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EDITORIAL

The Weddell Theory on the Pathogenesis of Leprosy

Dr. G. Weddell of the Department of Human Anatomy, University of Oxford, towards the end of 1962 had many of his ideas reported in the newspapers. These have had wide dissemination in newspapers at home and abroad. Examples of the headlines are the following: 'Oxford Research Clues may lead to end of Leprosy' (*Daily Telegraph*, 15.12.62); 'British Discovery may end Leprosy' (*Yorkshire Evening Post*, 15.12.62); 'New Theory on Leprosy' *The Times*, 15.12.62); 'New Theory on Leprosy Cause' (*East Anglian Daily Times*, 15.12.62); 'Leprosy Research' (*Glasgow Herald*, 17.12.62); 'Serious Doubts on Leprosy Theories' (*The Birmingham Post*, 15.12.62); 'Theories on Leprosy are now Doubtful' (*The Irish News*, 15.12.62); 'Leprosy Theories Shaken' (*Cork Examiner*, 15.12.62); 'Grave Doubts on Leprosy Theories' (*The Guardian*, 15.12.62); 'Leprosy Spread by inhalation or ingestion' (*Medical News*, 21.12.62); 'Miss 'X' speaks on new moves against leprosy' (*The Catholic Herald*, 21.12.62); 'U.K. Doctor's New Theory on Leprosy Prevention' (*South China Morning Post*, 18.12.62); 'Prevention of Leprosy' (*The Hindu*, 18.12.62); 'Leprosy: some experimental observations' (*Medical News*, 15.2.63).

The effect of all this newspaper publicity has seemed to spread in the minds of the public, and in those in charge of the control of leprosy in many countries abroad:

1. that transmission of leprosy by the skin is unimportant or even entirely negative;

2. that transmission of leprosy by the blood is on the contrary highly important;

3. that transmission of leprosy by the stomach, contrary to what is usually thought, is of considerable importance;

4. that transmission of leprosy and development of leprosy in the nerves is unimportant.

The longest newspaper article available to us is that of *Medical News*, London, 2nd February 1963. From that the following quotations are made:

1. "An intensive and extensive search using a number of different techniques failed to reveal any *M. leprae* passing through the epidermis into the skin to invade the cutaneous nerves in young children and adults, who were, or had been, in constant daily contact with open cases of the disease."

2. "Recently we had the opportunity of examining an untreated case with a single patch on the left arm above the elbow. This proved on histological examination under the light microscope to be a reactional tuberculoid lesion, and we were unable to find any *M. leprae*."

3. "On looking through our sections systematically, however, we were at first surprised to find two evenly stained, clearly outlined, 'normal-looking' *M. leprae* in two different Schwann cells in one of the normal nerve bundles. The cells in which these organisms were residing appeared to be normal, and so were the axons related to them."

4. "From these observations it is no longer possible to hold the view that *M. leprae* in all clinical forms of the disease are not at some period disseminated via the bloodstream."

5. "Leprosy is a highly infectious disease and its target is the sensory nerve Schwann cell.

The response of the patient depends upon three factors.

(*a*) The magnitude of the infection, i.e. the number of organisms which invade the body within a given period of time.

(Due to the long incubation period a single massive invasion may evoke the same response as a number of separate invasions by fewer organisms. Clearly then it could be envisaged that the magnitude of the invasion and the number of times invasion occurred could vary independently in such a way as to evoke a whole variety of different responses.)

(*b*) The resistance of the patient to the products of metabolism of the organism—clearly another factor which may be the cause of variations in the clinical picture.

(*c*) The genetic constitution of the patient which may characterise the particular pattern of the response in different countries and among different races.

The evidence so far available, that the portal of entry is through the skin as the result of repeated body-to-body contact with open cases, is weak. On the other hand, there is no evidence that the portal of entry is *not* through the skin."

6. "We have found no evidence that leprosy is *less* infectious than other mycobacterial diseases. Indeed there is every reason to support the growing clinical belief that, by regarding it as a serious infection and setting about reducing the lepromatous rate by drugs dispensed via a network of rural clinics, as well as by education and enlightened public health measures, the disease could be eradicated."

7. "Personal and public hygiene, coupled with drug therapy to reduce the magnitude of the infection, are as important in leprosy as in any other infectious disease."

8. "Secondly, that it is now clear, at least to us, that leprosy can only be stamped out quickly and effectively if practising physicians and charitable organisations continue to work in harmony. They must continue their policy of inviting biologists who are primarily interested in the basic medical sciences to co-operate with them in this work, as they have indicated that they are willing and anxious to do in the future."

The above extracts have been quoted to give some idea of what Dr. Weddell is aiming at. Everywhere scientists and leprologists have undoubtedly discussed this to the best of their ability on the publicity obtainable, and we think it would help if at this stage we report that all experienced leprologists consulted, and Dr. Weddell concurs, agree that nothing has been adduced to overturn the accepted ideas about the transmission of leprosy, namely that the blood; the respiratory tract; the stomach, may play some part, but it should be kept in perspective; and that the skin is not dethroned from its important place as probably the main route of transmission of leprosy. In other words, *the present public health measures of control of leprosy are so far nowhere required to be altered.* There is no harm in renewed attention to the hygiene of food.

(The remarks in the paragraph just above have been shown to Dr. Weddell, who approves.)

We are glad to publish in this issue of *Leprosy Review* on page 57 an article from Dr. Weddell and Miss Palmer which deals with this subject. It has just become available as we go to press, and discussion of it must necessarily be deferred to the next issue. Comments and letters are invited.

THE PATHOGENESIS OF LEPROSY

An Experimental Approach

G. WEDDELL and ELISABETH PALMER,
Department of Human Anatomy, Oxford.

Current views on the pathogenesis of leprosy lead one to suppose that it would be comparatively easy to find acid-fast organisms passing through the epidermis into the skin, particularly in babies in areas where there is repeated, prolonged and intimate contact with the skin of a lepromatous mother. These are the areas which are quite commonly the seat of lesions in the child in later years. However, no one has been able to do this although some authors have maintained that disintegrating bacilli can be found in the form of acid-fast granules in the cells of the superficial layers of the dermis. Be this as it may, no whole mycobacteria have been seen in the skin from contacts, except in their nerves at a stage when they must be regarded as having definitely contracted the disease. It might be argued that the chances of finding organisms in the epidermis are slim but that if relatively large biopsies were homogenized and centrifuged the organisms, which easily resist such procedures, would be concentrated and thus more readily found. Success has been claimed for this technique but we have not been able to find organisms in the skin of contacts by this means, although we have tried many times. Not all the contacts examined were inmates of leprosaria, however.

It is generally accepted that in every patient in whom a diagnosis of leprosy can be established, *M. leprae* are to be seen associated with cutaneous nerves. The problem, as it presented itself to us, was to determine how they reached them. A necessary step and the one we decided to tackle first was the determination of the particular elements in sensory peripheral nerves which were capable of ingesting particulate matter, including mycobacteria. Since the progress of treatment in leprosy is customarily checked from periodical skin biopsies we decided to inject carbon particles into the skin of patients with lepromatous leprosy 5-7 days before such biopsies were taken. We were considerably surprised to find that carbon particles were to be found in large numbers in Schwann cells related to degenerating axons in the cutaneous nerve bundles. We selected cases with the lepromatous form of the disease, for it is known that more cutaneous nerves than usual are passing through a degenerative and regenerative cycles. Clearly, the next step was to analyse the nature of this process and in the early stages this could be done only by using animals for our experiments.

We were fortunate at this point to be able to join forces with Dr. R. J. W. REES and together we carried out a series of controlled

experiments in which either carbon particles, or *M. lepraemurium* were injected into the sciatic nerves of rats. Healthy animals and others already infected with murine leprosy were used, the particles being injected into crushed nerves or between the stumps of divided nerves. These experiments showed that Schwann cells associated with degenerated nerve fibres behave as macrophages, showing phagocytic activity. They will even ingest *M. lepraemurium* which is not normally associated with nerve fibres in murine leprosy. This is particularly evident in the case of crushed nerves where there are no extraneural macrophages available. Fewer organisms were ingested by Schwann cells in healthy rats than in rats with murine leprosy, but never as freely as carbon particles. The next step was to determine the behaviour of Schwann cells of human sensory cutaneous nerves toward similar forms of particulate matter. To this end small fasciculi from the radial nerves at both wrists were excised and either heat-treated *M. leprae* or *M. lepraemurium* were injected on one side and carbon particles on the opposite side. Fortunately heat-treated *M. leprae* have a characteristic morphology which distinguishes them from the patient's own bacilli.

So far we have only had four volunteers on which we have carried out this kind of experiment but in each case we obtained an unequivocal result: following the injection of *M. lepraemurium* there was an inflammatory response and no organisms were seen in Schwann cells, but they were found in macrophages in the connective tissue sheaths of the nerve bundles. By contrast, *M. leprae* were found in large numbers in Schwann cells which, although only 5 days had elapsed since the original operation, were in a state of heightened activity comparable to that seen normally only 7 days after nerve section. In other words, if it is permissible to generalize from two sets of observations in four patients, certain Schwann cells in degenerating nerves are actively 'attracted' towards killed *M. leprae*. This conclusion was reinforced by another observation in which a segment of the radial nerve serving perfectly normal looking skin, free of sensory impairment, in a patient with a single lesion on the contralateral side, was removed. This was intended to serve as a normal human sensory nerve specimen for testing a new staining method for nerves for examination under the light microscope and comparison with its appearance under the electronmicroscope. We were greatly surprised to find one small bundle within the fasciculus undergoing degenerative changes comparable with those seen in the cutaneous nerve of patients with reactional tuberculoid leprosy, which included fragmented organisms. The findings under the light microscope paralleled those seen under the electronmicroscope but, although a prolonged search was made for mycobacteria in the affected bundle, nothing but acid-fast 'dust' was ever encountered under the light microscope. However, when the *intact* portion of

this nerve bundle was examined without expecting any mycobacteria, two viable organisms came to light lying in healthy Schwann cells related to healthy nerve fibres. So far no such organisms have been found under the electronmicroscope but there are still many sections to be examined. It remains to add that no mycobacteria were seen in the skin biopsy from the single patch on the opposite side, the histological picture being typical of tuberculoid leprosy.

Because of the possible significance of these findings we carefully surveyed the literature and have come across some papers reporting the presence of *M. leprae* in the Schwann cells of nerve trunks serving maculo-anaesthetic lesions in patients having a self-limiting form of the disease, who died from causes unconnected with leprosy. These confirmed and extended our own findings. It is also accepted by many authorities that *M. leprae* can be found in the Schwann cells in many nerve trunks of patients with single self-limiting maculo-anaesthetic patches which are quite unrelated to the lesion. Organisms are also present in the affected nerves in the poly-neuritic form of leprosy and in some of these cases no skin lesions whatever can be found. Thus our experimental observations, coupled with the reports in the literature, certainly lend no support to the view that *inunction* is the chief method by which the organism enters the body.

On this point it is necessary to describe some observations on human sensory skin nerves which may appear to be unrelated to leprosy. Our work connected with cutaneous sensibility necessitated the development of improved neurohistological techniques. As the result we can now say with certainty that there is a small but constant turn-over, i.e. degeneration followed by regeneration to be seen in all sensory nerves of the body. The changes are more obvious in those parts exposed to trauma and in the later decades of life.

We have also demonstrated that during Wallerian degeneration the macrophages which remove neural debris stem from within the perineural sheath. Many of them can be seen developing from Schwann cells related to non-myelinated axons.

It is of course premature to argue from this series of preliminary observations that *M. leprae* do not enter the body by inunction through the skin, but they strongly suggest that the evidence for this belief should be re-examined most carefully. Indeed, if our histopathological observations can be substantiated then it must be assumed that leprosy is potentially a highly infectious disease and basically in the same category as tuberculosis.

If we take our experimental observations at their face value then we are compelled to argue as follows: *M. leprae* invade the body by the bloodstream, by inoculation through the skin and, although we have no evidence for this, through the lungs and the intestinal walls. Certainly, inoculation through the skin must occur for cuts, pricks,

insect bites, etc., are unavoidable in areas where the disease is endemic. Once in the bloodstream the organisms are carried to their target organ, the Schwann cells of the sensory nerves, in which they lie protected by the basement membrane (this is only seen by electronmicroscopy) and multiply. The rate of multiplication is known to be very slow, for proven incubation period are seldom, if ever, less than two years. As in other mycobacterial diseases what follows depends upon: (1) the severity of the infection; (2) the natural immunity of the patient. Sooner or later, most sensory nerve Schwann cells will be involved in the process of Wallerian degeneration, which, as has been explained above, is now known to be a regular event. Those Schwann cells which lose their protective basement membrane and assume the role of phagocytes proceed to remove both neural debris and micro-organisms from the Schwann cells related to the degenerating nerves. If the number of organisms they contain is few then we can assume that the phagocytes will be able to digest them and dispose of them and thereby acquire further anti-body, if natural immunity is present. This will presumably result in the subject becoming lepromin positive and they will exhibit no lesions. In such cases further invasions will be promptly dealt with and even if invasion occurs the organisms will be unable to multiply.

If, however, the original infection is more severe, a larger degree of immunity will have been acquired. Thus, when the number of organisms is large enough to break through the protective basement membranes, there will be an explosive antibody-antigen reaction, a maculo-anaesthetic patch will appear and the disease will become self-limiting. Although maculo-anaesthetic lesions usually lead to a self-limiting form, this may not always be the case. In the 'African macule' a tuberculoid lesion is the first to appear and the patient is lepromin positive. Later, however, further lesions appear and the patient may even, in time, present with a lepromatous lesion and is found to be lepromin negative. This series of events can, if our assumptions prove correct, be explained on the basis of a low natural immunity coupled with repeated and massive doses of infection. The polyneuritic form of the disease, which is the most distressing of all, probably results from multiple severe infections in subjects with low natural immunity. Finally, the lepromatous form can be regarded as a result of massive infection in patients who have no natural immunity.

In different parts of the world and among peoples of different genetic stock the forms of the disease vary considerably. It seems that, genetically speaking, a greater resistance is inherited by some races than others.

There would thus appear to be three factors concerned in the pathogenesis of leprosy; (1) the severity of the infection; (2) natural

immunity, probably genetic in origin; (3) racial immunity, certainly genetic in origin.

This view brings leprosy into line with other mycobacterial diseases. If we are right, then it must be the long incubation period which has given rise to the suggestion that *M. leprae* has a low degree of infectivity. Indeed, it is difficult to understand how certain patients develop the disease often many years after living in countries where it was endemic, unless the organism is regarded as potentially very infectious. On the basis of our work such cases might well be the result of a sudden increase in neural turn-over and the release of a large number of organisms. The site of the lesion in leprosy, we would like to emphasize, is in our view no indication of the portal of entry but rather an expression of damage to the nerves in the skin, or at any point between the skin and spinal cord.

We should like to make it quite clear, that our description of the pathogenesis of leprosy must not be regarded as already proven. It is based as yet on a few experimental observations which must be validated statistically.

It seemed to us that leprologists would wish to know of our findings at this stage because they suggest so strongly that education in personal and public hygiene is just as important in the case of leprosy as it is in tuberculosis. Most workers in the field have already assumed this; all we have tried to do is to supply them with some ammunition, not necessarily for use in action but for thought.

As laboratory workers we are only anxious to help, not to issue edicts. We are well aware that in the long run it is the leprologist only who can solve the problem of the eradication of leprosy.

Summary

The authors describe certain of their findings in the histology of the skin and nerves which cause them to doubt whether inunction through the skin is as important as was previously thought in the pathogenesis of leprosy. They also call for attention to three factors (1) the severity of the infection; (2) natural immunity, probably genetic in origin; (3) racial immunity, certainly genetic in origin, and call for statistical and other research.

CHEMOTHERAPY OF LEPROSY WITH DIETHYL-DITHIOL-ISOPHTHALATE 'ETISUL'

by TADASHI HIRAKO,
National Leprosarium, Tama Zenshoen.

