LEPROSY REVIEW

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VOL. XXV. No. 1 JANUARY, 1954.

PHYSIOTHERAPY NUMBER

Principal Contents

The place of Physical Medicine and Orthopoedic Surgery in Leprosy

Investigation in Paralysis Patterns in the Forearm and Hand in Leprosy

Physiotherapy and Neural Involvement in Leprosy

Suggestions for Treatment by Physical Methods in Neural Leprosy

Leprosy Incidence and Control in East Africa, 1925-1952

Reviews

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EDITORIAL

THE HAND IN LEPROSY

The loss of manual skill from whatever cause is a most serious disability. These contributions of Paul Brand and Miss Ruth Thomas are important because they offer a real opportunity to prevent or reclaim the disabled hand resulting from leprosy. They mark a stage in the amelioration of this disease.

One of the major problems facing the orthopaedic surgeon is the restoration of the patient disabled from poliomyelitis. This disease presents many similar problems to those faced in leprosy. Both are infective and neither infection can as yet be controlled, though there is much to lead us to think that this may not be too far away. Until this fundamental solution has been reached, the orthopaedic surgeon can offer amelioration of the disabilities, often in striking fashion.

The patient crippled by poliomyelitis was once shunned and left to his own resources. At the turn of the century, and even earlier, Hugh Owen Thomas and Robert Jones and others developed operative procedures which brought relief to the untreated, terribly deformed paralytic, but their results were limited by the severity of the deformities with which they dealt. Important in their time, these operations are now seldom performed; we now rarely allow such deformities to develop. We have learned that in motor paralysis, deformity is caused by disuse and muscle imbalance. Deformity is preventable by maintaining a full range of joint motion, active or passive and the balancing of muscle pull by tendon transfer.

In poliomyelitis the crippled hand was the last to succumb to the surgeons attack. In the hand, stiffness and contracture are quickly the penalty of omission, nowhere in the body is it more obvious that maintenance of function, not restoration of function is the real solution to our problems.

Miss Thomas has shewn that this aphorism is no less true of leprosy than of poliomyelitis. She demonstrates that deformity of the hand in leprosy is unnecessary and the result of failure to maintain movement. *Deformity is preventable and unnecessary.* This, she rightly stresses, is not achieved easily or quickly, enthusiasm and never ceasing vigilance, are, and will always be essential. Muscle strength is difficult to assess accurately and the electrical reactions as used by Miss Thomas are often quantitatively unreliable. May we commend the now generally accepted M.R.C. method of grading voluntary power?

Paul Brand has pioneered but unlike some pioneers he has not become unbalanced. Applying the established principles of hand reconstruction in poliomyelitis and peripheral nerve injury to the

fundamentally similar problem of leprosy, he has achieved notable success. This, despite the difficulty presented by the contracted and stiff hands which have been his material.

From our now well established knowledge of hand paralysis arising from other causes, it is certain that Brand and Miss Thomas based their practice on sound orthopaedic principles. In future active exercises and the maintenance of joint range by passive movements can avoid contracture and stiffness. Surgical reconstruction of the supple mobile hand suffering from muscle imbalance in the intrinsic and thenar groups of muscles will be even more worthwhile than it is in poliomyelitis, where the long flexors and extensors are so frequently involved.

Little has been said of the sensory loss although in many ways this is the more serious disability in leprosy. The reason for neglecting this aspect is a simple one, it is not amenable to surgical cure. The solution to this must be in prevention or cure of the disease in its earliest stage. J. I. P. JAMES.

APPRECIATION AND CONGRATULATIONS

The Editor is desirous of expressing his thanks to the contributors to this number of the Review, which to him marks a landmark in leprosy history. How vividly does he bring to mind the half halting and ineffective attempts to improve the lot of the deformed patient before the orthopaedic surgeon and the physiotherapist were persuaded that leprosy was a disease worthy of their attention. It will be seen that the appeal of those who technically may no longer have leprosy, but whose constant cry is " What can we do with these hands? " has been fully, skillfully and altogether admirably answered by Mr. Brand and his enthusiastic team at Vellore.

We would especially thank Mr. James not only for his able summary of the position of orthopaedic surgery and physiotherapy in leprosy, but for his constant willingness to give of his skill and time to leprosy patients in Great Britain, and we would also express our appreciation for the co-operation of his staff.

To Sir Leonard Rogers we would offer our heartiest congratulations on reaching his 87th year. There is no one in the history of Tropical Medicine who has made a greater impact. When leprosy was fully encompassed by the words ' Leper ' and ' Unclean ' he stepped forth, a determined warrior, and said " These things shall not be ". Readers will realise on reading Sir Leonard Rogers' contribution how far his vision, his wise counselling and his dynamic personality have hastened this day, when we can say men and women, and, above all, little children, need no longer be gripped by paralysing fear.

THE PLACE OF PHYSICAL MEDICINE AND ORTHOPÆDIC SURGERY IN LEPROSY

PAUL W. BRAND, F.R.C.S. (Eng.)

(The substance of an address given to the International Leprosy Missions Conference in Lucknow, 1953, and published by kind permission of the Mission to Lepers, London).

The surgeon and physical therapist have three important objectives in the field of leprosy. The first is the prevention of deformity; the second is the correction of deformity when it has occurred, and the third is the rehabilitation of the crippled patient. These will be considered only in their relation to the crippled hand.

Prevention: In order to prevent deformity, we need to understand exactly how and why deformity occurs in leprosy and then find out how the various factors in its causation can be overcome. These causes of deformity, for the sake of simplicity, can be summarized in three main groups.

Group I. Causes which are associated with paralysis of the motor nerves,

Group II. Causes which are associated with paralysis of the sensory nerves, and

Group III. Causes associated with the direct effect of leprosy on the tissues of the hand.

There are two important deformities of the hand in leprosy. One is the limitation of movement and stiffness of the joints, and the other is the absorption and destruction of the fingers. We will discuss the cause, and prevention of each of these separately, and under the group headings mentioned above.

Joint Limitations: Motor paralysis causes a limitation in the range of active movement of the joints. The only common paralysis affecting the hand in leprosy is a high ulnar nerve palsy and a low median nerve palsy. This causes clawing of the fingers and inability to oppose the thumb. We do not know of any certain way of preventing this paralysis. The operation of nerve decompression is sometimes of value, especially in cases of acute swelling of a nerve. In the case of the ulnar nerve the operation consists in stripping of the sheath in the swollen segment, leaving the sheath in continuity beside the nerve. It may also be of value to transpose the nerve to the front of the elbow and bury it in muscle. The operation on the median nerve is a stripping of the sheath from the lower three inches above the wrist and the division of the flexor retina culam over the carpal tunnel.

In spite of all medical and surgical treatment, however, paralysis will frequently occur, and clawing of the hand will follow. It is important to know therefore the limitations of this palsy.

The forearm muscles that close the fist are only rarely paralysed and the power of the grasp is therefore usually good. The small muscles of the hand are commonly paralysed, and this causes an inability to open up the finger joints and to oppose the thumb to the fingers.

The patient is thus able to hold an object which is pushed into his hand but finds it difficult to open his fingers in preparing to grasp the object. This is the limit to which motor paralysis alone will cause deformity to a hand. The joint stiffness which frequently follows is due to the disuse of the fingers which follows paralysis. If the fingers are never fully opened, the skin on the palmar surface will slowly contract until finally the fingers cannot even be pulled open, and they become stiff in flexion.

The prevention of this disuse-stiffness is simple. If the patient is instructed to exercise his fingers daily and gently to pull them straight by using his other hand, he will never develop disuse stiffness, and a muscle balance operation will be able to restore his range of active movement.

Group II. Anaesthesia is not a direct cause of joint stiffness. It removes however the great safety factor of pain and temperature sensation and thus allows a constant succession of burns and injuries to the fingers. These injuries are mostly on the palmar surface of the fingers and heal by scars which pull the fingers into flexion deformity. Other injuries become infected and may cause suppuration in and around the joints leading to ankylosis or limitation of movement. This type of deformity is difficult to overcome by exercises and operation.

Most of these burns and injuries are avoidable if patients are trained to alertness against the common sources of injury. They should also be shown the importance of treating any small injuries that will occur in spite of vigilance.

The third and least frequent cause of joint deformity is a damage to the joint by the disease of leprosy itself. This usually takes place during a phase of acute reaction, and may take the form of a softening and osteoporosis of the sub-articular cancellous bone. The articular cartilage is then a shell unsupported by rigid bone beneath it, and may collapse under the slightest strain, giving a distorted joint. Such a joint may become completely stiff, or else have a limited and eccentric movement.

This softening of the sub-articular bone in the fingers seems to be most marked during the phases of reaction in lepromatous leprosy. It is a reversible condition and reossification may take place in the softened bone providing the articular cartilage has not collapsed in the meantime.

If the fingers are splinted during the phase of reaction, then the cartilage will not have any strain placed upon it and the joint will survive until reossification takes place. For the splinting we suggest a simple wooden splint, made of half a cocoanut shell placed on a straight wooden splint. The hand grasps the cocoanut shell, with the fingers surrounding it and the thumb beside it, and then the hand and forearm are lightly bandaged to the splint. The splint may be removed occasionally for gentle movements and for meals. The difficulty is to decide how long this splint should be worn. It is probably only necessary to wear it during acute reaction when the finger joints themselves are either swollen or painful.

Finger absorption: Group I.

Motor paralysis is not a cause of finger absorption. In fact it may be said to exert a protective function. If claw-hand occurs early in the disease before anaesthesia has been present for long, the ends of the fingers are curled up into the palm and the hand is not used. The fingers therefore do not encounter the same hazards that they would encounter if the hand were strong.

Group II. By far the greatest proportion of finger absorption is secondary to the trauma and burns which follow anaesthesia. There seem to be two types of injury which result in finger absorption. One is the frank open wound or deep burn which becomes secondarily infected and in which the infection deepens to involve the bone. A sequestrum is formed and extruded and then the shortened finger heals.

The second type of injury may occur in the absence of an open wound and is due to the summation of a larger number of small injuries and stresses which would not damage a normal hand. In an anaesthetic hand without normal powers of adaptation and recovery this causes scarring of the soft tissues and a fine fragmentation and absorption of the bone.

If one wants to prevent finger absorption from these causes one must not only train the patient to be alert to prevent gross injuries and burns, but must also guide him in the selection of an occupation. There are many occupations which are within the capabilities of the neural leprosy patient, but which involve a degree of stress and violence to the hands which is not justifiable for these patients.

The real trouble has been that in the past too many patients, and doctors too, have thought that finger absorption was inevitable and that therefore special care was scarcely worth while. We have been able to show that if an occupation is carefully selected, and if patients are instructed in detail in the way to use their hands in the every day tasks of eating and working and cooking, it is

possible for even the most advanced neural case to lead an active life without losing his fingers.

Group III. There is no doubt that the M. leprae invade the bone marrow and at certain stages of the disease may alter the structure of the phalanges, making them more liable to injury or hindering their recovery from injury. We do not believe that this direct effect of leprosy is a very significant cause of finger absorption. If care is taken of the fingers during acute reaction, and if fingers are splinted in the position of function when they are swollen or tender, finger absorption will be uncommon.

In concluding this section, we would emphasize that providing reasonable preventative care is taken with regard to these secondary changes that follow anaesthesia and paralysis, it should be possible for the vast majority of neural leprosy patients to keep their hands intact and active to the end of their days even although they may have some disability from paralysis. *This statement is true even in the absence of any operative surgery.*

Surgical reconstruction of the hands.

In every case active exercises and physiotherapy should precede surgery so that the maximum mobility of joints may be achieved before operation. The range of movement of a joint may increase after operation, but in general it may be stated that we are not able by operation to increase the total range of passive movement of a joint. What we are able to do is to give the patient the ability to use his fingers by his own muscles in the whole range through which they could previously be moved passively by the doctor. If the finger joints can be pulled open to an angle greater than right angle, then that hand is probably suitable for a tendon transplantation operation. The flexor sublimis tendons from the front of the fingers are transplanted backwards to act as lumbricals to extend the fingers, giving the patient the ability to open out his hand for grasping.

If the fingers are not able to be pulled open beyond right angle, then probably the hand is not suitable for tendon transplantation, but its usefulness may be improved by having the fingers opened to a right angle and fixed in that position by a joint fixation operation. This allows the patient to grip with the fingers against the palm, and a strong and useful grasp may result. The thumb in a paralysed hand usually lies beside the palm and can only be used in a sideways pinch between the thumb and the edge of the base of the first finger. If this is so, it is nearly always possible to do a tendon transplantation which will allow the patient to draw this thumb in front of the palm so that it will meet the other fingers for picking up small objects in a pinch movement or holding large objects between

the thumb and the fingers. Sometimes when a thumb has been paralysed for many years, the web of skin between the thumb and the hand becomes so contracted that the thumb cannot be pulled forward to oppose the fingers. In these cases sometimes the patient can help by stretching the skin in this web daily. If this is not successful, a preliminary operation may be necessary to graft new skin into the web so as to allow a greater range for the thumb.

For this brief review the surgical reconstructions have been over-simplified. There are actually about 15 different operations in regular use at this centre for hand reconstruction in leprosy.

We may summarize by saying that where the chief disability of the hand is due to *paralysis and weakness* rather than to stiffness, we are able to restore a good active hand movement by surgical operations. Where the chief trouble is *stiffness* and shortening of fingers, then the physiotherapist is likely to do much more good than the surgeon.

Having considered the reconstruction of the hand, we now have to recognise that the hand is only the tool of the mind. The mind which has lost hope and which sees no reason for effort is not going to make use of even a good pair of hands, and it will not be long before those hands are again damaged by disuse and carelessness.

Our ultimate object must be nothing less than the total rehabilitation of the patient until he is able not only to care for himself and to earn his own living, but to do it with pleasure and with enthusiasm.

The Rehabilitation Programme. The rehabilitation programme should begin at the very beginning of the patient's treatment and continue until he is settled in his home environment. When the patient has realized that he has leprosy, he is usually overwhelmed with despair.

