

S 1665

REPORT

ON

S1665

CERTAIN FEATURES OF

MALARIA

IN THE ISLAND OF SALSETTE

BY

MAJOR J. L. MARJORIBANKS, M.D., D.P.H., I. M. N.,
Deputy Sanitary Commissioner, Western Registration District.



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P R E F A C E

Government Resolution, General Department, No. 4008 of 26th June 1912, runs as follows :—

“ His Excellency the Governor in Council is pleased to direct that Major J. L. Marjoribanks, I. M. S., Deputy Sanitary Commissioner, Western Registration District, be deputed to investigate the malarial conditions prevailing in the Island of Salsette with a view to ascertaining and defining the dangerous malarious tracts of the taluka and indicating the direction in which and the limits within which residential development should proceed. Major Marjoribanks should also enquire and consider what measures are possible for the removal or abatement of the causes and conditions which give rise to Malaria in the tracts affected. He should carry out the enquiry during the months of September and October when the incidence of the disease will be at its height, and report the result to Government through the Sanitary Commissioner. During this time he will remain in charge of his ordinary duties.”

In a subsequent resolution the period allowed for the investigation was extended by a month.

The examination of a representative number of blood-films to the endemic index, and the dissection of mosquitos caught in houses, which species are the local carriers of Malaria, could only have been done by a full-time Malaria Officer, especially over so large an area as Salsette. Accordingly, the present investigation was limited to an examination of the Vital Statistics of Salsette, to collection of larvæ and adult anopheline mosquitos throughout the island, and their identification at a temporary headquarters, and to the taking of a Spleen Census of the children in the villages and hamlets.

For the collection of larvæ and adult mosquitos four compilers of the Sanitary Department were employed on a scale of pay similar to that of the Malaria Sub-Inspectors of the Health Department of Bombay Municipality, and two of them received preliminary training under the Malaria Assistant to the Health Officer. Each was given a cooly, paid at the Bombay rate.

The identification of specimens and the Spleen Census were carried out in person by the writer.

He acknowledges heartily the assistance rendered to him and the information given, by the Revenue, Educational and Meteorological Departments, and also the help he received from the parish priests and other clergy of Salsette.

If this report is read from the point of view of town-planning in Salsette it is assumed that the report “ On the possibilities of development of Salsette as a residential area”, by Mr. P. J. Mead, I. C. S., is available for reference.

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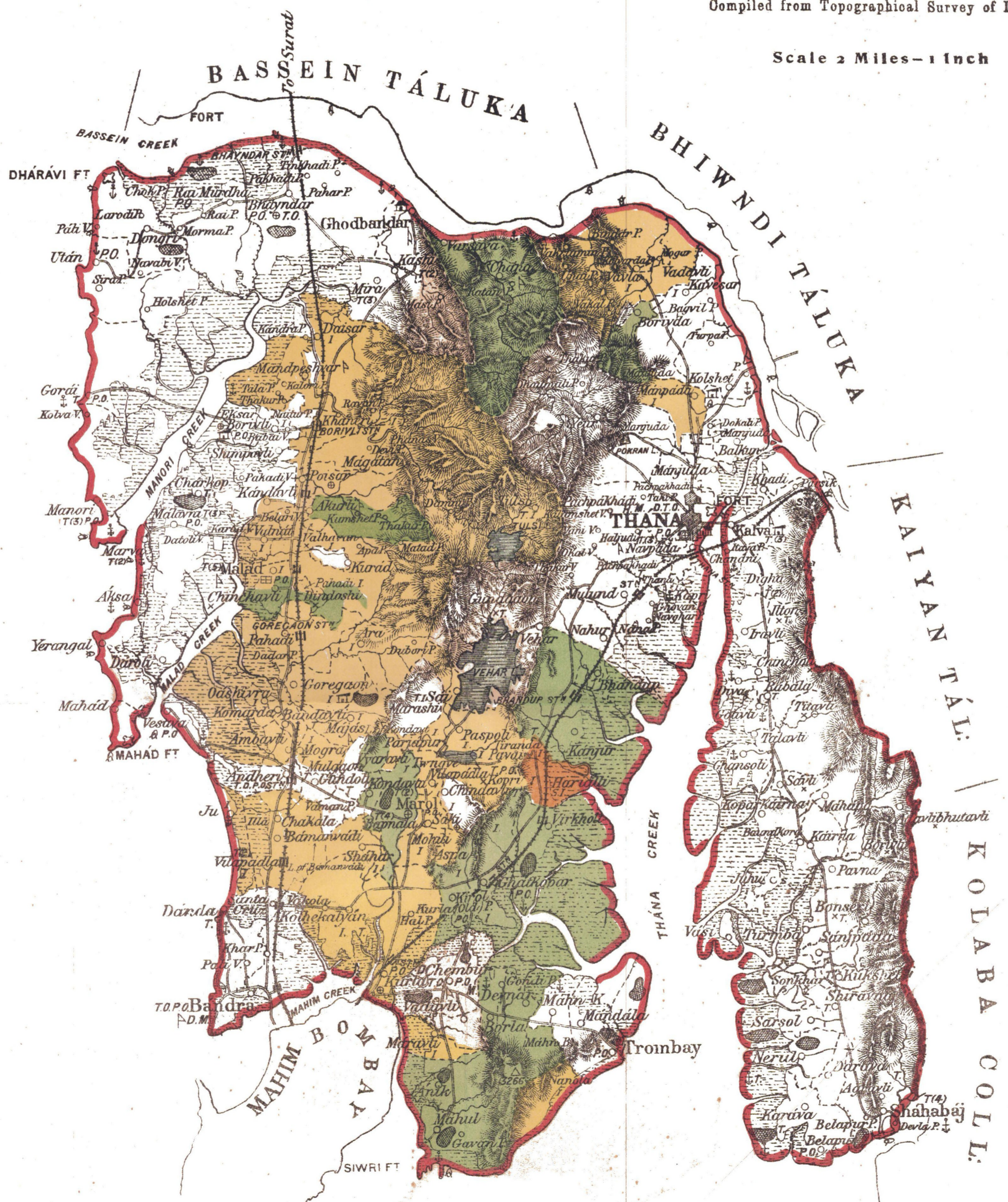
MAP
of the
SALSETTE TALUKA
of the
THANA COLLECTORATE

Compiled from Topographical Survey of India

Scale 2 Miles = 1 Inch

References

- Enam Village
- Bazar Village
- Khoti Village
- Sharikati Village
- Lakes



CHAPTER I.

GENERAL DESCRIPTION OF SALSETTE.

The island of Sáshti, or Salsette, lies just north of the 19th parallel of North Latitude on the west coast of India, and close to the mainland. The taluka of Salsette in the Thána District, to which it belongs, and of which it forms all but a strip on the mainland of about 47 square miles, known as the Khairan Patti, is some 250 square miles in extent. Salsette island is separated on the North and East from the mainland by a creek, of which the northern arm is known as the Bassein Creek, and the eastern the Thána Creek. To the South lie Bombay Island and Bombay Harbour. The taluka has a population of some 150,000 people in 140 towns and villages.

PHYSICAL GEOGRAPHY AND GEOLOGY.—The most striking feature of the geography of Salsette island, and one which has a very important bearing on its malariology, is its range of hills, the highest peaks of which are over 1,500 feet, though within a few miles of the sea. This range forms, as it were, the backbone of the island, and runs, diminishing in height, from the northern end southward. In the southern portion of the island is an area devoid of hills, though in the south-east corner, in what is known as the Island of Trombay, at the head of Bombay harbour, there is a hill 1,000 feet in height, of the same nature as the hills that run down the centre of the island.

Spurs from this main line of hills run westwards towards the sea.

Among the hills lie two artificial lakes, Tulsi and Vehar, which provide part of Bombay's water-supply. A third, Powai Lake, has in more recent times been constructed for the same purpose south of Vehar, though the shallowness of the bed has prevented the water stored from being of a quality that could be used.

The west coast is deeply indented by creeks, the two principal of which are the Malád and Manori Creeks, which detach, or almost completely detach, considerable portions of the land at spring tides.

It is unfortunate that there has never been a geological survey of Salsette. A geological map would have been useful in the present connection, for, as will be seen, there is a relation between the geology of the island and its malariology.

The hills of Salsette are of the same volcanic origin as those of the rest of the Konkan and the Deccan at this latitude. The relative steepness of its hills on their eastern face is as noticeable as in the case of the hills of Bombay Island, and depends on the fact that there is a dip in the strata to the westward of from 10° to 15°, the strata near the coast being, as a matter of fact, of a higher series than those far up in the ghauts. Most of this volcanic rock in Salsette is trap, derived from the lava of ancient volcanos, but in places the rock is breccia, derived from their ash.

There is certain amount of sedimentary rock to be found, however, especially in the South of the island, where it is continuous with that lying in the bed of what was once a great fresh-water lake, part of which covered areas now in the Island of Bombay.

The soil derived from the disintegration of the trap, which, if it contained more organic matter and were of a darker colour, would be known as a cotton soil, extends from the bases of the hill scarps down towards the sea. By the sides of the creeks it gives place to alluvium which, brought down to the coast by streams, has been washed back by the sea to form the flats that line the creeks of the island and are mostly submerged at spring tides. The alluvium is thus heavily impregnated with salt.

Along the west coast of Salsette are a series of what at one time were sea rocks, but which, by the gradual silting up of the creeks by alluvium, are now only separated from the land by the flats. The villages of Bháyndar, Dongri, Uttan, Gorai, Manori, Marva, Malavni, Akse, Yerangal, Marh, Daravli, Vesáve, Juhu and Bándra are all built upon islets recently more or less assimilated to the land in this way. In some of those places the trap shows itself and forms considerable ridges. In some it occurs in different stages of disintegration as muram, red earth and even soil on which rice and rabi crops can be grown. In other places any soil that has formed has been obliterated by blown sand, which forms dunes that line the shores opposite some of the villages.

Coincidentally with the process of silting up of the creeks there is in progress at some places a process of coast erosion going on which by the end of each monsoon noticeably alters the outline of the shore of certain localities, such as the islet of Juhu, to the North of Bándra.

CLIMATE AND RAINFALL.—There being no observatory on the island of Salsette no record of the temperature is available. The climate of the west coast is very much like that of Bombay, where January has an average mean temperature of 73·9° and May one of 84·7°. In the eastern or inland parts of Salsette the temperature varies considerably with the variations in geographical and geological formation.

In Bombay, as shown by the records of the Colába Observatory, winds are northerly in November, December, January and February. From the middle of March they begin to change to a westerly direction, and from the beginning of April to the end of September the prevailing direction of the wind is westerly; during the first half of October winds are unsteady and slowly change to a northerly direction. The south-west monsoon breaks in June, is at its height in July and August, and is over early in October. The north-east monsoon occasionally gives showers in November and December.

The following statement gives the total rainfall for the years 1902 to 1911 at Kurla and Thána. The greater precipitation at Thána is due to the influence of the hills of Salsette, which lie between the town and the sea. Even at Kurla the rainfall is slightly greater than at places actually on the coast:—

Year.	Rainfall at Kurla in inches.	Rainfall at Thána in inches.	Year.	Rainfall at Kurla in inches.	Rainfall at Thána in inches.
1902	77·62	81·17	1907	97·71	105·33
1903	103·62	126·97	1908	82·31	87·65
1904	60·89	91·98	1909	105·04	118·66
1905	43·78	58·32	1910	74·71	82·88
1906	72·22	84·48	1911	54·22	71·92

TREES AND CROPS.—Part of the central hill area is under "forest", the term being used in its technical sense. But almost everywhere, from the hill area right down to the alluvium, the soil of Salsette island supports a growth of trees and long grass, only interrupted by the rice-fields which cover so large an area of the island. Round the villages the commonest trees one finds are the Ámb (*Mangofera*), the Chinch (*Tamarindus*), the Sitáphal (*Anona*), the Bhendí (*Thespesia*), the Karanj (*Pongamia*), the Sâg (*Tectona*), the Râjan (*Mimusops*), the Bor (*Zizyphus*), the Kâjü (*Anacardium*), and, among palms, the Tâd (*Borassus*), the Nâral (*Cocos*) and the Shindí (*Phœnix*). So near a large city, both the long grass and the produce of many of the trees form a considerable commercial asset. Even the villas that line the Ghodbandar road, near each of the railway stations of the B. B. & C. I. Railway, from Andheri northwards, and which are at once the hope and the despair of the town-planner, are enveloped in palm or mango-orchards supporting a rank growth of grass.

PRICES.—Rice of the second sort is the staple food in Salsette Táluka. The following are the rates per rupee from 1901 to 1912 :—

Year.	Seers (80 tolas = 1 seer).	Chattaks.	Year.	Seers (80 tolas = 1 seer).	Chattaks.
1901 ...	10	3	1907 ...	9	4
1902 ...	10	3	1908 ...	7	6
1903 ...	11	2	1909 ...	9	4
1904 ...	10	3	1910 ...	9	2
1905 ...	10	2½	1911 ...	8	2
1906 ...	9	14½	1912 ...	7	5

POPULATION, CASTES AND EMPLOYMENT.—The three municipal towns of Salsette are Thána, Bándra and Kurla. Their census population, with that of the rest of the táluka, is given in the following table :—

Name of town or rural circle.	Census of 1891.	Census of 1901.	Census of 1911.
Thána ...	17,455	15,410	15,591
Bándra ...	18,317	22,075	22,885
Kurla ...	11,469	14,831	15,081
Rural Salsette ...	78,878	94,016	98,895
Total population of táluka ...	126,119	146,332	152,452

The chief occupation of the rural population is the cultivation of rice, on which not only members of regular agricultural castes but a great many other people are mainly dependent for their livelihood. Though there is only the one crop, and the rice-fields lie fallow for the rest of the year, the various processes incidental to the cultivation and storage of rice seem to provide the average cultivator or field labourer with work for the year round. A certain amount of market-gardening is done, especially in the coast villages, and in different places timber-felling and carting, grass-cutting, mango-growing, toddy-drawing, sea-fishing and salt and lime working provide the different castes with employment. Though there are a few large mills at Kurla town in the South of the island there is not the migration for work in the mills of Bombay that is so marked in the sea-coast tálukas of the neighbouring Kolába District.

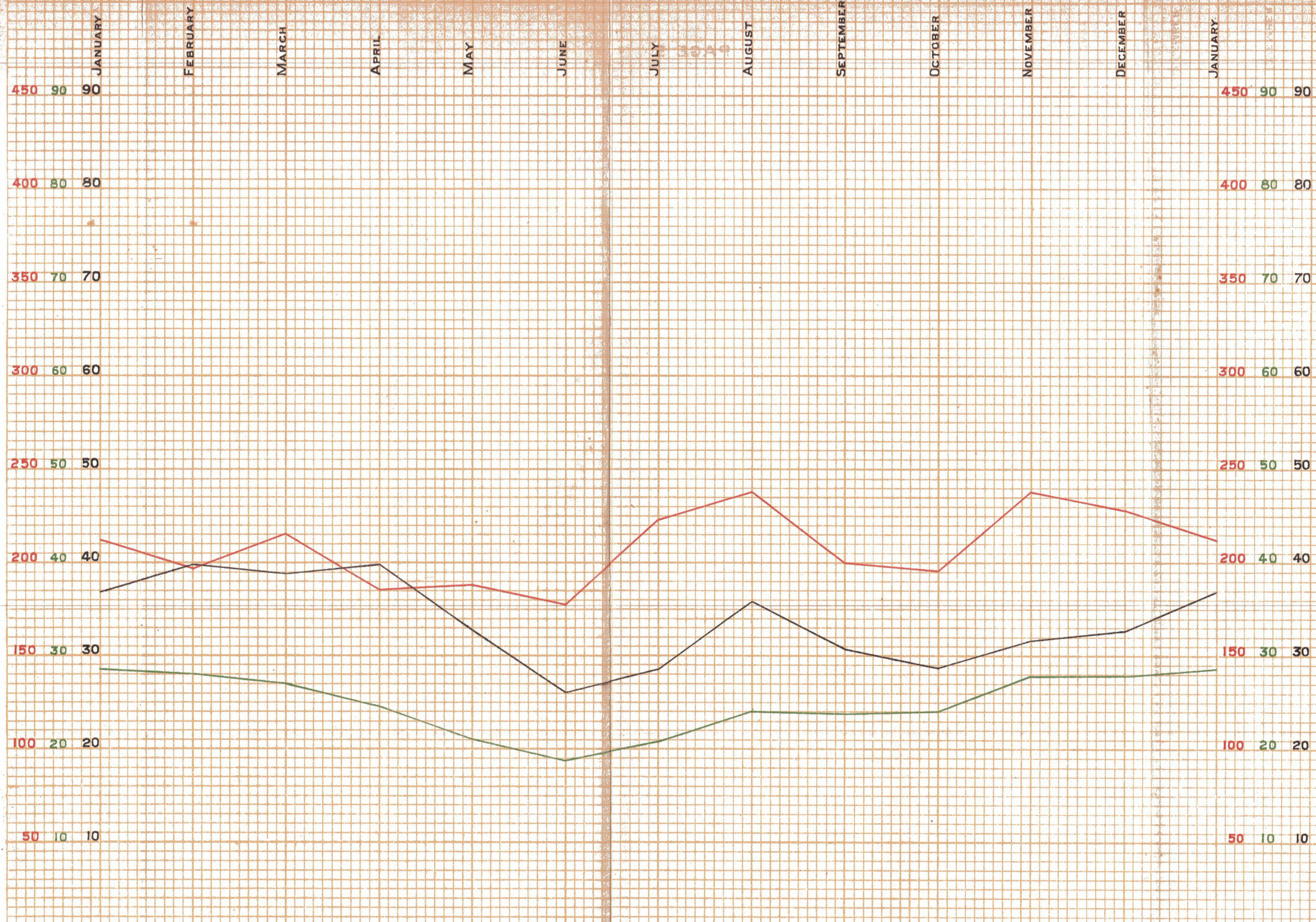
In rural Salsette there is little of a Musalman population. Of the better class Hindus there are a certain number of Bráhmíns and Parbhus. Besides those who more or less definitely follow some one occupation, such as Dhobis, Lohárs, Shimpis (tailors), Mális and Sonárs, and those whose occupation has always been mainly agricultural, such as Maráthas, Pánchkalshis and Dhodyas, there are castes who have more or less deserted their tribal or caste occupations to become occupiers of agricultural land or field-labourers, such as Agris (originally salt-workers), Bhandáris (originally only toddy-drawers) and Dublis and Varlis (originally forest tribes). The population of some villages mainly consists of Kolis, the term Koli being applied to several groups of fishermen and cultivators of mixed descent now classed as Hindus. Mahárs are met with, mostly in their capacity as out-castes and village servants, but also sometimes as well-to-do labourers, and even mechanics.

