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Editorial

"As knowledge advances and understanding grows, the prospects are even brighter for the eventual conquest of leprosy. . . . I wish all associated with the world-wide efforts to alleviate the suffering associated with this disease the greatest success in the years ahead."

These words formed part of the message President John F. Kennedy sent to all leprosy workers at the end of 1961. Incidentally, this was the same year in which he predicted that man would set foot on the moon before the end of the decade. As I am writing these lines, on an historical Sunday, 2 men will actually land on the moon within the next 12 hours.

Many things have been accomplished over the last 10 years. In his efforts to control his environment, man increases his knowledge of the world and develops new tools. The moon has been conquered, the genetic code has been unravelled, poliomyelitis is disappearing, rubella becomes preventible, and hearts are re-used. But leprosy at least has not yet been controlled. One of the most ancient scourges of mankind, it is still with us, affecting millions of people the world over. Yet, considerable efforts to fight the disease have been and are being made in many quarters, through national and international bodies, official and voluntary agencies. As a cheap drug, definitely active and easy to administer, the sulphones raised great expectations for controlling leprosy on an out-patient basis. The principles of their action seemed simple, for there is a consensus of opinion that leprosy is caused by *Mycobacterium leprae* and that patients affected with the disease constitute the sole reservoir for the micro-organism; destruction of all *Myco. leprae* through treatment of all the patients should, therefore, put an end to the transmission of leprosy. Throughout the world thousands of leprosy workers are tracking the bacterium by case-finding and early treatment. Provided that enough enthusiasm, enough workers and enough bicycles were available, it looked as though giving every leprosy patient the chance to get his weekly dose of the drug regularly over a number of years would eventually make the disease disappear from the earth.

However, is it too much to say that, unfortunately, the hopes raised 20 years ago, when sulphones were first used on a mass-scale, have not been fulfilled? Although some localized efforts in selected areas or countries have been successful, our aim to control leprosy on a global scale within a decade or two has not been achieved. In some areas, between 3 and 4% of the population are still affected. Still worse, new patients are appearing. Although no precise figures are available, it has been estimated that over the whole world the number of new cases per month runs between 15,000 and 20,000, a figure which most probably exceeds the total number of patients either cured or dead during the same period of time; it is even possible that the balance of cases is "in the red"; and while the population of the world continues to increase this figure is not likely to level off.

In spite of the accumulation of a bulky mass of statistical data, often complete and well collected, there have been few attempts to use them to evaluate the efficacy of large mass campaigns in controlling leprosy. Local experience in some areas is, however, somewhat disturbing. In a pilot study in India, with intensive case-finding, prevalence was found to be reduced by between 33 and 72% after 10 years of mass treatment. Although no threshold has been defined, it is generally admitted that interruption of transmission of the disease requires that a large proportion of the patients must be treated, more particularly those with lepromatous leprosy. Yet, in a relatively small country in Africa, it has been calculated that it would take over 25 years to ensure a progressive treatment coverage of the whole population with the resources at present allocated to leprosy control, and allowing for the comparative importance of this disease in relation to other health problems. In other

African countries where extensive coverage has been achieved for some 15 years, it looks almost as though the greater the number of patients treated and cured, the greater the number of new cases that arise. These are data from areas where relatively regular treatment of the patients may be expected. Every leprosy worker knows by experience, however, how difficult it is to secure regular attendance for treatment and how distressing is the rate of drop-out. The duration of treatment required to suppress the source of infection in any one patient is not known with certainty. Studies conducted in the Congo have shown rates of 50% and 90% of non-infectivity in lepromatous patients regularly treated with dapsone by mouth for $5\frac{1}{2}$ and 9 years respectively. Animal studies with *Myco. leprae* suggest, however, that the bacilli die after a much shorter period of treatment.

Thus, despite all our efforts and the availability of an active drug, the situation is not very bright. It is high time to stop for a moment and think, and ask ourselves: why did we not succeed? or at least why did we not succeed according to our expectations?

There may be many reasons for this, some good and some bad. Lack of money or of roads, poor local administration, shortage of personnel, or low priority for leprosy as compared with other health problems—these are some of the reasons that may be true locally, or for some campaigns, but they cannot explain the lag of leprosy-control activities in the world. We all know full well that compared with other diseases, leprosy is not desperately short of money. Poor roads, weak administration, insufficient personnel and other factors may also be reasons in some places. There is no easy pathway to the moon, but man tries to get there. There may be little or no administration in a locality, but when cholera strikes everything is organized at once; in the case of malaria there may be no personnel, but thousands of workers are soon set to spraying huts or distributing antimalarial drugs on a mass scale in the bush! As far as priority is concerned, this depends on the epidemiological situation in the various countries; in many parts of the world leprosy, be it only for the deformities it causes, is and will remain a high priority. The question that is still very debatable is not so much leprosy itself as perhaps the way leprosy control activities are carried out. These are incidental reasons which may or may not apply locally.

We may, however, wonder whether there are not perhaps more general explanations why leprosy control has not come up to expectations. It might well be that we embarked on these activities without sufficient knowledge of the natural history of the disease. *Mycobacterium leprae* was identified by Hansen around 1873. Almost a century later we are still unable to cultivate the organism *in vitro*. Animal inoculations have persistently failed, and recent achievements in the inoculation of the footpads of mice are not exactly what could be termed a routine technique. All this is well known and has often been repeated. It means, however, that no simple experimental model is available, with the result that neither bioassays, nor screening of drugs, nor studies for the production of a possible vaccine, are yet possible.

It is widely accepted that man is the sole reservoir of the organism. With respect to transmission, nothing is positively established, not even the route of entry. What happens to the mycobacteria once they are inside the human organism and during the months and even years of latency is not known either. The factors governing the host–parasite relation which determine whether an individual develops lepromatous or tuberculoid leprosy are a matter of speculation and conjecture, to say nothing of the factors involved in borderline transformation.

With respect to environmental factors, we known one thing—probably the only thing known for certain in the epidemiology of leprosy—and that is the higher risk of contracting leprosy by home exposure to lepromatous patients, as compared with similar exposure to tuberculoid patients or with

absence of exposure in the home. This is not saying much. To imagine what would be the efficiency of malaria control if we knew nothing about anopheles, or of tuberculosis if we had no access to *in vitro* models for drug screening, we have only to look back to the past. It is true that Snow was able to control cholera in London before the cholera vibrio was known and in the days before the bacteriological era, but this only shows that cholera control is less difficult than leprosy control.

Knowing so little, workers in leprosy quite naturally indulged in great hopes as soon as the sulphones became available. For centuries, with a few notable exceptions, the care of leprosy patients had been conducted in a swamp of ignorance, prejudice, denial, and sometimes selfishness. Suddenly it had become possible to cure the disease; all that seemed to be needed was simply to discover the patients and then treat them regularly with sulphones for a few years. Hard work and dedication would do the rest. Of course, hard work and dedication are still imperatively required. Nothing can be achieved without them. The point is that as man proceeds in the conquest of his environment, be it celestial bodies or diseases or social plagues, hard work and dedication have even more to be supported by knowledge. Columbus could afford to rely on courage, tenacity and chance to discover America, coupled with what seems today very meagre information and few techniques. Astronauts need no less courage and tenacity, and even good luck, but these qualities must be supported by a vast amount of sophisticated knowledge and elaborate planning. It is possible that accomplishments which can be achieved by "know-how" and goodwill alone are on the verge of being exhausted; further conquests, including that of leprosy, will require a great deal more investment in research.

In order to conquer leprosy, we need to know more about the deep mechanisms involved in the life and transmission of the infective organism responsible, the reaction of the human host, and the behaviour of the disease in populations. This means increased knowledge in the fields of microbiology, immunology and epidemiology. Then we shall eventually be able to face leprosy with more powerful weapons. Then efficient logistics for controlling the scourge could be planned, as is the case in the control of tuberculosis or yaws or smallpox.

Examples of potent weapons are either a specific vaccine—and this is speculation—or a fast-acting drug. This implies the cultivation of *Myco. leprae* and a demonstration of animal transmission. How many research workers in the world are involved in developing *in vitro* models at the moment? Only about a dozen and a half or so, I would guess. In the meantime, we have to do our best and continue with the present methods of sulphone mass-treatment. As we wait for new developments in research, this is our present task and the only thing we *can* do. However, in order to increase efficiency, control activities should be more completely assessed. An epidemiological evaluation of the present methods of control is badly needed. A business approach, and recourse to the methods used in economics, should be considered: for instance, a study of why we do not succeed in making patients accept treatment. Only so will it be possible to plan leprosy control activities efficiently, according to the needs and available resources, and with due consideration for all the other problems existing in the same population. And let us mean by planning the setting-up of priorities and the choice of optimal strategies in a concrete way, geared to the real situations, and not this kind of society game and self-deluding jargon which at times is called "planning".

On the other hand, research should be accorded a much higher priority in leprosy. If research does not provide us with new methods for controlling the disease, then whatever the amount of work, dedication, and money we put into control activities, we run the risk in 20 years from now of seeing not 15 million patients but perhaps twice as many. At the moment, the proportion of leprosy funds used for research is unreasonably low, especially when one considers

that one simple discovery (for example, in the field of microbiology) could change the face of the disease in the world and mean a cure for millions. More funds for research are thus positively needed; and this would be a safe choice, since it is known where the attack should be made and which type of research should be conducted to obtain a return considerably exceeding the sum invested.

Decision-makers concerned with the allocation of funds face a great responsibility. Either they will promote research, or run the risk that for many years to come efforts will be nullified and hopes deceived. More research is needed if the present dedication and activity of many workers are to yield their full results. Let us therefore not permit leprosy to play us its last trick by deceiving us into remaining romantic and thinking that action can replace knowledge.

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Ceylon

Plans are afoot for the creation of a Leprosy Association in Ceylon. The leprosy situation in Ceylon has not received much publicity of late, and the WHO 1963 estimate of 10,300 cases must be regarded as conservative.

Profiting from their experience with the Ceylon National Association for the Prevention of Tuberculosis, several prominent citizens are eager to arouse interest in the problem of leprosy in the island and to mobilize men of goodwill to action. It is more than likely that a determined and persistent case-finding campaign would reveal a far greater number of leprosy sufferers than is suspected at present.

Nepal

Following the recent successful leprosy seminar sponsored jointly by the Government of His Majesty the King of Nepal and the WHO, held in Kathmandu, 17 to 22 March, 1969, the Nepal Leprosy Relief Organization has been founded, with Her Royal Highness, the eldest daughter of His Majesty, as Chairman, and Her Royal Highness Princess Princep Shah as one of the most influential and active members.

Since Nepal opened its borders to the scientific and medical West, tremendous efforts have been made to telescope centuries of progress into a few short years. Much remains to be done, especially in the matter of leprosy, and mediaeval laws need to be revoked if leprosy sufferers are to feel free to offer themselves for diagnosis and treatment without fear of compulsory segregation. Despite the enormous difficulties of communication in such a mountainous country possessing few roads, leprosy could be tackled together with the other endemic diseases.

Pakistan

The Pakistan Leprosy Relief Association at its Annual General Meeting held in Karachi, with the Divisional Commissioner in the chair, renewed its promise to provide increased aid, both social and medical, to leprosy patients, and to encourage their rehabilitation. A Rehabilitation Centre and Workshop are to be constructed near the Manghopir Leprosy Hospital. Much more could be done if more money were available from donations. It is to be hoped that

a determined and concerted attack can be made on the problem of leprosy in Pakistan, especially East Pakistan, and that commendable efforts for the surgical treatment and rehabilitation of deformed leprosy patients may not divert attention from the greater task of discovering and treating leprosy before it has led to deformity. Education of the public should be one of the principal activities of the Pakistan Leprosy Relief Association. The whole-hearted co-operation of the voluntary agencies in these matters is of paramount importance.

Clofazimine (Lamprene, Geigy)

The rimino-phenazine compound that has from time to time figured in articles in *Leprosy Review* under the code number B 663 or G 30320 (Geigy) is now marketed under the proprietary name "Lamprene" Geigy, and the approved name "clofazimine". It is presented in soft gelatin capsules each containing 100 mg of active ingredient in a micronized form, suspended in an oil/wax base.

The initial trials of the drug in leprosy were reported in *Leprosy Review* by Browne and Hogerzeil in 1962, and numerous publications confirming the early opinions of its value in leprosy have subsequently appeared in this and many other journals. The suspected anti-inflammatory activity of the drug, when given in adequate doses, has been the subject of much investigation. A summary of the findings of a Working Party held in London in September, 1968, was published in *Leprosy Review* (1969) **40**, 1, 21-47.

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Rural Leprosy Control Problems in Biafra and Central India: A Comparison*

T. F. DAVEY, C.B.E.

INTRODUCTION

It is not given to many leprologists, after long experience in one continent, to move to another and there become directly involved in developing leprosy control work at field level. Such is the experience of the writer, and after 18 months at Dichpalli, in the Telengana area of Andhra Pradesh, it is interesting to compare leprosy control problems here with those encountered in the territory around Uzuakoli, Biafra (E. Nigeria).

This is of more than academic interest, for leprosy is a disease of major importance both in India and in Nigeria. Substantial Government leprosy control programmes were introduced in both countries—in Nigeria in 1945 and in India in 1953. It is probably no accident that in basic approach the two programmes were very similar. Where personnel are concerned there appears in general to be little difference in education and training. In E. Nigeria a major reduction in the prevalence of leprosy occurred between 1940 and 1960, well attested by experienced observers (Davey *et al.*, 1956; Davey, 1957). How far is this relevant to the situation in India? In this paper this question is examined in relation to the situation at ground level, as it confronts the paramedical worker and doctor in a rural area of Nizamabad District, with a population of 170,000, resembling in population density and means of access many similar areas in Biafra.

The basic objectives of leprosy control are the same everywhere. At the risk of tedium they may be summarized as follows:

(1) *Case finding:* the aim being to discover 100% of cases actually or potentially infective (bacteriologically positive by routine methods of examination), by a continuous process.

(2) *Effective treatment* of all cases, the first aim being to render all bacteriologically-positive cases negative by appropriate chemotherapy; the second, to render 100% of all cases inactive, with patients fully rehabilitated into society.

(3) *The protection of contacts*, the aim being to reduce the number of new infections to zero, first by the treatment of established cases, but also by such ancillary methods as DDS prophylaxis, BCG inoculation, and the minimizing of contact between infective patients and those living in close proximity to them.

The objectives are clear. The discovery and application of ways to make them attainable is a very different matter. Even granted a well organized and internationally approved plan of operation by the Health Services, local factors in the last resort determine what can and what cannot be done. These are considered here under 3 headings: immunological environment, sociological determinants, and economic factors.

IMMUNOLOGICAL ENVIRONMENT

The entire range of clinical manifestations of leprosy seen in Nigeria has been encountered also at Dichpalli. There is no evidence for any important differences in the intrinsic nature of the leprosy seen in the two areas. At the same time, clinical variations occur which have an immediate bearing on leprosy control.

Leprosy in E. Nigeria was characterized by a high prevalence, often exceeding 40 per mile, with a low proportion of lepromatous cases

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(around 10% of the total), and a high proportion of mild, self-limiting infections (including indeterminate, maculo-anaesthetic, and minor tuberculoid types) with little tendency to break down to more serious forms of the disease in identifiable circumstances. In contrast, in this part of India the total prevalence found in intensive surveys is lower, varying between 5.0 and 40.0 per mile, leprosy following the usual focal variation in prevalence between one village and another. The apparent lower prevalence is accompanied by a lepromatous case-type index of 20 to 25%, about double what it was in Nigeria. It should be noted, however, that whereas in surveys in Nigeria a population coverage of more than 90% was usual, in India we find that only by patient sustained effort can a figure higher than 70% be achieved. The missing 30% are certain to include a disproportionate number of leprosy infections, and it may very well be that there is little difference between the two areas in the actual prevalence of lepromatous leprosy.

At the same time, we find in India a decidedly higher prevalence than in Nigeria of unstable intermediate varieties of the disease, with a marked tendency to degenerate towards the lepromatous end of the spectrum. It is clear that many cases of lepromatous leprosy do not originate as such, but are the end result of this process of degeneration. This explains the frequent occurrence in lepromatous cases of severe nerve involvement with deformity, an infrequent finding in Nigeria.

Complex epidemiological and immunological factors must underlie this instability of leprosy in central India, though other endemic diseases and nutritional factors doubtless have a bearing on it. The subject will not be considered further here. For our purposes it suffices to note that leprosy in this Indian situation tends to be a more serious disease than in Nigeria, being generally less clear cut, more neurologically orientated, less predictable because more unstable, more productive of complications, and more prone to the various forms of reaction. On medical grounds, leprosy forces itself upon the attention of the Indian villager to a greater degree than was the case in E. Nigeria and thus fear of the disease is accentuated. Skilled medical supervision, important in Nigeria, is even more important in India, and calls for special attention in leprosy control planning.

SOCIOLOGICAL DETERMINANTS

The importance of careful medical and health planning is obvious in leprosy control, as indeed in the control of other communicable diseases. In India one is fortunate to be living in a country where a great deal of thought has been given to the planning of leprosy control and, with the economic resources available, it is difficult to envisage ways in which the National Leprosy Control Programme could have been bettered. In Nigeria, planning was more empirical, but when the need was evident, financial resources were provided by the Government to build up and extend on a national scale the plan of campaign already developed experimentally by voluntary agencies.

Leprosy is, however, unique in the importance of sociological factors in its control. More than one leprosy control programme has foundered through failure to appreciate this. The medical and health programme can only function if the people will accept it and co-operate in it. In the last resort the programme has to be determined by the sociological situation. From this standpoint there is considerable divergence between the two areas with which we are concerned. Leprosy is dreaded in both, but its control in E. Nigeria was a much simpler problem than is the case in India.

Social solidarity

Recent historical events have made plain to the world one of the remarkable features of Igbo Society in Biafra, namely the deep sense of community solidarity which is a national characteristic. At village level this means that family loyalty is part of a wider loyalty to the community as a whole. The relation between families is a blood relationship, all tracing their descent from a common ancestral family and being therefore conscious of an underlying

unity which is never obliterated by temporary family differences. This feeling often extends to embrace whole groups of villages. Where leprosy control was concerned this provided a highly favourable situation. While much prejudice against leprosy had to be broken down, community solidarity provided the basis for rapid progress. If heads of families in council decided to co-operate in a programme proposed to them, public opinion was thereby determined and united action by the village or group of villages as a whole was expected to follow. It was this that underlay the success of intensive surveys. In the same way, because of their sense of communal solidarity, a high proportion of patients came forward for treatment without a great deal of persuasion.

In this part of India the situation is quite different. Cohesion in the village community is created, not by blood relationship, but by the functional needs of the community for services from one group or another. Unity, as seen in Biafra, does not exist. Basic loyalties are given, not to the village as such, but to the family and group within the village. Community solidarity has given place to family and craft solidarity, a situation in line with that applying to wide areas of the world outside the continent of Africa. This social situation is altogether less propitious for leprosy control than that prevailing in Biafra, presenting leprosy control workers in India with problems quite outside the range of experience of their Nigerian counterpart. A few illustrations will suffice:

(1) United action for leprosy control is rarely achieved, because the motive of ridding the whole village of leprosy has little appeal. The occasional keen village head can do a lot to help, but is liable to face opposition from some influential rival family.

(2) In such a society it is of the greatest importance to every family to preserve its place in the hierarchy of status and influence. Leprosy is a grave threat to this and there is therefore every inducement to conceal the disease within the family as long as possible. Attendance at a leprosy clinic immediately stigmatizes the sufferer and his family. As a consequence regular attendance at clinics tends to be limited to the hard core of obvious cases, whose condition is already plain to all. In the same way, there is no enthusiasm for survey work, rather a grudging compliance with the wishes of the health authorities which falls short of the co-operation so necessary for the effective examination of all members of the household.

(3) The primary objective of people showing early signs of leprosy is all too often not the radical cure of the infection, but the covering up of its visible manifestations by as secret a method as possible. Most patients have recourse to practitioners of the traditional methods of medicine, whose medication often contains DDS in disguise. There is widespread taking of DDS without skilled medical control.

(4) The acceptability of the leprosy worker himself depends in no small degree on his own social background. Unless he comes from one of the higher strata, important sections of the village may be closed to him and he may even have difficulty in finding accommodation when his work demands his staying overnight.

If these experiences are related to the 3 basic objectives in leprosy control it immediately becomes apparent how profoundly the social framework affects the carrying out of leprosy control. Unless the importance of this is recognized, and methodology adapted to it, our objectives can remain an unattainable ideal.

Dynamism in outlook

In Nigeria, leprosy control was encouraged by the dynamic mood of the people. The country was opening up for the first time in history and there was a healthy readiness to accept change and development. In a number of places the leprosy workers were themselves the agents of this, and were the more acceptable because of it. That situation has no real counterpart in this area of India. Here, the whole process of development started earlier, and moves at a slower tempo. Hitherto, leprosy workers have had no opportunity to be pioneers in it.

Religious ideas

In Nigeria traditional religious ideas did not favour participation by the community in leprosy control. Leprosy contaminated the sufferer and any who took his part. In practice, however, the effect of this was limited. Where the prevalence of leprosy exceeded about 30 per mile, as it did in many places, the disease tended to create an anxiety in the community which had greater potency towards accepting leprosy control measures than religious ideas had in the opposite direction. Here in India, theology may be different, but its practical outcome resembles that in Nigeria. With the general prevalence of leprosy frequently between 10 and 20 per mile, the impact of the disease on the community does not reach the point where anxiety is created. As everywhere else in the world, religious ideas may profoundly affect the readiness of the individual patient to co-operate in leprosy control, but community attitudes are more important. In this connection brief reference may be made to an important difference between Nigerian and Indian village society where physical examination is concerned, particularly of women. Through the strictures determined by society in India, it seems inevitable that some early infections in women must remain undetected. This problem was far less important in Nigeria.

ECONOMIC FACTORS

In E. Nigeria the economic situation had little if any direct influence on leprosy control methods. It was always possible for the peasant farmer or his wife to attend a weekly treatment clinic if they so desired. With the customary division of village occupations during the week it was usually possible to choose a day when everyone could be at home without much inconvenience, and thus mass survey work was facilitated.

In this area of India the seasons are not so kind and large sections of the community, with little or no land of their own, live at subsistence level, dependent on precarious daily earnings for the bare essentials of life. In such circumstances food has to take priority over the treatment of a chronic disease. Thus, for many patients, regular attendance at a weekly treatment clinic held during normal working hours is out of the question, and cannot be expected. The only possibility for patients to come together to a centre would mean completing all treatment before 9 a.m. Mass survey work meets the same basic problem.

DISCUSSION AND CONCLUSIONS

These facts highlight certain very important points where leprosy control planning is concerned.

The important of sociological study

While the social problems surrounding leprosy have been recognized for decades, it is still possible for them to be given insufficient weight in medical and health planning. Every leprosy planning committee needs the advice of sociologists as well as that of doctors, for in the long run it is the social factors which determine success or failure.

The need for adaptability in leprosy control method

Organization may demand uniformity of method. The local social and economic situation will not bend itself to suit the convenience of the leprosy worker. Indeed, it is the social and economic factors which set the limits within which he has to work. It is futile to hold treatment clinics at places and times convenient to the leprosy workers, if patients cannot or will not attend them. The primary objective is to get into the homes of patients, and our methods must be adapted to this end.

One helpful factor in India is the serious care which many patients display in carrying out meticulously the advice of the doctor. In such a situation it becomes possible to give patients DDS tablets at monthly or even 3-monthly intervals, and experience has shown that many will taken them regularly and correctly.