The longer this despondency continues and the longer the patient believes that he will never be able to take his place in an active society, the more difficult will his rehabilitation become. If he can have immediate contact with a hopeful and enthusiastic group of social workers, technical instructors and physiotherapists, who clearly regard his return to activity as a foregone conclusion, and if he is allowed to work with a group of men who are already demonstrating that they can earn their living, then his mental outlook will change and the most difficult task in the rehabilitation programme will have been completed. After this, the tasks are mainly technical. They involve the assessments of the patient's ability and the selection of a trade which is within his capabilities and which will be unlikely to harm his hands.

We have made it a policy in Vellore that while men are staying in the Rehabilitation Centre as free patients the money that they earn by their trades is not paid directly to them, but accumulates to their credit until they are ready for discharge. From this fund they may claim a certain small proportion as pocket money from time to time, but the main bulk of the money is for the purpose of equipping them with the tools and raw materials of their trade when they finally leave. They purchase from the Rehabilitation Centre the same tools that they were using, at second-hand rates, and the Centre becomes responsible for seeing them established in their new work and for sterilising and marketing their products together with those which have been made at the Centre.

The Rehabilitation Instructors themselves must be fully convinced of the value and effectiveness of the method they are using. If a patient accidentally cuts or burns himself in the course of his work, the Instructor should show an immediate deep concern and treat the situation as a major calamity. He should dress the wound immediately, and with care. He should then take the patient straight back to his work bench, and find out *exactly* how the injury was caused and at once institute measures which may prevent the recurrence of such a happening. This may involve teaching the patient a new way to hold his tools. It may involve changing the shape or length of the handles of his tools, or altering the entire procedure of making the article concerned. When the patient sees that somebody with knowledge and experience is prepared to take a lot of trouble to prevent even the smallest cut or burn, he himself will have a greater respect for the fingers which everybody is trying to improve and preserve.

The measure of success should not be gauged by whether the patient is usefully occupied while in the sanatorium, but the question must be asked " Is this patient learning a way of life which he can continue in his own village environment after discharge? Will he be able to earn a reasonable living and still continue to preserve and improve the usefulness of his hands and his feet? Will he be independent of public charity and be able to develop his own personality, his faith, and his adjustment to his fellow men? " Anything less than this is not true rehabilitation.

We wish to acknowledge the help received in this investigation from the Indian Council of Medical Research, and we must also pay tribute to the vision of R. G. Cochrane who saw the possibilities and importance of these aspects of the treatment of leprosy long before he was able to get an Orthopaedic Surgeon or Physiotherapist to co-operate with him and work them out.

AN INVESTIGATION INTO PARALYSIS PATTERNS IN THE FOREARM AND HAND IN LEPROSY

RUTH E. THOMAS, S.R.N., M.C.S.P.

It is well known that in neural leprosy the hands frequently develop some degree of paralysis, often resulting in the deformity known as claw-hand. The purpose of this investigation was to see if by the use of physiotherapy or surgery this paralysis could be prevented or overcome, and so it became important to know how the paralysis usually progressed, and whether recovery could take place.

Paralysis in leprosy appears to be haphazard in some respects. It may be completely asymmetrical, and it may show periods of rapid progress and of complete arrest, which seem to bear no relation to the activity of the disease. But in one important respect the paralysis appears to conform to a certain pattern—it affects only certain nerves, and these nerves only at certain anatomical levels. The muscles of the forearm and hand may be considered in the following pattern:—

Muscles supplied by the ulnar nerve.
Muscles below the wrist supplied by the median nerve.
Muscles in the forearm supplied by the median nerve.
Muscles supplied by the posterior interosseous nerve.

It is well-known that there is a swelling of the ulnar nerve above the elbow in many cases of leprosy, and that swellings occur in other nerves as well. Mr. P. W. Brand has investigated these swellings at a series of autopsies and at operations, and has been able to show that the swellings in the nerves of the limbs occur in regular anatomical positions and that they are closely associated with the paralysis in the limbs. In the ulnar nerve the swelling begins at the olecranon groove and extends up the arm for 3 inches or more; in the median nerve the swelling begins at the wrist and extends for about 3 inches up the nerve. In the leg similar swellings are found in the lateral popliteal nerve proximal to the neck of the fibula and also in the tibial nerve proximal to the ankle. Swelling in the radial nerve is not so well defined.

Clinically it has been observed that muscles supplied by branches of the ulnar and median nerves given off below the specified swellings atrophy, and become paralyzed. It seemed, therefore, that the muscles commonly affected in neural involvement of leprosy were those supplied by the ulnar nerve, and the intrinsic muscles in the hand supplied by the median nerve. The flexor muscles in the forearm supplied by the median nerve, and the

extensor muscles in the forearm supplied by the posterior interosseous nerve did not usually appear to be affected.

To verify this clinical observation it was decided to test the following muscles electrically:—

(a) **Ulnar nerve:—**
Flexor carpi ulnaris
1st—4th dorsal interossei
3rd and 4th lumbricals
Abductor minimi digiti
Opponens minimi digiti

(b) **Median nerve:—**
Flexor carpi radialis
Palmaris longus
Flexor sublimis digitorum
Flexor longus pollicis
1st and 2nd lumbricals
Abductor policis brevis
Opponens pollicis

(c) **Posterior Interosseous Nerve:—**
Abductor pollicis longus
Extensor indices
Extensor carpi ulnaris.

In twenty patients—some very early cases, some with a fair degree of paralysis, and some with gross paralysis of all the muscles of the forearm and hand—the muscles of the upper arm (deltoid, triceps, and biceps brachialis) were tested. In every case all these muscles were normal, and these muscles were therefore not included in the detailed survey.

Some muscles it has not been possible to test, as they lie too deep to be affected by electrical stimulation through the skin, e.g. flexor profundus digitorum and palmar interossei. The three extensor muscles selected were chosen because Dr. Brand thought they might be useful for tendon transplantation operations and wanted to know whether or not they usually remain normal. In a few cases a test of all the extensor muscles of the forearm was required, and these occasional tests showed that all these muscles usually gave about the same type of response. That is, if one was normal generally all were normal; and if in an advanced case one muscle showed signs of denervation all the muscles usually showed a similar degree of denervation. Posterior interosseous paralysis is rare in leprosy, and no early cases have come our way, so there has been no opportunity to discover in what order the extensor muscles of the forearm become denervated.

In the course of this investigation it has been possible to find out which of the muscles selected generally remain normal and which ones usually deteriorate, and of the muscles which showed deterioration it has been possible to discover whether the denervation is slight, rather marked, or very gross.

For the purpose of electrical diagnosis of muscle denervation a Ritchie-Sneath stimulator was used. This machine has been designed to provide the forms of current required—faradic and galvanic currents—for electro-diagnosis of nerve and muscle lesions. If any suitable tissue, either nerve or muscle, is stimulated by

electrical impulses of known duration and voltage, it will be found that the voltage required for a minimum muscle response increases as the impulse duration is decreased.

These pulse volts are registered on a galvanometer, and are plotted on a graph against the various pulse lengths, and are joined to form a curve. The resultant strength duration curve is found to give a useful measure of the excitability of the tissue being tested. In this way it can be ascertained whether or not a certain muscle is normal, and if it is abnormal it is possible to tell whether the denervation is slight or gross.

When a muscle responds to galvanism only it means that there is " complete reaction of denervation," and when this is shown, one of two things may follow:

(a) " Partial Reaction of Denervation " may take place, when the muscle may gradually improve until it responds to faradism, and perhaps recover completely;

OR

(b) The muscle may continue to regress until " absolute reaction of degeneration " has taken place, when there will be no response of the muscle to either galvanism or faradism, and then we have only exceptionally seen recovery in the muscle. But in some hands where the intrinsic muscles have shown absolute reaction of degeneration when being tested through the skin, yet at open operation there has been a definite response when these same muscles were stimulated directly. In two cases, after a period of no reaction to galvanic stimulation, improvement has been observed in some of these muscles, and this improvement has gradually increased till (at the time of writing) there is partial reaction of denervation. In one case the flexors sublimis digitorum and longus pollicis of one hand have improved to a marked degree, but so far the other muscles give little or no response to electrical stimulation.

Every time a test was done on a patient, it was completed at one sitting because of the possibility of changes in muscle power over a period of time. Fifty patients with leprosy were tested. These patients were selected from a larger group who were attending a hand clinic, and therefore they do not represent anything like a cross-section of all patients suffering from leprosy because, of course, a large number of leprosy patients do not have any paralysis at all, and another large number have minimal paralysis which does not bother them and they therefore will not attend a hand clinic. These figures therefore represent patients with a significant or severe degree of paralysis. Furthermore, some further selection has been made so as deliberately to include in this series a few patients who had exceptionally severe paralysis and a few who

had typical mild paralysis. No selection has been exercised, however, in choosing patients with regard to the type of distribution of the paralysis. Initial tests gave the following results:—

Muscle	*Normal*	*Weaker than Normal*	*Gross Denervation*
(a) **Ulnar Nerve**			
Flexor carpi ulnaris	33%	26%	41%
Dorsal interossei:—1st	40%	3%	57%
2nd	37%	4%	59%
3rd	34%	3%	63%
4th	32%	5%	63%
Lumbricals ... 3rd	31%	5%	64%
4th	30%	6%	64%
Opponens minimi digiti	27%	5%	68%
Abductor minimi digiti	23%	8%	69%
(b) **Median Nerve**			
(1) In the hand:			
Abductor policis brevis ...	41%	5%	54%
Opponens pollicis	63%	1%	36%
Lumbricals ... 1st ...	44%	5%	51%
2nd ...	44%	6%	50%
(2) In the forearm:			
Flexor longus pollicis ...	70%	27%	3%
Flexor sublimis digitorum ...	76%	21%	3%
Palmaris longus	92%	5% (absent)	3%
Flexor carpi radialis ...	97%	—	3%
(c) **Posterior Interosseous Nerve**			
Abductor policis longus	79%	16%	5%
Extensor indices	81%	14%	5%
Extensor carpi ulnaris	79%	16%	5%

This table shows in a very striking fashion the uniformity of the paralysis in the upper limb, all the muscles supplied by one main peripheral nerve being paralyzed with about equal frequency, while muscles supplied by another main peripheral nerve, or by the same main nerve at a different anatomical level are either not paralyzed at all or are paralyzed more slightly or only in a more advanced stage of the disease.

It appears then that the muscles usually affected are those supplied by the ulnar nerve; and the intrinsic muscles in the hand supplied by the median nerve. The forearm muscles supplied by the median nerve usually escape paralysis, but in the one or two cases seen, where there is denervation in these muscles supplied by the median nerve there may also be denervation in the muscles supplied by the posterior interosseous nerve.

FOLLOW-UP ASSESSMENTS :

The aim in doing these tests was to find out if early cases of neural involvement in leprosy always continued to show gradual denervation of the muscle, or if improvement sometimes occurred. A certain number of early cases were selected and they were tested at intervals of 6-8 weeks. In this series the process of muscle degeneration was found to be more common than that of muscle

regeneration. From these tests it has been observed that of the muscles supplied by the ulnar nerve in the hand, abductor minimi digiti appears to be the first to commence denervation, but it also seems to be the last to show absolute reaction of degeneration. Similarly, of the muscles supplied by the median nerve in the hand, abductor pollicis brevis appears to be the first to commence denervation, but seems to be the last to show absolute reaction of degeneration. But this limited number of follow-up tests is not sufficient on which to base any definite conclusions.

In following up our cases at frequent intervals we have observed that in leprosy the normal course of paralysis is not a steady downward trend. There may be a period of improvement and then one of regression, or there may be a period of regression and then one of improvement followed again by another period of regression, or there may be a period of regression followed by one of improvement, etc. Often there are long periods when the paralysis is completely stationary. For example, in one patient who had had tendon transplantation operations to the four fingers and thumb of his right hand, for over a year this was a good functioning hand. Then for three weeks the patient complained of nerve pains in the forearm, but movements of the wrist and fingers were not hampered in any way. The patient woke up one morning to find that he was unable to use the extensor muscles of the forearm. Electrical tests showed that all these muscles were completely paralysed.

It is important to find out the cause of these improvements and regressions. Part of the work at the Vellore clinic will be to continue to observe these improvements and regressions, and to try and find out the factors initiating them.

SUMMARY.

The paralysis pattern in the forearm and hand demonstrated in 50 cases of leprosy with neural involvement shows a certain uniformity, in that the muscles supplied by one nerve are usually all paralysed at the same time and to about the same degree:

Muscles supplied by the ulnar nerve in the forearm and hand	All paralysed early.
Muscles below the wrist supplied by the median nerve	Also early paralysis.
Muscles in the forearm supplied by the median nerve	Paralysed rarely or slightly.
Muscles in the forearm supplied by the posterior interosseous nerve	Paralysed rarely or slightly, but an occasional total complete paralysis has been observed.

The progress of paralysis is often not continuous, but may show periods of improvement and regression. The causes of the latter demand further study.

PHYSIOTHERAPY AND NEURAL INVOLVEMENT IN LEPROSY.

RUTH E. THOMAS, S.R.N., M.C.S.P.

Many people do not realize how precious to them are the everyday functions of the hand that they take for granted. To be able to button up clothes, tie shoe laces, hold a spoon or glass, use a pen, or sew with a needle means independence. It is only possible to perform these actions because we have a brain to direct and two hands to carry out this direction. If these simple things cannot be done with one's hands then we must depend on someone else to do them for us.

This hand function that is taken so much for granted is the result of an extremely intricate and finely balanced system of many small and large muscles, tendons, and joints. Anything that disturbs a part of this finely balanced mechanism, no matter how small or insignificant it seems, results in a change in the appearance and function of the hand. The loss of even a part of the 20 small muscles of the hand may cause a serious imbalance in the hand which greatly reduces its usefulness. Many injuries and disease processes are the cause of the upsetting of the finely-balanced hand, and leprosy, by its involvement of the nerves, is one of these insidious but relentless enemies of our invaluable hand function.