All along the coast, both in the town of Bándra, and in the villages, a proportion of the population, most unusual for the Bombay Presidency, consists of Indian Christians. These are the descendants of the early converts of the Portuguese. In the villages they are nearly always cultivators, but Bándra town supplies Bombay with a considerable number of its clerks and mechanics. They are rapidly learning English, and becoming more and more Europeanized in their dress. Although their higher standard of living makes them more resistant to Malaria than many of the classes among which they live,

their villages have at times been severely visited by Plague, which has considerably reduced the population in some of them. Moreover, they are fond of showing their independence of the Bráhmín official, and one manifestation of this tendency, consisting of frequent refusal of the services of the vaccinator, renders them peculiarly liable to Small-pox.

The Bándra-Dánda Peninsula, and especially the ridge known as Páli Hill, has for long had a considerable European population, consisting mostly of Bombay business men, who go in daily to their offices. Especially since Plague established itself in Bombay their example has been largely followed by well-to-do Indian business men, who have built villas round every railway station in Salsette where Malaria is not sufficiently bad to make residence quite impossible. Except in the case of some of the stations nearer Bombay, such as Ghátkopar, those villas are not inhabited in the rainy season, nor in the cold weather till it is drawing to a close, the fear of Plague, and the desire for fresh air being the main inducements to a semi-suburban or rural life in the hot season.

The matter of these groups of villas, and the desirability of controlling building by the introduction of the principle of town-planning, are fully dealt with in Mr. Mead's Report, and town-planning is now being regulated by a Special Officer appointed for the purpose by Government.



SALSETTE TALUKA
CHART. N^o. I.

SHOWING
The mean annual death rate per mille of population for the ten years 1901-1910 for each month (black curve)

The same rate minus the death rates from Small-pox, Plague, Cholera and Dysentery & Diarrhoea (green curve)

and
The mean annual death rate of children under one year per mille of Mean Annual births for the ten years 1901-1910 for each month (red curve)

(CORRECTED FOR THE NUMBER OF DAYS IN THE MONTH)

ALSO

N	N	NNW	NW	W	WSW	WSW	WSW	W	N	NNE	NNE
50	60	50	60	70	70	85	85	55	20	50	55
6.1	6.7	7.3	7.4	5.9	8.7	9.4	10.8	6.9	5.3	5.4	5.9

N Normal mean wind direction at Bombay Observatory (Black letters)
50 Normal mean wind steadiness at Bombay Observatory (Black figures)
6.1 Mean wind velocity in miles per hour at Bombay Observatory (for one year only) (Red figures)

CHAPTER II.

VITAL STATISTICS.

Till near the end of the decennium 1901 to 1910 Salsette, for the purpose of the compilation of vital statistics, was divided into the Thána Town Circle and the Salsette Rural Circle. Since 1908 Bándra has been dealt with as a separate Town Circle, and it has recently been decided to constitute Kurla as a separate Town Circle from 1913. These separations of the urban from the rural population of Salsette will enable variations in the intensity of such diseases as Malaria, so much more a rural than an urban disease, to be more accurately studied over a period of years in the future than they can be at present.

In 1911 Captain B. Higham, I. M. S., when acting as Deputy Sanitary Commissioner, carried out for the Western Registration District the statistical enquiry ordered in Government Resolution, General Department, No. 4796 of 29th September 1910. He prepared charts for two series of years before and after the outbreak of Plague in the Presidency, showing curves for the mean monthly figures for each táluka, of Total Births, Total Deaths, and Infantile Mortality. He discontinued the plotting of curves for Still-births before he came to the vital statistics of the Thána District, as he found that the curves for different tálukas of the Násik District showed such a complete lack of conformity as to indicate that no reliance could be placed on the registration of Still-births. He also prepared tables showing "epidemic figures," on the lines laid down by Major Christophers. The compilations of Captain Higham, on which his curves were prepared, have been of considerable assistance in preparing the two charts that accompany this present report. Unfortunately, on account of the destruction of certain records, he was not able to obtain his pre-Plague figures for a decennium of continuous years. Apparently on account of some difficulty in ascertaining the populations on which some of the ratios should be calculated for this pre-Plague series of years, all the curves for the pre-Plague series, for Births, for Total Deaths, and for Infant Mortality, are below the corresponding ones for the post-Plague series. It was, accordingly, inadvisable to attempt to draw conclusions based on the differences shown between the several kinds of curves of the two series of years.

For the present report only the vital statistics of the intercensal decennium 1901 to 1910 have been taken. The figures are for the whole of Salsette Táluka, including its urban populations.

THE DEATH-RATE.—A description of the Seasonal Chart (Chart No. 1) is given on it. The principle followed in the preparation of the lowest curve in it has been that rural registration work, at any rate, is generally accurate as regards the *total* number of deaths, and that if the figures for certain diseases which (1) tend to be seasonal in their incidence, (2) are easily recognized even by ignorant persons and (3) are not themselves the sequelæ of Malaria, are deducted from the total, the residue will give a fair idea of the seasonal variations in mortality due to Malaria. A curve showing the death-rate among children under one year, calculated, not on the population, but upon the births, has been shown, both because this is the most accurate of all death-rates, and because it affords a very good indication of variations in the intensity of Malaria, infants being extremely susceptible to the disease. Letters and figures showing the normal mean wind direction and steadiness for the day for each month of the year at Colába (Bombay) Observatory are given at the foot of the chart, as also figures showing the mean monthly velocity of the wind in miles per hour for the year 1911. The "steadiness" is the excess percentage of observations in the direction of the monthly resultant.

It will be noticed that it is towards the end of the year that the Total death-rate curve and what we may term the curve of the Death-rate *minus* the rate for Special Diseases most closely approach each other, *i. e.*, it is then that there is least of those diseases. Early in the year they begin to diverge, as Plague begins to increase, and they remain widely apart for some months, their further divergence from each other in April being due to the superaddition of Cholera to Plague. The decline of Plague after April brings about a rapid fall in the

Total death-rate, which is not shared to any extent by the Infantile death-rate, and a greater approximation of it to the Death-rate *minus* the rate for Special Diseases. June is seen to be the all-round healthiest month. All the death-rates rise after the monsoon has well set in. The rise is better marked in the case of the Total death-rate than in that of the Death-rate *minus* that for Special Diseases, and more marked still, and earlier marked, in the case of the Infantile death-rate. Here Cholera, and Diarrhoea and Dysentery are in operation. Their decline in September and October with the dying away of the monsoon, and the approximation again of the two lower curves to one another, can be seen at a glance.

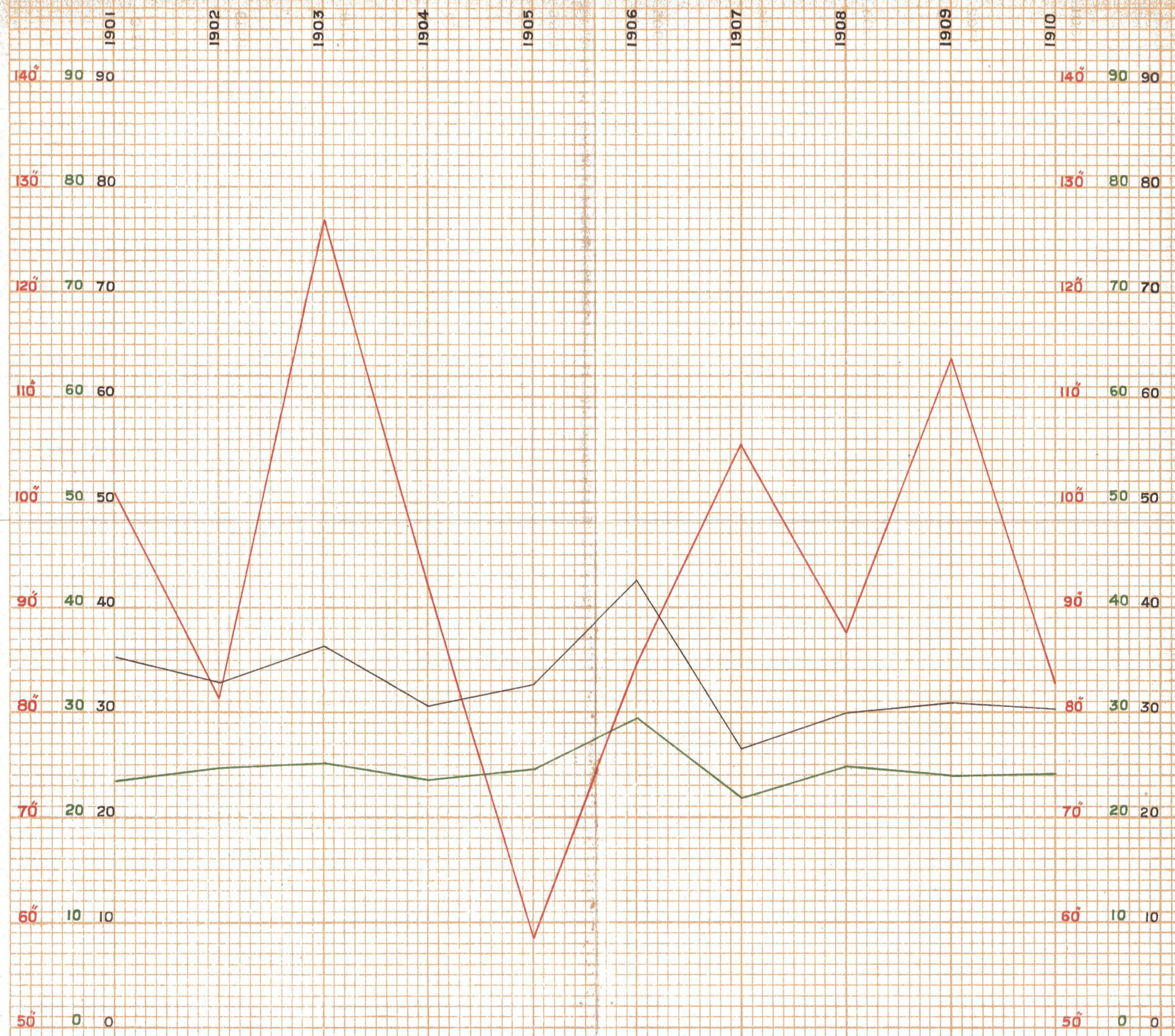
Malaria not being a disease that kills very rapidly, though it is accountable for so great a proportion of the deaths that do occur, it is not till the Malaria season is well established that its effect on the mortality is marked. In October there is slight rise in the Death-rate *minus* the rate for Special Diseases, but in the case of the other two death-rates any rise due to commencing mortality from Malaria is concealed by the fall in the mortality from diseases of the bowel. But in November the rise is very evident in all the death-rates; and, at a time when, as seen by the maximum approximation of the two lower curves on the chart to one another, there is less mortality from the Special Diseases taken together than at any other time of year, Infantile mortality is actually at its highest, because of the severity of Malaria at this season. In infants Malaria kills much more quickly than in adults, and less often through late complications, such as Pneumonia. This is probably the reason why the infantile death-rate is already falling in December and January from the maximum in November, while the Death-rate *minus* the rate for Special Diseases remains high, and actually reaches its maximum in January.

The continuous fall of this latter death-rate throughout the latter part of the dry season affords the best indication of the continuous decline that goes on then in the amount of Malaria. The curve for this death-rate certainly accords with the account the cultivators themselves give of Malaria, that is essentially a disease of the cold weather months, and that it is not till the warm weather commences that the country begins to be healthy. It is with the fall of this curve that the country residences of well-to-do Indians in Salsette begin to be occupied.

It will be noticed that it is in October that the wind is just changing round to the North, from the West, before beginning to blow steadily from the North in November, and that the reappearance of the Westerly element in March synchronizes with the commencement of this steady fall in the mortality that has been noted. This may be otherwise stated by saying that the absence of the sea-breezes coincides in point of time with the greater mortality from Malaria.

A description of the Yearly Chart for the intercensal decennium 1901 to 1911 (Chart No. 2) is given on it; it includes a curve for the variations in rainfall. The appearance of the curve showing the total Death-rate *minus* that for Special Diseases does not suggest that the death-rate from Malaria has shown any general tendency to increase during the decennium. Nor does it suggest that there was any very severe epidemic visitation of the disease. But it does show clearly two facts regarding the relation of Malaria to the rainfall that have been noticed in other parts of India. One is that a mere heavy rainfall does not of itself involve any necessary increase in the amount of Malaria. In the year 1909 the rainfall was over 113", and in 1903 it was 127", yet no marked rise in the amount of Malaria appears to have resulted in either case. The other well-known fact illustrated by this chart is that what does cause a marked rise in the incidence of Malaria is the occurrence of a year of defective rainfall followed by one of ordinary or even of rather less than ordinary rainfall. The most malarious year of the decennium was 1906, the rainfall for 1905 having been so extraordinarily low, for Thána, as to be little over 58".

Hitherto variations in the incidence of Endemic Malaria have mainly been studied; it remains to be seen whether the figures do or do not give an indication of the occurrence of waves of Epidemic Malaria, such as have been



SALSETTE TALUKA

CHART N^o 2.

SHOWING

The annual Death-rate per-mille for the years 1901-1910 (Black curve)

The same annual Death-rate less the Death-rates from Small-pox, Plague, Cholera and Dysentery & Diarrhoea (Green curve)

and

The total annual rain-fall registered at Thana town for the years 1901-1910 (Red curve)

shown, by a study of mortality figures, to have occurred in the Punjab. This is best shown by taking the mean of the deaths recorded throughout the decennium for some month which seems to have been free from special epidemic conditions, treating this figure as one, and subjecting the mortality figures for the different months of the different years to division by it, in order to see whether a high multiple of one is anywhere obtained.

In the following table the deaths for the different months of the different years of the decennium, less the deaths from the Special Diseases, are given, those figures which are less than ten per cent. above the mean of their particular month having been expunged, to show up the others more clearly:—

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Years.	
1901	...	492	420	425	...	...	...	...	...	...	...	...	1901
1902	344	364	389	449	1902	
1903	...	445	391	...	359	...	250	...	...	...	...	...	1903
1904	249	...	...	...	...	...	...	1904	
1905	360	...	332	295	258	...	...	...	...	...	1905	
1906	439	361	337	288	333	386	...	350	407	334	1906
1907	1907	
1908	351	...	...	...	...	1908	
1909	1909	
1910	351	409	334	1910	

June being the month in which the Death-rate *minus* the rate for Special Diseases is lowest, its mean for the decennium may be taken as one. In the next table the figures for the first table have been corrected so as to be figures for months of thirty days. They have then been divided by the mean of the figures for June, and the result is as shown. The figures for the rainfall at Thána for the years of the decennium have been inserted at the left hand side of the table, the rainfall for 1899 and 1900 also being given:—

Rainfall at Thána in inches.	Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Years.
41·87	1899													
36·61	1900													
70·74	1901	1·8	2	1·8	...	...	...	...	...	...	...	...	...	1901
81·17	1902	...	...	...	...	...	...	...	...	1·5	1·6	1·7	1·9	1902
126·97	1903	1·9	1·9	...	1·6	...	1·1	...	...	...	...	...	...	1903
91·93	1904	...	...	...	...	...	1·1	...	...	...	...	...	...	1904
53·33	1905	...	1·7	...	1·5	1·3	...	...	...	...	...	...	...	1905
84·43	1906	...	...	1·9	1·6	1·4	1·3	1·4	1·7	...	1·5	1·3	1·6	1906
105·36	1907	...	...	...	...	...	...	...	...	...	...	...	...	1907
87·65	1908	...	...	...	...	...	...	...	1·5	...	...	...	...	1908
113·06	1909	...	...	...	...	...	...	...	...	...	...	...	...	1909
62·88	1910	...	...	...	...	...	...	...	...	...	1·5	1·3	1·6	1910

Nothing that could be called an actual Epidemic Figure is to be seen, and it may be concluded that, although variations in the intensity of Malaria did occur, Malaria did not visit Salsette in Epidemic form during the decennium.

It will be observed that the highest mortality occurs early in 1901, the effect of the failure of the rains in 1899 having been to make the Malaria season of 1900-01 an unusually severe one.

THE BIRTH-RATE.—The seasonal birth-rate curves for all the nine *tálukas* of the Thána District show the same variations for different months. Although rural Salsette so much resembles the average *táluka* of the Thána District its curve shows those seasonal variations to a much less degree than the others, probably on account of its being almost the only *táluka* with anything of an urban population. Accordingly the birth-rate curve of Salsette *Táluka* is not shown in either of the two charts. The seasonal birth-rate of rural Salsette is probably really better represented by the curves for the other *tálukas*. In Captain Higham's charts for the decennium 1901—1910 those all show a continuous rise from between 24 and 34 per thousand per annum in February to between 44 and 58 in May. This high birth-rate is maintained in June, but there is a rapid and a uniform decline to between 32 and 39 in July. There is some further almost uniform decline in September, nearly all the *tálukas* having then a birth-rate of 28 to 32 per thousand per annum. With a slight but nearly uniform rise in November, and an exactly corresponding fall in December, the rates remain about the same level till the beginning of the rise after February. The Peint *Táluka* of the Násik District, which is geographically a part of Thána District, shows this same peculiar curve, which is not that of the other *tálukas* of the Deccan district of Násik, and which is not accounted for by any seasonal migration of the population, for none takes place in Thána District.

