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## SEASONAL VARIATIONS IN LEPROSY IN CALCUTTA

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It has been observed for several years that the numbers of new patients attending the leprosy diagnostic clinic at the School of Tropical Medicine, Calcutta, have been highest during the middle months of the year, usually from March to September. It has also been realized in a general way that during these months the numbers of cases of leprosy showing marked "tuberculoid" lesions tended to increase. No particular attention has hitherto been paid to this matter.

Recently a visit was made to our clinic by Dr. M. Oberdoerffer who, having studied leprosy in Nigeria for a time, was making a study tour in other countries. He drew our attention to a curious observation made by him in Nigeria, namely, that in certain areas at a certain season of the year there was an increase of activity of the disease in some patients. This increase was indicated both by the clinical signs and by the bacteriological findings; the proportion of cases giving positive smears from the lesions showed a marked increase. His opinions regarding the cause of this phenomenon are discussed later. In view of his observation, we have studied the records of our department to see if a similar phenomenon occurs in Calcutta.

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Clinical material studied.—At the diagnostic clinic, ordinarily held twice a week, about 1,500 new patients are seen each year. They are examined clinically and bacteriologically and the date of examination and the findings, including the classification, are recorded. Before September, 1936, bacteriological examination of all cases was not done, but only of those in which it was necessary for diagnosis. Therefore the older records of the department are of little value in the present study. In the two year period during which the new system has been in force and for which our records are complete, 2,779 new patients were recorded.

For the purpose of our present study we may divide these patients into three groups:

Group A, lepromatous type	704	cases
Group B, neural type showing involvement of nerve		
trunks only	174	cases
Group C, neural type with macular lesions in the		
alrin	1 009	00000

skin. ..... 1,902 cases

Seasonal variations in the numbers of new patients.—For several years the number of new patients attending the clinic has been low during the period from October to February, and higher during the remainder of the year. March to October. This might possibly be due to some such factor as seasonal employment in agriculture and industry, which might make it difficult for patients to come at a certain season. The records of the department show, however, that the numbers of patients of Groups A and B (i.e., of the lepromatous type and of the "anesthetic" variety of the neural type) remain fairly constant throughout the year, whereas the numbers of patients of Group C (with neuromacular lesions) fluctuate fairly markedly, being high from March to October and low during the rest of the year. This fact is shown in Text-fig. 1, which indicates the average attendance per clinic day, month by month throughout the two years (a) of patients with neuromacular lesions, and (b) of patients with other kinds of lesions.

This graph shows that the variations in the numbers of the new patients attending the clinic are caused chiefly by variations in the numbers of Group C cases. It is highly improbable that these variations are caused by seasonal variations in employment, etc., for if this were so the variations would affect all three groups.

Seasonal variations in the manifestations of the disease.—In patients of Group A seasonal variations in the manifestations of the disease would probably be rather difficult to detect unless they

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took the form of the presence or absence of lepra reaction. In our clinic we have no clear indications of the occurrence of such variations in this type of case. However, a study of the records of the Albert Victor Hospital, Calcutta, suggests that lepra reaction is more common during the hotter months of the year than at other seasons. This matter is being studied further and may be reported on later.

Variations in patients of Group B, in whom the leprous lesions are in the nerve trunks, would probably be difficult to detect. We have no data on this subject to present here.





It is in cases of the neural type in which there are macular skin lesions that seasonal variations are most likely to be detected, because the lesions affect the superficial layers of the skin and are circumscribed and limited in extent, and because the bacteriological examination of them can easily be performed.

Seasonal variations in clinical findings in neuromacular lesions. —We have elsewhere (2) discussed the various appearances which may be seen in such lesions. The patches may be flat and pale; there may be thickening and erythema at the margin only; there may be thickening and erythema of the whole patch; the surface of thickened patches is usually irregular and may be definitely papular; the thickening, erythema and inflammation may be slight or very marked, and occasionally actual ulceration may develop; flat patches may become thickened and erythematous for a time and then, with the subsidence of inflammation, may become flat again.

