The Problem of Tuberculosis in Balovale and Kabompo Districts

BY

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The Queen Elizabeth hospital, Balovale, has about 140 beds, and since the new buildings were opened in 1953 at least a half of them have always been filled with tuberculotics.

The Problem; Its Background

The hospital serves an area of about 12,400 squares miles with a population of approximately 70,000. These districts lie in the north-west of the territory, bounded to the north and west by Angola, and are in the valleys and catchment areas of the Zambesi and Kabompo rivers.

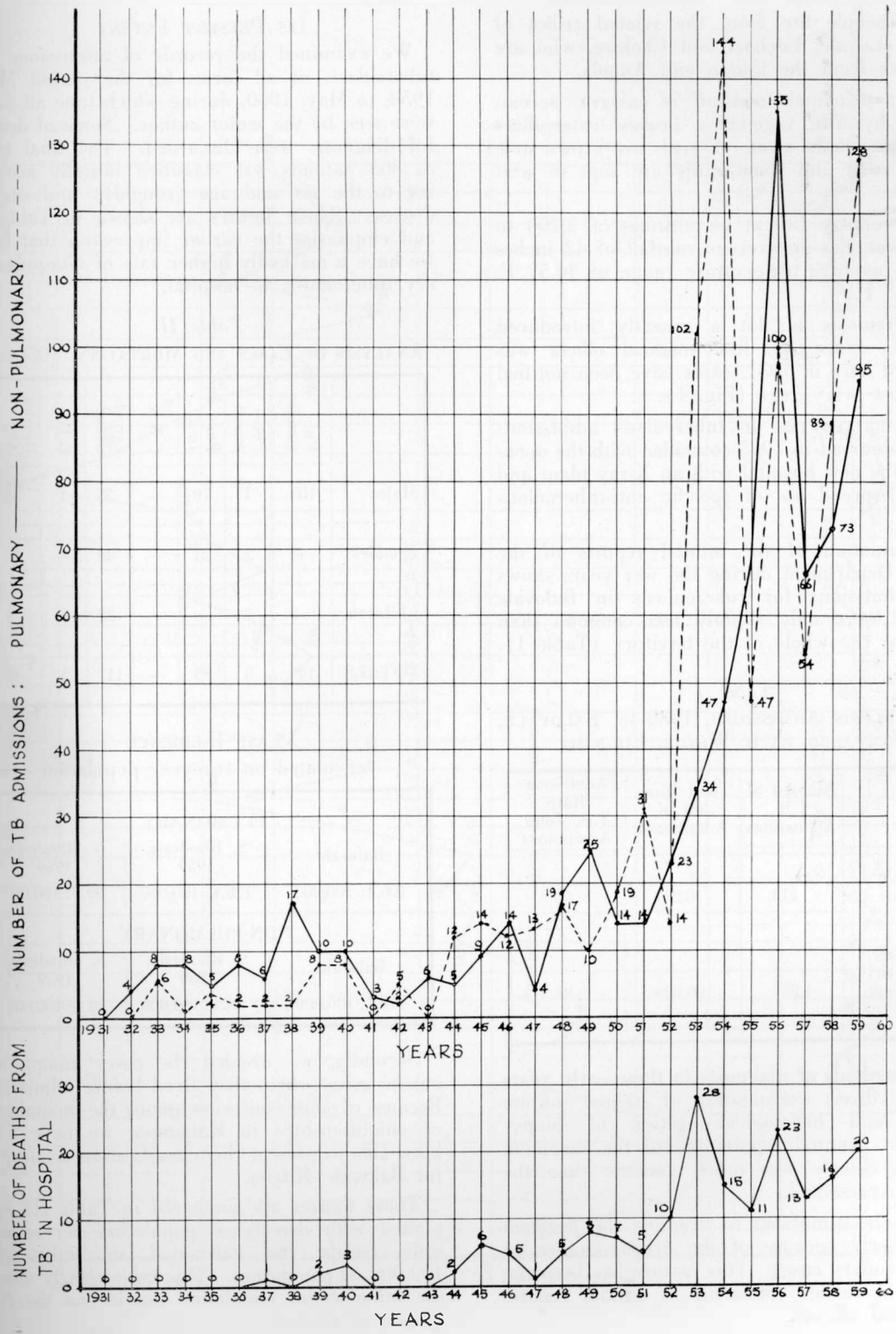

Fig. 1—Annual admissions for tuberculosis, 1931-59; and deaths.