The treatment of leprosy has gradually improved since numerous anti-leprosy drugs have been introduced not only sulphone compounds such as D.D.S. but also other types of preparations, thiourea derivatives, and antibiotics. Until ETISUL was recently reported to be effective for tuberculosis and also leprosy, there were no effective drugs for external use, in spite of the fact that one of the main lesions of leprosy is found in the skin. The results of its use obtained in a clinical trial for leprosy in Japan, has also confirmed ETISUL to be effective. Following are these findings, along with my evaluation.

Method of application

As a rule, the preparation was used alone, and it was rubbed into the skin, five days a week, in 5 to 10 gm. doses each time. A bath was taken several hours after the inunction to wash it off.

Cases treated

A total of 21 cases were treated with ETISUL, 15 lepromatous leprosy and six non-lepromatous leprosy.

TABLE 1

	Lepromatous leprosy	*Non-lepromatous leprosy*
1. Fresh untreated cases	8	6
2. Reactional cases:		
(1) Pseudo-exacerbation	3	0
(2) E.N.L.	1	0
(3) Others	2	0
3. Relapsing cases	1	0
Total	15	6

Results of treatment

In all cases, it was noted that there was a reduction of infiltration, redness and swelling, as well as destruction of bacilli.

In the cases of epithelioid cell reactional stages, such as Pseudo-exacerbation or Acute Infiltration in lepromatous leprosy and tuberculoid change in non-lepromatous leprosy, the infiltration of the skin eruptions promptly disappeared, and the general conditions were greatly improved.

In the cases of lepromatous leprosy, with the continuation of treatment, macroscopic reduction in size and thickness of leproma

as well as disappearance or improvement of infiltration were also observed clearly.

However, the efficacy of the preparation ceased after about six months in Case 1, about three months in Case 2 and about two months in Case 8. As the treatment continued infiltration, redness and swelling gradually increased again.

Concerning the occurrence of E.N.L., it was impossible to see the direct influence of this preparation, because the drug was used for a short period, and only a few cases were treated. Neither epithelioid cell reaction, nor neuralgia were observed when ETISUL was used.

Examination of the skin smears showed no remarkable decrease of the bacillary index, but all bacilli were fragmented morphologically.

After the application of ETISUL, lesions of nasal mucosa were greatly improved as were skin lesions.

In ocular lesions, however, it showed little efficacy.

Side-effects

No disturbance was observed in liver, kidney, haematopoietic organs or other organs.

However, dermatitis was frequently seen in many patients. There were two kinds of dermatitis. One was seen among the patients who received ETISUL for a few days (Case 12, 13, 14, 15, 17, 18, 19, 21). The other was frequently noted in patients who tolerated ETISUL one or two months but then developed dermatitis after that. The dermatitis gradually increased in severity in the latter. It began with red miliary papules, and then developed an appearance of eczematous changes. In those cases, the dermatitis disappeared soon when inunction was ceased, or could be cured by the usual ointment application on the affected area. However, the same kind of eruption recurred gradually when ETISUL was used again.

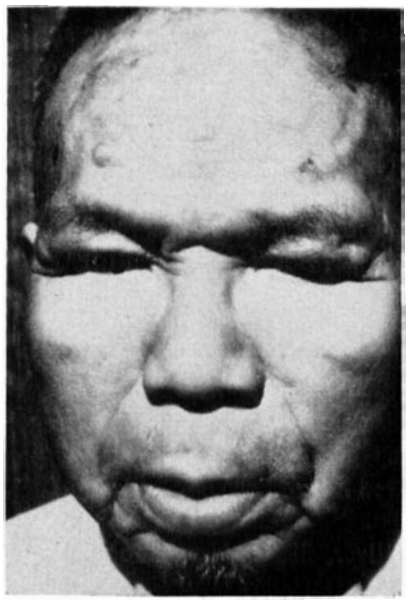
Evaluation

From the results obtained by the sole use of ETISUL in the treatment of leprosy, although only a small number of cases was treated, it could be said that ETISUL has a therapeutic effect on leprosy. In the treated cases, clinico-morphological improvement such as reduction and absorption of infiltration occurred. There was lessening of swelling in the lesions; bacteriologically, a fragmentation of bacilli was observed.

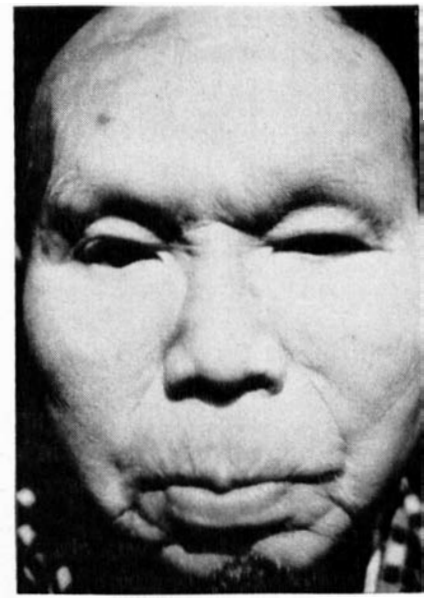
In the cases of tuberculoid reactions, however, the eruption often disappeared spontaneously. Therefore, it is difficult to evaluate the efficacy of this drug to the reaction. But ETISUL was interpreted as effective in my experience, because disappearance of the eruption seemed to be accelerated when ETISUL was employed.

In the cases of epithelioid cell reactions in lepromatous leprosy (Case 3 and 4), although the bacillary index conspicuously fell, it

Case 1

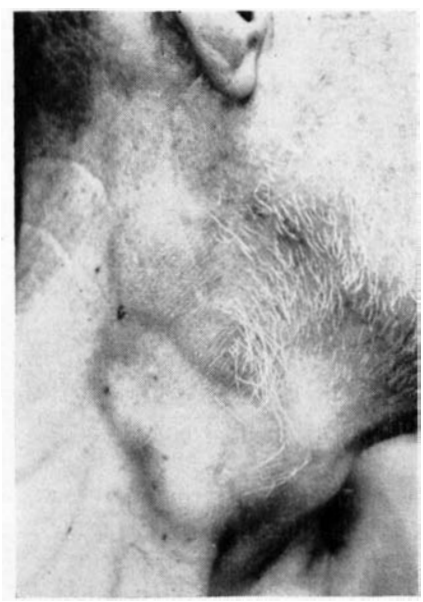


Before Etisul treatment.

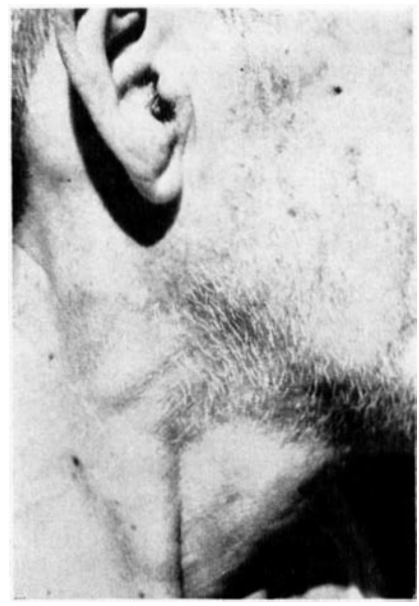


Six months after treatment.

Case 2.

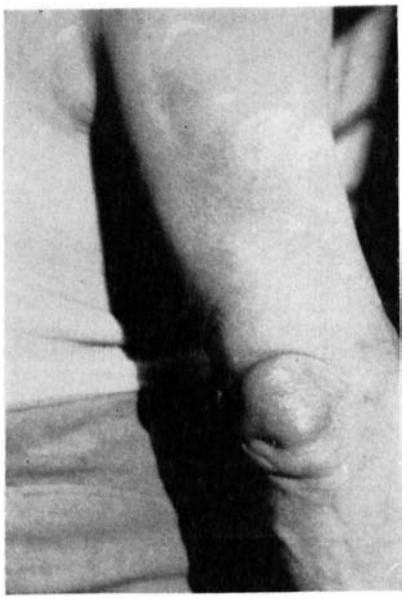


Before Etisul treatment.

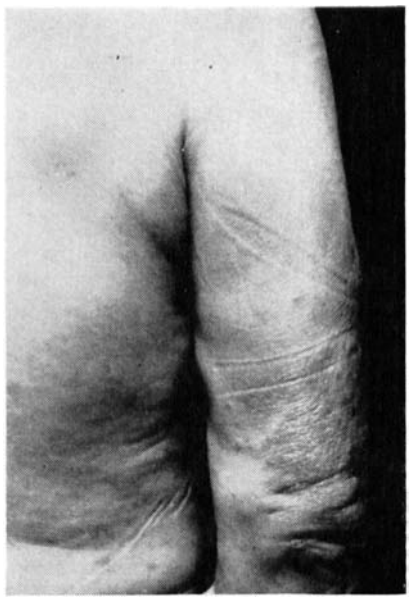


Six months after treatment.

Case 8

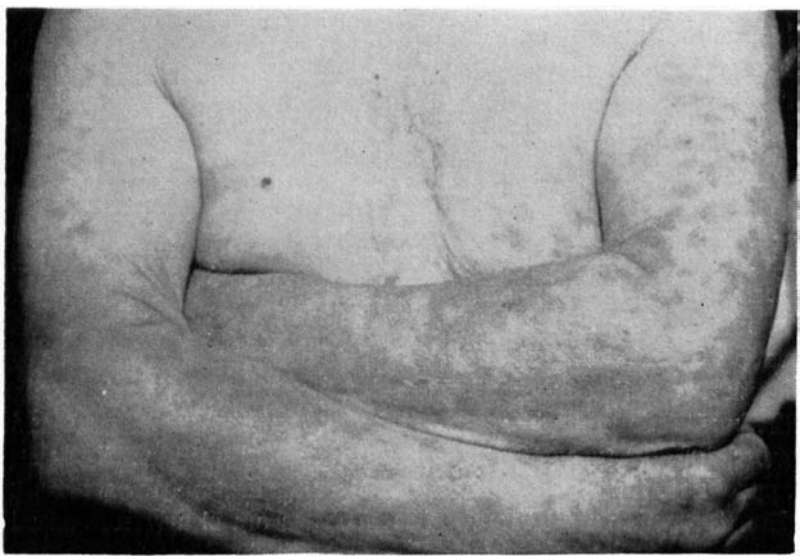


Before Etisul treatment.



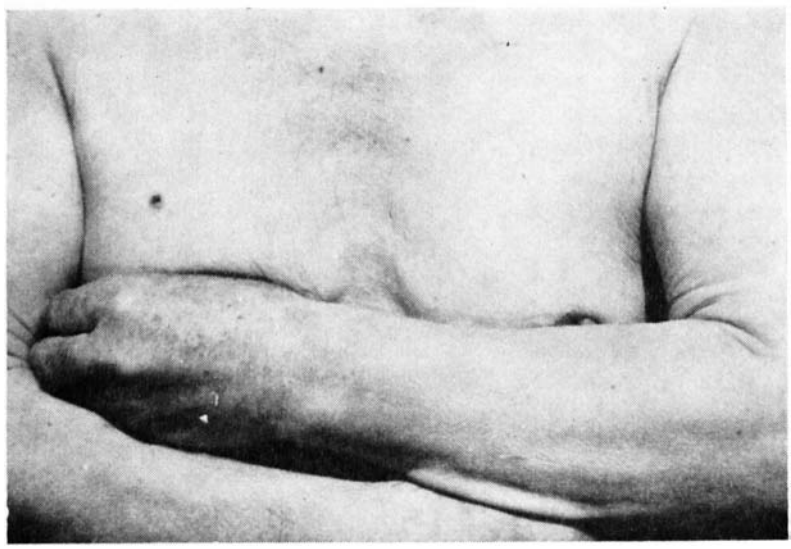
Four months after treatment.

Case 8



Before Etisul treatment.

Case 8



Four months after treatment.

can not be assumed that ETISUL solely effected this decrease, because the bacilli tend to be reduced promptly and spontaneously after the occurrence of this type of reaction.

In the cases of lepromatous leprosy, though the absorption of lesions was clinically and macroscopically observed, and also in some of them the reduction of bacilli was observed, it is difficult to believe that ETISUL excels D.D.S. as DAVEY, *et al.* or MCGREGOR, LECHAT, etc., reported. Our differences in observation may be attributable to the difference in leprosy patients between the southern countries and Japan. In this respect, I wish to wait for further investigation.

In the cases of tuberculoid reactions the drug was well tolerated for relatively long periods, and absorbed satisfactorily, giving good results, while in the cases of lepromatous leprosy the tolerable period was rather short. This was also recognized by DAVEY, *et al.* In our experience, ETISUL was not effective for more than three months or so. Nevertheless, it should be emphasized that in the treatment of leprosy, as well as other infectious diseases, it is necessary to attack the bacilli in a multiple way through the combined use of more and more different types of drugs, or by using drugs alternately at an appropriate time so that a better therapeutic effect may be achieved. Therefore, if these different types of drugs are clearly recognized to be effective for at least several months, we should use as many as possible, thereby accelerating and enhancing negativization of bacillus. On the other hand, however, the strong and irritating garlic odour of the preparation is a big obstacle to the long treatment

in leprosaria. Accordingly, we planned to apply this drug first to new patients in a special room. The preparation is recommended to be used not longer than three months, whether it is used alone or combined with other preparations. It should be then replaced thereafter at an appropriate time by other preparations. In spite of the warning, once voiced by MAYER, that drug resistance of bacilli will come to be a problem, as there is some similarity of chemical structure between ETISUL and thiourea derivatives, our experiment could not detect it. This should not give rise to disussion, because we used butoxy-diphenyl-thiourea in Case 1, 3, 4, 8, which were clinically resistant to ETISUL treatment, and observed that both infiltration and swelling subsided again or were more efficiently resolved. However, we have had no experience in using ETISUL in cases resistant to thiourea compounds.

No side effects was observed in the internal organs such as liver, kidney and haematopoietic organs. But it is to be regretted that dermatitis was frequently provoked by this preparation, although it is considered natural since preparations used externally easily cause dermatitis to some extent. It was rather frequent in ETISUL, however. In fact, many patients suffered from generalized dermatitis after a few inunctions, and application could not be continued. Besides this dermatitis, some cases had localized eczema-like patches, which appeared after one or two months treatment and gradually increased in number and size. The occurrence of these eczema-like patches could be due to the fact that we gave the inunctions more frequently (five times a week) than the usual method (two or three times a week).

We also tried ETISUL for the treatment of skin tuberculosis in patients who were not infected with leprosy, but almost all cases were afflicted with dermatitis after a few inunctions. So we could not get any results for tuberculosis.

From these findings, it appeared that leprosy patients were more tolerable to ETISUL than non-leprosy patients. And non-lepromatous patients tend to be more affected by dermatitis than lepromatous patients. Further, concerning the eruptions of the tuberculoid reactions, so-called tuberculoid leprosy (=Non-lepromatous exacerbation) were more easily affected by dermatitis than patients with epithelioid cell reaction in lepromatous leprosy. The dermatitis thus provoked was due to irritation caused by the active ingredient in ETISUL itself rather than the ointment base.

From all these points, it is considered that the dermatitis caused by ETISUL is connected with the degree of ETISUL absorbed from the skin. For lepromatous patients whose sweat glands or superficial vasomotor nerves are diffusely and extensively disturbed, this functional insufficiency may possibly cause poor absorption of the compound.

