Report on the prevention of malaria in Cyprus / by Sir Ronald Ross ; presented to both Houses of Parliament by command of His Majesty.

CYPRUS.

14.

REPORT

ON THE

PREVENTION OF MALARIA IN CYPRUS;

BY

SIR RONALD ROSS,
K.C.B., F.R.S., D.Ph., F.R.C.S., M.D., D.Sc., LL.D.;
Professor of Tropical Sanitation, Liverpool; Physician for Tropical Diseases, King's College Hospital, London.

Presented to both Houses of Parliament by Command of His Majesty.
January, 1914.

LONDON:
PRINTED UNDER THE AUTHORITY OF HIS MAJESTY'S STATIONERY OFFICE
By DARLING AND SON, LTD., BACON STREET, E.

To be purchased, either directly or through any Bookseller, from
WYMAN AND SONS, LIMITED, 29, BREAMS BUILDINGS, FETTER LANE, E.C., and 28, ABINGDON STREET, S.W., and 54, ST. MARY STREET, CARDIFF; or
H.M. STATIONERY OFFICE (SCOTTISH BRANCH), 23, FORTH STREET, EDINBURGH; or
E. PONSONBY, LIMITED, 116, GRAFTON STREET, DUBLIN;
or from the Agencies in the British Colonies and Dependencies, the United States of America, the Continent of Europe and Abroad of
T. FISHER UNWIN, LONDON, W.C.

1914.

[Cd. 7174.] *Price* 2½*d.*

REPORT

ON

THE PREVENTION OF MALARIA

IN

CYPRUS.

BY

SIR RONALD ROSS, K.C.B., F.R.S., D.PH., F.R.C.S., M.D., D.SC., LL.D.

I.—INTRODUCTION.

1. *Letters of Appointment.*—In 1912, His Excellency the High Commissioner of Cyprus, Major Sir Hamilton Goold-Adams, G.C.M.G., C.B., addressed to the Right Honourable the Secretary of State for the Colonies, Mr. Lewis Harcourt, M.P., a despatch of the 13th October, in which he stated that he had recently had many opportunities of ascertaining the widespread prevalence of malarial fever amongst the inhabitants of the Island; that for many years steps have been taken by the Government to combat it; but that in his opinion the Island Administration might have done more than it did to eradicate the disease. He therefore suggested that the Government should obtain the temporary services of some medical expert in order to go to Cyprus and study the subject locally with a view to advising the Government as to the direction in which further efforts should be made by it and by the local authorities. The presence of such an expert, he thought, would do more to encourage vigorous measures being taken than any number of circulars or addresses by the Government Medical Department.

In consequence of this letter the Right Honourable the Secretary of State appointed me in his letter dated the 27th November, 1912, to undertake the work.

2. *Progress of the Investigation.*—On receipt of these communications, I considered carefully the best method of procedure and the most appropriate date for my visit. This would be the ninth expedition of this kind undertaken by myself since I first proceeded for the same object to Sierra Leone in 1899. Since that time the subject of the prevention of malaria had become much more familiar to the world; and principles which were then not fully ascertained or not fully accepted were now admitted by all sanitarians; and the practical prevention of malaria had been undertaken with great or with partial success in many parts of the world. Moreover, the subject of malaria in Cyprus had already received very close attention from one of the most brilliant students of the Liverpool School of Tropical Medicine,

namely, Dr. George A. Williamson, formerly Medical Officer of Larnaca, Cyprus, who had already written an able paper upon the subject and had also already asked my advice regarding it—*see* [Cd. 2106] Selections from Colonial Medical Reports for 1901 and 1902, dated July, 1904, page 79. All this would largely facilitate my work in Cyprus—which, I gathered, was principally to advise the Government of Cyprus as to the best means for reducing malaria there and as to the best organization which would be likely to achieve this result. At the date of the Secretary of State's letter of the 27th November, 1912, the malaria season of that year was already over, and next year's malaria season would not commence until May or June, 1913. If I should delay my visit until the height of this year's malaria season in July and August, 1913, it would be too late to influence the infections until 1914. I wished, moreover, particularly to ascertain, for the purpose of practical mosquito reduction, when the anophelines of Cyprus commence to breed; and I could not ascertain this if I were to go late in the season. I therefore determined, with the sanction of the High Commissioner, to start in the spring, so that I might be in Cyprus when the breeding commences. This procedure would have the further advantage that it would enable me to suggest some preliminary measures which might be undertaken during the current year.

Consequently I arrived in Famagusta, Cyprus, on the 20th March, 1913. I was met at once by the Chief Medical Officer, Dr. Cleveland, with whom I was able to discuss many details on the way to the capital, Nicosia. On arrival at Nicosia I had the privilege of seeing His Excellency the High Commissioner, with whom also I considered many points of procedure. He was so good as to place funds at my disposal, not only for investigating the problems in the Island, but also for commencing some necessary work; and he gave me the temporary assistance of Dr. W. H. C. Patrick, District Medical Officer of Larnaca, and of two men to act as "moustiquiers."

My itinerary was as follows: On the 23rd and 24th March Dr. Cleveland and I visited the villages of Kythrea and others in the neighbourhood of Nicosia, where we found a very low spleen-rate but did not succeed in discovering any anopheline larvæ in the waters although there was a very suitable but small marsh just outside the walls of Nicosia, suggesting that the season was yet too early for the breeding to commence. On the 25th March, therefore, I proceeded to Larnaca, where I met Dr. Patrick and visited with him several villages in the neighbourhood, which showed a very much higher spleen-rate. We also examined the salt lake near Larnaca and the Mahommedan school at Larnaca. The next evening I returned to Nicosia. On the 27th March I visited the Government farm at Athalassa with Mr. Francis, the Government Analyst, and the neighbouring village; and the same evening we succeeded in finding two small anopheline larvæ in the marsh just outside the walls of Nicosia already referred to. On the 28th and 29th March I visited Deftera and other villages with Mr. Francis, finding higher spleen-rates in them. On the 31st March and 1st April I visited the town of Kyrenia and the villages of Bellapais and Kazaphani in that

district. On the 2nd April Dr. Patrick and I went, in the company of Mr. E. H. D. Nicolls, Director of Public Works, to investigate the villages in the neighbourhood of the large reservoirs in the Mesaoria, to the west of Famagusta. We spent two nights in the irrigation bungalow close to Akhyritou. There was much malaria in these villages; but we could find no larvæ in the reservoirs, which appeared to be to be much too open and full of fish to be very suitable for them. On the other hand we found many larvæ in the small marsh close to Akhyritou made for brick manufacture and partly fed by the discharge from the Akhyritou reservoir. The spleen-rate in this village was 100 per cent. On the 4th April we rode to Famagusta and found anopheline larvæ in the lake some miles west of that town. During the next two days Mr. Nicolls, Dr. Fuleihan and I examined the conditions at Famagusta, Trikomo, Verynia, Paralimni, and Varosia, and on the 6th April Mr. Nicolls and I returned to Nicosia by trolley in order to inspect the conditions along the railway line. In the meantime His Excellency Sir Hamilton Goold-Adams had gone on leave to England. On the 7th April I discussed with His Excellency the Acting High Commissioner, Captain Orr, and with Dr. Cleveland and Mr. Nicolls some preliminary points of importance, and on the evening of the same day I left Nicosia by Public Works motor car to study the Limassol and the Paphos districts with Dr. Patrick. On the 8th April we examined the barracks of the British troops at Polymidia near Limassol in company with the officer commanding and the Medical Officer, and also looked at some neighbouring villages. The same evening we studied the marsh near Limassol in company with the Mayor of Limassol and the District Medical Officer, Dr. Corsellis, and found numerous anopheline larvæ of full size in the sheep holes and also amongst the reeds of the marsh, and also discovered them in water escaping from the town water works. Next day, the 9th April, we proceeded by car to Paphos, and in the evening, in the company of the Commissioner, Major Bayly, the Mayor of Paphos, the District Medical Officer, Dr. Vassiliades, and several of the Rural Medical Officers, we examined some stagnant water close to the harbour of Paphos, where we found a very large number of anophelines and other mosquito larvæ. On the 10th April we returned to Limassol, studying the conditions *en route*, and in the evening we re-visited the Limassol marsh. On the 11th April we returned to Nicosia, examining the conditions *en route*. On the 12th April I prepared a popular lecture, which was delivered at the theatre in Nicosia before His Excellency the Acting Commissioner and a large audience on Sunday, 13th April. Next day Dr. Cleveland and ourselves met a number of the District and Rural Medical Officers in the Council Room and discussed with them for two hours a number of questions connected with malaria, showing them specimens which we had collected. On the 15th April Dr. Patrick, Mr. Nicolls, and Mr. Day, the General Manager of the railway, and myself left by special train for Morphou and the west of the Island, and examined the marsh near Syrianochorio where again we found large numbers of anophelines amongst the reeds

and the sluggish streams, and a very high spleen-rate among the children. On the 16th April Dr. Cleveland and I visited the prison, the lunatic asylum, and the leper colony. Between the 12th and the 16th April I had the privilege of holding a number of informal meetings with the Acting Chief Secretary, Mr. Bolton, and with Dr. Cleveland and Mr. Nicolls, at which I had the opportunity of discussing with them a number of possible proposals for dealing with malaria in the Island. On the 17th April I embarked at Famagusta, *en route* for Greece, which I wished to re-visit in order to compare the conditions there with those which I had found in Cyprus. I arrived at Athens on the 25th April, and immediately set out for the Copais Valley, which I had studied seven years previously. On returning to Athens I was introduced by His Excellency the British Ambassador, Sir Francis Elliot, to His Excellency Mr. Venezelos, the Prime Minister of Greece; with whom, in company with Professor Savas, the President of the Greek Anti-Malaria League, I discussed several important points in connection with that subject, all of which had much bearing upon the prevention of malaria in Cyprus. On the same day I left for England, where I have had frequent opportunities of consulting His Excellency Sir Hamilton Goold-Adams.