The people are from the related tribes of Lunda, Luvale, Luchazi and Chokwe, who are migrants from the Congo and Angola.

Their principal foodstuff is cassava, accompanied by fish, vegetables, insects, caterpillars and occasionally meat. Cereals are grown to a small extent and some cattle are kept in west Balovale.

The country lies at an altitude of 3,200 to 3,700 feet, has an average rainfall of 42 inches and an average temperature range of 46.5° F. to 92.3° F.

Tuberculosis is not a recently introduced disease. Since the first medical officer was stationed here in 1931, cases have been notified in almost every year (Fig. 1).

The marked rise in tuberculosis admissions which occurred in 1953 coincided with the opening of the new hospital with an X-ray plant and the widespread use of specific anti-tuberculous drugs.

Examination of the annual reports of the Health Department during the war years shows that admissions for tuberculosis in Balovale hospital were only slightly less common than those for the whole of the territory (Table I).

Table I

TUBERCULOSIS ADMISSIONS, 1939-45, BALOVALE, COMPARED WITH WHOLE COUNTRY

	Number of T.B. Admissions	Total Number of Admissions	Admission Rate T.B./Total Admissions
Balovale Hospital	113	10,247	1: 90
All other N.R. African hospitals	1,257	108,829	1: 86.5

The methods of diagnosis in these early years were by direct examination of stained sputum smears and histological section of biopsy material. Annual reports record the suspicion that the disease was more common than the figures represented.

We were stimulated to examine the problem more closely because of the preponderance of non-pulmonary cases. This feature has been the subject of earlier comments in annual reports of medical officers.

ITS PRESENT EXTENT

We examined the records of admissions for tuberculosis of all forms for the period May, 1958, to May, 1960, during which time all cases were seen by the senior author. Some of doubtful diagnosis were discarded. The final total of 365 patients was classified initially according to the sex and age (roughly) and site of disease. These figures are shown in Table II and emphasise the earlier impression that here we have a markedly higher rate of non-pulmonary tuberculosis in hospital.

Table II

ANALYSIS OF CASES AND MORTALITY, 1958-59.

	Pulmonary	Peritoneal	Bone and Joint	C.N.S.	Lymph Gland	G.U.	Deaths, All Forms
Males	103	1	70	—	55	1	30
Females	44	2	23	—	40	—	15
Children	2	2	—	—	22	—	4
TOTALS	149	5	93	—	117	1	49

CASE INCIDENCE

calculated on two-year population

PULMONARY		
Balovale	S. Rhodesia, 1959	N. Rhodesia, 1959
106.4: 100,000	120.1: 100,000	92.9: 100,000
NON-PULMONARY		
Balovale	S. Rhodesia, 1959	N. Rhodesia, 1959
154.2: 100,000	18.4: 100,000	18.4: 100,000

Secondly, we divided the cases among the chiefs' areas where they lived before admission. Because of some confusion among the incumbents of chiefdomships in Kabompo, we have only been able to present this classification accurately for Balovale district.

These figures are compared in Table III and plotted with density of population per square mile beside the calculated morbidity per 100,000 of population. This table clearly shows the influence of population density on the frequency of disease.