Social conditions have induced us in one area, where we have responsibility for leprosy control, to abandon leprosy clinics with failing

attendance for an experimental period, and instead to aim at visiting every patient regularly in his home at least once every 3 months, replenishing his supply of DDS and submitting household contacts to regular examination, all the time maintaining contact with base hospital and physiotherapy services. Time formerly spent on visiting absentees is thus rationalized, and its frustration has gone. For the theoretical planner, such a technique invites condemnation. In practice it meets the case better than any possible alternative. It is quoted simply as an example of the need for experimentation and adaptation in our approach to the people.

The need for a high standard in patient care

In the face of the social and economic strictures with which the patient has to contend, it is not sufficient to go to him armed with nothing more than DDS. One element in success in Nigeria was the range of skilled services which were offered to patients, treatment of ulcers, medicine for other complaints, hospital care, physiotherapy, legal aid, and welfare work. These all helped towards co-operation and created relationships of trust between patient and worker which were really important. We were fortunate to be able to offer these things. If they mattered in a situation unusually propitious, they matter still more where circumstances are difficult. This pinpoints the need for the training of paramedical workers in relevant aspects of general medicine, for skilled direct supervision of paramedical workers, and the importance of providing hospital and other necessary facilities for patients.

The importance of integrating leprosy with general health services

So many of the problems confronting the leprosy worker derive from the "separateness" with which leprosy is regarded. While a separate organization for leprosy seems inevitable if there is to be any progress, the very existence of special workers and special facilities emphasizes in the mind of the general public that here is a disease of peculiar seriousness. Has not the time arrived for a re-orientation in our thinking, designed to give the whole range of general health workers, from specialist to junior village worker, an understanding of leprosy and a knowledge of it that will make possible everywhere the inclusion of leprosy sufferers within the general medical and health services as a normal and ordinary procedure? An intensive build-up in the leprosy education of professional workers is as important as is health education of the general public. Only as leprosy is "normalized" in this way will leprosy lose its terrors and the patient his mental suffering. In Nepal it is proposed to integrate leprosy into the general health services from the start. Other countries will look with deep interest at what happens there.

Comparisons are not always odious. If in this case they indicate the favourable circumstances in which leprosy workers operated in E. Nigeria, it was the dedication of many of these workers which achieved quick results. Wardekar (1968) has shown that the same dedication can achieve success in the more difficult situation which prevails in many places, provided it is allied with patience, ingenuity, and adaptability.

SUMMARY

A comparison between leprosy control problems in Eastern Nigeria and in Central India reveals the determining influence which social factors have in deciding the success or failure of a leprosy control programme. Stress is laid on the need for social studies, adaptability in applying methodology to local conditions, and also the need for high-class patient care. The importance of integrating leprosy work with the general health services is also

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Leprosy Control Work at Polambakkam and its Critical Appraisal*

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INTRODUCTION

Polambakkam Leprosy Centre was started by Dr. R. G. Cochrane in 1937. After a pause in the activities for a few years, it was then handed over to the Belgian Foundation for Leprosy in 1955 and Dr. Hemerijckx gave it a new life.

It serves an area of 6000 sq. km (2300 sq. miles) with a population of 650,000 inhabitants, 53 roadside clinics (Mobile Treatment Units) covering the Control Area. A total of 15,960 leprosy patients are under treatment, while a further 10,790 patients are under observation after discharge from treatment. Priority is given to field work. A hospitalization ward of 60 beds is available at headquarters, with departments of surgery, physiotherapy, a laboratory and a workshop; a training centre for paramedical workers is attached. In addition, there is a social service and also a home for destitutes, which function independently under a private organization, "The Damien Foundation (Belgium)".

FIGURES

For the purpose of preliminary assessment, we are studying the situation of 12 units only. In these units treatment was started in 1955 and the survey in 1957. In the area covered the population, according to the Government of India Census in 1951, was 124,134; at the time of our first survey it was 138,817, and today, after repeated surveys, it is 152,858. The Centre deals with a stable population, few people having migrated permanently outside the control area.

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(a) *Number of patients* (see Table 1). Of the total of 8761 registered patients, 6844 are under study today, and of these, one-third show some active lesions while half of them have been discharged from treatment. The others are still under treatment for confirmation of inactivity or at the patients' request. (Criteria of activity: positive finding on bacteriological examination, erythema, tenderness in nerves, or appearance of new lesions.) Of the patients who have had more than 12 years of treatment, 18.5% (444 out of 2399) are still showing signs of activity of the disease. The number of new cases did not decrease after 1962, but has remained nearly constant around 320 per year, the average population being about 145,000.

(b) *Lepromatous patients* (see Table 2). Of the total of 994 registered lepromatous patients, 634 are living in today, and of the 478 of them who could be bacteriologically examined in 1968 74.8% (356) are negative (see Table 3).

Taking into account only lepromatous cases admitted in 1955-56, we see that 53 are still positive out of 308 who were examined in 1968. Analysis of the attendance shows that only 8 had a cumulative regularity of attendance of more than 75%; 4 have been negative for 4 years or more and then became positive again, while the other 4 have been positive throughout these 13 years, 3 of them because of continuous reaction.

(c) *Mode of detection.* More than 75% of the patients in these units came voluntarily for treatment, 7% were detected at the time of examination of healthy contacts and 15% during a mass survey. A study of these figures by type shows that 90% of the lepromatous patients

TABLE 1

Status of the patients at the end of 1968 according to the yearly registration from 1955 to 1968

Year of registration	*Cases registered**				*Active cases under treatment*				*Inactive cases still under treatment*	*Cases released from control area*	*Cases left control area*	*Cases died*
	Total	*L*	*N?L*	*N*	*Total*	*L*	*N?L*	*N*				
1955	2044	483	116	1445	299	64	42	193	383	829	275	258
1956	1194	149	106	939	145	25	28	92	101	642	210	96
1957	1002	88	94	820	111	17	25	69	84	565	198	44
1958	754	46	51	657	90	5	14	71	69	421	121	53
1959	5 11	40	55	416	89	9	20	60	53	245	104	20
1960	378	40	49	289	94	11	21	62	39	149	76	20
1961	569	33	63	473	113	10	19	84	73	239	119	25
1962	375	18	36	321	108	6	23	79	43	142	67	15
1963	307	20	33	254	99	4	19	76	51	97	49	11
1964	347	18	48	281	151	7	29	115	69	73	45	9
1965	314	16	38	260	162	10	23	129	49	57	35	11
1966	277	11	26	240	186	7	21	158	53	13	22	3
1967	371	21	34	316	314	17	32	265	25	5	25	2
1968	318	11	31	276	312	11	31	270	1	1	3	1
Total	8761	994	780	6987	2273	203	347	1723	1093	3478	1349	568

* L, Lepromatous; N, non-lepromatous; N?L, non-lepromatous ?

TABLE 2

Bacteriological status of lepromatous patients at the end of 1968 according to the yearly registration from 1955-68

Year	*Total no. of lepromatous cases registered*	*Existing no. of lepromatous cases after elimination*	+6 +5 +4 +3	+2 +1 +0.B	*Negative*	*Skin smears not taken*
1955	483	316	12	20	204	80
1956	149	93	8	13	51	21
1957	88	49	3	3	34	9
1958	46	18	1	2	11	4
1959	40	28	1	5	13	9
1960	40	21	3	6	9	3
1961	33	23	3	2	9	9
1962	18	10	–	3	5	2
1963	20	13	1	3	7	2
1964	18	13	1	3	3	6
1965	16	12	3	3	3	3
1966	11	9	–	2	3	4
1967	21	18	2	8	4	4
1968	11	11*	4	7	–	–
Total	994	634	42	80	356	156

*Note that these 11 lepromatous cases have been released from control.

TABLE 3

Cumulative regularity of attendance of lepromatous cases examined bacteriologically at the end of 1968 according to the year of registration

Year of registration	*High positivity (4+, 5+, 6+)*			*Low positivity (3+, 2+, 1+, OB)*			*Negative*			
	75–100%	50–74%	0–49%	75–100%	50–74%	0–49%	75–100%	50–74%	0–49%	*Total*
1955	1	5	6	5	9	6	108	68	28	236
1956	1	1	6	1	2	10	25	15	11	72
After 1956	9	6	7	10	18	17	35	44	22	168

TABLE 4

Type	*First Survey*	*Second Survey*					*Third Survey*				
	Total	*Total*	*Static population Previously examined*	*Static population Not examined*	*Immigrants*	*Births*	*Total*	*Static population Previously examined*	*Static population Not examined*	*Immigrants*	*Births*
Lepromatous	46	11	3	7	1	–	–	–	–	–	–
Non-lepromatous	851	269	118	110	25	16	56	37	11	5	3
Dimorphous (N?L)	52	11	5	4	2	–	3	2	1	–	–

registered voluntarily; 632 out of the total number of 994 lepromatous patients registered in 1955-56 before any survey had been carried out. During the first survey 46 cases of lepromatous disease were detected and during the second survey 11 cases, while no lepromatous case was detected during the third survey (see Table 4). The examination of apparently healthy contacts brought 14 lepromatous patients to treatment and the rest (291) came voluntarily for treatment between 2 surveys. It is also to be noted that the incidence of deformities (anaesthesia alone excluded) is twice as great in the voluntary patients as in the others (18.5% against 8.3%).

TABLE 5

Type	*Discharge patients*	*Patients with relapse*	%
Lepromatous	13	2	Too low figure
Non-lepromatous	3562	224	6.2
Dimorphous (N?L)	136	7	5.1
Total	3711	233	

(d) *Relapses* (see Table 5). In 3711 patients treatment could be stopped because the disease was found to be arrested, but 233 (6.2%) showed signs of reactivity of the disease and had to be readmitted for treatment. The 7 dimorphous (N?L) and the 2 lepromatous patients who were discharged from treatment presented the same type at the time of their relapse. Out of the 224 non-lepromatous patients 205 remained non-lepromatous at the time of relapse, 11 showed dimorphous features and 8 lepromatous features. The percentage of relapse (6.2%) is higher than that found in previous studies (Kandaswamy, 1968 (4.3%); Vellut, 1962 (3.4%)).

INTERPRETATIONS

For the last 20 years DDS has been extensively used in mobile units for the treatment of leprosy in order to control the disease. It is time to evaluate scientifically the methods and results of these Centres. This paper is a small attempt in that line for Polambakkam Centre.

Incidence

The number of new cases per year has not decreased, even after several years of work, and incidence remains around 2.2 per 1000. A possible explanation is that in an area where constant leprosy education and survey are carried on, all really early cases are detected with more and more expertise by medical and paramedical personnel. For instance, among the new cases registered in 1963 and later, 725 (37%) were non-lepromatous patients with a single macule and no deformity. Many of the school-children fall in that category. Another explanation, as we shall see later, is the persistence of a few positive cases which continue to keep the infection risks high.

Results of treatment

These results are extremely slow in appearing. Even after 12 years of treatment, 20% of the registered patients still show signs of active lesions, as do 14% of the lepromatous cases (89/632), 31.5% of the dimorphous (N?L) cases (70/222), and 11.1% of the non-lepromatous (285/2384). It is too early to say if this overall slowness in achieving results is due to irregularity in treatment or to inadequate dosage of DDS. At least it has shown the importance of regular attendance for the remaining lepromatous patients (see Table 3).

The problem of regularity in treatment remains a serious one in relation to a disease which is, in general, not painful, and does not affect the general state of health, and it is the more serious when treatment has to be continued for many years and sometimes for life. The heavy case-load per paramedical worker and the very extensive area covered add difficulties to obtaining a good attendance.

Mode of detection

It is clear from our attendance figures that the population is highly "leprosy conscious", for the great majority of patients came spontaneously for treatment. Efforts should therefore be concentrated on fostering motivation to come early and regularly for treatment rather than in making repeated surveys of an extensive area, leaving many people unexamined (see Table 4). A first mass survey is necessary to determine the size of the population being dealt with, to know if during the following years new cases have been previously examined elsewhere or if they are immigrants or not. It is also a means of educating the public and ensuring local collaboration. Patients detected by survey are usually irregular attenders because they have no personal motivation and because most of them have very benign disease and, as such, it can be said that a mass survey does not contribute directly to control of the disease.

Relapses

Many relapses are due to the fact that, at the time of admission in 1955-56, diagnosis of the type of leprosy could not always be accurately determined; in 1½ years we registered more than 12,000 cases at road-side clinics. When all the cases were reviewed later, many lesions had disappeared and we might have discharged from treatment as non-lepromatous, patients who had in fact dimorphous characteristics, and vice versa. Another reason is the fact that until recently we did not have strict criteria for stopping treatment, so it had to be left to the medical officers' appreciation to judge if and when a patient could be discharged. We were not insisting on a definite period of inactivity for consolidation. We have decided recently that there should be no discharge for borderline and lepromatous cases, discharge only after 5 years of inactivity for indeterminate and polyneuritic cases, discharge after 1½ years of inactivity for tuberculoid and maculo-anaesthetic cases. Out of the 233 cases of relapse a definite period of inactivity was noted for only 50. Many of the others were patients who had been absent for a long period and whose lesions seemed completely arrested when examined after that long absence.

OVERALL APPRECIATION OF THE WORKING OF THE CENTRE

Positive aspects

(1) The Centre has developed in accordance with the needs of the patients as persons.

Priority has always been given to field work. Care has been taken that all possible facilities are available at the road-side clinics, such as medical treatment, care of ulcers, with P.O.P. immobilization if necessary, shoe measurements, and taking of skin smears. Continuous training of the staff has been the next priority. The development of headquarters to make it a complete Centre with facilities for hospitalization, surgery, physiotherapy, histopathology and an administrative unit, came later on, when patients' needs arose; what is the use of simply making a patient non-infective if he is mutilated? This orientation towards the patients' needs has the main advantage of not disrupting their lives and so avoiding rehabilitation problems. It has, however, to be kept in mind that priorities may have to be changed with the long duration of activities.

(2) The location of the Centre was a particularly happy one in many aspects, and for the following reasons: (a) Dr. R. G. Cochrane had already prepared the ground and the public was really leprosy-conscious; there were a few cottages and work could be started immediately without waiting for buildings. (b) The population of the control area is relatively stable and the prevalence of leprosy is high. (c) Local collaboration has always been outstanding, and this is very important for a chronic disease with public health aspects needing participation of the public; also there is not much prejudice against leprosy as a disease. (d) Most of the paramedical and even medical staff came from places in or near the area and this assured a stability and reliability of personnel which again is a very important factor in a long-standing disease. (e) The political situation is stable and permits smooth working. (f) The proximity of other Leprosy Centres has in practice delimited our Control Area and allowed us to refer "outside control area patients" to other institutions, so avoiding the rush of too many patients to already crowded road-side clinics. Stress has been put on the follow-up of patients, their families and population migration within the control area. (g) The roads are good, so that every month the 2 vans of the Centre can cover 2332 km (1460 miles) for treatment only. Lastly (h), the climate is such that buildings for mobile units are not necessary, as there is very little rain.

(3) But what is probably the most outstanding characteristic was the happy collaboration between the foreign agency (The Belgian Foundation for Leprosy) which gave the impetus to start the Centre, the personnel, and the finances to establish it on a sound basis and to run it for 5 years and the Madras State Government which took charge of it after the 5 years. Because of this the work could continue on the same lines, and the staff remained the same and was integrated into Government service. The Centre is treated as a private organization with a 100% grant from the Government; this assures the recurring expenses, which come to about 14 rupees per patient per year. This supple structure allowed the Centre to receive very substantial contributions from abroad at a time of distress (the cyclone in November, 1966) so that we could build solid terraced buildings for hospital, staff quarters, and offices after more than 10 years of work.

Negative aspects

We may distinguish between the limitations and the failures:

Limitations. Because of the pressure exercised by patients from over the whole control area who were in a hurry for treatment, our programme started at explosive speed. This caused the examination notes on patients at the time of admission to be sometimes incomplete in description (e.g., note of presence or absence of deformities) and in type precision. The fact that only one of us had experience in leprosy aggravated the situation. When all the cases were reviewed later many of the lesions had faded and we could not say accurately if deformities had occurred before or after starting treatment. This has been a handicap in evaluating the results of treatment in respect of the patients admitted during the years 1955 and 1956.

Another limitation is the set-up itself of the

mobile clinics covering an extensive area with a high leprosy prevalence where a large number of patients have to be treated during a limited number of hours and when the tropical sun and wind combine sometimes to make the quietest doctor or paramedical worker "wild". Personal attention cannot always be given in these circumstances and this sometimes leaves the patients with a feeling of dissatisfaction with what appears to be "mass treatment". There is also the impossibility of carrying out detailed study or drug trials and if patients do not attend the clinic regularly there is no control on the way they take or do not take their medicine.

The very limited attention given to "clerical work" (detailed proforma for everything) may be considered as a limitation due to other priorities, mainly medical, or as a failure in planning. The establishment of an administrative unit was made 5 years after the beginning of the treatment campaign and is still managed with a minimum of personnel. Also the paramedical personnel was not trained to prepare detailed statistics.

Failures. The most obvious one has been the failure to get the medical officers at the general dispensaries situated within the control area to take an active part in the programme. It was tried, but did not succeed except in the case of 2 medical officers who at least have shown a continuous interest.

In an attempt to study the trend of leprosy in the area a lot of time was allotted to survey and re-survey of large numbers of the population at a good speed, but in the event the percentage of examinations (between 6.5 and 7.5%) was too low to give a significant result.

The Health Education part of the programme has not been pushed vigorously enough to ensure that patients would be motivated to come regularly for treatment, or that persons declared suspect of having leprosy by a paramedical worker at survey were willing to come for medical examination. This may have been due to the fact that the paramedical workers' load of population and patients is too heavy.

Solutions

It may be necessary to make a temporary change in our priorities, spending more time on the collection of data, and slowing down the pace of field work (healthy contact examination and survey). For this, the help of specialists in Public Health is necessary to advise and select which are the important data. Instead of re-surveying the general population for a fourth or fifth time we decided to concentrate on 12 villages, with a total population of 11,000 inhabitants and situated in different zones of the area and where treatment was first started in 1955. There, for the last 3 years, we have examined yearly more than 90% of the population. This may be considered as a sample showing the trend of leprosy in the area. We also consider that more time could be spent in health education about leprosy, both of the general public and in schools, and this might help in individual motivation of patients who are irregular in treatment.

REMAINING PROBLEMS

The following problems are not peculiar to Polambakkam Centre but have often been mentioned by many medical officers in charge of control units.

(1) Do we include the patient with an early, single, non-lepromatous macule without nerve involvement, which often heals by itself, in the common pool of leprosy patients along with lepromatous patients, borderline patients, and mutilated patients? Have such cases the same significance as far as public health is concerned? Are they not the reason why the incidence of leprosy does not decrease? Can they not be put at the same level as a tuberculosis primo-infection?

(2) Criteria of activity and discharge from treatment have to be fixed in some uniform way. What is the meaning of some acid-fast bacilli found in the superficial nerves of a few patients whose leprosy has been clinically arrested for many years? How long should we keep the patients under observation and "on register" after stopping treatment?

(3) The presence of a marginal number of positive cases is really a threat to the success of any leprosy control programme. Are such cases the result of resistance to DDS, or of inadequate dosage, or irregularity in treatment, or perhaps to malabsorption of DDS?

CONCLUSIONS

The prognosis in leprosy is a function of early, regular, and adequate treatment. This remains the fundamental truth of any leprosy work, and to succeed it must be accompanied by education and survey. Leprologists have a great need of help by specialists in other disciplines, not only in the field of research, to find a way to prevent leprosy (genetics, microbiology, immunology . . .), but also to stop its spread (epidemiology) and to help the clinical worker, mainly in ophthalmology and neurology. We see daily how orthopaedic surgeons have changed the prospects for many patients by the prevention of deformities and physical rehabilitation.

SUMMARY

This study of the situation of leprosy in an area where active control work has been in progress for 13 years shows that the incidence of the disease remains at 2 per 1000, but among the new cases many are non-lepromatous patients with only a single macule. A small number of cases remain bacteriologically positive even after 12 years of regular treatment. Both the positive and negative aspects of the scheme have been studied.

ACKNOWLEDGEMENTS

I wish to express my gratitude to the late Dr. Fr. Hemerijckx, who continually guided my steps in our leprosy control programme, to the Health Authorities of the Tamil Nadu Government and especially to Dr. V. Ekambaram, State Leprosy Officer, for their collaboration, and to the whole staff for their help. Special thanks are due to the paramedical assessment team who for the last 4 months have been collecting data day and night, and to the Pogiri staff who have helped us in the selection of data.

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Results after Five Years of Intensive Leprosy Control Work in a Highly Endemic Area*

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INTRODUCTION

The Leprosy Control Project sponsored by the Danish Save the Children Organization was started in 1962 in 2 highly endemic districts, Srikakulam and Visakhapatnam. The project is assisted by the United Nations Children's Fund (UNICEF) and the Governments of Andhra Pradesh and India, and receives technical guidance from the World Health Organization (WHO). It expanded gradually till it reached its present maximum size in 1966, and now covers an area of 2200 sq. miles (5630 sq. km) and a population of 15 lakhs (1,500,000). At present, 33,224 patients are under treatment, of whom 29,675 are living inside the project area, and 3549 come from outside it.

The primary aim of the project is to control leprosy in this part of Andhra Pradesh by treating all existing patients, thus reducing the number of circulating bacilli, and so check the spread of the disease in the community.

ORGANIZATIONAL SET-UP

There are 70 units in the project, with one clinic in each of them. The units are grouped into 5 zones, each headed by a zonal supervisor, assisted usually by 2 senior leprosy auxiliary workers. Care is taken to maintain the optimum ratio of one member of the supervisory staff for every 5 auxiliary workers.

One leprosy auxiliary worker is in charge of one unit and is responsible for case-finding and treatment of all patients in a population of about 20,000, living in a 3 or 4 mile (5 to $6\frac{1}{4}$ km) radius. The average number of "inside-area" patients treated in each clinic is 413. The clinics are held once a week and are planned in such a way that all are attended in rotation by one of the members of the zonal supervisory staff. He supervises the treatment, takes all important decisions, and after the clinic is over assists the worker in preparing his programme for the ensuing week.

The main functions of the leprosy auxiliary worker are health education of the public, contact examination, school surveys, and tracing of absentees in the villages of his unit. The zonal supervisor, though continuously guided by the senior supervisory staff from the Centre, is fully responsible for the planning and implementation of all activities going on in his zone, in close co-operation with his 2 senior leprosy auxiliary workers.

At the Centre there is a hospital with 50 beds and physiotherapy and laboratory facilities. Patients in need of intensive medical care, especially because of acute episodes, can be admitted to the hospital. Those suffering from intercurrent diseases are advised to attend general health centres or hospitals with which the Project maintains close co-operation. Besides the patients admitted specifically for physiotherapeutical treatment, the physiotherapy unit provides special care for all other patients in the hospital according to their disabilities and visits are also paid to the peripheral clinics at regular intervals, mainly to teach the patients how to live with anaesthetic hands and feet and to show how secondary deformities can be prevented.

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Bacteriological examination is done in doubtful cases for confirmation of diagnosis or for classification. It is repeated twice a year in all positive cases, smears being taken at the clinics and brought to the Centre for examination.

CASE FINDING

The main methods of case-finding consist in health education, contact survey, and school survey. In about two-thirds of the cases detected the patients came spontaneously to the clinics, influenced by the intensive health education, through the leprosy auxiliary worker, who is in close contact with the local population and takes an active part in the daily life of the villagers. The remaining cases are detected by examination of contacts and school-surveys, which are carried out twice a year.

A mass-survey is done in a pilot area as a built-in assessment of the standard case-finding methods and as an evaluation of the results achieved.

