

The Central Area.

This area may briefly be described as the area bounded on the West by the Vryburg, Christiana, Boshof, Jacobsdal, Fauresmith and Philippolis districts, on the South and East by the districts of Trompsburg, Edenburg, Bloemfontein, Thaba 'Nchu, Senekal, Kroonstad and Klerksdorp, and on the North by the Ventersburg, Lichtenburg and Mafeking districts.

The sand-veld of the Eastern portions of Boshof and Hoopstad districts in the Orange Free State and the Southern portion of Wolmaransstad districts in the Transvaal may be regarded as the centre or nucleus of the area where the disease is most prevalent. The incidence of the disease in this sand-veld area corresponds very closely with the distribution of Cynictis penicillata. A study of the relative ^{vant} maps clearly indicates this point.

The North-Eastern Area.

This area may be described as the one adjoining the Central area on the North-Eastern side by the districts of Heilbron, Potchefstroom and Krugersdorp and extending eastwards over the Brakpan, Bethal, Middelburg, Carolina, Standerton and Frankfort districts.

The Southern Area.

Apart from one centre on four adjoining farms with Swartkops as the nucleus in the Middelburg (Cape) district, the infection occurs as isolated spots over the districts of Cradock, Middelburg, Maraisburg, Hanover, De Aar, Britstown and Carnavon.

The Peninsular Area.

This is a small isolated area confined to the Cape Peninsula. Two cases, both in dogs, were discovered within

a period of two months. There is unfortunately no history associated with these two outbreaks to indicate the source of the infection. Its origin, therefore, remains obscure, especially in view of the great distance from known existing infection in wild animals. It is thought that Genetta felina may be responsible for these outbreaks, as Genetta abounds on the slopes of Table Mountain.

The Extreme Western Area of Griqualand West.

This area has recently become infected. An isolated case occurred on the 18th August 1939 in a Genet on the farm Selfdink in the Hay district.

The districts adjoining, and those in between, the areas described above must be regarded as suspected areas.

The incidence of the disease follows the distribution of Cynictis penicillata very closely. This is clearly shown by the fact that the disease has never been found in the lime slopes of the Gaap Mountains, a range running through Taungs, Earkly West and Herbert, West of and immediately adjoining the sandveld. The sharp decline in both the incidence rate of the disease and the population density of Cynictis is in marked contrast to the gradual decrease to the eastward of the Central area of both the incidence rate and the population density of Cynictis.

(2) The Occurrence of the Disease in Centres or Foci.

As has been pointed out before, Snyman and Thomas consider that although the disease is widespread over a large part of the country, it is restricted to more or less well defined centres over the greater part of that area.

On a large scale map, on which the boundaries of farms are marked, this becomes very evident. In order to illustrate this, a map of this description, showing the infected farms in the Vryburg district has been prepared. See map III.

(1) The Dealesville Centre (2).

For easy reference to Table I and the relative map, the index number is given after the name of the infected centre, The infected mongooses discovered near Dealesville were all found on the Southern portion of the Commonage. In the case of Doornrandjies and Kromspruit, although both cases of rabies occurred in oxen, there is, nevertheless, a history of a rabid mongoose in each of the two cases, and the paddocks in which these were found both adjoin that portion of the Dealesville commonage on which the infected viverrids were found. It is also to be noticed, that the infection had been known to exist in that comparatively small area for five years without any further spread having been reported.

(11) The Groenplaas (18) and Resida(23) Centres.

The former in Frankfort and the latter in Senekal district, are two very good examples of isolated centres of smouldering rabies infection. In both instances the nearest known infection was some 35 - 40 miles distant, and both centres are situated in areas where the yellow mongoose is not very abundant.

In the first mentioned centre a low ridge, on which isolated colonies of Cynictis are found, passes over both the farms Groenplaas and Boomplaas. It is probable that the infection may exist on the ridge of hills only, as the valleys on both sides of the ridge consist mainly of cultivated lands, where Cynictis, if present, would appear in restricted numbers. In view of the fact, that no cases except the one in an ox, were reported subsequent to the death of a European girl, in spite of the sensation created by her death from Hydrophobia following the bite of a Cynictis, it may safely be concluded that the disease may smoulder under such circumstances for a long time without being discovered.