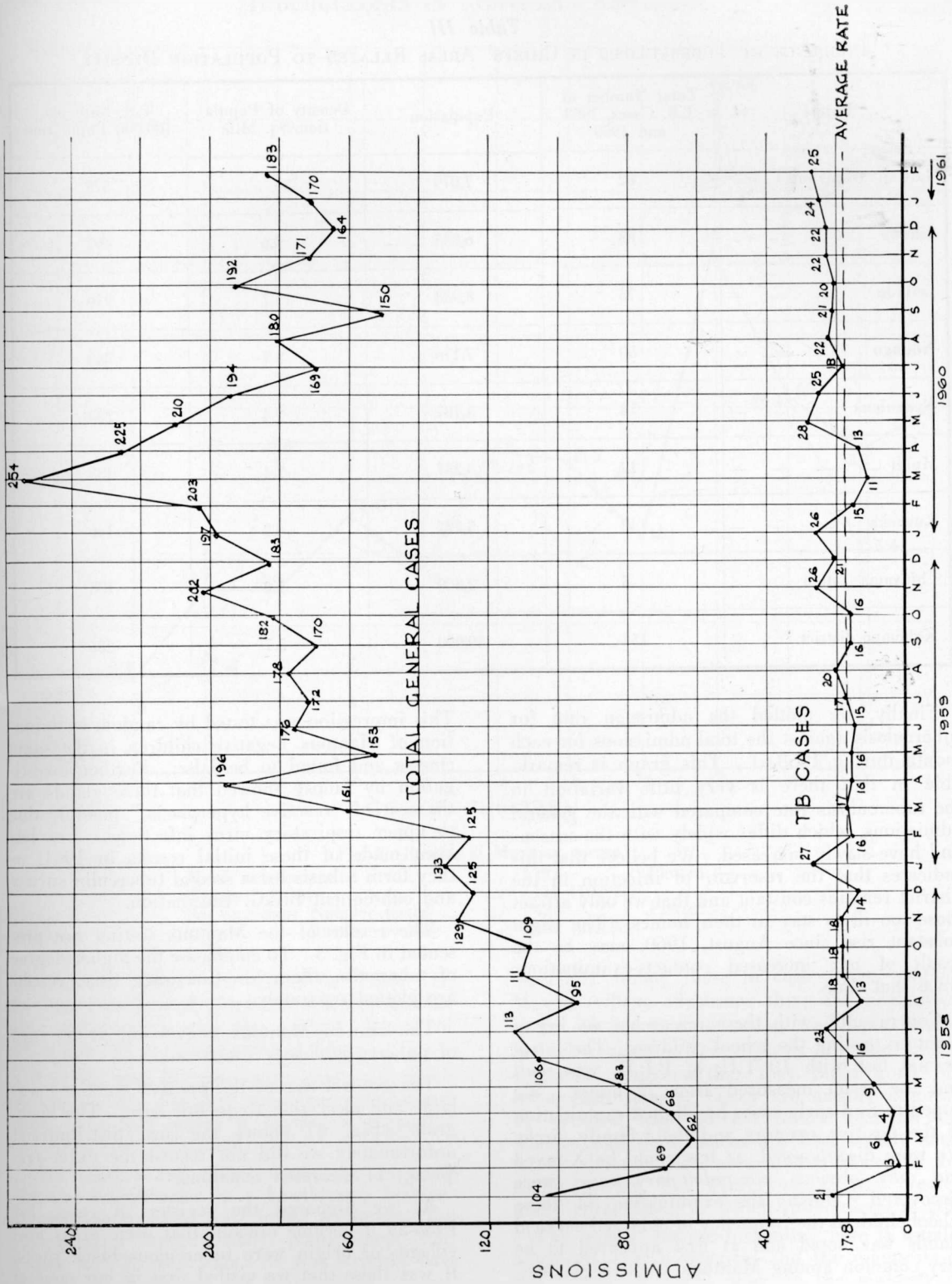

Fig. 2—A comparison of general and tuberculosis admissions.

Table III

INCIDENCE OF TUBERCULOSIS IN CHIEFS' AREAS RELATED TO POPULATION DENSITY

Chiefs	Total Number of T.B. Cases, 1958 and 1959	Population	Density of Population/Sq. Mile	T.B. Rate per 100,000 Population
Luweji (Chavuma)	82	7,079	35	579
Ishima	68	6,835	9.6	497
Ishinde	75	8,933	13.7	416
Ndungu	50	7,176	8.7	348
Nyakulena	14	3,707	7.4	188
Mpidi	12	3,237	2.4	185
Kucheka	12	5,227	4.2	116
Chinyama Litadi	5	2,300	1.0	108
Kabompo district	154	30,000	5.7	256

Finally, we plotted the admission rate for tuberculosis against the total admissions for each month during 1958-61. This graph is remarkable in that there is very little variation in the tuberculosis rate compared with the general admissions, which differ widely with the seasons and have slowly increased. We believe that this indicates that the reservoir of infection in the district remains constant and that we only attract those too ill to stay in their homes. The slight constant rise since August, 1960, may be the result of our increased contacts-examinations since that time.