CASE MANAGEMENT AND CASE HOLDING

The leprosy auxiliary worker (L.A.W.) conducts the clinic once a week from 7 a.m. to 12 noon in the presence of a member of the zonal supervisory staff. As a rule patients receive drugs sufficient for 4 weeks and are briefed about the possible side-effects of the drugs, which in practice are found to be very few. A list of absentees and of patients who are expected to attend the next clinic is prepared at the end of the clinic session, along with the L.A.W's tour programme.

He then visits the patients who failed to attend, finds out the cause, gives advice and counselling, and persuades them to attend next clinic; he also carries out contact survey and school survey as per programme. Domiciliary treatment is given only to physically disabled patients, as decided by the supervisory staff.

DEVELOPMENT OF THE PROJECT

The number of treated patients has increased gradually to reach its maximum at the end of the first half of 1967, when 30,087 patients were treated. Since then it has remained more or less stationary, fluctuating between 28,732 at the end of 1967 and 29,675 at the end of 1968.

The gradual expansion of the project from 1962 to 1966 (see Table 1) renders the interpretation of the evolution of the case-load very arduous.

TABLE 1
Development of the project

Year	*No. of new units opened*	*Population covered*	*Area*	
			sq. miles	*sq. km.*
1962	9	169,272	400	1035
1963	22	484,038	500	1295
1964	9	146,907	300	777
1965	15	346,157	500	1295
1966	15	317,802	500	1295
Total	70	1,465,176	2200	5697

In 1962, the staff had to become acquainted with the local situation and to establish contact with the authorities, methods of case-finding and case-holding had to be evolved, and auxiliary staff trained.

All these activities, unavoidable when establishing a new centre, inevitably delayed the elaboration of all activities in a systematical way, and caused some loss of time.

EVOLUTION OF THE CASE-LOAD IN THE UNITS STARTED IN 1963

The units which were started in 1963 give the most uniform and realistic picture of the results and achievements, after 5 years of intensive control work. In that year 22 control units were started, covering a population of 484,038. In this paper it is proposed to discuss only these units.

The first patients to be registered were the most obvious cases, although from the very establishment of the units a start was made with intensive case-finding. In 1964, after one year of functioning, 2881 new patients had been found. This number (i.e. of new detections) remained more or less stationary for 3 years and then dropped to approximately half, after 4 or 5 years of intensive control work. The high

TABLE 2
Evolution of case-load in units opened in 1963

Year	*New cases detected*	*Rate/1000 population*	*Cases released from control* No.	%	*Case-load at end of the year*	*Rate/1000 population*
1963	5937	12.0	–	–	5424*	11.2
1964	2881	6.0	–	–	7634	15.8
1965	2351	4.8	2	0.02	9150	18.9
1966	2596	5.3	56	0.5	10724	22.2
1967	1509	3.1	1433	12.3	10189	21.1
1968	1133	2.3	2353	18.8	10131	20.9

No. of control units, 22; population covered, 494,038.

*The difference between the total detections and case-load at the end of the year represents the cases which were not registered and those patients who died or left the control area.

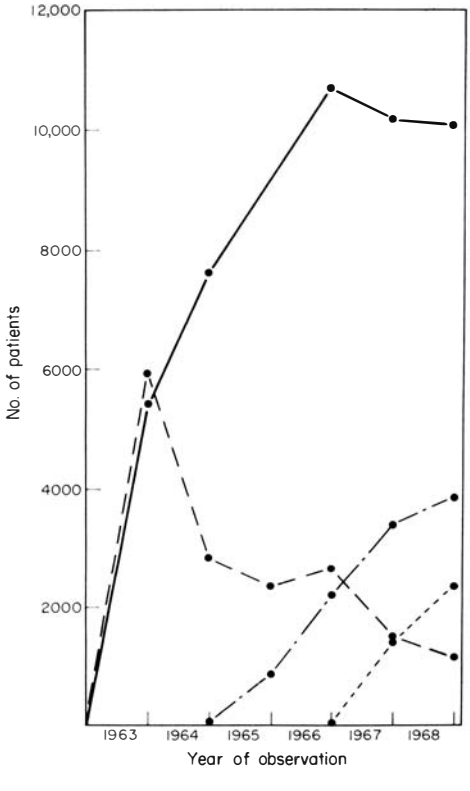

FIG. 1

Evolution of case-load, in 1963 units. —, Case-load; – – – –, new cases detected; — – —, inactive cases; . . . . . , released from control.

figure in the first year and the following 3 years could be due to the accumulation of cases before the start of the project.

After 2 or 3 years, a few patients could be released from control, mainly from among those who had already been receiving treatment for some time before the Project was started. But after 4 years 1433 (12.3%) of the existing number of patients were released from control, and after 5 years 2353 (18.8%) of the total number of patients were released.

During these 5 years, of course, some of the patients died or left the control area. No mention has been made of them because of their very limited influence on the consideration of the results obtained. The case-load at the end of each year is mainly a balance between the newly detected patients and those released from control (see Table 2).

Table 2 and Fig. 1 show a steady increase in the case-load until 1966 after 3 years of control. This figure remains stationary, with a slight tendency to decrease, up to the end of 1968, after completing a period of 5 years.

It is very encouraging to observe in Table 3 and Figs 2 and 3 that the case detection rate of lepromatous cases falls more rapidly and more significantly than in the overall group of patients. Although no lepromatous patients are released from control, the load of infectious cases has remained stationary since 1966, after 2 or 3 years of control work, the number of new cases found being compensated for by the

TABLE 3
Evolution of lepromatous case-load in units opened in 1963

Year	*New lepromatous cases detected*	*Rate/1000 population*	*Lepromatous case-load at end of the year*	*Rate/1000 population*
1963	1403	2.9	1364	2.8
1964	347	0.7	1603	3.3
1965	200	0.4	1696	3.5
1966	158	0.3	1749	3.6
1967	88	0.18	1725	3.6
1968	85	0.17	1728	3.6

No. of control units, 22; population covered, 484,038.

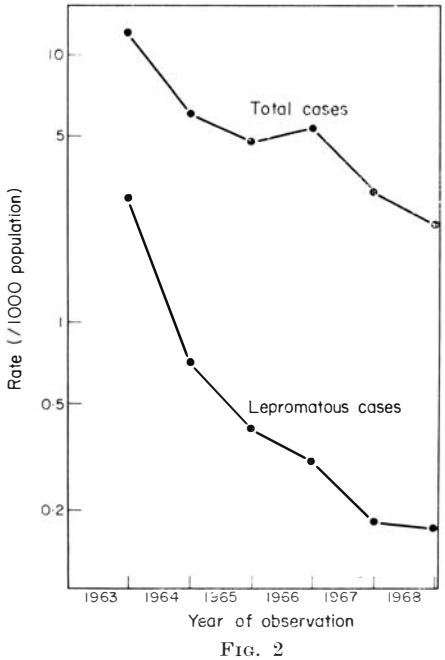

FIG. 2
Annual rate of detection of new cases (total) and of lepromatous cases.

TABLE 4
Proportion of lepromatous cases among new cases detected

Year	*No. of new cases*	*No. of new lepromatous cases*	%
1963	5937	1403	23.6
1964	2881	347	12.0
1965	2351	200	8.5
1966	2596	158	6.1
1967	1509	88	5.8
1968	1293	85	6.6

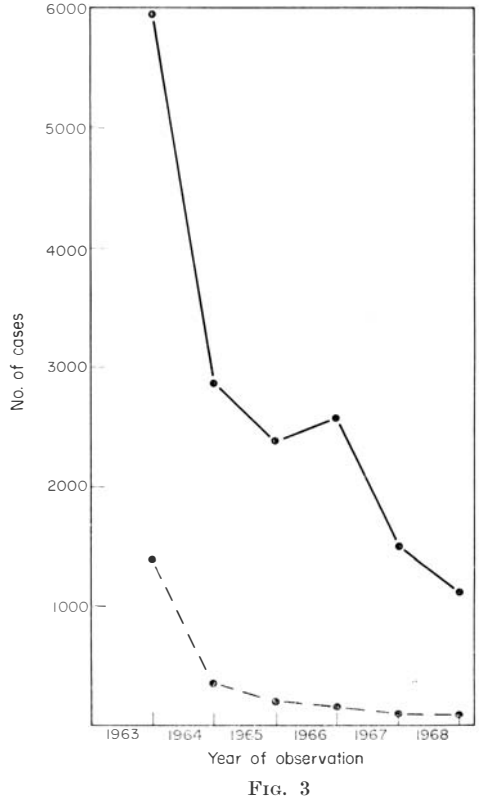

FIG. 3
New cases detected in 1963 units. —, Total cases detected; – – –, lepromatous cases.

number of patients who died or left the control area.

As can be seen in Table 4, the proportion of lepromatous cases among the new cases decreased from 23.6%, when the clinics were established, to less than 6% at the end of the observation period.

Even though the laboratory came into existence in 1963, it was not functioning in full swing in the initial stages. In 1964, 67.7% of the lepromatous patients were examined bacteriologically and 15.6% of them were found to be negative. These negative cases were treated previously by other organizations or in 1962 as "outside-area" patients. From 1965 onwards bacteriological examination was established and out of 92.7% examined bacteriologically, 24.9% were found to be negative.

TABLE 5
Bacteriological results

Year	*Total no. of lepromatous cases*	*Total no. of cases examined bacteriologically*	%	*Total no. of negative cases*	%
1963	1364	145	10.6	14	9.7
1964	1603	1085	67.7	169	15.6
1965	1696	1572	92.7	392	24.9
1966	1749	1703	97.4	662	38.9
1967	1725	1701	98.6	749	44.0
1968	1728	1716	99.3	775	45.2

Of the 1728 lepromatous cases existing at the end of 1968, 775 (45.2%) have been rendered bacteriologically negative, while 953 (55.8%) still remain bacteriologically positive. The morphological index (MI) is not determined as a routine in all bacteriological examinations, but most cases show bacillary fragmentation and in some the MI has been reduced to zero.

Patients who fulfil the requirements laid down by the WHO Expert Committee are declared inactive by one of the medical officers of the project. As can be seen in Table 6, the number of inactive cases increases gradually from 1965 onwards. At present 3875 (38.2%) of the 10,131 existing cases show inactive lesions and are receiving maintenance treatment. since the great majority of these patients have tuberculoid-type disease they may be expected to be released from control in 1969/70.

TABLE 6
Evolution of case-load in units started in 1963

Year	*Case-load at end of the year*	*Rate/1000 population*	*Inactive cases*	%
1963	5424	11.2	–	–
1964	7634	15.8	–	–
1965	9150	18.9	834	9.1
1966	10,724	22.2	2190	20.4
1967	10,189	21.1	3388	33.3
1968	10,131	20.9	3875	38.2

CONCLUSIONS

In the 22 units established in 1963, the case-load has remained stationary since 1966 and fluctuates since then around 10,000. The number of new cases found is compensated for by the number of patients released from control.

If the figures show a gradual decrease in the number of new cases, the reduction in the number of new lepromatous cases is still more pronounced. One of the reasons to explain this observation may be that the vast majority of new cases are detected in such an early stage, that is, before they evolve into an infectious form.

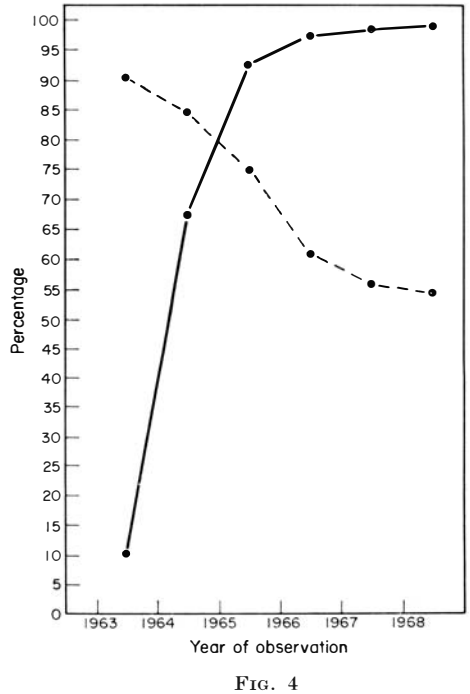

FIG. 4
Bacteriological results, in 1963 units. —, Bacteriologically examined cases (lepromatous); – – –, positive cases.

Besides a dramatic reduction in the number of new lepromatous cases, more and more existing lepromatous cases become bacteriologically negative: 45% of 1728 lepromatous cases. Although no information is systematically maintained regarding the MI of the still positive patients, it is known to have become zero in some of them.

Apart from the reduction in the number of circulating bacilli, the clinical results of DDS treatment will contribute to the reduction of the case-load. At the end of 1968, the number of inactive patients is 3 times as high as the number of new cases detected: 1133 new cases against 3875 inactive cases.

The latter cases are mostly of the tuberculoid type and it is expected that most of these patients will be released from control in the very near future, 1969 and 1970.

The data collected after 5 years of intensive control work indicate that a decrease in the case-load may be expected soon. The results of specific mass-treatment allow us to release from control about as many patients as new patients come up.

A reduction in the number of circulating bacilli has certainly been obtained and it is expected, and hoped, that this reduction will be of such a degree that it will decrease, if not entirely interrupt, the incidence of transmission, with an appreciable reduction in the appearance of new cases in the community.

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Leprosy Control in Tanzania*

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INTRODUCTION

The United Republic of Tanzania in East Africa comprises Mainland Tanzania (formerly known as Tanganyika) and the Islands of Zanzibar and Pemba. This article is concerned with leprosy in Mainland Tanzania, 362,000 sq. miles (940,000 sq. km) in area with a population, according to the 1967 census, of 12,231,000.

As is to be expected in any country of this size, geographical and climatic features vary widely—from the Indian Ocean coastal climate to the peaks of Mount Kilimanjaro, from dense bush to open savannah, from lush fertile country to near desert. Similarly, the inhabitants vary both as to tribal origin and way of life, though these differences are becoming less obvious (and certainly less important from the epidemiological standpoint) as standards of living slowly improve. Accordingly, leprosy prevalence varies widely.

HISTORICAL

The first scientific article on leprosy in this country was written in 1912 by Dr. Otto Peiper, a German army medical officer stationed in what was then German East Africa (Peiper, 1913).

Dr. Peiper describes the first organized leprosy work to be established in this country—the leprosy village built by the bequest of the Indian trader Sewa Haji near the Catholic Mission in Bagamoyo in 1897, and also the work done, mainly by Christian Missions, from 1902 when the Evangelical Mission collected 30,000 DM for the building of a leprosarium in the Tanga District. It is clear from Peiper's paper that leprosy was recognized even at this early time as a major endemic disease and a quite remarkable uniformity of policy was achieved by the widespread establishment of "Lepraheime" (segregation villages) generally near mission stations and supervised by mission staff, with advice from the military medical officers. Some of these segregation villages still exist—2 have become modern leprosy treatment centres—but there was little change in the general approach to the problems of leprosy until the sulphones became available.

With the advent of the sulphones there came to East Africa a man on whose work all that has happened since has been founded. Dr. James Ross Innes carried out extensive leprosy surveys in Tanganyika—as well as elsewhere in East Africa—and on the basis of his findings was able to advise the Governments of that time on practical leprosy control measures. Of at least equal value were his regular visits to the leprosy treatment centres, the majority run by devoted mission staff with few amenities in either staff or money. Wherever he went he spread enthusiasm and encouragement and inspired many doctors to spare time from their general duties to deal with the local leprosy problem—and these included Government district medical officers as well as mission doctors. So it became the established practice in this country that leprosy should be treated by general practitioners and not only by leprologists. In 1955 there were 8800 attending as out-patients, at special clinics, the majority in 2 regions under the direction of government doctors.

LEPROSY PREVALENCE

Innes (1949, 1950) carried out extensive surveys in many different areas and found, as expected, a wide range of leprosy prevalence rates which taken together gave an average rate of 18.1 per 1000. His conservative estimate of the total case load was 100,000.

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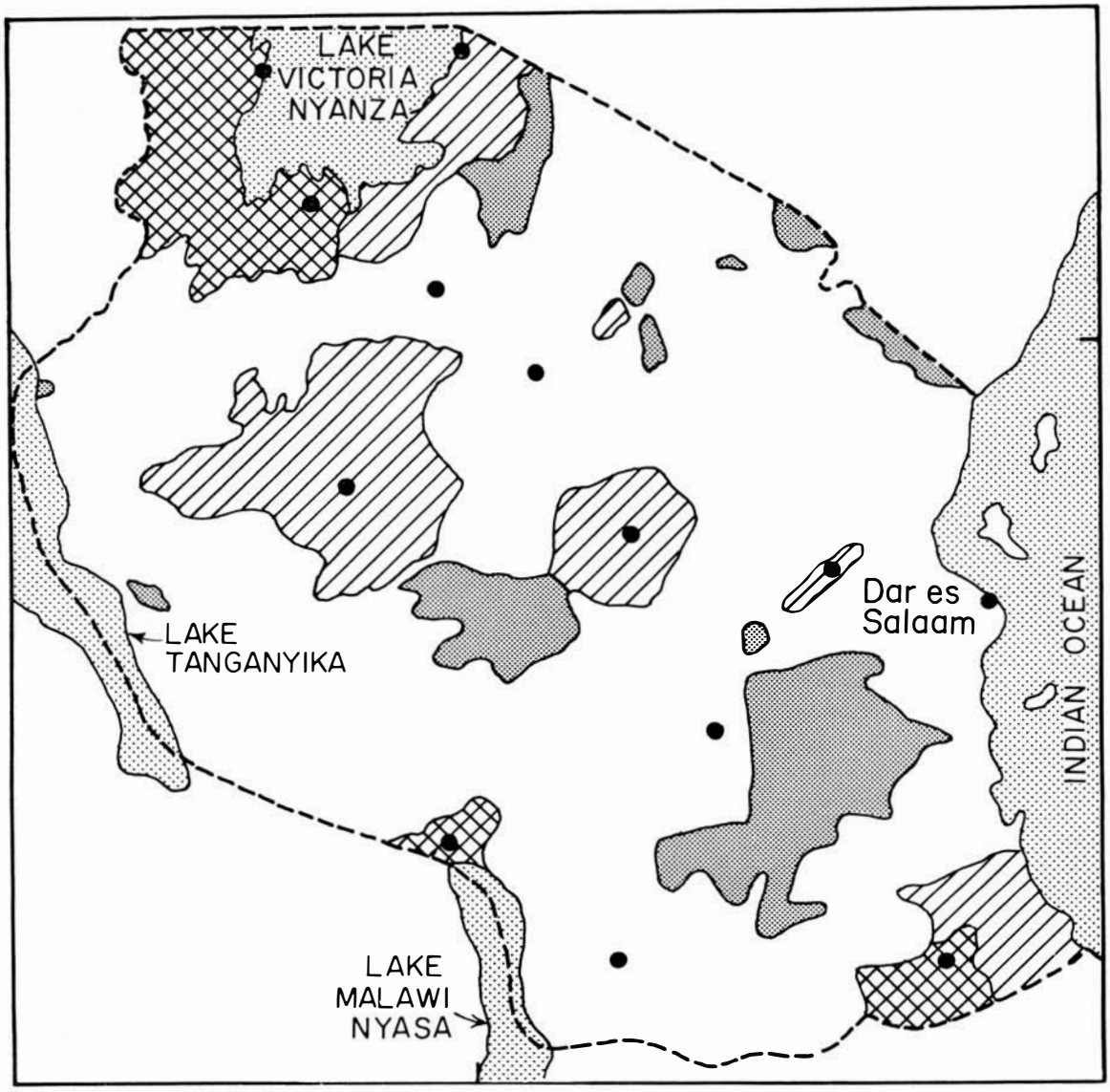

FIG 1

Sketch map of Tanzania mainland. – – – – – – –, National boundary; dark stipple, game parks and reserves (with no settled population); double hatching, established leprosy control areas as of December, 1968; single hatching, developing leprosy control areas as of December, 1968; ●, main leprosy treatment centres.

Whole population surveys have been carried out in 2 islands in Lake Victoria Nyanza. The first, by Innes (1949) in Ukara Island, giving a prevalence rate of 15.2 per 1000 in a population examined of 15,506; and the second, by Anten in 1967 in Kome Island, giving a prevalence rate of 27.2 per 1000 in a population examined of 8241 (90% of the census population=9134). These results, in very similar island communities, appear to indicate that leprosy has increased between 1949 and 1967, and other surveys carried out by Anten on the mainland tend to confirm this conclusion. In 1968 about 50% of the population of 6 villages were examined, a total of 3225 persons, of whom 75 were found to have leprosy, a prevalence rate of 23.3 per 1000. Innes had found an average prevalence of 15.8 per 1000 in this area in 1949.

Larsen, in 1968, carried out sample surveys in 6 villages in each of the districts served by his leprosarium. The results were as follows:

(a) *District A* (which had the better out-patient treatment campaign):

Total population of the 6 villages	4467
Examined	3989 (89.3%)
Total leprosy cases	85
Prevalence rate	21.3 per 1000
Active cases	32 (37.6%)
Disability rate	21.1%

(b) *District B:*

Total population of the 6 villages	4751
Examined	4023 (84.7%)
Total leprosy cases	51
Prevalence rate	12.7 per 1000
Active cases	29 (56.7%)
Disability rate	33.1%

(The epidemiology of leprosy in this area is of great interest and it is probable that in district A the prevalence of leprosy is past its peak, whereas in district B it is still rising.)

The most important areas of high leprosy prevalence are: (a) the densely populated country on the southern shore of Lake Victoria Nyanza, comprising the West Lake, Mwanza and Mara Regions and extending south to the Shinyanga and Tabora Regions, and (b) the Mtwara and Ruvuma Regions in the south.

THE LEPROSY TREATMENT CAMPAIGN

Since 1955 there has been a steadily growing campaign, with "prevention by cure" as the slogan and the objective of getting as many patients as possible under treatment at as early a stage in their disease as possible in order to limit both infectivity and the risk of disability. Clearly, one could not achieve this by requiring patients to segregate themselves or travel up to 200 miles to a special centre. Treatment must therefore be made available at every medical centre of whatever grade. Unfortunately, at this time there were only 2 medical officers engaged full time on leprosy duties, so only small scale, localized campaigns were practicable (Wheate, 1959). There were therefore 2 urgent requirements: (1) to get as many doctors as possible aware of the fact that leprosy was a comparatively simple public-health problem and its control was eminently practicable; (2) to give all paramedical workers, both those in training and those already in charge of rural dispensaries, a rudimentary knowledge of the disease and its treatment so as to enable them to run out-patient clinics with a reasonable degree of safety and efficiency.

To meet the first requirement, leprosy was included in several departmental conferences attended by all medical officers, and uncomplicated directives on the clinical and public health aspects of the disease were issued by the Ministry of Health. Increasing liaison with the Christian Missions resulted in their providing many full-time doctors to take charge of their leprosy institutions and to begin to look beyond their walls to the rural areas around.

The second requirement has been a more difficult problem, and our main effort has been concentrated on short courses of indoctrination and orientation for rural health staff. These courses have been held in various leprosy institutions in order to serve the needs of the local area. The principle has been to teach, specifically and didactically, only enough to enable the staff of rural dispensaries to diagnose leprosy, to recognize the more important complications which should be referred to hospital,

and to treat the remainder according to a simple routine drug regimen. This limitation of the objective made it possible to condense the course to a length of 2 weeks, a period for which the staff of rural dispensaries could be spared from their general duties. Perhaps it should be emphasized that the intention was not to provide full scale intensive training in leprosy control methods—we hope to start next year providing for this need—but to give priority to elementary training on as wide a scale as possible.

The leprosy treatment campaign has naturally, like every other aspect of development, gained momentum since Tanzania became independent in 1961. In 1958 there were 28,727 cases of leprosy under treatment at 344 centres and there was little change in these numbers up to 1961; thereafter successive annual statistics are summarized in Table 1.