For the past two years different forms of physiotherapy have been used at the leprosy clinic of the Christian Medical College Hospital, Vellore, South India. The aim has been to try and find out just what physical therapy can do for people with neural involvement in leprosy. A variety of cases—men, women and children—have received physiotherapy. From our experience we feel that there are three phases associated with the physiotherapy work:—

A. The mental state of the patient needs to be considered.
B. Physical treatment for the hands.
C. Rehabilitation.

A. The Mental State of the Patient.

For physiotherapy, or indeed any treatment, in leprosy to be successful, the psychological outlook of the patient is of the utmost importance. It had been found that most patients with some paralytic trouble of the hand or deformity of the fingers have given up their work when this paralysis or deformity began, or shortly after it commenced. This was sometimes due to the fact that the patient

himself felt this weakness and therefore felt he could no longer cope with his work, or it was sometimes because his employer had no use for a person with weak hands; or (and this was the worst reason of all from the psychological aspect of the patient) it was sometimes because no one would employ a person with leprosy. But, whatever the reason, the fact that the patient has had to give up his work tends to make him feel that he is no use to himself or anyone else, and that he is a burden to his family and society, with the result that he resigns himself to his condition and loses the will to help himself.

The main aim, therefore, is to win the confidence and co-operation of these people, and try to help them to help themselves, and to show them that weak or deformed though their hands may be they can, with care and practice, do much to help themselves. They must learn to realize that they cannot do many things as well as the normal person, and that their movements are necessarily slower because of their disability. In some way they must be taught to accept all this, and at the same time be encouraged to use what is left; and to learn that there are many things that they can, with practice, get to do as well as a perfectly normal person. The important point to remember is not to give them anything to do which is beyond their capabilities, for that will discourage rather than encourage them.

B. **Physical Treatment for the Hands.**

The patients who come for treatment have varying degrees of deformity, but they all conform to a uniform pattern. Usually the intrinsic muscles in the hand supplied by the ulnar nerve are the ones to become paralysed first:—

Muscles of the hypothenar eminence.
Dorsal and palmar interossei.
3rd and 4th lumbricals.
Adductors obliquus and transversus pollicis.
Opponens and abductor brevis pollicis.

Very often the intrinsic muscles in the hand supplied by the median nerve are also involved:—

Opponens and abductor brevis pollicis.
1st and 2nd lumbricals.

Paralysis of these muscles gives rise to flexion of the interphalangeal joints and hyperextension of the metacarpophalangeal joints, (main en griffe or claw-hand) and the thumb falls back to lie in the same plane as the palm. If these deformities are allowed to continue without physiotherapy, the flexion progresses to an irreversible contracture of the joints.

Amongst our patients are some very early cases with little or no flexion deformity, and certainly no contracture, but who have a slight degree of paralysis and atrophy of some of the intrinsic muscles of the hand resulting in weakness. With these people the aim was to try and prevent further atrophy of these muscles and to improve their condition as far as possible.

Other leprosy patients who attended for treatment had some deformity—either flexion deformity with no contracture, the patient being unable to extend his fingers actively though they could be extended passively; or flexion deformity with joint capsule contracture in some cases, and a contracture due to skin tightness in other cases, but in neither case could the fingers be fully extended actively or passively. With these people the aim was to try and loosen the stiff joints, or at least maintain the existing range of movement.

Several methods of physiotherapy have been used on a number of patients with varying degrees of paralysis and deformity. Careful records have been kept, and the results seem to indicate that physiotherapy is of great value in neural leprosy. The methods used have been:—

1. Oil Massage
2. Wax Therapy
3. Electrical stimulation

Each type of treatment was always followed by active exercises, and these were considered the most important part of the treatment.

1. Oil Massage.

The patient is given a little groundnut oil to rub over his hands and then instructed to massage his fingers in a downward direction, i.e. from metacarpo-phalangeal joint to finger tip. The aim is to straighten the fingers, and the massage done in a downward direction seems to straighten them better than when done in an upward direction. This type of oil massage was found to be of value because:—

(1) It is done by the patient himself, and could therefore be carried out by patients in their own homes, so it was useful for people who lived a long distance away and could not attend for treatment more than once or twice a week.

(2) Where there was flexion deformity of the fingers, but no contracture, it helped to maintain the mobility of the fingers and prevent them becoming contracted.

(3) Where there was some degree of contracture, and this contracture was due to skin tightness, *regular* daily massage helped to straighten the fingers gradually. Where there have been failures in straightening contractures this has probably been because either

the contracture was due to bony changes in the joint or to dense fibrous adhesions.

2. Wax Therapy.

Paraffin wax packs can be applied by dipping the hands a number of times in fairly quick succession into the bath of melted wax. Each coating should be allowed to congeal slightly before the next dip, and should be kept intact, as it is important that all air should be excluded. When the complete coating is $\frac{1}{8}$"-$\frac{1}{4}$" thick, the hand is wrapped in grease-proof paper and then in blanket material to preserve the heat. The patient is asked to keep the hands as still as possible to avoid any cracking of the wax glove.

The temperature at which the wax packs are applied varies from 120°F to 130°F, beginning with the lesser heat and increasing the temperature of the wax as the treatments progress. For a person with a normal skin it is possible to increase the temperature to 140°F with safety, but as most leprosy patients have anaesthesia of the skin to a greater or lesser degree, they are not given these packs at any temperature over 130°F, and that has proved a safe maximum. The pack is left on for 15-20 minutes, at the end of which time the wax glove is quite easily peeled off, and active hand and finger exercises are done.

This treatment increases the heat and circulation of the part to which the pack is applied, so that on removal of the pack the fingers feel more mobile and are better able to do the active exercises which follow. It has been found very useful for stiff joints, and the patients who have attended regularly for this treatment have also noticed that their joints have become looser and that consequently their hands are more useful. Most of the patients whose joints became increasingly stiff were those who were irregular in attendance for their treatments.

It has also been found that paraffin wax packs soften hard, dry, skins, so that the skin of such hands becomes more smooth and supple. In advanced neural leprosy, patients commonly lose the power to perspire on their hands and feet. In some of these patients wax therapy seems to have stimulated the sweat glands to reactivity in some way, so that perspiration functions again. In a few patients whose hands were completely anaesthetic, a gradual return to sensation of heat has been experienced. Occasionally wax packs have been prescribed for relief of pain in the fingers with good results.

Requirements:—

Thermostatically controlled wax bath, *or* two aluminium or

enamelled wash basins of different sizes with electric hot plate or oil stove.

Refined paraffin wax—which can be bought in blocks.

Grease-proof paper.

Blanket material.

Bath thermometer.

METHOD :—

If the thermostatically controlled wax bath is not obtainable, two wash basins of different sizes can be used. Water is placed in the larger bowl, and the smaller bowl containing the paraffin wax is placed in the water. The whole is placed on some kind of heater. An electric hot plate is best, but if electricity is not available, an oil stove can be used. If the latter is used extreme care should be taken while the stove is alight, as wax is inflammable.

The patient's skin should be examined before each treatment for minor abrasions, cuts, etc. If such are present the treatment is not necessarily contraindicated, but they should be covered with adhesive plaster.

Temperature:

As has already been stated, this should be between 120°F-130°F, beginning with the lesser heat and increasing the temperature of the wax as the treatments progress. 130°F has proved a safe maximum.

The part to be treated may be dipped 8-10 times in fairly quick succession into the bath of melted wax. Each coating should be allowed to congeal slightly before the next dip, and must be kept intact, as it is important that all air should be excluded. When the final layer of wax has been applied, the hand is wrapped in grease-proof paper and then in blanket material to preserve the heat. The patient should be asked to keep the hand as still as possible to avoid any cracking of the wax glove.

Duration: From 15-20 minutes, at the end of which time the wax glove is quite easily peeled off and put back in the wax bath. Then active exercises are done by the patient.

USES :—

1. The heat and circulation of the hand are increased so that the fingers feel mobile, and are better able to do the active exercises which follow—wax therapy is therefore useful as an aid to loosening stiff joints.
2. Hard, dry, and horny skins become smooth and supple.
3. In some patients whose sweat glands have ceased to function for a long time wax therapy seems to stimulate them to re-activity in some way, so that perspiration functions again.

4. In some patients whose hands were completely anaesthetic, a gradual return of sensation to heat has been experienced.
5. Relief of pain.

3. Electrical Stimulation.

Faradic and galvanic currents both possess the power to stimulate the excitable tissues, and their therapeutic properties are due, directly or indirectly, to this power. For example, when a muscle is weakened by injury or disease it can be strengthened by being artificially exercised by electrical stimulation. Rhythmic contraction and relaxation of a muscle not only exercises it, but it increases its circulation, and also has the effect of loosening fibrinous adhesions, and aiding the removal of exuded fluid. When reaction of denervation is present the infrequently interrupted or surging galvanic current is generally used, but if the reaction is of the normal type, the faradic current is usually employed, as these currents procure contraction of the weakened or paralysed muscles.

If a nerve is affected by disease, and this disease is gradual in its onset, at first it may not damage the nerve fibres, but afterwards it might do so. Also, the disease might not involve all the nerve fibres at first, but it might do so later, in which case the process of denervation is gradual. This appears to be so in leprosy where there is nerve involvement. Quite often the ulnar nerve on palpation at the elbow will be felt to be thickened, but apart from the patient experiencing pain along the course of the nerve, or being aware that some areas of skin are anaesthetic, there is often no immediate weakening in the hand or atrophy of muscles supplied by this nerve. In fact, degeneration causing atrophy of muscles and weakness of movement sometimes takes many months to become apparent.

The main aims in using electrical stimulation were:—

(a) To strengthen the muscles.

(b) In the event of gradual denervation to work the muscles for the patient and maintain their muscle tone, always hoping that after the period of denervation there would be a period of regeneration. Where this occurred, because the tone of the muscles had been maintained, the muscles should

(1) regain their strength more quickly than if nothing had been done and

(2) the possibility of flexion deformity and contracture occuring during the period of denervation was more likely to be delayed and possibly averted altogether.

In the very acute phases where the patient has severe pain,

it is best not to give electrical stimulation until this pain has subsided, for in such cases the condition would probably become worse (due to the stimulation) instead of improving.

Therefore, for this type of treatment early cases of motor nerve involvement in leprosy were chosen. That is, cases where there was muscle weakness, but little or no flexion deformity or contracture. From the records that have been kept it appears that electrical stimulation is beneficial in the majority of cases. But our observations also show that short periods of treatment are of little value, and that both the patient and physiotherapist must have patience to continue the treatment over a long period of time.

4. Exercises.

Although oil massage, wax packs, and electrical stimulation are useful as preliminary treatments, the stress is laid on exercises. The group of exercises used can be divided into 3 sections:—

Partly-passive, partly-active exercises
Assisted active exercises
Free active exercises

PARTLY-PASSIVE, PARTLY-ACTIVE EXERCISES :

As the majority of patients have no sensation of pain, this type of exercise needs to be done with extreme caution. It has a value providing it is done with great care, and that it is understood that it may produce increasing fibrous adhesions if done too violently, so that very careful supervision is required. Where there is flexion deformity but no contracture, the aim is to straighten the fingers passively and so maintain their full mobility. In such cases the precaution necessary is that of preventing hyperextension of any joints during the exercise. Where there is contracture of the fingers the aim is to decrease it by gradually loosening the stiff joints by passive stretching. It is in this type of case that extreme care and supervision is required, so that the passive part of the exercise does not become a strong forced passive movement.

EXAMPLES OF EXERCISES :

(1) Clasp the hands together, palms facing the body, and press the fingers towards the body, care being taken not to hyperextend the metacarpo-phalangeal joints. Then separate the hands, keeping the fingers as straight as possible while doing so. This exercise begins with a passive stretching of the fingers and ends with an effort on the part of the patient to keep the fingers straight.

(2) Place the hands, palms facing downwards, on a flat surface, and try to straighten the fingers. Light careful pressure may be given with the other hand to any fingers which cannot straighten without assistance. In this exercise the patient first makes the effort

to straighten the fingers, and if this straightening is incomplete, the other hand is used to try to complete the extension passively. In flexion deformity this is possible and no special caution is needed. But if contracture is present, then the pressure must be given lightly and with great care in order to avoid a forced passive movement, for such a movement could easily overstretch the contracting tissues. And even if it gives a temporary improvement it might well, in the long run, produce more adhesions from the multiple microscopic bleeding that might result by using too much force.

Some patients have a tendency towards ulnar deviation of the hand, or one or more of the fingers. In an attempt to correct this the " painting " exercise was introduced. The hand and fingers are kept still, but the forearm moves in the ulnar direction, and this pushing movement helps to correct the ulnar deviation.

ASSISTED ACTIVE EXERCISES :

In an assisted movement the aim is to help a patient to perform actively an exercise that he is unable to do freely, e.g. lumbrical action:—

Place the hands and forearms on a flat surface, palms facing upwards. Flex the metacarpophalangeal joints till there is a right angle between the palm of the hand and the fingers, then straighten the hand. The fingers should be kept straight throughout the exercise. If the patient is unable to do this exercise freely, the assisted method should be used.

Place the dorsal aspect of the fingers on a flat surface, the right angle between the palm and fingers should be maintained keeping the proximal phalanges in contact with the surface and at the same time exerting slight pressure in this region, bend and stretch the interphalangeal joints.

Therefore this can be a free active or an assisted exercise. If the patient is able to do this exercise freely, it means that his lumbrical muscles are functioning normally and that his grasp of objects is of a good range. But if assistance is required it means that the nerve supply to the lumbricals is lacking and they have become atrophied and lost their power of movement so that his grasp is of very small range. In these cases it is extensor communis digitorum which extends the interphalangeal joints, and flexors sublimis and profundus digitorum which flex the fingers, thereby maintaining the lumbrical movement which is essential for a good grasp.

Where the lumbrical muscle to any finger is no longer functioning, if a patient can learn to hyperextend the proximal interphalangeal joint of that finger, he may be able to maintain that hyperextended position while his metacarpophalangeal joint is being

flexed. In such a case the extensor communis digitorum is maintaining the hyperextension of the interphalangeal joint while the flexor sublimis digitorum is flexing the metacarpo-phalangeal joint. This trick is a useful one, and helps to improve the grasp of the patient who has this kind of paralysis.