It should be understood that in these tours of inspection we studied principally the practical question of prevention, not so much in each locality as for the whole of the Island. We generally took the spleen-rates in the village schools, and then formed an idea as to the presence and nature of anopheline-breeding waters. But we could not pretend to do so sufficiently thoroughly to cover the whole of future work at each spot. Such investigation will have to be carried on slowly in the future by the organization which I recommend.

Nevertheless, the tour of inspection actually made was, I think, quite sufficient to enable me to come to a conclusion regarding the principal points upon which I have been asked to advise. But I regret that I did not see several important officers with whom I should have liked to have conversed if I had had an opportunity of meeting them; and I should also have liked to have seen one or two of the larger villages, which I was forced to neglect in my itinerary.

Detailed microscopic work upon patients was not at all required; as this had already been done by Drs. Williamson and Cleveland and others. The entomological work on the mosquitoes of the Island has also been done in the past and will be continued in the future by the organization recommended by me, if this is adopted.

3. *Interim Recommendations.*—During my visit in Cyprus I was authorised by the High Commissioner to make any interim recommendations which I thought were urgently necessary and which might be feasible before this report could be prepared. Consequently I made the following ones:—

(1) A general spleen-census of the school children in the Island.

(2) The issue of thirty grains of free quinine to every scholar suffering from enlarged spleen—that is, enough quinine

for fifteen doses of two grains each, to be given daily by the schoolmaster.

(3) The allotment of twenty-five pounds to the Public Works Department for dealing experimentally with the marsh at Akhyritou.

The spleen-census was most ably planned and directed by Dr. Cleveland, and the marsh at Akhyritou was excellently dealt with by Mr. Nicolls, Director of Public Works, and Mr. Giles of that Department; and I was informed that the issue of free quinine would be carried out as far as possible at an early date.

Before I left the Island, I submitted to the Chief Secretary an interim statement as to the probable direction which my recommendations would take after consultation with the High Commissioner in England.

4. *Acknowledgments.*—I should like to take the opportunity to express my warm thanks for the assistance and kindness always rendered to me in Cyprus by the officials and by everyone else whom I met. They are specially due to His Excellency Sir Hamilton Goold-Adams; to Captain Orr, Acting High Commissioner; to Major W. N. Bolton, Acting Chief Secretary; to Dr. R. A. Cleveland, Chief Medical Officer; to E. H. D. Nicolls, Esq., Director of Public Works; to the Commissioners of all the districts; to the Government Analyst, W. Francis, Esq.; to Dr. Patrick and all the District and Rural Medical Officers with whom I came in contact; to the Mayors of Nicosia, Limassol and Paphos; to the Qadi of Cyprus and to The Most Venerable the Archbishop of Cyprus. My thanks are also due to Mr. A. Fiddian, of the Colonial Office, for having collected much valuable literature for me; and to Mr. H. C. Lukach for giving me valuable information on many points. I should like also to thank the members of the clubs at Nicosia and at Famagusta for their personal kindness to me.

II.—THE MALARIA DATA OF CYPRUS.

5. *General Data.*

Area of Cyprus.—3,584 square miles (9,282 sq. km.).

Population at the census of 1911:—

Christians	217,680
Mahommedans	56,428
Total	274,108

Density of Population.—76·48 per square mile.

The malaria data of 21 British Crown Colonies (exclusive of Cyprus) were collected by me in a Memorandum Regarding the Returns of Various Colonies and Protectorates on Mosquito-borne Diseases, presented to the Colonial Office and dated May 2, 1912. According to this the average density of population of twenty of the colonies referred to was only 28 per square mile. Barbados had 1,036, Mauritius 520, and British Guiana only 3 per square mile.

Births Reported in 1911—8,843.

Birth-rate per cent. of population—3·23 per cent., as compared with 2·85 per cent. in seventeen British Colonies.

Deaths Reported in 1911—4,686.

Death-rate per cent. of population—1·71 per cent., as compared with 2·37 per cent. in the seventeen British Colonies—suggesting imperfect registration.

Total Admissions to Hospital in 1911—1,857.

Admissions for Malaria in 1911—352.

Malaria Admission-rate per cent. of Total Admissions—19 per cent., as compared with 16·6 per cent. for the twenty-one Colonies.

Total Attendances at Dispensaries, &c., in 1911—33,015.

Attendances for Malaria in 1911—7,198.

Malaria Attendance-rate per cent. of Total Attendances—21·8 per cent., as compared with 22·2 per cent. for eleven Colonies.

Total Expenditure of Government for 1911-12 (*from Handbook of Cyprus*), *exclusive of Tribute*—£235,256.

Medical and Quarantine Expenditure for 1911-12—£12,794.

Proportion per cent. of Medical to Total Expenditure—5·4 per cent., as compared with an average of 7·4 per cent. for twenty Colonies.

The Medical and Sanitary Staff consists of a Chief Medical Officer, six District Medical Officers, and 13 Rural Medical Officers, all paid, or partly paid, by the Government. The towns of Famagusta and Limassol also employ Sanitary Officers; and there are in addition a number of private medical practitioners. The 13 Rural Medical Officers visit all the villages in turn, about once a fortnight each. There is no special Sanitary Officer for the Government, but the various Medical Officers are supposed to include sanitary duties amongst their other duties. There is no Government Sanitary Engineer. The towns do their own sanitary work, such as removal of refuse and road cleaning. There is a Government Analyst and a staff of dispensers, &c.

Medical Institutions.—A Lunatic Asylum, a Leper Farm, and six District Hospitals, each with its Dispensary.

Towns.—There are six of these with populations over 3,000 inhabitants each, namely:—

Nicosia	16,052
Limassol	10,302
Larnaca	9,262
Famagusta and Varosia	5,327
Paphos and Ktema	3,435
Morphou	3,228
Total	47,606
Average	7,951

Villages.—The remainder of the population, namely, 226,502 people, are mostly collected in 738 villages (*see* Report of Census of 1911), exclusive of 80 hamlets of less than 10 persons each. Only 537 villages have populations of over 100 each. The average population per village was 371.

Houses.—There were 67,046 inhabited houses in 1911, with an average population of 4·08 per house; and there were 18·71 houses per square mile of area.

Increase of Population.—Since the commencement of the British occupation in 1878, the population has been slowly increasing. The ratio of increase was 13·25 per cent. between 1891 and 1901, and 15·65 per cent between 1901 and 1911, chiefly among the Christian population. The males are in excess of the females. It is supposed that the population in ancient times may have been considerably greater than the present number.

Administration.—The Island is divided into six administrative districts, each with its Commissioner and District Medical Officer. Each district is divided into Nahiehs under a Mudir. Under the latter are the Muktars, or village headmen; amongst whose duties, as defined by law, is that of giving information of the outbreak of contagious or infectious diseases—but not (apparently) that of carrying out sanitary work. The muktars are elected by the villagers every second year, and are assisted by Azas, or village elders.

Municipalities.—Fourteen towns and large villages have been granted local self-government under Municipal Councils, which are elected by the householders every three years, and have general control over their areas, except as regards the police. Their revenues are derived from authorised fees, tolls, and rents; but they appear to have hitherto refused to levy the rates on property to which they are entitled. The revenues were in 1911 (Handbook of Cyprus):—

Town.	Revenue.	Expenditure.
	£	£
Limassol	4,340	4,288
Nicosia	2,935	3,124
Larnaca	1,670	1,603
Paphos	1,220	1,065

Geography.—Cyprus practically consists of two parallel mountain ranges, running west and east, with a large and comparatively flat plain, the Mesaoria, lying between them. The mountainous areas occupy quite two-thirds of the whole Island and consist of the usual ridges with valleys between them; and the valleys contain streams which work their way on all sides into the sea. In addition to the Mesaoria Plain, there are smaller flat areas near Limassol and Larnaca and Paphos, and there are also many smaller similar flat areas where many mountain streams debouch into the sea. The highest mountain (Troodos, 6,000 ft.) carries snow for a large part of the year, and consequently feeds streams beyond the rainy season. In addition to such streams, Cyprus possesses five perennial springs which run all the year round and are very valuable for agriculture. The Mesaoria Plain undulates considerably round the central part near Nicosia, but tends to become dead flat at either extremity, that is, near Famagusta on the east and near Morphou on the west.

Rainfall.—The Director of Public Works was kind enough to supply me with his detailed returns of rainfall month by month,

taken in a large number of stations. It is of course, unnecessary to reproduce these, but I attach in Appendix I. a meteorological sheet for the year 1911 (figures of which year have been frequently given above), and this will suffice to show the monthly distribution of the rainfall—a very important factor as regards the prevalence of malaria. This chart is roughly similar to those of other years. The bulk of the rainfall occurs during November, December, January, February and March. There may be a little rain in April, May, September and October, but there is usually very little indeed or none at all during June, July and August. This fact is of the highest importance as regards the prevalence of malaria in Cyprus, and also as regards its prevention; and will be considered later (Section 8) in detail. The average rainfall since 1905 is as follows (from the Handbook):—

19·35	inches	in	1905-06.
26·64	,,	,,	1906-07.
21·66	,,	,,	1907-08.
18·84	,,	,,	1908-09.
23·80	,,	,,	1909-10.
23·49	,,	,,	1910-11.
26·94	,,	,,	1911-12.

The average maximum temperature for the last ten years was 104·2° Fahrenheit. The average minimum was 31° and the average mean 65·49°. The centre of the Mesaoria Plain is extremely hot during July and August—in fact, hotter than any place in the Mediterranean, Egypt, and the adjacent littoral except Khartum; but of course the temperature on the hills is much lower.

The Mosquitoes of Cyprus.—The following list was given to me by the Entomological Department of the Liverpool School of Tropical Medicine; but doubtless many other species will be found when the insects are methodically collected (*See* also Appendix II).

Mosquitoes recorded from Cyprus:—

Anopheles maculipennis	—
Pyretophorus nigrifasciatus	Sept.
Pyretophorus palestinensis	June.
Stegomyia fasciata	—
Theobaldia spathipalpis	Sept.

Sanitary Laws.—A list of these, furnished to me by Dr. Cleveland, is given in Appendix III.