TABLE 1
Annual statistics for the occurrence of leprosy in Tanzania

Year	*No. of clinics*	*Total cases*	*New cases*
1962	475	28,289	8896
1963	466	45,122	9341
1964	542	55,699	12967
1965	500	45,643	9570
1966	573	60,046	10,941
1967	829	63,808	9463
1968	838	64,170	9728

The progress to date has been achieved by health education of the public, and the great majority of new patients have been "self-reporting", only a minority having been found by special case-finding activity, i.e., village examination, school surveys, etc. But the end-result is that only approximately 50% of the estimated number of patients are under treatment, and in order to co-ordinate both case-finding and treatment, regional leprosy officers have been appointed in all the 17 administrative regions. These include both government and voluntary agencies' medical officers.

The limitations of the mass-treatment campaign based on the general rural dispensary can be summarized as follows:

(1) The doctor supervising the general dispensary is seldom able to give more than perfunctory supervision to its general work and is even less able to undertake special care for a leprosy clinic.

(2) Case-finding activities are *nil*, virtually all new patients being self-reporting and, therefore, discovered relatively late.

(3) Case holding is extremely difficult. The rural medical aid in charge of a busy general dispensary cannot possibly have time to carry out home visits to defaulters.

(4) The standard of treatment of any complication, in particular plantar ulceration, is of necessity, under these conditions, inadequate.

Local leprosy-control schemes were therefore planned in order to set a higher standard, towards which ultimately all the work throughout the country could aspire. The main principles were:

(a) Special medical staff to be engaged in leprosy control duties.
(b) Treatment to be freely available at all medical centres and to be widely advertised accordingly.
(c) Regular supervision by the specialist doctor or doctors to be carried out, particular attention being paid to practical clinical instruction of the resident dispensary staff.
(d) Close harmonious relations with all local government officials at all levels to be fostered in order to ensure their co-operation in case-finding and case-holding.
(e) Particular emphasis to be placed on school surveys, with the object of controlling leprosy in the children who attend school (estimated to be 50% of the total of those of school age).
(f) Special leprosy staff to be trained on an "in service" basis, preferably after attending one of the 2-week courses of indoctrination mentioned above.
(g) While due priority will be given to the public health aspects of leprosy control, the human need as well as the economic

burden represented by chronic plantar ulceration and other disabilities due to neglected leprosy must be recognized and an effort made to do at least something in this field. This recognition is important also from the point of view of health education; the public attitude in the belief that "leprosy is incurable" is only strengthened by neglect to tackle the problem of "the incurable ulcer".

THE SWEDISH-NORWEGIAN SAVE THE CHILDREN CAMPAIGN AGAINST LEPROSY IN THE WEST LAKE REGION

This scheme began operations in 1962, covering 96 out-patient clinics in 4 districts and a population of about 658,000. (In 2 districts, Karagwe and Ngara, leprosy prevalence is low.) The scheme has registered a total of 5316 patients since its inception and of these, 1350 have been discharged clinically cured, 267 have died, and 1570 were under treatment as at 31 December, 1968—a net decrease on last year's figure. The defaulter rate has been of the order of 10% per annum but 86% of the patients attending do attend regularly.

An important investigation has been contained in the survey of disability among 5083 patients, using the WHO Classification of Disability:

Type A	569
Type B	199
Type C	48
Types A+B	518
Types A+C	17
Types B+C	7
Types A+B+C	28
Miscellaneous	24
	1410 or 27% of the total.

However, among 351 new patients registered in 1968 the disability rate was only 17%, a very marked reduction.

Regular case-finding examinations are carried out both in sample villages and in schools: In 1968, 47 villages with a population of 14,442 were examined; 48 new cases of leprosy were discovered (a rate of 3.3 per 1000). Examination of 10,700 schoolchildren in 73 schools revealed 12 new cases of leprosy (1.1 per 1000).

The new case-rate per annum appears to be levelling off and there is a steady decline in both the lepromatous and disability rates. Nevertheless, even in this very well organized and well-staffed scheme, after 6 years, complete control of leprosy has not been achieved.

THE GEITA LEPROSY SCHEME

Geita district is one of the 3 districts comprising Mwanza Region and is situated on the southern shore of Lake Victoria Nyanza. It comprises 3500 sq. miles (9100 sq. km) of land. The total population, which is expanding steadily as the result of immigration in order to cultivate cotton, is of the order of 400,000 (average density 115 per sq. mile, 45 per sq. km). It borders on the West Lake region. The Geita Leprosy Scheme was started in March, 1966. At this time 679 patients were registered as under treatment, the majority attending irregularly. The case-records showed a lepromatous rate of 15% and a deformity rate of 30%.

The staff comprised one physician, one rural medical aid, one clerk/leprosy scout and one driver. This team, travelling by landrover on average 22,000 miles (35,000 km) per annum visiting 32 medical units and stopping at 10 "mango tree stations" en route, had treated up to December, 1968, a total of 3367 patients.

The emphasis has been on regular supervisory visits to the rural dispensaries and on the constant teaching and encouragement of the staff in charge. The headquarters unit comprises wards, administrative offices, and out-patient treatment facilities and is specifically the "department for skin diseases" of the parent voluntary agency hospital (the Catholic hospital at Sengerema). The wards have provided hospital treatment for 100 cases per annum.

An important activity has been the complete survey of all registered schools in the district, an exercise which took 2 years to complete. Among the 13,195 pupils who were examined, the

leprosy prevalence was 26 per 1000. Of the 343 cases only one was lepromatous and 4 borderline. The headmasters were provided with a special register and a supply of dapsone tablets so that they could themselves personally ensure that the children took their treatment. Of equal importance, however, has been the experience gained in the field of case-finding by village surveys. After the total population survey carried out on Kome Island (*vide supra*) only 22% of the cases diagnosed presented themselves for treatment. After village surveys, 4 out of 58 patients diagnosed refused to accept the diagnosis, while 41 others allowed themselves to be registered but never returned to continue treatment. It is obvious therefore that, at least in this community, the social stigma associated with leprosy is considerable and few patients are willing to admit to having the disease at a stage when its complete cure is comparatively easy.

Clearly both more time and more special staff will be needed to bring about a change in the attitude of the public in this matter. As it is, the fact that after only 33 months of operation about 38% of the total estimated patients have been registered and 27% are under regular treatment can be considered a reasonable achievement.

In the ensuing phase of this campaign the emphasis will therefore be first on health education, with the development of health home visitors, whose duties will be to trace defaulters from both the tuberculosis and the leprosy clinics; and, second, on the extension of the present coverage to provide treatment for the entire population within a distance of 4 miles (6.4 km) from their homes.

FUTURE PLANS

It will be seen from the sketch map that a number of areas are marked as "developing leprosy-control areas". The most important of these areas is that to the south-east of Lake Victoria Nyanza which is densely populated and has an estimated leprosy prevalence of at least 20 per 1000. Second in importance is the large area in the south where there are already 12,000 patients under treatment, 3000 of these being in a special control scheme.

SUMMARY AND CONCLUSIONS

The gradual development of a mass-treatment campaign in Tanzania is described and the manner in which this is being evolved as an instrument of leprosy control is discussed. Experience seems to indicate that it is comparatively simple to get 50% of the estimated case-load of an area under treatment, but there are considerable practical difficulties involving the health education of the public, the deployment of special staff, and considerable transport expenses if any impact is to be made to encourage the other 50% to come forward.

ACKNOWLEDGEMENTS

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Leprosy Control in the Southern Province of Zambia*

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INTRODUCTION

In any developing country medical policy, as with any other departmental policy, needs to be viewed against the economic background. There are the basic facts of a relatively low per capita annual income, and the many other fields of development that vie for priority consideration, such as education, agriculture, or defence. There is obvious interaction between different departments, so that progress in education and agriculture, for example, is bound to benefit the health of the nation. In considering the health budget, an order of priority must be based upon the most pressing needs, the impact that any given measure will make upon a problem (including the interaction it will have on other health problems), the practicability of a project in terms of available trained staff, the availability of materials, and acceptability by the population, as well as some calculation of the likely return from money and time invested.

Zambia is one of the more affluent of the developing countries today, with a per capita average annual income of £118, compared with Nigeria £48 or E. Africa £28 (U.K. £560), but when our control programme began Zambia was part of the Federation of Rhodesia and Nyasaland, most of its revenue from copper was leaving the country for Britain or for Federal use, and very little money was available for health development. Even today, of the £339 million recurrent expenditure planned in the current 4-year National Development Plan only £9 million is allocated to health (as compared with £40 million for education). We had, therefore, to do everything possible to tackle the problem of leprosy without any additional funds being available, at least on the provincial level. In 1952 a national plan for the treatment and control of leprosy was drawn up by an *ad hoc* committee called by the Director of Medical Services and comprising both Government and mission medical officers interested in leprosy. Although this plan was initially accepted by the Government, after wider discussion it became apparent that differences in geography, communications, tribal customs, and distribution of the disease made it desirable to plan separate schemes for each of the 6 different provinces of the country. At a later date I was asked to accept responsibility for the co-ordination of leprosy treatment and control in the Southern Province of Zambia under the Provincial Medical Officer (P.M.O.) and the territorial leprologist. That a mission medical officer should be given what is usually thought of as a government responsibility was not considered unusual in Zambia, for the missions and the Government have for many years worked in the closest co-operation; the position was, of course, an honorary one, there being no funds available anyway!

ORGANIZATION

The Southern Province covers an area of 33,000 sq. miles (85,000 sq. km.). It is bounded on the north by the Kafue river, in the east and south by the Zambesi, while in the west and south-west it borders on Barotseland and the Caprivi Strip. The railway line from Rhodesia in the south, through Livingstone and up to the

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copperbelt, traverses the province from S.W. to N.E. and on it are situated 3 towns with populations of between 3000 and 7000, as well as Livingstone, the provincial centre, with a population of 34,000. Apart from light industries in the larger towns the province is almost an entirely agricultural area, with a thriving fishing industry now in the Zambesi (Gwembe) Valley on the banks of the Kariba lake. This latter development has taken place since the completion of the Kariba hydro-electric dam in 1959 and altered the pattern of disease amongst a previously backward valley tribe. The total population of the province is slightly under half a million (population density: 14 per sq. mile or about 5.4 per sq. km.), the majority belonging to the Tonga tribe. The climate is sub-tropical, temperatures on the plateau varying from 90°F (32°C) maximum to 40°F (4.4°C) minimum, with light frost in some areas in winter and an average rainfall of about 30 in. (75 cm.); in the Gwembe Valley temperatures just over 100°F (37°C) may be experienced in a more humid climate.

Although no detailed survey of the incidence of leprosy has been made in the province, our records suggested that there was a higher incidence of the disease in the Gwembe Valley (before the Kariba development the people here were very primitive and malnutrition was almost universal among the children) and in the Kafue basin to the north (Namwala District).

The province is divided into 6 administrative districts, each under a District Secretary, and the local authorities are known as management boards (or municipal councils) in the towns and rural councils in the country areas. Each of these has a health councillor, with other health workers under him. Communications in the province are rather better than in most other parts of the country, as the railway and the Great North Road, the surface of which has steadily improved over the years until now it is "tarmac" throughout its length, traverse the whole length of the province. Various bus services now connect strategic points in the rural sectors with the towns, so that many patients who 10 to 15 years ago walked distances of up to 100 miles can now travel most of the way by train and bus.

The medical service of the province, which is under the supervision of the Provincial Medical Officer in Livingstone, comprises some 55 to 60 centres, ranging from the Central Hospital in Livingstone with some specialist facilities and the District Hospitals to small Rural Health Centres doing mainly out-patient work, plus a similar range of hospitals and dispensaries operated by 6 different missions.

A random sample survey of leprosy prevalence carried out by Ross Innes in 1949 revealed an incidence of 10.3 per 1000 in the Southern Province as compared with 12.6 per 1000 for the whole of the country (Innes, 1951). This survey was based upon the examination of 11,246 people in the province. No other leprosy survey covering this area appears to have been recorded.

I was based at The Salvation Army Hospital, Chikankata, near Mazabuka at the north-east end of the province. Here there is a general hospital, with nursing and laboratory training courses, which has developed rapidly over the past 15 years to a 250-bed hospital, as well as the leprosy work. Our leprosarium, which at one time accommodated 450 in-patients, was the leprosy treatment centre for the province. At no time, until recently, did we have more than 2 doctors at Chikankata, so that the organization of the leprosy control programme had to be very much a part-time exercise. For this reason, and because we had no extra staff, it was impossible at any stage to carry out a general survey of the incidence of leprosy and these limitations also dictated a pattern for our organization which involved a large degree of remote control.

There were 2 other leprosy treatment centres in the province at this time—both of which came into being rather haphazardly as "squatters" appendages to the District Hospitals at Gwembe—which served the Gwembe Valley—and Namwala. When our first efforts at a co-ordinated leprosy programme began in 1961,

Gwembe had about 150 patients and Namwala about 40. No one at these centres had had any experience in leprosy and the overseeing given by frequently changing and over-worked government medical officers had usually been very scant. I began to pay monthly visits to Gwembe and later 3-monthly visits to Namwala; between these visits patients from the Namwala area were transported by road to Gwembe for examination.

Arrangements were made that all medical centres in the province would in future refer any suspected case of leprosy to one of the 3 treatment centres and no patient would be started on treatment until his case had been fully assessed and treatment prescribed by myself or my medical colleague from Chikankata. Out-patient treatment was also on a similar footing.

At Gwembe and Namwala we faced a formidable task. Records were either totally inadequate or non-existent, many healthy children of all ages were living freely in the leprosaria, many patients had the most appalling infected foot ulcers which had been treated only with the minimum of (unsterile) dressings, and there was little discipline among the patients. This is no reflection on those immediately responsible, for they had had thrust upon them a problem about which they knew little or nothing and were given virtually no facilities to deal with it.

A standard record card for leprosy patients was in use throughout the country and this had been carefully designed to meet all requirements. All patients' records were gradually brought up to date and full clinical details entered. During the assessment it was found that in many cases the disease was "burnt out" or clinically inactive and these patients were discharged to out-patient treatment or supervision. All the patients were receiving too high a dose of dapsone and this was reduced to a safe level. An all-out onslaught was made on the foot ulcer problem by teaching the sterile technique in the application of dressings, plaster, or other necessary surgical treatment and by teaching staff and patients the essentials in caring for anaesthetic feet and hands. One of the patients, a cobbler, was trained to make protective footwear and eventually we were well on the way to ensuring that all patients with anaesthetic feet had, and were wearing, microcellular rubber sandals made according to the Karigiri pattern. The incidence of foot ulceration fell steadily, partly as a result of treatment and preventive measures and partly also because in time patients learned to come for treatment at an earlier stage in the disease.

We were fortunate in having been able, before this time, to establish a pattern of total care of leprosy patients at Chikankata. Gradually this was extended to Gwembe and finally to Namwala. A small programme of occupational therapy had already been started at Gwembe and this was expanded with the enthusiastic help of the Medical Inspector in charge of this centre, without whose dedicated and intelligent support the whole provincial programme would have been impossible. The patients became more contented and so accepted more readily the stricter discipline being imposed to ensure regular treatment and a more peaceful community. All healthy children over the age of 2 years (younger when possible) were sent home to the care of relatives, and those who remained we put on to a register for the regular administration of dapsone prophylactically. This took time and persuasion to complete, but eventually the mothers recognized the benefits for their children.

As many patients who had been under treatment in the leprosaria for a number of years could now be discharged, so the inflow of new patients increased. The patients themselves and our own efforts in various parts of the province stimulated an interest in leprosy as a *curable* disease. The problem now was to ensure that those transferred to out-patient treatment continued with regular doses of dapsone, and that they would return for regular checks, at first 6-monthly and later yearly. This would reduce the relapse rate, which in turn would, we hoped, reduce the incidence rate.

AIMS OF THE PROGRAMME

(1) *Careful examination and assessment of every new patient with leprosy in the province*

Transport was arranged—either public transport or ambulance—from the centre to which they first reported to one of the 3 leprosaria. Only when active leprosy had been confirmed and laboratory investigations completed was treatment started. Similarly, all out-patients reported to one of these centres for their routine re-assessments.

(2) *The establishment of regular leprosy clinics at each of the medical centres in the province*

For the treatment of out-patients in their area, the government leprologist issued special registers (shared with tuberculosis patients), and periodic checks to see that they were properly kept were made during visits by the P.M.O., Medical Officers, leprologist or myself. We decided that, except in special cases like proved responsible teachers, no patient should be given dapsone to take at home. Patients were prescribed either a weekly supply of dapsone tablets if they lived within 5 miles of a medical centre, or fortnightly injections (5 to 10 miles) or monthly injections if over 10 miles. These distances were only approximate and depended upon such factors as age, degree of crippling, geographical obstacles (e.g. rivers in flood), and availability of public transport, but this system meant that we could be sure that if patients attended regularly they received their dapsone regularly. A provincial leprosy register has now been compiled showing details of every leprosy patient in the province, including details of treatment and dates of re-checks. It is hoped eventually to follow up all patients who have not presented themselves for re-checking.

(3) *Ensuring regular treatment of all patients*

In addition to the scheme outlined above, we tried by means of visits, letters, telephone calls, and any other means possible, to impress on all concerned the importance of regular treatment, and adequate follow up of non-attenders. Had it been possible to devote the time to regular touring we could have achieved a high degree of co-operation more quickly, but through the excellent support of the territorial leprologist, the P.M.O. and other health officials and by using most journeys undertaken as an opportunity to make personal calls at medical centres, the message was gradually put across. From the beginning we set the standard as 100% regular attendance for all patients, as it was found that too many of the medical staff were prepared to accept a much lower attendance rate that was not compatible with adequate treatment. Local authorities, including many of the chiefs, were enlisted in this effort, so that when a patient absconded or failed to attend regularly for treatment there were a number of alternatives available whereby he could be followed up. Recalcitrant patients were brought back into a leprosarium for a period of "re-education and re-establishment of treatment". The message was soon understood by a high proportion of the patients! Many also saw the value of continued treatment, and for some the clinics became social occasions for meeting old friends. A frequent source of difficulty was that certain patients, in their anxiety to return to their home, insisted that they lived within a reasonable distance of a treatment centre, but later it was found that they lived much farther away and could not be expected to continue regular journeys. The word "near" to the African could mean anything up to 50 miles! By use of a cyclostyled letter-form addressed to some responsible authority in the area concerned, such as a health councillor, district secretary, or local hospital or mission, we sought and obtained exact information on distance and on any special problems before a patient was considered for out-patient treatment. More recently government appointed leprosy and tuberculosis home visitors were appointed through a scheme devised by the tuberculosis and leprosy specialists. These home visitors were attached to strategic hospitals and could by bicycle cover a wide area, following up contacts and non-attenders, carrying out BCG vaccination, and keeping records, as well as encouraging

the co-operation of officials at all levels and referring any new patients they discovered to the nearest treatment centre. This is the first step towards mobile units, which are so valuable in any scheme of this type. Their effectiveness will be enhanced when a better calibre of home visitor becomes available. At this stage of the country's development suitable personnel are still in short supply.

(4) *Detection and treatment of early cases of the disease*

Here again not only did we try to impress on all medical personnel concerned the importance of early treatment and the essentials of diagnosis, but we also used the officials previously mentioned to foster a response from the patients. In this effort we were aided by the obvious ability of the ordinary villager to diagnose leprosy, even in its earliest phase. This ability, which has been noted by many other workers, is sometimes almost uncanny. All that is required, therefore, is to break down prejudice and misunderstanding and to do everything possible to minimize the disruption of normal life through attending for treatment. Education to reduce the stigma and the feeling of hopelessness attached to leprosy was needed. There were delays in plans for the production of posters, but I was able to speak to chiefs and other officials at local authority meetings and, to a limited extent, in schools. The former had the value of a 2-way exchange whereby we learnt some of the fears and genuine obstacles in the way of a patient coming for treatment. For example, the 2 government leprosaria had no segregation of the sexes in their overall arrangement of houses. For some time we had fought against various types of immorality occurring in leprosaria, in order to restore self-respect to the patients, increase the peace and happiness of the majority of them, and reduce the birth rate of healthy babies in an infected area. (It is a curious commentary on the "unconscious" attitude towards leprosy and its sufferers that intelligent people who would never dream of permitting a potentially degrading arrangement like this for patients with other diseases should tolerate it in regard to leprosy.) The African officials pointed out that we could hardly expect husbands to allow their wives to come for treatment—or at least not until the disease was far advanced—when it was likely to mean that a male patient might readily take her as a temporary wife. The position was soon remedied by taking steps to re-organize the leprosaria. In return we sought the help of the chiefs in stopping their practice of granting divorce on the sole grounds that the spouse was being treated for leprosy. They have now stopped doing this. Recognition that admission to a leprosarium may lead to a break up of a family, the loss of subsistence livelihood, with suffering for dependants, and the steps to be taken to prevent these consequences are an essential part of leprosy treatment and control. Therefore, the co-operation of chiefs, village headmen, local authority officials, and employers was enlisted to see that a man's cattle or land were looked after during his absence for treatment, that his wife and family were cared for, that his job was kept open or there was a reasonable promise of a job waiting for him on discharge. Progress in this respect was slow, but we found that employers, including the government departments concerned, were often very helpful with jobs. We finally came to the conclusion that the evils engendered by admission to a leprosarium might be greater than the effects of the disease itself, and therefore increasing emphasis has been laid on out-patient treatment at an early stage. The knowledge that admission to a leprosarium would be for a brief period only, or not necessary at all, is the best encouragement to patients to seek early treatment.

(5) *Training medical personnel in the essential facts of leprosy and its control*

Apart from the remote control methods referred to above and periodic circulars sent out through the P.M.O., the only other methods that proved practical were on-the-spot teaching during random visits, and the attendance of nurses, doctors and other health officials as occasion offered at our major clinics at one of the leprosaria in order to learn what they could.

Unfortunately these clinics were of such marathon proportions—lasting from early morning to dusk and seeing up to 100 new patients and re-checks in a day—that there was little time for teaching. An effort to arrange 1- or 2-day seminars at opposite ends of the province on different occasions for those responsible for leprosy care proved unworkable because of staff shortage at the smaller centres.