TABLE 2
Results of Etisul Treatment

Case No.	Patient's Name	Sex	Age	Type of disease	Nature of skin lesion	Pre-treatment	Duration of Etisul application	Clinical observation	Bacterial index	Side-effect	Result
1	T.A.	M	65	L	new		12 months	In six months leproma diminished by resorption. After six months thiourea compound was jointly administered.	5.0—5.0		good
2	T.O.	M	78	L	new		3 months	Infiltration gradually resolved, but it appeared again at the end of the third month.	4.5—4.5		good
3	I.T.	M	60	L	Ep.	PM	5 months	Infiltration resolved after several months of application.	3.3R.0	dermatitis	good
4	T.M.	M	38	L	Ep.	PM+TCI	5 months	Infiltration resolved after several months of application.	5.0R.2.0		good
5	Y.K.	M	55	L	reaction	PM	5 months	Infiltration gradually resolved.	1.		good
6	M.H.	M	65	L	reaction	PM	1 month	Infiltration gradually resolved.	2.3—2.0	dermatitis	fair
7	A.O.	M	32	L	E.N.L.	PM	2 months	No change.	5.0—5(0+ +)	dermatitis	unchanged
8	T.K.	M	74	L	new		4 months	Combined use with Kanamycin. leproma was kept flat and infiltration considerably improved.	5.0—4.0	dermatitis	good
9	B.K.	M	59	L	new		4 months	Combined use with sulphone compound. resolved favourably.	5.0—4.0		good
10	T.N.	M	28	L	new		3 months	In three months diffuse infiltration notably resolved.	4.3—3.3		good
11	H.A.	M	79	T	new		6 months	In three months entire lesion of infiltration flattened and resolved.	0.		good
12	H.I.	M	66	T	new		½ months	Dermatitis appeared after several applications, and treatment was discontinued.	0	dermatitis	—
13	H.O.	M	62	T	new		½ months	Dermatitis appeared after several applications, and treatment was discontinued.	0	dermatitis	—
14	K.O.	F	68	T	new		¼ months	Dermatitis appeared after several applications, and treatment was discontinued.	0	dermatitis	—
15	T.I.	F	62	T	new		¼ months	Dermatitis appeared after several applications, and treatment was discontinued.	1.0	dermatitis	—
16	S.M.	F	30	L	new		3 months	Leproma diminished and resolved gradually.	5.0—4.0		good
17	K.O.	M	50	L	relapse	PM	¼ months	Dermatitis appeared, and treatment was discontinued.	5.0	dermatitis	—
18	M.	M	39	L	Ep.	PM	¼ months	Dermatitis appeared, and treatment was discontinued.	5.0R.	dermatitis	—
19	S.A.	M	40	L	new		¼ months	Dermatitis appeared, and treatment was discontinued.	5.0	dermatitis	—
20	I.Y.	M	61	L	new		3 months	Infiltration slightly improved.	4.		fair
21	N.K.	F	55	T	new		½ months	Dermatitis appeared, and treatment was discontinued.	0	dermatitis	—

L: Lepromatous leprosy.
T: Tuberculoid leprosy.
Ep. Epithelioid cell reaction (Pseudo-exacerbation).
PM: Promin.
TCI: Butoxy-diphenylthiourea.

R.:

It was also reported that the white race is more easily affected by dermatitis (80-90%) than the black race (about 50%). And Japanese are situated at the middle (70-80%). Therefore, the tolerance to ETISUL may somehow differ according to the colour of the skin.

So-called lepra reactions by the employment of ETISUL were not observed. It does not act as strongly as thiourea compounds; the action is very mild and it is absorbed slowly without an intensifying of neuralgia. Therefore, it is suitable for use at the reactional stage, especially at the stage of epithelioid cell reactions. In these cases, it is most appropriate to use this preparation, because the inunction can be performed by the patients themselves, thereby obtaining the motorial exercise of their fingers, thus lessening sequelae and making a good prognosis possible. However, it is a pity that the occurrence rate of dermatitis is higher in tuberculoid cases.

It is desirable to get such a different kind of anti-leprosy drug for external use. We may expect more complete treatment of leprosy by the combined use of different types of preparations, as in tuberculosis.

Conclusion

We used ETISUL, the ointment of a derivative of mercaptan, diethyl-dithiol-isophthalate, for external application and confirmed it to be effective for the treatment of leprosy. It was noted that ETISUL has a mild action and does not provoke lepra reactions, therefore it is suitable for use in cases of tuberculoid lepra reactions.

However, the employment of ETISUL is to be largely restricted because of its tendency to provoke dermatitis. In addition, its effectiveness is of comparatively short duration, not more than several months, and also it has a strong garlic odour.

Nevertheless, it is noteworthy that a new and a different type of anti-leprosy drug has now been added to the line of leprosy treatments. Thus we may approach further to a complete cure of leprosy by a combined use of these drugs.

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CLUB-FORMS OF MYCOBACTERIUM LEPRAE

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Besides the well known granular forms of *M. leprae*, one may frequently observe larger bodies about twice the thickness of the bacillus. These have been recognised for many years. They were described in unstained preparations by SHOLTZ and KLINGMÜLLER (1900). They are acid-fast and metachromatic with polychrome methylene blue (BABES quoted by KLINGMÜLLER 1900). Although described as 'spore-like' they are not the structures which NEISSER at one time took to be spores (these were the vacuolar spaces between the granules according to KLINGMÜLLER) nor are they related to the Much's granules of mycobacteria which are not acid-fast and are probably artifacts (TOPLEY and WILSON, 1955). It is recognised however that club-like swellings similar to those of the diptheria bacillus occur not uncommonly in cultures of mycobacteria (TOPLEY and WILSON). Hereafter they are referred to as 'clubs'.

More recently a number of writers have referred to 'condensations' or 'metachromatic granules' without always making it clear whether these are the club-like swellings. DENNEY however, illustrated them in 1934. DE SOUZA ARAUJO (1959) described them clearly and found them to be visible under phase-contrast microscopy. He postulated that they might be concerned with regeneration of leprosy bacilli. It is surprising therefore that electron microscopy studies frequently omit any reference to 'clubs'; there are exceptions: BRIEGER and GLAUERT (1956). OKARDO (1958) demonstrated them in electron-micrograms of *M. lepraemurium*.

This paper describes further observations on such club-forms.

Material and Methods

Skin smears and biopsies were received as a routine from all patients at the Jordan Hospital, Redhill. Smears from Sungei Buloh were also included. Biopsies before treatment were followed up at six monthly intervals during treatment and smears were examined at six weekly intervals for the first six months, and thereafter at intervals of six months. Details of classification and length of treatment were made available. Classification was of the system described by RIDLEY and JOPLING (1962). The five groups are here referred to as tuberculoid, near-tuberculoid, borderline, near-leproma and leproma.

Although sections stained by the Fite-Faraco procedure following fixation in the F.M.A. fixative of LOWY (1956) showed the clubs clearly, they were not suitable for study because bacilli were usually in clumps. Skin smears or impression smears of biopsies were preferred.

1. Smears were heat-fixed and stained by the Ziehl-Neelsen method. The granularity index was determined as described by RIDLEY (1960). (By this method an index of 0 represents all solid bacilli and I0 all granular forms.) To indicate the number of clubs an empirical scale of +++, ++, + was employed.

2. Contact impressions of freshly excised skin biopsies were used for phase-contrast and for multiple histochemical studies. The correlation of stained structures with clubs was checked by phase-contrast or by restaining with Ziehl-Neelsen. The following stains were used:

(*a*) Vital staining using fresh contact impressions taken on slides prepared with a 1/15 mixture of 0.4% Janus green and 0.25% neutral red and dried in a dust-free atmosphere.
(*b*) Fat stains, exposure to Osmium tetroxide and Baker's method for phospholipids.
(*c*) Gomori's Alkaline Phosphatase, with controls for specificity.
(*d*) Standard Feulgen.
(*e*) Periodic acid-Schiff (P.A.S.).
(*f*) Metachromatic methods and Mayer's mucihaematin.
(*g*) The Millon reaction for amino acids.
(*h*) Spore stains.
(*i*) Clubs were also examined by fluorescent and polariscopic procedures.

3. Solubility tests in common fat solvents were carried out.

4. Club forms of *M. tuberculosis* in actively growing young cultures were compared with those of *M. leprae* by phase-contrast microscopy, solubility and staining by P.A.S. and metachromatic methods.

Results

In all cases clubs were not numerous in untreated cases of lepromatous leprosy and in active lesions of relapsing leprosy. Untreated borderline patients with fairly large numbers of bacilli showed few clubs with a marked numerical variation between the lesions from which smears were made. In the near-tuberculoid cases with bacilli solid but scanty there were no clubs.

The number of clubs appeared to decline in proportion to an increase in granularity index with the improvement of the patient under treatment. On average, in lepromatous patients there was a general fall from +++ to ++ after the first six months of treatment. Thereafter numbers varied greatly at different sites. Where granularity was in the region of 9-10 in cases on treatment for several years, clubs were negligible. In borderline patients response to treatment produced a fall from +++ to — in the first three to six months, and afterwards they were not seen at all.

Clubs were strongly acid-fast in the routine Ziehl-Neelsen preparations. Once stained they held the dye tenaciously, much more

so than the bacillary body itself. Usually they occurred in the solid uniformly stained bacilli. With treatment these bacilli were pale though still solid.

Clubs were located mainly towards the poles of the organism usually only one and sometimes two, one at either end. Less frequently the bacillus was fragmented and the club was seen in the centre. Never were there more than three in the same organism and this occurred only very rarely. Sometimes under phase-contrast microscopy 'the pedunculated comet-like' forms of DE SOUZA ARAUJO (1959) were seen, the bacillary bodies appearing as very short rods apparently emanating from the clubs.

Fluorescent staining presented the clubs as condensations rather than 'swellings'. These were isotropic and stained well with ordinary fat stains. No phospholipids were demonstrated but the clubs were strongly osmiophilic. They were P.A.S. positive and showed a γ-metachromasia with polychrome methylene blue and toluidine blue. Small granules within the bacillus reacted positively to the Feulgen technique, but these did not correlate with the clubs which were Feulgen negative. The bacillary body stained diffusely with Gomori's Alkaline Phosphatase and the clubs reacted strongly to it. They did not stain with spore stains or the Millon reaction. Vital staining was inconclusive.

Following extraction with xylol or chloroform clubs were not stainable. Staining was partially restored by subsequent soaking in oil and staining by Fite-Faraco's method. Clubs were insoluble in alcohol and acetone and resisted acids. After alkali their demonstration was difficult.

Club-forms of *M. tuberculosis* were seen only in actively growing young cultures. They occurred much less frequently than those of *M. leprae*. They were P.A.S. positive with a γ-metachromasia and insoluble in acetone. Because they were scanty they were difficult to study. But as far as could be demonstrated they were the same type of structure as the leprosy clubs.

In an attempt to explain why clubs are often unmentioned in studies of *M. leprae* by electron-micrographs, Dr. R. J. W. REES and Dr. R. C. VALENTINE undertook to examine a preparation containing clubs by electron microscopy. Material was provided from a lepromatous patient treated for 3½ years; the granularity index was 9 and there were no clubs in any of the smears save one, taken from a lesion obviously in a state of activity. This site was chosen for biopsy. The granularity index here was placed at 1 and the number of clubs +++. Contact impressions were made from the excised tissue before homogenising in preparation for electron microscopy, and afterwards smears were prepared from the homogenate. Both smears were stained by Ziehl-Neelsen. Clubs were plentiful in the preparation before homogenization; none at all were seen after.

The presumption was that the clubs had been destroyed during the process of homogenization of the tissue.

Discussion

The fact that clubs can be seen in unfixed, unstained, wet films is proof that they are not artifacts of drying, heat fixation or staining. They are strongly acid-fast and must therefore contain the constituent of mycobacteria which combines with carbol-fuchsin (mycolic acid and its derivatives). Their reaction to fat stains and solvents and to P.A.S. indicates that they contain a lipopolysaccharide complex and their reaction to Gomori's Alkaline Phosphatase shows the presence of this enzyme. In their absence of R.N.A. clubs differ from the volutin granules seen in some plant and animal cells. From the ease with which they are removed or are no longer demonstrable one assumes that they occupy a superficial position in relation to the organism. J. H. HANKS (1962) in studying the capsular components of leprosy bacilli, came to the conclusion that there was a double membrane in the organism, the outer one being easily destructible. Possibly the clubs lie between the two cell walls. After homogenization bacilli still retained their acid-fastness—a property dependent on an intact cell wall. One of the cell membranes must therefore have remained whole during the process. To preserve clubs for study by electron microscopy Dr. REES suggests that ultra thin sections rather than homogenates should be used.

The significance of clubs in *M. leprae* has not been fully elucidated. The questions are whether they have the same significance as other granular forms of this bacillus, and if not whether they are concerned with its viability or with a particular phase of its life cycle. It is clear from the results that clubs are not to be considered as granules; in their incidence and properties they are quite different. The fact that clubs decrease fairly quickly with treatment indicates that they are not the result of chemotherapy or of involution and death through this means. The finding that clubs are most numerous among solid-staining forms of bacilli, and in lepromatous rather than borderline types of leprosy, suggests that they are associated with growth, or possibly with the earliest phase of natural involution. It may be significant that clubs were prominent in the earliest phase of relapse when treatment was interrupted.

Summary

Club forms of *Mycobacterium leprae* have been studied in relation to the state of the bacillus and to treatment, by solubility tests and special stains, and by phase-contrast and electron microscopy.

Clubs were found to contain an acid-fast lipo-polysaccharide complex which was removed during the process of tissue homogenization prior to electron microscopy.

Clubs are not related to other acid-fast granules or to volutin.

They appear to be associated with the growth phase of the bacillus but their significance remains uncertain.

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DIPHENYL THIOUREA IN THE TREATMENT OF PATIENTS WITH RECURRENT LEPRA REACTIONS

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Although diamino-diphenyl-sulphone (DDS) is a potent anti-leprosy drug, there is a significantly small percentage of leprosy patients who do not tolerate DDS. Moreover, it takes a number of years for a patient treated with DDS to become disease-arrested. Hence, the search for newer anti-leprosy drugs goes on.

Diphenyl thiourea (DPT) is one of the recent anti-leprosy drugs. It was first recognized as a chemotherapeutic agent against mycobacterium tuberculosis (MAYER, *et al.* 1953). Later on, it was reported that patients who developed persistent erythema nodosum leprosum with DDS, tolerated therapeutic doses of DPT with great benefit (DAVEY 1958, GARROD 1959). On the basis of their findings, it was decided to try out the effect of DPT on a few of our patients who were subject to frequent lepra reactions during the course of anti-leprosy therapy with drugs other than DPT.

Material and Methods

Four lepromatous leprosy patients from the Schieffelin Leprosy Research Sanatorium, Karigiri, who had had frequent episodes of reaction, were chosen for this trial. They were not able to take any other anti-leprosy drug in therapeutic doses even for a short time without getting a lepra reaction. The anti-leprosy drugs used were: DDS, Thiosemicarbasone, Isonicotinic acid hydrazide (INAH) together with streptomycin and sulphetrone. Thiosemicarbasone was started in doses of 25 mg. per day and gradually increased up to doses of 150 mg. three times per day. Injections of streptomycin were started in doses of 1 gm. weekly and then gradually raised to a dose of 1 gm. every day. Along with streptomycin, INAH was administered in doses of 25 mg. once a day to start with. Gradually, its dosage was raised to 100 mg. twice a day. Injections of sulphetrone 50% solution were used. The initial dose given was 0.5 ml. once a week, and the dose was gradually increased to 3 ml. twice a week. First, anti-leprosy drugs such as DDS, thiosemicarbasone, streptomycin, INAH and sulphetrone were tried in smaller doses and so long as these drugs were tolerated. On most occasions the maximum dose could not be reached because of the onset of reaction. When it was found that they could not tolerate any of the above drugs, DPT was started with a dose of 250 mg. per day and gradually increased to the maximum dose of 1,000 mg. twice a day within a period of three months. DPT was stopped as soon as signs and

symptoms of reaction appeared and was started again soon after the reaction had subsided. Patients were considered to be in reaction if during the course of treatment they developed erythema nodosum leprosum, fever with a peak in the evening, arthralgia, particularly of the large joints like the knee, elbow and ankle and neuritis, chiefly of the ulnar, lateral popliteal and posterior tibial nerves.

A detailed history of the disease was obtained and a thorough physical examination was carried out. The frequency, duration and type of lepra reactions the patients had and the duration and the kind of previous anti-leprosy treatment were recorded. Haemoglobin percentage, routine blood counts, routine examinations of urine and stools were done initially and were repeated at regular intervals.