This relatively great height of a birth-rate, the mean of which, 34.21 per 1,000 for the decennium, is not high for an Indian district, in the months of March to June, would appear to connote a relatively increased virility in the months of June to September. As the phenomenon is not observed in the Deccan it must depend on something which influences the Konkani to a much greater extent than the Deccani.

There is one thing that the inhabitant of the Deccan knows little of, and that is the extraordinary difference which the presence or absence of the sea-breeze makes to the vitality of the inhabitant of the Konkan. If a reference is made to the meteorological figures at the foot of chart No. 1 it will be seen how closely this period of relative virility coincides with the monsoon, how it suddenly begins with the access of velocity in the sea-breeze in June, and the appearance of the southerly element, and how it ends as abruptly in October when the wind shifts round from the West to the North and the Malaria season sets in.

CHAPTER III.

THE ANOPHELINE MOSQUITOS OF SALSETTE.

The following are the species of Anopheline mosquitos which were found in Salsette during the present enquiry:—

Myzomyia culicifacies.

Myzomyia listoni.

Nedcellia stephensi.

Nyssorhynchus fuliginosus.

Nyssorhynchus jamesii.

Pyretophorus jeyporiensis.

Nyssomyzomyia rossii.

Nyssomyzomyia punctulata.

Myzorhynchus barbirostris.

It will be noticed that those are the same anophelines as those found on Bombay Island by Dr. Bentley, with the addition of *Py. jeyporiensis* and *N. punctulata*.

In Appendix I is given a table in which the anophelines are mentioned one by one, with the exact places where they have been found in the larval or adult state within the boundaries of the different villages, the latter being grouped according to the nearest railway stations.

In Appendix II another table gives the villages in alphabetical order, with the names of the different species, and the places in which they have been found. From both of those tables the record of *N. rossii* has been omitted.

It is hoped that this will facilitate any research that may in future be carried out in order to discover which mosquitos are the actual carriers.

In Appendix III notes are given on the apparatus used in collecting larvæ, and on the instructions issued to subordinates employed to collect them.

The first four of the anophelines mentioned have been found, in one part of India or another, to be carriers of Malaria.

The following table gives the proportion of adults captured and brought for identification from the East and from the West side of the island respectively, out of a total of 823 from the East side and of 1,168 from the West side. It will be noticed how closely the two sets of percentages resemble one another:—

Names of species.	East side.		West side.	
	Number caught.	Percentage of total.	Number caught.	Percentage of total.
<i>Py. jeyporiensis</i> ... ..	...	...	1	·08
<i>N. punctulata</i>	4	·48	...	...
<i>Ny. fuliginosus</i>	57	6·93	97	8·30
<i>My. culicifacies</i>	4	·48	2	·17
<i>Ny. jamesii</i>	2	·24	1	·03
<i>My. listoni</i>	4	·48	2	·17
<i>M. barbirostris</i>	23	2·80	26	2·22
<i>Ne. stephensi</i>	6	·73	2	·17
<i>N. rossii</i>	723	87·85	1,037	88·78
Total	823	...	1,168	...

The next table gives the proportion of the samples of larvæ of different species brought from different parts of the island, out of a total of 522 samples identified. As many as possible of the bottles of larvæ were kept standing in order to let the adults hatch out, scores of bottles being accordingly stocked for issue :—

Names of species.	Samples.	Percentage of total.
<i>Ny. fuliginosus</i>	145	27.78
<i>N. rossii</i>	115	22.03
<i>My. culicifacies</i>	93	17.82
<i>Ny. jamesii</i>	19	3.63
<i>My. listoni</i>	36	6.90
<i>M. barbirostris</i>	111	21.26
<i>Ne. stephensi</i>	3	.57

The figures for the larvæ are a much less reliable guide than those for the adults to the actual extent to which different species infest the island. The proportion of specimens of *N. rossii* larvæ found, for example, varies with the weather very greatly. A few weeks of dry weather is sufficient to cause their almost complete disappearance, and a single shower of rain to cause their re-appearance, at some places in every puddle or hoof-print.

It was unfortunate for the enquiry that the monsoon stopped unusually early, at the very beginning of September, as this made it impossible to conduct a really representative examination of the larvæ of the rice-fields.

WELLS.—The larvæ of six species, three of which, *My. culicifacies*, *My. listoni* and *Ny. fuliginosus*, are known carriers of Malaria in one part of India or another, were found in wells. The number of wells actually examined was not recorded, but, roughly speaking, two wells out of every three were found to contain the larvæ of one or more anophelines. Leaving out of consideration the wells in which the larvæ of *N. rossii* were found, and counting a well as one, two or three according to the number of species found in it, the following figures were obtained :—

Names of species.	Number of wells in which found.	Percentage of total.
<i>M. barbirostris</i>	54	33.75
<i>Ny. fuliginosus</i>	27	16.87
<i>My. culicifacies</i>	55	34.87
<i>My. listoni</i>	19	11.87
<i>Ny. jamesii</i>	5	3.12

BORROWPITS.—The borrowpits of the B. B. & C. I. Railway also deserve special mention, as they continue to breed mosquitos very late in the season, and long after most other temporary breeding-places have dried. Moreover, there is a chain of them running through the most malarious part of the country through which the line runs. A special re-examination of them was undertaken late in October, there having been practically no rain since the beginning of September. Larvæ were brought on this occasion from 55 borrowpits. Excluding 9 of them, in which only the larvæ of *N. rossii* were found, the proportion in which those of different anophelines were found was as follows :—

Names of species.	Number of borrowpits in which found.	Percentage of total.
<i>Ny. fuliginosus</i>	40	86.95
<i>M. barbirostris</i>	4	8.69
<i>My. culicifacies</i>	2	4.35

Notes on different Anophelines.

My. culicifacies.—The larvæ of this species were found in a great proportion of cases in wells. They were also found in streams, and would have been oftener were there more permanent streams in Salsette. They were also found in railway borrowpits and rice-fields. A very few adults were found in huts.

The larva is stated in James and Liston's "*Anopheline Mosquitos of India*" to have fully developed palmate hairs on the thorax. The present writer's experience, in several districts of this Presidency in which he has hatched out mosquito larvæ at different places, has been that palmate hairs are rarely found on the thorax in this species, and certainly never fully-developed ones. This is unfortunate, for it means that the larvæ of one of the principal Malaria-carriers of the west of India have to be put in the class whose characteristics are mainly negative.

My. listoni.—The larvæ of this species were also mostly found in wells. A few adults were found in cowsheds and other buildings.

In the standard description of this mosquito, given in *James and Liston*, the 3rd longitudinal vein of the wing is said to be white-scaled, this being one of the principal distinguishing characteristics, as this vein in the case of *My. culicifacies* is black-scaled. Dr. Bentley, however, states in his report that in the variety of *My. listoni* present in Bombay this vein is black-scaled. In Salsette, both in the case of adults caught in houses, and in the case of those hatched out from larvæ, the 3rd longitudinal vein of *My. listoni* was found to be white-scaled. This and the fact that the first dark area on the costa of the wing is not, as in the case of *My. culicifacies*, divided into two by a white spot, made it quite possible to distinguish *My. listoni* from the other, without having recourse to comparison of the relative length of wing-cells, as has been recommended.

Dr. Bentley further states that the larvæ of *My. culicifacies* are indistinguishable from those of *My. listoni*. There are species the larvæ of which may be difficult to distinguish from those of *My. culicifacies*, but as far as Salsette specimens go, the larvæ of no two species are easier to tell from one another than those of *My. culicifacies* and *My. listoni*, the appearance of those of the latter, with the large palmate hairs on the thorax and the abdominal palmate hairs conspicuously prominent at the sides of the segments, exactly corresponding with the illustration given in *James and Liston*.

Like *My. culicifacies*, *My. listoni* was not found to be the carrier by Dr. Bentley, in the case of the limited number of specimens of adults caught in Bombay Island and dissected, during his investigation. In parts of Bengal it is the chief carrier of Malaria, but it has not, so far, been found infected in Western India.

Neocellia stephensi.—This species, which is the carrier in the case of Bombay, is noted by Dr. Bentley as being scarce in the northern and non-malarious part of Bombay Island. In the Thána District, outside Salsette, the writer has found its larvæ in a nullah near Kalyán, and in the stream running into the creek at Bhiwandi just above the tidal limit. The present investigation has shown it to be so very scanty in Salsette that it is extremely unlikely to be the carrier of the Malaria which is so common over a large area of that island.

Ny. fuliginosus.—This is the tank-breeding mosquito *par excellence*. It is found in practically any tank one cares to examine in the Thána District. It is also the mosquito most commonly found in rice-fields and railway borrow-pits. Next to *N. rossii* it is the commonest mosquito in houses in Salsette. It is mentioned by Dr. Bentley as having been once found in Bombay.

In Burma and in Northern India this species has been found in some places to be the principal carrier of Malaria. Its ubiquitousness in Salsette

makes it difficult to hazard a guess as to whether it is likely to be a carrier there or not: that it breeds in numbers in non-malarious villages does not necessarily mean that it is not a carrier in malarious ones.

Ny. jamesii.—This is the species which seems to replace *Ny. fuliginosus* in Bombay Island, where it is very much commoner as a tank mosquito than in Salsette. It is distinguishable from *Ny. fuliginosus* in having speckled legs, and also by having certain differences in the scale markings of the veins of the wings. Even at a glance it is possible to tell the one from the other by the fact that *Ny. fuliginosus* gives the impression of having a dark wing with white spots, *Ny. jamesii* of having a light wing with black spots.

This mosquito is capable of being experimentally infected in the laboratory, though it has not been found infected in nature. It does not occur sufficiently commonly in Salsette to make it likely to be much of a carrier in any case.

Pyretophorus jeyporiensis.—This is not a widely-distributed species. Only one specimen, an adult, was found in Salsette. Its markings were as described in *James and Liston*.

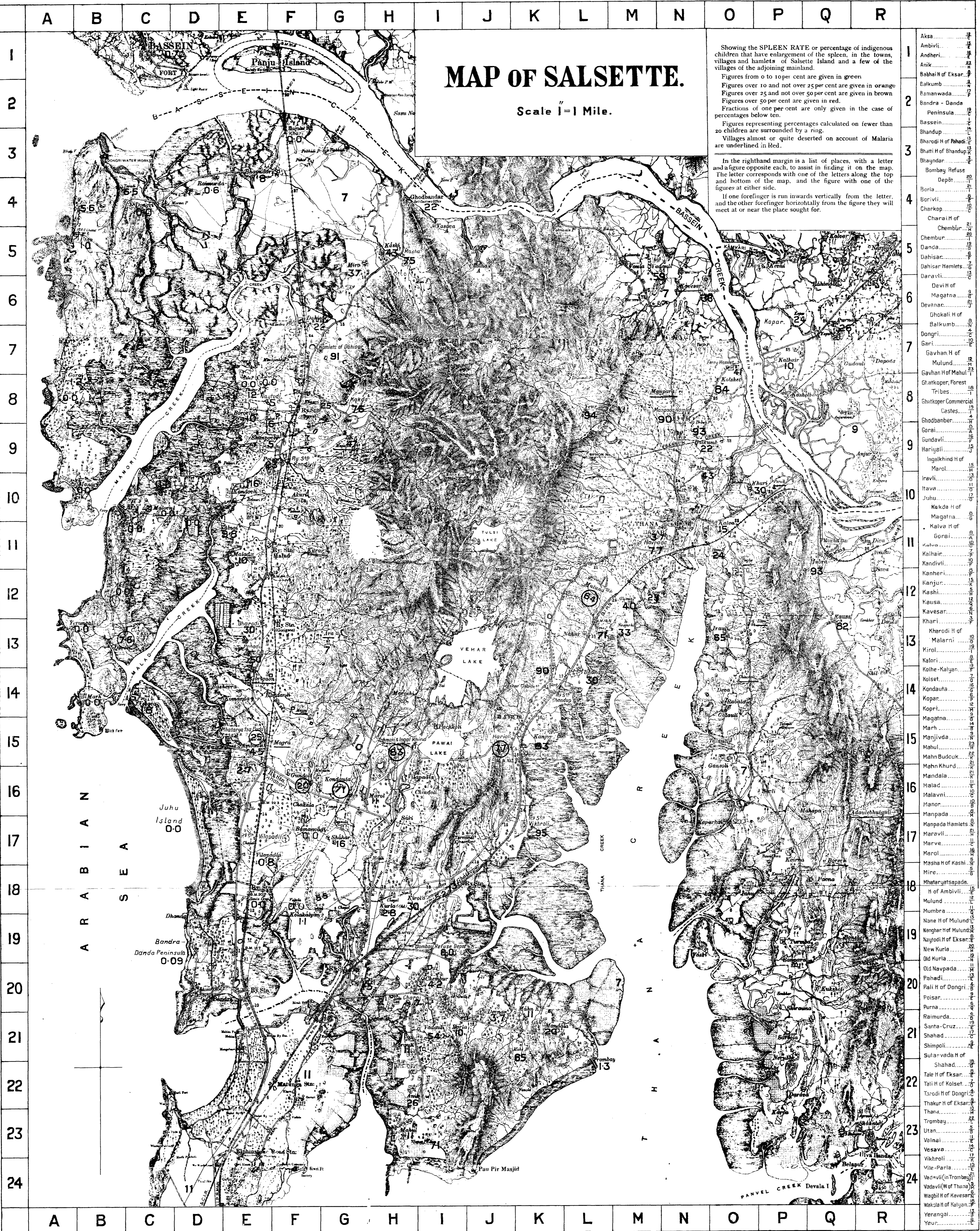
Nyssomyzomyia rossi.—This is infinitely the commonest of the anopheline mosquitos. Though its breeding places are such as rapidly dry up at the end of the monsoon it was, as usual, present in houses and cowsheds in such numbers as very seriously to interfere with the collection of more important species. Neither in Bombay, where Dr. Bentley dissected large numbers of specimens, nor in other places has this, the first described of the Anophelines, been found to be infected. Were it a carrier hardly any one would escape Malaria.

Nyssomyzomyia punctulata.—This species is easily told from all other Anophelines by its having half the proboscis black, and the other half white. Adults were found in a few places in the eastern side of the island. No description of its larvæ has as yet been published, and it was not found to hatch out from any of the samples of larvæ brought for identification in Salsette.

Myzomyia barbirostris.—This mosquito is the third commonest in the houses and cowsheds of Salsette, and its larvæ are by far the commonest in the wells. It has a great preference for dark, shady places. It has been infected experimentally, but has not, so far, been found as a carrier in Nature.

GENERAL CONCLUSIONS.—In the absence of dissection of captured adult mosquitos, to discover which are the carriers, it cannot be said that any definite indication can be found from a study of the distribution of Anophelines in Salsette. Mosquitos there are, which have a definite reputation elsewhere as carriers of rural Malaria, but they are to be found in places that, as tested by the Spleen Census, are quite free from Malaria, as well as in places notoriously subject to it, and the carrier of the urban Malaria of Bombay is very scarce in Salsette,

Whatever be the carrier it is evident that something more than the presence of facilities for breeding in abundance is required. The presence of sufficient dampness and shelter from the wind to enable the female to survive in considerable numbers till she becomes infected, and, further, until the parasite has gone through that part of its cycle which takes place in her body, and is present in her salivary glands, appear to be the factors which must be present to determine the malariousness of a locality,



MAP OF SALSETTE.

Scale 1" = 1 Mile.

Showing the SPLEEN RATE or percentage of indigenous children that have enlargement of the spleen, in the towns, villages and hamlets of Salsette Island and a few of the villages of the adjoining mainland.

Figures from 0 to 10 per cent are given in green
 Figures over 10 and not over 25 per cent are given in orange
 Figures over 25 and not over 50 per cent are given in brown
 Figures over 50 per cent are given in red.
 Fractions of one per cent are only given in the case of percentages below ten.

Figures representing percentages calculated on fewer than 20 children are surrounded by a ring.
 Villages almost or quite deserted on account of Malaria are underlined in Red.

In the righthand margin is a list of places, with a letter and a figure opposite each, to assist in finding it on the map. The letter corresponds with one of the letters along the top and bottom of the map, and the figure with one of the figures at either side.

If one forefinger is run inwards vertically from the letter, and the other forefinger horizontally from the figure they will meet at or near the place sought for.

1	Aksa	15
1	Ambivil	15
1	Andheri	15
1	Anik	23
1	Bahai H of Eksar	15
2	Balkumb	15
2	Bamanwada	17
2	Bandra - Danda	19
2	Peninsula	19
2	Bassein	14
3	Bhandup	14
3	Bharodi H of Pahadi	15
3	Bhati H of Bhandup	15
3	Bhayndar	15
3	Bombay Refuse	20
3	Depot	20
4	Borla	21
4	Borvili	16
4	Charkap	10
4	Charai H of	
4	Chembur	21
5	Chembur	14
5	Danda	15
5	Dahisar	15
5	Dahisar Hamlets	15
5	Daravli	15
6	Devi H of	
6	Magatna	15
6	Devanar	15
6	Dhokali H of	
6	Balkumb	15
7	Dongri	15
7	Gari	15
7	Gavhan H of	
7	Mulund	12
7	Gavhan H of Mahul	15
8	Ghatkoper Forest	15
8	Tribes	15
8	Ghatkoper Commercial	15
8	Castes	15
8	Ghodanbar	15
9	Gorai	15
9	Gundavli	15
9	Hariyali	15
9	Ingalkhind H of	
9	Marol	15
10	Iravli	15
10	Itava	15
10	Juhu	15
10	Kakda H of	
10	Magatna	15
10	Kalva H of	
11	Gorai	15
11	Kalhair	15
11	Kandivli	15
11	Kanheri	15
12	Kanjur	15
12	Kashi	15
12	Kausa	15
12	Kavesar	15
12	Khari	15
13	Kharodi H of	
13	Malarni	15
13	Kirol	15
13	Kalari	15
13	Kolhe-Kalyan	15
14	Kolset	15
14	Kondauta	15
14	Kopar	15
14	Kopri	15
14	Magatna	15
14	Marh	15
15	Manjivda	15
15	Mahul	15
15	Mahn Budcuk	15
15	Mahn Khurd	15
16	Mandala	15
16	Malad	15
16	Malavni	15
16	Manor	15
16	Manpada	15
16	Manpada Hamlets	15
17	Marvli	15
17	Marve	15
17	Marol	15
17	Masha H of Kashi	15
17	Mire	15
18	Mhataryatsapada	15
18	H of Ambivil	15
18	Mulund	15
18	Mumbra	15
18	Nane H of Mulund	15
19	Nanghar H of Mulund	15
19	Nayodi H of Eksar	15
19	New Kuria	15
19	Old Kuria	15
19	Old Navpada	15
19	Pahadi	15
20	Pali H of Dongri	15
20	Poisar	15
20	Purna	15
20	Raimurda	15
21	Santa Cruz	15
21	Shahad	15
21	Shimpoli	15
21	Sutarvada H of	
21	Shahad	15
22	Tali H of Eksar	15
22	Tali H of Kolset	15
22	Tarodi H of Dongri	15
22	Thakur H of Eksar	15
22	Thana	15
22	Trombay	15
23	Utan	15
23	Valnai	15
23	Vesava	15
23	Vikhroli	15
23	Vile-Parla	15
23	Vadavli (in Trombay)	15
23	Vadavli (W of Thana)	15
24	Wagbil H of Kavesar	15
24	Wakola H of Kalyan	15
24	Yerangal	15
24	Yeur	15

CHAPTER IV.