(6) *Health education in leprosy*

Much more could and should be done in this field, but we were encouraged by the measure of response that the methods described (4) produced. The emphasis was on early treatment to ensure early cure and avoid deformity and crippling, the safety of patients on out-patient treatment so that they could return to a normal life in society and be able to do a job, and stressing the fact that leprosy is just another disease which can be treated within a normal hospital system. School-teachers began to refer to us children whom they had discovered with suspicious patches, and the same teachers proved the most ready to accept children back into their classes when the latter were transferred to out-patient treatment and they sometimes helped by administering the dapsone tablets to the child themselves. At Chikankata we had a school for children with leprosy, including all the grades of primary school, which at one time had an enrolment of 120. Today there are very few children left in the leprosarium to go to school as most are now referred early for out-patient treatment and attendance at a normal school. A few children completed primary school education while in the leprosarium and were bright enough to qualify for a place in secondary school. There is a large secondary boarding school at the Mission and we eventually persuaded the school authorities to make an exception by accepting a child patient for school while he continued to live in the leprosarium. We were at first uncertain as to what would be the reaction of teachers and other children, but the steady education on leprosy had obviously had its effect and the child was fully accepted. Since then, others have proceeded to secondary schooling in this way. As we see it, there is no reason why in future there should be any special schools for leprosy sufferers who, if in-patient treatment is indicated, should be able to attend the local school. It has been our policy to employ patients for almost all the unskilled jobs (and a few skilled jobs) in and around the hospital, including ward cleaning, but not kitchen and laundry work. Public opinion is not yet ready, we feel, to accept leprosy patients in the two last-named departments. All along such moves have been questioned by the local population, by patients in the hospital, and also by higher authorities and we have tried to take these people into our confidence by explaining why it is safe. The same is true of the admission of leprosy patients to hospital beds and most people have come to accept the situation, but we believe that accelerating these progressive moves unduly could antagonize the public to the point of losing confidence in us. In a sense, the reverse problem has been faced with the healthy children of mothers with leprosy. As a result of the policy of keeping small children with their mothers in the government leprosaria, the government leprologist and I have both seen a number of children who have developed signs of the disease before the mother was discharged. At Chikankata we established a purpose-built nursery where young children were cared for under the over-all supervision of the Sister-in-Charge of the leprosy settlement. The nursery was staffed by at least one trained enrolled nurse and a group of pre-nursing candidates, and when mothers came in to feed and play with their children at specified times they wore long-sleeved gowns and masks to reduce skin and nasal contact. The children were given prophylactic dapsone and BCG vaccination and no case of leprosy has been diagnosed in 8 years. The recent work of Pedley (1967) who demonstrated the presence of *Myco. leprae* in the breast milk of women with lepromatous leprosy suggests that the only advantage of this elaborate routine may be the certainty of a regular prophylactic dose of dapsone. The

difficulty of ensuring this in an open leprosarium is, I feel sure, the explanation for the incidence of leprosy in apparently healthy children in the Government leprosaria. The nursery system enabled us to teach mothers child care and proper weaning diets and to give each child a full range of preventive inoculations, but cross infections of various origins caused repeated anxiety. Psychologically the ideal is, of course, for the mothers to keep their children, but one bears in mind that the child is exposed not only to the mother's bacilli but to those of the other patients as well. Again one comes back to the desirability of out-patient treatment.

RESULTS

The success of any control scheme will ultimately be assessed on the incidence of disease in the area concerned. Over the last 4 years (provincial figures of notifications were not available before 1965), that is, the 4 years after the inception of a co-ordinated treatment plan, there has been a steady decline in the 6-monthly and annual notifications of new cases of leprosy (see Fig. 1). The rate of reduction is greater than the 15% per annum which might be expected (Browne, 1962). Some reduction might be expected after a "pool" of long-standing cases had been located and placed under treatment in the early years of the programme, but the reduction in incidence, which could almost be called dramatic, has continued. It has also to be borne in mind that more intensive efforts to diagnose leprosy earlier would tend to influence notification rates in the opposite direction. An analysis of the average interval between the first onset of disease signs to presentation for treatment of patients admitted to Chikankata in any given year shows a steady reduction. While the history given by patients cannot be considered very accurate, especially in respect of time intervals, this inaccuracy would be expected to remain constant throughout the period under review. Fig. 2 shows that the average length of history has been reduced from 41.5 months in 1951 to 14 months in 1967. This means not only that healthy members of the population will be exposed to infectious disease for shorter periods (and to a lower bacillary concentration in the case of lepromatous patients) and will therefore be less likely to contract the disease, but also that some complications of the disease will become less common. Fig. 3 shows that the incidence of deformity—including claw hand, loss of digits, other forms of bone destruction, and foot ulceration—in patients admitted to the Chikankata leprosarium fell sharply before the inception of the provincial control programme when leprosy treatment first began at Chikankata, and that thereafter there was a slight but fairly steady decline.

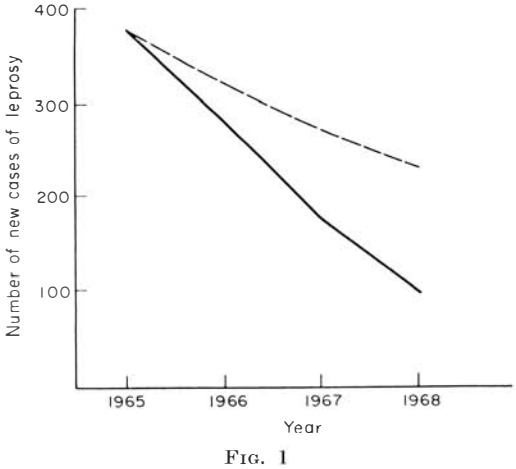

FIG. 1
Incidence of leprosy in the Southern Province of Zambia. —, Notifications per year; – – –, expected notifications (15% decrease per year).

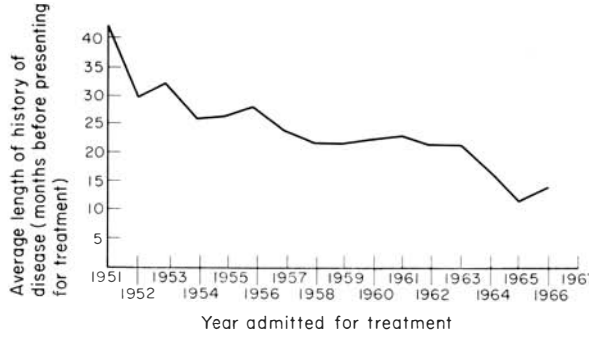

FIG. 2
Average length of history of disease in patients admitted to Chikankata leprosarium.

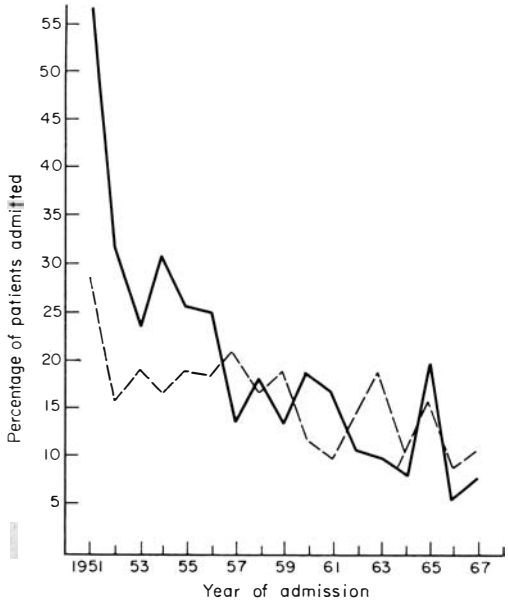

FIG. 3
Incidence of deformity and foot ulceration in patients admitted to Chikankata leprosarium. —, Deformity; – – –, foot ulceration.

Partly on account of the steady reduction in incidence of leprosy in the province and presentation for treatment of the disease at an earlier stage, the number of in-patients under treatment has been markedly reduced. From a maximum of 768 in-patients in the 3 leprosaria in 1964 there has been a reduction to just over 300 in 1968, and the Namwala leprosarium has been closed. This reduction represents a considerable saving in treatment costs and in the disruption of normal living. Fig. 4 shows the steady reduction in the length of in-patient treatment of patients admitted to Chikankata in the period 1955 to 1967. The duration of in-patient treatment could be reduced still further were it not for the problem of the sparsely scattered distribution of the population and the consequent difficulty in providing adequate medical coverage. Many patients are still in leprosaria who could be on out-patient care if they were near enough to a treatment centre. The effectiveness of out-patient treatment may be gauged by the fact that a survey carried out in 1967 showed a regular attendance rate of

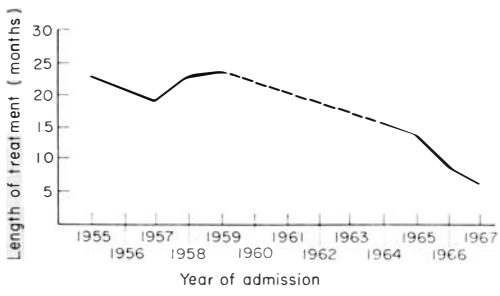

FIG 4
Average length of in-patient treatment of patients admitted to Chikankata leprosarium.

over 70% at the 55 medical centres in the province. While there is obviously still room for improvement, this figure compares favourably with similar results in other reported control schemes (ranging from 59 to 70%). The remote control necessarily used in our scheme owing to lack of staff and finance is an obvious disadvantage, but if this attendance rate can be achieved by the method used a further improvement should be possible if and when mobile units can be brought into operation. Furthermore, the system of dapsone distribution employed by us means that over 70% of all out-patients are actually taking dapsone regularly.

DISCUSSION

The control programme described was not the programme of choice but one of expediency. The cost in terms of money has been almost negligible and was more than offset by the saving in reduction of the number of institutionalized patients. It is felt that good progress has been made in 7 years towards the complete control of leprosy in the Southern Province of Zambia, but this could not have been accomplished without the hard work and enthusiasm of a team of workers in various fields and also the increasingly encouraging co-operation between Government, mission, and local authority personnel as well as that by the patients themselves. The progress could have been achieved in an even shorter time had the facilities we desired been available in the early stages of the programme. We had the

advantage of better road and rail communications than most of the other Zambian provinces, and therefore better medical coverage; but on the other hand the population of this area is probably more backward and less co-operative than some of the tribes in other provinces. Last year LEPRA launched a control programme in the Eastern Province run by a mobile team under an experienced leprosy worker and designed to improve out-patient treatment, carry out systematic case finding, and provide increased publicity and health education. This is already proving very effective and has enabled many patients who would otherwise be too far from a treatment centre to be maintained on an out-patient régime. The LEPRA Pilot Leprosy Control Project in Malawi working with a much more compact population (500 per sq. mile) in an area of only 2000 sq. miles and an estimated incidence of leprosy of 10 to 12 per 1000 is using 3 mobile teams (LEPRA Annual Report, 1966, pp. 6 and 7). This excellently planned project involves a considerable capital and maintenance cost, but is effecting a very thorough coverage of the entire population and is aiming at eradicating leprosy from the area. This it may be able to achieve in a relatively short time. The more gradual control scheme described above, by reducing the sources of infection at the rate at present indicated, stands to achieve a similar result but will require a longer time.

Our ultimate aim is to be able to treat all patients on an out-patient basis from the beginning, or at least after only a short period to allow for stabilization, and admit only those patients with complications—such as reactions or ulceration—for treatment in the leprosarium. However, until some form of mobile unit is in operation this will not be possible with our scattered population. We should endeavour to carry out some sort of systematic examination, together with BCG vaccination, of at least the more vulnerable part of the population, that is, the children and family contacts of known cases. To date, little in the way of contact examination has been possible. With an ever-increasing proportion of Zambia's children being able to attend school (by 1972 it is hoped to provide universal primary schooling) systematic medical examinations at school, probably combined with other health surveys or vaccination, should detect early disease in this important sector of the population.

When about to embark on this control scheme there was an opportunity to obtain training in surgical techniques for the correction of deformity in leprosy. We felt that the control approach should have priority and the results to date suggest that the amount of correctable foot and hand deformity will steadily decrease. In Zambia, at least, unlike India, there is little stigma attached to the claw hand and provided that a person can grip a plough or a cooking pot reasonably well he feels little disadvantage. The degree of co-operation of most of the patients is such that subsequent carelessness will often ruin a carefully repaired hand. However, plans were laid for a limited surgical programme for rehabilitation at another mission hospital in the province and the doctor there has been to Karigiri, India, for training. At present simple physiotherapy—mainly concentrated at the leprosaria, but simple exercises also carried out at out-patient clinics—can make some contribution to preventing deterioration in a paralysed hand or foot.

Perhaps the most encouraging feature of our results has been the high out-patient attendance rate achieved, despite the absence of field workers to carry out effective follow-up, and the high limit we set as the maximum distance from home to treatment centre for out-patients (other projects have set limits of 3 to 5 miles). An effective measure of co-operation from chiefs and local authorities was not easily achieved and still leaves much to be desired, but we have demonstrated that mobilization of all existing resources both within and outside the health services can be worth while and in this instance was essential. No generalizations can be made. It is obvious that not only was this programme not ideal but it would not necessarily

prove as successful in other situations. It cannot be described strictly as a control project, but it constitutes a co-ordinated treatment programme which appears to be achieving a useful measure of control of leprosy in a scattered population with a relatively low incidence of the disease. There is still a great amount of ignorance and prejudice about leprosy in Zambia and there is need for intensive education if complete control is to be achieved. It is hoped that the LEPRA project in the Eastern Province will achieve what we have failed to achieve, in an area with an identical incidence of leprosy according to Ross Innes's survey (Innes, 1951).

SUMMARY

A co-ordinated treatment programme for leprosy in the Southern Province of Zambia is described and its results in terms of control of the disease in the area are assessed. Despite absence of adequate funds and extra personnel it is suggested that this limited programme is achieving a useful degree of control. Co-operation is the key to success.

ACKNOWLEDGEMENTS

Thanks are expressed to all members of the team who have enthusiastically co-operated in our programme over the years, including the P M.Os concerned. In particular I would thank our own staff at Chikankata, and especially Sister Elizabeth Gaimer for the statistics she has compiled and to Dr. Colin McDougall, the present Government leprologist in Zambia, for his co-operation. Grateful acknowledgement is made of the consistent encouragement given by the late Dr. P. Glyn Griffiths who was the Government leprologist during most of the formative period of this programme.

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Leprosy Control in the Teso District, Uganda—A Review of the Last Twenty Years*

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Teso District is in Eastern Uganda with an area of 4500 sq. miles (11,500 sq. km.) and a population, based on the 1959 census, of 500,000. All belong to the same ethnic group and speak a language different from that of the Bantu people to the south and of the Nilotic group to the north. In a series of surveys prior to 1955 the leprosy prevalence rate was found to be 25 per 1000, meaning that the number of patients in Teso at that time was around 12,000; 20% were under the age of 15.

The Kumi Leprosy Centre consists of 2 units, one for children under the age of 16 at Kumi, and one for adults at Ongino 5 miles away, both under the same supervision. The beginnings go back to 1927, when 5 out-patient clinics were organized for the injection of leprosy patients with hydnocarpus oil. In 1930 concentration of this treatment was on a settlement at Kumi for children, because of the serious nature of the disease (not unlike that with which I became familiar on my arrival in 1949) and because, with a very scattered population, treatment could not be made available to many children who, to obtain it, would have had to walk many miles each week in all kinds of weather. The Ongino settlement for adults followed later, but it had to be built some distance away because it was not easy to obtain the land to add the adult unit to the children's settlement.

About 1950-51 a major change to more effective treatment became possible when gradually the sulphone drugs were introduced. The addition of sulphonamides, antibiotics and other drugs specific for the many complications which were more serious for patients suffering from leprosy, completely changed the outlook; but with the advent of these new weapons the effort of settlements was confined almost exclusively to the patients for whom there was bed-space or for those who did not live too far away to attend as out-patients. The fact remained, however, that in the whole of Uganda, with a population of 6 million dispersed over an area of 93,000 sq. miles (238,000 sq. km.) there, were between 80,000 and 90,000 patients, only 5% of whom had access to any treatment.

The problem in Teso was a reflection of that in Uganda. The people live in scattered family units, not in villages or towns as in other countries. The average population density was 60 per sq. mile (about 22 per sq. km.), but this was an average, and in some areas the people were even more dispersed; also there were no communal centres where people could gather. It was estimated that if Uganda had 1000 clinics organized uniformly, 75% of the patients would still have to make a return journey of 8 to 12 miles to obtain treatment. This was a physical impossibility for children and for those with complications, and in any case attendance depended upon the weather, for some roads and footpaths in the wet season might be impassable for weeks.

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†The Kumi Leprosy Centre is controlled by a Board on which the Uganda Government, District Councils, the British Leprosy Relief Association and Missions are represented. Miss Stone belongs to the Church Missionary Society and in recent years has been seconded to the Medical Research Council to work in the trial of BCG vaccination.

In Teso, to provide even this kind of skeleton service 60 clinics of one kind or another would have been needed. It was decided to make a beginning by putting a treatment village in each county (except Kumi which already had the Leprosy Centre). These villages were built and occupied by the end of 1955. At first, between 90 and 100 patients lived in each village, and large numbers of out-patients attended the village clinics. The villages were built by communal effort and patients who had far to travel could live in them and farm there. The primary object was not segregation for its own sake, but to create a hopeful community that could get treatment easily. The rapid response by the chiefs, the Health staff and the people in Teso created the dilemma of how to handle so many patients efficiently. A system of training paramedical personnel, approved and maintained by the District Councils that would ultimately guarantee them employment, was the next step and was essential to deal with the number of patients who applied for treatment. These numbers were in line with the official predictions from the surveys.

A village system was originally developed in Southern Nigeria in the early 1930's. Segregation of the patients was necessary to control the disease at that time, but it was even more necessary then to deal with the serious social consequences when the patients and the uninfected lived together. There the healthy people had not only an intense fear of contracting the disease if they assisted patients with leprosy, but because they believed that death was the end and that only death would enable the patient to be born again into a new healthy life in the tribe, they went so far as to drive patients from their homes, and often thought they were doing right if, by withholding food or using more drastic methods, an early death was precipitated. The patients lived in dread of the curse they thought had been inflicted on them as a punishment and lived in a state of terror. Some even left home to form new villages. There, a life of segregation was chosen by the patients themselves and was merciful, besides being the means of preventing the spread of the disease.

In Uganda the situation was happily different, but the difficulty was to get the medicine to the people who, by virtue of their natural dispersal, were to a large extent segregated. The settlements catering for a minority may have given the impression that an attempt was being made to control the disease, but in actual fact this was not so, because treatment of the few is not control of the many. Dr. Kinnear Brown was appointed as Consultant to the Uganda Government in 1951 and, after making a large number of surveys, he suggested a village-clinic system to overcome the problems created by the social pattern. This was accepted with enthusiasm in Teso and had begun to function by the end of 1955.

Treatment and control are not the same thing unless they are closely linked in the combined effort. The village-clinic system and the following up of contacts together provide what is necessary. The skeleton service mentioned as the ideal, which would still put a strain on patients wanting to attend, was not economically feasible because of the lack of housing, money and personnel. The choice finally made was within the resources available and took into account the social pattern. If patients are not to have to travel long distances, then the leprosy assistant must do so instead. What exists in Teso is a compromise between the ideal and the practicable. At the end of 1966 there were 8 leprosy assistants based in 7 villages and responsible for 16 other clinics. This has worked well and its success has depended upon the loyalty of those in the service and the closeness of the supervision. In 1967 one treatment village was closed for lack of patients. Concentration in that county can now be on out-patients. The number of patients living in each of the remaining villages has fallen to between 35 and 40. It is now the plan to cut maintenance costs and to make the treatment villages more attractive by building a nucleus of permanent houses for about 16 patients on each of the village sites and by adding a better dispensary,

and also a permanent house for the leprosy assistant in charge. While it is hoped that leprosy will not always be with us, long-term provision must nevertheless be made for a smaller number of patients.

The number of out-patients attending the various clinics averages 50 or less. As the number of in-patients has decreased, 9 other treatment clinics have been opened since 1967, but they have not brought in many new patients, i.e., patients who have not previously had treatment elsewhere. When new centres are opened it is very necessary to scrutinize past records to make sure that "new" cases really are new. The number now believed cured and no longer needing treatment is very encouraging. Between 1952 and 1961, 7950 patients were treated and 3500 officially discharged. It appeared at one time, after the first influx, that the number of new patients presenting each year was beginning to level out. In 1958, when some degree of stability had been reached, the number of new patients, that is, those attending for the first time, was in the region of 1000, but last year (1968) it had declined to 400, a satisfactory fall in 10 years of 60%. The patients now under treatment include those with chronic lepromatous or unstable disease and those needing individual attention for the complications which can develop early. The remainder are the new and early cases; some of these may resolve spontaneously and are carefully watched, but others obviously need treatment from the beginning.

The number of new patients with lepromatous leprosy coming forward for treatment has shown a marked decline, particularly in the last 5 years. It is significant that a number of those we see are from a group of patients who discontinued treatment: two I know to be patients who were not lepromatous originally, who were discharged, and whose lesions have become active again.

Many schemes are successful at the beginning, but when prolonged after the first impetus has gone and the early enthusiasm has waned they may reach a critical stage when no signs of progress can be detected. This was so at one stage in Teso, but in 1960 the trial of BCG vaccination against leprosy was introduced, with the support of the Uganda Government, the Ministry of Overseas Development, and the British Medical Research Council. This trial gave a new impetus which, I think, has led to a reduction in the number of new patients. The trial itself is concerned only with 19,000 children, some 9000 of whom were vaccinated, and it is its secondary effect which leads to the main point of this paper. During the routine follow-up examinations of the children in the trial a further 32,000 children have been vaccinated, but they are not included in the trial. The number of children in Teso under 15 is in the region of 165,000. Many of the vaccinated children are barely of an age to contract leprosy. The essential factor is *that a leprosy-minded team has been going into every parish in the district regularly for the past* 10 *years*, and apart from the trial, children and adults who have had leprosy and others with suspicious lesions are produced or have come forward for assessment and diagnosis. This has meant vigorous control and has led to a dramatic fall in the incidence of leprosy.

This report is not an attempt to advocate a trial of BCG in every district, but rather to emphasize the kind of effort required everywhere. The BCG trial, a separate issue, has simplified the work in Teso, has increased the leprosy effort and not detracted from it, and has demonstrated how important it is to concentrate adequately on the field, for this will then increase the usefulness of the provisions made at settlements. The BCG trial itself has been described separately (Brown *et al.*, 1966, 1968 and 1969) and in Uganda BCG vaccination has given 80% protection against the type of leprosy occurring now in children.

Settlements are needed to deal with those requiring individual attention, and it is important that their attitude should be scientific as well as humanitarian. They alone cannot cope with a countrywide programme nor can a

country do without them. The answer to leprosy, a rural and not an urban disease, lies where it is found, that is, *in the field*. I have mentioned the type of leprosy in children when the Kumi Settlement was first begun and the serious nature of the cases when I first came to Uganda. Besides the reduction in the number of adult patients, I see today a much milder form in the children.

At the end of 1967, of the 200 Teso children resident at Kumi 100 had single lesions. The vast majority had established and extending lesions which justified treatment. There were only 6 children with lepromatous leprosy from Teso. This encourages the hope that by treating early cases as they arise, it will be possible to reduce the incidence of leprosy to the insignificant level of that of tuberculosis now prevailing in countries where that disease was once a serious problem.

ACKNOWLEDGEMENTS

I wish to acknowledge the support of all the leprosy assistants, the chiefs and the Health staff, and the help given by Dr. Kinnear Brown. I am also very greateful to Dr. I. S. Kadama, M.B.E., Permanent Secretary and Chief Medical Officer to the Minister of Health, Uganda, for his permission to publish.