Another assisted active exercise is that of flexing the fingers into the palm, and letting the thumb move lightly over the fingers from index finger to little finger. This is mainly an active exercise, but is regarded as an assisted exercise where there is weakness in abduction of the thumb, because the position of the fingers helps to keep the thumb in abduction during the exercise. This is only possible if abduction and opposition of the thumb are normal or slightly weak. If these movements are very weak the patient can sometimes get the thumb into position, but cannot perform the full exercise.

ACTIVE EXERCISES:

Although passive and assisted active exercises have their uses, the main stress is laid on free active exercises, for in these exercises it is possible to find out just what the patient can do. These exercises also teach him to perform the various movements of the fingers, and in this way he learns to help himself, since all these movements are used in everyday life. A number of exercises have been tried, and the following are the ones that have proved most useful:—

(1) Place the forearms and hands on a flat surface, palms facing upwards. Bend the fingers to touch the palm, and then extend them as completely as possible. This is followed with flexion and extension of each finger separately, so that the weaker fingers have an opportunity to work without assistance from the stronger fingers. If there is marked flexion deformity or contracture of the fingers there is a tendency to hyperextend the metacarpo-phalangeal joints when extending the fingers. Care should be taken to avoid this hyperextension as much as possible.

(2) Place the hands palms facing downwards, on a flat surface, and perform abduction and adduction of the fingers, keeping the hand and fingers flat throughout the exercise.

In the practice of this exercise it has been observed that where the first dorsal interosseous is very weak or not functioning at all, the range of abduction of the index finger seems to be fairly good among some patients who have tried hard to produce this movement.

Similarly, where adduction and abduction movements of the little finger have become weak and practically ceased, gradually the movements have again become apparent. Electrical tests show that the muscles concerned are paralysed, so the return of these

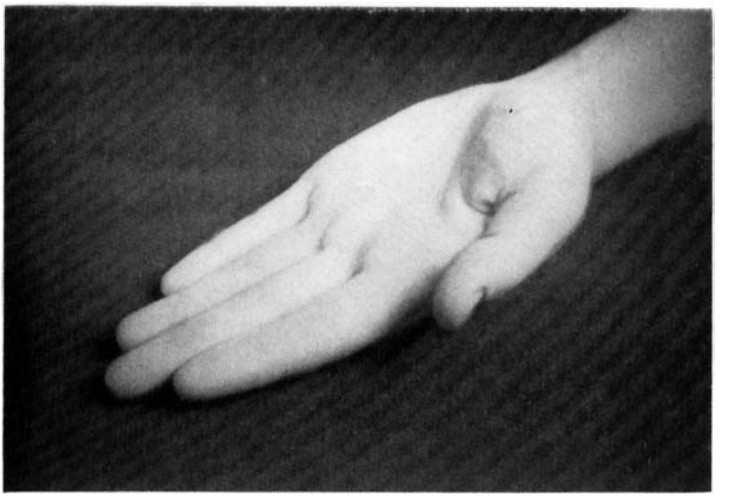


FIG. 1.

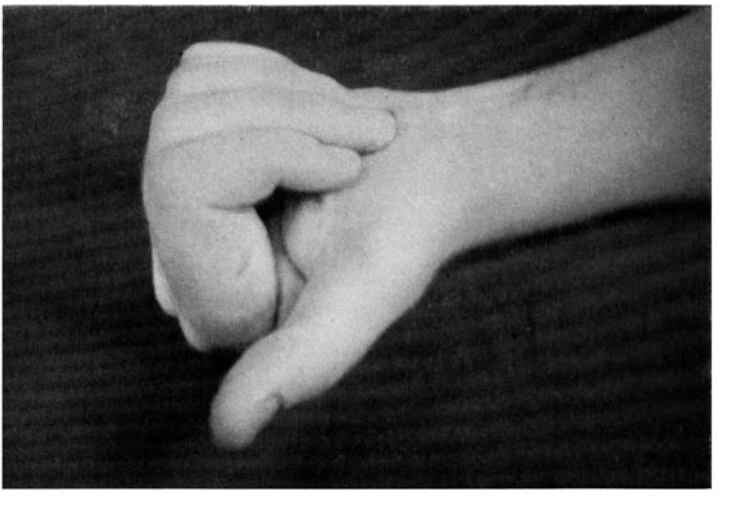


FIG. 2.

Place the forearm and hand on a table, palm facing upwards. (Fig. 1.) Bend (Fig. 2) and stretch the fingers together. (Repeat 6-12 times). Then bend (Fig. 3) and stretch each finger separately. (Repeat 6-12 times.)

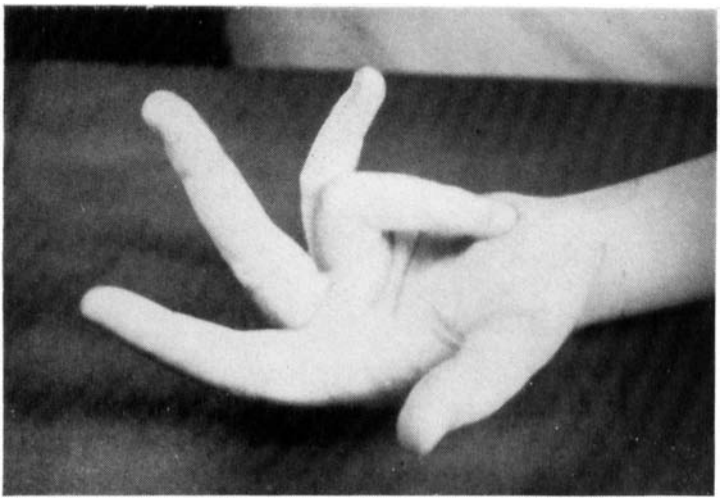


FIG. 3.

FIG. 4

(a) Same position as for Ex. 1: Bend the metacarpophalangeal joints till there is a right angle between the palm and the fingers, (Fig. 4) then straighten the hand. The fingers should be kept straight throughout the exercise. (Repeat 6-12 times.)

movements is due to some trick movement, resulting in greater usefulness of the fingers concerned.

(3) Extension of the wrist plus flexion and adduction of the fingers, followed by flexion of the wrist plus extension and abduction of the fingers. This combination of these movements is considered natural in the normal hand. Where patients find pure abduction and adduction difficult or impossible—(see previous exercise), these movements are often possible to a certain extent when performed with the other movements. Even if this exercise only maintains the limited range of abduction and adduction possible, it is worth doing for that reason alone.

(4) With the tip of the thumb touch:—
- (a) Base of each finger in turn.
- (b) Proximal interphalangeal joint of each finger in turn.
- (c) Distal interphalangeal joint of each finger in turn.
- (d) Tip of each finger in turn.

The fingers should be kept straight throughout, as these exercises are mainly for abduction and opposition of the thumb. Some patients find it difficult to perform the thumb movements while keeping the fingers flat. Where there is this difficulty it seems that there is usually a weakening of the abductor pollicis brevis muscle.

(5) Let the thumb tip meet the tip of each finger in turn, making an "O" shape. This exercise uses all the small muscles of the hand, and emphasis is laid on making the "O" as round as possible. It has been noticed that in hands where the lumbrical muscles are functioning well, the "O" is a reasonably good shape. But where the lumbricals are not functioning, the fingers flex more than is required at the proximal interphalangeal joints, and the "O" shape is far from perfect.

(6) " Picking-up-food " movement is a form of lumbrical action, together with opposition and abduction of the thumb. The tips of all 4 fingers and thumb meet together, the thumb and fingers being kept as straight as possible. This exercise is only possible where the intrinsic muscles of the hand are in a fairly good functioning condition.

Any exercise which tends to hyperextend the metacarpo-phalangeal joints should be discouraged, unless it can be very carefully supervised. It seems that one of the reasons why patients with claw hands find it difficult to extend their finger joints is because the metacarpo-phalangeal joints extend or hyperextend so easily. When a patient is assisted to extend his finger joints, it is done by stabilising the metacarpo-phalangeal joint in semi-flexion, and this enables the patient to use his hand better. Some surgeons have

fused the metacarpo-phalangeal joint in a semi-flexed position, and found that a claw hand works pretty well after this has been done. So that in choosing exercises, those that are likely to produce undue mobility in the metacarpo-phalangeal joints should be avoided, unless they can be carefully supervised. For example, the following exercises, though they are good for certain movements of the fingers, need to be done with great caution to avoid hyperextension of the metacarpo-phalangeal joints:—

Press the elbows in at the sides of the body, and place the palms and fingers of both hands together:—

(a) Keeping opposite finger-tips together, separate the palms and fingers and abduct the fingers, at the same time exerting slight pressure at the finger tips in order to straighten the fingers.

(b) Keeping opposite finger tips together and the fingers in adduction, separate the palms and fingers, at the same time exerting pressure on the finger tips.

(c) Keeping opposite palms and fingers together, abduct and adduct the fingers.

These exercises can be done only by patients with fairly good hands, or by patients who have the same degree of flexion deformity or contracture in the same fingers of both hands. Where the abduction and adduction movements are weak in one hand, they are sometimes helped by the better movements of the other hand.

SPLINTAGE.

The use of splints has deliberately not been discussed, because of insufficient experience, though it is felt that in certain conditions splints have a definite part to play. But it should be borne in mind that indiscriminate splinting is dangerous, as pressure sores are more likely to occur in anaesthetic hands than in normal hands. Therefore cases for splintage should be carefully selected, and splints should be light and applied with caution.

MEASUREMENT OF ANGLES.

The progress of all our patients, whether undergoing active treatment or not, was followed by periodic careful measurement of the range of movement of their fingers. It has been found that the most useful measurement to make is that of the proximal interphalangeal joint because the metacarpo-phalangeal joint is only rarely deformed or contracted, and the terminal interphalangeal joint is not very significant. The angle that is measured is the angle by which the middle segment of the finger fails to become straight with the proximal segment of the finger. If the finger is straight

then there is, of course, no angle or the angle is zero, but if that joint is flexed then an angle is formed.

A protractor with a moveable pointer is used for these measurements. When the pointer is parallel with the middle phalanx, the number at which the pointer rests is the degree or measurement of the angle. This angle is measured under 3 different types of circumstances: unassisted, assisted and passive.

To measure these angles the patient steadies his arm by resting the elbow on the table, and the forearm makes a right angle with the surface of the table. The patient is instructed to keep his wrist straight and to make a right angle at the metacarpophalangeal joint.

Unassisted angles: In this position he is told to straighten his fingers as much as possible. If he cannot straighten them, there will be an angle at the proximal interphalangeal joint. This measures the degree of working power of the intrinsic muscles of the hand.

Assisted angles: Using the same position, the physiotherapist exerts a little pressure on the proximal phalanx of the finger flexing the metacarpo-phalangeal joint. This gives a certain amount of support, and the patient is usually able to straighten out his finger more than when no assistance is given. This estimates the power of the long extensor muscles to extend the joint.

Passive range: The finger is passively straightened by the physiotherapist and if there is an angle it is measured. This estimates the degree of contracture of the proximal interphalangeal joint.

The following is a statistical comparison between two groups of patients which were assessed at regular intervals over a period of eighteen months. In the control group the angles of the patients' fingers were carefully measured at regular intervals, but *no* exercises were given. In the exercise group the patients were all on a regular scheme of exercises and the angles of their fingers measured at regular intervals.

	Control Group	*Exercise Group*
Deteriorated	35%	12%
No appreciable change ...	50%	32%
Improved	15%	56%

It is interesting to note that the percentage of deteriorating hands is greater in the control group, and that the percentage of improvements is greater in the exercise group, and that the majority of patients improved.

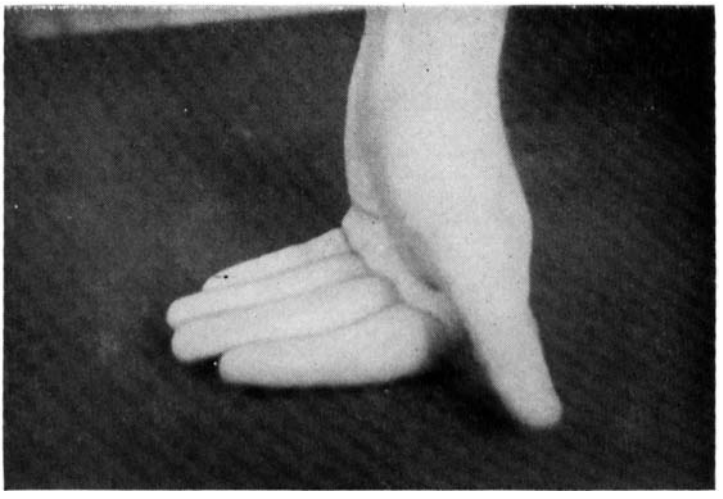


FIG. 5.

(b) Where there is flexion deformity this will not be possible as a free exercise, so the assisted method is used: — The dorsal aspect of the fingers is placed on the table, and there should be a right angle between the fingers and the palm which should be maintained throughout the exercise. (Fig. 5.) Bend (Fig. 6) and stretch the interphalangeal joints of the fingers, at the same time exerting pressure on the proximal phalanges. (Repeat 6-12 times.)

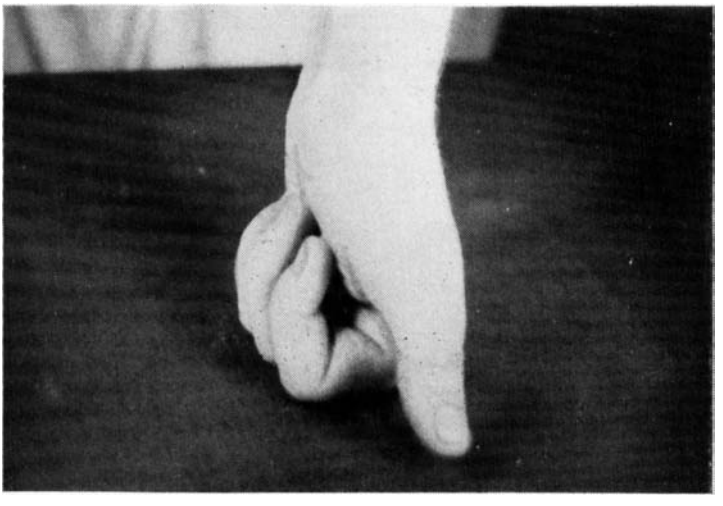


FIG. 6.