THE SPLEEN CENSUS.

The percentage of indigenous children showing enlargement of the spleen, a condition rarely due in childhood to any other cause, has been found to be a most excellent means of judging of the extent to which Malaria prevails in a community.

In working out the Malariology of an area sufficiently limited to be dealt with completely, the taking of the Spleen Rate, as it is called, is only one of a number of means of study. But the Spleen Census by itself gives results so accurate and so rapidly obtainable that when it is merely a case of finding out whether a given tract of country is malarious or not, or of judging of the relative malariousness of different parts of one, it is neither practicable nor necessary to combine with it any other means of demonstrating the amount of Malaria present. A Spleen Census among children has accordingly been used as the best method of demonstrating the great variations which exist in the extent to which the different parts of Salsette are affected by the disease.

The accompanying map of the island of Salsette shows the percentage figure of the Spleen Rate marked in under the name of each town or village. In order to show more graphically the wide differences that exist between different places in respect of Malaria, different colours have been used. Figures up to 10 per cent. have been entered in green; those up to 25 in orange; those up to 50 in brown, and those above 50 in red.

It is an obvious possible use of this map to take its figures as a guide in making out another map, showing the whole island marked out in patches of colour, according to their relative malariousness or non-malariousness, in order to assist those who have to judge of where to build and where not to build. But the *boundaries* of such coloured areas would be very difficult to determine in any reliable manner, and the more so in those very parts where Malaria has so thinned the population that the means of taking a representative Spleen Census are absent. It is better not to attempt to make the figures show more than they do show, and to trust to the general lessons they teach for guidance, in areas where they do not give detailed information.

While the Spleen Rate is not influenced by the severity or otherwise of a particular Malaria Season to anything like the same extent as an Endemic Index consisting of the percentage of children found to harbour the malarial parasite in the blood, it is only to be expected that good and bad years should make some difference in it. It is well at the outset to note, then, that the year 1911, which is the one whose Malaria season would exercise the greatest influence on the Spleen Rate taken in 1912, was a distinctly mild fever year, as the season of 1912 promises to be also, so that the figures certainly do not over-estimate the extent to which Malaria prevails in Salsette.

The following table gives in alphabetical order the towns, villages and hamlets in which the Spleen Census was taken. In the case of the villages round Thána, it was taken by the writer in December 1911, in the course of an investigation carried out in order to find out if any part of the environs of Thána was sufficiently non-malarious to allow of the building of residences for district officers. Here the Spleens are not classified according to size. In the case of the villages and towns of the rest of the island, in which the Spleen Census was taken in October and November 1912, as part of the special investigation which is the subject of this report, they are classified according to the method recommended by the Central Malarial Committee. In all 7,156 children were examined :—

Village or Hamlet.	Place on map.	Size of spleen in children examined.					Total of children examined.	Spleen rate per cent.	
		Spleen not enlarged.	Spleen just palpable.	Spleen 2-3 fingers breadth below ribs.	Spleen a hand's breadth below ribs.	Spleen extending down to navel.			
Aksa	13 C	17	...	...	...	...	17	Nil.
Ambivli	15 E	84	1	...	2	1	88	4.5
Andheri	16 F	71	1	1	...	...	73	2.7
Anik	23 H	28	4	3	1	2	88	26
Babhai, Hamlet of Eksar	8 F	73	7	7	...	...	87	16
Balkumb	9 N	Spleens not classified.		...	...	...	65	23
Bamanwada	17 F	20	...	...	...	...	20	Nil.
Bandra-Danda Peninsula	19 G	1,000	...	1	...	...	1,001	0.09
Bhandup	14 L	78	15	15	3	1	112	30
Bharodi, Hamlet of Pahadi	13 E	14	1	3	2	...	20	30
Bhatti, Hamlet of Bhandup	13 K	3	4	16	5	3	31	90
Bhayandar	3 E	110	1	...	...	1	112	1.73
Bombay Refuse Depôt	20 I	41	...	...	...	...	41	Nil.
Borla	21 I	35	1	3	...	...	39	10
Borivli	8 E	54	...	6	...	...	60	10
Charkeop	10 C	75	...	...	...	...	75	Nil.
Charai, Hamlet of Chembur	21 H	67	...	5	...	...	72	7
Chembur	20 I	141	3	3	1	...	148	4.2
Dahisar	6 F	57	5	9	2	...	73	22
Dahisar Hamlets	7 G	4	11	23	8	...	46	91.3
Danda—see Bandra-Danda Peninsula	19 D	...	...	...	...	...	...	...
Daravli	13 C	12	...	1	...	...	13	7.7
Devi, Hamlet of Magatna	9 G	8	3	2	2	...	15	46.6
Devnar	21 J	51	...	...	2	...	53	3.7
Dhokale, Hamlet of Balkumb	8 N	Spleens not classified.		...	...	...	35	33
Dongri	4 C	74	...	...	...	...	74	Nil.
Gavhan, Hamlet of Mulund	12 M	Spleens not classified.		...	...	...	50	40
Gavhan, Hamlet of Mahul	23 I	6	5	6	2	2	21	71
Ghatkopar, Forest Tribes	18 I	6	2	7	4	3	22	72.7
Ghatkopar, Commercial Castes	19 I	109	6	...	...	...	115	5.2
Ghodbander	4 H	69	3	14	1	1	88	22
Gorai	8 A	163	1	...	1	...	165	1.2
Gundavli	16 F	12	1	1	...	1	15	20
Hariali	15 J	4	2	8	3	...	17	76.5
Ingal Khind, Hamlet of Marol	15 H	2	3	5	2	...	12	83.3
Iravli	13 O	Spleens not classified.		...	...	...	37	64
Itawa	11 O	Spleens not classified.		...	...	...	66	24
Juhu	17 D	116	...	...	...	...	116	Nil.
Kakda, Hamlet of Magatna	8 G	6	6	9	4	...	25	76
Kalva	10 O	Spleens not classified.		...	...	...	27	15
Kalva, Hamlet of Gorai	8 A	40	...	...	...	...	40	Nil.

Village or Hamlet	Place on map.	Size of spleen in children examined.					Total of children examined.	Spleen rate per cent.
		Spleen not enlarged.	Spleen just palpable.	Spleen 2-3 fingers breadth below ribs.	Spleen a hand's breadth below ribs.	Spleen extending down to navel.		
Kandivli	10 B	92	4	3	...	...	99	7
Kanheri	8 F	18	...	3	2	1	24	25
Kanjur	15 K	6	5	12	9	3	35	83
Kashi	5 H	43	12	18	2	...	75	43
Khari	3 F	Spleens	not clas-	sified.	...	...	90	80
Kharodi Hamlet of Malavani	10 D	41	...	...	...	...	41	N/L.
Kirol	19 I	56	16	7	1	1	81	30
Kalori	8 E	20	...	...	...	...	20	N/L.
Kolhe Kalyan	19 F	179	...	...	2	...	181	1.1
Kolshet	7 O	Spleens	not clas-	sified.	...	...	44	84
Kondivate	16 G	5	...	2	...	...	7	71.4
Kurla (new)	20 H	128	1	1	...	...	130	1.6
Kurla (old)	19 H	103	...	3	...	...	106	2.8
Mahn Budruk	22 K	8	2	10	1	2	23	65
Mahn Khurd	21 K	51	2	4	...	...	57	11
Mahul	23 H	67	2	6	...	...	75	11
Malad	11 E	209	2	18	...	...	229	9.5
Malavan	10 C	88	...	...	...	...	88	N/L.
Mandala	21 K	23	3	3	...	...	29	20
Manjivda	9 N	Spleens	not clas-	sified.	...	...	37	43
Manori	10 B	209	...	...	...	...	209	N/L.
Manpada Hamlets	8 N	Spleens	not clas-	sified.	...	...	40	90
Maravli	21 H	33	1	2	1	...	37	11
Marh	14 B	45	...	...	...	...	45	N/L.
Marol	16 H	106	3	3	1	1	119	10
Marve	11 C	36	...	...	...	...	36	N/L.
Masha Hamlet of Kashi	5 H	6	3	12	2	1	24	75
Mira	5 G	52	10	15	3	3	83	37
Mhatarya tea pada, Hamlet of Ambivli	15 E	9	1	2	...	...	12	25
Mulund	12 L	Spleens	not clas-	sified.	...	...	11	64
Nana, Hamlet of Mulund	13 L	Spleens	not clas-	sified.	...	...	23	71
Navghar, Hamlet of Mulund	13 M	Spleens	not clas-	sified.	...	...	49	33
Navpada	11 M	Spleens	not clas-	sified.	...	...	26	77
Naytodi, Hamlet of Eksar	8 E	19	1	...	...	...	20	5
Pahadi	13 E	11	4	5	...	2	22	50
Pali, Hamlet of Dongri	4 B	34	2	...	...	...	36	5.6
Poisar	9 E	69	10	7	3	1	90	23
Raimurda	4 D	158	...	1	...	...	159	0.6
Santa Cruz	19 F	64	...	...	...	...	64	N/L.
Shahad	17 G	49	2	7	...	...	58	16
Shimpoli	9 E	20	...	1	...	...	21	4.76

Village or Hamlet.	Place on map.	Size of spleen in children examined.					Total of children examined.	Spleen rate per cent.
		Spleen not enlarged.	Spleen just palpable.	Spleen 2-3 fingers breadth below ribs.	Spleen a hand's breadth below ribs.	Spleen extending down to navel.		
Sutarwada, Hamlet of Shahad	18 G	17	1	...	...	...	18	5.5
Tale, Hamlet of Eksar	8 E	58	...	...	...	...	58	Nil.
Tari, Hamlet of Kolset	7 O	Spleens	not classified.	...	...	...	27	41
Tarodi, Hamlet of Dongri	4 C	29	1	1	...	...	31	6.5
Thakur, Hamlet of Eksar	8 E	21	2	1	...	...	24	12.5
Trombay	22 L	74	1	...	...	...	75	1.3
Utan	5 B	194	1	1	...	...	196	1
Vakola, Hamlet of Kolhe Kalyan	19 F	53	...	...	...	...	53	Nil.
Valnai	11 E	37	4	...	...	...	41	9.3
Vesava	14 C	108	2	...	...	...	110	1.3
Vikhroli	17 K	2	3	12	8	13	38	95
Vila Parla	18 E	127	1	...	...	...	128	0.78
Vadavli (in Trombay)	21 Y	13	7	5	2	1	23	54
Vadavli (N. of Thana)	5 M	Spleens	not classified.	...	...	...	133	59
Waghli, Hamlet of Kavasar	6 N	Spleens	not classified.	...	...	...	164	42
Yerangal	13 B	60	...	...	...	...	60	Nil.
Year	8 L	Spleens	not classified.	...	...	...	88	94
Total of Children examined	...	...	...	...	...	...	7,156	...

The Spleen Census has its Scylla and Charybdis. On the one hand, if one strikes a percentage on a very small number of children, as one sometimes must, if hamlets are to be taken separately from the villages to which they belong, there is a certainty of a very obvious kind of error. On the other hand, if the figures for a village and a small hamlet belonging to it are added together for the purpose of striking the percentage on as large a figure as possible, though the children of the hamlet have a larger proportion of enlarged spleens than those of the village, the percentage struck is not accurate either, being rather higher than that of the village, and a good deal lower than that of the hamlet.

The principle here followed has been to compound the figures for a village and its hamlets only when there was no great difference found between the proportions of enlarged spleens, and to employ a special sign on the map to indicate a place where the rate has been calculated on a very small number of children.

In this connection the matter of class composition in different villages and hamlets must be alluded to. It is found, as a rule, that the poorer fed a class or caste of people is, the more liable are its members to Malaria, and *vice versa*, and the peoples of Salsette are no exception to the rule. The children of the well-to-do commercial castes who reside in villas in Salsette for part of the year may be left out of account: their Spleen Rate would not have been taken even had they been in residence, as their children are not born and bred in Salsette. Bráhmíns, again, form such a relatively small proportion of the inhabitants of villages that no conclusions can be based on any figures relating to their children. But in some villages almost the whole, and in others quite the whole of the inhabitants are Indian Roman Catholics, and it was quite noticeable that their higher standard of living makes them tend to have a lower Spleen Rate than the average of cultivators. At the other end of the scale the distinctly

primitive castes, such as the Dublas and Varlis, tend to have the highest Spleen Rate of all.

Had it been possible to have dealt with this factor of the standard of living alone, and to demonstrate its influence by comparing the Spleen Rate, say of considerable numbers of Christians with that of considerable numbers of Dublas living under identical conditions, instructive figures could have been obtained. But in Salsette it is another factor that mainly determines the amount of Malaria in a given number of people of any class, namely, the physiographical situation of their villages. Indian Christians in Salsette tend to live in villages in non-malarious areas by the sea: Dublas and Varlis tend to live in hamlets in malarious areas on the lower slopes of the hills. That when, as an exception, Indian Christian cultivators live in a particularly malarious area, they suffer as badly as anyone could, is shown by the case of the entirely Christian village of Vikhroli, where the Spleen Rate was 95 per cent, and where the proportion of very large spleens was particularly high.

On account of this impossibility of comparing different peoples living under sufficiently identical conditions no attempt at classification by race, religion or caste has been made, and this fact must simply be allowed for in considering the value of the Spleen Rate as it was taken.

As in other places in India, the tendency of urban areas to be remarkably free from Malaria is strongly manifested in Salsette. This tendency is apt to be slightly exaggerated in a Spleen Census of mixed urban and rural areas, from the fact that, without very special measures, such as house-to-house visitation, one is almost wholly dependent for the Spleen Census in towns on the examination of school-children, as the street children, among whom the percentage of enlarged spleens might be expected to be higher, cannot be collected in the ready way in which they usually are in villages. But, allowing for this, the tendency is remarkably evident. Exceptionally great facilities for the propagation of the local carrier of Malaria, such as there are in the malarious wards of Bombay City, appear to be necessary, otherwise a densely-populated urban area is the last place where Malaria is to be found.

The table shows that out of 1,001 children of the Bándra-Dánda Peninsula, of whom by far the most were born and bred in Bándra bazaar, only one was found on examination to have enlargement of the spleen. Making all allowance for the accessibility of Bándra to the sea-breezes the figures are very remarkable.

Still more significant, however, is the case of the Thána bazaar. The Spleen Rate here, which was taken by the Civil Surgeon, Major Kukday, I. M. S., was only 3.7 per cent. in the midst of a tract of country the intense malariousness of which may be seen by a single glance at the Spleen Map. Only the thick of the bazaar of Thána is non-malarious: the suburbs, such as Navpáda, are severely malarious.

The one phenomenon that is brought out most prominently by the map and its figures is the evident relation of Malaria to the range of hills shown on it. In other parts of India also the tendency has been observed for malariousness to increase as the hills are approached. Thus, in one investigation the percentage of children found to be infected with Malaria in the environs of Calcutta was nil; further and further north it was 12, 25, 40, 55, and at the foot of the Himalayas 72. And not only in Salsette but anywhere in the Thána District one finds it to be a fact well-known to the villagers, and capable of ready demonstration by the taking of a Spleen Census, that it is the dwellers on the slopes of the hills, or near their bases, that suffer most severely from Malaria.

In this connection the mainland part of the map, on the east side, may profitably first be studied. The remarkable feature of this part of the country, where the Parsik range of hills towers above the creek, is the line of villages along its sides that have been completely, or almost completely deserted on account of Malaria. (Villages thus deserted are underlined in red on the map.) In places down by the creek-side, such as Itáva and Iravli, the descendants of the former inhabitants of those villages are still living. All the

account they can give of the matter is that about forty years ago the villages on the slopes had to be abandoned on account of the "wāit hawa," (literally the 'mal-aria') of the mountain. Even down at the water-side the influence of the proximity of the hill is seen in the spleen rates found in the villages. On the east of the range, where the villages are entirely shut off from sea-breezes, the spleen rates are among the highest possible: 82 per cent. at Kausa, and 93 per cent. at Mumbra.

An attempt that was made ten years ago to solve the problem of house accommodation at Thána by building bungalows for Government officers on one of the northern slopes of the Parsik range, was a complete failure. The bungalows proved as malarious as the villages of the Parsik range had been, and residence in them has had to be given up entirely.