Concurrently with these researches we began Mantoux testing the school children. The intradermal test with 10 T.U. of P.P.D. was used and the result measured after 72 hours. We hoped to find early cases by clinical examination of the positive reactors and their family circle. We were disappointed, as few could be X-rayed and only obvious *non-pulmonary* cases were discovered. During the examination of these school children the frequency of enlarged cervical glands was noted and at first appeared to be very common among Mantoux positive reactors. This impression was tested by random examination of Mantoux negative children in the same classes and found to be false. Further investigation by biopsy showed that these glands are the seat of "reactive hyperplasia," possibly due to upper respiratory virus infections. Use has been made of these initial results in 1961, as they form a basis for a second tuberculin survey and subsequent B.C.G. vaccination.

The results of the Mantoux testing are presented in Fig. 3. To emphasise the higher degree of tuberculin allergy in Chavuma, these results are plotted separately.

The rise in Mantoux conversion at the age of puberty is clearly illustrated.

The general size of the positive reactions was large and ulceration frequently seen. The histogram (Fig. 4) shows the size distribution; unfortunately we did not record the exact frequency of ulcerated reactions.

As we prepared the register of cases for 1958-59 it became obvious that some areas and villages of origin were tuberculous black spots. It was these that we visited first in our contact

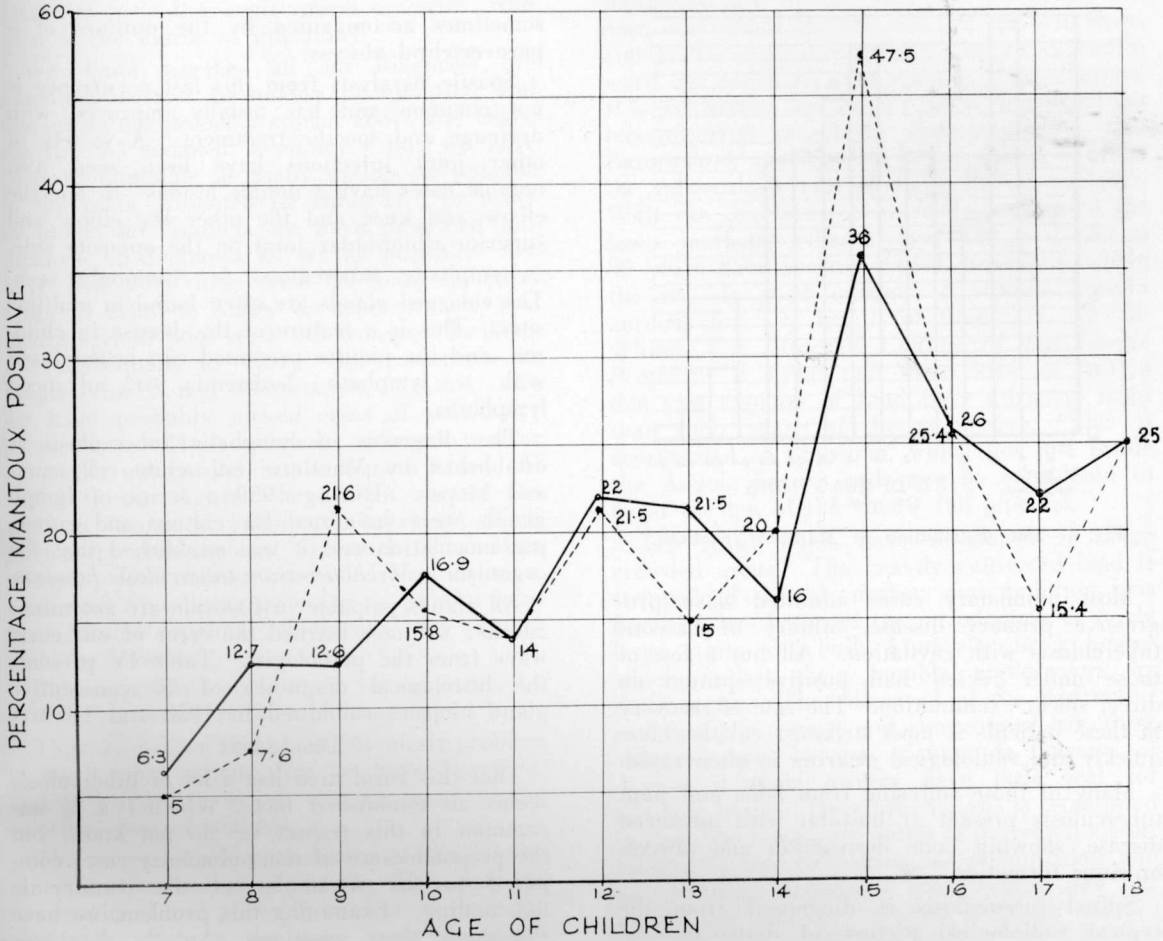

Fig. 3—Results of Mantoux survey.

Total number tested	1,187	Plotted ————
Number positive	114 (10.6%)	
At Chavuma: Number tested	454	Plotted - - - - - - -
Number positive	135 (29.7%)	

examination tours. As shown in Table III, the Chavuma area of Chieftainess Luweji has the most tuberculosis and the highest degree of tuberculin allergy among the children.

It is an area of reasonably good soil, which is rare in this northerly extension of Kalahari sand. For this reason it is densely populated and intensively cultivated.