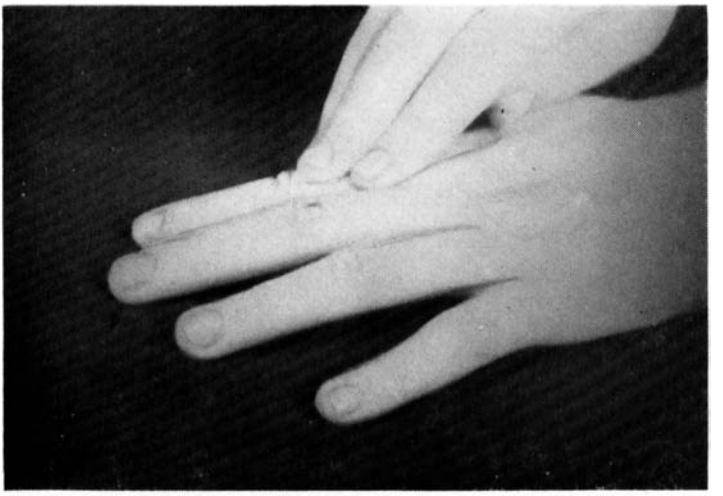


FIG. 7.

Same position as for Ex. 4: The patient should try to straighten the fingers actively. For any fingers that cannot do this, light careful pressure with the opposite hand can be exerted on the proximal interphalangeal joint of the finger in order to straighten it. (Fig. 7.) (Repeat 6-12 times.)

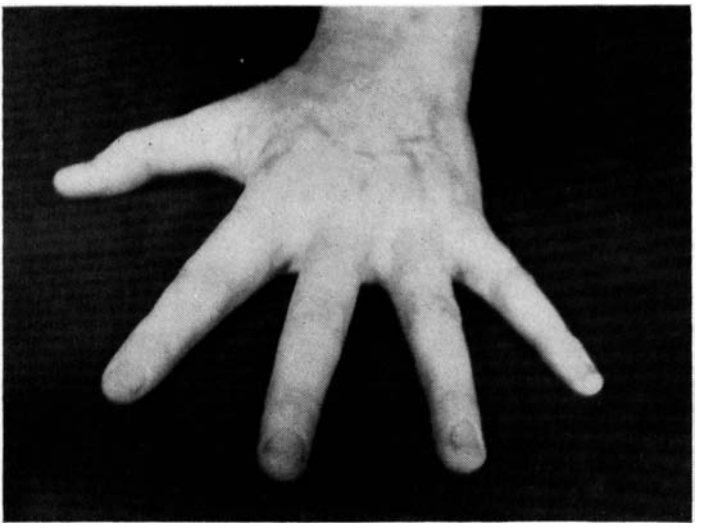


FIG. 8.

Place the hand and forearm on the table, palm facing downwards: abduct (Fig. 8) and adduct (Fig. 9) the fingers keeping the hand and fingers straight while doing so. (Repeat 6-12 times.)

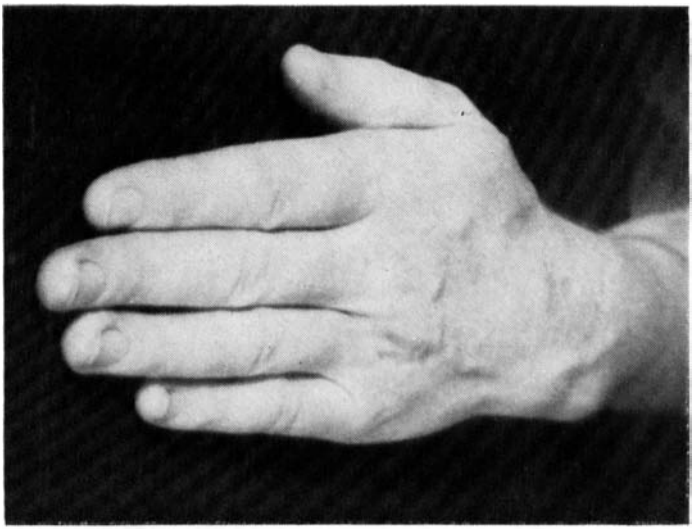


FIG. 9.

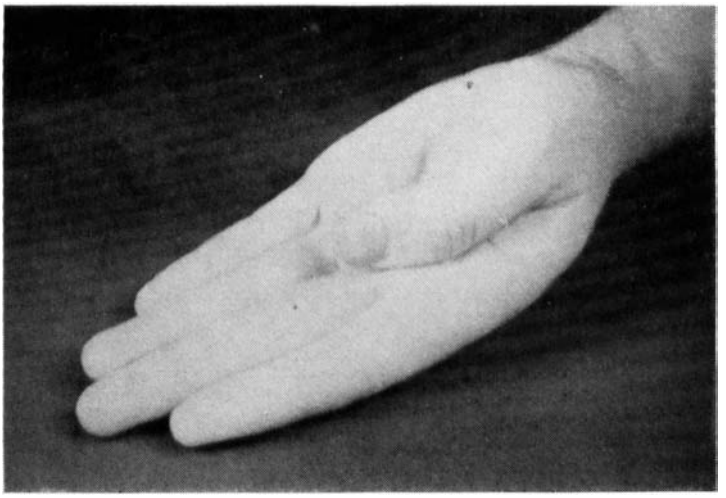


FIG. 10.

Same position as for Ex. 1: Touch the base of each finger in turn with the tip of the thumb. (Fig. 10) In between each movement the thumb should be fully extended and abducted (Fig. 11). (Repeat 6-12 times.)

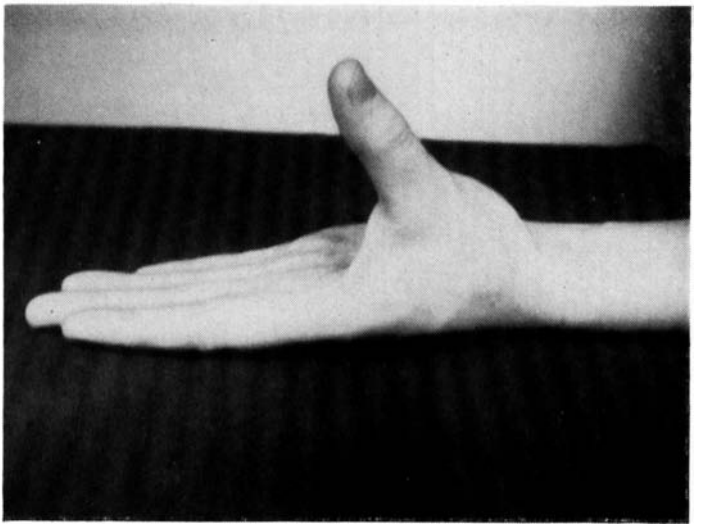


FIG. 11.

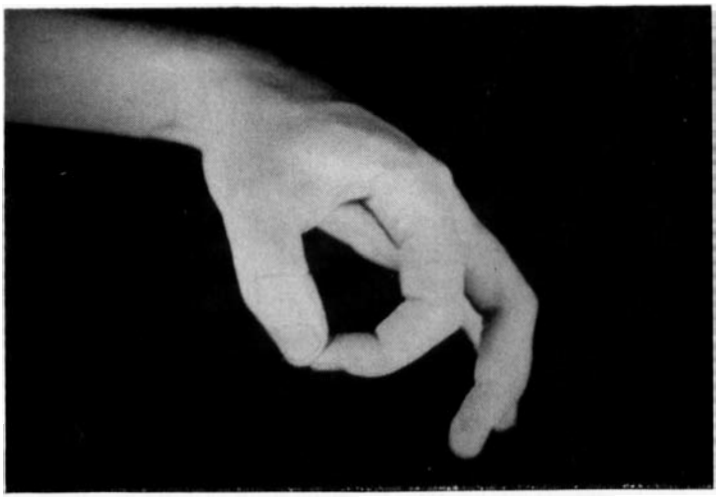


FIG. 12.

With the tip of the thumb touch the tip of each finger in turn. (Fig. 12.) In between each movement the thumb and fingers should be fully extended (Fig. 13). (Repeat 6-12 times.)

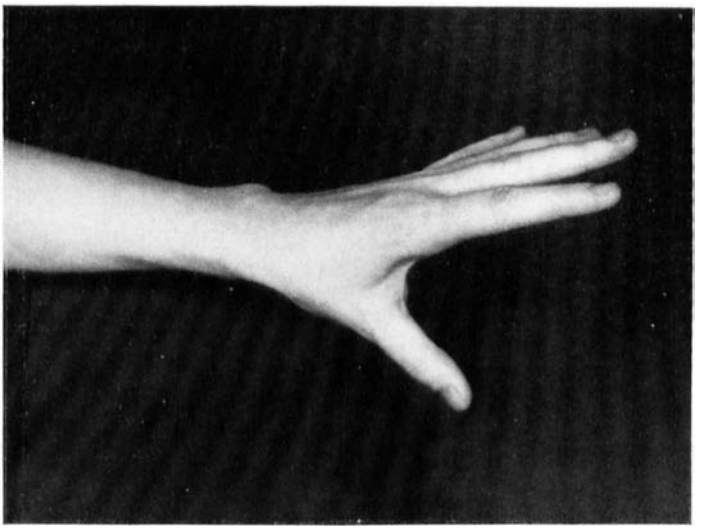


FIG. 13.

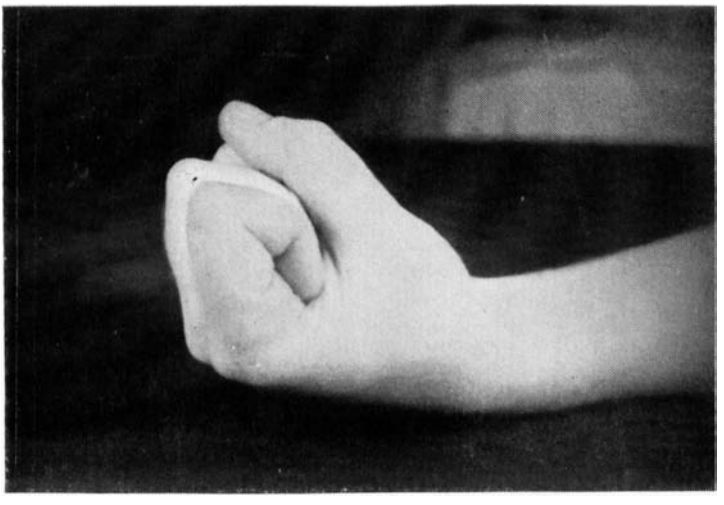


FIG. 14.

Make a fist with the hand and let the thumb brush lightly over the fingers from index to little finger (Fig. 14). (Repeat 6-12 times.)

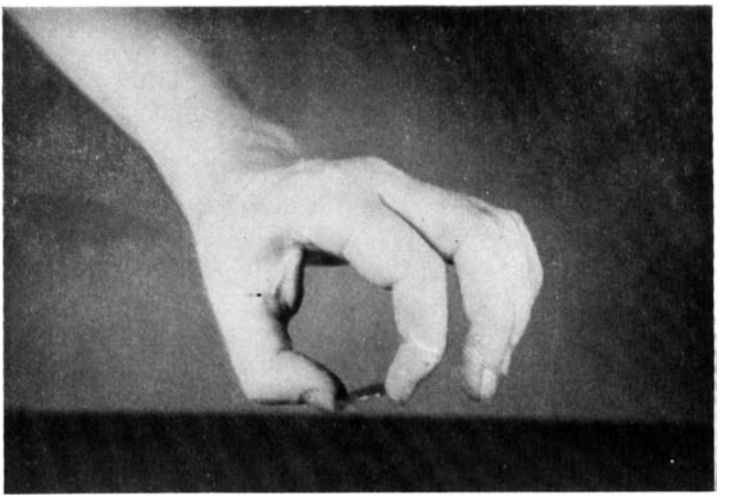


FIG. 15.

Picking up small objects of different shapes and sizes with the thumb and one finger, using each finger in turn. The thumb should use the abduction-opposition position as much as possible (Fig. 15). (Repeat 6-12 times.)

Our experience in this work has shown us that short courses of physiotherapy (e.g. less than 3 months) are not sufficient to benefit a patient with leprosy. Long courses of treatment (at least 3-6 months, preferably longer) are necessary if physiotherapy is to be of value to the patient. Regularity of treatment is also an essential factor for improvement. Results of the past two years' work in Vellore divide the patients into four main categories:

1. Those who improve.

2. Those who seem to go through a period of gradual denervation and then a period of regeneration. Because the treatment has been regular the muscle tone has been maintained as much as possible, and the fingers have not become stiff, and have therefore been able to regain their strength and usefulness.

3. Those who do not improve, but physiotherapy prevents the fingers becoming further deformed and contracted.

4. Those whose hands became worse, and with one or two exceptions, this has only occurred with patients who were irregular in attendance for treatment, or who only attended for a month or two.

C. **Rehabilitation.**

It is important that some rehabilitation programme be carried on at the same time as physiotherapy, so that the patient may have reasonable hope that he may become active, useful, and independent by his own efforts, and in this way he will develop a happier out-

look towards the future. The occupation should be one which stimulates the active interest of the patient so that he looks forward to doing it. It should also be an occupation which will do him no harm. For instance, bamboo basket making has proved an unsuitable trade, partly because much of the weaving depends upon touch reflexes, and many leprosy patients have no sense of touch, and so their hands continually suffer minor injuries from splinters when doing this type of work. But a trade such as simple carpentry has proved to be within the power of most patients, provided some care is taken to see that the handles of all tools are adjusted where necessary to fit the strongest part of the grasp. The making of simple garments with a sewing machine also appears to be within the scope of their capabilities. Finally, the occupation should be one at which he can earn a living wage, so it is of great importance that patients should be shown how to make the best use of their hands, and taught trades in which their skill and dexterity may compete on equal terms with others with normal hands.

ACKNOWLEDGMENTS.

