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The Secretary of the Expert Committee on Malaria

has the honour to transmit hereunder

SOME OBSERVATIONS TENDING TO SUGGEST A RECENT DECREASE IN IMMUNITY TO MALARIA IN THE POPULATION OF FREETOWN

(Section 1.4 of the Agenda)

by

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1. The control of Malaria in Freetown, Sierra Leone, has been carried out since 1943 with the main emphasis on temporary larvicidal methods; the use of residual and "knock-down" imagocides being secondary only, while drainage and town-planning schemes have so far been of negligible importance. The larvicides used have been:

1943 - 45: Malariol
1945 - Paris-green and Starch suspension
1945 - 50: DDT Emulsion

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2.1 Reduction of Anopheline Population

The control measures, as assessed by weekly "spray-sheet" catches, have produced a progressive decrease in the population of Anopheles gambiae over the years, and the almost complete disappearance of A.funestus. This is illustrated by Table I below. (Figures for 1943 and 1944 not at hand, but very much higher than 1945)

TABLE I

ROOM DENSITY INDICES FOR URBAN AND SUBURBAN AREA
(Average No. Female Vectors per bedroom over 6 Months)

YEAR	WET SEASON	DRY SEASON
1944-45	-	1.3
1945	17.0	-
1945-46	-	3.0
1946	30.3	-
1946-47	-	1.4
1947	8.9	-
1947-48	-	0.37
1948	3.5	-
1948-49	-	0.37
1949	4.8	-
1949-50	-	0.49

2.2 The anopheline population therefore showed a very marked decrease up to 1947 (with a relapse in 1946); since then it has tended to fluctuate round a reasonably low figure. In view of the fact that other statistics have shown an apparent increase in the incidence of the disease since 1947, very thorough investigations into the operation of the control house (or catching station)

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system were carried out in 1949 and 1950. The figures in Table I are based on the weekly spraying of 86 control houses - approximately one per cent of the total number of houses in Freetown. In the wet season of 1950 over two hundred additional houses were being sprayed each week. The results showed that the control houses were in fact a representative sample, and that the results of their spraying can be relied upon as a measure of the actual population, not perhaps an absolute measure as assumed by TURNER and WALTON, 1945; but as an effective standard of comparison of one year's work with another's, and between one district and another.

3.1 Malaria Rates

Since the dry season of 1947-48, the parasite rates shown by regular examinations of blood-films taken from certain groups of the population have ceased to fall, and in certain cases have risen to higher levels than existed in the first years of the control. This loss of correlation with the observed density of vectors is shown by three out of four groups:

1. Infants (attending the Infant Welfare Clinic, Connaught Hospital).
2. Schoolchildren (at regular examination of the youngest 60 pupils - 5-7 age group at schools covering the area).
3. Pregnant Women (attending the Ante-natal Clinic, Connaught Hospital).
4. Hospital Patients (Out and In-patients at Connaught Hospital)

It is most convenient to discuss the schoolchildren first.

3.2 Malaria rates in Schoolchildren

Tables II and III below give the parasite rates in urban, suburban, and rural schoolchildren from 1943 to 1950.

TABLE II - WET SEASON

	1944	1945	1946	1947	1948	1949
Urban	18%	15%	15%	8%	8%	11%
Suburban	46	19	18	16	18	21
Rural	51	38	4	21	18	-

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TABLE III - DRY SEASON

	1943-44	1944-45	1945-46	1946-47	1947-48	1948-49	1949-50
Urban	29%	16%	11%	8%	9%	11%	11%
Suburban	28	19	18	14	-	18	26
Rural	40	27	23	27	21	21	40

It will be seen that the parasite rate of the urban children tends to fluctuate about the 10% level; TURNER and WALTON quote 10% as the irreducible minimum for Freetown children, due to infections brought in from outside the controlled area. In an attempt to demonstrate the introduction of malaria in this way, a group of 480 children were separated into new entries and old pupils. The actual district of origin was ignored as the childrens' answers could not be relied on, while the school rolls would hardly be wrong. The "new entry" group must include many Freetown children; the "old pupils" may include some who had vacationed outside.