6. *Previous Studies of Malaria in Cyprus.*—The parasite of malaria was discovered by Laveran in 1880, two years after the commencement of the British occupation of Cyprus. Little work appears however to have been done in the Island in the light of his investigations for more than twenty years, although I read that there was an unpublished report upon the fevers of Cyprus by the former Chief Medical Officer, Dr. Heidenstam, in 1886. Early in the present century, however, Dr. George A. Williamson, M.A., M.D., District Medical Officer of Larnaca, received a course of instruction under me at the Liverpool School of Tropical Medicine, and immediately set to work on the subject of malaria in the

Island. His experiences, called "A Report on Malaria in Cyprus," and dated the 3rd April, 1903, were published in a Colonial Report and re-published in "The Selections from Colonial Medical Reports," dated July, 1904, No. 27. This forms an admirable monograph on the whole subject of malaria in Cyprus. The author begins with some remarks on the mosquitoes of Cyprus—especially the *Anopheles maculipennis*. He states that in the months of January and February there were a few culicines but no anophelines, and no larvæ of either group. In March a very few anophelines towards the end of the month. In April a few anophelines and more plentiful culicines. In May a great majority of anophelines over culicines. In June and July, the same as for May. In August, fewer mosquitoes, but culicines and anophelines both common. In September, October, and November still fewer mosquitoes, and culicines and anophelines present in about equal numbers. In December, a few culicines and extremely few anophelines. Thus he found anophelines commonest in May, June and July, and absent in December, January and February. He observed also that anophelines do not seem to bite much until May is well advanced; but he states that he found no anopheline larvæ until the beginning of May, and not after the beginning of November; but in the next sentence he remarks that the anophelines begin to hatch out in the end of March or in April—which scarcely agrees with his previous statement. The insects hibernate from November in houses and stables. He found the larvæ in newly-made shallow wells; in borrow pits; and in clean puddles. But they were absent in certain reservoirs near the Kouklia marsh; in the ordinary deep wells sunk for the domestic water supply of villages; in small receptacles; in large channels; in domestic water tanks containing fish; and in the salt lakes. Other details given by him agree with the usual observations. Regarding the effect of rain, he remarks that rain falling during the winter gradually evaporates and is absorbed during the heat of the summer; but if there are late spring rains (end of March, April and May) then there is a longer time for the existence of pools suitable for the breeding of mosquitoes, and, in effect, these pools will be found swarming with mosquito larvæ later on. He adds that heavy rain in the end of October and November will have an excellent effect in scouring out the pools, while the temperature, being below that required for the breeding of mosquitoes, does not allow of these pools again becoming, for that year, a breeding place. He gives an excellent table showing the cases of malaria admitted to the Larnaca Hospital during the twenty years 1882-1901. These numbered 10,076, or about five hundred a year on an average. The distribution of cases shows that they were fewest in February and March, and most numerous in August, when they were more than five times as numerous as in March. This is the common monthly distribution of malaria in the south of Europe. He also gives an excellent chart comparing the malaria prevalence with the rainfall and the temperature. He notes the great resemblance of the Cyprus statistics with those of Italy; and observes that the period of greatest malarial incidence is also the one during which the temperature is over 70° Fahrenheit. He again emphasises the

effect of the spring and autumn rains on malaria, the former causing it and the latter checking it. Dr. Williamson's figures are so large that I think his results must be accepted as being statistically sound. Coming to the microscopic examination of the blood, he succeeded in finding the parasites of malaria in 470 out of 503 cases which were diagnosed as being due to malaria; so that he actually succeeded in detecting the parasites in 94·4 per cent. of his cases—a very good result. The different species of parasites found by him in these cases were as follows:—

	Per cent.
Tertian	48·47
Quartan	8·03
Æstivo Autumnal (malignant) ...	43·50
	100·00

He also gives a table showing the seasonal prevalence of each species, from which it appears that the cases of tertian commence first in July and those of malignant later in September, whereas the quartan cases do not show so much variation (possibly owing to their small numbers). Passing on to the study of the prevention of malaria he repeats the principles generally laid down. He corresponded with me on the subject and quotes a passage from one of my letters—though of course, as I had not seen the Island at that time I could only form my opinion very insufficiently from the data. Partly as the result of my letter he concluded that mosquito reduction was not much called for; but he emphasised the usefulness of fish as the destroyers of larvæ and the utility of mosquito nets and of quinine and malaria education. He also urged that every encouragement should be given to the Muktars of the villages to dispense small doses of quinine to the villagers. For the treatment by quinine he advocates a dosage which would now be thought to be too small and not sufficiently continued. His monograph is one of the best ones written at that time on the subject; but, of course, subsequent investigations have modified some of the smaller details since then.

On my arrival in Cyprus in March, 1913, Dr. Cleveland, the Chief Medical Officer, showed me some excellent preparations of malaria blood, made by him—so that it is evident that the medical staff of the Island have been fully able to use this method of diagnosis.

On 19th January, 1909, a Commission which was appointed to enquire into the working of the irrigation reservoirs in the Mesaoria submitted its report to the Chief Secretary of Government. It appears that the large irrigation reservoirs which had been made since 1897 in the eastern part of the Mesaoria had called for investigation, partly on agricultural grounds and partly because some of the neighbouring villagers complained that they increased the malaria. The Commission, of which Dr. G. A. Williamson was a member, carefully considered the latter question in detail; concluded that the reservoirs did not have much effect; and suggested various remedies. They also

published an excellent addendum on biting flies by Dr. Williamson, and another addendum on Instruction for the Public regarding malaria.

7. *The Measurement of Malaria in Cyprus, March-April,* 1913.—I now come to the observations made during my own visit to Cyprus. It will be unnecessary in this report to discuss the various theoretical points that arise (as I did in previous reports of mine regarding my visits to West Africa, Egypt, and Mauritius), as the whole of this subject has been fully set forth in my book on "The Prevention of Malaria" (Murray), with contributions by twenty of the leading workers against malaria throughout the world. I think, therefore, that we might take these points as being for the most part definitely accepted; and may proceed at once to their practical application in the case of Cyprus.

The first thing to ascertain was the exact amount of malaria now present in the Island. One method of measurement is to compare the admissions and attendances for malaria with the total admissions into all the hospitals and the total attendances at all the dispensaries for all diseases during a given year. The figures for this have already been recorded in section 5 above. The proportion of admissions for malaria was 19 per cent. of the total admissions into the hospitals during 1911, and the attendances for malaria were 21·8 per cent. of the total attendances at the dispensaries during the same year. The corresponding admission ratio for twenty-one Colonies studied by me was 16·6 per cent.; and the corresponding attendance ratio for twenty Colonies studied by me was 22·2 per cent.—so that these figures show that Cyprus stands roughly at about the average figure for the British possessions (exclusive of India and some other areas).

Of course, some of the Colonies show much higher rates and others much lower ones; for instance, Lagos showed a malaria admission rate of 52·2 per cent., and Mauritius had an attendance rate of 32·9 per cent. On the other hand, there is little or no malaria in the Seychelles and some of the West Indian islands.

Another method for measuring malaria is to determine the proportion of children whose blood at a given date shows the presence of malaria parasites in large numbers. Unfortunately this method is very laborious and would not give any reliable results for a large area like that of Cyprus under many months work. Moreover, for other reasons discussed in my book, it is inferior as a method to the simple spleen tests, which are now being fairly generally employed. Hence, directly I arrived in the Island, I suggested to Dr. Cleveland that a general spleen census should be taken on the lines advised by me and used in Mauritius and Ceylon. Dr. Cleveland at once issued instructions to the various District and Rural Medical Officers to carry out the work in the areas under them; and the results are given *in extenso* in Appendix VI.

Most of the studies were made on the children in the schools, because this gives great facilities, not only for the measurement of malaria, but also for the treatment of the school children who have enlargement of the spleen. The various medical men employed on the task visited certain schools and examined as

many of the children as they could in them. The children so examined were divided into four classes, namely:—

(1) Those without enlargement of the spleen;
(2) Those with small enlargement;
(3) Those with medium enlargement;
(4) Those with great enlargement.

For reasons given by me in my book, I class the enlargements of the spleen so found under the numbers 1, 3, 6, and 9, because these numbers are likely to give roughly the comparative sizes of the organs with no enlargement, and small, medium, and great enlargement respectively. Of course, different medical officers are likely to differ considerably as to what exactly they consider to be a small, medium, or large spleen; but, nevertheless, for a large public health census of this nature, the figures are sufficiently accurate to give us a very good test as to the amount of malaria which is present, and which indeed has been present for some time past, in a given area. The proportion of all the children with any enlargement of the spleen at all is called the *spleen-rate*. Another ratio, which I call the average spleen, is obtained as follows. The number of children with no enlargement is added to three times the number of children with small enlargement, to six times the number of children with a medium enlargement, and to nine times the number of children with a great enlargement; and the total so obtained is divided by the total number of children examined. Obviously this figure gives the average size of the spleen for all the children concerned, according to the principles mentioned above.

There is always a certain amount of observational and also statistical error in all such estimates; and these can be taken into account if we please. But we are not seeking here an absolutely exact measurement, but only one which gives approximately the degree of prevalence of the disease in Cyprus.

The simple spleen-rate is the most free from observational error; but even this is subject to a considerable amount of it—a point which I now understand more strongly than before. This arises from the difficulty of saying whether a spleen which is just palpable under the ribs is really a pathological enlargement at all, especially in the case of very young children. It has been stated that the spleen of healthy infants is often palpable, and the question arises whether it is not sometimes palpable also in the case of slightly older children. This question cannot be fully answered without making a similar study of a large number of children in non-malarious countries. I propose to undertake the work shortly in England, but cannot possibly complete it in time for this report. On the whole, I think that Dr. Patrick and myself accepted as enlarged spleens those which I should hardly have accepted as such in India or Mauritius—a circumstance which tends to increase the spleen-rate of Cyprus in comparison with those countries. But I do not think that this point will make any really great difference in the total figures obtained.