The case of the island of Trombay, forming the south-east corner of Salsette, may next be studied. With its hill of trap-rock, rising to 1,001 feet, whose sides, as they slope down to the sea, are covered with the soil which is a product of the disintegration of the trap, and the edging of salty alluvium along its shores, on which the abundant growth of trees and grass comes to the usual abrupt conclusion, the island of Trombay forms an excellent miniature edition of Salsette. No detailed demonstration of the relation of Malaria to the hill is required; the figures show the closeness of that relationship so well themselves. Villages close to the base of the hill or on the slopes of one of its spurs, have a Spleen Rate of over 50 per cent., which rapidly gives way to smaller rates, ranging from 10 per cent. upwards, at a little distance from the hill. The hamlet of Charai, at the cross-roads, is far enough away to have only 7 per cent. Further north, Chembur, which is still nearer the edge of the tree and grass-covered area, has but 4.2 per cent. But what will be found most significant is that the Spleen Rate of the children of the Mahárs and Bhangis of the Bombay Municipal Refuse Depôt, a little further North still, is *nil*.

People will not, of themselves, build their villages right out in the open, away from the shade of trees, nor will any one build villas or bungalows either. This is only natural, and it must be accepted as an axiom in considering what advice is worthwhile giving. But the one drawback of it, in the case of a malarious tract of country, is well seen here, where the Mahárs and Bhangis of the Refuse Depôt are not only better off in respect of Malaria than the well-to-do artisans of Chembur, but have absolutely no Spleen Rate at all. The reason for it consists in the fact that they cannot choose their place to live in themselves. Their occupation necessitates their living out on the salty alluvium, where there are no trees, and the shortest of grass will hardly grow. Nobody else would live in such a place, and the result is that no other village in the whole of the East of Salsette is like theirs: it is the only one that does not have Malaria in it.

The effect of the sea-breezes is well seen in the case of the village of Trombay itself, which has a Spleen Rate of only 1.3 per cent., in marked contrast to the neighbouring villages inland.

If a general view is taken of the island of Salsette it will be seen that the central hills are surrounded with a ring of villages all having a Spleen Rate of anything between 50 per cent. and 95 per cent. Yeur is the village at the highest altitude that was visited: its rate is 94 per cent. It is very noticeable how, as one passes outwards from the hills to the sea, the Spleen Rate decreases, even where it is only a creek that represents the sea, as in the case of the eastern side of Salsette, while on the western side the villages most completely exposed to the sea-breezes have no Spleen Rate at all. The gradation is in some parts very noticeable; indeed one might in some parts draw lines connecting figures of the same colour and find that they ran parallel with the direction of the range and of the coast-line. Corresponding with the isobars or isotherms on a meteorological chart, these lines of approximately equal spleen intensity might be called "isosplens". Starting near Thána for example, one such isosplen (red) would run from Navpáda southwards through Mulund, Nána, Bhatti, Kanjur, Hariáli and Vikhroli. Another (brown), further from the hills and nearer the creek, would run from Gavhán through Navghar and Bhándup. Another

(orange) would curve round the head of the Thána creek where it contracts, opposite Thána town, to the narrow channel connecting it with the Bassein creek, and would include Itáva, Kalva and Kopri. In this grassy tract of country through which the G. L. P. Railway runs, from Ghatkopar northwards, the hills are too near the creek to leave room for villages so free from Malaria that a green isosplen could be drawn at all. To be able to draw an isosplen in each of the four colours one would have to start at the north-west side of the hills. Here the red would begin at Masha and pass southwards through the hamlets of Dahisar, and through Kákda. South of this the villages close to the hills are actually deserted so that no Spleen Rate can be taken in them at all. The brown isosplen would begin, a little further out from the hills than the other, at Kashi, and pass through Mira, then re-appear first at Devi, a hamlet of Magatna, and then again to pass through Bharodi and Pahadi. The orange would begin at Ghodbandar, a little further north than the others. Here the hills come right down to the creek, and there is, so to speak, a direct conflict of opposing influences. The sea-breezes do exert a marked effect, for Ghodbandar has a much lower Spleen Rate than any other village in Salsette commanded to such a degree by the hills. This orange isosplen would pass through Dahisar, Kanheri, Babái, Poisar and Gári. Outside it, and just before the tree and grass-covered country gives place to the alluvial flats, one might draw a green isosplen of villages that have a Spleen Rate of from five to ten per cent. It would start at Naytodi, and run south through Borivli, Shimpivli, Kandivli, Valnai and Malád. West of this, and fringing the sea-coast, is the long series of villages built on what are more or less islands separated by creeks and mud-flats from the mainland of Salsette, which were mentioned in Chapter I. In most of those villages there is absolutely no Spleen Rate at all. In just one or two is there a rate worth noticing. Thus Dongri village has two hamlets, Tarodi and Pali, that lie just at the base of a small hill, one on each side of it. In their case there is thus a reproduction in miniature of the conditions that bring about malariousness elsewhere, and the one hamlet has a spleen rate of 6.5 per cent., and the other of 5.6 per cent. But, taking those places on the coast as a whole, from Bháyn-dar on the north down to Bándra on the south, they are found to be all either wholly free from Malaria, or affected by it to a perfectly negligible extent.

Turning to the north-east corner of Salsette, we find very malarious conditions to the north of Thána. Though not quite so badly affected as those nearer the hills, the villages on the Bassein creek have a considerable Spleen Rate; they are too far round the corner, so to speak, to get the benefit of the sea-breezes. There are two villages deserted on account of Malaria here, Mánpara and Kavesar; the inhabitants of the latter have all shifted down to Wágbil on the creek-side. The case of Kolshet, and its hamlet, Tari, the inhabitants of which work the ferry for the Agra road traffic, is instructive. Kolshet is not out of the jungle; it is surrounded with trees and grass, and has a Spleen Rate of 84 per cent. Tari is on the shore, beyond the edge of the trees, just a hundred yards or two down the road, and its Spleen Rate is less than half that of Kolshet.

There now only remains for consideration a limited but important area in the South of the island, bounded on the North by the hills, and on the South by the Bándra creek. For the most part of this area is not under the influence of the hills, but at the north-west and north-east corners of it are two places, Andheri and Ghátkopar, which may be said to be just on the edge of the danger zone. The Spleen Rate of Andheri, 2.7 per cent., would not be noticeable were it not that nowhere south of it is there practically any Spleen Rate to record at all. At Ambivli, just north of Andheri, it is 4.5 per cent. A little further still up along the Ghodbandar road we have on the right the deserted village of Mogra, and on the left, on the slope of a grassy hill, a hamlet with a Spleen Rate of 25 per cent.

At Ghátkopar the hill castes, who nowadays mostly work as rice-field labourers, and whose work takes them to fields close to the hills, where they camp out during the rice-harvest, have a Spleen Rate of 73 per cent. The commercial classes, mostly Kacchi Bhattias who go to Bombay daily to their business, but who are resident here all the year round, have a Spleen Rate

of only 5·2 per cent. Their children are not exposed in the way the others are in the Malaria season, and they have every advantage that good housing and good feeding can give; more typical little bantias and banianis could hardly be seen. The sudden change which a short distance from the hills makes may be seen by comparing the Spleen Rate of Kiroi, where the people mostly work in the rice and grass-lands at the foot of the hills, with that of Old Kurla, down by the head of the Bándra Creek.

It will be seen how free from Malaria are places right away from the hills, such as New Kurla, Kolhekalyan, Vakola (close to Santa Cruz Cantonment), Santa Cruz and Vila Parla.

In attempting to account for that relationship of Malaria to Physiography which is so unmistakeably brought out by the Spleen Census, it is impossible at present to do anything more than surmise that it is the dampness of the ground associated with the constant movement of underground water from the hills towards the sea, and the shelter from the wind provided by the rank growth of trees and grass on the soil formed by the disintegration of the trap, that enable the anophelines to survive so well after the breeding-season, and to persist in numbers long enough into the dry season to become infected, to develop the parasite, and thus to start the cycle of infection of the mosquito by man and of man by the mosquito.

CHAPTER V.

RECOMMENDATIONS.

The subject of practical measures for the diminution of Malaria in Salsette may be considered under two headings, prevention in existing villages, and Prevention in new building areas.

PREVENTION IN EXISTING VILLAGES.—It is here the indigenous population that has to be thought of, both in its own interests and in those of the citizens of Bombay. While, in the abstract, the indigenous population of any malarious taluka of the Thána District is as deserving of protection as that of any other, there is a strong practical reason for devoting special attention to the case of the villagers of Salsette, in the proximity of this highly infected area to the City of Bombay, even if the tendency to suburban building is left out of account.

Without prejudice to anything recommended under the second heading it may at once be said here that in rural Salsette anything like a general attack on the breeding-places of the mosquito is out of the question. We are not here, as in Bombay, dealing with a series of artificial breeding-places, localized over a limited area of very valuable ground, but with natural breeding-places widely distributed over a large tract of country, most of which is of no greater value than such rice or forest-land would be in any other part of the Presidency.

The only series of breeding-places that can be abolished, and should be abolished, is the chain of borrow-pits along the B. B. & C. I. Railway, which, as already pointed out, continue to pour forth mosquitos in October, weeks after all the natural breeding-places in the neighbourhood have dried up. The line runs through a distinctly malarious tract of country from where it leaves Andheri Station to where it emerges on to the alluvial salt-lands at a point between Borivli and Bháyndar Stations, a little to the North of Dahisar village. The worst part of this region is that north and south of Goregaon Station.

The simplest way of dealing with borrow-pits is to run them into one another by a connecting channel, and to have outlets here and there into nullahs, as they occur. But as the Railway Company has already taken up the necessary land for the quadrupling of the line the opportunity should be taken, when construction work is in progress, to abolish the old borrow-pits altogether, and to see that no new ones are left either. Exactly how they shall provide materials for the extension of embankments is a matter for the railway engineers to settle. The only principal that has to be laid down is one which is coming to be well understood in connection with engineering in the tropics, that excavations should be made in such a way that they will drain promptly and completely into the nearest water-course.

It would be well if the due observance of this principle were in future made a regular condition of the acquisition of land by railway companies.

Though, with this exception, *breeding-places* cannot be attacked there is some evidence that it would be worth while to attack the *resting-places* of mosquitos. The extraordinary immunity from Malaria enjoyed by those whose villages are outside the tree and grass-covered area, and are completely accessible to the sea-breezes, is an obvious indication to expose to the sea-breezes as far as possible villages less happily situated. Every encouragement should be given to those who own or occupy the grass-lands of villages to cut the grass early, and keep it cut, in the actual vicinity of both villages and hamlets, and also to cut it early and keep it cut, on the side of any hill which may command a village or hamlet. While people cannot be expected to do without trees to shade their actual houses, the presence of a space free of trees as wide as possible around the village site will tend to promote the necessary ventilation, and the presence of brushwood or undergrowth of any sort in the vicinity of villages should in any possible way be discouraged.

While a great proportion of the adults in malarious places have acquired immunity by slow degrees, or are alive merely as examples of the

survival of the least susceptible, the disease is always in an active condition in the case of the children, whose spleens are the reservoirs which keep up the supply of the infection, and carry it on from one fever season to the next. The diminution of the size of those semi-liquid reservoirs should therefore be the chief aim of our anti-malarial measures, for if one cannot protect the children from the mosquitos the obvious thing to do is to protect the mosquitos from the children. Repeated individual attention to each child with an enlarged spleen is what is necessary; such children are only indirectly infectious, but for practical purposes they should be regarded as if they were directly infectious, and should be looked upon as an immediate source of danger to their neighbours, rich or poor.

The only way to keep up this constant attention to the state of the children's spleens is by means of a Travelling Dispensary. It is not suggested that Salsette should merely be one of the 26 talukas of the Presidency to which one of the existing travelling dispensaries is sent during the fever season, but that Salsette should have an itinerant Dispensary of its own, worked on special lines, and financed independently of Provincial or of Local Funds. The endowment of such an institution by a private individual, or by the trustees of a charitable fund, would be of benefit not merely to the inhabitants of one town, as in the case of a stationary dispensary, but to the whole of the people of the island who are out of reach of the existing hospitals and dispensaries; moreover, as a preventive institution, its object would be to protect those who are well besides treating those who are actually sick, and so to help the island to become a healthier place for Bombay people to come and live in. To be of any real service the work would have to be carried on the whole year round as each individual spleen would need repeated and systematic attention, and it would accordingly be advisable to provide a caravan for the purpose, in which the Assistant or Sub-Assistant Surgeon in charge could comfortably live even in the monsoon months. One compartment of this would be fitted up as a surgery, and a considerable stock of medicines could be kept in it. The caravan would be drawn by a yoke of bullocks. Two peons would be required. One would accompany the doctor on his visits to villages off the road, and carry the haversack he would take with him; the other would stay behind to look after the caravan. If the doctor wished to take any members of his family with him in the dry weather a small tent could be added to the equipment.

Salsette is fortunate in having its interior encircled by a made road, so that the dispensary could actually circumambulate the island. Experience would show what time was required in order to work the villages once properly, and the period of a pergrination would be fixed. Each time the caravan came round its books would be inspected and its stock made up, by the Civil Surgeon, Thána, or by the Medical Officer of Bándra Hospital, who would have to satisfy himself that the work done was not being confined to a mere distribution of medicines, but that the individual children, whose names were entered in the registers as having been found to have enlarged spleen, were being attended to on each round, and sufficient medicines left for their treatment.

The name of the dispensary, including that of the person whose memory it was desired to perpetuate by the gift of it, could be inscribed on the sides of the caravan.

PREVENTION IN NEW BUILDING AREAS.—If the investigation on which this report is based shows that certain of Mr. Mead's original suggestions are not such as can be carried out it should be remembered that Mr. Mead in his report was the first to suggest a malariological investigation in Salsette in connection with the town-planning he advocated.

Before individual areas are considered it may be well to lay down certain principles which should be adopted where building is being sanctioned. In the first place the leaving of any excavation which can hold water, in connection with the building of houses, should be prohibited by by-law. Wells, again, are very prolific breeding-places of mosquitos and they are not needed in places that have a pipe-water-supply. Their construction should not be sanctioned in such places. Legal powers to order the closing of wells after the introduction of a water-supply would be advantageous; they need not be made

use of in places where there is little Malaria, and where it is not showing signs of increasing. Tanks also are undesirable. To do without them means extra provision, in connection with the pipe-water-supply, of well drained dhobi gháts, and of places where buffaloes can be washed by their owners, as it does not do to prohibit tanks, and not provide for the due performance of their functions otherwise.

A good deal more can be done to prevent Malaria where the development of a regular garden city is in question than where it is merely a case of giving permission to individual owners of plots to build. It is much easier in the former case, for example, to act upon a recognition of the fact that a combination of trees or bushes with grass tends to make a place far more malarious than it would be with only the trees, or only the grass. But the practicability of preventing this combination should always be kept in mind where new acts, or new by-laws, are being drafted.

Even looking at the matter from the point of view of the safety of the well-to-do, it pays in the planning of a new urban area, to see that a certain standard is kept up for the building of the houses for the poorer classes in the local bazar, and that the promiscuous running up of huts for casual labourers and their families is discouraged.*

The question is to what parts of the island are really suited for residential development may now be considered. It is just because there are such wide variations in the amount of Malaria in the case of places situated at no great distance from one another, and otherwise equally well suited for development, that it is so well worth while to pay attention to the matter. It is not as though Salsette were, like so many localities in India, simply a malarious tract of country in which one had to make the best of it, and be thankful to find some spots here and there that were rather less malarious and one or two that were distinctly less malarious than the rest. The point about Salsette is that while parts of it are about as malarious as any place could be, there are such considerable areas with practically no malaria at all that one can quite well afford to set up a very high standard indeed. The Central Malaria Committee, looking to the general experience of India, classifies areas as "Healthy" in which the average Spleen Rate is not over ten per cent. In spite of the intense malariousness of parts of the island, Salsette can quite well afford not to call ten per cent. healthy, when it is a question of finding room to house a considerable part of the future suburban population of the city of Bombay. There is space enough without. It is only want of means of communication with Bombay that has in the past so often compelled those who wished to build to content themselves with a plot of ground in a malarious or in only a relatively non-malarious locality. Roughly speaking, it may be said that no Indian who has to go in to Bombay daily will live more than a mile from a railway. Hence it is that healthy tracts have been left undeveloped, while villas, that their owners only occupy for certain months of the year, are clustered in numbers round the stations of the B. B. and C. I. Railway in parts of the island which have, within the last generation or two, become so malarious that the indigenous population has largely disappeared.

The whole question of the development of healthy areas in Salsette is bound up with the question of the possibility of providing efficient means of communication with them. To make it possible for means of communication, such as main roads along which an electric or petrol tramway can be run, to be profitably provided it will be necessary in the future to concentrate attention and funds upon places that really have a future before

* Thána is one of the two districts of the Presidency that suffer the most from Plague. While touching on the subject of a possible future garden city in Salsette it may not be out of place to note how well it would pay its promoters to make it plague-proof. This does not mean extra expense. It only involves laying out and building the place so that rats will not find it worth while to live in it. Grain would have to be stored, and banias' shops be kept in special buildings not inhabited by human beings, and cattle and human beings would have to live apart. The poorer houses would be built like the inexpensive, but rat-proof houses of Eastern Bengal, where plague, though often introduced, has failed again and again to take root. For details of the subject the Journal of Hygiene, Plague Supplement I, pages 189 to 192, may be referred to.

them. The area receiving attention has hitherto been too extended a one. Town-planning has too often consisted in going after people who have built villas in unsuitable areas, and treating these as if they were the nuclei of future townships. The discouragement of building in unsuitable places is a necessary corollary to the encouragement of it in healthy ones.

Coming to parts of the island in detail, one may say without hesitation that Trombay may be put aside as distinctly unsuitable for development; there is not room for a healthy area between the hill and the mud-flats. Chembur might be considered a possible place, but the area round it is not sufficiently large to make it alone worth special means of communication.