1. We wish to thank the Indian Council of Medical Research for making this investigation possible.
2. We also wish to acknowledge gratefully the technical assistance rendered by Mr. R. Namasivayam in much of the detailed survey of the work done.

BIBLIOGRAPHY.

1. COCHRANE, R. G., *Practical Text-book of Leprosy*, 1947.
2. MUIR, ERNEST, *Manual of Leprosy*. 1948.
3. BUNNELL, STERLING, *Surgery of the Hand*. 1944.
4. ALDERSON, STANLEY, Physical Therapy in Leprosy, *Leprosy Review*, Vol. XIX, No. 4, Oct. 1948.
5. BRAND, P. W., Rehabilitation for Leprosy Patients, *Leprosy in India*, Vol. XXIII, No. 1. Jan. 1951.
6. MORRIS, ROXIE, Comparison of Chronaxie and Manual Muscle Testing of Muscles Affected by Poliomyelitis, *The Physical Therapy Review*, Vol. XXXI, No. 7, July 1951.
7. LAUGHLIN, EVA M., Physical Therapy in the National Leprosarium, *The Physical Therapy Review*, Vol. XXXII, No. 1, Jan. 1952.
8. FLOYD, W. F., and SILVER, P. H. S., Patterns of Muscle Activity in Posture and Movement, *Physiotherapy*, Vol. XXXVIII, No. 3 March, 1952.
9. RITCHIE, A. E., Electro-diagnosis—Routine or Research? *Physiotherapy*. Vol. XXXVIII, No. 9, Sept. 1952.
10. SPURRELL, W. R., Precision, *Physiotherapy*, Vol. XXXVIII, No. 9, Sept. 1952.
11. PULVERTAFT, R. GUY, The Care of the Injured Hand, *Physiotherapy*, Vol. XXXVIII, No. 12, Dec. 1952.
12. NERVE INJURIES COMMITTEE, Aids to the Investigation of Peripheral Nerve Injuries, Medical Research Council (London). War Memorandum No. 7 Revised Second Edition 1943.
13. *Ciba Symposia*, Vol. IV, No. 4, July 1942—The Hand.
14. *Ciba Clinical Symposia*, Vol. III, No. 8, Dec. 1951—Surgical Anatomy of the Hand.
15. BRAND, P. W., Reconstruction of the Hand in Leprosy, *Annals of Royal College of Surgeons of England*, Vol. II, Dec. 1952, pp. 350-361.

SUGGESTIONS FOR TREATMENT BY PHYSICAL METHODS IN NEURAL LEPROSY

RUTH E. THOMAS, S.R.N., M.C.S.P.

Physiotherapy is a comparatively new line of treatment where leprosy is concerned, and for it to be successful the psychological outlook of the patient is of the utmost importance. Many patients who have some paralytic trouble of the hand or deformity of the fingers give up their work when this paralysis or deformity begins, or shortly after it commences. This may be due to the fact that the patient himself feels this weakness and therefore feels he can no longer cope with his work, or it is sometimes because his employer has no use for a person with weak hands; or (and this seems the worst reason of all from the psychological aspect of the patient) it is sometimes because no one will employ a person with leprosy. But, whatever the reason, the fact that the patient has had to give up his work tends to make him feel he is no use to himself or anyone else, and that he is a burden to his family and society, with the result that he resigns himself to his condition and loses the will to help himself.

The main aim, therefore, is to win the confidence and co-operation of these people, and try to help them to help themselves, and to show them that weak or deformed though their hands may be they can, with care and practice, do much to help themselves. They must learn to realise that they cannot do many things as well as the normal person, and that their movements are necessarily slower because of their disability. In some way they must be taught to accept all this, and at the same time be encouraged to use what is left; and to learn that there are many things that they can, with practice, get to do as well as a perfectly normal person; the important point being not to give them anything to do which is beyond their capabilities, or they will become discouraged rather than encouraged.

For two years several methods of physiotherapy have been used on a number of patients with varying degrees of paralysis and deformity at the Leprosy Clinic of Vellore Christian Medical College Hospital, South India. Careful records have been kept, and the results seem to indicate that physiotherapy is of great value in neural leprosy. This article has been written with a view to stimulating other Leprosy Sanatoria to introduce some of the treatments as a routine measure.

It has been found that short courses of treatment (e.g. less than three months) are not sufficient to benefit the patient. Long courses

of treatment (at least 3-6 months, preferably longer) are necessary if physiotherapy is to be of value to the patient.

ELECTRICAL STIMULATION.

Requirements :—

Faradic Unit:— Smart-Bristow type is recommended. (This is not dependent on the main supply, but is fitted with dry cells.)

2 rubber covered wires, each about 3 ft. in length.

1 metal plate electrode 3" x 2", and 1 lint pad 4" x 3".

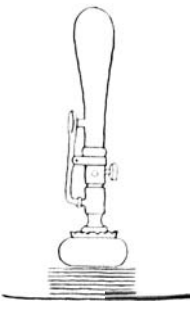
1 disc electrode not more than $\frac{1}{2}$" in diameter.

1 bowl for warm water.

1 mackintosh for covering the table.

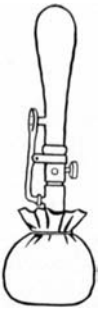
METHOD :—

1. The wires are attached to the 2 terminals of the Faradic Unit.
2. To the other ends of the wires are attached the metal plate electrode to one, and the disc electrode to the other.



Small pieces of lint.
Larger piece of lint.

Disc Electrode



Larger piece of lint fixed firmly round the disc and small pieces of lint with cotton.

3. The disc electrode should be well padded with several layers of lint to minimise sensory stimulation when applied to the patient.
4. The piece of lint used for the pad should measure 12" x 16", and should be folded with the edges facing inwards till there are 16 thicknesses of lint—about $\frac{1}{2}$" thickness.

FIG. (a) Piece of lint for pad.

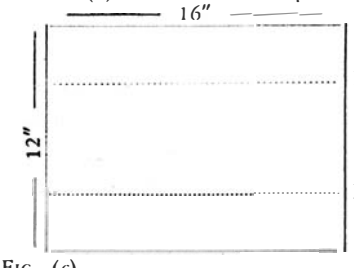
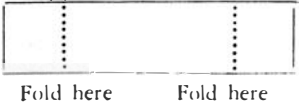


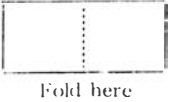
FIG. (b)

FIG. (c)



Fold here Fold here

FIG. (d)



Fold here

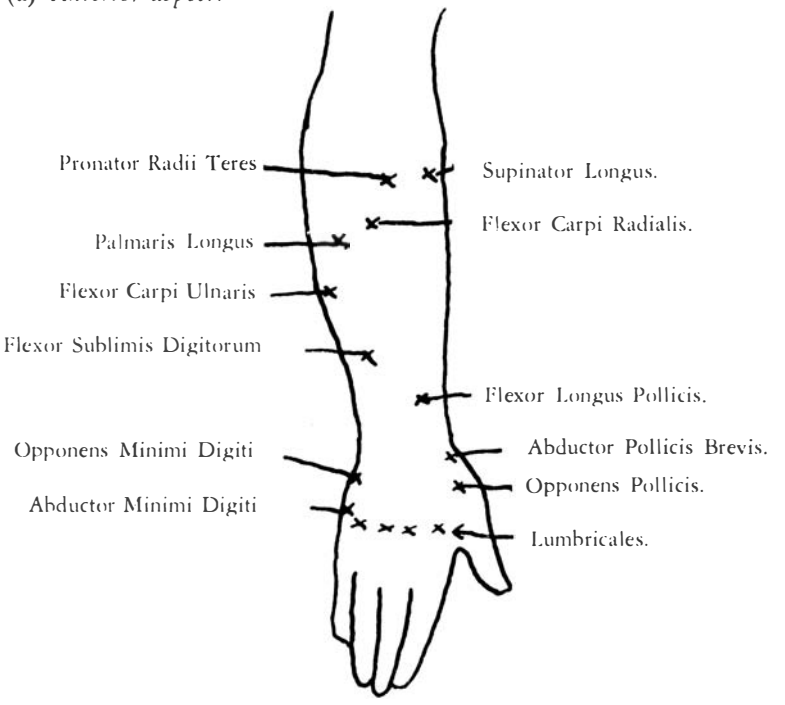
FIG. (e)

Pad ready for use.

5. The pad is then immersed in the water, and allowed to remain in it till thoroughly soaked. Then it is squeezed fairly firmly so that it does not drip water, but it must not be squeezed till it is too dry. The pad and plate electrode are then placed in the position required, the pad being between the skin and the electrode, and are known as the " indifferent " electrode:—
   (a) For treating flexor muscles of the forearm with the disc electrode, the pad and plate electrode are placed on the table with the extensor aspect of the forearm resting on it.
   (b) For treating the extensor muscles of the forearm with the disc electrode the pad and plate electrode are placed on the table with the flexor aspect of the forearm resting on it.
   (c) For treating the dorsal interossei the palm of the hand is placed on the pad.
   (d) For treating the intrinsic muscles of the palm of the hand the dorsum of the hand is placed on the pad.
6. The disc electrode is known as the active electrode and it can be used either (a) for stroking firmly up and down the forearm, thus working the different muscles in turn or (b) for picking out the motor point of each muscle and treating each muscle separately for 6-12 times.

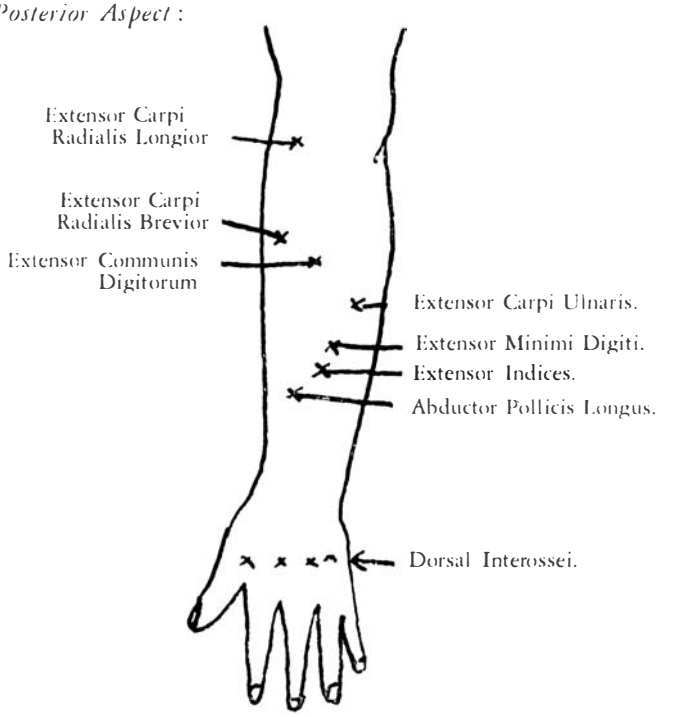
Motor points of the Left forearm and Hand

(a) *Anterior aspect.*



Motor points of the Left Forearm and Hand

(b) *Posterior Aspect* :



(a) *Stroking or Labile Faradism* :—The machine should be set at the strength required, and the disc electrode moved firmly up and down the forearm, working from the Radial side to the Ulnar side several times on the flexor aspect, and then in the same way on the dorsal aspect.

(b) *Surging Faradism* :— The disc electrode should be placed on the motor point of one muscle, and the current is " surged " (i.e. gradually increased and gradually decreased) 6-12 times. Then the disc electrode is placed on the motor point of another muscle and the " surging " repeated, and so on till each muscle has been treated. All the intrinsic muscles of the hand have to be treated in this way, but those of the forearm may be treated by either the labile or surging methods.

To " Surge " the current :— In the machine there will be a thick rod about 6" in length which fits easily into a hole at the side of the machine (if the Smart-Bristow machine is used). This rod is known as the " core." When the core is almost completely withdrawn from the machine the current is weak, and when the core is pushed in to its full length the current is strong.

The core is smoothly pushed in and out 20-40 times a minute,

allowing complete relaxation of the muscle between each contraction. It is not always necessary to push the core in to its full length, the current need only be sufficiently strong to produce a moderate contraction of the muscle.

7. Conclude this treatment with active hand and finger exercises.

N.B. in order to ascertain that the machine is in good working order before treating a patient, the operator should always test the current on himself first.

USES :—

1. To strengthen the muscles.
2. In the event of gradual denervation to work the muscles for the patient and keep them in tone, always hoping that after the period of denervation there will be a period of regeneration. Where this occurs, because muscles have been kept in tone they should (a) regain their strength more quickly than if nothing had been done, and (b) the possibility of flexion deformity and contracture occurring during the period of denervation is more likely to be delayed and possibly averted.

LEPROSY INCIDENCE AND CONTROL IN EAST AFRICA, 1924-1952 AND THE OUTLOOK

LEONARD ROGERS, M.D., F.R.C.P., F.R.S.

HISTORICAL INTRODUCTION.

The writer's investigations on the treatment and epidemiology of leprosy now extend over the last forty years. A brief history of the development of modern anti-leprosy measures is advisable before dealing with their application to British East African territories.

In 1915-17 the writer established that early cases of leprosy only could be treated effectively by the injection of soluble hydnocarpates, in place of the thousand year old oral administration of the nauseating chalmoogra and hydnocarpus oils. The new method of treatment, however, failed in advanced cases, which alone were discovered and imprisoned for life under the old system of " compulsory segregation."

In 1921-24 an intensive study of some fifty years literature on

leprosy enabled the writer to formulate a plan for finding and treating effectively the hitherto hidden early amenable cases as the essential first step in his plan to control and reduce the incidence of the disease. Many of the data on which this plan was based were recorded in 1922, and the full facts and deductions from them were published early in 1925 in the first (1925) and later editions in 1931 and 1946 of *Leprosy* (Rogers & Muir, pp. 1—137, History, Epidemiology and Prophylaxis).