Dr. Cleveland's results are as follows:—Out of 9,178 children examined in Cyprus 21·82 per cent. were found to have enlarged

spleen; and the average size of the spleen of these children was 1·78 times the normal size. These are fairly high figures, but by no means excessive. For example, in Mauritius in 1908 the spleen rate of 31,000 children was 34·1 per cent.; whereas the average spleen was 2·54 times the normal size. From these figures we can infer with a very high degree of probability that the Cyprian malaria is much less in amount than the Mauritian malaria.

It will be seen from Dr. Cleveland's census (Appendix VI.) that the rates differ largely according to district and also according to localities. They are the highest in the Larnaca and Limassol districts and lowest in the Nicosia district. In several of the villages the spleen-rate reaches 100 per cent. of the children actually examined, and the average spleen reaches more than five times the normal size. Some of the figures, however, show certain discrepancies which suggest that the rates were not taken quite accurately—a thing which is not to be wondered at in this first attempt at a general spleen census. Major Christopher, I.M.S., has shown the existence of a mathematical law governing the two rates, namely, that the average size of spleen bears a constant ratio to the spleen-rate. Exceptions to this law are found occasionally in the tables of Appendices V. and VI., suggesting that there has been some error. But these details will doubtless be rectified on a subsequent trial. In the meantime, the tables given form an extremely useful evidence of the amount of malaria, not only throughout the Island or in each district, but, what is still more important, in each village examined.

Appendix V. contains some spleen-rates obtained by myself in association with Dr. Cleveland, Dr. Patrick, and Mr. Francis. My examinations were made at random in various parts of the Island, mostly in the schools. They show a spleen-rate of 25·4 per cent. and an average spleen of 1·67. These figures agree fairly closely with Dr. Cleveland's, but, of course, I examined much fewer children (1,016), so that the statistical error is very much greater.

The enlargement of the spleen recorded in these figures may be taken with certainty to be almost entirely due to malaria. No kala-azar has yet been found in the Island; and nothing which I saw there led me to suppose that it was present. My investigations of kala-azar made in Assam in 1898 furnished me with a very clear clinical picture in that terrible disease. The children which I saw both in Mauritius and in Cyprus did not accord with that clinical picture. But, what is more definite, the death-rate among the children in these countries does not suggest the presence of kala-azar in any way. Of course, a very small proportion of the enlarged spleens may be due to some other causes than malaria; but this proportion is certain to be always so small that it cannot affect the total figures to any appreciable extent.

The general appearance of the children and the villagers in Cyprus did not lead me to suppose that the malaria there is intense as a general rule. At a few spots with high spleen-rates both the children and the people looked sickly, but as a rule they appeared much more robust than the Indian population of Mauritius, or indeed than the Greek population of Moulki, in

Greece, or than many villages which I examined years ago in India.

On the whole, therefore, I conclude that the malaria of Cyprus is of medium degree. It is much less intense as a whole than that of Mauritius or than that of many isolated localities, even in Cyprus. On the other hand, a general spleen-rate of over 20 per cent. is by no means to be ignored.

We must remember that these spleen-rates were taken at quite the least malarious time of the year, that is just before the commencement of the malaria season of 1913. I have no doubt that at the end of the present year there will be a very much larger spleen-rate throughout the Island. We must remember that the Mauritian spleen-rates were taken in the middle of the malaria season of that Island.

Another point to be remembered is that the amount of malaria varies from year to year. During epidemic years, as clearly shown in parts of India, it may reach twice and thrice the intensity that it reaches in non-epidemic years. Last year was by no means an epidemic year in Cyprus, so that the figures now given may be taken to represent a very normal state of affairs.

Lastly, there are facts to suggest that malaria tends to increase in many localities with increasing civilization, irrigation, and so on. A spleen-rate of 20 per cent. must always, therefore, be looked upon as a public danger, as we never know what it may not develop into at a later date.

It is known from many researches in various parts of the world that the disease has a great influence upon the total death-rate, apart from the actual deaths directly due to it, which can be put down as amounting nearly to about 0·5 per cent. of the total cases. Thus, wherever the spleen-rate is high the death-rate is high. It is not possible at present to determine exactly the influence exerted by malaria upon the total death-rate in Cyprus, because the death registration is not sufficiently exact to give the figures; but by analogy we must infer that it is considerable, that it causes a large infantile mortality, and that it tends thus to keep down the population, and, therefore, the prosperity, of the whole Island. When the sanitary organization proposed by me has been in working for some time the exact figures will doubtless emerge from the statistics, and Government will be better able to calculate the mischief caused by the disease.

8. *Mosquito Breeding during March to April.*—As stated in Section 2, one of my principal reasons for visiting Cyprus so early in the year was to ascertain the exact date when the anophelines commenced to breed there. For a week after my arrival I failed to find any anopheline larvæ anywhere, even in a small but very suitable marsh just outside the walls of Nicosia, in the gardens at Larnaca, in the Government farm at Athalassa, and in certain waters at Kythrea; and it was not until the 27th March that we discovered larvæ in the first mentioned marsh. Other waters at Deftera, Dikomo, Ortakq, and in the Kyrenia district, though suitable, proved negative; as also the waters in the large Mesaoria reservoirs examined by us on the 2nd and 3rd April. But we found considerable numbers of large anopheline larvæ in the village marsh at Akhyritou on the 3rd April and, next

day, in the deep fresh water lake to the west of Famagusta, where the insects were present along the margins in small numbers. Our next find on the 8th April was in the escape from the water-works of Limassol, where they abounded; and also in the marsh to the west of Limassol, where they were very numerous in the sheep holes, and also in the smallest driblets of marsh water amongst the reeds. These insects were of all sizes, from the smallest to the largest larvæ. On the 9th April we found large numbers in a big ditch close to the sea at New Paphos. On the 15th April we also found large numbers, but mostly small insects, in the marsh near Syrianochorio, both in gently running waters and in the ooze amongst the reeds. Thus, up to the middle of April I had found anopheline larvæ in six different localities, and I may add that my search was largely assisted by Dr. Patrick, Mr. Nicolls, Mr. Francis, and by our *moustiquiers*, one of whom, Mehmed Aziz, had become very expert at the work.

On the whole, therefore, I conclude that the anopheline breeding was only just commencing by the middle of April, and that the insects were not very numerous then. This agrees exactly with Dr. Williamson's observations. During the whole of my visit I found only two adult anophelines, one at Akhyritou, and one brought to me from somewhere outside Nicosia. The adults, therefore, would be likely to appear in the latter part of April, but not to abound until several new generations had taken place, that is towards the end of May, which also agrees with Dr. Williamson's notes.

It should be noted also that at this season we failed in finding anophelines in the pools in the various river-beds, where, however, they are likely to abound later in the season, when the pools tend to dry up. We also failed to find them in any of the wells, probably because the water was still too cold for them; but, it will be remembered, Williamson found them in shallow wells later in the season, and Dr. Cleveland informed me that he has frequently found them since, even in the deeper wells. We discovered no anopheline larvæ in the margin of the salt lake at Larnaca, or in many other small waters which otherwise appeared suitable for them; but doubtless these waters will be inhabited at a later season.

Probably all the larvæ that we found were simply those of *Anopheles maculipennis*, with the exception of one which hatched out into a *Pyretophorus cardamatisi*, Newstead and Carter.

While searching for the anophelines we found large numbers of culicines in all the waters where we found the former, and also in some others where the former are likely to breed at a later season. The insects hatched out from these larvæ were sent by me to the Entomological Department of the Liverpool School of Tropical Medicine, where they have been identified by Mr. H. F. Carter, S.E.A.C. Dipl. His list of identifications is given in Appendix II. and contains six species which were not mentioned in his previous list (Section 5). Williamson appears to have been quite right in saying that the flush of anophelines is preceded by one of culicines. There were also some culicines in cess pits at Larnaca; and numerous Dixa larvæ were found in many places.

As often noted, they are extremely likely to be mistaken for anopheline larvæ.

On the whole I was rather surprised at the paucity of mosquitoes in Cyprus. I had been badly bitten by them at Cordova in Spain on my way out, but was not bitten in Cyprus at all, and scarcely saw an adult mosquito until I went on board ship on my return journey. It will be of interest to add that the breeding seemed to be in a still less advanced condition in Greece in the latter half of April—where I did not see a single insect or larva either in Athens or at Moulki.

The date of the commencement of breeding is a point of supreme importance for Cyprus, because it must limit the principal breeding season between that date and when nearly all the surface waters dry up, say, at the end of May. This would give practically only about two months (April and May) for the whole breeding season. As Williamson says, the autumnal rains in September are mischievous rather than advantageous to the insects, because they flush out the pools that remain at a time when the weather is too cold to be suitable for breeding in the new pools which may be formed. But we must remember that there are certain permanent waters in the Island in which anophelines breed all through the summer. These are principally:—

(1) Wells;
(2) Deep pools in river-beds;
(3) Pools formed by ill-managed irrigation—especially by irrigation from the perennial streams;
(4) Waste waters from stand-pipes and waterworks (such as that of Limassol);
(5) Cess pits (?);
(6) Cisterns;
(7) Brick pits;
(8) Possibly certain deeper pools in marshes or ditches which last through the dry weather.

Most of these waters exist only occasionally, but the wells are found almost everywhere, and may be one of the principal sources of the malaria of the Island; though, for reasons to be presently given, I infer that they are not the principal source (Section 10).

9. *Some Local Observations.*—A complete study of all the seven hundred villages can of course be conducted only by a proper organization working continuously for several seasons; but I may now give some notes of my own.

