SOUTH AFRICA

- Provincial Boundaries: ————
 District Veterinary Officers Boundaries: - - - - -
- VEGETATION —
- FOREST**
 Evergreen and deciduous bush and sub-tropical forest. ————
 Temperate evergreen forest. ······
 Evergreen sclerophyllous bush. ————
- PARKLAND**
 Evergreen and deciduous tree and bush. ————
 Sub-tropical evergreen and deciduous tree and thorn forest. ————
 Thorn country. ······
- GRASSLAND**
 Tall grass. ————
 Short grass. ————
 Mixed grass. ————
- DESERT SHRUB**
 Thorn country and desert shrub. ————
 Desert shrub. ————
 Desert succulents and desert grass. ————

TICKS — A. HEBRAEUM distribution.

- Ticks collected. A. hebraeum present. —○—
 " " " " No A. hebraeum present. —○—
 A. hebraeum absent throughout district. —○—



Scale: 1:100,000
 0 10 20 30 40 50 60 70 80 90 100 Miles

UNION OF SOUTH AFRICA

- Provincial Boundaries: ————
District Veterinary Officers Boundaries: - - - - -
- VEGETATION —
- FOREST**
- Evergreen and deciduous bush and sub-tropical forest: [Blue wavy line]
 - Temperate evergreen forest: [Blue dotted line]
 - Evergreen sclerophyllous bush: [Blue dashed line]
- PARKLAND**
- Evergreen and deciduous tree and bush: [Green wavy line]
 - Sub-tropical evergreen and deciduous tree and thorn forest: [Green dotted line]
 - Thorn country: [Red dotted line]
- GRASSLAND**
- Tall grass: [Yellow wavy line]
 - Short grass: [Yellow dotted line]
 - Mixed grass: [Yellow dashed line]
- DESERT SHRUB.**
- Thorn country and desert shrub: [Red wavy line]
 - Desert shrub: [Red dotted line]
 - Desert succulents and desert grass: [Red dashed line]



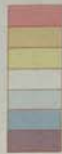
Miles 0 10 20 30 40 50 60 70 80 90 100

UNION OF SOUTH AFRICA

Provincial Boundaries.....
District Veterinary Officers Boundaries.....

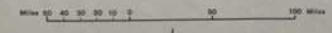
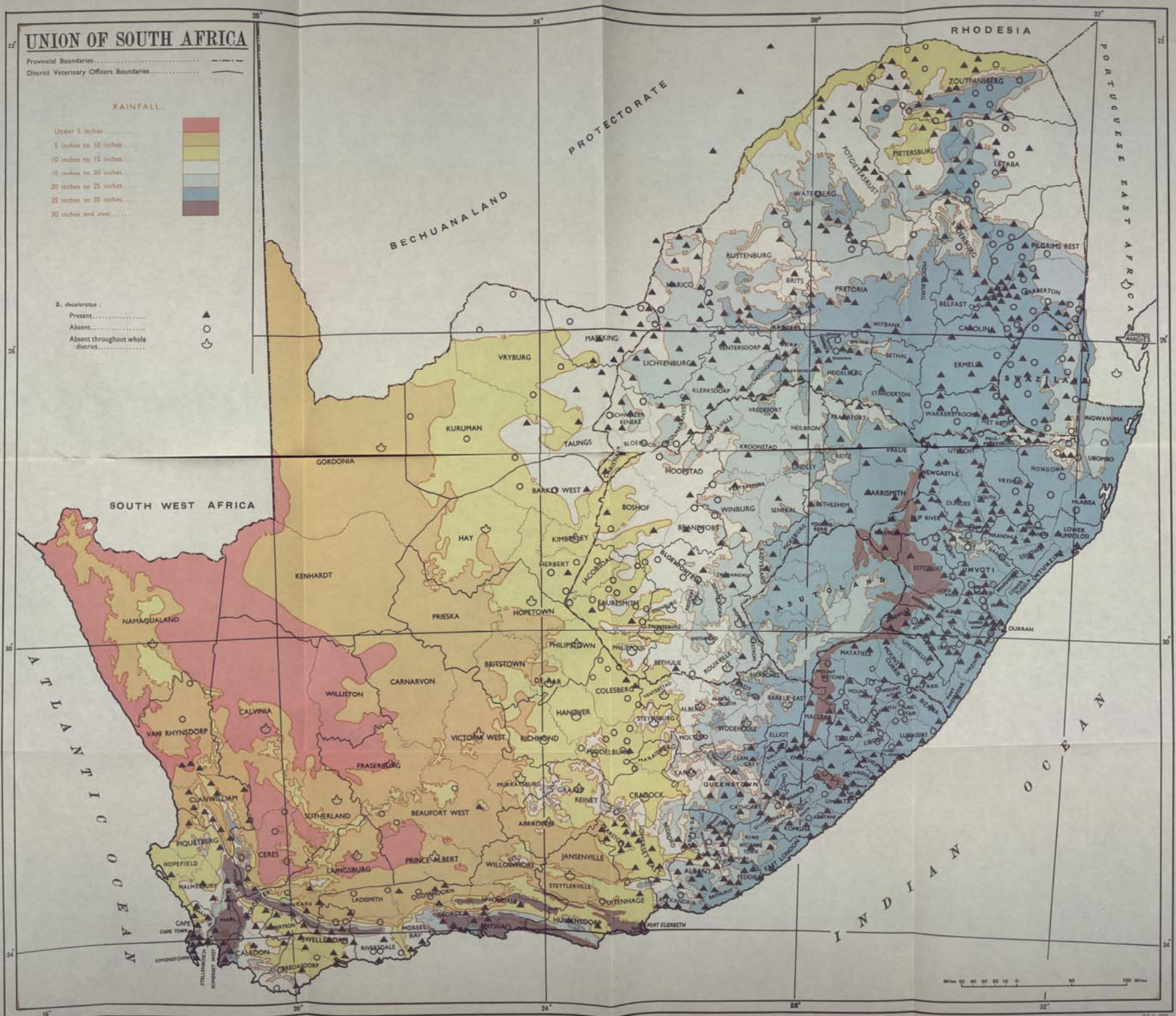
RAINFALL