The part of the island between the hills and the Thána Creek, through which the G. I. P. Railway runs northwards from Ghatkopar Station, is one which also is wholly unsuitable for development. The abundant grass lands and the plentiful space around Vikhroli Station led to the selection of Vikhroli by a committee which sat in 1909 as the best site on which to locate the Bombay Municipal Slaughter-house, when that is removed from Bándra, with its allied trades. But the Spleen Rate shows that the scheme would be quite impracticable; there would be such incessant invaliding among the employees, and such a high death-rate among their children. The area is as unsuitable for institutions as it would be for villa residences.

No part of the island—north of Thána—would be suitable for development either, even were it provided with means of access.

Both New and Old Kurla are non-malarious, though there is no room near the Railway Station for building, unless reclamation of flats were undertaken. Ghatkopar is so much on the border-line and so near the danger zone that it is more difficult to give an opinion about it. The part south of the railway is safe enough, and there appear to be some healthy bungalows north of it, but one would certainly deprecate any encouragement of building on the Agra Road.

On the west side of the island the large area round Bháyndar Station in the extreme North, consisting of salt-lands, is unobjectionable from the present standpoint, as it is so free from Malaria. Some Indian commercial men do not find Bháyndar too far from Bombay to live in, but the want of a water-supply is the great hindrance to its development, and there is, unfortunately, no other area suitable for development with which it could combine in managing to afford one.

The next area to be considered is that to the south of this, from Dahisar, between Bháyndar and Borivli Stations, along the B. B. and C. I. Railway to Andheri, which may be considered its southern limit. The Ghodbandar Road runs through it close to the railway, and it is along this road that there has been so much building of bungalows mostly used only in the hot weather, the only reason for building them in this malarious part of the island having been the presence of the railway, on which station after station has been opened for suburban traffic as the bungalows grew in number. Not all parts of this area are equally malarious; that round Goregaon Station is the most so. But the railway runs much too near the central hills of Salsette to allow the neighbourhood of its stations within this area, which is bounded on the East by a line of villages deserted years ago on account of the increasing malariousness of the climate, to be fit for anything that could seriously be called town-planning. It does not do anybody any particular harm that well-to-do people, who can bring their servants and their supplies from Bombay, should elect to live here in the hot weather if it suits them. Their doing so does not involve the planting down of any all-the-year-round population of poorer-class people; that is why it is unobjectionable. But to provide them with roads, water-supply, markets and schools would not only use up part of funds that should be concentrated on the development of more hopeful parts of the island and attract future settlers to the less desirable places; it would also mean that bazaars would form, in which middle-class and poor people would be living all the year round, in a climate which would involve a sick-rate among them and their children higher than there is any need for in the case of people who are to live in Salsette.

There should be no extension northwards of the road already built to the place of pilgrimage at Mandapeshwar. The really important roads in this area are those leading from the railway stations to villages on the west coast; those should continue to be kept up to their full width. There is no objection to the construction of small lengths of accommodation road, at the discretion of the Officer in charge, Salsette Building Sites, for the benefit of existing groups of villas badly needing an exit to the railway. But the principle should be observed that their construction is not to encourage the formation of further bungalows and a bazaar. Requests have been made for an English school at Malád or Borivli, where a certain number of upper-class people do live all the year round. This is contra-indicated on the same principle of non-encouragement. It has also been proposed to utilize part of a charitable fund that exists for the provision of dispensaries in Salsette, to establish one at Borivli. Strictly speaking, the same objection should hold good in this case also, but it would be rather paradoxical to object to the establishment of a dispensary in a place because the neighbourhood was an unhealthy one. Borivli is a little market-town for a great part of north-west Salsette, and a dispensary there would serve a number of existing villages.

There now remain the two healthy areas of Salsette to be considered; that lying to the South of, and beyond the influence of the hills, and that consisting of the islets of the west coast.

As regards the more immediate future the area in the South of Salsette is the more important from the point of view of actual development. It includes the Bándra-Dánda Peninsula, and its boundaries can easily be defined; they form a triangle. Andheri is for the B. B. and C. I. Railway what Ghatkopar is for the G. I. P., the station on the border line, north of which the country very rapidly becomes malarious. No development should ever take place north of the metalled road that runs east from Andheri, and to go too far east along this road would bring one too near the southern end of the hill range. A line is best drawn from Andheri to Old Kurla, to leave out any country within the range of its influence. The base line of the triangle is the Bándra Creek, and the third line is drawn to meet it from Andheri in the direction of Dánda, or of Bándra point.

The flats of the Bándra Creek extend for some little distance into this area, and it is further limited by the existence of the danger zone of the rifle range, south of Santa Cruz Station, and the cantonment of Santa Cruz, near the village of Vakola, but these still leave a considerable area of ground, only parts of which have been built over. The only reason why the rest has not been considered in town-planning schemes, is that it lies more than a mile from the nearest railway station. There is none of it beyond the reach of the water-supply scheme which is being prepared by the Engineer in charge, Salsette Building Sites, so that the only problem is that of means of communication.

The problem would, of course, be most completely solved if it paid the two railways, and if it suited their policy, to have a connecting line between, say Kurla and Andheri, when electrification is brought in. Failing this, such an undertaking as a petrol tramway, to be constructed along one of the future roads within the area, would best meet the difficulty. As regards roads, it has to be remembered that, building apart, the present utter want of means of communication between the two sides of Salsette Island is one that will have to be fulfilled in any case. Strangers to Bándra can hardly believe that there is no way to a town so close as Kurla, and that the Agra Road can only be reached by long and circuitous routes. One of the roads that have been provisionally suggested would continue the Bombay Improvement Trust's new road on the west side of the G. I. P. Railway line from Kurla. Besides running northwards to join the Agra Road it would have a branch crossing the head of the creek and connecting up with the present road that runs westwards from Santa Cruz Cantonment to the station and the Ghodbandar Road. Another suggested road would run westwards from the acute bend of the Agra Road north of old Kurla. Perhaps the most important of all the projected roads is that which would run west of the narrow Ghodbandar Road northwards from the Bándra Municipal Building towards Andheri.

But although it is in connection with this southern area that the attention of the town-planner will be most profitably directed in the meanwhile, no one who has visited the islets of the west coast, of which Mr. Mead writes with such enthusiasm, can fail to see in some of them the most ideal of all sites for a garden city. With those which could most easily be made accessible from the B. B. and C. I. Railway the great difficulty is that of inducing owners or occupiers of the land to allow development to take place. The Khot of Juhu is represented by some twenty odd individuals, so it is small wonder that this beautiful little island, so close to the railway, and so healthfully situated, remains totally undeveloped. Vesava, on the other hand, has already been largely taken up. For a garden city, to be developed as a whole, say by a company, and in connection with which boating and golf throughout the year, could be provided for its sporting residents, the village lands of Malavni would be decidedly the most suitable, could the difficulty be got over of inducing occupiers of agricultural land to allow development; that is to say, development as opposed to the mere dotting about of the peninsula with bungalows on available bits of land. A copy of the village map, showing the tenure of the lands, accompanies this report. There is water-supply enough to allow building to start, but not to go on far, and it would depend on what was thought now of the future prospects of Malavni whether it was considered advisable to attempt to make provision for its future needs in projecting the water-supply for the South of Salsette. Instructions might meanwhile be given that Government land at Malavni should not be sold for agricultural purposes.

Communication with the railway would have to be provided by petrol or electric tramway along about $4\frac{1}{2}$ miles of road already constructed up to part of its width, between Marva village and Malad Station.

Building-stone and lime are available in abundance locally, and as a brick and concrete factory is about to be built on the coast in the neighbourhood the question of building materials would present no difficulty.

A very little reclamation would link up with Malavni the neighbouring villages of Charkop, Marva and Aksa.

It is not necessary in this report to go into the subject of the suitability of the other village lands of the west coast, which, unlike Malavni, would mostly have to be reached by the bridging of creeks. It would only be after the development of Malavni that their future would have to be thought of.

It is only necessary in concluding this report to point out that it is not alone in Salsette that it is worth while to bear in mind in connection with building sites that relation of physiography to Malaria which is so striking a feature of the climate of the Konkan, but which there has not previously been an opportunity of demonstrating in any detail. His experience of this relation has been of considerable use to the writer already in giving an opinion regarding the different places suggested as the new head-quarters of a district, and there may often be smaller locations to be selected, such as that for a Police post, for example, where a difference of position, quite within the limits of administrative feasibility, might make a very considerable difference to the health and efficiency of those whose duties called them to occupy it.

J. L. MARJORIBANKS

Major, I. M. S.

APPENDIX I.

Table of anophelines, showing places where found, and name of nearest railway station. Stations on the B. B. & C. I. Railway are taken in order going "Up" towards, and stations on the G. I. P. Railway "Down" from Bombay. The record of N. rossii has been omitted from this table. The term "Gauthan" means the actual village site.

M. Barbirostris was found at the following places :—

(Borivli Railway Station).—Larvæ in Railway Borrow pit, mile No. 21 east side; 20 east side; 21-24, 20 west side; No. 24 west side.

DAHISAR.—Larvæ in 2 wells in S. No. 133.

KASHI.—Larvæ in rice field in S. No. 6; well in S. No. 95; rice field in S. No. 3 in the village; adults in cowshed in Gauthan.

MIRA.—Larvæ in rice fields and stream named Dhobidai; Tank named Chari Adults in cowshed in Gauthan.

(Kandivli Railway Station).—POISAR.—Larvæ in well of D. L. B. Adults in cowshed in Gauthan.

(Malad Railway Station).—ARE.—Adults in cowshed in Gauthan.

CHARKOP.—Larvæ in well in S. No. 12.

KURAR.—Larvæ in well in S. No. 11.

MALAD.—Adults in cowshed in Gauthan.

MALAVNI.—Larvæ in wells in S. No. 12.

VALNAI.—Larvæ in Tank in S. No. 10; and tank named Khandala.

(Andheri Railway Station).—Adults in cowsheds in S. Nos. 19 and 9.

AMBIVLI.—Adults in cowshed.

BANDIVLI.—Larvæ in Tank in S. Nos. 24 and 25; wells in S. Nos. 1, 17 and 19.

CHAKALE.—Larvæ in rice field in S. No. 39.

MAROL.—Adults in cowshed in Gauthan.

MANJAS.—Adults in cowshed in Gauthan.

WYARAVLI.—Adults in hut in Gauthan.

(Bandra Railway Station).—Larvæ in Railway Borrow pit near mile No. 10 east side; well right hand side of St. Joseph's Convent School; Pool in S. No. 241; wells in S. Nos. 235, 241, 223, 204, 189, 203, 240, 198, 197, 239, well in Gauthan; well in Bungalow No. 40; well in Rungari's chawl, well in Municipal School No. 1.

MATMAULI (MOUNT MARY).—Larvæ in wells in S. Nos. 280, 271, 27; 282, 281, 268, 246, well of Bungalow No. 81, well of houses Nos. 4 and 88, well in S. Nos. 270, 282, 281, 270.

PALI HILL.—Larvæ in well in S. No. 325.

(Ghatkopar Railway Station).—Adults in cowshed in Gauthan.

KIBOL.—Adults in Pacca house in Gauthan.

MAHAL.—Larvæ in wells in S. Nos. 139, 147.

MAHN KHURD.—Larvæ in wells in S. Nos. 88, 91, 38.

MARAVLI.—Larvæ in wells in village.

NAVALI.—Larvæ in rice fields in village.

WADHAVLI.—Larvæ in wells in S. No. 2; Pool in S. No. 1; well in village.

(Vikhroli Railway Station).—HARIYALI.—Adults in cowshed.

PACHKOLI.—Larvæ in Pool in the village.

(Bhandup Railway Station).—Adults in cowshed in Gauthan.

(Thana Railway Station).—DHOKALI.—Larvæ in wells in the village. Adults in cowshed in Gauthan.

KAVESAR.—Adults in cowshed in Gauthan.

KOLSET.—Larvæ in well in S. No. 268. Tank in village; wells in S. Nos. 247, 10.

KOPRI.—Adults in cowshed in Gauthan.

MANJIVDA.—Adults in cowshed in Gauthan.

MANPADA.—Larvæ in well in the village.

THANA.—Larvæ in well in B. No. 127; rice field in S. No. 6; well in H. No. 56; well in B. No. 122; well in H. No. 194.

Ny. Fuliginosus was found at the following places:—

(Bhaynder Railway Station).—Larvæ in Railway B. P. near mile No. 22 east side of Railway line of B. B. & C. I. Railway B. P. mile No. 24 west side; mile No. 25 east side.

(Borivli Railway Station).—Larvæ in Railway B. P. near mile No. 23 east side; mile No. 22 west side; mile No. 20 west side; of Railway line of B. B. & C. I. Tank in the same village.

DAHISAR.—Adults in cowshed in Gauthan.

EKSAR.—Larvæ, rice field in S. No. 20; tank in S. No. 202.

KASHI.—Adults in cowshed in Gauthan.

MAGATNA.—Adults in cowshed in Gauthan.

MIRA.—Larvæ, Pool in the same village; in S. No. 323; tank in the same village Tank, Chari, in the same village; rice field; Stream, Dhobidai running by the village Adults in cowshed in Gauthan.

(Kandivli Railway Station).—AKARLI.—Larvæ in Pool, well in the village. Adults in cowshed and Hut in Gauthan.

KANDIVLI.—Larvæ in Railway B. P. near mile No. 19 east side, west side of the Railway line of B. B. & C. I.; tank near S. No. 15; rice field in S. No. 12; Adults in cowshed in Gauthan.

POISAR.—Larvæ in Pool stream in S. No. 5 of the village. Adults in Pucca houses and cowshed in Gauthan.

(Malad Railway Station).—ARE.—Adults in hut in Gauthan.

KURAR.—Larvæ in tank in the village in S. No. 3.

MALAD.—Larvæ in Railway B. P. near mile No. 18 east side of B. B. & C. I. Railway; well; rice field in S. No. 106 of the village. Adults in cowshed in Gauthan.

MALAWANI.—Larvæ, well in S. No. 64; tank; wells in S. Nos. 50 and 88; tank to the east of S. No. 99.

WALNAI.—Larvæ in rice field in S. No. 14. Adults in cowshed in Gauthan.

(Goregaon Railway Station).—PAHADI.—Adults in cowshed in Gauthan.

GOREGAON.—Larvæ in Railway B. P. near mile No. 17 west side; 16 east side of B. B. & C. I. Railway; tank in S. No. 100; well in S. No. 24 in the village.

(Andheri Railway Station).—Larvæ in Railway B. P. near mile No. 17 east side, 16 west side of B. B. & C. I. Railway; Railway B. P. in S. No. 24; rice field; tank in S. No. 81; rice field in S. No. 81 in the village.

BANDIVLI.—Larvæ in Pools in S. Nos. 41 and 24; well in S. No. 17, and tank in S. Nos. 24 and 25 in the village.

BRAHMANWADA.—Larvæ in well in S. No. 54; tank in the village. Adults in cowsheds in Gauthan.

CHAKALE.—Larvæ in tank in S. No. 48 in the village; and rice field in S. No. 39. Adults in cowsheds in Gauthan.

GONDIVLI.—Larvæ in tank in the village.

KANDIVLI.—Adults in cowshed in Gauthan.

MANJAS.—Adults in cowshed and hut in Gauthan.

MAROL.—Adults in Pucca house, and cowshed in Gauthan.

MOGARE.—Larvæ in Railway B. P. on the B. B. & C. I. line.

OSHIWARA.—Larvæ in wells in S. No. 48 in the village.

(Vila Parla Railway Station).—Larvæ in Railway B. P. near mile No. 16 west side; 15 east side and west side; 14 east side of B. B. & C. I. Railway; tank named Gaon Talav in the village.

(Santa Cruz Railway Station).—Larvæ in rice field in S. No. 377; Railway B. P. near mile No. 13 east side; 12 west side; 13 west side of B. B. & C. I. Railway.

(Bandra Railway Station).—Larvæ in Railway B. P. near mile No. 11 west side; 10 west side; 11 east side; 10 east side of B. B. & C. I. Railway; well in house No. 14; well in S. No. 261; tank in the town.

MATMAULI (MOUNT MARY).—Larvæ in well in the village.

PALI HILL.—Larvæ in well in S. No. 264 in the village.

(Kurla Railway Station).—Larvæ in Pools in S. Nos. 212 and 215; rice fields in S. Nos. 262 and 211, and 253; Railway B. P. on G. I. P. Railway line.

(Ghatkopar Railway Station).—ANIK.—Larvæ in tank in Gauthan; wells in S. Nos. 4, 23; rice field in S. No. 20; Pool in S. No. 75 in the village.

CHEMBUR.—Larvæ in Pool in the village.

GHATKOPAR.—Adults in other building in Gauthan.

MAHUL.—Larvæ in rice fields in S. Nos. 2 and 66; stream east of S. No. 172; Tank south of S. No. 179 in the village.

MAHN KHURD.—Larvæ in stream near S. Nos. 104 and 105 in the village.

MARAWALI.—Larvæ in tank south of Gauthan in the village.

NANALA.—Larvæ in well and rice fields and stream in the village.

(Vikhroli Railway Station).—HARIYALI.—Adults in hut and cowshed in Gauthan; adults in cowshed in Gauthan.

PACHAKOLI.—Larvæ in Pool in the village.

PAWAI.—Larvæ in tank of Pawai south side of the tank.

VIKHROLI.—Larvæ in rice fields; well; Tulsi Tank in the village.

(Bhandup Railway Station).—Larvæ in well in S. No. 31; rice field in S. No. 39 in the village; adults in cowshed in Gauthan.

KANJUR.—Larvæ in Pool; rice field in the village.

(Mulund Railway Station).—Adults in cowshed in Gauthan.

(Thana Railway Station).—BALKUMB.—Larvæ in well in the village.

DHOKALE.—Larvæ in well in the village.

KAVESAR.—Adults in cowshed in Gauthan of Wagbilpada of the village.

KOPRI.—Larvæ in rice field in S. No. 36 of the village. Adults in cowshed in Gauthan.

MANJIVDA.—Adults in cowshed in Gauthan. Larvæ in rice fields of the village.

MANPADA.—Adults in cowshed in Gauthan.

