PART I.

A PRELIMINARY SURVEY OF FACTS BEARING ON TUBERCULOSIS IN SOUTH AFRICAN NATIVES.

CHAPTER I.—GENERAL CONSIDERATIONS.

CHAPTER II.—ANTHROPOLOGICAL AND HISTORICAL NOTES ON THE BANTU TRIBES OF SOUTH AFRICA.

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CHAPTER I.—GENERAL CONSIDERATIONS.

1. ISOLATED COMMUNITIES.

A community may be regarded as "isolated" in so far as concerns its epidemiology when it is completely cut off from commercial, military or other relations with the outside world. Certain islands in the Pacific were at one time "isolated" in this sense; some of the more northerly Eskimo tribes are, perhaps, so "isolated" to-day; and until recently, a few African tribes have remained isolated through the operation of geographical and other factors; such, for instance, as the Bahr-el-Ghazal Dinkas, so placed in the marshes and steppes to the south-west of Lake No on the White Nile that they were able to maintain an isolation undisturbed up to 1902 by any more permanent "penetration" than an occasional slave-hunting "razzia" by wandering Arabs.

In the case of such isolated communities the tribe or clan usually spreads its population widely over the area occupied. The exigencies of a life depending on the grazing of herds, the capture of game and the raising of crops in bush-clearings, demand wide spaces; and huts are arranged in family "kraals" instead of in villages or towns; these "kraals" being frequently changed from place to place according to the needs of a semi-nomadic people.

In these circumstances, the passing on of bacterial infection from one person to another is limited to a far greater extent than in more sophisticated communities; and, more especially, in diseases of slow development like tuberculosis, sporadic cases, if they occur, tend to die out with the individual or family. While reliable statistics are, of course, in the nature of things, unobtainable, it has been the almost universal experience of those qualified to judge who have had opportunities of studying such communities before tribal conditions were unduly disturbed, that tuberculosis has been conspicuous by its absence both in the humans and also in their cattle.

The manner of life, in these isolated tribes, presents a sharp contrast to that in the big cities of Asia on the one hand and, even more so, to the life of the civilized and industrialized communities of Europe, with their never-ending contacts between individuals and their free communications as between cities and countries.

2. THE TUBERCULOSIS OF VIRGIN SOIL.

Although the native races of South Africa can no longer be considered as "isolated," their contact with civilization is of relatively recent date and, save for intermittent touch between the coastal fringes of immigrant tribes and European trading, missionary and marine
stations during some four centuries, and Arab coastal settlements for a much longer period of time, may be regarded as falling within the limits of the last hundred years.

In these circumstances, it is obviously desirable to start the consideration of the disease in South African Natives by a brief survey of the tuberculosis of virgin soil. In the words of G. Bushnell \(^1\) "We cannot comprehend how a general tuberculization influences the dissemination and progress of tuberculous disease until we know how communities and individuals fare who have had no previous acquaintance with the tubercle bacillus."

It will be noted that Bushnell uses the expression "communities and individuals"; but a moment's reflection suffices to show that our information can only be exact in so far as it concerns individuals; seldom or never as it concerns communities, since individuals may be studied when they abandon their isolation and enter civilization, but communities cannot be moved about in this way and the penetration of civilization into the midst of "isolated" populations is usually so gradual that no sharp contrasts present themselves for examination.

As to uninfected individuals, while many instances might be cited from older records, there has never been a more favourable opportunity for the study of their behaviour on their sudden introduction into a "tuberculized" environment than that presented by the French "Colonial Troops" called to Europe for military service in the late war.

A. Borrel, \(^2\) to whose lot it fell to study this problem in Senegalese troops arriving in France, has made a contribution to the subject which is likely in the future to become classical and which demands the closest attention from all those who desire to approach the study of tuberculosis in the African races. He showed conclusively that these practically uninfected persons—only four to five per cent. were found to give a positive tuberculin cuti-reaction on arrival—were exceedingly susceptible to tuberculosis and tended to develop the disease in a severe and generalized form. He found that the disease presented two stages; an initial glandular phase with no fever and no definite change in the general state, tending to last, under Army conditions, for one, two, or three months; and a subsequent phase characterized by fever, emaciation and generalized lesions such as caseous lobar or lobular pneumonia, affections of the serous membranes, pleurisy and miliary tuberculosis, either primary or secondary. This latter phase was usually short and death often ensued within a fortnight to two months after its inception.