Under 5 inches.....
5 inches to 10 inches.....
10 inches to 15 inches.....
15 inches to 20 inches.....
20 inches to 25 inches.....
25 inches to 30 inches.....
30 inches and over.....



B. decoloratus:

Present.....▲
Absent.....○
Absent throughout whole district.....◊



The collections from this area of control were of very uneven quality, those from Somerset East and from Pearston were excellent, those from the other districts but very poor, and none at all from Bedford; very few collections were made from the mountains.

This unevenness of the collections is to be regretted all the more, not only since this area forms a gradual transition from the *Fish River plains* to the *Karoo veld*, but also because report has it, that it is in the Adelaide district, that a farmer suffering heavy losses from heartwater amongst his merino sheep changed over to cattle farming and instituted conscientious and regular dipping, and is now sheep farming again with no losses from heartwater.

The dipping practices, even as judged from the meagre collections sent in, seem to be most unsatisfactory, in the lower lying areas and along the rivers. Either the dipping intervals are totally inadequate or the cattle are dipped every fortnight and the sheep, running on the same farm, but once a year! *A. hebraeum* has apparently been dipped out from one or two farms in the lower lying regions of Adelaide.

Area 50, G.V.O., Kroonstad.

One odd record from near Vredefort undoubtedly represents an introduction into the *mixed grass* or *middleveld* of the Orange Free State.

Area 53, G.V.O., Boshof.

One odd record from Rabane Ranch in the Hoopstad district situated on an "outlier" of *thorn country* or *bushveld*. *A. hebraeum* otherwise is absent from these Southern "outliers" of the *Bushveld*. It is possible that this represents an introduction which has been able to maintain itself.

Area 57, G.V.O., Graaff-Reinet.

One odd record from the *Karooveld* near Aberdeen, this seems to be merely an introduction. However, it may be worth mentioning that this record is within the upper reaches of the Sunday's river.

SUMMARY.

1. The distribution of *A. hebraeum* has been given in terms of political divisions as well as in terms of vegetational coverage.

2. *A. hebraeum* is seen to be present in the parklands and in the bushveld of the summer rainfall areas, where the bush coverage offers adequate shelter; it is absent, however, from the more arid bushveld regions even though the bush shelter would be adequate.

3. It is concluded that where farming conditions are favourable the tick could be controlled by dipping