CASE REPORTS

Case No. 1. SLRS. 293. Male aged 35 years was first seen on 24.8.1956. He gave a history of having had leprosy for the past two years.

On examination, there were vague hypopigmented macules on the medial aspect of the thighs which were not anaesthetic to touch and had ill-defined borders. There was gross infiltration of the ear lobes, trunk and limbs. An ulcer between the 1st and 2nd toe of the right foot was also present. Red blood cell count was 4,890,000/c.m.m. Haemoglobin was 12.25 grams per cent, packed cell volume (PCV) was 39 per cent. The urine showed no abnormality and the stools showed hook worm ova and whip worm ova. The bacteriological index was 3.62. For a period of 32 months and 26 days DDS, Thiosemicarbasone, Sulphetrone injections, INAH alone, INAH in combination with DDS and INAH with streptomycin were tried one after the other. These drugs could only be administered in quantities well below the therapeutic dose and only for short periods because of the onset of reactions. The total period during which he received anti-leprosy treatment in one form or other was 11 months and one day. During the regime there were seven episodes of lepra reactions, the total duration of reaction amounted to four months and six days. There was only a minimal change in the bacterial index from 3.62 to 3.00.

On 20.5.1959, he was started on DPT. At this time his haemoglobin was 14.25 gm. per cent and the total white blood cell count was 15,800/c.m.m. Urine and stools showed no abnormality.

From 20.5.1959, for a period of 36 months and 20 days, DPT was given as long as he could tolerate the drug, which amounted to 32 months. During this period, too, he had lepra reaction seven times. However, the total duration the patient was in reaction was only 2 months and 19 days. The bacteriological index came down steadily from 3.00 to 1.12. Blood, urine and stools showed no abnormality.

Case 2. SLRS. 1225. A male aged 19 years reported in Schieffelin Leprosy Research Sanatorium, Marigiri, on 19.10.1956, with a history of having had leprosy for seven years. He had five years of irregular treatment with DDS. On examination, the face and trunk showed some areas of gross infiltration and on the rest of the body there was fine infiltration. Glove and stocking anaesthesia was present. All the peripheral nerve trunks were thickened.

The haemotological investigations showed haemoglobin of 9.75 gm. per cent, PCV of 36 per cent. RBC count of 5.27 million per c.m.m. The bacteriological index was 3.12. Hook worm ova were present in the stools.

He was given DDS to begin with and because of the onset of lepra reaction, it was changed to streptomycin and INAH and later on INAH in combination with thiosemicarbasone in quantities well below the therapeutic dose. Out of 26 months and 7 days of hospital case, he had reaction 9 times. The total period he was in reaction amounted to 6 months and 28 days. He was on specific treatment for 19 months and 9 days. The bacteriological index at the end of this period was 1.87.

DPT was started on 20.5.1959. The haemoglobin was 10.25 gm. per cent. The white blood cell count was 10.800 per c.m.m. The urine showed no abnormality. During the next 18 months and 24 days, the patient tolerated DPT for 16 months and 26 days. He had three episodes of lepra reaction. The total period he was in

reaction amounted to one month and 11 days. The bacteriological index dropped from 1.87 to 1.25 within a period of about 1½ years. At this point the patient discontinued treatment.

Case 3. SLRS. 1160 A male aged 20 years was seen on 24.9.1956 with a history of having had a patch on the left buttock for two years. The disease gradually spread and involved the entire body. On examination, there was gross infiltration over the face, trunk and limbs. Nodular infiltration of the ear lobes was also noticed. Examination of the cardio-vascular system revealed a rough presytolic murmur in the mitral area. Plantar ulcers were present on both feet. Examination of the lungs and abdomen did not show any abnormality. Haemoglobin was 9.00 g. per cent, PCV 33 per cent. Hook worm ova were present in the stools. Urinalysis was done and found to be normal. The bacteriological index was 3.75. He was given injections of 50% sulphetrone, starting with an initial dose of 0.5 ml. twice weekly and gradually increased to 3 ml. twice a week. For 12 months there was no evidence of any lepra reaction. The bacteriological index fell from 3.75 to 2.75. No anti-leprosy drug could be administered in therapeutic doses for the next 18 months because of the onset of lepra reaction. The drugs tried were: DDS, thiosemicarbasone and streptomycin in combination with INAH. Within a period of 39 months and 26 days, he had lepra reaction nine times. During this period, he had some form of anti-leprosy therapy for a total period of 22 months and 14 days. The total period during which he was in reaction amounted to 26 months and 19 days. The bacterial index during this period dropped to 1.37.

DPT was started on 20.1.1960, when the bacterial index was 1.37. He had DPT for 13 months and 7 days without a single episode of lepra reaction. The bacterial index steadily came down from 1.37 to 0.37. DPT was discontinued because of a relapse of the disease, viz. the appearance of new nodules showing bacilli in the form of rods.

Case 4. SLRS. Male aged 20 years was first examined on 7.12.1956, at which time he gave a history of having had leprosy for seven years. He complained of loss of voice since six months.

On physical examination, there was gross nodular infiltration of face, limbs and trunk. Heart, lungs and abdomen revealed no abnormality. His bacteriological index on 21.12.1956 was 3.87. His haemoglobin was 10 gm. per cent, total RBC 3,450,000 per c.m.m., PCV 35 per cent. During a period of 28 months and 2 days, attempts were made to treat the patient with DDS, thiosemicarbasone, injections of sulphetrone, streptomycin and INAH. The total period during which he received some form of anti-leprosy treatment was 19 months and 27 days. But, it must be noted that at no time was the full therapeutic dose of any of the above-mentioned drugs ever reached. Sometimes, small doses of these drugs precipitated a reaction. So, all efforts to treat him with anti-leprosy drugs met with failure. During this period, he had lepra reaction nine times and the ninth attack lasted for ten months and 26 days. The total period during which he was in reaction amounted to 13 months and 22 days. The bacterial index however, came down from 3.87 to 1.62. Since no other anti-leprosy drug could be given continually in full doses without causing a lepra reaction, he was given DPT from 20.5.1959. His bacterial index on 20.5.1959 was 1.62. His white blood cell count was 18,000 per c.m.m. Haemoglobin was 9 gm. per cent. Urine showed no abnormality. During the following period of 17 months, he received effective anti-leprosy treatment for a period of 13 months and 20 days. However, he had lepra reaction seven times, the total period amounting to four months and six days only. His bacillary index fell from 1.62 to 0.37 in 17 months.

Results

As mentioned above, the treatment of these patients either with DPT or drugs other than DPT, had to be stopped with the onset of reaction. A mild reaction was ignored and treatment was continued. In assessing the value of DPT, two methods were used: (1) the 'percentage duration of treatment' and (2) the average number of days per month the patient could tolerate treatment. The 'percentage duration of treatment' was calculated as follows:

The number of months a patient was actually given DPT or drugs other than DPT, was separately added up and expressed as a

percentage of the total period of hospital care with that particular regime.

The 'percentage duration of reaction' was calculated in a similar way. The number of days per month a patient was in reaction was

Case No.	*Regime*	*Total period of each regime in months*	*Duration of actual treatment with DPT or other anti-leprosy drugs*	*Percentage duration of treatment*	*Average duration of treatment in days/month*
1	Other drugs	32 months and 26 days	11 months and 1 day	34.1%	10 days
	DPT	36 months and 20 days	32 months	87.2%	26.1 days
2	Other drugs	31 months	19 months and 9 days	62.2%	18.7 days
	DPT	18 months and 24 days	16 months and 26 days	92.2%	26.9 days
3	Other drugs	39 months and 26 days	22 months and 14 days	56.9%	17 days
	DPT	13 months and 7 days	13 months and 7 days	100%	30 days
4	Other drugs	28 months and 2 days	19 months and 27 days	70.9%	21 days
	DPT	17 months	13 months and 20 days	80.3%	24 days

also calculated and a comparison was made between DPT and drugs other than DPT. The results are tabulated below.

Duration of Treatment

In Case No. 1, the percentage duration of treatment was 34.1% with the anti-leprosy drugs other than DPT and 87.2% with DPT. The average number of days of treatment administered per month was ten days for the other drugs and 26.1 days for DPT, viz. an increase of 16.1 days per month with DPT. Thus, DPT was significantly better tolerated than the other drugs.

In Case No. 2, with DPT the percentage duration of treatment increased from 62.2% to 92.2% and the average number of days the patient could take treatment without reaction increased from 18.7 days per month to 26.9 days per month. This is significantly more than the other drugs.

In Case No. 3, the percentage duration of treatment increased from 56.9% to 100% with DPT. Similarly, the average number of days per month the patient tolerated treatment increased from 17 days to 30 days. Thus, it would be seen that the duration of treatment with DPT was much greater than that with the other anti-leprosy drugs.

In Case No. 4, the increase in the percentage duration was from 70.9% with the other anti-leprosy drugs to 80.3% with DPT.

The average number of days per month the patient could tolerate treatment increased from 21 days per month to 24 days per month. This increase is not particularly striking.

Duration of Reaction

In Case No. 1, the patient was in reaction for 12.61% of the total period of 32 months and 26 days. On an average, he was in reaction for 4 days per month. When treated with DPT, only 7.18% of the period of treatment or on an average 2.1 days per month were taken up by lepra reactions. This meant that the percentage duration of reaction was reduced by 5.43% or 1.9 days per month.

In Case No. 2, during the first 31 months when other anti-leprosy drugs were used, the patient was in lepra reaction for only 22.36% of this period. When DPT was substituted, he was subjected to lepra reaction for only 7.26% of the total peroid which was 18 months and 24 days. Thus, the duration of reaction with DPT was three times less than that noticed with the other anti-leprosy drugs used prior to DPT.

The above results are tabulated below in detail:

Case No.	*Regime*	*Total period of each regime in months*	*Total duration of reaction with DPT or drugs other than DPT*	*Percentage duration of reaction*	*Average duration of reaction (in days per month)*
1	Other drugs	32 months and 26 days	4 months and 6 days	12.61%	4 days
	DPT	36 months and 20 days	2 months and 19 days	7.18%	2.1 days
2	Other drugs	31 months	6 months and 28 days	22.36%	3.1 days
	DPT	18 months and 24 days	1 month and 11 days	7.26%	2.1 days
3	Other drugs	39 months and 26 days	26 months and 19 days	80.2%	20 days
	DPT	13 months and 7 days	NIL	NIL	NIL
4	Other drugs	28 months and 2 days	13 months and 22 days	48.93%	14.7 days
	DPT	17 months	4 months and 6 days	24.7%	7 days

Case No. 3 with the other anti-leprosy drugs was in reaction for 80.2% of 39 months and 26 days. This meant that on an average

the patient was in reaction for 20 days per month whereas on DPT the patient was not subject to even a single episode of lepra reaction. This was a significant advantage over the other drugs.

In Case No. 4, the percentage duration of reaction was 48.93% of the total period of 28 months and 22 days with the drugs other than DPT, viz. an average of 14.1 days per month. On the other hand, with DPT, the same patient was in lepra reaction only for 24.70% of a period of 17 months, an average of 7 days per month. Thus, the duration of reaction was halved with DPT.

Improvement in the bacterial index:

The average fall of B.I. in indices per year was calculated and tabulated as follows:

Average Fall in Bacterial Index Per Year

	Case 1	*Case* 2	*Case* 3	*Case* 4
During the phase prior to DPT	0.23	0.48	0.79	0.96
During the phase of DPT	0.60	0.39	0.92	0.88

A review of the above results will show that the improvement in the bacterial index was better with DPT in Cases 1 and 3. The other cases did not show a result that was better than the other anti-leprosy drugs.

Severity of Reactions

There was no difference in the severity of each episode of reaction, viz. the degree of fever, erythema nodosum or neuritis.

Comments:

DAVEY, T. F., in 1958, reported the beneficial effects of DPT on seven cases of lepromatous leprosy who were subject to persistent erythema nodosum. They were able to tolerate therapeutic doses of DPT. GARROD, J. M. B., in 1959, reported that 11 out of 33 patients tolerated DPT with less reaction and also showed improvement clinically. KIM, J. S. and TOPPLE, S. C., in 1962, reported that a third of the 33 patients who were subjected to lepra reaction with DDS tolerated DPT without being subjected to lepra reaction.

Summary

In this study of four cases of lepromatous leprosy with recurrent reactions it was seen that the advantages of DPT were that:

1. *The number of days the patient was in reaction was very much less than that with the other drugs.* So, it is reasonable to assume that all the consequences of reactions such as the duration of hospitalization, pain and discomfort to the patient and the incidence of deformity may be less.

2. *The number of days the patient could be subject to anti-leprosy treatment with this drug were more than the other drugs.*

In this connection, it must also be noted that:

1. During treatment with DPT no particular advantage in the

rate of fall of the bacterial index over the other drugs was seen.

2. The severity of each reaction when it occurred in the DPT regime appeared to be the same as the other drugs.

3. Although during certain periods sub-therapeutic doses of anti-leprosy drugs were used in these patients, a fall in bacterial index was noticed. The number of cases studied is small. The extreme variability of a patient's susceptibility to reactions from year to year has not been taken into account. DPT seems the best available treatment in cases of recurrent or persistent reactions.

Acknowledgement

We are most grateful to Ciba Pharma Private Ltd. for supplying us with the necessary quantities of diphenyl thiourea for this trial.

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DAVEY, T. F., *Lep. Review* (1956) 27:94 and 103.

INDWELLING ACRYLIC PROSTHESIS AFTER POST-NASAL EPITHELIAL INLAY

Dr. P. N. GUTGUTIA, M.B., B.S., (PAT).

Post-nasal epithelial inlay followed by retrograde bone graft has become a standard procedure for cases of depressed nose such as caused by leprosy, syphilis, and some other less common conditions. The epithelial inlay provides the missing lining in such cases and the problems of support of the bridge and tip of the nose is solved by a retrograde bone graft (ANTIA 1959).

Such a bone graft has to be tunnelled between the new skin grafted lining and skin cover of the nose and is fixed to the nasal bones. In some cases of leprosy, the nasal bones are so greatly absorbed that to get anchorage for adequate fixation for the graft is difficult. In some cases the lining and covering skin is so thin that chances of button holing is great which may lead to exposure of the graft and subsequent absorption.

These cases are not ideal for bone grafting. We have tried to solve this problem by an acrylic prosthesis which is simple in making, cheap and gives adequate support. We recommend even the routine use after epithelial inlay if the patient is agreeable to the permanent wearing of such a prosthesis.

Similar prosthesis has been used by L. R. MCLAREN (1958) for syphilitic depressed noses. Our aim in this paper is to impress the fact that such a prosthesis is very easy to make and a junior member of the staff or technician can be trained to make it.

It will be worthwhile here to point out that the inlay cavity should be carried up to the root of the nose in front of the nasal bones. If the nasal bones are very prominent they should be taken off at the top. This ensures that the whole bridge line is supported in continuity by the prosthesis providing an even contour, rather than the upper part being supported by the nasal bones and the lower part by the prosthesis. This often leaves a distinct notch in the dorsal line at the junction of the nasal bones and the prosthesis. The oro-nasal fistula should be made slightly wider than the base of the alae so that introduction of the prosthesis is easy.