(1) The plain round Nicosia did not seem to be at all favourable to anophelines, and is in fact little malarious. I ascribe this to the extreme dryness of the plain and to the permeability of the soil. Although all the villages here have wells, the spleen-rates are certainly not high until we proceed in the direction of Deftera or Dicomo, where there are streams. In fact, as a general rule in this district a high spleen-rate is always associated with some local stagnant water in addition to the local wells. The case of Kythrea and Neochorio is particularly interesting, because these villages are supplied by the perennial Kythrean stream, which is used over a large area for irrigation. Yet I found a very low spleen-rate in both villages, even in Neochorio, which is on the flat plain. The

reason for this appears to me to be that the water of the stream is used with the utmost economy and is not allowed to lie about anywhere. Each field receives its proper allotment during one or two days in the week, after which the fertilising flood is turned into other fields. On the other hand, at Dicomo there appears to be severe malaria due to a small marsh of utterly waste water from a stand-pipe. Thus we have the antithesis of a useless water causing malaria in one place, and an extensive useful water causing none in another place. But where the available water is in excess the villagers did not appear to economise it so carefully, with the result that local malaria is caused.

(2) My studies of the reservoirs west of Famagusta entirely confirm the findings of the Commission. We found no anophelines in the reservoirs, and they did not seem to be suitable for them, because of the fish which they contain, unless they are allowed to become weedy round the margins later in the season. It is true, however, that there was a high spleen-rate in Prastion, Gaidhoura, Kouklia, and Kalopsyda, and a very high spleen-rate of 100 per cent. at Akhyritou; but I could not attribute these to the reservoirs, and think that they are due to marshy pools somewhere over the flat adjacent areas, and to the causes mentioned in the Commission Report. At Akhyritou we found many anophelines in the village marsh below the reservoir, and the long channel which runs through the marsh and takes the escape water of the reservoir down to the sea was so full of weeds that it might become dangerous later in the season. The marsh is used for brick making by the villagers, and is, I think, the principal source of the high malaria rate amongst them. There is also a small marsh at Kouklia, and Kalopsyda is open to the great flat plain lying to its north. In fact this plain is so open in all directions that very small breeding pools upon it may possibly furnish mosquitoes which would be capable of travelling miles to the nearest village. There was also a small pond at Gaidhoura, which, though apparently quite isolated from any other waters, contained plenty of small fish, but may breed mosquitoes later in the year. I think that the malaria in this district is caused in precisely the same manner as the malaria in the other villages, namely, by the local breeding; and that it can be removed simply by the same methods, without interfering with the irrigation reservoirs, except as regards keeping their edges clean of weeds. While we were at Akhyritou, the Public Works Department started an experimental treatment of the marsh with a fund allowed at my request by the Acting High Commissioner. The weeds were cut by a weed cutting chain, and the banks suitably drained.

(3) The only anophelines which we found in the Famagusta area were those in the large lake to the west of the town; but I doubt much whether this lake really affects the town itself. There used to be a marsh in the moat; though this has recently been drained; and I suspect that it was this marsh which has maintained the spleen-rate of the town, amounting to 32·5 per cent. in the Mohammedan school. Possibly also the numerous wells in the town and in Varosia are responsible for this spleen-rate—which appears to be rather high for the amount of breeding surface found

by me. A more thorough enquiry is needed during the height of the summer to explain it.

On enquiry amongst certain farmers living to the west of the town, I could find no indication of there being any very great migration of mosquitoes from the large lake. (*See* Section 13.)

The two villages of Derynia and Paralimni to the south of Famagusta are very interesting. Both villages lie close to a large salt lake, but the former is notoriously free from malaria, and the latter is notoriously unhealthy (the spleen-rate in the latter is lower than I expected, probably because nearly all the inhabitants take quinine. (*See* Appendix V., which contains my figures.) It can scarcely, therefore, be the salt lake which is the cause of the malaria. On examination, Dr. Fulheihan and I found no breeding surface near Derynia, but a large marshy stream close to Paralimni, which probably explains the facts. Wells occur in both villages.

(4) In Larnaca the principal breeding water appears to be in the gardens and in some isolated waters round the town. I did not give much time to the study because Dr. Patrick was carrying it out in a very capable manner for me; but the malarious rate in the whole of this district is very high and requires careful attention in connection with local breeding areas.

(5) The escape from the waterworks at Limassol can very easily be dealt with, and we showed the defects to His Honour the Mayor. The principal source of the malaria is very probably the large marsh which commences about a mile to the west of the town and extends for many miles further west. I think that the eastern edge of this marsh is quite within striking distance of the town and may have to be dealt with ultimately (Section 13).

Regarding the barracks of the troops at Polymidia, we could find no signs of breeding anywhere close at hand; but neighbouring villages contain irrigation waters; and I think it very likely that the soldiers acquire their infection in them, or in Limassol itself. There was a question whether the troops did not become infected during the annual marches to and from Troödos; but I suspect that the explanation just given is the more probable one.

(6) The ditch at New Paphos was probably capable of hatching many thousands of anophelines a night, but I understand from the Commissioner, Major Bayly, that it has been already drained.

(7) Syrianochorio gave a spleen-rate of 100 per cent. amongst the few children found in the school. It also suffers from bilharzia disease, due to the river. The village is only a small one and the malaria infection arises from the large marsh in the neighbourhood, in which we found many anophelines. It would be out of the question to drain this marsh for such a small village.

It is unnecessary to remark here upon many other localities seen by me, which offer no exceptions to the general rule regarding malaria. Some villages appear to be healthy and others to be very unhealthy, and the latter are usually, and probably always, associated with some local marshy conditions, large or small. The spleen census will indicate very exactly the spots to which attention should be turned, and the proposed organization will then be able to study their local conditions.

10. *Relations between Malaria and Breeding Surface in Cyprus.*—That such a relation exists has been known to the world since the time of Empedocles of Sicily, that is, since 500 B.C. The relation was worked out numerically by Major Fowler and myself in Mauritius in 1908 in the Clairfond marsh, where we showed definitely that the spleen-rate of the villagers diminishes decisively and rapidly the further the people live from the pools of water. Subsequently Major Robertson, I.M.S., made some excellent similar studies in India showing how the disease diminishes directly with the distance from the breeding area. My observations in Cyprus simply confirm the same law. Wherever the malaria rate is high, there we may expect a large local breeding surface.

It will of course be understood that by breeding surface I do not mean *any* water or even *any* stagnant water. I mean water which breeds the local carriers. Here as elsewhere that water is generally more or less stagnant, and generally contains a certain amount of fine, green, flocculent water weed and other shelter for the larvæ, and is not open to fish, or subject to quick desiccation or scouring out. A place may possess much water and even much stagnant water, without possessing much breeding surface. For instance, at Kythrea there is very much water, but, as I have said, not much breeding surface (Section 9 (1)).

Wells occur all over the Island and may or may not be associated with high spleen-rates. I think that the explanation is that they supply only a few anophelines as a rule, perhaps enough to cause a low spleen-rate of something up to 10 per cent. Where the spleen-rate rises above this, I have always found some additional breeding surface in the close neighbourhood. This is important, because the wells are often very troublesome to deal with. More exact information will be obtained upon this point in the course of future studies; but I think that the broad lines can be accepted as pretty certain. I should add here that malaria has now been studied so much that I have been able to construct a mathematical equation containing most of the factors implicated in the spread of it—this equation has been accepted by good mathematicians and enables us very definitely to allot its proper quantitive force to each separate factor (Prevention of Malaria, Second Edition). I may therefore now proceed, without further analysis, to proposals for prevention.

III.—THE PREVENTION OF MALARIA IN CYPRUS.

11. *Methods which may be used.*—These are:—

(1) The use of mosquito nets, wire gauze to windows, culicifuges, &c. This is chiefly applicable to public buildings, such as barracks, prisons, railway stations, hospitals, &c.; but it is very difficult to apply to the mass of the people, especially in poor villages, where the houses are often so constructed that it would be more expensive to apply wire gauze to them than to rebuild them entirely. Mosquito nets will seldom be employed by the poor, and culicifuges are never very satsfactory.

(2) Quinine.—If every case of malaria is treated completely with quinine, the malaria parasites throughout a locality will be destroyed, and the mosquitoes will therefore be innocuous however numerous they may be. But a complete quinine treatment requires for an adult an administration of something like five hundred grains of quinine altogether, given in varying doses ordered by medical men and taken with the utmost regularity. The method has now been tried all through Italy, Greece, and in many parts of America and India, and the results have often proved disappointing because of the difficulty of getting people to take the drug properly. This difficulty is experienced even with soldiers and much more, therefore, with the poor populace, especially the children (who are the principal carriers of malaria).

(3) Mosquito Reduction.—This consists principally in draining away the breeding waters of anophelines, or in so treating them that the larvæ are killed. The destruction of the winged insects has also been advocated. The method can only be done properly by the local Public Health authorities, who have to find the money for the treatment of the breeding waters. The cost varies largely according to the nature and the amount of the local breeding surface.

The advantages and disadvantages of these several methods have now been discussed throughout the world during the last fifteen years. Probably each method by itself would completely stamp out malaria if it could only be absolutely thoroughly employed—which is seldom, if ever, the case. It generally happens, therefore, that we employ two or more of the methods partially and simultaneously. In Panama all the methods have been employed together with the greatest possible success; but in most localities those methods which are easiest under the local circumstances are those which have been selected. The question is what are the best arrangements which will cost the least money and cause the greatest reduction of malaria; and I understand that it is my principal duty to advise upon this point for Cyprus.

All the methods have their defects and their advantages. Mosquito nets and wire gauze are most suitable for public institutions and for the wealthier and more intelligent inhabitants. They should always be recommended; but, as already stated, it will be almost impossible to enforce them upon the general populace.