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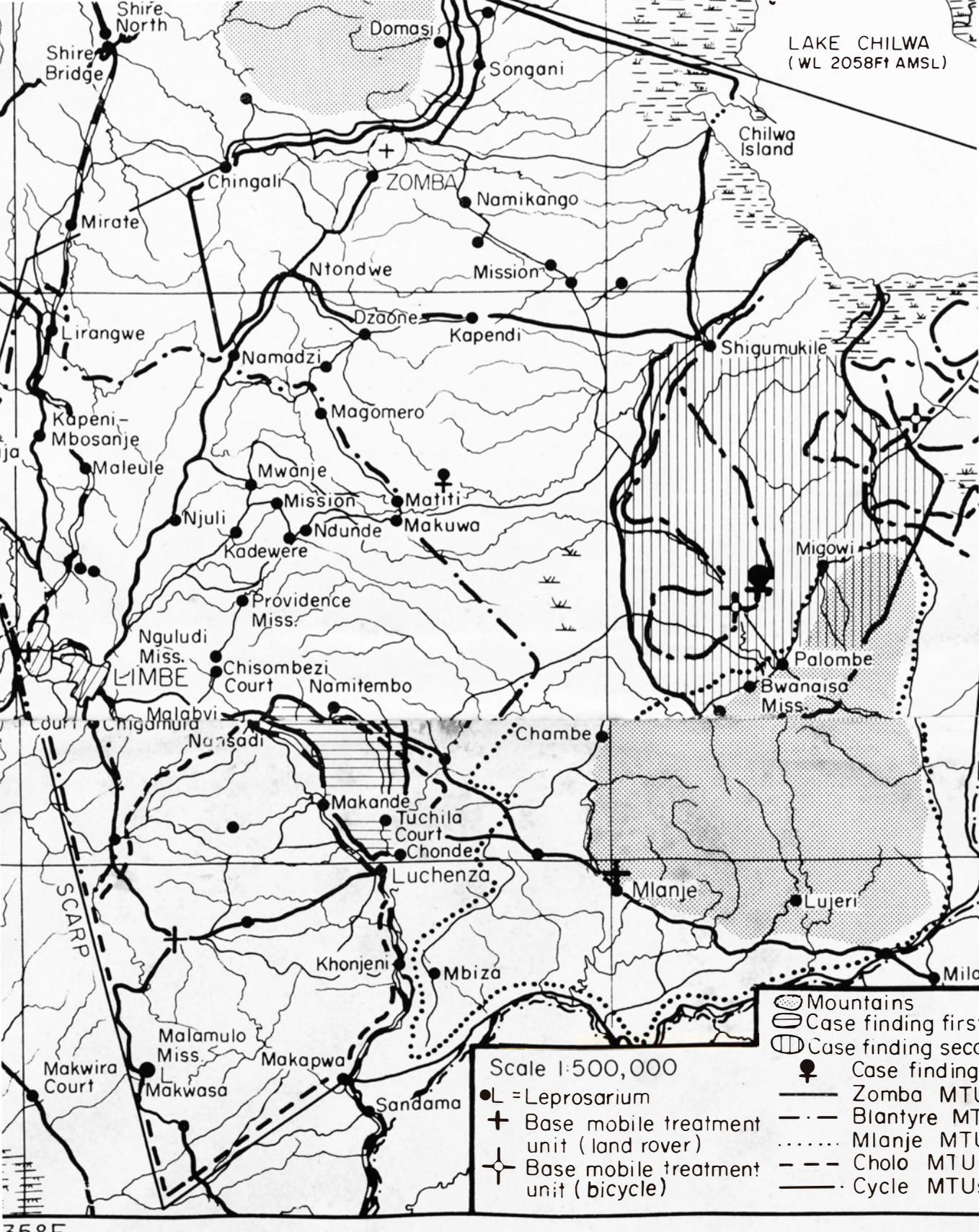
LAKE CHILWA
(WL 2058Ft AMSL)
Shire North
Shire Bridge
Domasi
Songani
Chilwa Island
Chingali
ZOMBA
Namikango
Mirate
Ntondwe
Mission
Dzaone
Kapendi
Lirangwe
Namadzi
Shigumukile
Magomero
Kapeni-Mbosanje
Maleule
Mwanje
Mission
Matiti
Njuli
Ndunde
Makuwa
Kadewere
Migowi
Providence Miss.
Nguludi Miss.
LIMBE
Chisombezi Court
Namitembo
Palombe
Bwanaisa Miss.
Malabvi Court
Chigamula
Nansadi
Chambe
Makande
Tuchila Court
Chonde
Luchenza
SCARP
Mlanje
Lujeri
Khonjeni
Mbiza
Malamulo Miss.
Makapwa
Makwira Court
Makwasa
Sandama
Mountains
Case finding firs
Case finding seco
Case finding
Zomba MTU
Blantyre MT
Mlanje MTU
Cholo MTU
Cycle MTUs
Scale 1:500,000
L = Leprosarium
Base mobile treatment unit (land rover)
Base mobile treatment unit (bicycle)
35°E

FIG. 1

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LEPRA Control Project in Malawi*

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INTRODUCTION

In the agreement drawn up between the Government of Malawi and the British Leprosy Relief Association (LEPRA) the main objectives of the Leprosy Control Project were laid down, these being: (1) to demonstrate to the world that, for all practical purposes, leprosy can now be eradicated, and (2) to show how best this can be done. It was also agreed that the duration of the Project would be from 7 to 10 years.

The selection of Malawi for this project depended on the following factors: (1) a fairly high leprosy prevalence of between 10 and 20 per 1000; (2) a high population density with reasonable communications passable at most seasons; (3) a relatively untouched area; and (4) most important of all, the full co-operation of the Government with the personal interest of His Excellency the President, without which the Project could not be carried through.

The project area situated in the southern region of Malawi seemed most nearly to fulfil these conditions. This is an area of some 2000 sq. miles, 15½° south of the equator, with the inhabited parts lying between 2000 and 4500 ft. above sea level. Rainfall is heavy but is confined to the first 4 months of the year, during which rivers—normally almost dry beds—become impassable, and earth roads become treacherous and slippery. According to the 1966 census there were 1.3 million people within the area, so population is dense and villages are mere local concentrations of the housing, which is scattered throughout the farms. The area includes the city of Blantyre–Limbe with some 120,000 inhabitants, Zomba the administrative capital (20,000 inhabitants), and 2 smaller townships.

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In the south many people are engaged in the tea industry, but elsewhere work is largely on small farms, with some estates (tobacco or tung oil), and in the north-east there is fishing around the shores of the large shallow Lake Chilwa.

MATERIALS AND METHODS

The leprosy prevalence rate was believed to be at least 10 per 1000. In-patient treatment was available only at one large Mission Leprosarium in the south-west corner of the area, or at 2 others, one small and one large, outside our area to the north. Dapsone was available at the Government dispensaries, but these were often far apart and the staff were too busy to be concerned with chronic sickness, with the result that little treatment was given and very few of the patients registered attended regularly.

After the preliminaries were agreed, Dr. Gordon Currie was seconded in 1965 by the Malawi Government to start local planning. It was extremely fortunate that a fund for leprosy work, given in memory of a local family, already existed in the country and from this a very generous donation was made for our capital expenditure. In general, the plan was a base in Blantyre within the grounds of the Queen Elizabeth Hospital with office, laboratory and ward facilities, and from this mobile treatment units were to cover the area, coupled with case-finding teams who were to give BCG vaccination to all leprosy contacts under 20 years of age. Initially it was decided that routine treatment would be with dapsone in a dosage of up to 100 mg daily. Detailed records were to be kept of all leprosy patients and a punch-card system was devised for these and for their contacts who received BCG.

By the beginning of 1966 the team was assembling and Dr. Currie handed over to Dr. Molesworth as Director, with Mr. J. H. Eldon as Administrator, and Mr. Drake as Survey Officer. Three medical assistants were seconded by the Malawi Government for training. During this training period all existing clinics were visited, their registers amended and brought up to date, and the villages from which patients came were plotted on a large scale map on which the runs of the mobile treatment units could then be planned. Treatment of all out-patient leprosy cases was taken over by the team.

By May, 1966, we were able to launch the first "mobile treatment" run, and though this was an entirely novel idea it proved very popular from the start. Intensive planning and propaganda at all levels contributed largely to its success. August, 1966, saw the start of a second unit based on Mlanje, and in September a third unit based on Zomba. These units were in the charge of the medical assistants and 3 more assistants were brought in for training.

During this period the plans for the Centre were finalized and building began in August, 1966. The publicity which accompanied the unveiling of the foundation stone by His Excellency the President highlighted a fear, obviously felt by many, that the presence of the Centre in the heart of Blantyre would bring more leprosy patients into the town. This was countered in both the press and on the radio, and we are now fully accepted as a part of the hospital, but the incident was revealing of the underlying fear of leprosy that exists.

Case-finding

Generally, of course, before such a project starts a preliminary survey should be conducted, but for various reasons, such as lack of staff, size of the area and its population, and most important the very loose cohesion of village structure, this could not be done. It was therefore decided in July, 1966, to begin work with the examination of contacts of known leprosy patients. However, this method proved extremely arduous and time-consuming and produced very limited results; in fact, after 5 months it became obvious that for practical purposes everyone in a village must be considered a contact. The results were as follows: 6886 people were examined, 163 new cases of leprosy were discovered, and 4780 contacts were vaccinated with BCG. In addition, a number of new "unrelated" cases were found, as well as some unrecorded patients who had received some treatment elsewhere (designated P.T.U., i.e., previously treated but unrecorded).

Following this, an attempt was made to gather the people of different villages together at one time and place for examination of spite of intense preparation this plan proved unworkable, as well as costly of time and personnel, owing to the loose structure of village life. Although a large number of people were examined it was sometimes impossible to discover just where they came from, and the village headmen proved of little help.

In the light of this experience it was decided to select a reasonable area, establish the team in it on a residential basis, and from this to move from village to village in an attempt to obtain complete coverage which would give us a base-line from which to assess the progress of the Project. We chose Chief Nkalo's Authority as it was of manageable size, and also the team leader came from the area and was well known and respected. Much local publicity was given and we received a big send off at a meeting with the District Commissioner, Chief Nkalo, and all his headmen when we were introduced and in turn introduced our team and our objects. In return we were promised full co-operation. The team then moved in and, living at the team-leader's village, radiated from there. All new cases were referred to the Mobile Treatment Unit which covered the district very adequately, so that treatment followed discovery with minimal delay.

Our final figures for this work were as follows: total number of persons examined 19,581, new cases discovered 59, P.T.U. cases 4, known cases 119, and doubtful cases 14, giving a

prevalence of almost exactly 10 per 1000. The coverage achieved was 87% of the census figures. Most of the new cases were in the age group 5 to 19 years, 3 times as many being discovered as were already known. It is very difficult with this age-group to convince them that early lesions are in fact those of leprosy and do need treatment. This survey occupied the team leader, 2 writers and a driver for 6 months. BCG vaccination was given to 11,900 children, but only to those aged under 15, as school surveys had shown that by this age nearly all were Mantoux positive. The team then moved on to a second area which has proved much more difficult and the work there is still going on. A second team has just been created to work further north, in the south of Zomba District.

The Centre building which was begun in August, 1966, was habitable by April, 1967, as far as office accommodation was concerned, and was functioning in all departments by the end of the year. Ward accommodation is 36 beds, and the unit is largely self-supporting, drawing on the Queen Elizabeth Hospital only for such facilities as feeding, sterilizing, radiography, and the daily dispensing for the wards. Co-operation with the hospital staff is excellent.

In February, 1968, a fourth mobile treatment unit was started in the south-west corner of the region, filling a gap which we had not reached before. This is a difficult area, with hills and deep valleys involving much back trekking.

FIG. 2
Clinical examination en route.

It is also an area with a high rate of onchocerciasis.

In the opposite corner of the project area, that is, just north of Mlanje Mountain, 2 bicycle mobile treatment units were sited in a region where landrover vehicles get bogged down during the rains. These units are working reasonably well, but are costly of supervision as they consist of a single man with minimal training whose main duties are the faithful distribution of dapsone and to refer any suspected cases to the visiting officer. One more such run is to be set up along the line of the rivers entering Lake Chilwa from the west, and this will complete our coverage. No patient will then, except by choice, have to travel more than 3 miles to obtain treatment.

Attendance has built up well but varies from season to season, from 55% in the wet and planting seasons to 75% in the dry season. The largest group of defaulters is among patients with non-lepromatous (tuberculoid and indeterminate) leprosy and aged 20 to 40 years, among whom work and marriage produce more movement and also the urgency for treatment is less apparent. We have now just completed the first 3 years of the mobile treatment runs and of our total of 9368 registered patients, 7547 are receiving treatment from these units. We have also found these units by far the best advertisement for leprosy treatment; patients spontaneously report to them for diagnosis and children are brought to be seen—in fact, the units have gained the confidence of the people.

Hitherto we have deliberately not discharged patients from treatment, although many which we inherited could obviously now be sent home, but they were retained as giving us a line on source cases in our case-finding work. New patients who began treatment with us are only just becoming due for review. The detailed recording of each case has hitherto prevented reviews being carried out on the mobile runs.

The number of new cases has remained almost the same, namely 1500 in 1968 and 1557 in 1967, but now there is a marked decrease in P.T.Us. At the beginning of 1967

P.T.Us averaged 145 per month and new cases 125; by the end of 1968 the number of P.T.Us was 60 and of new cases 110.

The case-finding team discovers only a small proportion of new patients, as the majority of them report spontaneously to a Mobile Unit or to the Centre, but the team discovers the earlier cases as well as giving us the basic information we need. Laboratory control consists of taking smears 6-monthly from lepromatous and borderline cases (BI and morphology). It is remarkable that the percentage of solid-staining forms, even in untreated cases, is very low, and we are at a loss to explain this finding.

Running costs

The total budget divided by the total number of patients gives a figure of £3 10s. per head per annum; but allowing for the fact that quite half of this figure is absorbed by the Centre, the actual cost per patient is under £2 per head, and this will, of course, decrease as the patient load increases.

Staff

The Centre staff consists of a director, medical officer, administrator, laboratory superintendent, physiotherapist, 2 registered nurses (SRN), a secretary, a clerk, and a relief driver. For the *wards and Centre out-patients department* the staff comprises: a medical assistant, an assistant nurse, 7 assistant nurses in training, and 7 ward servants. In the *Laboratory* there are 2 laboratory assistants, and a hospital servant. The 4 *Mobile Treatment Units* (*Landrover*) have each a medical assistant, a clinic attendant with bicycle, and a driver, the 2 *Mobile Treatment Units* (*Bicycle*) have each a clinic attendant, while lastly, the 2 *Case-finding Teams* have each a medical assistant, a driver, and 2 writers—one male and one female (locally and temporarily recruited).

FIG. 3
Giving treatment for leprosy in a village.

Present position and comments

An out-patient system for treatment has now been set up which gives adequate coverage to the project area. Each Landrover team averages 70 miles a day 5 days a week, with a patient density of 4.5 per mile travelled. This system is based on the Centre, which has full facilities, including ward accommodation, surgery, physiotherapy, and laboratory, and is sited within the grounds of the main hospital of Blantyre; this arrangement works well. We have found that patients with lepromatous and borderline leprosy need hospital treatment more often that those with the non-lepromatous forms (in the ratio of 70% to 30%), a fact to be borne in mind for future planning; and also that more male patients are admitted, or are more ready to accept admission, than female (again in ratio of 70%to 30%).

Training of all grades of personnel is undertaken. We consider this to be a very important part of the work, for the more that leprosy can be recognized by general medical and social workers the better. A case-finding team has covered one Native Authority area and has moved to a second, while (1969) another team is about to become operational. BCG vaccination has been given to 40,000 children under 15 years of age. Although the rate of new cases (patients reporting voluntarily or being discovered) shows no fall as yet, the type of leprosy shows a swing towards the tuberculoid form. The sex distribution is almost exactly the same as that of the census, i.e. 48% male and 52% female. These divide into: lepromatous (lepromatous and borderline): male 17%, female 11%; non-

lepromatous (tuberculoid and indeterminate): male 31%, female 41%. These observations are based on a total of 7311 patients seen up to December, 1968.

CONCLUSION

The progress to date has justified this imaginative venture undertaken by LEPRA. It is too early as yet to attempt an overall evaluation, but out-patient treatment has been shown to be possible and, with the necessary modifications, applicable to many conditions and lands.

We feel that the original objective, namely the eradication, for all practical purposes, of leprosy will be realized and the area left only with non-infective cases and the few sporadic new cases which are bound to occur. But these can be readily dealt with by the existing health services which, provided training and teaching have been adequate, will be well equipped to carry on the work.

Lepr. Rev. (1969) **40,** 243-248

Integration of Leprosy Control into the Health Centre Scheme*

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INTRODUCTION

In the last 100 years 2 outstanding events inspired the interest of the medical world in leprosy: the identification by Armauer Hansen in 1874 of the *Mycobacterium leprae* as the aetiological agent of the disease, and the discovery by Faget in 1941 of the action of the sulphones on the infecting mycobacterium. After Hansen's discovery physicians of international reputation from all over the world became interested in the pathology of leprosy, this increasing interest culminating in the First International Leprosy Congress, which was held in Berlin in 1897. Up to the introduction of the sulphones charitable organizations had predominated in leprosy work, but after their introduction leprosy became a curable disease and medical as well as public health schools included leprosy in their field of activities to an increasing extent. This change of attitude has without doubt been accelerated by the decision, exactly 20 years ago, of the World Health Organization (WHO) to include leprosy in its aid programme.

MATERIALS AND METHODS

Bechelli and Martinez Dominguez (1966) gave an idea of the magnitude of the leprosy problem in the world. They estimated that more than 2000 million people are living in areas with a prevalence rate of at least 0.5 per 1000 and may eventually be at risk of infection (Table 1). According to WHO estimates the number of new leprosy patients during the next 5 years is expected to be approximately 1 million. It is further estimated that of the total number of patients in the world (more than 10 million) less than one-fifth have so far received any treatment.

Most of the countries with a high leprosy prevalence are located in the tropics or subtropics (Fig. 1). Economically considered, they are classified as "developing" countries, that is, countries characterized by a low gross national product, an inadequate infrastructure, slow growth of productivity with an economy mainly based on agriculture, uneven distribution of property, and a very high proportion of the population living in rural areas.

In the health sector the predominating features are infectious diseases, nutritional deficiencies, and high infant mortality rates. The limited health services are mainly of the curative type, with a concentration of physicians and hospitals in the capital cities and larger towns. In the rural areas the patient-

TABLE 1

Leprosy prevalence throughout the world according to WHO estimates in 1966 (Bechelli and Martinez Dominguez)

Estimated leprosy (*rate per* 1000)	*No. of countries in:* *Africa*	*America*	*Asia*	*Europe*	*Oceania*
Less than 0.5	1	17	13	13	2
0.5—0.9	1	9	7	1	0
1.0—4.9	19	16	15	1	4
5.0—9.9	7	2	10	0	3
10.0—19.9	9	3	0	0	6
20.0—29.9	4	0	1	0	3
30.0—39.9	7	0	0	0	0
40.0—49.9	6		0	0	0
More than 50.0	2		0	0	2

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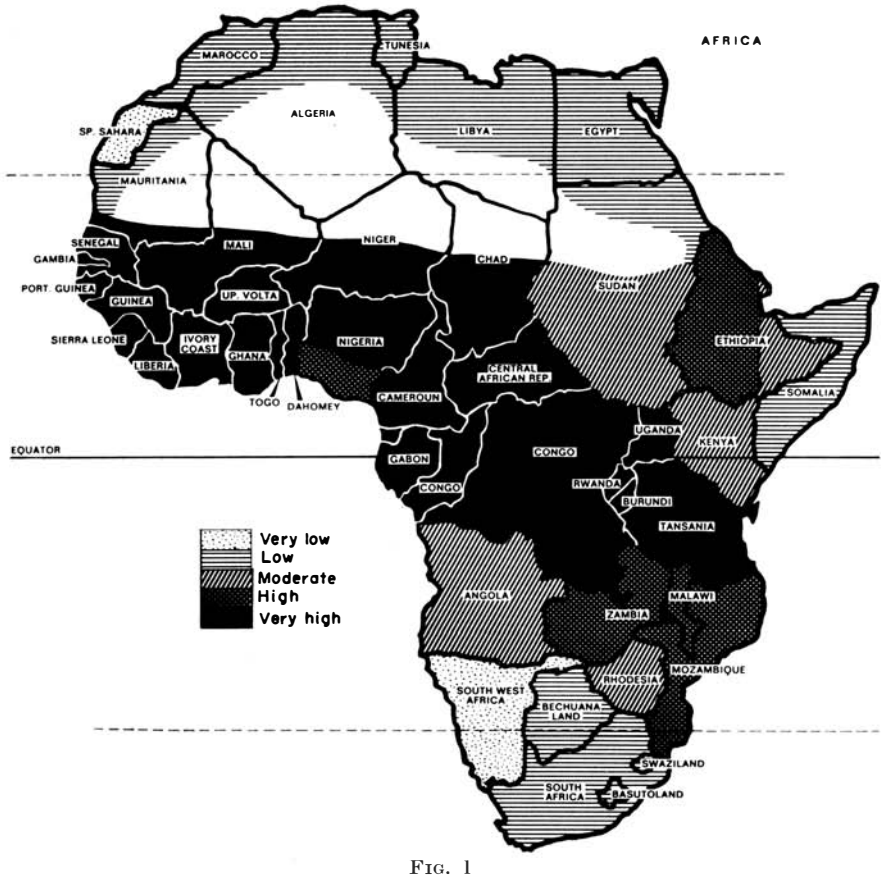

FIG. 1
Leprosy prevalence in Africa.

doctor rate ranges from 10,000 up to 500,000 patients per physician, particularly in Africa, and the relatively small number of hospital beds are available for only a minority of patients (Table 2). The population growth rates are around 2%, with a life expectancy of only 35 to 40 years, but even less than 30 in some African countries.

Being aware that the vicious circle of disease–poverty–fatalism–loss of productivity–increasing poverty–leading to more sickness, must be broken, the governments of these countries began to recognize that health is an integral part of their economic and social development.

TABLE 2
Ratio of physicians to number of inhabitants in various countries of the world (1964-66)

Physician rate per population	*No. of countries in:* *Africa*	*America*	*Asia*	*Europe*	*Oceania*
Less than 1000	0	2	2	15	3
Up to 2500	3	10	6	5	4
5000	8	11	6	0	2
10,000	7	5	5	0	1
20,000	12	2	3	0	1
40,000	11	0	4	0	0
60,000	2	0	1	0	0
More than 60,000 inhabitants	4	0	0	0	0

In their over-all planning for economic and social progress most of the developing nations are now giving adequate consideration to public health, their goal being to eradicate disease, poverty, and illiteracy. The guiding principle of their planning is the provision of the highest possible degree of well-being and health to the maximum number of people at the lowest possible cost.

The limitation of financial, technical and personnel resources is the decisive factor in the type of service to be applied. The maximum budget earmarked for health in developing countries lies around 15% of the total revenue, and ranges from 25 cents (U.S.) up to 4 dollars (U.S.) per head per year (Table 3). Nationalized health services have proved to be the most feasible solution in the majority of African and Asian countries, because they allow the main emphasis to be placed on the preventive aspects of medical care. In the organization of public health services the rural health centre has become the basic institution for the implementation of the various health programmes. In most instances, planning provides for a capillary network of health centres evenly distributed throughout the country. The size of population to be cared for varies between 20,000 and 80,000 individuals, depending on density, local needs, communication system and geographical structure. The activities of the health centres include: control of communicable diseases (often with priority for malaria), maternal and child welfare, environmental sanitation, health education, medical care, with some laboratory facilities, collection of vital statistics, and, to an increasing extent and mainly in Asian countries, family planning.

TABLE 3

Percentage of national budgets allotted to public health in some industrialized and developing countries with nationalized health services (1962-66)

Country	*Percentage of budget*
Congo (Brazzaville)	18.0
Dahomey	15.0
Togo	14.0
Great Britain	13.0
Bolivia	11.2
Japan	10.5
Sierra Leone	7.8
Soviet Union	6.6
Ethiopia	5.7
Iraq	5.6
Brazil	5.1
Indonesia	5.0
Turkey	5.0
India	4.6
Laos	2.5

The gap between planning and realization of such essential health services necessitates the training and employment of larger numbers of auxiliary personnel able to take over tasks generally reserved for physicians. Most of the countries give preference to the "polyvalent" health worker. The few physicians available in rural areas have to devote most, if not all, of their time to tasks of training, supervising and planning. Subcentres or health stations in varying numbers—a rate of at least 5000 persons per health station is desirable—are attached to the health centres. The required buildings are preferably constructed in local style and material in order to achieve maximum cost-effectiveness (Figs 2 to 4).

The health centre is usually operated by a team, with a health officer in charge and assisted by community nurses, midwives, sanitarians, laboratory technicians, health educators, dressers, and clerks in varying numbers. The health stations are run mainly by nurses or dressers, all of whom have received their education within the country and are trained for, and on, the job, being supervised by workers of a higher level, generally the district or provincial officer of health.