Technique

First a gutta-percha mould is prepared to give the required shape to the nose. Gutta-percha is a latex rubber compound, supplied in the form of sticks of sheets. We prefer the black variety in sheet form. It becomes soft when put in hot water and can be moulded into the desired shape. Chilled water helps to harden it quickly—about 30 cubic cm. of the gutta-percha is put in hot water. When it becomes soft it is introduced into the cavity through

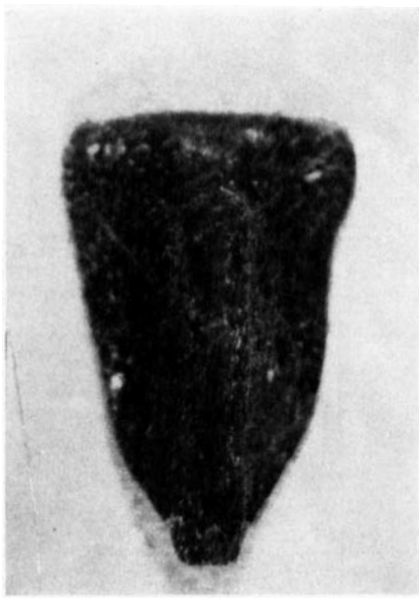


FIG. 1. *Gutta-percha prosthesis (front view).*

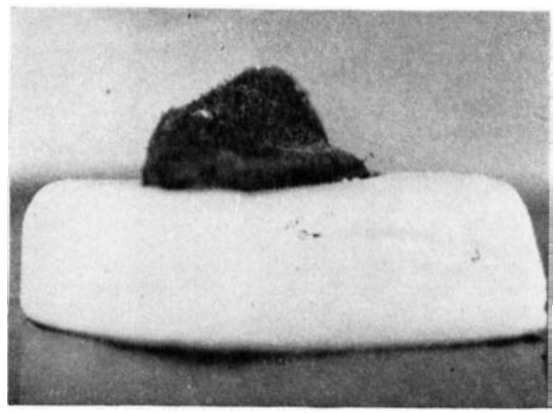


FIG. 2. *Gutta-percha prosthesis half embedded in plaster-of-paris.*

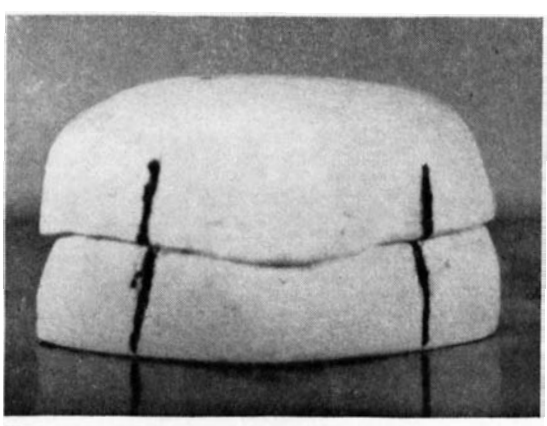


FIG. 3. *Gutta-percha prosthesis completely embedded in plaster-of-paris.*

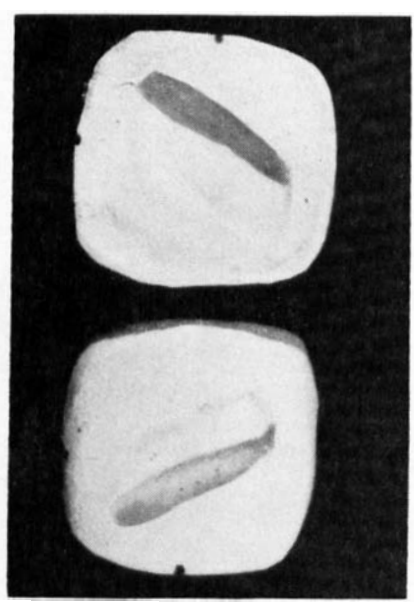


FIG. 4. *Plaster-of-paris negative in two halves.*

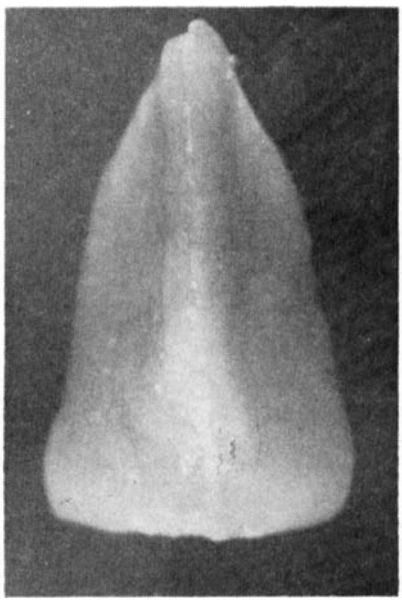


FIG. 5. *Acrylic prosthesis.*

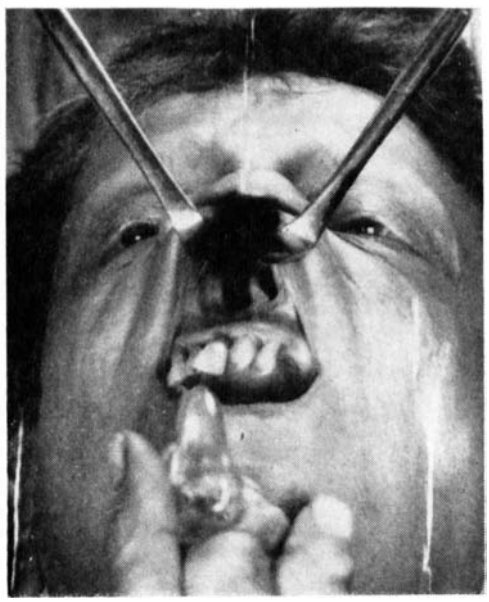
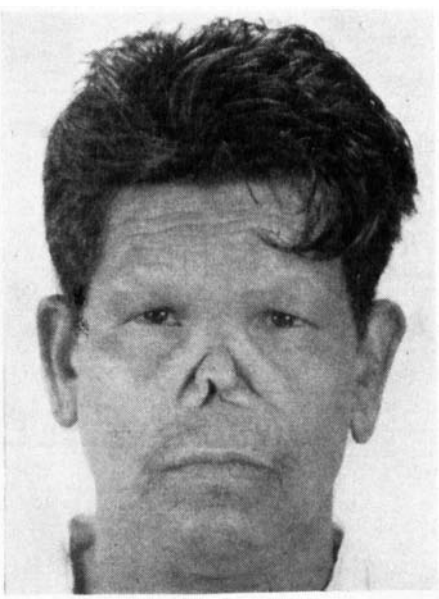


FIG. 6. *Showing the post-nasal inlay cavity with the prosthesis in the mutilated hands of the patient.*



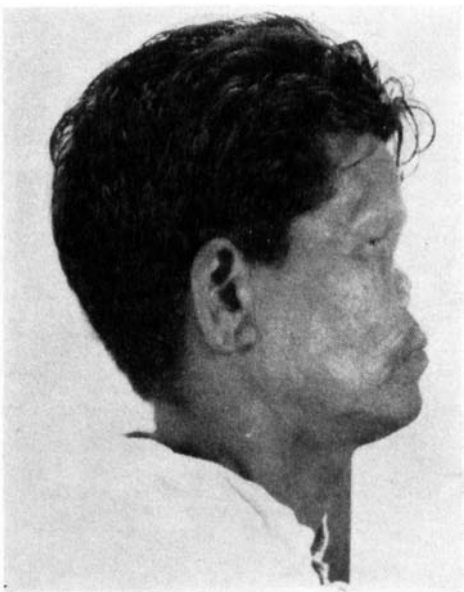


FIG. 7 and 8. *Pre-operative appearance of a case.*

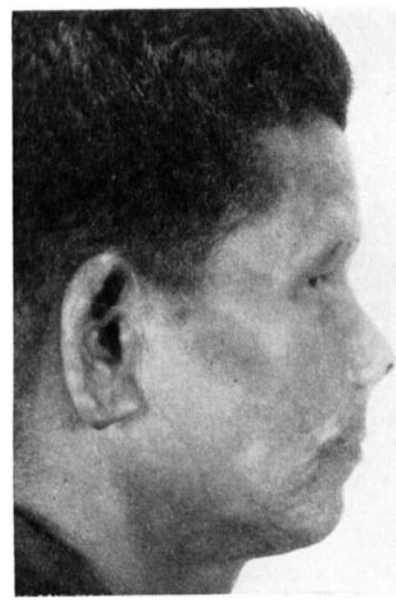


FIG. 9 and 10. *Post-operative appearance of the same case with the prosthesis.*

the oro-nasal fistula. By external pressure the gutta-percha is moulded so as to give the nose the desired shape. When it hardens it is taken out of the cavity and the sides of the vertical limb of the mould are scraped out by a knife to allow for the normal air way (Fig. 1).

This mould is now converted into an acrylic-prosthesis. Normal acrylic is hot-curing and has to be processed under controlled temperature. This is a complicated dental process. The other variety is cold curing acrylic which is supplied in the form of powder and liquid. When the two are mixed, it sets in 15 minutes. We prefer this type of acrylic for technical simplicity.

The next step is to make a negative of the gutta-percha mould in plaster of paris. About an ounce of water is taken in a rubber bowl. Plaster of paris powder is added to it to make a thick paste which is poured on to a flat surface. The gutta-percha mould is smeared with vaseline and is embedded half into the paste. The paste is then made into a nice square platform with half the mould embedded in it (Fig. 2). When the plaster hardens the upper surface of it and the mould are again smeared with vaseline. More plaster of paris paste is prepared and poured over the mould and the upper surface of the plaster. Care is taken that no air is trapped in. When the plaster hardens, the corresponding points of the two halves of the plaster is marked by a pencil in both dimensions (Fig. 3) and the two halves separated. The gutta-percha mould is now removed from the plaster by dipping in boiling water. The negative in two

halves is now ready (Fig. 4). The inside of the negative is coated with a layer of 'separating media'. The liquid component of the cold-curing acrylic is poured in to both halves of the negative to which the acrylic powder is gradually added. The cavities in both halves of the negatives are filled in slight excess by pouring alternately the liquid and the powder. The two halves are now pressed together, pencil marks being used as the guide to correct positioning. After 20 minutes (Fig. 5) the two halves are separated and the acrylic prosthesis is taken out.

A small file is used to rub-off the irregularities on the surface of the prosthesis and also for minor adjustments for it to fit the nose properly.

The air passages of the nose communicate with the external nares through the space formed by the lateral wall of the nose and the vertical limb of the prosthesis, and so there is no difficulty in breathing.

The patient himself takes out this prosthesis daily, cleans it with soap and water and re-introduces it. The oro-nasal fistula is kept open for the purpose. If the patient finds difficulty in introducing the prosthesis because of the deformity of his hands, a small wire loop is introduced into the base of the prosthesis.

This work was done in the Plastic Surgery Department of Sir J. J. Group of Hospitals, Bombay, under the kind guidance of Dr. N. H. Antia, M.B., F.R.C.S. The patients shown in the photographs No. 6 to 10 have been operated on by him. I wish to express to him my heartfelt and grateful thanks.

I acknowledge my gratitude to Mr. H. D. Shaikh, M.D.S., of Sir C. E. M. Dental College, Bombay, who showed the methods of conversion of the gutta-percha mould into acrylic prosthesis.

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THE PATTERN OF LEPROSY IN THE GAMBIA, WEST AFRICA

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Introduction

The territory of the Gambia is situated in West Africa extending along both banks of the River Gambia to a distance of 11 to 24 km. and for about 482 km. from its mouth. It is an enclave of the Republic of Senegal and it has an area of about 10,360 sq. km. and a population of about a third of a million. Bathurst is the capital, situated on an island at the mouth of the river. The country consists of Bathurst and the small adjoining Kombo St. Mary Division (formerly known as the Colony) with a combined population of about 40,000. The remainder of the country forms what was formerly known as the Protectorate and is divided into Western, Lower River, MacCarthy Island and Upper River Divisions. There are five main tribes of which the Mandingoes (or Mandinkas) predominate and these are spread fairly evenly throughout the territory on both banks, but especially concentrated in the Lower River Division. The Gambia, in common with most of West Africa, has a moist, tropical climate. The country has few natural resources and its economy is based almost entirely on the export of ground-nuts. The country has recently gained internal self-government and has appointed its first Premier.

The Gambia Leprosy Control Project first began to operate in August 1957. The work to date has been almost entirely field work, that is, on a mass out-patient treatment basis. A summary of the Annual Report for the Project for 1961 appeared in the July 1962 issue of the *Leprosy Review*.

Past surveys have shown the incidence of leprosy in the Gambia to be 2.5% (C. M. ROSS, 1947) and 2.4% (MCFADZEAN, 1954). During the present examination it was found that the incidence for the Bathurst area was 2.9 per mille and for the rest of the country 16.0 per mille, the overall incidence for the Gambia being 14.5 per mille. MALLAC found the incidence for the up-river areas in 1960 to be 17.0 per mille. These latter figures, which are lower than the previous two surveys, are of course based on patients actually registered only and not on any intensive survey of whole populations so that the true incidence is likely to be somewhat higher than these figures suggest.

Between November 1961 and May 1962, a country-wide tour of all the leprosy clinics was made by the leprologist in order to examine, and record details of, every patient present, to verify

diagnoses as far as possible and to make the first official discharges of those in whom the disease was either cured or arrested.

It must be pointed out that the disease was classified entirely on clinical grounds since neither bacteriological, immunological nor histological facilities were available. The disease was typed either Lepromatous or Tuberculoid or Dimorphous (that is, borderline cases, clinically showing features of both polar types) or Indeterminate. The latter diagnosis could be made only in cases which had very recently presented themselves being applied to those cases showing only one or very few nondescript macular lesions which were doubtless leprosy but which showed no other symptoms or signs to put them into one of the other categories. They are the lesions of uncertain prognosis and there is no nerve involvement. Tuberculoid leprosy was diagnosed in cases with very limited lesions, either in number or size, usually asymmetrical, since this is the type with a high degree of resistance (positive lepromin). If the lesions were very widespread, indicating a poor tissue response or defense, and if definite features of the pure Lepromatous type were not seen, the case was classified as Dimorphous. These latter lesions were, therefore, usually multiple (large and small lesions), widespread often symmetrical and of variable morphology; nerve thickening was present in many cases.

The ages of the patients in this survey must, of course, in by far the most of them, be approximate as most of them have no exact knowledge of their date of birth. The ages were judged mainly on physical development. 'Boys' and 'Girls' refer to patients up to and including 16 years of age.

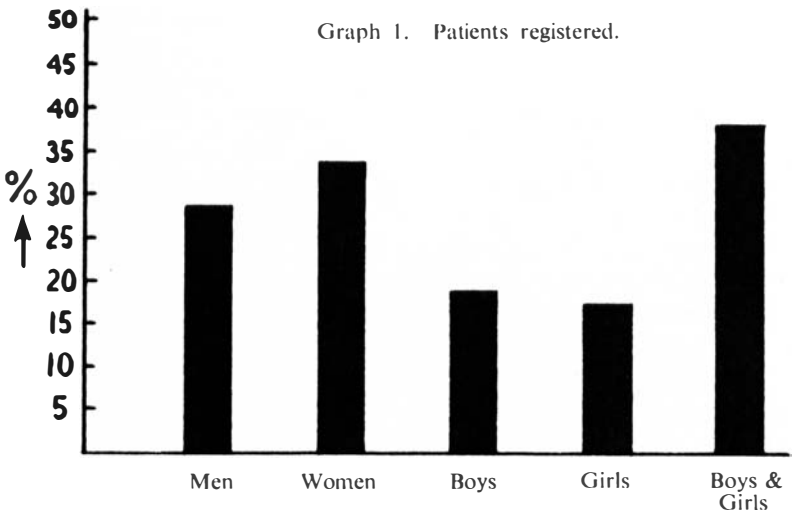
Bearing in mind the above points, this paper is intended to give a fairly accurate overall picture of the types of leprosy and its disabilities occurring in the Gambia.

The disabilities (deformities and mutilations) were classified and graded according to the scheme suggested by the Second W.H.O. Expert Committee on Leprosy, which met in Geneva in August 1959.

Grand Totals: The following shows the total numbers of leprosy patients registered, examined and discharged:

TABLE 1

	No. registered	*% of total registered*	*No. examined*	*% of total examined*	*No. discharged*	*% attendance*
Men	1,199	28.33	790	27.93	137	65.88
Women	1,447	34.19	968	34.22	236	66.89
Boys	807	19.06	548	19.37	189	67.90
Girls	780	18.43	523	18.49	166	67.05
Totals	4,233		2,829		728	66.83



Graph 1. Patients registered.