(iii) The Mara (28) Centre,

Bloemfontein district. From the history obtained on the first case of rabies in this centre it is obvious that the disease has been smouldering there for a number of years. A very careful survey of the vivirrid population was made, when the meercat eradication operations (to be described later) were undertaken. It was found, that the two vleis, which pass over the area and which later join, allowed the meercats which abounded there, to come in close association over the two farms on which the outbreaks occurred. See Sketch Map No. IV.

(iv) The Trompsburg Focus.

Map No. V. The Trompsburg Commonage is divided into three grazing camps, known as the cow, calf and refuse-camps, which are separated by wire fences only. A spruit, which is dry for the greater part of the year, runs through all three camps. The colonies of the yellow mongoose are mainly along the valley in which the spruit runs, except that portion of it which runs through the calf-camp. This interruption of the continuity of the occupation of the valley by the yellow mongoose is caused by the abattoirs, in the vicinity of which no colonies occur. Between the cow-camp and the calf-camp, is a large low lying plain in which the yellow mongoose, although it has been seen there, no colonies have been found. The plain and the abattoirs on one side and the village on the other side forms a barrier between the cow and calf camps which the yellow mongoose very seldom traverses.

From the places marked on the map, where the diseased mongooses have been found, it is obvious that they have all originated from the cow-camp adjoining the town on the South. It is hardly conceivable, that mad mongooses would wander through the town to be found on the other side. One must

therefore accept the probability that the diseased meercats have not come from either the calf- or refuse-camps. Besides both camps are frequented by herd-boys and any infected mongoose would have come to their notice in the North, just as they have in the South. It is therefore accepted, that the infection is confined to the area immediately to the South of the town.

From the above it is obvious, that rabies in the lesser carnivora may smoulder on a comparatively small area, three miles square for five years before spreading to adjoining areas, and periods as long as 19 months have elapsed without another case occurring.

(v) The Swartkoppies (44) focus, Middelburg (Cape).

In view of the isolated number of outbreaks of rabies in the Southern area, it would not be unreasonable to conclude, that where infected animals are discovered on four adjoining farms, that there is a common source of infection. It is also interesting to note that the disease occurred there in three different species of Viverrids.

(vi) The Centres of Rabies Infection in the Vryburg District .

From the sketch map No. III which shows the infected farms (boundaries in thick lines) in the Vryburg district, it is clear that there are four infected areas. The first with Middelbult as centre, consists of five farms, which are adjoining and two farms a short distance away. The disease occurred in the following order, a suspected case in an ox on England in 1926, Zaaiplaas 1930, Middelbult 1932, Crondale 1933, Caledon 1934, Maizefield 1936, and Skietpan in 1938. The order in which the outbreaks occurred shows the slow advancing character of the disease. It is difficult to

*How do we, not that the
interacting farms do not
harbour infection. What
procedure was adopted to
verify this.*

understand that the disease should spread from England, assuming that this farm forms the origin of the infection, to Zaaiplaas and not to Maizefield. Similarly, that it should skip Skietpan to occur on Caledon and to appear five years later only on Skietpan.

The second centre is that formed with Lorenzo, the oldest known infection. In this case there are four farms adjoining in which the infection has been smouldering from 1926 to 1937, a period of almost eleven years, and in the case of the two adjoining farms, Massouwskop and Kromspruit, for a period of six years.

*How do we know it
was smouldering & not
present on other farms*

The third centre consisting of the two farms, Vryburg Commonage and Boston, may be considered as a separate infection. It is, however, possible that it is connected with Kromspruit

The fourth centre not shown on the map consists of two adjoining farms forty miles away from the nearest infected area of Vryburg town.

(vii) Even in Hoopstad district,

where the disease is widespread, it is possible to group infected farms together, so that definite centres of infection are formed. Two such centres viz. Tevrede (5) and Hestersrust (8) exist in that area. In the former case four farms are adjoining. The infection was discovered on three of the four farms in the same year, and six years later only on the fourth farm, Rechtvaardig.

*How was the possibility of
infection occurring in the interim
checked upon*

In the case of the other centre, although the farms are not adjoining, the area in which they are situated is a triangle with sides approximately five miles long.