Our study of the clinical appearance of these patches at various seasons of the year indicates a very curious fact. It is in the months of March, April and May that signs of inflammation in the form of thickening and erythema are most likely to appear. These signs commonly persist for three or four months and then gradually subside, usually by the end of September. We do not wish to imply that inflammation in the patches is seen only at this season, for it may be seen at any time of the year. Nevertheless, taking cases as a whole, we are definitely of the opinion that in Calcutta it is far more common for these appearances to be seen during the middle months of the year, from March to September, than at other seasons.

Seasonal variations in bacteriological findings in neuromacular lesions.—In patients of Groups A and B, seasonal variations in the bacteriological status of the lesions may occur, but if so they will probably be difficult to detect. In cases in Group A, bacilli are always present in large numbers, and in Group B, lesions are deep in the nerves and cannot be examined bacteriologically under ordinary circumstances. Therefore, in our present study we will confine our remarks to patients of Group C, which is by far the largest in our material.

Considering first the bacteriological findings of this group as a whole, recorded month by month during the two-year period, Text-fig. 2 shows the percentages of cases in which the bacteriological examination of the lesions gave positive results. It shows clearly three things: (a) That in 18 out of the 24 months under review the percentages of positive cases were between 0 and 10. (b) That during the months of March, April and May, in both 1937 and 1938, the percentages of positive findings rose markedly, attaining figures between 20 and 25, the maximum in 1937 being in May, and in 1938 being in April. (c) That immediately after this period in both years (i.e., in June), the percentages fell markedly, to below 5. These facts indicate clearly the existence of fairly marked seasonal variations in the results of bacteriological examination of skin lesions of the neuromacular variety.

The question now arises as to what kind of lesions is involved in these variations in bacteriological findings. Do the variations occur only in those patches which show definite thickening and erythema, or are they also seen in those in which such signs are not

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present? This question is answered in Text-fig. 3, prepared on a similar basis to Text-fig. 2 except that the cases are divided into two groups, the first one (upper curve) consisting of cases showing definite erythema, usually with thickening, and the second one (lower curve) consisting of cases in which the lesions did not show those features. This graph indicates that there is an increase in positive bacteriological findings in both groups, but that the increase is most marked in those lesions that show definite thickening and erythema.



TEXT-FIG. 2. Percentages of new patients with neuromacular lesions showing bacilli in smears, September, 1936 to November, 1938.

Discussion of the findings.—The three chief findings recorded above are as follows: (a) an increase in attendance of new patients during the period from March to September, caused chiefly by an increase in the number of patients showing lesions of neuromacular type; (b) a marked tendency for inflammatory changes (erythema and thickening) to appear in neuromacular lesions in the months of March, April and May, and to persist for three or four months before subsidence; and (c) an increase in the percentage of patients showing bacilli in smears from neuromacular lesions during the months of March, April and May, with a subsequent marked fall in June. These three findings are, we believe, related to each other.

It should be stated that most of the patients who attend the clinic for diagnosis do not do so immediately after the disease appears, for most of them give a history of the presence of symptoms for several months, if not several years. It is not, therefore, the first appearance of the symptoms which brings them to the clinic as a rule, but rather an increase of symptoms and the appearance of inflammatory changes in previously existing lesions.





The fact that these inflammatory changes occur most<sup>2</sup> commonly in March, April and May explains the increase of attendance during these three months, and the fact that inflammatory changes often persist for three or four months explains the continued high attendance of new patients during the months of June, July, August and September. There is thus a clear connection between the first and second findings reported above.

The connection between these two findings and the third one, of an increase in bacilli in the lesions, is fairly obvious, but there is one curious thing about this third finding. The increase of positive findings is seen only during March, April and May and ends abruptly in June, whereas patients with markedly inflamed lesions are still seen in our clinic during June, July, August and September, but bacilli are found only rarely in these lesions during that period. 7, 2

What is the explanation of this fact? We believe it to be that during March or April, for some reason which is not apparent, the bacilli in neuromacular lesions of many patients tend to increase in number. This increase is followed by an increase in cellular activity of the lesions, and in some cases, but not in all, by the appearance of definite signs of inflammation. It is this increase in activity of the lesions that brings the patient to the clinic. In a few weeks, however, the increased cellular activity overcomes the increased numbers of the bacilli, after which they are no longer found in smears. The signs of inflammation and activity, however, take a good deal longer to subside and may persist for two or three months after the bacillary increase has been overcome.

