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The Secretary of the Expert Committee on Malaria
has the honour to communicate hereunder
a note on

THE ECONOMIC IMPORTANCE OF MALARIA IN AFRICA

(Section 2 of the Agenda
and pro parte
Sections 1.4 and 3.1)

by

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INTRODUCTION

The policy of all countries which are governed in the interest of the inhabitants is the elimination of all avoidable infectious disease, and there is no example known to the writer where it has been considered necessary to appraise the economic effects as a preliminary. The bare fact that illness and death are harmful to the social organism is universally accepted both by the humanitarian and the economist. Efforts are made to control disease even though the actual statistical loss is small, as is - for instance - that due to pulmonary tuberculosis in England and Wales where it causes an annual mortality of 0.432 per 1,000 but is considered to be a material blemish on the community. There is no accepted standard on which a study of the economic

importance of disease can be based. The high mortality and high birth rate in England in the nineteenth century might easily have been presented as economic assets in that they produced a large class of people willing to work for long hours for a pittance. The conditions then ruling were very similar to those in most of Africa at the present time, the important vital statistics in 1860 - 1869 being: birth rate 35.2, death rate 21.4, infant mortality rate 154 and total mortality between birth and 15 years 315 per 1,000. These conditions were altered by deliberate effort in the absence of obvious economic effects, but the alteration has now proved to the great economic advantage of the country. High death rates and high birth rates produce a population pattern which rarely, if ever, coincides with economic welfare. The reason for prevention of disease rests, however, on humanitarian grounds and does not take into account such questions as whether infants who may die are economic units or not. The writer has always taken this attitude and would not assent to any policy which implied that illness or death amongst children could be overlooked because they produced no economic damage.

Though it must always remain a secondary consideration disease has an economic importance, and over most of the tropical world malaria is thought to be one of the most important diseases. The writer has never heard its economic importance questioned by an industrialist, and has never been asked to substantiate a case for it. The attitude expressed has always been that it is impossible to create and run an efficient organization with staff and labourers subject to illness, the cost of which far exceeded the immediately observable loss because efficient organization requires reliability, and this is completely at the mercy of sickness.

While both industry and government in most parts of the world accept without question the economic damage caused by malaria, there is a school of thought in Africa which believes that its most severe degrees are relatively harmless to the economic and social welfare of the people. From this it is deduced that it would be wrong to reduce the endemicity from a major to a minor degree as it might be from a harmless to a harmful one. This is the only way in which thought in Africa differs from that elsewhere; when minor degrees of endemicity are considered all are agreed that the loss due to malaria might have important economic repercussions. The first point in an analysis of the economic

importance of malaria in Africa must, therefore, be an enquiry into the validity of the evidence that the most severe degrees of malaria there are economically unimportant.

HIGHLY ENDEMIC MALARIA

The word "hyperendemic" will be avoided. CHRISTOPHERS (1924) originally described this condition and gave a precise definition: "hyperendemic conditions may be defined as those in which the spleen rate (children) is permanently over 50%". Though very widely accepted and adopted by the Health Organization of the League of Nations this definition is now being questioned and a more exact one proposed in its place. Until the resulting confusion is cleared it is best to describe any actual degrees of endemicity considered.

The most severe degree of endemicity is that which is incompatible with continued human settlement, populations exposed to it dying out unless reinforced by immigration. There are large tracts of land where such conditions prevail in India and Ceylon. They are mostly heavily infested with Anopheles fluviatilis though in some the vector is A. minimus or A. culicifacies. The first of these is, however, the most potent vector; it may show a sporozoite rate exceeding 20% throughout the year (COVELL and HARBHAGHWAN, 1939) and is almost exclusively anthropophilic. It occurs in large numbers in certain foot-hill areas and as a consequence of its prevalence large tracts of land in the neighbourhood of the western mountain range of India (the Western Ghats) and the Himalayan foot-hills are almost devoid of population.

The second degree is one which while severe permits human colonization, and is characterized by the acquisition of a marked tolerance by the adult population as well as by a high child mortality. It was first described in India where it was studied on account of its acknowledged economic effects, and has since been described in several other places including Africa. The classical description in Africa, on which are based almost all subsequent conclusions that this degree is economically harmless, was made by WILSON (1936). He had studied a group of 443 people of the Digo tribe living near Gombero, Tanganyika, from three points of view: parasitological, clinical and in relation to their vital statistics.