(viii) It has been pointed out in the case of the infection on the Trompsburg Commonage, that the disease may exist in a comparatively small area. Further such

cases may be mentioned where infected meercats at different intervals have been found on the same farm and even in the *same* locality on a ^{the} farm.

On the Edenburg Town Commonage (See Map No VI) infected Cynictes were found in April and August 1933 at the points marked X on the sketch map. In June 1939 a further infected Cynictes was found on the same part of the Commonage at the point marked XI.

On the farm Sunnyside near Bloemfontein outbreaks of rabies occurred on the 4th and 21st of May and again in July of the same year. All these outbreaks occurred in an area with a radius of less than half a mile. (See sketch Map VII)

On the farm Philip in Hoopstad district an outbreak of rabies occurred in November 1937 in an ox, (See Map VIII) and on the 23rd of May the following year a rabid Cynictes was found in the same camp, where the ox had been grazing. More such cases can be quoted e.g. Beestekraal in Hoopstad district, of the discovery of the disease on comparatively small areas of approximately 1,000 morgen in extent. These cases further support the view that the disease occurs in restricted areas,

(3) The Origin of the Infection in Fresh Outbreaks.

In nearly every fresh outbreak of the disease the same question is raised: What is the origin of the Infection? In the absence of any direct evidence, the only reply that can be given is that the disease has always been there, but has remained undiscovered. This reply is based on the presumption as has been shown above, that rabies may smoulder in the lesser carnivora in a comparatively small area for periods up to eleven years, ^{before} without being discovered. Most of these isolated "fresh" outbreaks should probably therefore not be considered as newly started foci, but rather as old

established infections that are being discovered.

There are many outbreaks where a single infected animal was found, and without any attempt at eradication, the disease has presumably disappeared. Areas where such sporadic outbreaks have occurred should therefore be regarded as suspect until they can be proved otherwise. There are many instances where the disease has appeared recurrently after periods of up to eight years, e.g. Trompsburg Commonage, the farm England in the Vryburg district, Cyfergat in the Wolmaransstad district where the first case that was definitely diagnosed as rabies came from. It will be noted that the first case was diagnosed in two European boys bitten by a Cynictis in 1928, and only eight years later was another case recorded on the same farm in a dog.

One often hears it related when dealing with sporadic outbreaks, that animals behaving very strangely were seen there twenty or more years ago. For instance at Ventersvlei, Bloemfontein district an obviously rabid wild cat was said to have been discovered near the homestead in broad daylight some twenty years ago. This story is all the more interesting as the nearest known infection is some 30 miles away.

(4) The Spread of the Disease.

It has often been said that migratory animals will spread an infectious disease as fast and as far as they themselves can travel. Unfortunately very little is known about the migratory habits, if any, of the principal carriers, Cynictis and other species of Viverrids. The possibility, that such animals may be removed over long distances as pets, should not be over looked. The pet Suricata, which developed rabies in Carnavon in 1930, might easily have been the cause of an outbreak in a different part of the country. Similarly the two pet Suricates, to be described later, that were moved to

Natal, where Suricates do not occur, might also have been the cause of an outbreak.

Several cases are recorded in Table I where domestic animals, fortunately, cattle only, have been responsible for fresh outbreaks. In the case of Nieuwebaby, Boshof district, the ox was removed from Middelpunt, a farm on which a suspected case of rabies occurred in a domestic cat.

In the outbreak in the donkey on the farm Waagpunt, Boshof district, the donkey was removed from the farm Lemoenplaas some 10 miles away, a week before the onset of symptoms. A similar movement of an infected ox took place in the outbreak at Kommandosdrift, Wolmaransstad district. The outbreak listed as Goedgedacht, Wentersburg district actually occurred in an ox on an adjoining farm where the oxen had been grazing.

Owing to the long period of incubation in rabies in some cases a period of six months or more, the possibility of spreading the disease by movement of domestic animals is very real and may explain why the disease may at times take unexpected long jumps. However apart from the few cases mentioned where animals were removed during the incubation period of the disease, it has been found that the disease spreads relatively slowly to adjoining areas in the wild carriers.

(5) The Probability of a Seasonal Influence on the Occurrence of Rabies.