The most essential points then established are (1) Child infections, usually through living in the same house as a case of leprosy, are of crucial importance;

(2) In 95 per cent of cases, in which the necessary data are recorded, infection was derived from close, usually house, contact with a cutaneous case or preferably muco-cutaneous but now classed as lepromatous, and only 5 per cent from nerve cases, probably mixed with lesions of the skin or mucous membranes;

(3) The highly infective advanced lepromatous cases form only one-fifth of the total number in India, and one-fourth in Nigeria. These only need to be isolated, at proportionately small cost, greatly to reduce the incidence of new infections. In South-East Nigeria these cases have voluntarily submitted to isolation in villages specially built for them, for the sake of obtaining the hydnocarpate injection treatment. The recent use of sulphones has greatly facilitated such isolation;

(4) Isolation of infective cases is not sufficient by itself, for the simple reason that this leaves in the homes of the isolated numerous infected children in the incubation stage. They will nearly all develop the first symptoms of leprosy within the next five to ten years. Many of these will develop into incurable, crippled nerve cases, others into infective cutaneous or lepromatous cases, who in their turn will infect other members of their households and so on indefinitely. This is the explanation of the failure of a century's use of compulsory segregation in South Africa even to prevent a steady increase in the incidence of leprosy (see Leprosy, 3rd Edition, 1946, p. 136, for chart demonstrating the success of the measures here advocated in controlling the disease in that country), but with the retention of compulsory segregation powers, which after some years rarely had to be enforced owing to the power even of the hydnocarpate injection treatment to attract numerous early cases voluntarily to seek admission to the leprosy institutions.

A SMALL SCALE TRIAL OF THE ABOVE PLAN AT NAURU ISLAND, S. PACIFIC.

The practicability of this plan under favourable circumstances

led to an unprecedented 40 per cent reduction in the incidence of the disease within three years, a two-thirds reduction in six years, and a fall to only one-seventh of the original very high rate of about 30 per cent at a recent date. (See Leprosy, 3rd Edition, 1946, p. 137).

LARGE SCALE TRIAL IN SOUTH-EAST NIGERIA.

The Owerri Province of South-East Nigeria was selected for a crucial trial as the most highly infected extensive area found in British territory by the British Empire Leprosy Relief (BELRA for short) a quarter of a century ago, with seven times the leprosy incidence of India. The successful results will shortly be recorded by Dr. T. F. Davey, who was in charge of the test for some fifteen years. It will suffice here to mention that the all-important child infections have been reduced from a high figure to only 2 per cent, and some of the forty odd out-patient dispensaries have been closed down for want of leprosy patients! The Nigerian Government have thus been led to take over the measures and rapidly to extend them over the twenty-two provinces with a population of 22,000,000. The greatest leprosy problem in the British Empire thus appears well on the way to being solved, with large scale financial help from the Colonial Development and Welfare Fund.

BELRA funds (of which £45,000 were spent in 1952 in poor leprosy-infected African provinces under British administration) are now being utilised in extending their successful Nigerian measures to the very extensive British administered territories of East Africa, the most important remaining British leprosy problem. The main purpose of this paper is to record the anti-leprosy work, under great financial difficulties, during the last three decades, and the great efforts now being made by means of a striking combination of the resources of the East African governments, missionary bodies of various denominations, and of BELRA, with the valuable help of Toc " H " lay workers, to control and eventually greatly to reduce the incidence of leprosy in British East Africa within the next few decades.

1. Anti-Leprosy Measures in the Uganda Protectorate, 1924-51.

1924. Uganda leprosy camps were reported to contain 551 cases.

1925. Practically all the known cases of leprosy had been found in the eastern districts of Teso, Lango and Mbale.

1927. The first Secretary of BELRA, Mr. Frank Oldrieve,

toured East Africa. There were altogether 924 cases under treatment.

1928. There were 889 cases under treatment in the Eastern, and 717 in the Northern area: a total of 1,910.

1929. Dr. Wiggins, a retired Colonial Medical Officer, returned to Uganda and established hospitals and dispensaries for leprosy treatment, with financial help from BELRA, including a hospital for infected children at Kumi, in the eastern Teso district, and a voluntary segregation camp at Kapisi.

1930. The children's hospital at Kumi was reported to be the " most pleasing feature " of the work. Dr. Sharp, C.M.S., had by this time established a voluntary leprosy colony on an island in Lake Bunyonyi, in the south-western Kigezi district, with the help of a Government grant.

Dr. Robert Cochrane, BELRA Medical Secretary, toured Uganda, made a valuable report and arranged for grants, the value of which were acknowledged in the annual Government medical report. He advised surveys of the incidence of leprosy, the provision of leprosy treatment centres, and the appointment of a whole-time leprosy medical officer. Finances for the last could not be supplied by Government.

1931. BELRA grants amounting to a total of £15,350 are recorded as having been received by the Uganda Government for anti-leprosy work during this year.

Surveys of areas in eleven provinces of Uganda in 1930-31 of a population of 2,141,147 revealed 8,158 leprosy cases recognisable by the native chiefs or 3.8 per mille. The true number is no doubt much higher (see Table, p. 51). They suffice to show that at that time the financial resources of both the Government and of BELRA were far too small to permit a full campaign against leprosy on the lines of the successful measures in Nigeria.

1932. This year's medical report states that " The demands for leprosy relief are becoming so great that it is impossible to satisfy them from the sum of money which is set aside for this purpose in the Protectorate estimates." It is further stated that in 1931 a leprosy survey " revealed the great extent of the disease in various districts of the Protectorate." Further, either enormously increased provision from Protectorate revenue or an organisation for the relief of leprosy, must be developed upon lines which differ from those of the past; for it is impossible to provide a larger grant than in the past. The Government annual grants for leprosy work at this period averaged approximately £3,000.

1934. The Buluba Mission leprosy colony was opened this year

in the south-eastern Busoga district, with supervision by the neighbouring Government medical officer. Land was supplied for crops to make the colony largely self-supporting, and " considerable improvement among those who received regular treatment " was noted. Alepol, (sodium hydnocarpate) was chiefly provided. The Nyenga mission settlement was reserved for crippled, uninfective nerve cases; a humanitarian work. This annual medical report also records the opinion that " it would appear that the successful control of leprosy resides in the establishment of colonies "; that is, for advanced infective cases, to diminish the danger to their households and other close contacts.

1935. " The results of treatment were encouraging, and 5 cases were discharged free of symptoms " under alepol.

1936-37. In the Bunyoni colony (C.M.S.) the treated cases showed 9 per cent. disease arrested, and 11 per cent. improved. Children up to about 2 years of age in the untainted home had risen to 36, and only one had shown early signs of leprosy.

1938. BELRA'S Medical Secretary, Dr. E. Muir, toured the Protectorate, and on his advice advanced cases were separated from early ones. BELRA supplied a Toc H lay worker, Mr. Lambert, who proved very useful.

1940-45. Second world war; no information available.

1947. Dr. Ross Innes arrived as Inter-territorial Leprologist for East Africa in general and began leprosy surveys. Further, 200,000 sulphetrone tablets were ordered for use in treatment.

1948. Government expended £4,500 capital and £1,000 for maintenance. Their out-patients numbered 576, a very small proportion of the Protectorate cases, as the section on surveys and incidence estimates will show.

1949. Since the introduction of the sulphetrone drugs Government expenditure has risen sharply. Dr. Ross Innes' surveys have led to many requests for admission by leprosy cases, mostly advanced ones.

1950. Sulphones, for choice D.D.S., are used, but " It is interesting to note that the use of hydnocarpus oil has increased coincidentally with the extended use of the new synthetic preparations."

Leprosy settlements are being expanded and new sites sought for in W. Buganda. Government and African Local Government expenditure in grants for settlements reached £15,326.

1951. Reports on the use of sulphones state that early tuberculoid cases do not respond well to sulphones, and major tuberculoid ones do best on a combination of sulphones and hydnocarpus

oil, but " burnt-out " cases with ulcers, bone changes and deformities, respond to no treatment.

Local settlements for infective cases, with out-patient dispensaries, are advised for the control of leprosy, as used successfully in Nigeria.

Discussion. The foregoing notes indicate that prior to the leprosy surveys of Ross Innes and others from 1948 onwards, insufficient cases had been isolated or treated to effect any decline in the incidence of the disease, largely through lack of funds. Useful experience of anti-leprosy measures had, however, been gained.

Surveys. Those of Ross Innes are shown in the table on page 51. They indicate that the total number of cases is approximately 80,000, or 17.8 per mille. Lepromatous ones were 22.3 of the total, or 17,800 cases which require to be isolated and treated—a formidable task.

It is noteworthy that he reported that " strong indications were found of effective control that had been exercised in the past by the Lake Bunyoni leprosarium (under the care of Dr. Sharp, of the C.M.S.) in reducing the incidence of leprosy," for only a moderate incidence was found where previously it had been very high. He further testified to the " incalculable " saving of new infections due to the " curative and segregation work " of the same institution, which he considers has reduced the incidence of leprosy in the district from 25-30 per thousand to 6.1 per thousand." (Intl. Jl. of Leprosy, 1951.)

Moreover, H. W. Wheate (East African Med. Jl. 1950, 27, 274) records a similar decline in the Teso eastern district, served by the Kumi and Ongino settlements. Both these, and the Bunyoni settlement, received material financial help from BELRA, and their good influence provides a hopeful augury for the greater success of the extensive anti-leprosy measures now being organised in Uganda by the Government, with BELRA and Mission help.

II. Anti-Leprosy Measures in Kenya Protectorate, 1924-51.

1924. The number of cases in Kenya Protectorate is not known, but it is believed that the incidence is " not very high." It is difficult to establish leprosy settlements, but at four, with regular treatment, results " have been encouraging."

1925. Moogrol treatment was painful and unsatisfactory, so sodium hydnocarpate is being used orally and by injection.

1926. No site has been found for the proposed new settlement on the coast. Those at Malindi and Lamo are unsatisfactory.

1927. A survey of a poulation of 128,147 on the shores of Lake Victoria revealed 461 leprosy cases, or 3.6 per mille. BELRA is giving help, and the Secretary of BELRA, Mr. Oldrieve, toured East Africa.

1928. There were 547 voluntary admissions. Alepol " treatment is said to be very effective."

1925-36. The number of cases treated yearly rose from 373 to 528 with an average of 447. In 1934 about 1,000 cases were seen at dispensaries.

1937. Two small camps were reported to contain 241 cases only. A large percentage were long-standing deformed cases, in which treatment was unsatisfactory. The crippled, little infective, cases were to be repatriated and only the infective (lepromatous) cases were to be isolated, although in too small numbers appreciably to reduce the number of new infections. Large scale voluntary isolation of the highly infectious cases was not possible for want of funds.

1938-41. Annual medical reports not available.

1942-44. These very short war-time reports do not mention leprosy.

1945. " The appointment of a Special Leprologist for East African Territories is a welcome beginning, and a more humane and vigorous policy is necessary."

1946. Leprosy is reported to be relatively unimportant as compared with tubercle.

1948. Only 291 cases are under treatment. A wide survey is due and Colonial Development Funds are available, but sulphones are not yet obtained.

1949. Dr. Ross Innes, after making a survey, reported 10.2 per mille, and estimated the total number of leprosy cases at 35,000 in Kenya. (See Table.) Most cases are non-infectious and could be treated at home. Preliminary plans for a leprosarium at Itesio have been made for about 500 infective cases.

1950. Good results reported in the cure within 17 months of the non-infective and mild tuberculoid and early " indeterminate " cases by sulphones. Infective lepromatous cases also showed great improvement. The report adds that " There now seems to be little doubt that leprosy can be controlled, and possibly even eradicated, provided the necessary finance can be made available." Three leprosaria are required, each under a full-time medical officer.

1951. A new leprosarium has been begun at Itesio in the Nyanza province with the help of an experienced Toc H lay worker supplied by BELRA. D.D.S. treatment gives encouraging results with

remarkable freedom from toxic effects. Thiacetazone is also being tried.

Discussion. Prior to 1949 the Kenya annual medical reports indicate little progress during the quarter of a century in the adoption of modern anti-leprosy measures. However, during the few subsequent years the adoption of the more effective sulphone treatment, combined with the stimulus of Ross Innes' surveys in revealing the serious incidence of leprosy in the Kenya Protectorate, have led the Government to the conclusion that leprosy can be controlled, and possibly even eradicated, provided the necessary finance can be made available. At the present time a large leprosarium is being constructed near the Kenya border under the supervision of a Toc H worker provided by BELRA.

Survey. The results of Ross Innes's survey revealed an approximate estimate of 35,000 cases, or 10.2 per mille population. Infective lepromatous ones formed about 20 per cent. of the total; this indicates a total of about 7,000 which require isolation to prevent further infections from them, and to permit them to receive efficient sulphone treatment. The urgency of providing leprosaria for this purpose is shown by the statement of Ross Innes that he had only found 50-60 cases under effective treatment and some 200 others in two camps! The incidence in different areas varied from 0.9 to 32.7 per mille. Overcrowding and high humidity again favoured high incidence. This indicates the necessity of seeking out dry localities for the new leprosaria. This is being done and in 1953 it was reported by BELRA that the new one at Itesio already had 2,500 registered patients, most of whom were out-patients coming from as far as 15 miles away for treatment.

III. Anti-Leprosy Measures in Tanganyika Territory, 1924-51.

Early History. When Tanganyika Territory was under German control before the first world war, by 1912, 3,800 leprosy cases had been isolated in 47 villages without adequate supervision or treatment, or the exclusion of the uninfected.

1924-29. The annual medical reports of the British Protectorate either give no information or record no data of interest.

1927. The BELRA Secretary, Mr. Oldrieve, toured East Africa.

1930. " The abolition of compulsory segregation, together with treatment by injections, has induced large numbers of early cases to present themselves for treatment." Moreover, the Native Authorities show keen interest and have rendered much assistance, and the help of various missionary societies is invaluable. BELRA has provided £300 for buildings, in addition to supplies of anti-leprotic drugs. The Government gave £4,000.

1931-32. Work was continued on the same lines and the Government acknowledged their indebtedness to the missions and to BELRA for help.

1934. Anti-leprosy work was restricted by world-wide financial depression, but was continued at three settlements and at treatment centres at medical stations. A number of non-treatment settlements remained scattered throughout the territory. These were presumably a remnant of the old unsatisfactory German ones above mentioned.