The villages are almost continuous in parts and are intermingled in a bewildering fashion. Where tuberculosis was found common the surroundings were usually poorly kept and houses in a broken state. It was striking how the spread of disease was found to be concentrated in small villages and family groups, especially among those in close house contact. Maseka village illustrates this; the population is 40, 20 per cent. of whom had been treated for tuberculosis. It is a point of pride among Chavuma residents that they build good big rectangular houses. They are usually admired by visitors, who do not notice that all the window and door spaces are kept tightly shuttered. It is a rich area where foodstuffs are easily grown, but overcrowding has created many rural slums in which tuberculosis is rife.

The type of disease presenting here is usually advanced and destructive, and the diagnosis of tuberculosis is easily made in the majority of cases.

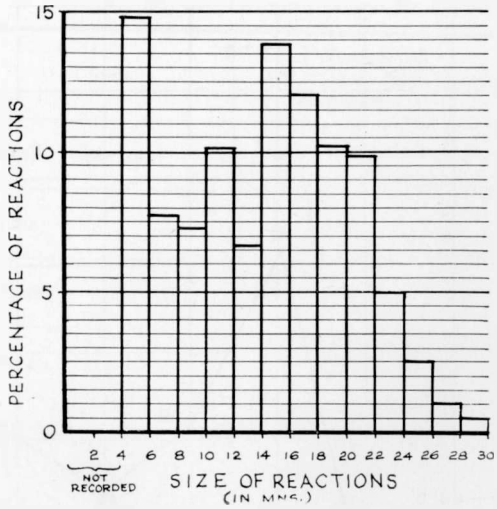

Fig. 4—Size distribution of Mantoux reactions.

Most pulmonary cases admitted have progressive primary disease, miliary or caseous tuberculosis with cavitation. All but a few of those under review had positive sputum on direct smear examination. The rate of recovery in these patients is most striking; cavities close quickly and radiological clearing is often rapid.

Many of those suffering from bone and joint tuberculosis present at hospital with advanced disease, showing bone destruction and abscess or sinus formation.

Spinal tuberculosis is diagnosed from the typical radiological picture of destruction of the bodies of vertebrae, usually contiguous, sometimes accompanied by the outlines of a paravertebral abscess.

Spastic paralysis from this last occurrence is not common and has usually improved with drainage and specific treatment. A variety of other joint infections have been seen, two notable cases having double lesions—in one the elbow and knee and the other the elbow and superior tibiofibular joint on the opposite side.

Lymphatic tuberculosis is commonly seen. The enlarged glands are often found in multiple sites. This is a feature of the disease in children, and the picture presented can be confused with a lymphatic leukaemia or advanced lymphoma.