Quinine will never be taken in sufficient doses by the general population; and D. Thomson, working under my direction, suggests that an insufficient dosage is likely if anything to increase the sexual forms of the parasite, that is, those which are engaged in their transmission. Many recent disappointments with this method have occurred; for instance, I may refer to the remarks of the Director-General of the Indian Medical Service, at the last meeting of the General Malaria Committee of India, held at Madras on the 18th November, 1912, in which he mentions these disappointments. On the other hand, the method lays the responsibility of malaria reduction almost entirely on the people themselves, and thus saves the authorities much trouble. For example, the Government of Greece has done little more than

issue good Government quinine at a low price, thus practically telling the people to save themselves if they can; and it actually makes a profit from such sales, but I doubt whether this is sufficient to make more than a very partial reduction of the malaria. For example, in the village of Moulki in Greece, which I examined in 1906 before such sale of quinine, and again this year after my visit to Cyprus, I found that the spleen-rate had fallen from 55 per cent. to 28 per cent.; but here in addition to the quinine the breeding pools round the village had been kept carefully oiled by a British company, so that the reduction cannot all be fairly attributed to the quinine. Moreover, such reduction is often more apparent than real; the people get slightly less fever and less enlargement of the spleen, but large numbers of them still remain infected and sickly. Probably a thorough quinine treatment can only be carried out by an extremely large staff of doctors and dispensers residing more or less permanently in each group of villages, examining the inhabitants very frequently, and insisting upon their taking the drug properly. In the end this would be much more expensive than mosquito reduction, especially if we remember that the salary of a single medical man is often as great as the payment of from twenty to fifty of such workmen as are usually employed in treating breeding waters. And, as the villages could never support such an expense, most of it would in the end fall on Government.

As already stated, the cost of mosquito reduction falls almost entirely upon the Government; but this has the advantage that it enables Government to do the work almost without reference to the public because the large majority of breeding pools and anophelines occur in the roads and the fields and not in private premises. Moreover, no rational person objects to the reduction of mosquitoes, which saves him much annoyance as well as much sickness; while the reduction of every species of mosquitoes besides anophelines tends to reduce other maladies. This method has also the very great advantage that it compels the authorities to keep a strict sanitary watch upon the whole of the area under them.

The cost and applicability of all the measures depends also upon other circumstances, namely:—

(1) The existence of a capable sanitary department;
(2) The state of education of the local sanitary and medical officers;
(3) The intelligence and education of the people.

Where all these are unsatisfactory, as in most parts of the world, the anti-malarial measures are much more difficult.

12. *The Suitability of Cyprus for a large Anti-Malaria Campaign.*—I must remark in the first place that something has already been done in Cyprus to educate the people. Excellent instructions, published by Dr. Williamson, have been issued and widely circulated in the suitable languages, and a good primer of hygiene by the Chief Medical Officer printed in 1909. Arrangements have also been made to enable the muktars to give quinine on furnishing certain statements regarding the necessity of doing so. Hence, during my visit I found that the people of

Cyprus were already quite cognisant of the fact that mosquitoes carried malaria—though, of course, they do not always believe it. Moreover, I must confess that I found them to adopt an extremely intelligent attitude on the question—much more so than I have always found even amongst English people in various parts of the world. We always conversed with the priests and schoolmasters and others in the villages as much as time would allow, and found them quite ready to help any strong lead in the direction of malaria prevention.

It is now recognised that special instruction in tropical medicine and sanitation is almost indispensable for medical practice in warm countries. The Chief Medical Officer of Cyprus holds the Cambridge diploma, and, as already stated, Dr. Williamson obtained the Liverpool one. Several other Medical Officers of Cyprus have attended the schools; but I am informed that the majority have not done so, and indeed find a difficulty in doing so, because the teaching in England is in a language which they do not speak.

Regarding a sanitary department, I must confess that Cyprus can scarcely claim to have one at present. It is true that the Medical Officers are held to have sanitary as well as medical duties, but this is not nearly sufficient. A busy medical man who is superintending, or actually carrying out, clinical work cannot possibly carry out the sanitary work of a large district as well. There must be sufficient numbers of sanitary inspectors, a good Public Health Act, sufficient funds for sanitary work, and, above all, a sufficient labour force for such work throughout the towns and villages. Sanitary work demands brain, eyes, and hands; but at present Cyprus possesses only the brains—that is, the capacity to do sanitary work, if only the proper inspectors and the proper labour could be provided.

Coming now to the question: which of the possible measure is most applicable to Cyprus, we must consider the following points:—As stated in Section 10, the breeding of anophelines in Cyprus practically lasts only during the months of April and May, and occurs in comparatively small waters. Moreover, except in a few small, abolutely flat areas, the ground is much sloped in a manner which renders drainage easier. Both these circumstances together are strongly in favour of mosquito reduction for the Island. In fact, after having examined many parts of India and West Africa, the Panama Canal zone, Egypt, Mauritius and Greece, as well as Cyprus, I think that the only country which lends itself better to mosquito reduction than Cyprus is Ismailia, in Egypt, and perhaps one or two very arid tracts in India. The absence of rainfall during the warm months of the year is a most valuable asset. Things are quite different in Panama or Sierra Leone, for example, where there are torrential rains during the whole of the breeding season. If, therefore, mosquitoes can be reduced in such places as these the process should be much easier in Cyprus.

On the other hand, quinine distribution is just as difficult in Cyprus as it is anywhere else, this difficulty depending upon the natural unwillingness of the people in Cyprus and elsewhere to take an unpleasant medicine for the rest of their lives.

Mosquito nets and wire gauze may be strongly recommended for Cyprus in public notices, but they will only be used there, as elsewhere, by the more well-to-do classes.

On the whole, therefore, Cyprus is most suitable for a pretty thorough mosquito reduction combined with a certain amount of quinine distribution, especially in the schools.

13. *Suggestions.*—The conduct of future operations against malaria can be left with confidence to the Medical Department of Cyprus. I may, however, be perhaps allowed to make a few small suggestions.

(1) At first the operations can be commenced most actively in the most malarious villages and also in the largest of the malarious ones. Obviously, money spent in such will affect a larger number of people than the same money spent in small or in only slightly malarious areas. Another claim for speedy action is the facility with which local conditions can be dealt with.

(2) Quinine distribution should be pushed with the greatest vigour amongst school children, especially those with enlarged spleen; and it may be useful to encourage school masters to give the drug and also to show them how to do it. It was suggested to me that quinine can also be distributed by mudirs, muktars, tithe superintendents, tax collectors, police, and the priests and schoolmasters of the villages, besides the Medical Officers, the Sanitary Inspectors and the dispensers, but I do not know how far all these suggestions will be found to be practicable.

(3) The tracts on malaria prevention for the public can be issued again with advantage to all the schools. Chapter 2 of my book on "The Prevention of Malaria" has been specially written for this purpose; I do not know whether it would be worth while translating it into Greek. The Greek Anti-malaria League also issues many pamphlets, and perhaps the Medical Department would like to obtain copies of these from the President of the League, Professor Dr. Savas, "Laboratoire D'Hygiene," Université, Athens.

(4) Arrangements might be made for distributing gold-fish, with printed directions in Greek and Turkish, to all owners of irrigation cisterns.

(5) Considerable difficulty is likely to be experienced with the wells, and these should be carefully examined in July and August for larvæ, with a view to finding the best way of destroying the insects in them.

(6) During the whole of my tour I saw only three large waters which will be a danger to the Island. These were the deep lake to the west of Famagusta, the marsh to the west of Limassol, and the marsh close to Syrianochorio. The first is below sea-level and cannot be drained or filled up. Even to cut the weeds round the margin and deepen the edges would be a very expensive work. I doubt, however, whether this lake really influences the malaria-rate in Famagusta or Varosia, because the peasants living to the west of the town, who would be first visited by mosquitoes from the lake, do not appear to be suffering particularly from malaria. I do not advise any

measures at all being taken for this lake until it has been conclusively shown that malaria remains in Famagusta in spite of a careful mosquito-reduction policy in the moat, the gardens, and all through the town area. In fact, I suspect that the disease in Famagusta is due, not to the lakes, but to small waters and wells in the town itself.

The marsh to the west of Limassol is, I think, near enough to influence the town, and the Public Works Department might be asked to prepare a scheme for dealing with it by some of the known methods to a distance of a mile to the west of its eastern margin. It might be drained, deepened, converted into a lake, or planted witb trees. This will be a matter for future consideration; but in the meantime the escape from the Limassol waterworks should be dealt with promptly.

I consider that nothing can be done with the marsh close to Syrianochorio; the village is too small to justify a great expense. It will therefore be an excellent site for an energetic quinine prophylaxis by itself. Efforts should also be made to prevent bilharzia infection in this village as, if care is not taken, that very serious disease is likely to spread in the Island.

(7) I am told that the general registration of births and deaths requires much improvement. This can probably be effected without difficulty.

(8) I am much obliged to the various medical men who, in response to a request from Government, furnished me with their views on the prevalence of malaria within the areas served by them. I have used the information so obtained in compiling this Report; and hope that everything will be done to encourage similar interest in the subject on the part of all the medical men in the Island.

(9) The best way to keep accurate information regarding all the 738 centres of population in the Island would be to file in the office of the Chief Sanitary Officer a number of sheets, each of which refers to each centre of population and gives the sanitary data for it, including population, birth-rate, death-rate, spleen-rate, breeding pools, refuse heaps and all other necessary items. This file would be indispensable when the Sanitary Department comes to carry out general improvements.

Postscript.

To Report on the Prevention of Malaria in Cyprus. Dated the 6th July, 1913.

Spleen-rates.—In Section 7, page 15, I stated that there was some doubt as to whether a spleen which is just palpable under the ribs is or is not in a condition of pathological enlargement, and suggested that the only way to answer the question would be to examine a large number of children in a non-malarious locality, such as England. This work has now been done by Major Christophers, I.M.S., Major Perry, I.M.S., and myself in three

large schools in London. On making *a very careful* study (by palpation only) of 469 children of over three years of age, we find:—

	Number	Percentage
Spleen not palpable	458	98·9 or? 97·65
Spleen doubtfully palpable ...	6	1·28
Spleen palpable	5	1·07
Spleen below ribs	0	0·00
Total children examined ...	469	100·00

I think that these figures will establish a very useful standard for comparison, because all the children were far removed from any possibility of malaria infection, while all three observers possess a large experience in this kind of work. The children were bent forward over the observer's knee in a position which relaxed the abdominal muscles, and the fingers were then pressed upwards under the ribs in search of the spleen. Only in 1·07 per cent. of them could that organ be felt; and in none was it enlarged sufficiently to be felt below the ribs. But in 1·28 per cent. of them it was doubtful whether what was felt was really the spleen or perhaps some intestinal content lying between that organ and the fingers. In the positive cases the enlargement, if any, was of the slightest degree and was probably due to various maladies of children which are known to affect the spleen to a small extent. The general picture presented was absolutely different to that seen in malarious areas.