The causation of seasonal variations in leprous lesions.—As far as we know only two workers have emphasised the importance of seasonal variations in leprosy and they have given quite different explanations for this phenomenon. The first worker is Stein (4) who summarized his article as follows:

The occurrence of exacerbation of leprous processes depends upon changes in the atmospheric conditions. There is no relation between exacerbation and the annual or monthly temperatures, the barometric pressure, rainfall or winds. Exacerbations occur in a region with the passage of "variable layers" of different systems (cyclones, anticyclones, etc.). The greatest number of exacerbations (73 percent of my cases) occurred during the passage of cyclones and occluded cyclones. The greatest number of exacerbations were observed during the passage of the warm front of cyclones (44 percent), and the next the cold front (29 percent). In cold seasons exacerbations prevail when the warm front sets in, and to the contrary in warm seasons when the cold front passes. Multiple cases of exacerbation are more numerous and appear more frequently in winter. In stable weather only a small number of cases of exacerbation was observed (7 percent) and they appeared only as isolated cases. The exacerbations of leprous processes appear not only on the day the variable layer passes, but also on the previous day.

Stein's observations were made in Leningrad, where exacerbations of leprous processes are seen chiefly in spring and autumn.

The other worker is Oberdoerffer (3), who studied seasonal variations in leprosy in the Okigwi division of southeastern Nigeria. He found (a) that in many cases the symptoms of leprosy first appeared in the months of December and January, and (b) that in these months bacteriological examination of lesions of the neuromacular variety gave a percentage of positive findings that was considerably higher than in other seasons. He suggests that these seasonal variations are due to variations in diet. He states that the period of December to March is the one of highest consumption of the coco-yam (Collocasia antiquorum), and he quotes the ex-

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periments of Clark (1) who found that the coco-yam contains toxic saponins that vary in amount according to the season, there being most in December. Oberdoerffer therefore considers it possible that the consumption of the toxic coco-yam may provoke symptoms in patients in whom the infection is latent, and may also be causally related to the apparent increase in bacilli in patients with existing lesions.

Thus two reasons have been given for seasonal variations, namely, meteorological conditions and toxic food. Is there any evidence that either of these factors cause the variations seen here in Calcutta?

Meteorological conditions in Calcutta.—The mean maximum and minimum temperatures in Calcutta, recorded month by month during the two-year period under review, are shown in Text-fig. 4. The mean humidity, recorded at 8 a.m. and 12:30 p.m. during the same period, is shown in Text-fig. 5, at the foot of which the rainfall is recorded. The numbers of thunderstorms and the distribution of major cyclonic disturbances are shown in Table 1.

Disturbance and year	Month											
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
(a) Thunderstorms 1936	_	_	_	_	_	_	_	_	22	7	0	1
1937	0	7	4	6	19	14	12	10	20	11	0	Ó
1938	2	0	2	3	17	11	8	8	13	9	0	-
(b) Cyclonic disturb- ances												
1936	0	0	0	0	1	1	2	2	1	1	0	0
1937	0	0	0	0	0	1	1	1	3	1	0	0
1938	0	0	0	0	1	0	0	0	0	1	1	-

**TABLE 1.** The numbers of (a) thunderstorms and (b) major cyclonic disturbances in the two-year period 1936-1938.

From the data here given it is obvious that the months of March, April and May (i.e., the months in which the "exacerbations" in leprous lesions commonly arise) are not characterized by the occurrence of thunderstorms and cyclones. It is true that in May both phenomena may occur, but not more frequently than in some other months of the year. September has the largest number of these disturbances, but it is just at this month that the exacerbations begin to decline markedly in frequency. Thus it does not appear that the activation of leprous processes seen in Calcutta can be explained by the meteorological factors described by Stein, namely, the passage of various layers of different systems, cyclones and anticyclones.