The parasitological evidence is well known and undoubtedly shows the

acquisition of a considerable degree of tolerance. Before such evidence can be taken to prove the total absence of ill effects, however, it must show a complete tolerance and not merely a partial one in comparison with the children. The great majority of the films taken from adults showed low parasite counts, but 25 out of 1,803 showed parasite densities exceeding 1,000 per cubic millilitre and two showed counts exceeding 8,000 per cubic millilitre. The frequency of these is equivalent to each individual showing these densities five times a year and once every second year respectively. On parasitological evidence alone this cannot be taken as proving a complete protection.

The clinical evidence rests on quite a different footing owing to a desire not to interfere overmuch with the people. The author himself undertook little clinical work, and states in explaining the complaints of illness that they were "for the most part from the records of an African dispenser, but in some cases a diagnosis was made by Mrs. WILSON or myself".

The analysis showed that amongst the 443 people of all ages there were 208 illnesses in 20 months, an average of 0.28 per person per year. The causes of illness are classified by age and no single individual over the age of six years complained of "fever" on any occasion. This evidence must be interpreted with the greatest care. The actual sickness is below the monthly sickness for a comparable group in England and Wales. The standard of diagnosis was low and the information given cannot be used to substantiate a case that malaria produced no morbidity.

The statistical examination concerned has as its major component an enquiry into the fate of the children born to 114 women. On the average they were 35.5 years old, they had had 2.75 children out of whom 1.17 had died (42.5%) and 1.58 survived. In the case of 32 women who had completed the child bearing period the average number of surviving children was 1.13.

These figures can have only one interpretation. If a community is to survive the average mother must have at least one female child who lives to become a mother herself. In statistical language the net reproduction rate must be at least 1.0. In the example quoted it is certainly far below this and probably about 0.55, a figure which would produce a moribund community only to be supported by constant immigration. This latter need not be dramatically large to conceal the loss, about 2% of the population per annum, but it would be

essential to save the community from continuous reductions in numbers. The author himself only noted 11 deaths and deduced a death rate of 20.19, but the figures given above which referred to 145 deaths are much more significant. Seven of the 11 deaths noted during the study occurred in children of whom, however, only one had been seen within two weeks of death. This one died of malaria.

The mortality rates shown are in marked contrast to those for the Digo people as a whole, published by PHELIP (1933) from whose figures it may be seen that over the whole tribe 24% of children would be expected to die before reaching the age of 16 years.

GARNHAM (1949) has also made a study of the effects of immunity in Africans. His observations are confined to children, whom some do not consider to be economic units, but they have a direct bearing because they are used by others, such as SWELLENGREBEL (1950), to support the statement that the African community has attained a perfect balance with its parasites, and suffers no ill effects. The community studied was reported to have an infant mortality rate varying from 262 to 340. All children reporting sick at hospital with parasitaemia and no other obvious cause of illness were diagnosed as suffering from malaria and presumably treated for this disease. Some of them died, and GARNHAM showed that between 31 and 35% of these actually died of malaria. The group on which he carried out his post-mortems was selected in two ways:-

- (a) by the original diagnosis made, and
- (b) by the fact that every effort had been made to prevent them dying of malaria and none to prevent them dying from any other cause.

The figures merely show that children died of malaria but give no indication of the frequency with which they did so. He also states that the clinical effects are mild but illustrates his statement by one case which received quinine within a few hours of first coming under observation.

The examination of the data leads the writer to the following conclusions: the community on which the classical description of African hyperendemicity is based is a grossly unhealthy one and actually moribund unless continuously reinforced; there is evidence that the adults acquire a very marked tolerance

but the evidence that this is absolute is lacking, the clinical evidence on which it is affirmed that Africans suffer no ill effects is far too unsubstantial for any serious conclusions.