AGE GROUP	NEW PUPILS		OLD PUPILS	
	No.	Parasite Rate	No.	Parasite Rate
5-6	171	17.5%	41	5.0%
6-7	31	19.3	101	4.0
7-8	41	15.0	95	9.5
TOTAL	243	17.7	237	6.3

The conclusions to be drawn here are:

(a) New pupils from outside the town do increase the observed urban and suburban parasite rates.

(b) If the figure of 10% due to this is accepted, as the urban rate has at times fallen as low as 8%, a rise to 12% may be faced with equanimity.

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The schoolchildren, therefore, provide no evidence for either a decrease in immunity or an increase in transmission. Spleen rates of this group since 1947 have been calculated in only a few cases and by several different observers. Very few of those which have been compiled exceed 10%.

3.3 Malaria in Infants and Expectant Mothers

These two groups may conveniently be considered together, as they have always shown a very close correlation, rising and falling in unison from month to month. Up to 1947 both groups showed a steady decrease; since that year spectacular increases have been observed. Tables V and VI show this anomalous tendency.

TABLE V

WET SEASON PARASITE RATES

Year	Infant Welfare Clinic	Ante-Natal Clinic
1944	24.2%	38.7%
1945	15.7	16.8
1946	15.7	12.2
1947	11.2	8.3
1948	21.2	14.0
1949	31.0	14.0

TABLE VI

DRY SEASON PARASITE RATES

Year	Infant Welfare Clinic	Ante-Natal Clinic
1944-45	15.5%	22.2%
1945-46	8.6	13.0
1946-47	10.7	9.0
1947-48	11.2	8.5
1948-49	17.0	12.5
1949-50	20.0	18.0

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The reason for this apparent reversal of the results of the work of the Malaria Control Unit could be:

(a) an increase in transmission due to a higher level of anopheline population, with or without an increase in the sporozoite rate

(b) loss of resistance in the human population due to reduced frequency of infection. This would cause not only increased frequency of parasitaemia, which is already very apparent, but also heavier degrees of parasitaemia, severer clinical symptoms, and higher mortality.

It is unfortunate that at the time of writing figures on these three points are not available. The first, an increase in the proportion of "+++" infections has been demonstrated, and can be produced from Malaria Control Unit files. The latter two points have been remarked on by several medical officers of long experience.

3.4 Hospital clinic figures analysed by districts

The patients attending the two clinics discussed above in the year 1949 were divided into groups on the basis of the addresses given, with a view to ascertaining if, for example, people from the rural areas were swelling the malaria rates by coming into town using the improved post-war transport facilities. The result of the analysis was exactly the reverse of this, and also contrasts completely with the picture shown by the children. Table VII shows that the apparent increase in protection from malaria as one moves from the less to the more intensively controlled areas does not apply to infants or pregnant women.

TABLE VII - PARASITE RATES

Area	School Children			Clinics
	1947	1948	1949	1949
Rural (Uncontrolled)	36%	36%	45%	20%
Rural (Controlled)	18	31	28	18
Suburban	14	18	23	22
Urban	8	8	11	23

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The results of the analysis into smaller districts, chosen to give a sample of at least 60 patients in each, range from 17% to 29% in the urban area; 27% to 12.5% in the suburbs; and 22% to 15% in the rural villages. The more extreme figures in all cases apply to the smaller samples, so that the impression is that of a uniform distribution of malarial infection, which has not been modified by either the type of environment or the application of control measures. As the areas considered present vector densities (wet season 1949) ranging from 570 down to 1 (i.e. No. of female vectors found in one room over six months), it must be concluded that these parasite rates do not reflect the amount of transmission taking place. A further illustration of this is shown by the study of the last months of the 1949-50 dry season.