The diagnosis of lymphatic tuberculosis is established by Mantoux test, white cell count and biopsy. During 1959 a series of lymph glands were submitted for culture and guinea pig inoculation and it was established that the organism is *Mycobacterium tuberculosis hominis.*

All glands palpable in Balovale are not tuberculous; we have learned the error of our early ways from the pathologist. Table IV presents the histological diagnoses of 60 consecutive gland biopsies submitted in 1958 and 1959.

DISCUSSION

That this rural area has a lot of tuberculosis seems an established fact. Whether it is uncommon in this respect we do not know, but the preponderance of non-pulmonary cases compared to the remainder of the country is outstanding. Examining this problem, we have considered three questions. Are the diagnoses correct? Are the people more susceptible by

Table IV

HISTOLOGICAL DIAGNOSES OF LYMPHATIC GLAND ENLARGEMENT

	Tuberculosis	Neoplasms	Non-Specific Hyperplasia	Sarcoid
Male	21	Bronchogenic carcinoma: 2 Lymphosarcoma: 2 Reticulum cell sarcoma: 1	10	2
Female .... —	14	Reticulum cell sarcoma: 1	7	—
TOTALS	35	6	17	2

reason of their diet, environment or race? And what is the source of infection?

We doubt whether all our diagnoses are absolutely correct in quality or quantity, and our errors are probably spread above and below the line of complete accuracy. But we have tried to eliminate as many doubts as possible in the cases presented in Table II. In order to judge our findings we have described our methods of diagnosis as far as possible. We have had very little time to tour the rural areas in detail to follow up case contacts, and in this area of poor roads our transport facilities are inadequate to carry many suspects to hospital for X-ray examination. In this way we have probably missed cases of pulmonary tuberculosis. These unknown sufferers recover or perish unrecorded in the remote areas. If added to our figures they might reverse the ratio in favour of pulmonary infection. Non-pulmonary tuberculosis is much less often missed. The average rural African is more concerned by a lump or bump or painful joint than chronic coughing which may vary slightly with the seasons.

This hypothesis could only be supported by a mass miniature radiography survey.

Thus we believe that the tuberculosis problem is much more serious than we have described, and in particular we do not see many of the existing cases of phthisis.

The general build and stature of the inhabitants in these areas is small. This may be constitutional and probably confers on them the ability to exist on the poor foodstuffs which can be grown on sandy soils.

We do not see frank cases of malnutrition in adults or kwashiorker in children, but a general level of subnutrition is found in the district. This chronic state is reversible when good feeding is instituted, as demonstrated by the contrast of the muscular recruits returning from the Rand mines with the "weeds" setting out. The foodstuffs consumed are varied, but lack first-class protein and fat. This protein lack is more marked away from the large rivers, as in the tributary streams fishing is only seasonal, dependent upon the floods. The poor diet here is a contributary factor in predisposing people to tuberculosis.

The greatest single environmental factor we have found to influence the incidence of the disease is density of population, as shown in Table III.

The increase of population here has occurred naturally and by migration from Angola. This southward flow of the Lunda/Luvale people has been continuous for the past 200 to 300 years, and on the whole their primary migration southward has ended at some point in these districts. It is well known that further secondary migration has occurred across the Kabompo river into Barotseland, and it would be interesting to know the tuberculosis rate in these Luvale enclaves. With the development of roads leading to the town markets, villages over the past 20 to 30 years have become settled, especially where the soil is good enough to sustain cassava gardens for any length of time. (C. M. N. White: *The Material Culture of the Luvale People.*) It seems that these oases of soil in this vast expanse of sand have attracted more than their share of the population. This is accentuated at Chavuma, which lies just inside the Angola border and may be considered to be at the top of the almost full pipeline.

The rural slums have developed in these crowded areas. The heavily cultivated land is stripped of sizeable timber, and ambition plus necessity has hastened the introduction of fairly large, quite well built, kimberley brick houses which outlast their humble predecessors by many years. Thus deprived of the destructive action of the termite and cleansing of fire, these villages may become dangerous havens of disease if their owners have little zeal for hygienic living. Once tuberculosis is established in them the downward spiral of decreased vigour leading to less cultivation, to malnutrition and to spreading disease is soon begun, and the results are seen in crowded unkempt villages with life at a subsistence level.