It is stated that malaria of a degree corresponding to that found at Gomboro is widely distributed in Africa, and from this it is often concluded that findings on the Gomboro population can be applied to a large part of the population. This wide distribution is not supported by substantial evidence. Bagster WILSON (1949) states that the most severe degree occurs throughout Kenya, Uganda and Tanganyika below an elevation of 4,000 feet. He quotes in support of this statement his own work at Gomboro and the studies by KAUNTZE and SYMES (1933) and McCARTHY (1941) who reported on Taveta and Zanzibar respectively. Neither of the areas described by these writers comes within the definition of hyperendemicity which is derived from the Gomboro people and is now proposed for general use. A notable part of that definition is that it requires evidence of immunity in the form of the absence of seasonal changes of the parasite rate except in the youngest children. In the two Taveta areas the parasite rate showed seasonal changes from 41 - 63% and from 24 - 52%. Even at their maximum they did not justify inclusion within the present definition. In one of the Zanzibar areas there had been a severe epidemic which affected all groups of the population, adults and children alike, and in the two other rural areas there were marked swings in the parasite rate, from 54 to 83% and from 63 to 79%.

The area studied by SCHÜFFNER et al. (1932) is also quoted as an example of this type of endemicity. It was noted by those authors that the parasite rate in adults showed a rise from 8 to 36% in a few months in the course of one malaria season, which is quite incompatible with the idea of a firm adult immunity.

The only East African area in which there is published evidence of a degree of endemicity corresponding to the definitions now used is Gomboro itself. There are many other studies showing a lesser degree of endemicity and immunity in adults, and it is not justifiable to apply conclusions from the one group to any major part of the tropical African community.

2.1.1 Effect on the Distribution of Populations

The population of Central Africa is, on the whole, sparse. The average density in East Africa does not exceed about 20 per square mile, or in West Africa about 50. The detail of distribution has been studied in east, south-east and central Africa by GILLMAN (1936), BAKER (1937) and BAKER and WHITE (1947). These works are illustrated by maps which show that the people are very irregularly distributed, dense pockets of population alternating with very sparsely populated or even virtually empty areas. The general distribution shown, however, cannot be correlated with the endemicity of malaria. There are several examples of over-crowding in known highly malarious zones, and much of the occupied country is relatively non-malarious. A few of the empty areas are related to past epidemics of trypanosomiasis and some to tribal warfare, but for the most part the distribution of people is determined by the availability of perennial surface water to people unequipped with tools. The dual correlation of rainfall and agriculture has led to the concentration of people in some of the more highly malarious areas. It seems that A.gambiae has not been able to prevent their establishment. The most severe degree of endemicity of malaria does not in fact occur on any large scale in Africa, a fact which can as readily be explained by the difference between A.fluviatilis and A.gambiae as by the suggestion that there is some racial difference between the reactions of the people of the two continents.

2.1.2 Effects on the Movements of Population

The occurrence of an exaggerated amount of malaria in individuals or groups which move within endemic areas, or move from healthy to endemic areas, is acknowledged throughout the world, and it has not been suggested that the reaction in Africa differs from that elsewhere. Many of the densely populated areas such as that around Mount Kilimanjaro are relatively free of the disease, the tendency is for populations in these areas to expand producing a pressure on land and in turn a pressure to emigrate. Migration is almost invariably to less healthy areas where the migrant suffers from clinical malaria which may be severe. There are many references to this in the literature referring both to individuals and groups. It may be very obvious when construction gangs for public works are recruited, when the resulting epidemic may bring work to an end. It occurs almost throughout the malarious parts of Africa and is not confined to the most malarious central zone. Thus BLAIR (1950) reports that in Southern

Rhodesia the growing pressure of population in crowded pockets constantly enforces this movement, which is always associated with a high morbidity and mortality. Much of this increase is due to the differing endemicities in the areas of origin and final settlement. It is, however, contributed to by the man-made malaria which accompanies movement and the construction of houses. BLAIR mentions that local movement of 40 to 50 miles to apparently similar areas is often accompanied by severe epidemics of malaria for this reason.

The most obvious industrial migration within Africa is from highly malarious areas to the healthy mining districts such as Johannesburg, and this movement is not seriously affected by the disease. There is, however, a very large and constant movement within central Africa which is less obvious, people migrate in considerable numbers for many hundreds of miles to seek work on estates which by their nature tend to be in warm, moist and malarious places. This movement is accompanied by excessive illness amongst the migrants.

The economic development of Africa will almost inevitably be largely on an agricultural basis in the foreseeable future. The studies referred to above have shown the existence of considerable tracts which are now empty but which could be made habitable by the proper development of village water supplies. Utilization of land in this way will involve both the mass movement of people and considerable construction work for their accommodation. It may be expected that without control measures it will be accompanied by epidemics of malaria such as those mentioned in Southern Rhodesia.