The totals for the various Divisions were as follows:

TABLE 2

	Colony	*Western Division*	*Lower River Division*	*McCarthy Island Division*	*Upper River Division*	*Totals*
Population	40,000 (estimated)	42,766	80,844	62,618	64,985	291,213
No. registered	114	384	1,399	1,502	834	4,233
Incidence per 100	0.29	0.9	1.7	2.4	1.3	1.45
% of total registered	2.69	9.07	33.06	35.49	19.71	—
No. examined	62	245	903	1,054	565	2,829
% of total examined	2.19	8.66	31.93	37.27	19.97	—
No. discharged	8	70	189	285	176	728
% discharged of No. examined	12.90	28.57	20.93	27.04	31.16	25.73
% attendance	54.39	63.81	64.54	70.18	67.74	66.83

Types of Leprosy: It was found that 6.15% of the total number of patients examined had lepromatous leprosy, 6.26% dimorphous, 86.72% tuberculoid and 0.81% indeterminate.

Of the total lepromatous, 62.65% were men, 29.88% women, 4.6% boys and 2.87% girls.

Of the total dimorphous, 44.07% were men, 42.93% women, 8.47% boys and 4.52% girls.

Of the total tuberculoid, 24.52% were men, 33.85% women, 21.34% boys and 20.28% girls.

The indeterminate were a very small number, and were mostly diagnosed in the girls. (*Vide* Introduction.)

It was found that of the total number of patients examined,

47.31% were males (27.93% men, 19.37% boys) and 52.69% were females (34.22% women, 18.49% girls).

It is usually agreed that the disease has a higher incidence in men than in women. This is probably related to men's generally greater exposure to the disease by reason of their daily occupation outside the home, but this does not apply in the Gambia. Here, a great number of women work for long hours in the rice fields in addition to assisting with other farmwork.

Although, therefore, a larger proportion of women are under treatment, a slightly higher percentage of the children are boys. However, a larger proportion of the lepromatous patients are men and although there are more boys under treatment than girls, a higher percentage of the lepromatous children are boys. The females thus generally have the milder form of the disease.

Age groups

It was found that the numbers of males and females in each age group very closely corresponded except in the 21-30 years groups where the females formed nearly 60% of this group.

Of the total number examined 1.45% were in the estimated age group 0-5 years, 13.04% were in 6-10 years, 33.2% in 11-20 years, 25.1% in 21-30 years, 15.4% in 31-40 years, 8.41% in 41-50 years and 3.39% in the over 50 years group.

Thus, 47.69% of the patients examined were under 21 years of age, and 72.79% were under 31 years of age. Only 11.8% were over 40.

Age at onset of Disease

All patients were asked how long it had been since they had first noticed some sign of the disease. This must again, be approximate since it depended on the patient's own memory or that of a relative.

It was found that 62.68% of all patients stated that they showed some sign of leprosy before they were 21 years of age. In fact, 35.46% were in their first ten years of life and 83.08% developed the first sign before 31 years, whereas only 5.87% said they first showed any sign after 40 years of age.

These figures confirm previous opinions that children and young adults up to the age of 21 years are most susceptible to the infection of leprosy, and it is very rare for adults, especially over 40 years, to become infected.

Contacts

All patients were asked if they had knowledge of any other person in their family or otherwise suffering from leprosy with whom they had been in contact at any time and from whom they believed they had contracted leprosy.

Only 159 patients out of 2,829 examined, that is 5.62% of them, gave a positive answer. Such answers were obtained in about 11% of both the lepromatous and dimorphous patients and in about 5% only of the tuberculoids, and were as follows:

TABLE 3

Relationship given by patient of affected contact	*No.*	*% of total cases attributable to each contact*
Brother	40	25.16
Mother	39	24.53
Sister	29	18.24
Father	20	12.58
Daughter	7	4.40
Son	5	3.15
Aunt	4	2.52
Uncle	4	2.52
Grandmother	3	1.89
Cousin	3	1.89
Husband	3	1.89
Wife	2	1.26
	159	

Thus, as far as could be ascertained from this small number of positive histories, about one quarter attributed their disease to contact with an infected brother and about one quarter with an infected mother. A sister accounted for less than one fifth, and a father for less than one seventh. Other relationships were in a very small minority.

Disabilities

It should be pointed out that there were actually 818 patients (28.85%) recorded with disabilities but many of them had developed more than one type of lesion.

The figures given below of the various disabilities concern the actual numbers of these various types of lesion (of which there were 2,155 in all) so that patients with more than one disability will occur more than once in these figures.

Of this total of 818 patients, there were 143 (17.52%) lepromatous, 108 (13.23%) dimorphous and 567 (69.25%) tuberculoid. This means that 82.19% of the total lepromatous (174), 61.01% of the total dimorphous (177) and 23.01% of the total tuberculoid (2,455)

showed one or more disabilities either of hands, feet, face or in gynaecomastia or leprotic laryngitis.

Nerve Involvement. (A1-5, B1-5, C3)

This refers to patients who showed any signs of neuritic complications of either hands, feet or face, that is, anaesthesia only, claw hand, muscular paralysis, absorption of digits, trophic ulceration or facial palsy.

Of the total patients (2,829) examined, 776, that is 27.43% (4.49% lepromatous, 3.71% dimorphous, 19.23% tuberculoid) showed one or other, or several of these lesions. Of this number (776) with lesions, 51.93% were men, 41.36% women, 4.51% boys and 2.19% girls.

Of the grand total examined (2,829), 14.24% were men showing these nerve lesions, 11.34% were women, 1.24% boys and 0.61% girls.

The lepromatous formed 16.36% of the 776 patients thus affected, the dimorphous 13.53% and the tuberculoid 70.11%.

Furthermore, it was seen that of the 174 lepromatous patients, 127 showed nerve lesions, that is 73%, whereas of the 177 dimorphous cases 59.32% (105) showed nerve involvement and only 22.16% (544) of the tuberculoid cases (2,455) were similarly complicated.

These latter figures do not seem to agree with the usual observation that nerve lesions are more common in tuberculoid than in lepromatous leprosy. However, this fallacy was apparently due to the fact that a very high percentage of the lepromatous cases were in the later stages of the disease, as shown by the following table:

TABLE 4

No. of years of progress of disease	*No. of patients (lepromatous)*
0–2	10
3–5	29
6–9	66
10–19	61
20+	8
	174

Anaesthesia to pain, of hands (A1)

This was recorded where there was anaesthesia only, as obtained from the patient's own history, and where there was no other lesion present. Anaesthesia was, of course, usually present in those cases below recorded as grades 2-5 in both the hands and feet (A and B).

Eighty-six patients (3.04%) gave this history of absence of pain

sensation in their hands, 45 (52.32%) were men, 37 (43.02%) women, 1 (1.16%) boy and 3 (3.5%) girls.

Eighteen were lepromatous (10.35% of this type), 9 dimorphous (5.08%) and 59 tuberculoid (2.4%).

Claw Hand—mobile (A2)

This deformity is due to involvement of the ulnar or median nerve or both, the former usually above the elbow and the latter above the wrist.

In this series, the deformity was noted in patients who also had a useful thumb and in whom the hand was not stiff in the clawed position.

One hundred and thirty-nine patients (4.91%) had this deformity, of whom 70 (50.36%) were men, 43 (30.94%) women, 19 (13.68%) boys and 7 (5.04%) girls.

They were composed of 13.79% of the lepromatous patients, 11.87% of the dimorphous and 3.83% of the tuberculoid.

Intrinsic paralysis involving fingers and thumb, or fingers only but with contracture (A3)

This degree of deformity was shown, either uni or bilaterally, in 147 patients, that is, 5.2% of the total examined. Of this number, 61.22% were men, 34.02% women, 3.4% boys and 1.36% girls. Amongst them, there were 17 lepromatous patients forming 9.77% of the total lepromatous (174), 16 dimorphous forming 9.04% of this type and 114 tuberculoid forming only 4.64% of the tuberculoids.

Partial absorption of fingers, but with useful length remaining (A4)

This occurred in 269 patients (9.51%), 129 (47.95%) of this number being men, 127 (47.21%) women, 9 (3.34%) boys and 4 (1.49%) girls.

The lepromatous patients with this degree of mutilation were 46 in number (26.44% of the total lepromatous); 40 were dimorphous (22.6%) and 183 were tuberculoid (7.45%).

Gross absorption of fingers—stumps only left (A5)

Two hundred and twenty-seven (8.02%) of all patients were thus affected. Of these, 131 (57.72%) were men, 92 (40.53%) women, 1 (0.44%) boy, and 3 (1.32%) girls.

The patients with this deformity included 39 lepromatous (22.42% of this type), 29 dimorphous (16.39%) and 159 tuberculoid (6.48%).

Anaesthesia to pain, of feet (B1)

This was recorded where there was anaesthesia only, as obtained from the patients' own history, and where there was no other lesion present.

Only 12 patients (0.42%) gave this history of absence of pain sensation in their feet without any other disability.

Seven (58.33%) were men, 4 (33.34%) women, 1 (8.33%) boy, and no girls.

Seven were lepromatous (4.02% of this type), 1 dimorphous (0.57%) and 4 tuberculoid (0.16%).

Ulceration of feet (B2)

Ulcers of the feet were recorded even if they were, at the time of examination, in a healed state.

14.49% (410) of all patients examined had such present or past ulceration. Of this number, 54.39% were men, 41.46% women, 3.41% boys and 0.73% girls.

Of the total men (790) examined, 28.23% (223) showed foot ulceration; of the women (968), 17.56% (170); of the boys (548), 2.55% (14); and of the girls (523), only 0.57% (3).

The ulcers occurred more commonly bilaterally, and when unilaterally, more on the left foot than the right one.

Furthermore, the figures showed that of the lepromatous patients, 36.79% developed foot ulceration, whereas the corresponding figures for the dimorphous and tuberculoid cases were 32.76 and 11.73% respectively.

Foot-drop (B3)

Foot-drop, due to involvement of the external peroneal nerve, does not usually recover without adequate operative treatment. In this series of cases it was found in 132 patients out of 2,829, i.e., 4.67%. It was also found that 5.17% (9) of the lepromatous patients (174) had either uni- or bi-lateral foot drop, 10.15% (18) in the case of dimorphous types (177), and 4.28% (105) of the tuberculoid types (2,455).

Of the men examined (790), 12.53% (99) showed this deformity, of the women (968), 3.1% (30) and of the boys (548), 0.55% (3), but there were no girls (523) affected.

The men formed 74.99% of the total number with foot-drop, the women 22.73% and the boys 2.27%.

Partial absorption of foot (up to one-third of surface area of sole lost) (B4)

This deformity was nearly three times more common than foot-drop. It occurred in 11.84% of the patients (9 lepromatous, 18 dimorphous and 105 tuberculoid).

Again, a higher percentage of the lepromatous patients showed this type of mutilation than the other groups. In fact, it occurred in 34.49% of lepromatous cases, in 25.59% of dimorphous and in only 9.33% of the tuberculoid. Also men suffered more than women,

and boys more than the girls—the figures being, 21.52% of the men, 15.91% of the women, 1.28% of the boys and 0.76% of the girls.

Of the total number with this deformity 50.75% were men, 45.97% women, 2.1% boys and 1.2% girls.

Gross absorption of foot (more than one-third of foot lost) (B5)

Only 39 men and 11 women showed this degree of mutilation.

Twenty-seven had this deformity in both feet.

Of these 50 (1.77%) patients (78% men, 22% women) with gross absorption of foot, 8 were lepromatous, representing 4.6% of this type; 5 dimorphous, representing 2.8% of this type and 37 tuberculoid, representing 1.5% only of all the tuberculoid cases.

Permanent mark or stigma of leprosy not amounting to ugliness (e.g., loss of eyebrows, deformity of the ear) (C1)

This was recorded in 47 (1.66%) patients, of whom 27 (57.45%) were men, 18 (38.3%) women, 1 (2.13%) boy and 1 (2.13%) girl.

Forty-five were lepromatous (25.86% of this type), 1 was dimorphous (0.56%) and 1 was tuberculoid (0.04%).

Collapsed nose (C2)

Forty-seven patients (1.66%), of whom 36 (76.6%) were men and 11 (23.4%) women, had a collapsed nose. No boys or girls showed this deformity.

Forty-two were of lepromatous type (24.14% of the total lepromatous), 1 was dimorphous (0.56%) and 4 were tuberculoid (0.16%).

Lagophthalmos (C3)

Out of the 2,829 patients examined, 174 (6.15%) had either uni- or bi-lateral lagophthalmos, 113 being of the bilateral type. 112 (64.37%) were men, 58 (38.34%) women and 4 (2.3%) girls. There were no boys with lagophthalmos.

Twenty-eight were lepromatous (16.1% of this type), 22 dimorphous (12.43%) and 124 tuberculoid (5.05%).

Loss of vision in one eye or dimness of vision both eyes (able to count fingers) (C4)

Sixty-two (2.19%) patients had this disability. Thirty-six (58.06%) were men, 24 (38.71%) women, and 2 (3.23%) boys. There were no girls with this affliction of the eyes. Out of these 62 patients, 44 were actually blind in one eye and 18 had the dimness in both eyes.

Eleven were lepromatous (6.32% of lepromatous patients), 5 were dimorphous (2.83%) and 46 tuberculoid (1.87%).

Blindness (both eyes) (C5)

Only 2 (0.07%) patients were completely blind. Both were women, one being of the dimorphous type and the other tuberculoid.

Gynaecomastia (D1)

Fourteen men (ages 20-45 years) and 1 boy (aged 14 years) had this deformity, that is, 7.14% of the total lepromatous and dimorphous men and boys, 12 were bilateral.

Twelve were lepromatous (10.26% of lepromatous men and boys), 3 were dimorphous (3.23%).

Laryngitis (D2)

One lepromatous woman presented with this disability 0.04%— of the total patients examined.

Of the 174 patients with lagophthalmos, only 11 showed, in addition, either blindness in one or both eyes or dimness of vision both eyes, as follows:

1.	W.	Tub.	Bilateral Lagophthalmos	+ Bilateral Dimness
2.	M.	Tub.	Bilateral Lagophthalmos	+ Left Blindness
3.	W.	Dim.	Bilateral Lagophthalmos	+ Bilateral Blindness
4.	M.	Dim.	Bilateral Lagophthalmos	+ Right Blindness
5.	M.	Tub.	Bilateral Lagophthalmos	+ Right Blindness
6.	M.	Lep.	Bilateral Lagophthalmos	+ Right Blindness
7.	M.	Tub.	Left Lagophthalmos	+ Right Blindness
8.	M.	Tub.	Left Lagophthalmos	+ Right Blindness
9.	M.	Tub.	Bilateral Lagophthalmos	+ Left Blindness
10.	M.	Tub.	Right Lagophthalmos	+ Right Blindness
11.	M.	Tub.	Bilateral Lagophthalmos	+ Right Blindness

Therefore, 163 patients had lagophthalmos without any affection of the eye itself, and 53 patients had blindness or dimness as above but without lagophthalmos.

Summary of Disabilities in the three types of Leprosy

The disabilities occurred on average 2.46 per lepromatous patient, 1.55 per dimorphous patient and 0.59 per tuberculoid patient. In nearly every type of disability a higher percentage of the lepromatous patients suffered than dimorphous and a higher percentage of the latter type than the tuberculoid cases. Hence, although a much larger number of disabled were of the tuberculoid type, they actually formed a much smaller percentage of the tuberculoids compared with the percentage of disabled amongst the other two types. As already explained, a very high percentage of the lepromatous cases were in the later stages of the disease (Table 4).

It was also found that a higher percentage of men (53.74%) than women (35.25%) suffered disabilities. Also 6.92% of the boys were affected as against 3.33% of the girls.

(These figures do not include indeterminate patients (23) for reasons explained at the beginning of this paper, nor one lepromatous male who had bilateral gynaecomastia only.)

Of the total lepromatous (174) examined, 142 (82,19%); of the dimorphous (177), 108 (61.01%); and of the tuberculoid (2,455), 567 (23.05%) had one or more disabilities.

Combined disabilities of hands and feet were the most common (28.77%), followed by those of the hands alone (25.34%) and then those of hands, feet and face (24.97%). Less common were disabilities of feet only (7.83%), face only (6.24%), hands and face (5.51%) and least common, feet and face (1.35%).

