STATISTICAL INVESTIGATIONS
WITH SPECIAL REFERENCE TO THE INCIDENCE OF MALARIA IN LAHORE CANTONMENTS.

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The cantonments of Mian Mir in the Punjab enjoyed for so many years an unenviable reputation as a hotbed for malaria; and other diseases, the heritage of tropical climates, that a time came when it was apparently considered advisable to "lose" Mian Mir, and there came into being, on the same site, Lahore cantonments.

Unfortunately the laudable object aimed at was not entirely achieved, and Lahore cantonments are still a black sheep among cantonments from the point of view of health, and of those whose work and interests lie in the direction of "Disease Prevention and Preservation of Health."

With the object of limiting to the maximum extent mosquito breeding in cantonments, a drastic change of policy was introduced in 1904, and complete cessation of irrigation in cantonments was ordered.

The net result of this policy was the gradual production of a barely habitable desert, in which life was plagued by vast and never ending clouds of dust raised by every animal or vehicle, not to mention the undue frequency of true dust-storms, which together make life miserable in this station.

Statistically it was claimed that there had been considerable reduction of malaria as the result of no irrigation, but it must be confessed that the claim was far from being generally accepted, and some senior combatant officers and medical officers, who had prolonged or repeated experience of Lahore cantonments, were inclined to be sceptical of the alleged improvement.

The misery of the "dry period" was not forgotten, and even if there had been a fall in the malaria incidence, it was doubtful whether it had been worth while at the cost of comfort; and whether there had not been a concurrent increase in other diseases, notably respiratory, as a result of the ubiquitous and ever present dust.

It was with the object of answering at least some of these questions that this work was undertaken.

Perusal of the published Health Statistics for India as a whole, and Lahore district since 1900, emphasizes very markedly the changes in methods, nomenclature, diagnosis, etc., occurring over so prolonged a period.
### All India, British Troops

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Admissions</th>
<th>Malaria Admissions</th>
<th>P.H., M.</th>
<th>Total Deaths</th>
<th>Malaria Deaths</th>
<th>P.H., M.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1900</td>
<td>1,184.9</td>
<td>282.5</td>
<td>32.5</td>
<td>264.4</td>
<td>72.5</td>
<td>18.4</td>
<td></td>
</tr>
<tr>
<td>1901</td>
<td>1,298.2</td>
<td>320.8</td>
<td>39.9</td>
<td>260.9</td>
<td>76.0</td>
<td>21.2</td>
<td></td>
</tr>
<tr>
<td>1902</td>
<td>1,303.0</td>
<td>324.4</td>
<td>40.9</td>
<td>264.4</td>
<td>82.4</td>
<td>22.9</td>
<td></td>
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<tr>
<td>1903</td>
<td>1,330.1</td>
<td>344.4</td>
<td>42.4</td>
<td>292.4</td>
<td>88.4</td>
<td>25.0</td>
<td></td>
</tr>
<tr>
<td>1904</td>
<td>1,333.1</td>
<td>355.5</td>
<td>50.7</td>
<td>284.5</td>
<td>96.4</td>
<td>27.0</td>
<td></td>
</tr>
<tr>
<td>1905</td>
<td>1,424.8</td>
<td>432.8</td>
<td>63.2</td>
<td>296.2</td>
<td>108.2</td>
<td>32.0</td>
<td></td>
</tr>
<tr>
<td>1906</td>
<td>1,403.0</td>
<td>382.0</td>
<td>49.0</td>
<td>302.0</td>
<td>105.2</td>
<td>31.0</td>
<td></td>
</tr>
<tr>
<td>1907</td>
<td>1,409.3</td>
<td>398.3</td>
<td>53.8</td>
<td>311.3</td>
<td>109.1</td>
<td>32.0</td>
<td></td>
</tr>
<tr>
<td>1908</td>
<td>1,392.0</td>
<td>380.0</td>
<td>49.0</td>
<td>321.0</td>
<td>105.0</td>
<td>31.0</td>
<td></td>
</tr>
<tr>
<td>1909</td>
<td>1,391.4</td>
<td>382.4</td>
<td>53.8</td>
<td>321.4</td>
<td>105.8</td>
<td>32.8</td>
<td></td>
</tr>
<tr>
<td>1910</td>
<td>1,371.0</td>
<td>364.0</td>
<td>51.0</td>
<td>314.0</td>
<td>114.0</td>
<td>32.0</td>
<td></td>
</tr>
<tr>
<td>1911</td>
<td>1,371.0</td>
<td>364.0</td>
<td>51.0</td>
<td>314.0</td>
<td>114.0</td>
<td>32.0</td>
<td></td>
</tr>
</tbody>
</table>

**Remarks:**
- 1899-1900: During the period 1900-01, 18,500 cases of malaria were reported, with a decrease in 1901. There was an increase of 3,000 cases in 1902.
- 1903-1904: There was a decrease of 1,500 cases in 1904.
- 1905-1906: Very poor monsoon...
- 1907-1908: Very dry autumn...
- 1909-1910: Abnormally healthy year. (Detention)
- 1911-1912: Replacement by territorials and new army, heavy sandfly...
- 1913-1914: Heavy epidemics of malaria, simple continued fever, very dry monsoon...
- 1915: Heavy epidemics...
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During the earlier years, 1900-1907, malaria cases are to be found under the headings, intermittent and remittent fevers, whilst simple continued fever (S.C.F.) comprised practically all other fevers that were not enteric or malaria.