NAVADA.—Larvæ in rice field in S. No. 42 of the village. Adults in cowshed in Gauthan.

KOLSET.—Adults in cowshed at tari in the village.

THANA.—Larvæ in tank behind House No. 57; well in H. Nos. 131 and 132 tank named Makhwal; well in H. No. 38 in the town.

WADHAWLI.—Larvæ in tank, well in the village; adults in cowshed in Gauthan.

My. Jamesii was found at the following places:—

(Borivli Railway Station).—DAHISAR.—Adults in cowshed in Gauthan.

KASHI.—Larvæ in rice field in S. No. 14.

MIRA.—Larvæ in rice field.

(Kandivli Railway Station).—AKURLI.—Larvæ in Dhondlai Tank.

KANDIVLI.—Larvæ in rice field in S. No. 12.

(Andheri Railway Station).—ANDHERI STATION.—Larvæ in Railway B. P.

(Bandra Railway Station).—BANDRA.—Larvæ in well.

(Ghatkopar Railway Station).—GHATKOPAR.—Larvæ in well in S. No. 1,

CHEMBUR.—Larvæ in salt pool.

MAHUL.—Larvæ in well in S. No. 1.

MARAVLI.—Larvæ in rice field.

(Vikhroli Railway Station).—VIKHROLI.—Larvæ in Vihad Tank and rice field.

PAWAI.—Larvæ in tank.

(Bhandup Railway Station).—BHANDUP.—Larvæ in tank, adults in cowshed in Gauthan.

(Mulund Railway Station).—NAHUR.—Larvæ in well and rice field.

(Thana Railway Station).—THANA—Larvæ in well.

WADHAVLI.—Adults in cowshed in Gauthan.

Py. Jeyporiensis was found at the following place :—

(Borivli Railway Station).—MAGATNA—Adults in cowshed in Gauthan.

N. Punctulata was found at the following places :—

(Bhandup Railway Station).—Adults in cowshed in Gauthan.

(Mulund Railway Station).—Adults in cowshed.

(Thana Railway Station).—KOPRI—Adults in cowshed on Gauthan.

Ne. Stephensi was found at the following places :—

(Malad Railway Station).—WALNAI—Adults in cowshed in Gauthan.

(Andheri Railway Station).—GONDIWALI—Larvæ in rice field in S. No. 21.

(Ghatkopar Railway Station).—MARAWALI—Larvæ in Pool.

(Thana Railway Station).—MANPADA—Adults in cowshed in Gauthan.

WADHAVLI.—Adults in cowshed on Gauthan.

My. Listonii was found at the following places :—

(Borivli Railway Station).—EKSAR—Adults in cowshed in Gauthan.

DAHISAR.—Larvæ in well in S. No. 249, and stream in S. No. 24, and rice field.

(Kandivli Railway Station).—POISAR.—Larvæ in well in S. No. 5.

(Malad Railway Station).—KURAR.—Larvæ in wells in S. Nos. 11 and 30 and stream in S. No. 5.

CHARKOP.—Larvæ in well in S. No. 12.

WALNAI.—Larvæ in wells in S. Nos. 13 and 19.

(Goregaon Railway Station).—Larvæ in Railway Borrow pit, mile No. 17, west side.

(Andheri Railway Station).—Larvæ in well in S. No. 14.

(Vila Parla Railway Station).—Larvæ in Railway Borrow pit.

(Santa Cruz Railway Station).—Adults in Building.

(Bandra Railway Station).—Larvæ in well behind St. Joseph's Convent School.

MATMAULI.—Larvæ in wells in S. Nos. 27, 271 and 282 and a well in Bungalow No. 38.

PALI HILL.—Larvæ in wells in S. Nos. 161 and 325 and in Bungalow No. 6.

(Vikhroli Railway Station).—TIRANDAJ.—Larvæ in pool and stream in Bhui Dongari ;

(Bhandup Railway Station).—Larvæ in well in S. No. 23.

KANJUR.—Larvæ in stream.

(Thana Railway Station).—Larvæ in wells in S. Nos. 3 and 127.

YEUB.—Adults in cowsheds in Gauthan.

My. Culicifacies was found at the following places :—

(Borivli Railway Station).—Larvæ in Railway Borrow Pit mile No. 22 and No. 21 west and east side, No. 20 east side, and a well in S. No. 12.

DAHISAR.—Larvæ in wells in S. Nos. 29, 133, 254 and in Railway Borrow pit.

EKSAR :—Larvæ in well.

MIRA :—Larvæ in pool.

(Kandivli Railway Station).—Larvæ in tank near S. No. 15.

AKURLI.—Larvæ in rice field.

POISAR.—Larvæ in rice field, and in well in S. No. 5.

WADHWAN.—Larvæ in well in S. No. 12.

(Malad Railway Station).—Larvæ in wells in S. Nos. 1, 2 and 102.

ARE.—Adults in hut in Gauthan.

- DINDOSHI.—Larvæ in well.
- KURAR.—Larvæ in well in S. No. 5.
- WALNAI.—Larvæ in well in S. No. 13.
- (Goregaon Railway Station).—Larvæ in Railway Borrow pit mile No. 14 west side.
- (Andheri Railway Station).—Larvæ in rice-field in S. No. 809.
- BRAHMANWADA.—Larvæ in well in S. No. 3.
- CHAKALA.—Larvæ in well in S. No. 46.
- MOGRA.—Larvæ in Sarkari well.
- OSHIWARE.—Larvæ in pool in S. No. 48.
- (Vila Parla Railway Station).—Larvæ in Railway Borrow pit mile No. 14 east side, and in wells in S. Nos. 241, 245 and 247.
- (Santa Cruz Railway Station).—Larvæ in wells, Railway Borrow pit, and in well in S. No. 114.
- (Bandra Railway Station).—Larvæ in well in S. No. 261 and in Railway Borrow pit mile No. 10 west side.
- PALI HILL.—Larvæ in wells in S. No. 325.
- MATMAULI.—Larvæ in wells in S. Nos. 270, 281 and 282.
- (Kurla Railway Station).—Larvæ in well.
- (Ghatkopar Railway Station).—Larvæ in tank and rice-field in S. No. 195.
- VADHAVLI.—Larvæ in well in S. No. 55.
- ANIK.—Larvæ in stream.
- MAHAL.—Larvæ in stream to the north of S. No. 151.
- NANALA.—Larvæ in stream.
- (Vikhroli Railway Station).—Larvæ in wells.
- HARIYALI.—Adults in cowshed on Gauthan.
- TIRANDAJ.—Larvæ in well and stream.
- (Bhandup Railway Station).—Larvæ in Railway Borrow pit mile No. 14/15 and in well in S. No. 3 and some others; adults in pucca house on Gauthan.
- KANJUR.—Larvæ in well.
- (Mulund Railway Station).—Larvæ in well in S. No. 30 and in rice-fields in S. Nos. 16 and other in Gawhanpada; adults in cowshed on Gauthan of Nawa-gharpada.
- NAHUR.—Larvæ in well, pool in S. No. 102 and stream in S. No. 1.
- (Thana Railway Station).—Larvæ in wells in house Nos. 3 and 194 and in other wells and stream.
- DHOKALE.—Larvæ in well.
- MANJIVDA.—Adults in cowshed.
- MANPADA.—Larvæ in wells.
- NAVAPADA.—Larvæ in Railway Borrow pit.

APPENDIX II.

Table of villages in alphabetical order in which anopheline larvæ and adults were found:—

AKURLI.—*My. Culicifacies* larvæ in rice field; *Ny. Jamesii* larvæ in tank named Dhondlai; *My. Fuliginosus* larvæ in pool, and well; *My. Fuliginosus* adults, hut and cowshed in Gauthan.

ANDHERI.—*My. Listonii* larvæ in well in S. No. 14, tank in S. No. 81, rice-fields in S. Nos. 81 and 809; *My. Barbirostris* adults, cowsheds in S. Nos. 9 and 12.

ANIK.—*Ny. Fuliginosus* larvæ in tank in Gauthan; *My. Culicifacies* larvæ in stream; *Ny. Fuliginosus* larvæ in wells in S. Nos. 4 and 23; pool in S. No. 75; rice-fields in S. No. 20.

AMBIVLI.—*M. Barbirostris* adults, cowshed.

ARE.—*Ny. Fuliginosus* adults, huts and cowshed on Gauthan; *My. Listonii* adults, cowshed in Gauthan; *M. Barbirostris* adults, cowshed in Gauthan; *My. Culicifacies* adults, hut in Gauthan.

BALKUMB.—*Ny. Fuliginosus* larvæ in well.

BANDIVLI.—*M. Barbirostris* larvæ in wells in S. Nos. 1, 17 and 19; tank in S. Nos. 24 and 25; *Ny. Fuliginosus* larvæ in tank in S. Nos. 24 and 25, pools in S. Nos. 24 and 41, well in S. No. 17.

BANDRA (SEE ALSO MATMAULI AND PALI HILL).—*M. Barbirostris* larvæ in wells in S. Nos. 189, 197, 198, 204, 223, 230, 235, two in 239, 240 and 241, one in Gauthan, one in Bungalow No. 40, one in Municipal school No. 1, one in Rangari's chawl, one at right hand side of St. Joseph Convent's School, and 5 wells, and one pool in S. No. 241; *Ny. Fuliginosus* larvæ in well in S. No. 261, one in House No. 14, and one tank; *My. Culicifacies* larvæ in well in S. No. 261; *Ny. Jamesii* larvæ in well; *My. Listonii* larvæ in well at side of St. Joseph Convent's School; *M. Barbirostris* adults in cowshed in Gauthan.

BHANDUP.—*Ny. Fuliginosus* larvæ in well in S. No. 31; rice field in S. No. 39; adults in cowshed in Gauthan; *My. Culicifacies* larvæ in well in S. No. 3, well of khot, well of Mahar; adults in pacca house on Gauthan; *Ny. Jamesii* larvæ in tank, adults in cowshed in Gauthan; *My. Listonii* larvæ in well in S. No. 23; *N. Punctulata* adults in cowshed in Gauthan.

BORIVLI.—*Ny. Fuliginosus* larvæ in tank; *My. Culicifacies* larvæ in well in S. No. 12, and one well.

BAMANVADA.—*Ny. Fuliginosus* larvæ in well in S. No. 54, in tank; adults in cowsheds in Gauthan; *My. Culicifacies* larvæ in well in S. No. 3.

CHAKALE.—*M. Barbirostris* larvæ in rice field in S. No. 39; *Ny. Fuliginosus* larvæ in rice field in S. No. 39; tank in S. No. 48; adults in cowsheds in Gauthan; *My. Culicifacies* larvæ in well in S. No. 46.

CHARKOP.—*M. Barbirostris* larvæ in well in S. No. 12; *My. Listonii* larvæ in well in S. No. 12.

CHEMBUR.—*Ny. Fuliginosus* larvæ in pool; *My. Jamesii* larvæ in salt pool.

DAHISAR.—*M. Barbirostris* larvæ in two wells in S. No. 133; *Ny. Fuliginosus* adults in cowshed in Gauthan; *My. Culicifacies* larvæ in wells in S. Nos. 133, 29 and 254 and one well; *My. Listonii* larvæ in well in S. No. 249, and one well, stream near S. No. 24; *Ny. Jamesii* adults in cowshed in Gauthan.

DHOKALE.—*M. Barbirostris* larvæ in wells; adults in cowshed in Gauthan; *Ny. Fuliginosus* larvæ in one well; *My. Culicifacies* larvæ in well.

DINDOSHI.—*My. Culicifacies* larvæ in well.

EKSAR.—*Ny. Fuliginosus* larvæ in rice field in S. No. 20; tank in S. No. 202; *My. Culicifacies* larvæ in well; *My. Listonii* adults in cowshed in Gauthan;

GHATKOPER.—*Ny. Barbirostris* adults in cowshed in Gauthan; *Ny. Fuliginosus* adults in building in Gauthan; *My. Culicifacies* larvæ in tank, rice field in S. No. 185; *Ny. Jamesii* larvæ in well in S. No. 1.

GONDIVLI.—*Ny. Fuliginosus* larvæ in tank; *Na. Stephensii* larvæ in rice-field in S. No. 21.

GOREGAON.—*Ny. Fuliginosus* larvæ in well in S. No. 24, tank in S. No. 100.

HARIYALI.—*M. Barbirostris* adults in cowshed in Gauthan; *Ny. Fuliginosus* adults in hut and cowshed in Gauthan; *My. Culicifacies* adults in cowshed in Gauthan.

KANDIVLI.—*Ny. Fuliginosus* larvæ in rice-field in S. No. 12, tank in S. No. 15; adults in cowshed in Gauthan; *My. Culicifacies* larvæ in tank in S. No. 15; *Ny. Jamesii* larvæ in rice-field in S. No. 12.

KANJUR.—*Ny. Fuliginosus* larvæ in rice-field, in pool; *My. Culicifacies* larvæ in well; *My. Listonii* larvæ in stream.

KASHI.—*M. Barbirostris* larvæ in well in S. No. 95, rice-fields in S. Nos. 3 and 6, adults in cowshed in Gauthan; *Ny. Fuliginosus* adults in cowshed in Gauthan; *Ny. Jamesii* larvæ in rice-field in S. No. 14.

KAVESAR.—*M. Barbirostris* adults in cowshed in Gauthan; *Ny. Fuliginosus* adults in cowshed in Gauthan of Waghilpada.

KIROL.—*M. Barbirostris* adults in pæca house in Gauthan.

KOLSET.—*Ny. Barbirostris* larvæ in tank, wells in S. Nos. 247 and 268, well in S. No. 10 of Tarichapada; *Ny. Fuliginosus* adults in cowshed in Gauthan of Tarichapada.

KONDIVTA.—*Ny. Fuliginosus* adults in cowsheds in Gauthan.

KOPRI.—*Ny. Barbirostris* adults in cowshed in Gauthan; *Ny. Fuliginosus* larvæ in rice-field in S. No. 36, adults in cowshed in Gauthan; *N. Punctulata* adult in cowshed in Gauthan.

KURLA.—*Ny. Fuliginosus* larvæ in rice-fields in S. Nos. 211, 258 and 262, pools in S. Nos. 212 and 215; *My. Culicifacies* larvæ in well.

KURAR.—*M. Barbirostris* larvæ in well in S. No. 11; *Ny. Fuliginosus* larvæ in tank in S. No. 3; *My. Culicifacies* larvæ in well in S. No. 5; *My. Listoni* larvæ in well in S. No. 11, streams in S. Nos. 5 and 30.

MAGATNA.—*Ny. Fuliginosus* adults in cowshed on Gauthan; *Pg. Jeyporiensis* adults in cowshed in Gauthan.

MAHUL.—*Ny. Fuliginosus* larvæ in rice-fields in S. Nos. 2 and 66, in tank to the south of S. No. 179, in stream to the east of S. No. 172; *M. Barbirostris* larvæ in wells of S. Nos. 139 and 147; *My. Culicifacies* larvæ in stream to the north of S. No. 151; *Ny. Jamesii* larvæ in well of S. No. 1.

MANJIVDA.—*My. Culicifacies* adults in cowshed; *M. Barbirostris* adults in cowshed on Gauthan; *Ny. Fuliginosus* adults in cowsheds and larvæ in rice-fields.

MALAD.—*My. Culicifacies* larvæ in wells of S. Nos. 1, 2 and 102; *Ny. Fuliginosus* adults in cowsheds on Gauthan, larvæ in well and in rice-field in S. No. 106; *M. Barbirostris* adults in cowshed on Gauthan.

MALAVNI.—*M. Barbirostris* larvæ in well in S. No. 12 and other well; *Ny. Fuliginosus* larvæ in tank to the east of S. No. 99, and in wells of S. Nos. 50, 64 and 84.

MARAWALI.—*M. Barbirostris* larvæ in well; *Ny. Fuliginosus* larvæ in tank; *My. Jamesii* larvæ in rice-field; *Ne. Stephensi* larvæ in puddle.

MATMAULI (MOUNT MARY OR BANDRA HILL).—*M. Barbirostris* larvæ in wells of S. Nos. 27, 271, 282, 270, 281, 282, 270, 246, 268, 281, 280, and in wells of houses Nos. 4, 38 and 81; *Ny. Fuliginosus* larvæ in well; *My. Culicifacies* larvæ in wells of S. Nos. 281, 282 and 270; *My. Listoni* larvæ in wells of S. Nos. 27, 271, 282 and a well of bungalow No. 38.

MANJAS.—*M. Barbirostris* adults in cowshed on Gauthan; *Ny. Fuliginosus* adults in cowshed and hut of Gauthan.

MAHN KHURD.—*M. Barbirostris* larvæ in wells of S. Nos. 58, 91 and 88; *Ny. Fuliginosus* larvæ in stream.

MANPADA.—*M. Barbirostris* larvæ in well; *Ny. Fuliginosus* adults in cowshed of Gauthan; *My. Culicifacies* larvæ in well; *Ne. Stephensi* adults in cowshed on Gauthan.

MAROL.—*M. Barbirostris* adults in cowshed on Gauthan; *Ny. Fuliginosus* in house and cowshed on Gauthan.

MIRA.—*M. Barbirostris* larvæ in Dhobidai stream and Chari Tank and in rice-fields, adults in cowshed on Gauthan; *Ny. Fuliginosus* larvæ in puddles and tank, adults in cowsheds on Gauthan, in streams, in tank and in rice-field; *My. Culicifacies* larvæ in Sarkari well, puddle and rice-field; *Ny. Jamesii* larvæ in rice-field; *My. Listoni* larvæ in rice-field.

MULUND.—*Ny. Fuliginosus* adults in cowsheds on Gauthan; *My. Culicifacies* larvæ in well in S. No. 80 and in rice-field in S. No. 16, adults in cowshed on Gauthan.

NAHUR.—*My. Culicifacies* larvæ in well, stream in S. No. 1, puddle in S. No. 102; *Ny. Jamesii* larvæ in well and rice-field.

NAUALA.—*M. Barbirostris* larvæ in rice-fields; *Ny. Fuliginosus* larvæ in rice-fields, in well and in stream; *My. Culicifacies* larvæ in streams.