The actual financial cost of this impediment to movement cannot be measured, but the epidemics which result from it are of first importance to any development work whatever its nature.

2.2 Effects on Agriculture, Industry and Transportation

The characteristic of these three is that they depend largely on manual work and are seriously affected by illness among the workers. The amount of loss due to illness may be far out of proportion to the actual number of days lost. In many parts of Africa the amount of crop harvested is determined by the amount of land which can be ploughed and sown during a very brief period when it is softened by the rains, the length of which, in dry years, is recognized as the bottle-neck in agricultural production. Disease during this period whether it

produces actual invalidism or only debility will affect the final crop to a major extent. During this time it is also common for all people over about six years of age to be busily engaged, and the children then become obvious economic units amongst whom illness has obvious economic effects. Industry and transport services depend for their efficient running on reliability of their staff and labourers. Uncertainty as to the numbers likely to be available on successive days leads to a dislocation of work and extravagant management which are more costly than the actual loss involved by absence. This is characteristic of all industry but becomes more marked in those which attempt an efficient organization comparable with those of European and American countries. Illness can totally prevent the development of this efficiency without necessarily invaliding a large proportion of the workers.

There is no doubt that the amount of illness suffered by the adult African brought up under the influence of malaria is less than that of the non-immune migrant such as the European. A good guide to the ratio between the two is supplied by the War Office Statistics on the Health of the Army (1948). The record for West African troops shows that in 1941 and 1942 the admissions of Africans to hospital for malaria amounted to 71 and 73 per 1,000 at risk. In the same years the admissions of British troops were 895 and 762 per 1,000. In later years both of these figures declined in response to more effective control measures. It would, therefore, seem that the African coming from mixed sources of the highly endemic type suffered about one-tenth the number of acute attacks that the European suffered under similar conditions. Among East African troops there are a number of studies which throw light of a similar nature. WILSON and WILSON (1945) studied a group of 137 men for 28 weeks who had a parasite rate of 16.1%. The number of cases of malaria reported during this time was equivalent to 66.5% per year, but they considered this nothing but an indication of the frequency of fever from various causes. It was, however, indisputable that the rate varied greatly according to the origin of the people. The equivalent annual percentages amongst immune, semi-immune and non-immune people were 31, 89 and 107. OSBORN, RAPER and WRIGHT (1944) studied the actual causation of illness amongst soldiers with parasitaemia and complaining of fever. They concluded that the actual cause of clinical illness was malaria in 75% (384 out of 512) of them. Amongst the immune group it was the cause in 62.5% and in the

non-immune 89.4%.

Parasite counts exceeding 500 per 1,000 were associated with actual clinical malaria in 88% of all cases.

RAPER, OGBORN and WILSON (1944) in the course of chemotherapeutic trials studied the average duration of untreated malaria in adult Africans. In the immune group fever lasted 4.4 days and parasitaemia 7.3 days, in the non-immune group fever lasted 9.3 days and parasitaemia continued for 13 days or more.

These studies relate to groups of adult Africans living on the whole under well controlled conditions, who were examined under standards of diagnosis commonly applied to the European. The amount of sickness they suffered might be taken as reasonably representative of the normal happening in the African.

In typical industry in Africa the common figures of the incidence of malaria are considerably above these. The following are typical of what is found in most industry:-

<u>Concern</u>	<u>% Incidence amongst Africans per year</u>
Sisal estate, East Africa	183
Railway,* Nyasaland:	
Africans 1940 - 45	59
1946 - 49	22
Indians 1940 - 45	69
1946 - 49	62
Timber concern, West Africa	88

* Practising control by anti-larval measures around main centres but not along the line or at minor centres. Control extended of DDT in 1946. The average time lost per case was 3.4 days.

These figures give the order of observable loss commonly encountered. In all cases they are minimum figures as there is a considerable absenteeism which remains unexplained except in relation to a small proportion who resort to hospital.

The direct effect of malaria on settled industry in central Africa is, therefore, to impose a certain observable load of cost due to absenteeism and the

wasted overhead charges incurred in such things as housing and recruitment. In well established industry these losses are not such as to produce economic dislocation, but their economic importance is commonly recognized particularly where high industrial efficiency is attempted as in the copper belt. The establishment of new industry involving construction work and a departure from the normally accepted lines of recruitment of labour may involve very much larger losses amounting to dislocation of the work.