The introduction of microscopical diagnosis of malaria (1904-1905), with its early imperfections in technique, resulted in an apparent fall in the malaria incidence, coupled with a corresponding increase in that of simple continued fever, to which those cases of malaria were relegated in which parasites were not discovered in the blood.

By 1908 differential diagnosis between malaria, influenza, sandfly fever, etc., had become well established and the term pyrexia of uncertain origin (P.U.O.) was introduced to cover obscure fevers of short duration still undifferentiated.

The terms intermittent, remittent and simple continued fever were necessarily discarded as valueless.

The object of this investigation has been to ascertain to what extent, if any, it is justifiable to ascribe a direct improvement in the incidence of malaria to the cessation of irrigation in Lahore cantonments (1904-1917).

It had previously been shown by Colonel Kelly, I.M.S., that during the "dry period" a distinct lowering of incidence could be charted out, with reference to the combined incidence of malaria (intermittent and remittent), simple continued fever, pyrexia of unknown origin, sandfly fever, considered as a group, probably containing the great majority of the cases of malaria that occurred.

Reference to these charts showed the incidence to have been as follows:-

<table>
<thead>
<tr>
<th>Year</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1903-04</td>
<td>878.4 per mille</td>
</tr>
<tr>
<td>1904-17</td>
<td>399.0</td>
</tr>
<tr>
<td>1918 to date</td>
<td>726.7</td>
</tr>
</tbody>
</table>

In searching records, certain factors have been brought to light which cannot have failed to influence statistics to such an extent as largely to nullify their value.

In 1902 a great fall in the incidence of malaria occurred in Lahore cantonments, the reason for this, even if correct, cannot now be ascertained. It is noteworthy that this fall was markedly greater than that which occurred in the incidence for all India.

Again, in 1922 there was throughout India, and equally in Lahore cantonments, a similar marked fall in the incidence of disease generally and especially of malaria.

Thus unexplained falls in incidence occur and must be taken into account.

As is well known they are frequently balanced, as was the case in 1923, by subsequent increased incidence, which may assume epidemic proportions.

In Lahore cantonments the fall in 1902 to 270 per mille had been
similarly followed by a return to an incidence of 1,006 per mille, approximating more nearly to the incidence of 1,059 and 1,354 per mille, which had obtained in 1900 and 1901 respectively.

During that year (1902) figures for all India showed a small decrease only, so that it would appear that the cause of this great variation was in this case to be found in Lahore cantonments.

The year 1904 saw another great decrease of incidence, from 1000·6 per mille (in 1903) to 507 per mille, i.e., malaria was apparently halved, but this apparent improvement took place, as far as can be ascertained, prior to the cessation of irrigation.

In 1905 irrigation had ceased in Lahore cantonments, and there was shown a tenfold decrease in malaria (vide figures) from 507 per mille to 51·7 per mille.

It is unfortunate that the same year witnessed an enormous (and progressive) rise in the incidence of simple continued fever to 350 per mille.

It must be stated that this was very largely due to the fact that the microscope was in this year taken into general use as the routine criterion of diagnosis, and a very large (and unjustifiable) number of cases of malaria were thus relegated to the heading of simple continued fever owing to inability to discover the parasite.

The addition of the ratio of incidence per mille of malaria to that of simple continued fever during these years makes a considerable difference in the aspect of things.

Thus statistics for Lahore cantonments were as follows:

<table>
<thead>
<tr>
<th></th>
<th>Malaria</th>
<th>Simple continued fever</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1904</td>
<td>507</td>
<td>Plus 77</td>
<td>584 per mille</td>
</tr>
<tr>
<td>1905</td>
<td>33</td>
<td>350</td>
<td>383</td>
</tr>
<tr>
<td>1906</td>
<td>236</td>
<td>238</td>
<td>474</td>
</tr>
</tbody>
</table>

In addition to these records of admissions, perusal of the report of the Public Health Commissioner to the Government of India (1908) reveals the remarkable fact that from 1904-1908 no less than 25,668 cases of malaria were treated in barracks.

It will be obvious that any conclusions based on the admissions to hospital during the period in question (1904-1908) will be completely invalidated, and that no inference can be drawn from these data as to the influence of the cessation of irrigation on the malarial incidence.