TABLE VIII - RAINFALL and PARASITE RATES

Month	Rainfall	Parasite Rates	
		Infants	Pregnant Women
December	1.43 in.	14%	13%
January	nil	16	7.5
February	nil	17	15
March	0.41	22	22

In this case, although conditions became progressively less favourable for mosquito breeding, parasite rates rose in the New Year, very markedly in the case of the women. During those months A.gambiae was not found at all in the urban and suburban area, A.funestus was found in one place in an outer suburb, but the same technique was producing quite large numbers of A.melas in the Western rural area and of all three species in the uncontrolled village of Wellington just outside the control boundary to the East.

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3.5 Hospital Patients

As mentioned above (3.3), experienced observers have remarked on an increase in the intensity of parasitaemias and severity of symptoms shown by African patients. Infants and older children have in the last two years been admitted suffering from really severe attacks of malaria, and there have been a number of deaths. In July 1950 three children (5-7 years) died in one day and one on the following day. This was brought to the notice of the DMS and so to the malaria entomologist; a malaria inspector sent to make enquiries was told that all four had not been outside Freetown for over a year and that only one had previously been ill.

Statistical evidence to back up these impressions is not available to the writer, but would almost certainly be forthcoming. If so, it would bear out the prediction made by TURNER and WALTON (1945) that endemic and hyperendemic conditions of the pre-control period would be replaced by a state of affairs where:

1. Primary infections were delayed, with consequent absence of protective bodies acquired from the mother.
2. Attacks would be so infrequent that tolerance would never be gained.
3. Attacks of malaria would be evenly spaced throughout life.
4. Untreated attacks would lead to a higher mortality at all ages.

These writers also quote the following data of the actual numbers of positive blood films taken annually from adult hospital patients.

TABLE IX

Year	No. of Positive Blood Films, Connaught Hospital
1940	690
1941	597
1942	974
1943	973
1944	2081
1949	1460

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No explanation is offered for the sharp increase in 1944. The figure has since been fairly stable at levels between 1500 and 2000. Percentage parasite rates for the years 1943 to 1945 are again not available at the moment of writing; they showed a tendency to decline until 1946, after which year they rose as shown below.

TABLE X

PARASITE RATES OF HOSPITAL PATIENTS

Year	Wet Season	Dry Season
1946-47	-	6.7%
1947	13.5%	-
1947-48	-	10.1
1948	21.5	-
1948-49	-	11.4
1949	21.4	-
1949-50	-	14.0

4. CONCLUSIONS

The various sets of data presented above are incomplete, and even if complete could only be regarded as circumstantial. Moreover, one group - the schoolchildren do nothing to confirm the case for a decrease in immunity. Certain other figures (such as morbidity or mortality per 1,000) are not available and would not be reliable if they were. Others again are not to hand.

But the whole case hinges on the anopheline density figures. Dr. WALTON (private communication, 1949) would look for the cause of the raised parasite rates in a breakdown of the control house system. The answer to this proposition is outlined in section 2, and it can only be added that as an indicator of local breakdowns in the antilarval work the system, as expanded since 1948 has worked admirably. It is a sampling method, and subject to the usual sources of inaccuracy

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inherent in all such methods. Deficiencies in technique will make it inevitable that the mosquitoes found are a proportion only of the total indoor resting population, which is in turn a proportion only of the whole population; the relevant ratios in each case are unknown, and if known might well be variables. A reverse effect will arise from the fact that the houses sprayed are selected - in the case of the original 81 (since increased) as of attractive type; in the case of the additional ones on observed high catches. In spite of these deficiencies, however, the writer strongly holds the view that the system still provides a reliable comparative index of Anopheline density, assuming no change in the house-haunting propensities of A.gambiae.

In the statistics from the clinics, there is a possible analogy between the present day villager, with a high degree of exposure to infection and a low malaria rate and the townsman of the pre-1948 period. The townsman of today, protected as he is, may owe his high malaria rate to some new factor in himself or his environment.

5. ACKNOWLEDGEMENT

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Reference: TURNER and WALTON 1945: Report on Malaria in Freetown and District S.L. Medical Dept. Paper No.1.