I conclude, therefore, that the spleen-rates recorded in Appendix V. of my Report, and also probably in Appendix VI., and discussed in Section 7, were actually due to malaria within a possible error of between 1 per cent. and 2 per cent. For practical purposes it will be safe, I think, to record *all palpable spleens as being probably malarial*—the small margin of error being negligible in comparative work, and the enlargements noted by us in London being so small as to be scarcely noticeable in rapid pathometric studies. It is understood, of course, that kala-azar is not present.

When discussing spleen-rates in my Report, I forgot to mention the enlarged spleen found amongst about 8 per cent. out of three hundred children of all ages in Egypt, examined by Day and Ferguson, and described by them in their paper in the "Annals of Tropical Medicine," November 1909, Vol. 3, No. 3. It will be remembered that this enlargement is generally associated with definite cirrhotic enlargements of the liver in about 2·3 per cent. of the cases. Further researches on the subject were made by my brother, Dr. E. H. Ross, then Medical Officer of Health for Cairo. He found that, out of 7,034 children, 483 or 6·8 per cent. had palpable spleen, and 1,015 or 14·4 per cent. had palpable livers. In 1909 I examined a number of children with him in Cairo, but we did not succeed in finding a single case. The condition has, however, been also observed in Syria. Day and Ferguson declare that it is not due to either kala-azar or malaria, though the symptoms may easily recall the former.

If a similar disease occurs in Cyprus, it will only be declared by very careful study of the children in connection with the future spleen censuses which I have recommended. Probably, the best way to detect its presence will be to examine the liver as well as the spleen, and a frequent enlargement of the former will serve to raise suspicion. I should say, however, that this form of splenomegaly appears generally (though not always) to be of a very slight nature, the spleen being little more than only just palpable under the ribs, while the malaria spleen so frequently reaches a great size. Day and Ferguson's diseases may, however, possibly account for, say, 5 per cent. of the Cyprian splenomegaly; but this must not be admitted until a careful search has been made for enlarged liver and the other symptoms noted by the authors.

APPENDIX I.

NICOSIA HOSPITAL.

METEOROLOGICAL RETURN FOR THE YEAR 1911.

	Temperature.						Rainfall.		Winds.	
	Solar Maximum.	Minimum on Grass.	Shade Maximum.	Shade Minimum.	Range.	Mean.	Amount in Inches.	Degree of Humidity.	General Direction.	Average Force.
January	—	—	56·8	31·7	25·1	44·4	4·46	76	N.	0·4
February ...	—	—	55·7	32·8	23·4	44·8	2·31	78	„	0·8
March	—	—	62·9	37·6	25·3	52·3	1·67	78	W.	0·6
April	—	—	71·3	44·1	27·2	59·8	0·65	72	„	0·4
May	—	—	80·4	50·6	29·8	68·0	1·47	66	„	0·5
June	—	—	92·1	60·1	32·0	76·6	0·00	55	„	0·4
July	—	—	97·7	64·4	33·3	80·0	0·00	60	„	0·2
August	—	—	98·8	66·0	32·8	82·0	0·00	58	„	0·2
September ...	—	—	91·5	59·9	31·6	76·4	0·17	60	„	0·3
October	—	—	83·4	54·8	28·6	70·6	0·15	63	Calm	0·0
November ...	—	—	74·5	46·8	27·7	61·6	1·26	74	„	0·5
December ...	—	—	63·2	39·8	23·4	52·8	6·43	78	„	0·9
Total Means ...	—	—	77·4	49·0	28·4	64·1	18·57	68	W.	0·4

APPENDIX II.

SOME CYPRIAN CULICIDÆ, MARCH-APRIL, 1913.

Identified by Mr. H. F. CARTER, Entomological Department, Liverpool School of Tropical Medicine.

Culex pipiens ; L.
Culex tipuliformis ; Theo.
Culex hortensis ; Fic.
Theobaldia spathipalpis Rond.
Theobaldia annulata ; Sch.
Theobaldia morsitans. (?) Theo. (= Culicada morsitans ; Theo.).
Anopheles maculipennis ; Mg.
Pyretophorus cardamatisi. News. and Carter (? = P. nursei ; Theo.).

APPENDIX III.

LIST OF LAWS, &c., GOVERNING THE MEDICAL DEPARTMENT.

QUARANTINE :—

X of 1879, Quarantine Law.
XIX of 1901, Quarantine and Customs Law.

PUBLIC HEALTH :—

I of 1883, Infectious Disease Prevention Law.
III of 1892, Public Health (Villages) Law.
IV of 1891, Lepers Law.
IV of 1880, Contagious Diseases (Animals) Law.
XII of 1905, Food and Drugs Law.
XIII of 1894, Coroners Law.
III of 1896, Burials Law.
VIII of 1885, Municipal Councils Law.

MEDICAL REGISTRATION :—

1861 Medical Civil Administration Law (Imperial Ottoman Code).

CHEMISTS AND DRUGGISTS REGISTRATION :—

XIII of 1900 and 1911, Pharmacy Law.

BIRTHS AND DEATHS REGISTRATION :—

XVI of 1895, Births and Deaths Registration Law.

APPENDIX IV.

RETURN OF BIRTHS AND DEATHS FOR THE YEAR ENDED THE 31ST DECEMBER, 1911.

District.	Population.	Births.		Deaths.	
		No. of Births	Rate per 1,000.	No. of Deaths.	Rate per 1,000.
Nicosia	81,497	2,488	30·52	1,253	15·37
Larnaca	29,737	900	30·26	642	21·58
Limassol	46,084	1,248	27·08	662	14·36
Famagusta	58,530	1,831	31·28	1,104	18·86
Papho	38,508	1,439	37·36	643	16·69
Kyrenia	19,752	937	47·43	382	19·33
Total	274,108	8,843	32·26	4,686	17·09

APPENDIX V.

SPLEEN RATES.

Taken by Sir R. Ross with Dr. CLEVELAND, Dr. PATRICK, or Mr. FRANCIS, March-April, 1913.

Town or Village.	Children Examined.	Spleens.				Spleen Rate.	Average Spleen.
		1.	3.	6.	9.		
						Per cent.	
Kythrea	114	109	5	0	0	4·4	1·1
Neokhorio	52	52	0	0	0	0·0	1·0
Paleorotissa	37	36	1	0	0	2·7	1·0
Aradippou	70	46	18	6	0	34·3	1·9
Levadia	40	13	20	5	2	62·5	3·3
Larnaca (Mah. Sch.) ...	60	42	16	2	0	30·0	1·7
Kalochorio	25	13	11	1	0	48·0	2·1
Athalassa Farm	6	2	4	0	0	66·6	2·3
Eylenja	54	47	6	1	0	13·0	1·3
Strovolo	50	48	2	0	0	4·0	1·1
Deftera (Chr. Sch.) ...	50	35	10	5	0	30·0	1·8
,, (Mah. Sch.) ...	6	5	1	0	0	16·6	1·3
Kata Dikomo	63	51	11	1	0	19·0	1·4
Ortakq	13	5	5	3	0	61·5	2·9
Kyrenia (Mah. Sch.) ...	25	23	2	0	0	8·0	1·2
,, (Chr. Sch.) ...	38	38	0	0	0	0·0	1·0
Bella Paise	40	40	0	0	0	0·0	1·0
Kazaphani (Mah. Sch.)...	26	19	5	2	0	26·9	2·8
,, (Chr. Sch.) ...	20	19	1	0	0	5·0	1·1
Prastion	50	20	27	3	0	60·0	2·4
Akhyritou	30	0	25	2	3	100·0	3·8
Famagusta	40	27	8	5	0	32·5	2·0
Derynia	30	25	4	1	0	16·6	1·4
Paralimni	23	15	6	2	0	34·8	1·9
Kato Polymidia	40	28	12	0	0	30·0	1·6
Syrianochorio	14	0	8	6	0	100·0	4·3
Total	1,016	758	208	45	5	25·4	1·67

(Spleen rates taken in several villages have been mislaid.)

APPENDIX VI.

GENERAL SPLEEN CENSUS.

ABSTRACT OF SPLEEN RATE FIGURES. FEBRUARY, MARCH, APRIL, 1913.
(Children under 15 years.)

Town or Village.	Population.	No. of Births.	Birth-rate per 100.	No. of Deaths.	Death-rate per 100.	Total Examined.	Spleens.				Spleen Rate.	Average Spleen.
							1.	3.	6.	9.		
Nicosia ...	34,090	841	2·46	504	1·47	3,980	3,424	319	158	79	13·96	1·51
Larnaca ...	16,562	474	2·86	293	1·76	756	380	256	95	25	49·73	2·57
Limassol ...	12,939	242	1·87	206	1·59	718	502	121	61	34	30·08	2·14
Famagusta	24,134	761	3·15	394	1·63	1,701	1,269	271	104	57	25·39	1·89
Papho ...	7,887	194	2·45	139	1·76	1,074	838	119	68	49	21·97	1·90
Kyrenia ...	13,355	604	4·52	264	1·97	949	762	120	44	23	19·70	1·67
Total ...	108,967	3,116	2·85	1,800	1·65	9,178	7,175	1,206	530	267	21·82	1·78

NOTE.—Population and births and deaths taken from Census and Returns for 1911.

SEPARATE RETURNS OF THE SPLEEN RATE OF THE SIX DISTRICTS OF CYPRUS.

Period : February, March, April, 1913.

(Children under 15 years.)

Spleen Rate of Nicosia District.