It is to be noted, however, that although cases which reached the second stage were almost invariably fatal, those detected early and while still in the "glandular" phase, if placed at rest and given suitable food, tended to do well. Borrel reports that 50 per cent. of such cases regained their health and were fit to be repatriated.

To Borrel's records of his post-mortem findings in the fatal cases, reference will be made later in this Report.
For reasons already given, it is difficult or impossible to obtain satisfactory information on how previously uninfected communities behave when infection is introduced. It may be stated with some confidence, however, that the return of individual cases infected elsewhere to such communities does not invariably or even usually light up epidemic tuberculosis. Provided that the community in question still retains its isolated character and continues to follow its primitive mode of life, the spread of the disease, when thus introduced, may, it seems, be arrested or only proceed very slowly; eventuating, perhaps, if the introduction of further cases continues from time to time, in a curious type of endemic and relatively benign tuberculosis in which the fulminating cases described in France by Borrel and others are not frequently observed.

What appears to be an instance of this type of endemic tuberculosis has recently been described by Paneth in the Karo Districts of the Dutch East Indies; but opportunities for observing tuberculosis in these circumstances are naturally rare.

This rarity or absence of epidemic spread of acute tuberculous disease in "isolated" communities exposed to occasional infection is, perhaps, to be explained in terms of the tendency to spontaneous arrest of cases in the "glandular" stage, as noted by Borrel, when placed at rest and suitably dieted.

A type of contact more frequently observed is that in which, under conditions of "segregation," a previously "isolated" community is placed under new and unfamiliar surroundings and provided with "civilized" substitutes for its primitive manners, customs, foods and habitations. In these circumstances, each member of the community, if infected with tuberculosis, tends to behave just as has been above described for the Senegalese troops described by Borrel, and the result is an approximation to epidemic rather than to endemic tuberculosis.

A recent paper giving an extremely interesting and tragic account of tuberculosis in such circumstances is that by R. G. Ferguson, in which he describes the behaviour from 1870 onwards of the disease in the Indians of the Great Canadian Plains.

Reference has already been made to the case in which civilization gradually penetrates into the heart of a previously isolated community. Here the issues tend to be somewhat obscured by the gradual nature of the change and results, as might be expected, vary according to circumstances. When the penetration leads to or is accompanied by a marked change in the diet and mode of life of the community, the results may be very similar to those described by Ferguson.

For an example, the reader is referred to a recent article by V. Suk, "On the Occurrence of Syphilis and Tuberculosis amongst Eskimos and Mixed Breeds on the North Coast of Labrador," a paper described by its author as a "Study in the Extermination of Aboriginal Races."

Instances might be multiplied, but the above will suffice to establish the point that members of isolated communities exhibit a marked susceptibility to tuberculosis when brought into contact with infection;
and that although the infection may be fairly well tolerated under natural or tribal conditions, this susceptibility is fraught with extreme danger when exposure to infection is accompanied by a sudden change in occupation, food, housing and mode of life.

3. Intermediate Stages from Isolation towards Agglomeration.

It was, again, the importing of French and other Colonial troops into Europe which afforded unique opportunities for contrasting the tuberculosis, not merely of Colonial Natives with that of Europeans, but of the various types of Colonial Natives with each other.

Ch. Roubier, after a close study of French Colonial troops exposed to tuberculous infection in France and Germany, found that they fell into three main groups, as follows:

(a) Those races which had already experienced considerable "contact" with Europeans in their original surroundings. The Algier-Moroccan units afforded examples of this group and presented clinical types of tuberculosis which, while often severe, tended more towards the types of phthisis met with in Europe.

(b) Those from remote and sparsely populated places where there was very little contact with "civilization." The Senegalese troops, with their marked susceptibility to tuberculosis, belonged to this group.

(c) Those races which, although remote from European civilization, include relatively large agglomerations in their native townships. Such were the units from Indo-China; and their resistance to tuberculosis was fairly high.

Borrel had likened the tuberculosis of the Senegalese to that of European infants. Roubier went further and noted that the tuberculosis of the Algier-Moroccan and Indo-Chinese was of the more benign type met with in European children and adolescents.

4. Analogy with the Tuberculosis of Infancy and Childhood.

This similarity between the clinical manifestations of tuberculosis in individuals arriving from isolated or relatively isolated surroundings into a society in which tuberculous infection is general, and the clinical types met with in infants and young children of European races, is very interesting and well calculated to guide us in attempts to formulate conceptions as to the pathogenesis of the disease.