From the statistics drawn up to show the relationship of the side of the body to the disabled organ in the various sexes and age groups, the following points were deduced:

Hand disabilities were almost equally common on the right side (17.84%) as on the left (18.28%) in the men, and only slightly more common on the right (18.62%) than on the left (16.33%) in women.

In the men, 63.87% of the hand disabilities were bilateral; in the women, 65.04%.

Feet disabilities were more common on the left (20.63%) than on the right (18.03%) in men, and also in women (20.05% left/15.99% right).

In men, the bilateral feet disabilities formed 61.34%, and in women 63.96%.

Facial deformities were more common on the right (23.43%) than on the left (13.14%) in men, and similarly in women (26% right/12% left).

In the men, the bilateral facial deformities formed 63.43% and in women 62%.

Gynaecomastia occurred on the left (20%) in 2 men and in 1 boy, and bilaterally (80%) in 12 men.

Thus, from these figures it can be seen that 60-65% of hand, feet and facial disabilities were bilateral in both men and women. Furthermore, there was not a very marked difference in the incidence of right and left-sided deformities in the hands and feet in both adult sexes, that is, approximately 15-20% occurred unilaterally.

In the case of facial stigma, unilateral blindness, and lagophthalmos, these were twice as common on the right (23-26%) in both men and women than on the left side (12-13%).

As there were only small numbers of boys and girls showing disabilities, a comparison is not attempted.

Summary and Conclusions

1. This paper is an attempt to show, from an examination of as many leprosy patients as was possible at the time, the distribution of leprosy throughout the various divisions of the Gambia.

2. The diagnosis of the disease was entirely clinical and was divided into the two main polar types, lepromatous and tuberculoid, plus the dimorphous type and a few indeterminate cases (where these were seen very early and were, in actual effect, leprosy but indeterminate of type).

3. The occurrence of leprosy in the various sexes and age groups has been analysed and some conclusion reached regarding the age of onset of the disease and the relationship of certain cases to contacts (obtained from actual histories).

4. Disabilities of hands, feet and face and also gynaecomastia and leprotic laryngitis were recorded and have been analysed according to their occurrence in the various types of the disease and in the various sexes and ages.

5. It can be seen that leprosy appears to have a high incidence (more than 10 per mille) in the Gambia. This high total incidence but rather low lepromatous rate (6%) is an indication that the disease is serious from a public health point of view, since it indicates that there must exist every opportunity for the spread of the disease even from this small number of contagious cases. The stigma attached to leprosy in the Gambia is very slight compared to that in most other countries.

6. The high childhood rate (38%) also indicates the favourability of circumstances to the spread of the disease.

7. The combination of this low lepromatous rate and high child rate may be some indication that leprosy is not a diminishing disease in the Gambia.

8. Such a widespread and disabling disease as leprosy in the Gambia, especially amongst the active working population (children and young adults), must have a hampering and deleterious effect on the agricultural development of the country. Since agriculture is the mainstay of the economy of the country, then it must be logical to assume that this disease must also affect the country's economy and requires, therefore, urgent priority for its eradication.

Acknowledgement

I am grateful to the Director of Medical Services, Dr. S. H. O. Jones, C.B.E., for kind permission to publish this paper.

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PHYSIOTHERAPY IN INDIA

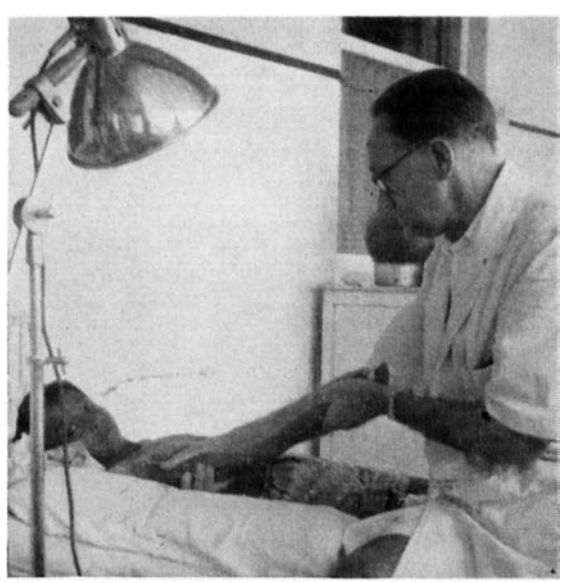
by HARRY W. WILLIAMS, F.R.C.S.,

Edin. Convener Physiotherapy Sub-Committee Christian Medical Association of India, Chief Medical Officer, Catherine Booth Hospital, Nagercoil.

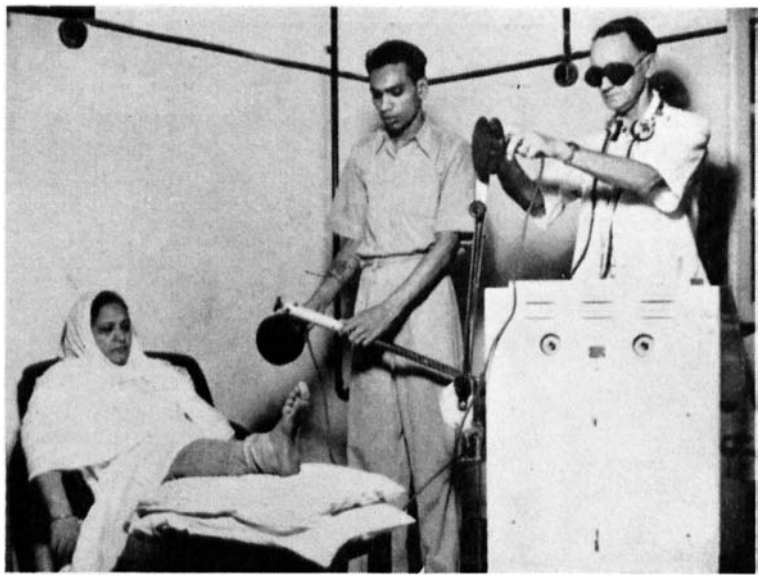
India had a golden age in medicine in the 6th and 7th centuries B.C. and at that time was perfecting empirical treatments in medicine and surgery, some of which are in use even today. The greatest surgeon was Susruta, and in his treatise he gives importance to massage in rehabilitating the injured. Much of the learning of this golden age was lost in the next two millenia but massage continued as an art practised by the village barber, who as in the British Isles was also a surgeon of limited repertoire. Generations of British residents in India have been familiar with the visits of these craftsmen, who added a few minutes pummelling of the scalp and neck to each haircut; pumping the victim for gossip the while, for barbers were the traditional news carriers. In fairness it must be said that they gave one interesting titbits of local news whilst snipping!

I remember a middle-aged Irish business executive who was chronically sick from a congenital abnormality. When I called on him I would often find him in the garden clad in bathing slip and stretched on a cane chaise longue – his whole body glistening with oil as the barber worked him all over. It induced in him a great sense of well-being. Of remedial exercise these practitioners knew nothing and the only use of heat I have encountered was in cupping, used particularly on the abdomen. In 1939 the war came to India, at first at a mild tempo but by 1943 camps, training schools, and huge temporary hospitals were springing up all over India. In Poona at 3 I.B.G.H. a large Rehabilitation Department was set up with a pavilion for exercise classes. I remember the gay insouciance of the amputee classes and the plodding competition of 'KNEES 1, 2, 3' classes presided over by a corporal down-graded to C – the reason being, I felt, that he was a born physiotherapist. The occupational therapy was exceptionally good, wood work, metal work and leathercraft were taught in the main centre, whilst enthusiastic W.V.S. workers went from ward to ward with all kinds of fancy needlework. Ten miles away was an Indian Base Hospital where a smaller department discovered that traditional prejudice coloured a disabled man's attitudes; leather for example could only be handled by non-caste people, needlework was a tailor's job but knitting was highly popular. To return to Poona – electrotherapy was well represented and the whole was supervised by a few English M.C.S.P.S. With the close of the war this pioneer effort did not bear adequate fruit in civilian practice. The mission hospital to

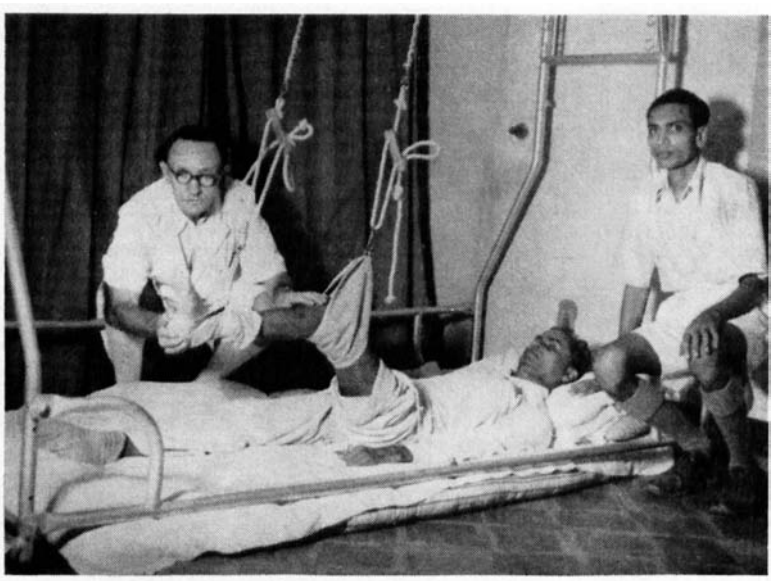
which I was appointed in 1939 had a small electrotherapy department with long-wave diathermy, infra-red and U.V.L. lamps. Treatments were given by a doctor or a senior nurse trained by him. This was a common feature in most large hospitals. In 1951 a few missionary institutions had a qualified physiotherapist on the staff and a year or so later a tentative start was made in training Indian personnel. The Victoria Institute for the Blind in Bombay commenced a two-year training for its patients and at the same time 250 miles north, at the Salvation Army Emery Hospital in Anand, Brigadier Beer, L.C.P.S. (Bom) M.C.S.P., took the first two students for a course based on the M.C.S.P. but reduced to two years. Dr. Beer's story is a remarkable one. He was appointed first to the Emery Hospital as Business Manager. In this capacity he managed the first X-ray machine installed there but felt keenly that the hospital's vital need was more dedicated doctors. So he sat with the boys in the local High School to pass the Bombay Matriculation exam and then proceeded to the College of Physicians and Surgeons, Bombay, for this medical diploma, though by now he was in his middle thirties. It was a proud day for him when he rejoined the staff as a doctor, and a tragedy when a few years later he suffered double detachment of the retina and became blind. But he refused to give up and with the help of the St. Dunstan's Institute he obtained his physiotherapy training and again returned to Anand to develop the embryo electrotherapy section which had been a sideshow of the X-ray Department. A ward dedicated to the memory of Dr. Pennell, the great missionary who was murdered in his



Brigadier Beer giving treatment



In the Physiotherapy Department



Brigadier Beer giving treatment

Two hands one with characteristic deformity before operation; the other with full movement after a tendon transplantation operation.

The hand after operation showing normal grip—the loss of this renders the leprosy patient incapable of a handicraft.

hospital on the N.W. frontier of India, was handed over to Dr. Beer. Redecorated and fitted with cubicles, it was soon busy and gradually outdoor exercise equipment was added and a physiotherapy pool.

Under the persistent enthusiasm of Dr. Beer the Christian Medical Association of India established a physiotherapy subcommittee, inspected the Anand School, and set up an examining body. Stanley Beer died suddenly whilst on holiday in 1956 but the training continued under Captain Roger Wellman, M.C.S.P. and Dr. Beer's first student, Capt. Jethulal. The diploma was recognised by the Indian Association of Physiotherapists. The first graduates went to Ludhiana Medical College, Baroda Medical College and Vellore Christian Medical College in 2 of the 3 as the only physiotherapist. By 1957 a fine Rehabilitation Centre was being erected in Bombay under the supervision of Mr. Venton Gough, M.C.S.P. of the W.H.O., and 50 miles north of Anand in the thriving cotton city of Ahmedabad, a beautiful building was under construction . . . but not one physiotherapist was available at that time.

To the Bombay centre has now been added one at Madras and one at Vellore Christian Medical College. These also conduct a two-year course, essentially the same as the one commenced by Dr. Beer. The practice of orthopaedics and reconstructive surgery has made great strides in India since the war and surgeons are well aware of the importance of the physiotherapist's work, but the number available is hopelessly inadequate.

The situation in the Catherine Booth Hospital – the southernmost hospital in India – can well illustrate both the problems and the opportunities. In a 355-bed general hospital a Department of Reconstructive Surgery was opened last year, and to the limited use of electrotherapy (given in a room of the X-ray Department) was added the diagnostic and therapeutic use of faradic and galvanic currents and remedial exercises. It is surprising how much can be done with little money. Fixed bicycle, Guthrie-Smith frame and slings and walking cradles were made by local craftsmen. In January a full Physiotherapy Department was opened, but despite careful search no trained physiotherapist could be found. Eventually one was seconded to us and in addition to organising routine he conducted a three months' practical course for four young assistants with good basic education (Matriculation or Inter Science). These are capable of carrying out routine treatment prescribed in each case by the surgeon or physician. This scheme is working and the staff is fully occupied. On the surgical side much corrective surgery for poliomyelitis is being done, as well as the usual fracture service. This can only be a temporary expedient, for the hospital has about an eighth of the medical staff of a similar British Hospital and the orthopaedic surgeon cannot afford the time. A commencement has

been made in the reparative surgery of leprosy and no account of physiotherapy in India would be complete without reference to this field. With the advent of sulphone drugs, which are curative in leprosy, reparative surgery became worthwhile. Dr. Paul Brand at Vellore Christian Medical College pioneered tendon transplantation for hand and foot palsies, and a number of plastic surgeons in various parts of the world, experimented with facial repair. These procedures are now standardised and every leprosarium is aware of the need for rehabilitation. The Mission to Lepers has organised a number of six-month courses for workers in this field. In Nagercoil plans have been drawn and funds are being collected to provide separate accommodation for leprosy patients and a department which will give physiotherapy and occupational therapy courses.

The nub of the problem here as elsewhere is staff. It will be a long while before India has enough physiotherapists of her own. Until then she needs foreigners capable of establishing this para-medical science and of teaching Indian students. India welcomes foreigners who come with a primary desire to serve her people. The word 'missionary' is in common use even in Parliament to describe such disinterested service. We need such at Nagarcoil.

ABSTRACTS

Isoniazid Resistant and Dependent Strains of Mycobacterium Lepraemurium Studied in Vivo and in Vitro. P. D'ARCY HART, R. J. W, REES and R. C. VALENTINE. The J. of Path. & Bact., **84,** No. 1. 1962, pp. 105-111.

Since *Mycobacterium lepraemurium* does not multiply in cell-free medium the usual techniques for producing and demonstrating drug-resistant strains are not practicable in this species.

Mice were infected with *Myco. lepraemurium* and treated with isoniazid. The proportion of bacilli in the liver that were degenerate was assessed with electron microscope. This porportion increased at first but, in some animals, later decreased, suggesting that healthy drug-resistant bacilli were becoming dominant. A substrain of the bacilli that was passaged three times in further groups of treated and untreated mice appeared, from the trend of numbers of stainable bacilli in the liver and from the animals' survival times, to be not only drug resistant but also, to some degree, drug dependent; the dependence was strongest in the first passage from an isoniazid-treated animal.

A substrain from the third passage in isonizaid-treated mice showed elongation of the bacilli *in vitro* when these were incubated in a nutrient medium containing isoniazid in concentrations up to 5μg. per ml. This strain required a concentration of 25μg. per ml. for complete inhibition of the elongation. In contrast, an isoniazid-sensitive strain was completely inhibited by 1μg. per ml. The resistant strain showed evidence of slight isoniazid dependence *in vitro*.