The question of racial or tribal susceptibility to disease is a difficult one, as many environmental factors may work equally in succeeding generations and create a false picture of an inborn defect. But in considering rural village Lunda/Luvale people it begs the question to quibble about the origin of aetiological factors which are now hard at work, regardless of whether they are linked to soma or psyche.

These people are very susceptible to tuberculosis and their tissues have little resistance to the infection when it is established. The frequency of large often ulcerated Mantoux reactions and the incidence of destructive spreading type of disease illustrate these facts.

During our present B.C.G. campaign we shall have an opportunity to observe the occurrence and rate of healing of lesions induced by the vaccine which will give us some measure of inherent resistance.

This lack of inherent resistance suggests that the population has been exposed to tuberculous infection for a short time and has not built up any great average level of tuberculin sensitivity. This argument is slightly at variance with our statement above that cases have occurred since 1932. These were probably scattered because roads were non-existent and villages few and widespread.

Thirty years ago the mode of travel out of the districts was by the Zambesi to Mongu or beyond and thence to Livingstone. Migrant labour from here was usually occupied in sanitary work on the line of rail in the days of bucket latrines and the "night cart." It was not until the road from Chingola was completed that any number of men sought work in the mines or industry, but in recent years this migration to the Copperbelt and Rand mines has become appreciable, and among those returning we have found quite a few tuberculotics.

In considering the origin of the infection here we must suspect the line of migration of the majority of the population.

The earliest people left the kingdom of Mwanta Yamfwa, in what is now Katanga, and travelled into Angola to settle along the Luena and Zambesi rivers, whence they slowly moved or expanded southwards. We have no knowledge of the Portuguese settlements in Angola, but expect that these Lunda/Luvale people had some contact with the colonists or their agents in the slave trade, the Ovimbundu. Perhaps some of them contracted tuberculosis in the 1800's and it has smouldered on to be fanned into flames by the twin winds of increased communication and land overcrowding. This attractive theory is apparently supported by our finding of increased tuberculin allergy and morbidity at Chavuma, on the Angola border, but personal enquiries among visiting Portuguese officials and medical staff have not brought forth any admission of a tuberculosis problem comparable to ours. We do draw patients from the adjacent territory and quite a number are tuberculotics, and so we wonder if our neighbour's appreciation of the situation is delayed by the remoteness of the area and poor roads.

CONCLUSION

In final analysis we believe that this tuberculosis epidemic has arisen because good land overcrowding has resulted in fixed unhealthy villages, where susceptible people with little inherent resistance live; and exist upon a poor diet which ill-fits their tissues to withstand the spread of the tubercle bacilli.

The general measures to help combat this spreading disease should be designed to make better use of the poor sandy soil in growing *foodstuffs*. In this respect it seems quite wrong that expensive efforts should be made to teach the people to grow marketable rather than consumable products.

Secondly, greater use must be made of the native authority orders which govern the siting and density of villages and their hygienic condition.

The specific measures we use are: treatment with a combination of streptomycin, isoniazid and P.A.S. until the disease is arrested, and at least two years' follow-up confirms this. To aid detection of cases we have instituted a local register of tuberculotics, from which we can select the bad villages to visit and collect contacts to X-ray. To raise the level of tuberculin sensitivity we have commenced B.C.G. vaccination of all school children who are Mantoux negative. This should be extended to the whole population at risk if time, staff and transport permit. In this work we have used the Glaxo freeze-dried vaccine and early checks have shown that 86 per cent. have been converted within three months.

SUMMARY

(1) The extent of the tuberculosis problem in two adjacent rural districts is described and the ascertainable morbidity shown to be 106 per 100,000 for pulmonary cases and 154 per 100,000 for non-pulmonary cases, the latter being eight times the national figure.

(2) The most crowded area is shown to be worst affected, although situated on the best food-growing soil.

(3) The type of disease encountered and methods of diagnosis are described.

(4) The epidemiological factors of diet, environment and race are discussed and the prime importance of overcrowding good land is stressed.

(5) General agricultural and public health measures are recommended for solution of the problem and the specific curative and preventive measures being used are described.

Acknowledgment

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