It will be recalled that Borrel noted in his Senegalese patients a "glandular" phase during which there was still a good chance that the case, if detected and placed at rest on a suitable diet, might do well and regain health. It was in the cases undetected at this early stage that the second or "generalized" phase supervened under the stress of continued military duty and passed on so rapidly to a fatal issue.
These glandular affections are characteristic of tuberculosis in infants and children, and in them, to a much greater extent, rest and good food suffice to lead on to toleration of the disease, gradual diminution in the adenitis, and a maintenance of health.

The existence of this "larval" or glandular stage, during which normal health is usual but in which undue exertion or inter-current disease may have serious effects in leading on to a generalization of the infection from the glands through the blood stream into other organs, is a fact which must be taken into account by those engaged in the medical inspection of Native recruits for industry, as well as by those charged with the care of the children of infected parents.

The subject has been discussed by Cummins in a recent paper with special reference to the analogy between European children and African Natives; and a series of masterly articles on the tuberculosis of childhood by Opie and his co-workers will repay study by those interested in the question.

5. Theories suggested to explain differences in susceptibility to tuberculosis.

It will be seen then that "communities and individuals who have had no previous acquaintance with the tubercle bacillus" fare badly when brought into contact with infection; especially when such contact is accompanied by an abrupt change from a free and natural life and an accustomed diet, to living, working and nutritional conditions to which the individual or the community is not yet adapted. Just as wild animals in nature entirely escape tuberculosis yet show, in captivity, a marked susceptibility to the disease, so does man, in his primitive surroundings, escape this affection; and yet, in spite of his often splendid physique, he is found to possess little or no resistance when exposed to infection. Some of the theories which have been propounded to explain this susceptibility will now be discussed.

Hippocrates held that certain physical types were especially subject to tuberculosis. These he defined as follows:—"The form of the body peculiarly subject to phthisical complaints is the smooth, the whitish, that resembling the lentil, the reddish, the blue-eyed, the leucophlegmatic, and with the scapulæ having the appearance of wings." This notion of a phthisical habitus, naturally acceptable to medical men up to the time when more delicate methods of diagnosis revealed the existence of actual but latent disease as a frequent precursor of the developed malady, is a tribute to the clinical acumen of Hippocrates but need not detain us in relation to phthisis in the African Native; since the latter, as we know too well, may be a picture of physical perfection on arrival into an industrial community and yet die of acute phthisis a few months later.

Nor need we long consider the view of tuberculosis as an inherited disease expressed by Pierre Desault in the following words: "Those who have the misfortune to be born of phthisical parents are very liable to the disease, because phthisis is transmitted by inheritance."
In spite of recent claims to the discovery of filtrable forms of the germ capable of passing through the placenta, the theory of inherited tuberculosis cannot explain the susceptibility of members of isolated communities since the ancestral stock has been free from tuberculosis for generations.

This idea of inherited tuberculosis was abandoned when Villemin proved the infective nature of the disease and Robert Koch isolated the causative bacillus.

The modern view was expressed by Koch as follows: "Tuberculosis is explained most naturally by supposing that the infective germ is not inherited but rather certain peculiarities favourable to the development of germs which may later on come into contact with the body; in fact, it is the predisposition to tuberculosis which is inherited." Thus, it will be seen that Koch favoured the idea of an "inherited predisposition" to infection; a theory which received support from the statistical investigations of Karl Pearson on the liability of the children of phthisical parents to tuberculosis. Maynard, of Johannesburg, in 1912, warmly upheld the views of Pearson on this point. Sanarelli, on the other hand, propounded a theory of "inherited resistance" to infection, this quality being less marked in persons showing a liability to the disease than in those capable of escaping it. Either theory will serve to explain the susceptibility of members of isolated communities when exposed to infection.

It is clear, for instance, that in the absence of tuberculosis, an absence usual in primitive tribes, those born with an inherited predisposition would escape the disease and live to propagate their kind. It is equally clear that, in the absence of an inherited resistance, the unprotected would survive and multiply. On either theory, an isolated community, once brought into contact with infection, might be expected to come off badly as compared with an old-standing industrial population from which the "predisposed" or the "non-resistant" families had been eliminated.

Neither theory, however, appears to fit well with the facts of variation in resistance to tuberculosis characteristic of the different age-periods in civilized man. The age of infancy, even in the most resistant communities and races, is characterized by the occurrence of those types of tuberculosis associated with "virgin soil"; the tuberculosis of young and growing children suggests less power of resistance than that of adolescents; while young adults are more liable to acute phthisis than persons of middle age who tend to manifest the chronic forms of the disease.