Effect on Education

Malaria may be detrimental to education either by causing absenteeism amongst the children or by causing chronic illness which prevents them taking full advantage of their teaching. MACDONALD (1926) studied a number of children whilst they were actually attending school and found that in an area where the spleen rate was 50% there were 34% of the children who showed a pyrexia of 100°F or over. In another area where the spleen rate was 72% the percentage with pyrexia of this degree was 57. Similar observations had been made by other workers on the West coast of Africa. On a review of the evidence the author came to the conclusion that the pyrexia was due to malaria.

The effect on education needs no further elaboration. Teachers accustomed to the standards of Europe or America would ridicule the possibility of adequate instruction of a class the majority of which was actually febrile. The most urgent need of Africa at the present time is the elaboration of school teaching, not only to small numbers but to the mass of the population. If half of the school children remained permanently ill it might be regarded as a wastage of half the effort, but the position is more that all the population is ill for a material part of its school time, which must result in a wastage of a very material proportion of the total effort expended on education.

The Effects of Malaria on Social Welfare

The social welfare of a population depends firstly on the nature of the group and only secondarily on the efforts made to advance it. An important feature of the nature of the group is the age constitution of the population, the relation of which to social advancement in tropical countries has been discussed by LYNN SMITH (1949). There are two chief types of population pattern. The one, marked by a high death rate and a high birth rate, shows a gross excess

of people in the younger age groups, the other, marked by a low death rate and a low birth rate, shows a smaller proportion of young people and a relative excess of middle aged and old. The factors which cause a high death rate inevitably enforce the first type of population pattern unless they are to be accompanied by constant diminution in numbers. The amount of death and the proportion of it which is due to malaria is, therefore, important in relation to social welfare.

It is generally agreed that the death rate in most African countries is high, and figures such as that quoted by Bagster WILSON for Gombero of 20.19% are typical. It is, however, commonly overlooked that these figures of crude mortality cannot be compared with the crude death rates in England and similar countries. The proper comparison is given by the fact that in England and Wales in 1948 94.5% of children born will probably survive to 15 years of age, whilst in the Gombero series the percentage will be only 57.4, the true mortality this time being nearly eight times as great as in England and Wales. Similar figures occur in almost all parts of Africa where they have been examined. KAUNTZE and SYMES quoted figures equivalent to the survival of 47.3%, CULWICK and CULWICK (1939) one of about 46.5% and PHILIP one of about 76.0%.

The amount of this mortality which is due to malaria is a matter of acute disagreement. DAVIES (1948) considered it to be the primary cause of death in 16% of post-mortems on children under one year of age, and 9% of those aged one to ten. GARNHAM showed it to be the cause of death in 31 to 35% of a selected series near Kisumu. It should, however, be remembered in relation to studies such as these that they inevitably refer to selected populations to whom the chance of treatment has almost inevitably been offered, and therefore cannot be taken to represent conditions in the field. The only direct method of estimation is by a comparison of mortalities before and after the institution of malaria control measures. In the course of very extensive surveys and medical work in the Belgian Congo by FOREAMI DE BRAUWERE (1949) it has been shown that the universal administration of prophylactic anti-malaria drugs to infants reduces the infant mortality by about 100 per 1,000 births per annum. In Freetown, Sierra Leone, where treatment for malaria has for many years been readily available it was shown by TURNER and WALTON (1946) that the introduction of effective mosquito control reduced the infant mortality by 36 per 1,000 per year. Evidence from Mauritius, where malaria has been endemic or epidemic for 80 years, shows that

the actual reported mortality from malaria varies from 4.8 to 7.5 per 1,000. The recent results of elaborate malaria control measures suggest by their effect on the crude mortality that this is certainly not an over-statement and perhaps an under-statement.

The evidence from other countries where malaria control measures have been practised on a scale not envisaged in Africa shows that malaria control measures have caused a reduction in the total mortality quite out of proportion to the previously known mortality from this specific disease. In Ceylon such measures have decreased the crude death rate from 22 to 13.2 per 1,000. The endemicity varies greatly throughout that country and in those parts where it is severe and is nearly perennial, as in the lowlands of central Africa, the reduction is much more marked. In the North Central Province the death rate declined from 31.8 to 15.4, while in two non-malarious districts the reduction, possibly due to control of fly-borne diseases, was from 18.9 to 18.0 and from 16.6 to 14.1.