It is necessary to state that with complete understanding of the method of transmission of malaria, treatment of this disease out of hospital was forbidden.

It will thus be seen that important deductions were drawn from the fall in incidence of malaria occurring in 1905, that this fall was accompanied by a very marked and corresponding rise in the incidence of simple continued fever (reasons given above), and the combined incidence of several fevers considered conjointly tends to modify considerably the remarkable
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fall in the incidence of malaria, which was claimed to be the result of the cessation of irrigation.

It is also noteworthy that the fall began in 1903 and continued through 1904 to 1905—the first year after cessation of irrigation. The incidence of malaria rose again, however, in 1906.

These points do not appear to have been much emphasized in the past.

In an exactly similar manner the end of the "dry period" cut across a period of rise in malarial incidence which had begun two years previously (in 1915) and went on until 1921, after which there came the remarkable fall seen in 1922 (during the second wet period be it noted).

The year 1922 was extremely healthy; the year 1923 was one in which a tremendous epidemic occurred, and there is no reason to suppose that irrigation influenced incidence more, or less, in either of these two years.

As stated above, if, as would appear, 25,668 cases of malaria were treated between 1904-1908 as out-patients, i.e., not admitted to hospital, all deductions as to the incidence of malaria, based as usual on admissions to hospital, are valueless during that period.

It is incontrovertible that statistics have in the past been widely influenced by the use and abuse of the system of detaining patients.

This system not being in use in civil life, it will be readily understood that from 1914 onwards statistics were adversely affected by medical officers with limited experience of army methods admitting direct to hospital many cases that might without detriment have been treated in barracks or by means of detention in hospital for a day or so.

It accordingly became necessary after the Great War to circulate orders to the effect that these methods of treatment were not to be lost sight of.

Unfortunately, lack of experience and judgment resulted indisputably in a certain amount of abuse in this system.

In order to remove finally elements such as these, which tended to vitiate statistics, orders were issued in 1923 standardizing both treatment in barracks and the detention of patients in hospital.

At first a reaction ensued, and, by absolutely rigid adherence to a period of twenty-four hours, the object of the system was defeated, so that a little later a slight modification desired by most medical officers, and generally agreed to as the correct one, was ordered by Army Headquarters, and it may be taken that the accuracy of medical statistics in India was greatly enhanced by this definite standardization of the system of detention.

While the foregoing remarks tend to show that there is a possibility that more has been claimed from the cessation of irrigation in Lahore cantonments than can be justified statistically, it should not be inferred that the presence of irrigation is per contra entirely without effect on the incidence of malaria.

This is far from being the case, and it is indeed considered that the irrigation channels constitute a great danger, providing as they do, through seepage, vast numbers of breeding places for mosquitoes.
It is not proposed to enter into a lengthy discussion as to the nature of the anti-malarial measures indicated in Lahore cantonments, but the opportunity is taken of emphasizing the fact that, through lack of funds, anti-malarial measures on the present scale cannot be expected to effect material improvement in the incidence of malaria in this and many other cantonments.

By the grant of sufficient funds it may be possible to improve the totally inadequate drainage system, in which outstanding improvement is even now seen compared with former years.

Similar adequate funds are necessary to repair and keep repaired the defects in the irrigation channels.

By such measures, and attention to minor sources of danger, it is possible to reduce breeding places in cantonments, and thereby help to lessen the chances of infection.

A measure which the experience of the current year (1924) has further shown to offer very considerable hopes of success with regard to breeding places hitherto beyond the scope of local authorities, is the deep absorption pit, as advocated by Lieutenant-Colonel W. J. Mackenzie, R.A.M.C., now Director of Hygiene and Pathology, and the progressive extension of this method in Lahore cantonments is strongly indicated.

It is emphasized, however, that, in view of the density of the sources of infection in the shape of the native population of the bazaars, and the unrestricted breeding possibilities for mosquitoes just outside cantonments, the only measures offering any hope of real success must be on a scale hitherto unattainable, and would probably necessitate complete mosquito-proofing of barracks—coupled with all the other accessory methods which it is necessary to employ, as shown in those places (e.g., Panama Canal zone) where a really determined effort has been made to stamp out the disease.

My thanks are due to the Director of Medical Services in India for permission to publish these notes, which were collected solely with the object of giving a satisfactory reply to the General Officer Commanding Lahore District and other officers who were interested in a very controversial subject.

Statistical, meteorological and other data have been extracted from the Reports of the Public Health Commissioner for India, and Annual Reports of District Laboratories and Sanitary Officers.

It is regrettable that, owing to the long-continued adherence to a somewhat obsolete form of health report for all India on the one hand, and a multiplicity of individual efforts on the part of sanitary officers on the other, large gaps exist which could not be filled in, and it was not until uniformity was established, after the war, that it became a simple matter to extract the required information year by year.