If *ideal* conditions exist, leprosy is adequately taken care of by the health-centre scheme. According to the needs, clinic hours for special diseases such as leprosy, venereal diseases, tuberculosis, or yaws can be arranged and held at regular intervals. Home visiting, case finding, surveys, treatment follow-up, examination of contacts, correction of insanitary conditions, health education of the public, and other measures can most easily be effected through a properly functioning health centre organization,

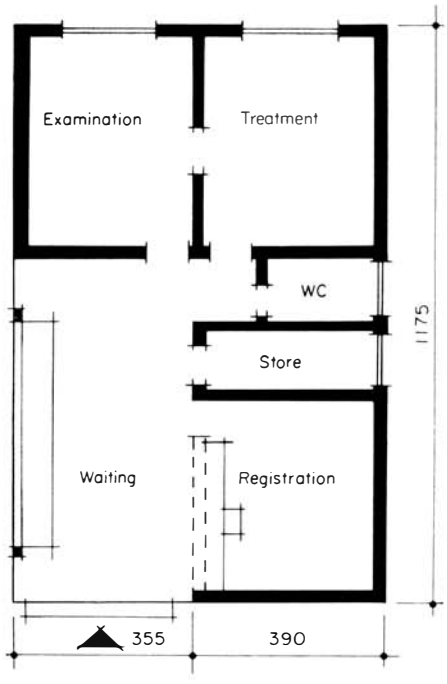

FIG. 2
Floor plan of a health station.

benefiting the whole population including, of course, leprosy patients.

In the majority of countries with a leprosy problem, control measures were initiated before health centres came into existence. Specialized services, often in close co-operation with missions or private institutions, have been in charge of leprosy control. Here the trend is directed toward gradual integration of leprosy services into the health centre scheme as far as out-patient treatment is concerned. At the end of this development the health centres could become the main institutions for the implementation of leprosy control activities.

The specialized leprosy services continue to exist at the ministerial level, their main objectives being:

(1) preparation of a plan of operations for the control and eventual eradication of leprosy;

(2) integration of the leprosy control programme into the scheme of basic health services;

(3) co-ordination and supervision of all governmental and non-governmental activities in the field of leprosy control;

(4) promotion of a rehabilitation programme;

(5) training of medical personnel at all levels in leprosy work;

(6) advising hospitals, clinics, health centres and other institutions on current leprosy problems;

(7) enlightenment of the public on the nature of the disease and its prevention;

(8) collection of as much information as possible on the incidence and spreading of the disease, as well as on social and other factors promoting and contributing to its spread; and finally

(9) maintenance of an effective reporting and notification system.

The operation of one or more demonstration centres with the aims of training personnel and

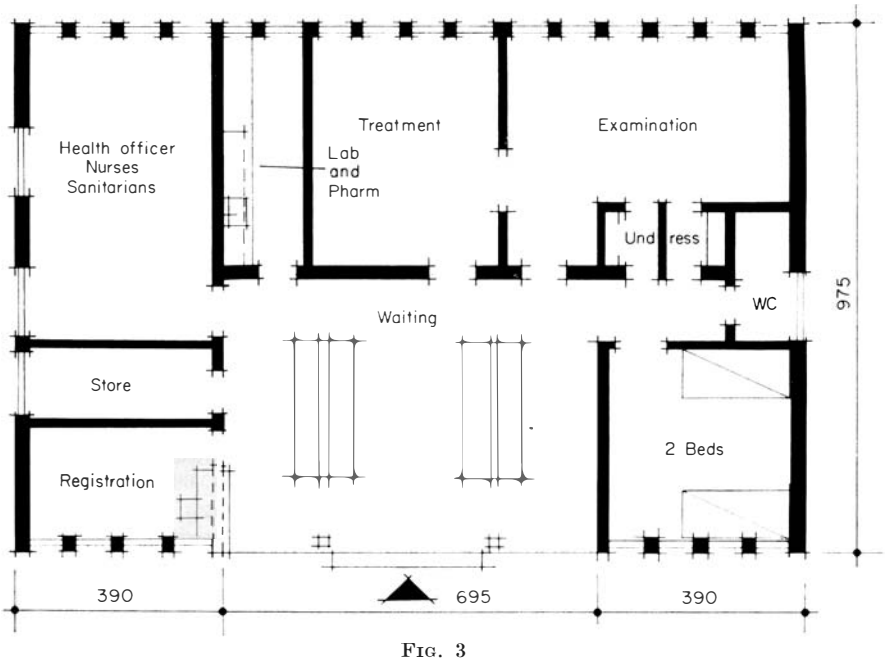

FIG. 3
Floor plan of a minor health centre.

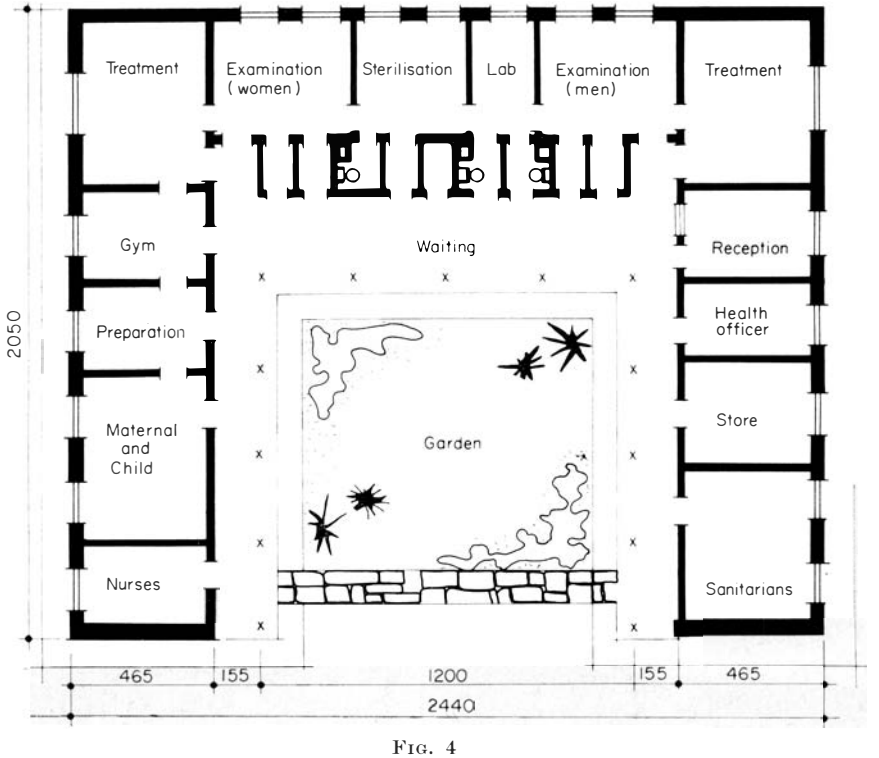

FIG. 4
Floor plan of a major health centre.

forming a cadre of leprosy workers, introducing modern methods of diagnosis and treatment, and performing research in the field of leprosy has proved to be of the greatest value for the implementation of the control programme.

It is up to the chief of the leprosy control services to see to it that leprosy receives fair and just consideration within the health planning of the country, taking into account the chronicity of the disease, the number of persons involved, the social stigma and prejudices associated with it, the problem of rehabilitation, and other factors of importance. The guiding principle in leprosy control must be: early cure is the best prevention!

SUMMARY

Three significant developments make the expansion of leprosy control possible: the introduction of the sulphones; the importance given to out-patient treatment in combating leprosy; and the integration of leprosy control activities into the basic health-centre scheme. Special efforts should be made to harmonize general planning with new developments in the expansion of rural health services and the integration of the specialized services, such as leprosy control, into the scheme of the general health services.

It is indispensable to balance the planned expansion of the health services with the financial potential of the country and its capacity for training public health personnel.

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Lepr. Rev. (1969) **40**, 249 250

Plan of Leprosy Control in Nepal being Carried out in a General Hospital*

J. C. PEDLEY

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Addressing the closing session of the Ninth International Leprosy Congress in London, Dr. Stanley Browne said: "There is no single world-wide plan for dealing with leprosy, but in every area there is a plan which is better than others".

It would appear from all the available evidence that the endemicity level of leprosy in Nepal is not less than 10 per 1000 and is probably as high as 15 per 1000. The population of Nepal is reckoned to be about 10 million. Thus, there may be about 150,000 people suffering from leprosy in the whole country. Two factors make the prevention and control of leprosy in Nepal very difficult: (1) *Poor communications*. Throughout most of the country there is scarcely any other means of travel than on foot by mountain trails. (2) *Repressive leprosy laws*. If these laws are enforced, a patient can be deprived of his land, made to leave his village, and go and live for the rest of his life in a government leprosy colony where there is no segregation of the sexes. These laws make the control and prevention of leprosy very difficult, as people who contract the disease are naturally afraid to disclose it.

In these conditions, what is the "plan that is better than others" for carrying out a programme of leprosy control in Nepal? A simple one, which is to be described, has been worked out in the leprosy wing of a general hospital situated in the mountains of western Nepal. My thanks are due to the Leprosy Mission for seconding me to the United Mission in Nepal so that I might have the opportunity to carry out leprosy work in this context for nearly 10 years.

*Received for publication 9 July, 1969.

Leprosy patients attend the out-patients department like any other patient. In-patient care is also provided for treatment of trophic ulcers of the foot, reactive states, and reconstructive surgery. This aspect of the work has become widely known and patients continue to attend in steadily increasing numbers. Case-finding surveys into the remote villages from which they come are unlikely to take place for a very long time to come, but in the meantime a doctor experienced in leprosy and settled in one place over a long period can build up confidence and draw people with the disease out of their villages to come for treatment.

Many of our patients are anxious to protect their families from contracting the disease, and some patients have asked me to let them have preventive medicine to give to their children, even before I suggested it. I believe that it is right to uncover this anxiety and exploit it for the purpose of instituting preventive treatment. Thus, during the past 18 months it has become a firm practice not to allow a patient, no matter what type of leprosy he has, to leave the hospital until his family have been listed and preventive treatment has been prescribed for all close contacts. This means that to any close contact aged 4 years and over, 50 mg of DDS per week is given, while children under 4 years and above the age of 1 year are given 20 mg per week. Children under 1 year of age will receive the drug in the breast milk (Tuason and Rivera, 1965).

Up to the time of writing, nearly 1000 close contacts of 250 patients have been put on preventive treatment, and this number will steadily increase to the end of the year because:

(a) there are several hundred more patients on the register whose close contacts have not yet been inquired into, and (b) there will be more close contacts of new patients who will be added to the register before the year is out. The average distance which these 250 patients travel to the hospital is 35 miles, and by the time they get back home again the round journey will have taken them 8 or 9 days. Not a few of them travel distances of 100 to 150 miles to reach the hospital. Therefore, I rarely give less than 6 months' to 1 year's supply of curative and preventive DDS, which costs between 3 and 8 shillings a year for one family. Of these 1000 close contacts, the proportion of children to adults averages approximately 3 to 1. It would not be possible at the present time to reach all these contacts by personal visitation, but we can and do reach them through out patients who, in a sense, become our paramedical workers.

While I am unable to give a critical appraisal of this preventive work, my belief in the value of taking DDS prophylactically is based on experience gained while acting as medical officer to a government leprosy colony in this country. The number of children born annually in the colony increased from 20 to 69 over a period of 10 years. All the children were given regular prophylactic doses of DDS during this time. I never saw any ill effects of the drug, and not one of the children developed leprosy, although many were living in close contact with patients with very advanced lepromatous disease.

As regards the emergence of drug resistance to DDS, I have yet to meet an example of this. The occurrence of it is regarded as rare by some competent workers (Pettit and Rees, 1964). I therefore believe that this plan of bringing close contacts under preventive treatment can do no harm, and may do much good.

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Lepr. Rev. (1969) **40**, 251-253

Letters to the Editor

B I

Thank you for giving us the opportunity to reply to the letter from Dr. John H. S. Pettit regarding our paper entitled "An Open Trial of Low Doses of Dapsone in the Management of Lepromatous Leprosy".

It is because the findings were unexpected and disturbing that we felt it necessary to publish them. While it would not be proper for me to enter into a discussion with Dr. Pettit on the merits and demerits of the bacterial index (BI), I may add that most of the comments that Dr. Pettit has made in this regard would be applicable to the supposedly more sensitive parameter, namely the morphological index (MI). We are aware of very marked variation in the score given by two highly reputable laboratories in relation to the MI and, therefore, the observer's error that Dr. Pettit is pointing out, seems to be not very different from the assessment of BI, as compared to MI. I should like to state that these smears were taken and read by one senior technician with random checks by one of us (A.B.A.K.).

I would refer Dr. Pettit to page 620 of *Leprosy in Theory and Practice*, 2nd edition, 1964 (Appendix 3), where Dr. Ridley discusses the Bacteriological Indices; we have followed the definition of the positivity that Ridley gave in that paper according to his system of 0 to 6. I may add that we are not aware of "reasonable consensus of belief that in untreated lepromatous leprosy the initial BI would be above 4+". In fact this consensus (if it exists) may apply only to sanatorium-based leprosy research and certainly not to studies based on intensive domiciliary treatment programmes where it is very common to find early cases of lepromatous leprosy, the majority of which tend to have a BI below 3+ on Dr. Ridley's scale. In our domiciliary treatment programme, which has over 8000 patients, more than 50% of new registration of lepromatous leprosy patients have a BI of below 3+.

I may further add that we have been inoculating bacilli from skin biopsies from patients on low doses of DDS at periodic intervals, and data available to date suggest that the bacilli in the skin of patients treated with small doses of dapsone are viable even after 18 months of continuous treatment. I must further add that the presence of DDS in the sera of these patients has been authenticated through the courtesy of Dr. C. C. Shepard, so that there is no doubt that these patients to whom we are referring have had regular doses of DDS. The further analysis of data regarding these patients since submission of our paper is in keeping with the findings which we have already presented.

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Anbu Jeevaratnam
P. S. S. Rao

Christian Medical College and Hospital
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S. India

11 October, 1969

B 663

In their paper "The effect of methylcellulose on the phagocytosis of *Mycobacterium lepraemurium*" (*Lepr. Rev.*, 1969, **40**, 83-86) Drs Wong and Gibson make some points involving B 663 (Lamprene) which require comment.

First: B 663 is not "taken up by macrophages in particulate form" as these authors state (p. 86) but rather it would appear to enter the macrophages in solution linked to a lipoprotein carrier which is then split off (Byrne, Conalty and Jina, 1969), with the consequent intracellular formation of crystals of B 663.

Second: there is no need to invoke the concept of enhancement of phagocytosis to explain the activity of B 663 as its activity

against a wide spectrum of mycobacteria is also apparent *in vitro* (Barry and Conalty, 1965). Indeed not only does B 663 not enhance phagocytosis by macrophages but in high doses it actually depresses this (Conalty, 1966; Byrne, Conalty and Jina, 1969).

Third: from their findings that methylcellulose did not alter the course of *Myco. lepraemurium* infection and that individual macrophages ingested the polymer or the bacilli preferentially they concluded (p. 86) that B 663 "must be administered either in high dosage or over prolonged periods in order to gain access to bacilli lying within cells". This extrapolation is unwarranted and is not borne out by the therapeutic findings in: experimental tuberculosis (for literature references see Barry and Conalty, 1965), *Myco. lepraemurium* infection of mice (Chang, 1962), or *Myco. leprae* footpad infection of mice (Shepard and Chang, 1962).

In conclusion we should like to express our disquiet at the publication of results based on experimental work in which no less than half of the experimental animals died from intercurrent infection.

M. L. Conalty
A. Jina

Laboratories
Medical Research Council of Ireland
Trinity College, Dublin 2, Eire

22 July, 1969

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B 663

It has been brought to our attention by Dr. M. L. Conalty that after submission of our paper to the *Leprosy Review* (1969, **40**, 83) evidence was presented that B 663 (Lamprene) is not taken up into the macrophages by phagocytosis and that the speculation we made about the possible sequestration into macrophages which did not contain bacilli was unjustified.

None the less, our preliminary observations showed there is evidence of preferential uptake of certain materials by particular macrophages, and this is a factor which should be borne in mind when the *in vivo* action of chemotherapeutic agents is being considered, since the uptake must be related to events at the cell surface, perhaps including pinocytosis.

I wish to emphasize that demonstration of preferential uptake would be expected to be influenced by the relative quantities of the materials administered simultaneously. When a large number of organisms is administered with a given dose of methylcellulose, some uptake of both may be observed, whereas with a smaller inoculum segregation may be more evident. So far, by the methods used, we have detected only small numbers of bacilli in cells containing large quantities of methylcellulose, whereas cells which had ingested large numbers of bacilli did not contain demonstrable methylcellulose.

Another point made by Dr. Conalty and Mr. Jina is that B 663 does not enhance phagocytosis. In our experience we found no evidence of enhancement of phagocytosis by methylcellulose, and we remarked in our paper that the action of drugs such as B 663 "cannot be ascribed to an enhancement of phagocytosis alone".

P. C. Wong

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31 October, 1969

BACTERIAL INDEX

I should like to claim a little space in your columns to consider the paper by Karat *et al.* entitled "An Open Trial of Low Doses of Dapsone in the Management of Lepromatous Leprosy" (*Lepr. Rev.*, 1969, **40**, 99-105) in which the authors admit that some of their findings are disturbing.

These are the findings connected with the Bacterial Index (BI) of their patients, and I must admit that I find equally disturbing the tendency to rely on this index as having some statistical or scientific value. It should not be necessary, Sir, to remind your readers that the skin-scraping technique is grossly inaccurate—taking, as it does, an unmeasured amount of tissue fluid and spreading it over an undefined area. It is therefore imperative to do everything possible to diminish technical variation and I should be glad to know if all the smears reported in each of their cases were taken by the same person.

I am at present engaged on an international study of the treatment of lepromatous leprosy, and scrapings taken by physicians in many parts of the world are sent to me. It is fascinating to note the difference in area that these smears cover, and to see that the size varies not only from worker to worker but also from smear to smear. It might well be that only one technician took all the smears in the paper under question, but as there is no comment on this I will not be convinced that the BI actually rose during treatment until I have been offered a little more evidence.

It is also necessary to question the authors' definition of positivity, that is to say, how they grade 1+, 2+, etc. It seems to me certain that they do not use Ridley's Logarithmic Index, as there is a reasonable consensus of belief that in untreated lepromatous leprosy the initial BI would be above 4+, and more than half the cases reported have an initial BI under 3+ (and 2 more with a BI of exactly 3.00). As Ridley took pains to show, the logarithmic index is not accurate but has simply been devised to reduce the inconsistencies of a non-scientific technique.

I should be grateful if Dr. Karat and his co-workers could tell us a little more about these matters. If all their smears were made by one worker and if their definitions of the BI have eradicated the problems that worried Dr. Ridley, it would be true that their findings needed further study. It is also possible that by now (as their paper must have been completed by March, 1969) they have further results regarding the BI in these patients; it is to be hoped that the patients continued on low dosage, as otherwise we shall never know whether the "tendency of the BI to rise" was a fact or an unfortunate combination of technical errors.

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17 September, 1969

Lepr. Rev. (1969) **40**, 254-255

Book Reviews

Santé et développement en Afrique, by L. P. Aujoulat. Librairie Armand Colin, 103 Boulevard Saint-Michel, Paris, Ve, 1969. 285 pages.

For far too long, and with some justification, leprologists used to be accused of isolationism. They kept themselves to themselves, blissfully unmindful of the ferment and turbulence going on around them in the world of scientific medicine. Nowadays, they may face the charges that they are so concerned that leprosy should not be forgotten or neglected that they tend to over-emphasize its importance and commandeer more than their fair share of cash and publicity.

Here is a book that should be read by all those interested in leprosy as it occurs in the setting of the medical and economic problems of the developing countries.

Dr. Aujoulat is not a specialist leprologist, and some of his expressed views on the success of leprosy campaigns may appear unjustifiably optimistic, but he has an unrivalled and intensely practical knowledge of the larger problems of health and disease, of rural and tribal Africa, of control of tropical endemic disease and the disquieting health hazards of the new industrialization and urbanization. He paints on a wide canvas, with sweeping strokes, but his touch is so sure and so elegant that the reader follows him with mounting interest. He insists time and again that medical policy has to take account of the human factor and non-medical considerations; it must anticipate and, if necessary, mitigate the results of its own spectacular successes.

The book is written in the eloquent French characteristic of the author, and its severely practical passages are illumined by flashes of personal experience culled from distant days in the African bush or more recent contacts with health administrators around the conference table. It is unfortunate that the proof-reading is below standard.

Watch Those Eyes. Eye Complications in Leprosy, 2nd ed., by Margaret Brand. The Leprosy Mission, London. Price: 1s. 6d.

The increasing attention paid to the ocular lesions of leprosy owes a good deal to Dr. Brand's efforts, and the appearance of this second edition of her excellent guide to diagnosis and treatment is further evidence of their success.

Clinical vigilance and the timely application of basic remedies, rather than access to advanced technical expertise, are the important requisites for prevention of much of the blindness for which leprosy is responsible. Dr. Brand's advice to the leprologist without special ophthalmic training is admirably clear, and invaluable also to the ophthalmologist unacquainted with leprosy.

In the further editions to be expected an index would be a useful addition.

Pathology in the Tropics, by G. M. Edington and H. M. Gilles. London. Edward Arnold (Publishers) Ltd., 1969. 756 pages. Price: £5 net.

This comprehensive and authoritative volume fills a long-felt gap, and fills it admirably. It is clear as well as full, illustrated with excellent black-and-white photographs, and provided with over 80 pages of collated references that will be appreciated by those working away from central libraries.

Epidemiology and geographical pathology receive an emphasis that is merited by their importance but frequently neglected in books of this type. The appendix includes descriptions of diagnostic procedures and techniques not readily available elsewhere.

The chapter on leprosy gives an excellent account of the macroscopic and microscopic aspects of the host-parasite relation in this disease, and omits nothing that could be compressed into its 15 well-packed pages. Leprologists would perhaps wish for fuller treatment of such subjects as immunology in relation to the various types of leprosy, of cell-mediated immunity, and of recent microbiological experimental work. But for the general reader, the pathologist to whom leprosy is no longer a far-off disease but one that may arrive in his laboratory as a skin-smear or a "sarcoid" granuloma or a skin section showing a sheet of foamy cells, this chapter should be sufficient to whet his appetite for more exotic fare.

Misprints are rare. The statement that "pure anaesthetic leprosy is a relatively common clinical entity" (p. 264) would not go unchallenged in Africa, or even outside Africa.

The paperback edition is good value at £5; a hard-back edition is available at £10.

We predict a most useful life for the first edition of this work.

Essays on Tropical Dermatology, ed. by R. D. G. Ph. Simons and J. Marshall. (Amsterdam.) Excerpta Medica Foundation, 1969. 292 pages. Price: U.S. $20.00/£8 7s. Sterling/Dfl. 72.00.

There is some truth in the jibe that leprologists see leprosy when they should not, and that dermatologists do not diagnose leprosy as often as they should. Although written primarily for physicians dealing with dermatoses, particularly as they present themselves in tropical countries, these *Essays on Tropical Dermatology* will help both leprologists and dermatologists to recognize skin conditions that are not infrequently misdiagnosed. Unusual appearances of common dermatoses as they are modified by environmental factors in the tropics, are described and illustrated.

Of particular interest to our readers would be the chapters on Granuloma multiforme and Sarcoidosis,

in addition to chapters entitled *The fight against leprosy* (Latapi), *The treatment of leprosy* (Cochrane), *Borderline leprosy* (Jonquières) and *Treatment of the acute lepra reaction* (Languillon). These chapters provide a useful summary for the non-specialist reader, without advancing any views that are novel or epoch-making. Latapi emphasizes the importance of domiciliary treatment integrated into a comprehensive medical programme and the need to counteract outmoded attitudes. Cochrane concentrates on unexceptionable advice on treatment with a few standard drugs. Jonquières deals competently with the difficult problem of the intermediate forms of leprosy, while Languillon gives useful hints on the management of patients with lepromatous leprosy undergoing acute exacerbation.