These facts strongly suggest that each individual in "tuberculized communities" must acquire—in varying degree—his own resistance through intermittent contact with small doses of tuberculous infection. That increased resistance may be acquired through graded infection with tubercle bacilli has been proved up to the hilt by animal experiment;
a concrete argument which is better established than much of the
evidence adduced in support of "inherited predisposition" and "in-
herited resistance." In the words of Opie,10 "There is indeed very
little convincing evidence for or against the opinion that inherited
susceptibility on the one hand or inherited resistance on the other
modifies the progress of tuberculosis in human beings."

While, however, the evidence for and against both these theories
falls short of being conclusive, the marked difference in susceptibility
to tuberculosis still noted between the white and negro populations
of the United States after seven or eight generations of co-existence in
the same country does suggest very strongly that some inherited factor
may play a part; and it is natural that the subject should have received
attention from laboratory research workers in recent years. It is
recognized that "passive immunity" to certain toxins can be trans-
mitted to the offspring by the female, though this immunity is tran-
sitory. But apart from this transmission of "passive" anti-bodies,
there is also the possibility that the power of actively producing anti-
bodies may be transmitted to the offspring in varying degree. In the
transmitting of this power, the male parent might participate as much
as the female, as was pointed out in 1907 by Theobald Smith11 as
follows: "Though the male parent does not transmit directly any
passive immunity, yet there is no evidence to show that he does not,
equally with the mother, transmit the capacity for producing anti-
bodies, which capacity . . . varies much from family to family."

Aptitude to create immunity has been shown more recently by
Grasset69 to be hereditarily transmissible as a fixed character; the
reactive faculty, notwithstanding that there may be no occasion for
its application, being transmissible as a latent character from generation
to generation, although it is subject to considerable variation in the
same species.

Working on this idea, Lewis and Loomis12 have been able, by the in-
breeding of guinea-pigs over several generations, to produce more or
less "pure" families, each differing from the others in the power of
developing resistance to tuberculosis. It is, of course, very difficult
to be sure how heredity works under the conditions of such experiments
or to establish exactly what are the factors at play; but the findings
show conclusively that certain of these inbred families resist tuberculous
infection better than others: thus, family "35" is demonstrated to be
more resistant than family "13"; these differences not being confined
to tuberculo-resistance but being demonstrable also in relation to the
capacity for producing anti-sheep cell amboceptor and in the liability
to anaphylactic shock.

These experiments cannot be overlooked in their relation to such
fundamental questions as racial susceptibility to tuberculosis. But
over and above all these complex problems of heredity stands the
established fact that, under the influence of infection, an increasing
power of resistance can be acquired by the individual; and that, as
it can be acquired, so, under certain circumstances, can it be lost.
For the practical hygienist, these latter facts are of outstanding importance, because the variations in acquired resistance are known to depend to a considerable extent on environmental factors capable of modification. Amongst these factors, inadequate or unsuitable food, industrial fatigue, physiological stress and a low standard of living play an important part, as also faulty habits, such as alcoholic excess, to which, in its deleterious effect on the health of South African Natives, Mitchell has called attention. It is obvious that these latter factors can only operate in a "tuberculized" population, since they do not cause tuberculosis but merely activate or aggravate existing lesions. As will be shown, however, later in the Report, the Native population of South Africa is already extensively infected and may be regarded as "tuberculized" in the sense of the term as above employed.

Much might be written in amplification of these general considerations as to tuberculosis, but an exhaustive examination of the subject would be out of place in what is merely an introduction to an intensive study of tuberculosis in the South African Native industrial worker.

For fuller details and bibliographies, the reader is referred to the standard works of Calmette, Bushnell, Ziemann, Metchnikoff, Burnet and Tarassevitch, Hamburger, Cobbett and others; and, in regard to the history of the theories of "inherited predisposition," tuberculous diathesis and dyscrasia to the excellent paper of Bullock and Greenwood in which this side of the question is fully treated.
Collection Number: AD1715

SOUTH AFRICAN INSTITUTE OF RACE RELATIONS (SAIRR), 1892-1974

PUBLISHER:
Collection Funder: Atlantic Philanthropies Foundation
Publisher: Historical Papers Research Archive
Location: Johannesburg
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