Thomas and Neitz (1933) at the termination of the great drought of that year, speculated on the influence the copious rains and floods that followed the drought, would have on the incidence of rabies. It was thought, that as a result of the abnormal floods that a large proportion of small wild animals

would be drowned and so lessen the incidence of rabies.

The copious rains started in the middle of November only, and the anticipated decline in the incidence rate occurred in September of that year and therefore was not related to the rain.

Schumann and Thompson (1934) in a study on South African Rainfall, Secular Variations and Agricultural aspects, divided the Union of South Africa into 32 districts, on a basis of the distribution of the average monthly rainfall, as well as on the topography of the country.

In their tables the rainfall is indicated as the percentage of the mean rainfall based on data (in the case of districts No's 28 and 32) from 1904 to 1933.

Table II gives the percentage and monthly average rainfall for the rainfall districts No's 28 and 30 as well as the average of the two combined, as compiled from the tables given by Thompson and Schuman.

Table II

The actual — summer rainfall expressed as percentage of the average fall for Districts 28 and 30

Year	Actual precipitation	Percentage of the average annual fall
1929 - 1930	15.5 } 15.5	100%
1930 - 1931	17.2 } 19.2	120%
1931 - 1932	13.0 } 13.2	86%
1932 - 1933	9.6 } 10.9	68%
1933 - 1934	23.4 } 20.6	144%
1934 - 1935	16.0 } 18.8	114%
1935 - 1936	19.1 } 17.7	120%
1936 - 1937	16.9 } 19.5	119%
1937 - 1938	11.3 } 13.5	81%
1938 two months	8.5 } 7.8	113%

TABLE IIa.

The average monthly rainfall for Rainfall Districts 28 and 30 calculated from the monthly percentage given by Thompson and Schumann.

The average annual rainfall being taken as 16.86 and 20.43 for districts 28 and 30 respectively.

Month.	Percentage monthly rainfall of the mean annual for Districts		Average monthly mean Rainfall in ins. District.		Average in ins. of districts 28 and 30 combined.
	No. 28.	No. 30.	No. 28.	No. 30.	
Jan.	17.2	16.3	2.89	3.33	3.11
Feb.	20.1	16.5	3.40	3.37	3.38
March	18.1	16.0	2.97	3.27	3.12
April	7.7	7.7	1.39	1.56	1.48
May	3.5	4.1	.73	.84	.78
June	0.8	1.4	.14	.29	.26
July	1.4	1.3	.22	.28	.24
Aug.	1.6	2.0	.28	.41	.34
Sept.	2.4	4.1	.40	.84	.62
Oct.	5.5	7.2	.90	1.47	1.18
Nov.	9.4	12.0	1.50	2.45	1.97
Dec.	12.3	11.4	2.07	2.33	2.20
		Total	16.86	20.43	18.65

From the boundaries of the rainfall districts defined by Schumann and Thompson it was found that the Central Rabies Area as described very nearly coincides with rainfall district No. 30, and the greater portion of No. 28. The small areas of the other districts that are not included in the Central Rabies Area shows only a few isolated outbreaks. The rainfall for the nearest station was obtained for record purposes. The monthly rainfall for the Central Rabies Area was obtained from the Meteorological office for the years 1929 to 1938. The data of 22 stations were used in compiling the actual monthly rainfall in graph 1.

Graph No. 1 shows for the Central Rabies Area

- (a) The average monthly rainfall. Table II (a), ~~in Appendix~~.
- (b) The actual monthly precipitation.
- (c) The monthly number of outbreaks of rabies indicated in Table III.

Table III.

Summary of the Incidence of Rabies. 1929 - Aug 1939.

Year	Jan	Feb	M	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1929	1	1	.	2	2	.	3	2	1	-	1	-	13
1930	1	2	2	-	-	-	-	-	3	2	-	-	10
1931	1	-	-	1	1	1	-	-	1	-	-	-	5
1932	-	-	-	1	2	4	2	2	2	2	-	3	18
1933	-	3	2	3	1	4	5	6	-	1	2	-	27
1934	2	-	1	-	-	1	1	-	-	1	-	-	6
1935	1	-	-	2	1	-	2	3	3	2	2	4	20
1936	2	8	1	2	4	3	2	4	5	-	-	-	31
1937	1	-	1	-	1	-	-	2	1	-	3	4	13
1938	1	-	2	2	4	2	2	5	7	6	-	4	35
1939	3	2	1	-	5	2	4	5					18
<u>Total</u>	13	15	10	13	21	17	21	29	23	14	9	15	179

The Periods during which the Incidence rate of
Rabies was Comparatively high.