The effect of these mortalities, in which the writer believes that malaria plays a major part, is to enforce a distorted population pattern. The proportion of children under 15 in a healthy community such as England and Wales is 21.43%. In the area studied by FOREAMI it is 50.8%. KUCZYNSKI (1948 and 49) gives the following figures for some territories under British influence:-

Gold Coast -----	42.2%
Gambia -----	36.2%
Nigeria -----	41.3%
Uganda -----	41.5%

No reliable figures were available in Kenya or Tanganyika, but referring to the latter country he states that the high ratio of children to adults commonly found coincides very rarely with good economic, health and sanitary conditions.

The meaning of these figures is that the population spends a major part of its effort in the fruitless production and partial up-bringing of children who do not survive to become the "economic units" who are said to be the important group of the population. LYNN SMITH summed up part of the situation in the statement that, as a result, every breadwinner has more mouths to feed than is the case in areas where persons in the dependent ages do not make up such high proportions of the population. It means also that many youngsters, large numbers of them hardly more than babes in arms, are cast forth to make their own way

in the world. And it also signifies that such a high proportion of women's energy is going into the physiological process of reproduction that the care and feeding of the children, their training and education, are likely to be steadily neglected.

There is a tendency to regard population patterns such as the ones commonly found in Africa as typical of communities and a way of life and immutable. It may be overlooked that they are rapidly changing in many countries and that even the earliest changes are of recent occurrence. In England and Wales the revolution from the pattern identical with that of Africa has been completed within the last 90 years. In 1861 children under 15 years of age amounted to 35.6% of the total, and 315 out of every 1,000 born failed to survive to 15. The steps which brought about the change were conscious on the part of the community as a whole or of the individuals who comprised it. They were:-

- (a) A reduction in mortality and particularly during the early years of life,
- (b) An enhanced interest in the up-bringing and education of children once the high probability of survival became generally accepted, and
- (c) A conscious limitation of births to prevent competition on the newly raised standards of up-bringing.

The resultant changes have made the improved social welfare of England and Wales possible.

Disease has other effects on social welfare, but they are chiefly through its influence on education and earning capacity to which adequate reference has already been made.

DISCUSSION

The importance which is attached to the effects of malaria in Africa depends very largely on expectation of happenings in that continent. If it is thought that it is destined to remain economically and socially unchanged, or only slightly changed, the crude effects on the working ability of a limited part of the population can be taken as the major consideration. The deaths can be ignored and illness amongst the dependent groups of the people can be regarded as

immaterial. If it is thought that an economic and social revolution should be encouraged, with the ultimate object of progress comparable to that in other continents, a different attitude must be adopted. Health conditions must then be considered on those same standards which are adopted in relation to healthier countries. Not only must the major grave defects be noted but attention must be paid to apparently minor ones. Morbidity must be considered not only in relation to crude output of work but also in relation to standards of reliability and to its effects on education and well-being. The object of public health in that case must be the eradication of all avoidable infectious disease regardless of the group of the population on which it falls, accepting that all groups are of social or economic importance. Vital statistics must be compared with those in countries from which serious infective diseases have nearly been banished, and the disproportion in every age group noted.

If these standards are adopted malaria is a most important economic and social factor in Africa. It causes illness amongst all groups of the population. Perhaps the most serious effect of that illness is its interference with proper education, which has a very close relation to economic advancement. As a secondary consideration it causes illness amongst working groups of the people. The existence of this illness in adults is admitted universally in all except the "hyperendemic areas". In these it is a matter of dispute but they form a very limited part of the total African picture.

On these standards even the least estimate of the importance of malaria as a cause of mortality would rank it as one of the most important killing diseases in an advanced country. In an area where the child mortality is nearly 10 times as great as it is in England and Wales the assertion that malaria is only responsible for one-tenth of it places it on a par with all causes of death combined in England. The higher estimates which are made on the basis of field observation place it as considerably more important than the total mortality in England. The economic effects of this mortality produce a social condition which is incompatible with economic health.

Progress of the country must involve from its earliest stages the movement of people both to newly developed agricultural areas and to would-be industries. Malaria is a major impediment to both of these movements and can result in their dramatic failure. The control of malaria is now almost universally regarded as an essential concomitant of any organized movement and of would-be industry.

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