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Is there any other meteorological factor which may influence the leprous processes? Stein states that temperature and humidity have no apparent influence on them in Leningrad, but this may not be true in Calcutta. The months in which there is an increase in the numbers of patients showing exacerbations are those in which the temperature is high and rising; the humidity is at first low, rising later. The moderate fall in temperature and rise in humidity seen in June, with the onset of the monsoon, is coincidental with a marked decrease in the number of lesions showing bacilli in smears, although clinical signs of inflammation may still persist. The onset of the cool season in October is accompanied by a fall in the numbers of patients showing signs of inflammation in the lesions. Thus there appears to be a definite correlation between climatic conditions and the manifestations of leprosy in Calcutta, inflammation in patches appearing most commonly at that season when the temperature is high and the humidity is low.



TEXT-FIG. 4. Mean temperatures at Calcutta, by months. Upper curve, mean maximum; lower curve, mean minimum.

Diet in Calcutta.—Let us now consider Oberdoerffer's theory that the toxic saponins of the Collocasia antiquorum cause the increased activity in the lesions. Collocasia in various forms is consumed by most classes of people in Bengal. It is eaten in small quantities frequently throughout the year as a vegetable and as a seasoning, but it does not form a staple part of the diet. In East Bengal, the alluvial part of the province, it is grown and eaten much more than in West Bengal, which is a laterite area, but West Bengal has much more leprosy than East Bengal. No suggestion has ever been made that collocasia can have any ill effect, and it is looked upon as a valuable addition to the diet of persons with "rheumatism." No studies of its possible toxicity have been made. It does, however, have certain irritant qualities which cause a burning sensation in the mouth and throat.



TEXT-FIG. 5. Total rainfall (figures) and mean humidity at 8 a.m. (upper curve) and 12:30 p.m. (lower curve) at Calcutta, by months.

A few weeks ago we placed two rats on a diet consisting entirely of collocasia. They both died within three weeks, but postmortem examination showed appearances more suggestive of malnutrition and starvation than of definite toxic action. It is clear that collocasia cannot be given as a staple food, but there is no evidence that taken in small amounts as a supplement to ordinary diet it has any harmful effect. It cannot, however, be said that the matter has been properly studied.

The available evidence suggests that the seasonal variations in activity of leprous lesions that are seen in Calcutta are caused chiefly by seasonal variations in climatic conditions. There is at present little or no evidence to support the idea that seasonal increase of activity is due to toxic foods, though until the matter has been studied further it will be impossible to express a final opinion on it. In many patients in early phases of the disease, activity in lesions is largely confined to the hot dry season. If this activity is caused directly by climatic conditions it is probably unpreventable; but if, as is just possible, it is caused by some other factor, or by a combination of factors some of which are under control, it might be possible to prevent the seasonal activity and thus considerably improve the prognosis in such patients.

#### SUMMARY AND CONCLUSIONS

1. Analysis of the records of new cases appearing at the Calcutta leprosy clinic over a period of two years (1936-1938, 2,779 cases) shows that larger numbers per month come between March and October than in the rest of the year.

2. This seasonal increase is found to occur in the neuromacular cases and not in those of the lepromatous type or of the neural type without macules. The seasonal variation in the clinical and bacteriological findings in the 1902 neuromacular cases is studied.

3. It is found that clinical signs of activity in the form of thickening, erythema and radial extension are more common during the months from March to September than at other seasons.

4. It is found that during the months of March, April and May the percentage of neuromacular lesions in which bacilli are found in smears rises markedly, reaching a maximum of about 23% in April or May, and that it falls to below 5% in June; during most of the year the percentage is below 10.

5. These findings are interpreted as demonstrating: (a) that in the early months of the year, bacilli in neuromacular lesions tend to multiply and cause increased cellular activity; (b) that the bacillary increase tends to end abruptly in the month of June; and (c) that the increase in cellular activity subsides a few weeks after the bacillary increase has subsided.

6. The causation of these seasonal variations is discussed in the light of the publications of Stein, who attributes a seasonal incidence of lepra reaction to sudden changes in meteorological conditions, and of Oberdoerffer, who attributes seasonal variations seen in Africa to varying consumption and varying toxity of cocoyam (Collocasia antiquorum) at different times of the year. Neither of these factors seems to explain the seasonal variations seen in Calcutta.

7. The seasonal variations in Calcutta appear to be related to meteorological conditions, the period of increased bacterial activity being confined to the hot, relatively dry season and ending abruptly with the onset of the rainy season, the cellular activity gradually subsiding later.

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