Table V shows the periods in which the incidence rate of rabies was comparatively high.

For the sake of comparing the periods contained in Table V with the seasonal precipitation, the periods have been divided according to the rainfall, into summer for the months November to March; early winter May and June; mid-winter July and August; late winter September and October. The month of April which marks the end of the rainy season and the beginning of winter is given as a separate period.

Table V. The months in which the incidence
rate of Rabies was comparatively high.

Summer	April	Early winter	Mid winter	Late winter
Dec. 1932	1933	June 1932	July 1929	Sept. 1930
Feb. 1933		June 1933	July 1933	Sept. 1935
Dec. 1935		May 1936	Aug. 1933	Sept. 1936
Feb. 1936		May 1938	Aug. 1935	Sept. 1938
Nov. 1937			Aug. 1936	Oct. 1938
Dec. 1937			Aug. 1938	
Dec. 1938			Aug. 1939 Sept. 1938	
<u>Total</u> 7 times	once	4 times	7 times	5 times

In comparing the data in Table V with the data in the graph, the following points are rather striking:

(1) Early Winter.

It will be noticed that an increase in the incidence rate of rabies occurred four times during early winter. In three out of the four cases was the rainfall for the previous late summer months far below normal. May 1936 being the exception.

(2) Midwinter.

The incidence rate of rabies increased seven times during midwinter.

(3) Late Winter.

The increases in the incidence rate of the disease occurred in each case before any rains had fallen.

(4) April.

The only time when an increase occurred during the month of April was in 1933, when an abnormally low rainfall was recorded for the previous summer.

Thus to summarise, the incidence rate of rabies was comparatively high sixteen times when the precipitation was below normal for the previous late summer months or before any rain had fallen. In the 17th case the rainfall for the previous summer was 20% above normal.

The highest increase in the incidence rate occurred during 1933, late 1936 and 1938, at times when the veld was comparatively bare, especially in 1933 and 1938 when the previous summer rainfall was 32 and 19 per cent below normal. A photograph taken of the veld on the Vryburg Commonage on November 15th, 1938 shows the barrenness of the veld during that period.

(5) Summer Periods.

An increase in the incidence rate of rabies occurred seven times during the summer months. On these occasions the climatic conditions were as follows:

December 1932.

A little rain fell in the previous September but October and November being dry, the little rain in September had no influence on the veld.

February 1933.

The increase in the incidence rate of rabies during the summer coincided with one of the worst droughts known in the country.

December 1935.

The rainfall for the month was above the normal as well as that for the previous two months. So that the increase

occurred at a time when the vegetation was well grown.

February 1936.

The same applies in this case as in the previous one.

November 1937.

The preceding two months were dry, when rain should have fallen normally. The veld as can be expected was bare and dry.

December 1937.

The rainfall for the previous two months was far below normal, and that for the same month above normal. But at the time when the incidence rate of the disease reached its peak, the veld was still bare, as the copious rains resulted in dense vegetation only after three weeks.

December 1938.

Although some rain had fallen in October a very severe frost occurred during the middle of November, and December being still dry the veld was exceedingly bare, as will be seen from the photograph referred to above.

Five out of the seven cases described above may be described as being dry or very dry, resulting in very poor vegetation, and in two of these months severe droughts were recorded.

In the remaining two months viz. December 1935 and February 1936 copious rains had fallen during the preceding months, so that the veld was practically overgrown and the vegetation tall.

It will be seen from the above that the incidence rate of rabies tends to increase during the winter and that when increases are recorded in summer they coincide with conditions of veld in which the vegetation is very short or almost absent.

On twenty-one occasions out of twenty-four when a comparatively high incidence rate of rabies was recorded it coincided with periods when the vegetation was short or no vegetation existed, and on three occasions only occurred when the grass