NAVAPADA.—*Ny. Fuliginosus* larvæ in rice-field in S. No. 42, adults in cowsheds on Gauthan; *N. Punctulata* adults in cowshed on Gauthan.

OSHIVRA.—*Ny. Fuliginosus* larvæ in well in S. No. 48; *My. Culicifacies* larvæ in puddle in S. No. 48.

PAOHAKOLI.—*M. Barbirostris* larvæ in puddle; *Ny. Fuliginosus* larvæ in puddle.

PAHADI.—*Ny. Fuliginosus* adults in cowshed on Gauthan.

PALI HILL.—*M. Barbirostris* larvæ in well in S. No. 325; *Ny. Fuliginosus* larvæ in well in S. No. 264; *My. Culicifacies* larvæ in wells in S. No. 325; *My. Listoni* larvæ in wells in S. Nos. 6, 161 and 325.

PAVAI.—*Ny. Fuliginosus* larvæ in tank; *Ny. Jamesii* larvæ in tank.

POISAR.—*M. Barbirostris* larvæ in well, adults in cowshed on Gauthan; *Ny. Fuliginosus* larvæ in puddle and in stream S. No. 5; adults in house and cowshed on Gauthan; *My. Culicifacies* larvæ in well in S. No. 5 and rice-field; *M. Listoni* larvæ in well in S. No. 5.

SANTA CRUZ.—*Ny. Fuliginosus* larvæ in rice-field in S. No. 377; *My. Culicifacies* larvæ in well in S. No. 114 and other; *My. Listoni* adults in building in Gauthan.

THANA.—*M. Barbirostris*, larvæ in wells in S. Nos. 56, 122, 194, 127, and in rice-field in S. No. 6; *Ny. Fuliginosus* larvæ in wells in S. Nos. 38, 132, 131, and in tanks one named Mahhamel and the other behind H. No. 57; *My. Culicifacies* larvæ in wells in Patawai No. 3, in H. No. 194 and some others and in stream; *Ny. Jamesii* larvæ in well; *My. Listoni* larvæ in wells in S. Nos. 127 and 3.

TIRANDAJ.—*My. Culicifacies* larvæ in well and stream; *My. Listoni* larvæ in stream and puddles.

VADHAVAN.—*My. Culicifacies* larvæ in well in S. No. 12.

VALNAI.—*M. Barbirostris* larvæ in tank called Khandala and in tank in S. No. 10; *Ny. Fuliginosus* larvæ in rice-field in S. No. 14, adults in cowshed on Gauthan; *My. Culicifacies* larvæ in well in S. No. 13; *My. Listoni* larvæ in wells in S. Nos. 13 and 19; *Ne. Stephensi* adults in cowshed on Gauthan.

VIKROLI.—*Ny. Fuliginosus* larvæ in well, tank, and rice-fields; *My. Culicifacies* larvæ in wells; *My. Jamesii* larvæ in rice-field, Vihad Tank and other tank.

VILA PARLA.—*Ny. Fuliginosus* larvæ in tank; *My. Culicifacies* larvæ in wells in S. Nos. 245, 241 and 247.

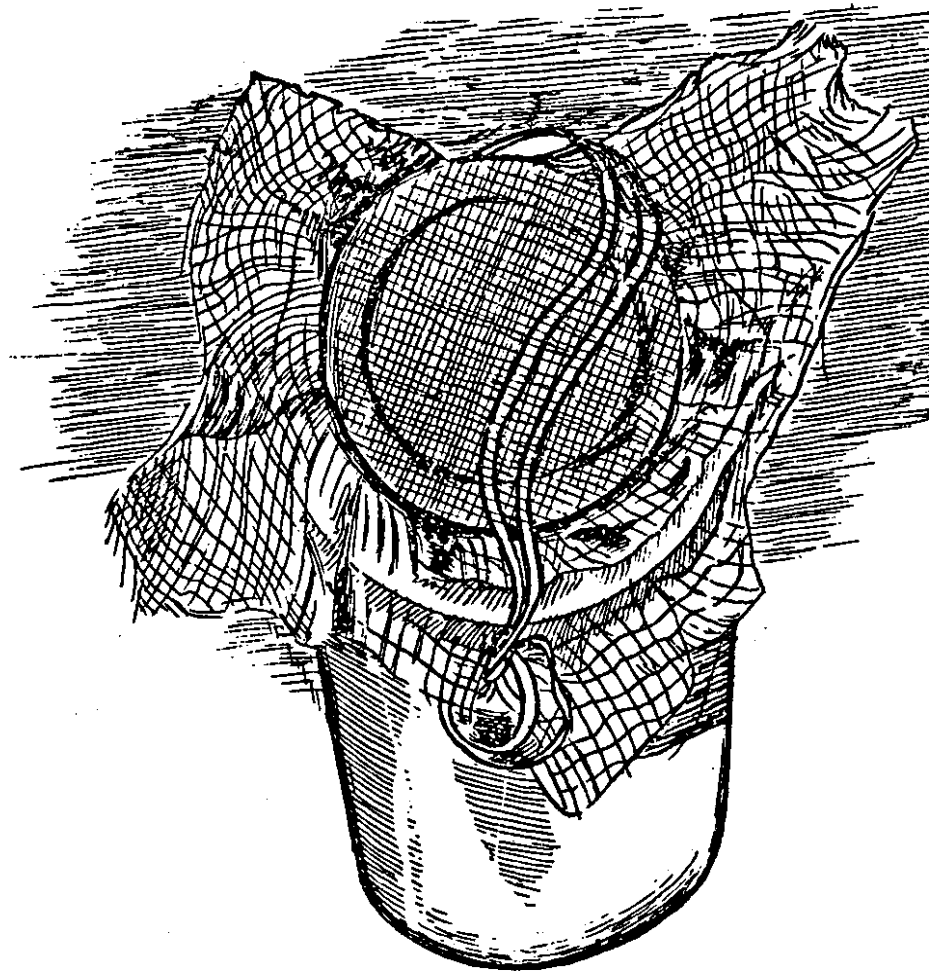
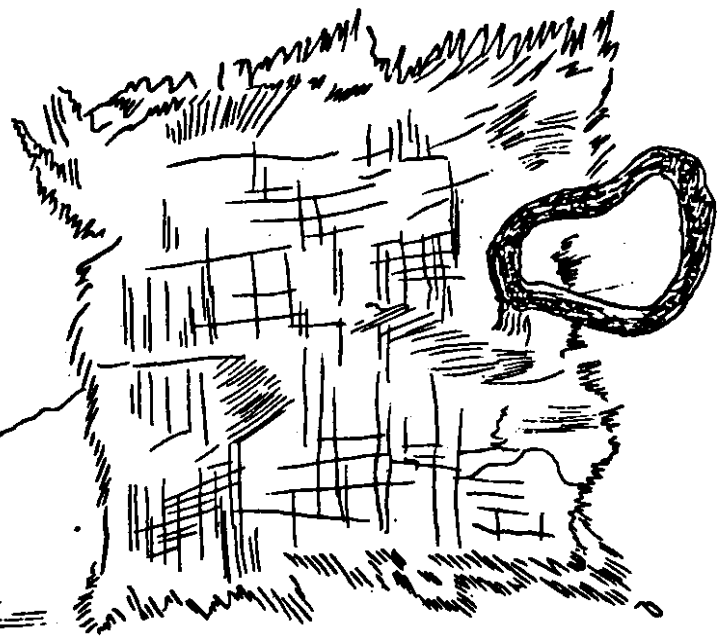
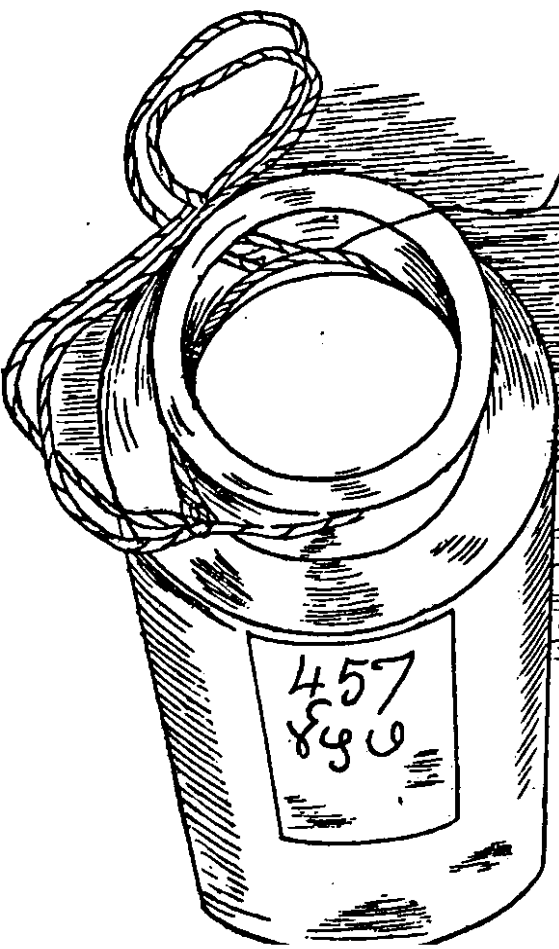
WADHAVLI in TROMBAY.—*M. Barbirostris* larvæ in puddle and in well in S. No. 2; *Ny. Fuliginosus* larvæ in well and tank; *My. Culicifacies* larvæ in well and in stream in S. No. 55.

WADHAVLI near THANA.—*Ny. Fuliginosus* adults in cowshed on Gauthan; *Ny. Jamesii* adults in cowshed on Gauthan; *Ne. Stephensi* adults in cowshed on Gauthan.

WYARAWALI.—*M. Barbirostris* adults in hut on Gauthan.

YEUB.—*My. Listoni* adults in cowsheds on Gauthan.

Dr. Williamson



APPENDIX II.

Apparatus used for the Capture and Development of Larvæ.

The Salsette enquiry afforded a pretty extended opportunity for testing the relative usefulness of different forms of apparatus that have been used or suggested for use elsewhere, and finding out the best way of using those that were found to be really practical. The following were found the best to use:—

DR. BENTLEY'S WELL-NET.—This is described in Dr. Bentley's Report on Malaria in Bombay. A substitute, which does not fold up like the original, was obtained for the Salsette investigation through the Malaria Assistant to the Health Officer, Bombay Municipality, from a Borah named Hassan Ali Abdul Ali. The well-net is absolutely indispensable, and even with its use larvæ will be missed if Dr. Bentley's directions about inverting the net and washing it are not followed in every case.

BUCKET.—This is needed to bring up some of the water of each well to wash the larvæ out of the net. If the rest of the kit is to be carried in it the bucket should be as large as possible; otherwise, the smaller it is the better.

ENAMELLED FRYING-PAN.—This was introduced by Dr. Bentley merely to wash the net, but in the Salsette enquiry it proved to be by far the most useful vessel for catching larvæ in tanks and streams, as the width of the sweep one can give with it enables such a large surface of water to be examined at a time, and as it can stand rough usage so well, when the bottom of a stream is being examined.

LONG ENAMELLED SPOON.—This is chiefly of use in skimming the larvæ from the water in the frying-pan, but it is also useful in examining hoof-prints and other small hollows containing water.

ENAMELLED MUG.—The two latter articles suffice for nearly every open place but a mug is needed for work in rice-fields and places where long grass stands in water.

QUININE BOTTLE.—Both for carrying in the field and for keeping the larvæ in afterwards to hatch out, the most useful bottles to use are ounce-of-quinine bottles, which are obtainable easily in the bazaar. These are cylindrical bottles of seven fluid ounce capacity, and the most suitable ones are those which have a broad flange on the lip. Each should be fitted with a string round the neck to which to fix another loop of string, like the handle of a basket, to carry the bottle by. The cap of the bottle is best made of a little square of coarse *dangri* or *khadi* cloth, tied to the string on the neck by a thread a couple of inches long. This cloth is of open texture, and allows free access of air. To the upper surface of the cap, near one edge, should be sewn a loop of silk elastic. If the cap is laid on the mouth of the bottle it can be fixed on in a second by laying the forefinger of the left hand, which holds the bottle, on the insertion of the loop, against the neck, and slipping the loop down over the mouth with the right hand. The bottles are carried in the field with the caps hanging down. Each is capped as soon as it is filled, without the aid of any string. A good rule to make is that, once it is capped, no bottle is to be opened, except by the Malaria Officer himself.

Each bottle has a label, bearing simply a serial number, in English and in the vernacular, which is written on it when the day's batch of bottles is being issued, and which corresponds with a number in the register. The bottles are carried in a wooden box or tray with compartments, which has a handle rising from the middle compartment, and as each is filled and capped the searcher enters the number in the margin of his note-book, and opposite this makes a note of the kind of collection of water the larvæ were taken from, and the village survey number, or other means of identification of the place. At the end of the morning's or evening's search the bottles are returned to the laboratory, and the notes copied from the searcher's note-book into the register, opposite the serial numbers. If carbons are used with the note-books individual searchers need not attend the laboratory; they tear out the pages and send them in with the bottles. The bottles are examined as soon as the Malaria Officer has time to attend to them and then write up his part of the register. In Salsette the register was kept somewhat in the following fashion:—

Serial number.	Date.	Rice-field.	Well.	Tank.	Cistern.	Puddle.	Salt-pan.	Railway Borrow Pit.	Stream.	Swamp.	Locality.	<i>My. halimnosa.</i>	<i>N. rosei.</i>	<i>My. cutifacies.</i>	<i>My. Jamesi.</i>	<i>My. listoni.</i>	<i>M. barbirivris.</i>	<i>Ms. stephens.</i>	Remarks.	Identified by larva of image.
457	5th Oct. 1913	..	1	S. N. 271 Mount Mary.	1	1	..	} I = I } I = L } I	
458	Do.	1	Gauthan of Akarli.	1		

As the examination of the contents of each bottle is finished and the result registered the number on its label is heavily crossed out with blue pencil. The peon in attendance, who recognizes this marking, removes the bottle, rinses it out, and fixes on a new blank label, and the bottle, with its cap and elastic hanging from it, is placed in the stock for re-issue with a fresh serial number.

Although it pays to keep the specimens for several days, to let as many adults develop as possible, it is seldom worth the trouble to change the water in the bottles; as a rule if larvæ will not develop in their own water they will not do so in any other. In Salsette it was found that a greater proportion of specimens yielded adults when kept standing in the dry weather after the monsoon than during the wet weather itself.

However many bottles have accumulated on the shelves, with only the numbers on them to distinguish them, if a rule is observed that only one bottle is allowed to have its cap off at one time no mistake in identity can occur, even if the Malaria Officer is called away in the middle of examining larvæ or adults taken out of a bottle.

A stylo pen pipette is useful for taking out larvæ for examination under the microscope.

When adults have developed in a bottle, if it is desired to mount them without chloroforming them *in situ*, which would wet them, and kill the remaining larvæ in the bottle, they may be transferred to a dry bottle in the following way; to let any escape should be considered bad technique:—

Hold the wet bottle in the left hand, with the forefinger and thumb forming a ring round the neck, and pressing the margins of the cap against the glass. Slip off the elastic band inserted on the cap. Invert a dry bottle, with its cap hanging off, over the wet one, and clasp both bottles with the right hand. With the left pull off the cap of the wet bottle sideways from between the two mouths, and let it hang. The mosquitos will fly up into the dry bottle. If any are sluggish the lower bottle may be bumped on the table, or tilted so that the water touches their hind legs. When all have flown up and been counted lay the cap of the dry bottle on the palm of the left hand, slip the still inverted bottle rapidly on to it, and adjust the elastic before turning the bottle up. Then copy the number of the wet bottle on to the label of the dry.

A window-sill is a convenient place for this dry bottling.

The following directions to those who are to collect the larvæ are only for the using of the kit described above, and are intended to supplement the general instructions which are usually given. The use of Dr. Bentley's well-net is described on page 69 of his report, so directions for this are not given here.

Directions given to Searchers.

For field work the following should be taken:—A well-net, a bucket, a frying-pan, a long spoon, a mug, a boxful of quinine bottles and a note book with carbon sheet and pencil. The mug, the spoon and pan should each have a loop of string fixed to its handle. When a tank or stream is to be examined the pan, the spoon and a bottle, with its cap hanging down, should be taken from the cooly, and the spoon and the bottle hung from the third and fourth fingers of the left hand. Nothing is to be put on the ground. The water should be considered to be in three layers or levels, the surface, at which the larvæ may be feeding, the middle, in which they may be concealed in green weed, and the bottom, on which they may be resting. The surface should first be skimmed with the pan. After each sweep the pan should be held at rest, and examined, plenty of time being given to allow the larvæ to come to the surface. If any are seen the pan should be grasped at the side opposite the handle with the thumb and first two fingers of the left hand, while the spoon is taken off the third finger with the right hand. Held like a pen, it is used to skim the larvæ off the surface and pour them into the bottle which hangs from the little finger.

If the bottle gets too full of water before there are many larvæ in it the water may be partly poured away by bridging the mouth of it with the forefinger at one side, and cautiously tilting the bottle in that direction. The water runs away under the finger, while the larvæ at the surface are not disturbed.

The "middle layer" of the water of the tank or stream should then be examined, if there is green weed present, piece after piece of it being brought up in the pan. If no larvæ come out of the weed to the surface of the water in the pan the weed should be squeezed like a sponge with the hand under water.

Lastly, the bottom should be examined, and stirred up with the pan, the surface water being then skimmed for the larvæ that may have come up when disturbed.

The cooly may meanwhile employ himself in searching for larvæ with the mug.

The larvæ of not more than one tank, well or stream may be put into one bottle, though a chain or rice-fields or borrow-pits may be considered as one. When enough larvæ have been secured the cap is to be fixed on with the elastic, and the bottle given back to the cooly. The number of the bottle, and a short description of the piece of water from which the larvæ were taken, with the name of the village, and if possible the survey number, should be entered in the note-book, before the cooly replaces the bottle in its compartment of the box.

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