Studies on Mycobacterium Lepraemurium in Tissue Culture: II. *The Production and Properties of Soluble Antigens from Myco. Lepraemurium in Tissue Culture.* R. J. W. REES and ROSEMARY D. TEE. Brit. J. exp. Path., **43,** No. 5, October 1962, pp. 480-487.

The present studies were undertaken on cultures of rat fibroblasts in which continuous multiplication of the rat leprosy bacillus *Myco. lepraemurium*, was maintained by subculturing the infected cells to fresh flasks every 20-30 days and changing the media every ten days. Filtered media were concentrated approximately 12-fold and screened, by agar-gel diffusion tests, for the presence of soluble mycobacterial antigens using a test rabbit anti-*Myco. lepraemurium* serum. From a total of 36 individual or pooled 10-day culture filtrates from five cultures of *Myco. lepraemurium* tested, 23 contained antigens which precipitated with the *Myco. lepraemurium* serum and which also reacted, though less strongly, with rabbit anti-*Myco. tuberculosis* serum.

Present investigations suggest that the mycobacterial antigen in the culture filtrates is predominantly polysaccharide since the

precipitation lines stain with periodic-acid Schiff reagent and the antigenicity of the culture filtrates is only slightly reduced by heating to 65° or by exposure to papain.

The evidence suggests that the mycobacterial antigen present in the culture filtrates is being actively produced by the multiplying bacilli because no antigen is present in filtrates harvested from comparable numbers of non-multiplying *Myco. lepraemurium*. Although antigen is present in the media none has been detected in the rat fibroblasts, wherein the bacilli are multiplying, indicating that the antigen rapidly diffuses out of the cells.

The culture filtrates which contain soluble mycobacterial antigens also elicited a delayed type reaction in the skin of guinea-pigs sensitized with BCG.

REPORT

Gambia Leprosy Control Project
Annual Report for 1962

by I. A. SUSMAN, M.B., CH.B., D.T.M. & H.,
Medical Officer, Leprosy.

1. Introduction

The Gambia Leprosy Control Project has continued in 1962 to concentrate on the re-organisation and development of the field work, that is, of the mass out-patient treatment work since it does not yet possess a proper Leprosy Headquarters and Centre.

The tour of the Medical Officer, Leprosy, to examine all the patients attending the leprosy clinics was continued into 1962 and by the completion of this tour 2,829 patients had been examined, of whom 728 were presented with official Discharge Certificates to show that their disease had been cured or arrested and they no longer required treatment. This was the first batch of leprosy patients ever to be discharged officially from treatment in the Gambia.

This country-wide examination of the patients revealed, amongst other things, that leprosy is not a diminishing disease in the Gambia, that it has a high incidence here – certainly more than 1% and that there is a high childhood rate – 38%. Furthermore, it showed that nearly 30% of the patients seen suffered from some disability or deformity of either hands, feet or face or a combination of such deformities.

Treatment in all the out-patient clinics has been continued as once weekly doses of DDS in tablet form up to a maximum of 600 mgm.

The Project was very grateful for the gifts of a typewriter and duplicating machine received from UNICEF.

A 'Summary of the Annual Report for 1961 of the Gambia Leprosy Control Project' by the M.O. Leprosy was published in the July 1962 issue of the *Leprosy Review* (the quarterly publication of the British Leprosy Relief Association).

In addition to the chief difficulty and drawback of working without a proper Headquarters and Centre, there was still no permanent microscopist provided to carry out routine smear examinations, also no accommodation for stores and office files, etc., and of course, the difficulties of travelling around the country on poor roads with broken down bridges or ferries and of not always finding habitable accommodation whilst trekking.

2. Staff

The following was the position at the end of 1962:

Dr. I. A. Susman, Medical Officer, Leprosy at Mansa Konko, L.R.D.

Mr. F. Mead, Leprosy Control Officer (Belra Layworker) at Bansang, M.I.D.
Leprosy Inspector, grade 2. Vacancy.
Mr. S. K. K. Kinteh, Assistant Leprosy Inspector, Brikama, W.D.
Mr. K. Sanyang, Assistant Leprosy Inspector, Bwiam, W.D.
Mr. I. M. Drammeh, Assistant Leprosy Inspector, Essau, L.R.D.
Mr. M. Jammeh, Assistant Leprosy Inspector, Mansa Konko, L.R.D.
Mr. K. G. Cham, Assistant Leprosy Inspector, Illiassa, L.R.D. (on leave).
Mr. L. Camara, Assistant Leprosy Inspector, Georgetown, M.I.D.
Mr. B. A. Dabo, Assistant Leprosy Inspector, Georgetown, M.I.D.
Mr. L. B. Jaiteh, Assistant Leprosy Inspector, Kaur, M.I.D.
Mr. C. M. Barry, Assistant Leprosy Inspector, Basse, U.R.D.
Mr. S. B. Kinteh, Assistant Leprosy Inspector, Basse, U.R.D.
Mr. H. S. Jallow, Assistant Leprosy Inspector, Bajakunda, U.R.D. (on leave).
Mr. S. L. Barrow, Assistant Leprosy Inspector, Bajakunda, U.R.D.
Mr. M. J. K. Jawo, Clinic Assistant, Leprosy, Diabugu, U.R.D. (on leave)
Clinic Assistant, Leprosy. Vacancy.
Mr. W. E. O. Goswell, Clerical Assistant, Mansa Konko, L.R.D.

Several changes in postings were made during the year particularly entailed by the inauguration of the Land Rover Circuits. The M.O. Leprosy was on leave from 15th July to 9th November.

The L.C.O. was on leave from 11th March to 10th August.

The L.I. grade 2 retired in March to take up politics.

One A.L.I. was dismissed on disciplinary grounds in December.

One Clinic Assistant, Leprosy (S. L. Barrow) was appointed to A.L.I. in December.

At the end of the year the assistance of only two Dresser/Dispensers (at Bakau, and Bathurst) was being retained for conducting leprosy clinics instead of seven D/Ds as at the beginning.

During the year the work was hampered by the fact that there was no replacement for the L.I. grade 2, who provided a considerable amount of supervision of the Junior Staff. In addition, there was nobody to fill the short gap between the M.O.'s departure on leave and the L.C.O.'s resumption of duty.

3. Transport

At the end of 1962 the Leprosy Project had nine Land Rovers, of which seven were received about the middle of the year as a further gift from UNICEF for the purpose of conducting Mobile Treatment Circuits.

The remaining four (of the eight) UNICEF motor cycles were withdrawn at the beginning of the year because of repeated breakdowns and long periods of unservicability experienced with them.

During the year all the A.L.I.'s were able to purchase push-bicycles by means of a government loan.

At the end of 1962 a supply of bicycles was gifted by UNICEF to the Leprosy Project.

4. Out-Patient Clinics

During 1962, the method of giving treatment in as many villages as possible, which was started in 1961, instead of at a few fixed

spread-out clinics only, was extended by means of all the staff using push-bicycles.

The new UNICEF Land Rovers were unable to start to go into service until towards the end of the year because of the commencement of the rains at the time of their arrival and also because of the taking of leave of the L.C.O. (Belra) and then the M.O., Leprosy about this time.

In October, the first two vehicles were posted at Georgetown, M.I.D., one to conduct a circuit of clinics on the North bank and the other one on the South bank. The former covered the clinics previously carried out by the D/D Karantaba, Sami, the A.L.I., Kuntaur and the northern half of those done by the A.L.I. Georgetown. The South bank circuit covered the southern half of the area of the A.L.I. Georgetown plus the area of the A.L.I. Dankunku. Thus, each of these vehicles was, of course, able to cover a much larger area than one bicycle was able to cover and, in addition, areas previously uncatered for by leprosy clinics were able to be included in the circuits.

In December, further Land Rovers were posted at Mansa Konko and Basse to conduct clinics around the villages, again weekly intineraries being carried out extending leprosy treatment to as many villages as possible in these areas. The Mansa Konko circuit covered the areas previously catered for by the A.L.I.'s at Mansa Konko and Kaiaf plus that of the C.A., Leprosy at Bureng. The Basse circuit covered the southern half of the Upper River Division taking in the areas of the D/D, Kristi Kunda and opened up the eastern end of the MacCarthy Island Division on the South Bank, not previously covered.

Two more vehicles were based at Farafenni, L.R.D. and Brikama, W.D. in the new year.

These mobile circuit Land Rovers cover approximately 200 miles each per week, one day of each week being arranged for the servicing of the vehicle usually whilst the local clinic is being conducted.

By this means of taking leprosy medicine as near as possible to the patients' homes, many more leprosy sufferers were coming under treatment, which should also be more regular and continuous – very important points for the success of any leprosy project.

Examples of the increases in the numbers of new patients registered by the inauguration of Land Rover circuits are clearly given by the following figures:

MacCarthy Island Division:

21 new cases in August.
29 new cases in September.
Land Rovers introduced in October.

52 new cases in October.

Lower River Division:

34 new cases in October.
31 new cases in November.
Land Rover introduced in December.
52 new cases in December.

Upper River Division:

18 new cases in October.
21 new cases in November.
Land Rover introduced in December.
88 new cases in December.

There were, however, three areas not covered by Land Rovers but were being maintained as bicycle circuits – these are at Essau, L.R.D. Bajakunda, U.R.D. and Diabugu, U.R.D.

The new method of giving treatment with Land Rovers also enables some of the Project Staff to become available to carry out more extensive examination and supervision of contacts, detection of new cases, investigation of patient absentees, propaganda work, etc. At most of the Land Rover stations, two officers were posted.

More dressings were available in 1962 for the benefit of patients with ulcers though the medicament itself (Boro-iodoform powder) was still in very short supply.

Several circulars of instruction to all officers giving leprosy treatment were issued during the year, and others on the 'Prevention of Deformity—Care of the Hands and Feet in Leprosy Patients' and on 'The Diagnosis of Leprosy' are being prepared.

5. Allatento Leprosy (Isolation) Village

The name of this village was officially changed in 1962 from the previous title of 'Allatento Leper Camp' – an announcement also being made to this effect over Radio Gambia.

This village, situated on the main road about 1 mile west of Bansang Hospital in the MacCarthy Island Division, has continued to be supervised very largely by the Leprosy Control Officer (stationed at Bansang).

Allatento still remains the only centre for the isolation of contagious leprosy patients willing to go there and for a few patients requiring a little extra care for ulcers.

On 31st December there were 24 patients resident, as follows:

	Men	*Women*	*Boys*	*Girls*	*Total*
Lepromatous	14	2	1	–	17
Dimorphous	3	–	–	–	3
Tuberculoid	4	–	–	–	4
					24

There were seven lepromatous males admitted during 1962.

A daily schedule of treatment with DDS was introduced towards the end of 1962 to replace the previous weekly routine.

During the year five patients received courses of Etisul (Diethyl-dithiol-isophthalate) in addition to DDS and made excellent progress clinically. Only one was reported to have developed a severe reaction at the end of the year and this apparently responded to injections of 'Fantorin' (antimony).

The two female patients have been employed as cooks for the village, and one male patient was employed as a Dresser, all receiving 1/- per day for their services.

Further building improvements have continued here and more personal comforts provided for the patients, e.g. 'local' beds have been supplied to all patients.

Various gifts have been distributed amongst the patients from the Busy Bees, Bathurst, the Methodist Church of the Gambia, and the Gambia Branch of the British Red Cross Society. Mr. Beale, Headmaster of the Gambia High School, also donated a very handsome transistor radio.

Allatento was visited during the year by the Governor, H.E. Sir Edward Windley, and his successor H.E. Sir John Paul with Lady Paul, also Dr. Liston from the Dept. of Technical Co-operation, London, and the Minister of Health, the Hon. Mr. Daffeh and Dr. N'Dow, the Medical Officer of Health.

6. Propaganda

This aspect of the Project has continued to be stressed by posters in English and Vernaculars, by articles in the Gambia News Bulletin, by the publication by the Government Printer of the booklet 'The True Facts About Leprosy' (Ghana) prepared and revised for the Gambia by the M.O. Leprosy and fairly widely distributed especially amongst schools, and by the M.O. Leprosy's talk over Radio Gambia which was also put out in the Vernaculars.

7. Statistics

At 31st December 1962, there was a total of 4,450 cases registered for treatment of whom approximately 37% were children (up to 16 years of age), 33% women, and 30% men.

This compares with 4,135 patients registered at 31st December 1961.

During the year a total of 1,253 new patients (339 men, 431 women, and 483 children) were registered. 431 patients, therefore, absconded from treatment. This compares with 2,991 removed from the registers as absconders in 1961. 499 were officially discharged during the year, and eight deaths were reported. The

following are the figures obtained from the last Quarterly Return of patients under treatment for 1962.

Men	*Women*	*Children*	*Total*
1,311	1,486	1,653	4,450

From the Monthly Returns for December 1962, the total numbers of patients registered in the various divisions were as follows:

Bathurst area	94
Western Division	339
Lower River Division	1,787
MacCarthy Island Division	1,482
Upper River Division	913

The tour of all the clinics in the country which was started in November 1961 was continued until May 1962, by the Medical Officer, Leprosy, in order to examine all the patients attending, to verify diagnoses, to record particulars and to issue Discharge Certificates to those in whom the disease was cured or arrested.

The following numbers of patients were examined on that particular tour in 1962 (January—May).

	Men	*Women*	*Boys*	*Girls*	*Total*	*%*
Lepromatous	74	36	3	4	117	6.27
Dimorphous	61	48	10	6	125	6.70
Tuberculoid	362	540	371	342	1,615	86.58
Indeterminate	1	3	1	3	8	0.43
Grand Totals	498	627	385	355	1,865	100

Of this grand total of 1,865, there were 499 (26.75%) patients issued with Discharge Certificates and it is hoped that these will be kept under periodic (six monthly) observation for at least two years.

Several further visits, by both the M.O. Leprosy and the L.C.O. (Belra), were also made during the year to supervise the work of the staff and give advice. Several patients were again examined during some of these visits.

Attendance rates increased to an average of 70% by the inauguration of mobile circuits whereas formerly, with static clinics, the attendance rate was only about 30% on an average.

A paper entitled 'The Pattern of Leprosy in the Gambia, West Africa' was prepared by the M.O. Leprosy for publication. (The original contained 4 histiograms and 27 tables.) This showed, in addition to the figures quoted above in section 1, indicating the seriousness of the leprosy problem in the Gambia, that there was here a lepromatous rate of 6.15%, a dimorphous rate of 6.26% and a tuberculoid rate of 86.72%.

Also, of the total number of patients examined, 47.31% were males (27.93% men, 19.37% boys) and 52.69% were females (34.22% women, 18.49% girls).

Furthermore, 47.69% of the total were under 21 years of age, 72.79% being under 31 years of age, and only 11.8% over 40.

The highest incidences of the disease were found to be in the MacCarthy Island Division (24 per 1,000) and Lower River Division (17 per 1,000); Upper River Division also had a high incidence (13 per 1,000), but the Western Division (9 per 1,000) and especially the Bathurst area or Kombos (3 per 1,000) showed much lower incidences.

8. Conclusion

Although progress has been made in the field work by the very great extension of clinics throughout the country, diminishing the degree of absenteeism amongst the patients, and by the discharge of a further some 500 patients in 1962, and by the spread of propaganda and education about leprosy to the public, and even the improvements at Allatento Leprosy Village – all these points do not alter the fact that the Gambia still is only in the 'Project' stage as regards its fight against leprosy, and cannot become a real 'Service', aiming to control and eventually eradicate the disease, until it makes provision for a proper headquarters and centre where special medical and surgical treatment can be given to leprosy patients requiring it, in addition to a laboratory service and better isolation accommodation and where newer drugs can be used or tried out.

It is still hoped that in 1963 a Propaganda-Treatment Survey of all the schoolchildren in the Gambia will be possible.

A Land Rover Caravan Conversion is very urgently needed in order to carry out to the full the trekking programmes, vital to this Project, by both the M.O. Leprosy and the L.C.O. (Belra).

It is hoped, too, that 1963 will see further progress by the Gambia Leprosy Control Project not only in the field work and by the discharge of more leprosy sufferers cured from the disease, but also in the direction of a proper headquarters and centre as already indicated.