Town or Village.	Population.	Births.	Deaths.	Total Examined.	Spleens.				Spleen Rate.	Average Spleen.
					1.	3.	6.	9.		
		Per cent.	Per cent.							
Nicosia	16,052	2·04	1·48	2,282	2,195	73	13	1	3·81	1·09
Kythrea	2,125	3·38	1·41	114	109	5	0	0	4·38	1·08
Neokhorio ...	736	2·98	1·08	52	52	0	0	0	0·00	0·00
Paleorotissa ...	556	2·51	0·53	37	36	1	0	0	2·70	1·05
Kaimakli ...	2,206	1·94	0·86	171	167	3	1	0	2·28	1·06
Strovolo	1,036	3·66	1·25	70	70	0	0	0	0·00	0·00
Ayios Dometios ...	752	3·72	1·86	140	140	0	0	0	0·00	0·00
Ayios Omologhedates.	721	1·24	0·97	90	90	0	0	0	0·00	0·00
Athienou ...	1,914	2·66	0·41	199	157	31	10	1	21·10	1·65
Petra	574	4·87	1·21	57	40	17	0	0	29·80	1·05
Prastio	220	2·45	4·54	23	3	9	7	4	86·95	4·69
Kazivera	146	3·41	3·41	22	3	8	5	6	86·36	5·04
Kyra	171	4·09	5·26	16	3	6	6	1	81·25	4·12
Avlona	220	1·36	1·36	32	7	13	8	4	78·12	4·06
Filia	314	5·09	2·86	32	3	11	12	6	90·62	8·18
Olga	126	—	4·76	16	4	6	6	0	75·00	3·62
Kormakitis ...	628	2·07	4·14	53	13	23	12	5	75·47	3·75
Myrtou	430	2·32	6·97	84	43	20	13	8	48·80	2·65
Morphou	3,228	2·35	0·80	336	187	54	55	40	44·34	3·09
Lefka	1,008	3·96	1·58	84	51	22	8	3	39·28	2·28
Lemethou ...	473	3·17	1·26	23	18	5	0	0	21·73	1·43
Pyrgos	454	2·42	2·42	47	33	12	2	0	29·28	1·72
Total	34,090	2·46	1·47	3,980	3,424	319	158	79	13·81	1·51

Spleen Rate of Larnaca District.

Larnaca	9,262	1·81	1·52	305	239	48	16	2	21·63	1·62
Aradippou ...	1,884	5·04	3·50	70	36	28	6	0	48·44	2·22
Pyla	556	2·51	0·53	47	9	30	5	3	77·55	3·18
Voroklini ...	410	4·87	2·43	35	0	25	9	1	100·00	3·94
Kalokhorio ...	533	5·62	1·87	25	13	11	1	0	48·00	2·08
Livadia	624	2·88	1·12	40	13	20	5	2	67·50	2·82
Alectrico	322	2·79	0·31	20	2	9	7	2	90·00	4·45
Anglissides ...	410	3·90	0·73	35	10	23	1	1	71·42	2·68
Kalavasso ...	839	5·48	1·90	47	30	9	2	6	36·17	2·61
Skarino	308	4·87	2·92	30	2	22	6	0	93·33	3·46
Kophino	469	1·06	0·42	20	3	9	6	2	85·00	3·70
Khirokitia ...	493	4·66	3·65	30	2	11	16	1	93·33	4·66
Korno	452	3·31	1·54	52	21	11	15	5	59·61	3·44
Total	16,562	2·86	1·76	756	380	256	95	25	49·73	2·57

SEPARATE RETURNS OF THE SPLEEN RATE OF THE SIX DISTRICTS OF CYPRUS—*continued.*

Period : February, March, April, 1913.

(Children under 15 years.)

SPLEEN RATE OF LIMASSOL DISTRICT.

Town or Village.	Population.	Births.	Deaths.	Total Examined.	Spleens.				Spleen Rate.	Average Spleen.
					1.	3.	6.	9.		
		Per cent.	Per cent.							
Limassol	10,302	1·48	1·50	430	377	43	6	4	12·55	1·36
Episcopi	936	4·48	2·56	100	38	18	26	18	62·00	3·00
Yermassoya ...	562	1·42	0·88	67	47	10	5	5	29·85	2·26
Pyrgos	398	3·51	0·75	48	12	24	8	4	75·00	3·50
Asgata	399	3·50	2·25	50	19	15	13	3	62·00	3·02
Moni	342	3·21	2·92	23	9	11	3	0	60·82	2·17
Total	12,939	1·87	1·59	718	502	121	61	34	30·08	2·14

SPLEEN RATE OF FAMAGUSTA DISTRICT.

Famagusta and Varoshia.	5,084	2·72	1·24	329	269	49	11	0	18·23	1·46
Ayios Yeorghios...	321	5·29	2·49	52	14	13	8	17	75·07	4·88
Peristerona Pygi...	641	6·24	3·12	84	55	20	7	2	34·52	2·08
Gypsos	783	2·92	1·66	55	41	11	2	1	25·45	1·75
Ormidia	502	4·18	2·19	44	34	7	2	1	22·72	1·72
Spatharico and Arnadhi.	363	4·68	6·33	24	0	10	6	8	100·00	5·75
Lapithos	311	4·82	1·28	20	6	7	4	3	70·00	3·90
Strongylo ...	329	1·51	1·21	25	9	9	4	3	64·00	3·48
Mousilita... ...	182	6·04	2·19	26	12	7	6	1	53·84	3·00
Acheritou ...	522	1·91	1·53	39	19	13	3	4	51·28	2·87
Asha	1,382	1·73	1·44	14	11	2	0	1	21·42	1·85
Avgora	717	3·62	1·25	72	50	17	2	3	30·55	1·94
Sotira	466	3·21	1·71	37	23	8	6	0	37·83	2·24
Derinia	696	2·29	1·00	73	60	9	3	0	16·66	1·45
Komi Kebir ...	1,167	2·65	1·02	134	131	1	2	0	2·23	1·08
Galatia	814	3·19	3·47	105	90	1	7	7	14·28	7·88
Ayios Theodoros	629	1·90	1·27	27	20	2	3	2	25·92	2·29
Komi-tou-Yalou	680	3·38	2·50	41	35	0	5	1	14·63	1·80
Lefkonico ...	2,036	3·29	0·93	145	139	5	1	0	4·13	1·10
Tricomo	1,501	3·33	2·53	63	43	13	6	1	31·74	2·01
Paralimni ...	1,322	1·58	1·13	72	48	20	4	0	33·33	1·83
Phrenacos ...	500	3·40	1·40	36	30	6	0	0	16·66	1·33
Liopetri	383	3·65	3·39	19	13	5	1	0	31·57	1·76
Xylophago ...	474	3·39	1·26	27	24	3	0	0	11·11	1·22
Kalopsida ...	436	4·13	2·29	34	10	15	7	2	70·58	3·38
Aphania	456	1·75	1·09	31	16	11	4	0	48·38	2·35
Vatili	1,437	3·34	1·73	74	67	7	0	0	9·45	1·18
Total	24,134	3·15	1·63	1,701	1,269	271	104	57	25·39	1·89

SEPARATE RETURNS OF THE SPLEEN RATE OF THE SIX DISTRICTS OF CYPRUS—*continued.*

Period : February, March, April, 1913.

(Children under 15 years.)

SPLEEN RATE OF PAPHOS DISTRICT.

Town or Village.	Population.	Births.	Deaths.	Total Examined.	Spleens.				Spleen Rate.	Average Spleen.
					1.	3.	6.	9.		
		Per cent.	Per cent.							
Ktima	3,091	1·55	1·06	354	327	16	8	3	7·62	1·27
Yeroskipos ...	783	4·21	1·78	53	45	6	2	0	15·09	1·41
Messoyi	367	2·17	0·81	76	69	6	1	0	9·21	1·22
Konia	296	4·38	1·35	63	51	8	2	2	19·04	1·66
Chloraka	378	3·70	1·32	53	46	5	2	0	13·20	1·37
Polis and neighbouring villages.	770	2·85	2·20	261	142	43	40	36	41·76	3·11
Ano and Kato Acourdalia.	204	4·90	0·98	32	22	6	2	2	31·25	2·18
Argaka	180	4·44	1·66	26	18	6	2	0	30·76	1·84
Tsada	650	3·84	1·38	48	27	11	6	4	43·75	2·75
Emba	434	4·60	2·76	44	41	3	0	0	6·81	1·11
Tala	331	1·20	5·73	41	38	2	1	0	7·31	1·21
Episcopi	403	1·73	4·44	23	12	7	2	2	47·82	2·73
Total	7,887	2·46	1·76	1,074	838	119	68	49	21·97	1·90

SPLEEN RATE OF KYRENIA DISTRICT.

Kyrenia	1,726	3·41	1·79	76	74	2	0	0	2·89	1·05
Bella Paise ...	613	5·70	1·46	30	24	6	0	0	20·00	1·40
Kazafani	736	4·61	0·27	14	9	4	0	1	35·71	2·14
Ayios Epiktitos ...	753	4·11	1·59	32	12	5	8	7	62·50	4·31
Templos	135	11·11	8·88	17	11	4	2	0	35·29	2·05
Karmi and Trimithi.	874	6·16	2·36	53	39	7	4	3	26·41	2·09
Karava and Lapithos.	4,635	4·33	1·63	311	257	41	12	1	17·36	1·48
Vassilia	548	5·29	1·45	43	31	11	1	0	27·90	2·32
Kara Koumi ...	36	2·77	—	23	19	3	1	0	17·39	1·47
Larnaca-tis-Lapitho.	562	3·02	0·71	75	66	5	3	1	12·00	1·44
Sisklipo	320	5·00	2·18	34	32	2	0	0	5·88	1·11
Ayios Ermolaos and Phota.	553	3·57	1·70	59	43	8	3	5	27·11	2·20
Kryni	203	3·44	0·49	9	8	0	1	0	11·11	1·55
Aghirda	178	10·11	5·61	24	21	2	1	0	12·50	1·37
Pano and Kato Dicomo.	1,087	4·59	3·22	113	89	17	4	3	21·62	1·69
Sykhari, Vormos and Koutsoventis.	396	4·79	2·55	36	27	3	4	2	25·00	2·16
Total	13,355	4·52	1·97	949	762	120	44	23	22·16	1·86