Some abbreviations might well have been written in full: thus on p. 143, I.L.A. stands for International Leprosy Association, and O.M.S. for *Organisation Mondiale de la Santé* (World Health Organization).

The photographs in these chapters, and indeed throughout the book, are excellent.

Synthetic phenazine derivatives and mycobacterial disease: A twenty-year investigation, by Vincent C. Barry. *Scient. Pro. R. Dubl. Soc., Series A*, **3**, 153.

Dr. Barry has again placed us in his debt. In this Boyle Medal Lecture he retraces with unadorned skill the fascinating Odyssey he pursued in company with his Dublin colleagues in the search for an antimycobacterial drug. He allows us to peep into the captain's chart-room and to share with him, in retrospective imagination, some of the hazards of the voyage, the false courses taken in ignorance, and the crucial calls at the Isle of Serendip, where he made valuable and unsought discoveries.

From synthetic antimetabolites to the conscious and progressive modification of diploicin (the first organic chlorine compound found in nature), we can follow the story of the synthesis of scores of rimino-phenazine compounds, until the development of some that were far more active than streptomycin or the thiosemicarbazones in experimental murine tuberculosis. B 663 proved to be the most active, both as a causal prophylactic and also as a treatment for the established infection: it is still the only compound known to achieve this effect on oral administration. It is strange that no published report has appeared concerning its value in human tuberculosis. However, B 663 is still the only drug that has held murine leprosy in check for as long as 816 days without the development of drug-resistance. The supposition that B663 is of no value in human tuberculosis may be correlated with the observation that the drug is concentrated in macrophages. This fact suggested to Barry and his fellow chemists, and subsequently to Cochrane and Browne, that B 663 should be tried in human leprosy. The subsequent results of the clinical investigations conducted at Uzuakoli have received wide publicity.

B 663 has been found of value in treating ulceration due to *Myco. ulcerans* and also to an atypical avian strain of bacillus.

The anti-inflammatory properties of B 663 in erythema nodosum leprosum may be associated with some impairment of macrophage action in processing antigen, and hence to some immunosuppressive activity.

Barry briefly touches upon the mode of action of these rimino-phenazine compounds. Since B663 is strongly taken up by living mycobacteria, it is possible that it interferes with terminal hydrogen transfer, but much is still obscure.

B 663, or Lamprene (Geigy), has now passed the Dunlop Committee, and has received the approved name of clofazimine.

Lepro. Rev. (1969) **40**, 256

Obituary Notice

ERNEST MAX BRIEGER, 1891-1969

Dr. E. M. Brieger, who died on 31 January, 1969, was born, brought up and educated in Breslau, and obtained his medical degree at the University of Breslau. After distinguished service as a medical officer in World War I, he became director of the Municipal Tuberculosis Hospital of his home town. He was the German representative on the Committee for After-care and Rehabilitation of the International Union against Tuberculosis, and it was his pioneer work in this field that brought him into contact with England, and in particular with Papworth Village Settlement. When the establishment of Hitler's regime forced him to leave Germany, he joined the staff at Papworth, where he took charge of the Department of Industrial and Clinical Physiology.

From the problems of rehabilitation and gross pathology in tuberculosis, he increasingly directed his interest towards the relation between the causative organism and the host cell. It was the proximity of Papworth to the Strangeways Research Laboratory at Cambridge, with its world-wide reputation for research in tissue culture and cell biology, that led to discussion with the Director of the laboratory, Dame Honor Fell. This marked the beginning of a happy period of association with the laboratory, which extended over 25 years. Abreast of new technical developments, Dr. Brieger was one of the first to use the electron microscope in the study of biological material. In the mid-1940's he collaborated with Dr. V. E. Cosslett at the Cavendish Laboratory in an investigation into the filterable form of the tubercle bacillus.

Some 10 years later, Dr. R. G. Cochrane drew Dr. Brieger's attention to various aspects of the host–parasite relation in leprosy, and encouraged him to investigate some of these problems, using the techniques that he and his colleagues had developed in their studies of the tubercle bacillus. He made many attempts to cultivate the leprosy bacillus in a wide variety of cells and tissues, the bacilli having been derived from different types of leprosy. His lack of success in this field led him to investigate the viability of the bacilli in biopsy material, both by studies on bacillary metabolism (in collaboration with the late Professor R. F. Naylor) and by the morphological appearance of the bacilli in thin sections as seen under the electron microscope. He subsequently investgated the role of the lysosomes, described earlier by De Duve and his colleagues in Louvain, in the extensive destruction of intracellular leprosy bacilli. He was the first to show by cytochemical and electron-microscopical studies that lysosomes were involved in cellular defence in leprosy. His interests extended widely throughout the fields of cell biology and bacteriology. His tremendous enthusiasm for these research activities found their inspiration in his deep compassion for those suffering from the diseases to the study of which he devoted his life.

We are indebted to Miss Jennifer M. Allen for the substance of this notice.

Abstracts

following 3 abstracts are reprinted, with permission, from *Trop. Dis. Bull.*, 1969, **66**, 5:

1. **Effect of BCG-vaccination upon the multiplication of *Mycobacterium leprae* in the footpads of mice,** by M. MALDA, K. NAKAMURA, and H. KATAYAMA. *Lepro*, 1968, **37**, 2. (In Japanese, English summary.)

In a series of experiments in which groups of 2 to 4 mice were used, vaccination with BCG delayed the multiplication of *Mycobacterium leprae*, injected into the footpad 24 to 51 days before to one month after vaccination. The method of counting the bacilli in the footpads was described in an earlier paper (this *Bulletin*, 1968, **65**, abstr. (2827)); the BCG was administered as a suspension either in saline or in Drackeol No. 6, as an adjuvant.

The results show that the vaccine was more effective if injected subcutaneously into the footpad, or intravenously, than if injected intramuscularly or intraperitoneally. Although in some of the experiments, the live vaccine appeared to afford more protection than the killed one and in other experiments this appeared to be reversed, the highest degree of protection was obtained with the live BCG in the adjuvant.

(As this abstract is based on the English summary and tabulated results, it is difficult to assess the value of the authors' conclusions, especially as the sizes of groups of mice were small.)

S. R. M. Bushby.

Pathological study of nasal deformity in lepromatous leprosy, by C. K. JOB, S. KARAT and A. B. A. KARAT. *Lepr. India*, 1968, **40**, 2.

This study is based on nasal biopsies of 26 patients with perforated septum or other nasal deformity, both in the active stage of lepromatous leprosy and after healing.

The subepithelial tissue, the septal and lateral cartilages and the bony part of the septum were infiltrated by lepromatous granulation tissue with some lymphocytes and plasma cells. In one case a necrotic septum was infiltrated by polymorphs. After healing the cartilage was hyalinized and the eroded area replaced by fibrous tissue. It was concluded that collapse of the nose is due mostly to destruction of cartilage which is brought about by infiltration of lepromatous granulation tissue and not by secondary

D. S. Ridley.

3. **Studies in mice of the action of DDS against *Mycobacterium leprae*,** by C. C. SHEPARD. United States—Japan Co-operative Medical Science Program. Proceedings of a symposium on sulfones. San Francisco, California, 11 May, 1967.

Nine strains of *Myco. leprae* from untreated patients were tested in mice against a diet containing 0.0001% of DDS and all were sensitive. Only 1 out of 6 was sensitive to a diet containing 0.00001% DDS. Apparently the minimal inhibitory concentration of DDS is about 0.02 μg/ml, which 1/100 of the blood concentration in men taking 50 to 100 mg/day. This action is partially antagonized by *p*-aminobenzoic acid. Probably leprosy might be treated effectively by spaced administration of DDS or by injection of repository sulphones, but certain precautions are desirable.

following 5 abstracts are reprinted, with permission, from *Trop. Dis. Bull.*, 1969, **66**, 6:

4. **A controlled study of polymorphisms in serum globulin and glucose-6-phosphate dehydrogenase deficiency in leprosy,** by M. F. LECHAT *et al. Int. J. Lepr.*, 1968, **36**, 179.

As a part of a study of genetic polymorphism and leprosy, 5 genetic markers were investigated in patients with leprosy and in control subjects from Cebu, Philippines. There were 557 patients, of whom 256 were affected with lepromatous leprosy, 224 with tuberculoid leprosy, and 77 with other types of the disease or unclassified disease. There were 434 control subjects without manifestations of leprosy, comprised of medical students and skin clinic patients. The markers investigated were haptoglobins, transferrins, serum group-specific components (Gc) and β-lipoprotein (Ag), and glucose-6-phosphate dehydrogenase (G6PD). The phenotypic distributions were analyzed in relation to leprosy, type of leprosy, and lepra reaction. Age, sex, duration of disease, and province of birth in the Philippines were also considered. Gene frequencies were derived.

An association between haptoglobin polymorphism and leprosy is suggested by an excess of Hp 1 : 1 phenotypes and/or the Hp 1 gene, observed particularly in lepromatous but also in tuberculoid or total cases when compared with control subjects. No differences, however, were observed for transferrins, Ag, and G6PD. Because of technical problems, no conclusions were drawn concerning Gc types.

G. R. F. Hilson.

5 **Liver function tests in leprosy,** by A. DHOPLE and S. BALAKRISHNAN. *Indian J. Med. Res.*, 1968, **56**, 10.

In an attempt to determine the degree of functional damage sustained by the liver in patients suffering from various forms of leprosy, the authors employed a battery of tests rather than relying on a single test which in the past has been the basis of most published reports. Morphological changes in the liver cells, and the presence of typical granulomata, have been well documented. The following tests were done on sera from 74 patients with lepromatous leprosy, 36 with

tuberculoid leprosy and 16 healthy controls: serum bilirubin, proteins, turbity (zinc sulphate), cholesterol, alkaline phosphatase and transaminases.

Patients with tuberculoid leprosy showed only slight departures from the normal pattern in the protein profile and turbidity tests. Those with lepromatous leprosy showed marked alterations in these tests, and higher serum bilirubin alkaline phosphatase levels. The serum transaminases (glutamic-pyruvic and glutamic-oxalacetic) were normal, in contradistinction to previously reported findings. These results are interpreted as indicating some degree of liver dysfunction (but no active cellular necrosis) in patients suffering from lepromatous leprosy.

(The wide ranges of values obtained in the various tests reflect the severity and duration of leprosy as it affects the structure and activity of a complex organ that has a multiplicity of functions and a considerable reserve capacity.)

S. G. Browne.

Serological tests for treponemal infection in leprosy patients. An evaluation of the fluorescent treponemal antibody absorption (FTA-ABS) test, by M. F. Garner, J. L. Backhouse, C. A. Collins and P. J. Roeder. *Br. J. Vener. Dis.*, 1969, **45**, 1.

Serological tests for treponemal infection were carried out on 270 patients with lepromatous leprosy and 250 normal controls, from the Philippines. All sera were subjected to the Cardiolipin Wassermann reaction, the Venereal Disease Research Laboratory test, the Reiter protein complement-fixation test, the fluorescent treponemal antibody test, the fluorescent treponemal antibody absorption test, and the *Treponema pallidum* immobilization test. A reactive TPI test result was taken as evidence of treponemal infection and all other test results were compared with it.

Sera from 5.6% of the leprosy patients showed evidence of treponemal infection. BFP reactions occurred with 8.1% of leprosy sera, the VDRL slide flocculation test being responsible for the majority of these. Non-specific reactive results to the RPCF and FTA-200 tests are discussed. Special attention was given to evaluating the FTA-ABS test against the TPI test. They were found to be of almost equal specificity and of equal sensitivity.

It is concluded that, where the TPI test is not available, the FTA-ABS test can replace it in detecting BFP and non-specific reactions to serological tests for treponemal infection in sera from patients with the lepromatous form of leprosy.

7. **Studies of sulfone resistance in leprosy. A case of partial resistance,** by J. M. H. Pearson, J. H. S. Pettit and R. J. W. Rees. *Int. J. Lepr.*, 1968, **36**, 2.

Earlier reports (this *Bulletin*, 1965, **62**, 108; 1967, **64**, 633) showed the dapsone (DDS) sensitivities of leprosy bacilli of 4 out of 9 patients who had active lepromatous leprosy, in spite of at least 13 years' treatment with sulphones; one strain was resistant to the drug; the strains were examined after intensive treatment for 6 months with 300 mg DDS twice weekly by injections. This paper describes in greater detail the clinical history of the patient with the resistant strain and the subsequent sensitivity studies. He was admitted in 1937 to Sungei Buloh Settlement, Selangor, Malaysia, at the age of 14, and treated with hydnocarpus oil until 1948 when the treatment was changed to injectable DDS, 400 mg twice weekly. The treatment was continued until 1961 during which time skin smears remained positive, although the clinical response was considered satisfactory. In 1961 multiple small nodules appeared and the treatment was changed to thiambutosine. In January, 1962, a biopsy showed "typical foamy leproma" and in September sulphone therapy was resumed.

In March 1963 he was referred to the Leprosy Research Unit with extensive lepromatous leprosy; positive skin smears showed a morphological index (MI) of 37. With intensive sulphone therapy there appeared to be some clinical improvement and the MI fell to 12. Treatment was continued to March, 1964, when the MI was still 15 and treatment was changed to 500 mg sulphormethoxine (Fanasil) daily, later twice weekly, but because of severe erythema nodosum leprosum treatment was discontinued. The MI had fallen to 4 but in February, 1965, it had risen to 28, treatment during this period having been stopped. In February, 1965, treatment with the rimino-phenazine B 663, 100 mg thrice daily for 6 days a week, was started; the result was excellent.

The sensitivity of the bacilli to DDS was measured by the footpad technique (*ibid.*, 1964, **61**, 929) on biopsies taken in March, 1963, May, 1964, and February, 1965. The final test showed the organism to be resistant to 0.04% sulphormethoxine, and 0.025% DDS in the diet of the mice which gives concentrations of 2.6 to 4.0 μg/mil of DDS in the serum; strains of leprosy bacilli from untreated patients are usually sensitive to 0.0001% or less DDS in the diet.

The degree of DDS resistance of these strains was less than that found in other strains (*ibid.*, 1965, **62**, 108) and the patient is considered to be the first case of reported "partial" sulphone resistance. Other cases presumably exist, and the authors recommend that in the *in vivo* sensitivity test mice be treated with 0.025, 0.01, and 0.001% DDS in the diet, and they conclude that only strains that multiply in mice on the lowest dose can be regarded as fully sensitive and the patient likely to respond to full doses of DDS.

S. R. M. Bushby.

A comparison of the effectiveness of two freeze-dried BCG vaccines against *Mycobacterium leprae* **in mice,** by C. C. Shepard. *Bull. Wld Hlth Org.*, 1968, **38**, 1.

In previous publications (this *Bulletin*, 1965, **62**, 880; **63**, 1202), the author reported that vaccination of mice with BCG affords them protection against infections with *Mycobacterium leprae*. The BCG vaccines used in these experiments were mainly fresh liquid pre-

parations grown in the laboratory. The author, in the present paper, now reports results of similar experiments with British (Glaxo) and Japanese (Research Institute for Tuberculosis, Kiyose-Machi) freeze-dried preparations.

The methods used were essentially those described in the earlier publications, but in brief the mice were inoculated intradermally in the flank with 0.01 ml of vaccine. Each vaccine was given in dilutions of 1 : 1, 1 : 10 and 1 : 100 to groups of 20 mice. After 32 days the mice were challenged with 5×10^3 *Myco. leprae* in the right hind footpad. Growth of *Myco. leprae* in unvaccinated control mice was monitored by counts of acid-fast bacilli (AFB) in footpad tissues of pools of 4 mice taken from 4 groups monthly, starting 3 months after challenge. When the harvest of *Myco. leprae* per footpad in the control animals had risen above 1×10^6, counts of AFB were made on pools of footpad tissues of 8 mice from each group; the counts on each group were repeated 3 months later. A liquid vaccine, prepared from a 17-day culture of the Rosenthal strain, was used as a standard.

The results showed that all the vaccines provided distinct protection, but it was not possible to decide which vaccine was most effective because their optimal activities were not manifested at comparable times. At 6 months after challenge, shortly after the growth of *Myco. leprae* in the control mice had reached plateau values, the results were related to dose, and the vaccines appeared to arrange themselves in order of potency. However, in the second harvest, the relative potency of the 2 freeze-dried products had reversed, and the relationship between dose of vaccine and protection was different for each vaccine.

Considerations of results in mice lead to speculation about the ways the vaccine protection might be manifested against *Myco. leprae* in human beings. If the protection were exerted against the potentially infectious inoculum, the result might be simply prevention, or perhaps delay, of clinical disease. If the protection were directed against the new growth of *Myco. leprae* in the subject, the result might be a stabilization of the infection at an early stage, or perhaps a greater tendency for minimal disease to resolve. Based on experience with more acute infections, vaccine prevention is often regarded as a single event in the infectious process, but *Myco. leprae* infections develop extremely slowly in man, and it seems reasonable to assume that a protective effect could be exerted at various times in the infectious process.

S. R. M. Bushby.

The following 5 abstracts are reprinted, with permission, from *Trop. Dis. Bull.*, 1969, **66**, 7:

9. **Is it safe to treat the lepromatous patient at home? A study of home exposure to leprosy in Hong Kong,** by R. M. Worth. *Int. J. Lepr.*, 1968, **36**, 3.

This study provides data for assessing the validity of the assumption, accepted in some circles but not in others, that patients with leprosy who no longer harbour morphologically normal *Mycobacterium leprae* in skin or nasal mucosa, are incapable of spreading the disease. Sixty-six families were identified in which one parent (64) or two (2) were suffering from histologically confirmed lepromatous leprosy, untreated at the time of intake. Of the 109 children exposed to bed contact or close living contact with an untreated parent, in the crowded housing conditions of Hong Kong, 6 out of 63 boys and 4 out of 46 girls developed signs of leprosy. Ninety-five of these 109 children were considered to be at risk, the remaining 14 not having been observed for a minimum period of 7 years.

Further analysis revealed that all the children developing leprosy were among the 70 who had been exposed, while under the age of 7 years, to a parent with untreated leprosy. None of the 30 children born into these homes after the parent had begun taking sulphones, showed signs of leprosy during the minimum period of 7 years of observation, although the skin of the parent continued to harbour *Myco. leprae.*

"A large majority" (unspecified) of the children had been given BCG vaccination, but none received prophylactic sulphones.

It is concluded that sulphone treatment of the patient with bacilliferous leprosy rapidly reduces to zero the risk of his continuing to be the source of contagion. This finding, supported by experimental evidence provided by the mouse footpad technique, indicates that domiciliary treatment of patients with lepromatous leprosy carries no greater risk to the community than prolonged segregation of patients having viable or non-viable *Myco. leprae* in the skin and nasal mucosa.

(This suggestive study should be repeated on a larger scale, with additional bacterioscopic investigations concerned particularly with the duration of morphologically normal *Myco. leprae* after treatment had been instituted, and the relation of this factor to the occurrence of secondary cases among the child contacts. Data relating to the timing of BCG vaccination, if given, and the appearance or non-appearance of leprosy lesions, should be sought.)

S. G. Browne.

10. **Survival among leprosy patients with special consideration of cancer as a cause of death,** by A. Oleinick. *Int. J. Lepr.*, 1968, **36**, 3.

The author found that the mortality rate among the 953 leprosy patients admitted to the Carville Leprosarium, Louisiana, between 1939 and 1963, was approximately the same as that of the general population. The type of leprosy made no difference. Because of the special circumstances attending the introduction of sulphone therapy during the early 1940's and its application to patients who had been chronically ill with severe leprosy, the mortality rate (among females) was rather higher during the first few years after 1939. During the sulphone era, there was a slight excess in mortality in middle-aged males and older females during the first 5 years after their admission to Carville.

In view of the differences in reported series, and

the theoretical interest of chronic lymphoid stimulation (manifested by hyperglobulinaemia and the presence of numerous auto-antibodies in the serum), a special study was made of the mortality from malignant disease. The risk of leukaemia or lymphoma was not found to be increased in this series.

S. G. Browne.

An electromyographic study of lagophthalmos in leprosy, by J. Chaco, A. Magora, H. Zauberman and Y. Landau. *Int. J. Lepr.*, 1968, **36**, 3.

Clinical and electromyographic (EMG) studies, carried out in Israel on leprosy patients with lagophthalmos, confirmed that the 2 parts of the orbicularis oculi muscle (upper and lower) can be affected independently. Where both parts are affected, the lower is generally the first to be involved and later shows a higher degree of paralysis. Weakness confined to the lower part of the muscle may indicate selective damage to the zygomatic branch of the facial nerve, and trauma apart, is not found in facial palsies of other origins. No EMG evidence of subclinical damage to facial muscles was found, in contrast to findings in hand muscles, and damage to the facial nerve was usually preceded by damage to ulnar and median nerves.

W. H. Jopling.

Pathologic changes and their distribution in peripheral nerves in lepromatous leprosy, by C. K. Job and K. V. Desikan. *Int. J. Lepr.* 1968, **36**, 3.

This is an important study of the clinical and histological appearances of the ulnar, median and radial nerves in lepromatous leprosy. Post-mortem examination of 4 active cases showed that these nerves were normal at their origins but became thickened when they became superficial. Thickening increased gradually in the ulnar nerve, reaching a maximum about 2 cm above the medial epicondyle, then becoming normal in size in the forearm to increase again in thickness at the level of the proximal crease of the wrist. Thickening was abrupt in the median nerve, occurring as it emerged from the cover of flexor digitorum sublimis and reaching a maximum at the level of the transverse carpal ligament. Thickening of the radial nerve commenced in the lower fourth of the forearm where it pierces the deep fascia and divides into medial and lateral branches.

With regard to the histological changes, these were maximal where the nerves were most thickened and consisted of large numbers of foamy macrophages; large concentrations of acid-fast bacilli inside macrophages, perineural cells and Schwann cells; oedema; increased vascularity; thickened perineurium; demyelination; destruction of axons; and diffuse fibrosis. Demyelination was much more prominent than axonal degeneration.

The authors discuss the reasons for these changes being most marked where the nerves are subcutaneous, and suggest that lowered temperature and exposure to trauma are the operative factors.

W. H. Jopling.

Antipyretic and anti-inflammatory action of flufenamic acid in acute reaction of lepromatous leprosy, by C. S. Goodwin. *Lancet*, 1968, Oct. 19, 854.

In 22 cases of lepromatous leprosy with acute reaction, flufenamic acid (Arlef) had a significant antipyretic effect with accompanying fall in the erythrocyte sedimentation rate. Erythema nodosum subsided in 23 out of 25 episodes, and all the signs and symptoms of acute iridocyclitis and neuritis were relieved. High-dosage, short tapered courses, up to 25 mg per kg of body weight per day, were the most effective and were tolerated well. One patient given up to 28 mg per kg per day of flufenamic acid had neutropenia, but 10 days after treatment was stopped his leucocyte count had returned to normal.

W. H. Jopling.

14. **Glucose-6-phosphate dehydrogenase deficiency in leprosy.** Letter from M. Kher and S. Grover. *Lancet*, 1969, *i*, 1318.

The authors found that the prevalence of G-6-PD deficiency was 22% in 120 leprosy in-patients, compared with 9.4% in the general population of Nagpur (Central India) and surrounding areas. They suggest tentatively that this deficiency may predispose patients to infection with *Myco. leprae*. They also remark that sulphones may induce haemolysis in patients with G-6-PD deficiency.

S. G. Browne.

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