1934-37. The average total segregated cases in these years was 3,400, and the Government expenditure averaged £3,540, including drugs. No bacteriological examinations or classification of the cases was possible. Eleven settlements were under the Government and twenty under missions.

1938. BELRA'S Medical Secretary, Dr. E. Muir, toured the Protectorate and made a valuable report (see *Leprosy Review*, Vol. X, pp. 53-80). He urged the appointment of a whole-time leprosy officer for East Africa, " a generous grant towards the cost of a leprosy officer having been offered by BELRA."

1942. " Marked progress, under the supervision of Mr. Lambert, a Toc H lay worker sent out by BELRA, has been made in the reorganisation of the Makete Settlement at Tukuyu." There are 905 patients, systematic treatment and records have been instituted. 2,400 acres are under cultivation, fruit trees have been planted in large numbers, nurseries of hydnocarpus oil plants and palm oil established. There are 400 head of cattle, goats, pigs and numerous industries and handicrafts have been introduced." Moreover, new dispensaries have been built, nearly all by the patients, and ten miles of road opened. Administrative and Native agencies have helped " and Mr. Lambert's hard years at work are now bearing fruit."

1943. Leprosy reported to be widespread in the south, with 2,057 cases in the South Highland Province. There were now 1,122 cases being treated at Malote. Dr. T. F. Davey, Leprosy Adviser to the Government of Nigeria, paid a visit and gave advice. It is also recorded that Mr. Lambert's good work " has shed a ray of hope."

1944. The doctors and others who help in the leprosy work are flooded with leprosy patients, the majority of them beyond hope of cure.

The East African Governments have agreed to appoint a leprosy specialist based on Tanganyika. Lambert's work was flourishing, with 2,068 leprosy patients, " cultivation notably improved and

there are no idle hands." Only 12.5 per cent. are open (infective) cases. Sixty-five were discharged in 1944, and a total of 323 in the last four years.

1946. A census of Makete showed 1,461 residents, only 633 of whom showed symptoms of leprosy (a relic of German days), many of whom were not infective; they have been induced to leave.

1948. Dr. Ross Innes was now Inter-territorial Leprologist for East Africa; his survey of the Southern Highland and the Lake Provinces of Tanganyika revealed a leprosy incidence of 14.3 per 1,000 inhabitants.

Sulphetrone was introduced this year and supplied to all qualified Government and mission doctors, for treatment of patients under their personal control.

1950. A total of 4,468 leprosy patients in Government and mission institutions were under treatment by sulphetrone drugs at heavy cost. The much cheaper avlosulphones were largely used at a yearly cost per patient of only 14 to 16 shillings, against 300 shillings for sulphetrone.

In the meantime search for sites for new leprosaria had not yet proved successful, so it was decided to enlarge the Makete one to hold 1,000 resident patients in the high incidence Southern Highland Province. A sum of £100,000 was projected for the revised plan to develop three leprosaria within the next five years. The yearly maintenance grant was also raised to £11,920, and the total expenditure on drugs, chiefly sulphones, amounted to approximately £3,500.

1951. This year 1,227 cases under Government, and 3,779 under missions were treated, making a total of 5,006. Avlosulphones were increasingly used in spite of very disturbing reactions in the absence of resident doctors, but this was more than offset by its being very much cheaper than sulphetrone. Although sulphones are a tremendous advance, experience shows that a small proportion of cases are resistant to sulphone therapy.

Decisions have also been taken to develop the leprosaria at Chazi, Eastern Province, and at Kolondoto, Lake Province. Expenditure for maintenance of Government and mission institutions was £19,700, and for drugs approximately £6,000.

Discussion. Tanganyika was handicapped by having had to take over from the Germans after the first world war 47 leprosy settlements without care or treatment of the patients, and with many uninfected persons living with the patients. The first ray of hope resulted from the work of Lambert, a Toc H lay worker, in 1942,

as recorded above. In 1950 the use of the sulphone treatment allowed of further advance.

Survey. Ross Innes found an approximate total leprosy incidence of 80,000 cases, or 18.1 per mille. The infective lepromatous cases formed 22 per cent; this indicated a total of 6,600 requiring accommodation in leprosaria, but the medical reports reveal that in Government and mission institutions only 5,006 cases of all stages were receiving treatment. In 1952, however, 200 patients received their discharge certificates in one institution. Moreover a new one was under construction at Mkunya by a BELRA worker.

TABLE OF EAST AFRICAN LEPROSY INCIDENCE AND SURVEYS

Protectorate	*Estimated total population*	*Rate per mille of surveyed population*	*Estimated total cases of leprosy*	*Percentage of lepromatous cases*	*Estimated total lepromatous cases*
Uganda	5,000,000	17.8	80,000	22.3	17,800
Kenya	5,400,000	10.2	35,000	20.0	7,000
Tanganyika	1,600,000	18.1	80,000	22.0	17,600
Nyasaland	2,000,000	14.3	30,000	22.2	6,600
N. Rhodesia	1,600,000	12.6	20,000	20.4	4,080
TOTAL	15,600,000		245,000		53,080

IV. Anti-Leprosy Measures in Nyasaland, 1924-51.

1924-26. About 300 cases a year were treated by injection of moogrol (Chaulmoogra esters) at rural dispensaries, but it was doubtful if the cases had been diagnosed early, and the mission doctors had difficulty in getting the patients to continue the treatment long enough.

1927. The Secretary of BELRA, Mr. F. Oldrieve, visited the protectorate and it is recorded that the activities of the missions as regards leprosy were greatly stimulated by his advice, and by small BELRA grants to each of the eight mission centres, in addition to the free supply of drugs for the leprosy patients.

1928-31. Leprosy cases treated in the mission centres averaged 555 yearly. Alepol (sodium hydnocarpate) had largely replaced the more painful moogrol injections.

1935. Admissions were the more advanced and crippled cases in which treatment was " disheartening," but at the centre at Malamulo early cases were treated with " considerable success."

1938. By this time 13 mission centres admitted leprosy cases, and Government supplied a subsidy of £900 a year to supplement mission and BELRA Funds.

1939. Dr. E. Muir paid a visit on behalf of BELRA, which did much to stimulate interest, and the Government hoped soon, in

spite of the war, " to put leprosy control measures on a sound footing in the near future."

1940-47. At this period the yearly number of the cases treated at mission centres averaged about 250, and at Government hospitals and dispensaries 300. The annual Government grants rose to £1,500, and in 1948 to £7,000.

1949. Owing to food shortage only infective and early cases were admitted for treatment, and sulphetrone was first supplied to a few centres for trial.

1950. By the end of this year it became possible to supply sulphones for all patients under registered medical practitioners; they only formed a fraction of the total number, but aroused new hopes.

In 1950 the Nyasaland Government accepted in principle the necessity for the provision of leprosaria on a large scale for the voluntary isolation and treatment of infective cases; together with the treatment of low infectivity ones as out-patients at low cost. Sites in low humidity areas were sought out for that purpose.

1951. This year's medical report states that the " enormity of the problem facing Nyasaland " is seen from the fact that less than 2 per cent. of the estimated leprosy cases are under active treatment, which, it is believed, will terminate the infectivity and arrest the disease. The scope for treatment is only limited by the quantity of drugs available. Funds have been asked for from the Central African Colonial Development Fund for epidemiological research on the distribution of leprosy, and the possibility of an attack on the disease through the Native Authorities.

Discussion. The foregoing notes illustrate the efforts during the last three decades of Government, missions and BELRA to provide modern anti-leprosy measures in a backward and poor country. Useful experience had been gained and important progress was made with the introduction of sulphone treatment.

Survey. As shown in the table, the survey carried out by Ross Innes led to an approximate estimate of 30,000 cases of leprosy among a population of 2,000,000, or 14.3 per mille. Infective lepromatous cases amounted to 23 per cent.; this figure indicated a total number of 6,600, only 1,000 of which were accommodated in institutions. Moreover, 82 per cent. of the cases lived in close contact with an average of four healthy children each: a tragic situation demanding the supply as soon as possible of available preventive methods.

V. Anti-Leprosy Measures in Southern Rhodesia, 1924-51.

1924-25. A table of African hospital admissions shows no leprosy

cases in 1924, and only 14 in 1925, but gives no further information.

1926. One Government leprosy settlement with mainly voluntary admissions. Stimulated by reports from India of out-patient treatment, a trial clinic was opened under a missionary doctor.

The Superintendent of Natives is averse to enforcing provisions of Leprosy Repression Act and compulsory segregation " as more likely to defeat its own ends and lead to concealment."

1927. A Government leprosy settlement at Ngomahuru was opened with 63 admissions.

The first BELRA Secretary, Mr. F. Oldrieve, toured the province with facilities provided by the Government, who recorded that the " visit has done much to enlighten both official and public opinion." Early cases of leprosy are coming forward for treatment. The total numbers are unknown.

1928. In addition to the Ngomahuru settlement, voluntary treatment centres have been provided for voluntary treatment at Mtoko and Mnene under medical missionaries supported by Government funds. The response has been good and 50 per cent. of the patients are voluntary ones.

Release on probation of non-infective cases as potentially cured has encouraged early cases to attend for treatment.

1929. The Government settlement has been placed, for the first time, under a residential medical officer, Dr. B. Moiser, with experience of leprosy in West Africa. The appointment has been more than justified and alepol has been used with satisfactory results in treatment.

1930. A survey by Dr. Moiser of 6,814 people revealed 55 leprosy cases, or 5.1 per mille, including 27 early non-infective ones, most of whom were unaware of their symptoms. The policy of the Government was declared to be to eliminate leprosy, to separate healthy children from contact with the infected, and to cure early cases; all progressive measures based on recent advances in the control of leprosy incidence. This year 135 cases were discharged as being no longer infective.

1931. Leprosy incidence was reported to be at the rate of 2 to 5 per mille. BELRA supplied £550 for a water supply, and £200 for other purposes.

1933. The Government policy was, without repealing the leprosy laws, to make the leprosy institutions resemble voluntary hospitals, where early cases could be treated before reaching a highly contagious stage, and most discharged without mutilation and re-examined every six months.

" The Colony is greatly indebted to BELRA for grants and for the satisfactory methods of treating leprosy, with the aim of eradicating the disease."

1934 and 1935 also record the appreciation of the Government for grants from BELRA.

1936. Dr. Moiser records his opinion that there has been some decrease in the incidence of leprosy. This year 213 leprosy patients were " discharged with their disease arrested."

1937 and 1938. Moogrol continued to yield good results. Cases discharged with their disease arrested numbered 155, or 13.9 per cent. of the treated.

1939. This year Dr. Moiser reported the discharge with disease arrested of 170 cases, or 57.8 per cent. of those treated.

Dr. Muir paid a visit as BELRA Medical Secretary, and found a large proportion of lepromatous cases, as in Nyasaland.

1940. Dr. Moiser reports very satisfactory results from treatment with sufficient doses of up to 10 cc. of moogrol two or three times a week, but little effect from small doses. Infants have been weaned after one year of breast feeding, and in eleven years not one was admitted with leprosy. One good result of the voluntary system of segregation is that discharged patients readily return for further treatment when necessary.

1941-44. During these war years the very brief reports give no information regarding leprosy; there was no medical officer at the Ngomahuru settlement.

1946-47. A new medical officer was appointed and the settlement re-organised.

1948. The sulphone treatment was introduced on a small scale in the preceding year and good results in Europeans were noted this year, which completely altered for the better the outlook of the patients. Desperate need arose for more accommodation. Sulphetrone was being used mainly, but lepra bacilli were still present.

1949. The number of European patients has been reduced owing to the good results of sulphetrone treatment; fewer Africans from Ngomahuru, where 250 lepromatous cases are under sulphetrone, and neural and lepromatous cases are nearly equal in numbers, with a total of 886 cases. The dosage had to be reduced on account of many severe reactions and anaemia.

1950. Both sulphetrone and D.D.S. are giving excellent results in neural and active tuberculoid cases as well as in lepromatous ones, but progress is slower in the last class. Steps are being taken for the earlier release from the leprosaria of non-infective cases, with continued out-patient treatment, and for making a comprehensive survey.

1951. " The atmosphere at both hospitals has been completely changed by the new drugs." Improved recreational facilities, and a school, attended by 100 children, have been a great success.

Smaller doses of sulphones cause much less reaction, but lepra bacilli can still be found in severe cases after two years' treatment. Patients come from neighbouring territories; 58 patients are under observation for discharge.

Discussion. The outstanding point in the foregoing notes is the successful use of full doses of moogrol by injection by Dr. B. Moiser, a retired Medical Officer from Nigeria, but small doses failed to benefit the leprosy patients. It is noteworthy that in 1936 he recorded his opinion that there had been some decrease of the disease where he worked. Between 1948 and 1951 sulphone treatment affected a change for the better.

Surveys. I have found no record of any such extensive measure. As Southern Rhodesia has a less hot and humid climate than other parts of East Africa, the use of the successful Nigerian method of campaign should prove effective here.

VI. Anti-Leprosy Measures in Northern Rhodesia, 1928-51.

1928-30. The average total number of leprosy cases registered in Northern Rhodesia in these years was 5,576. They were enumerated by the District Medical Officers, and in districts without one by the District Officer; this left a very large margin for error, as shown by the data of a later survey given in Table on page 51. No other information is given in the annual reports for these early years.

1931. A number of leprosy patients were given light labour on small wages. They were well received and more amenable to longer treatment. They were presumably fairly early cases.

1932-40. Only figures of the cases treated at hospitals were recorded in these and other years. Between 1931 and 1951 they varied between 60 and 215, with an average of 130.

1942. It is recorded in this year's medical report that since Dr. E. Muir, BELRA Medical Secretary, visited Northern Rhodesia in 1939 considerable progress had been made in the treatment and care of leprosy patients. Three colonies had been established, and three more were being constructed, all under missionary control but subsidised by Government. The services of a BELRA lay worker had also been obtained.

1943-44. Only short war-time reports without any noteworthy information.

1945. New leprosy centres being established, but there is nowhere near enough accommodation for all that seek it.

1946. " There is enormously more leprosy in the country than the hospital figures suggest."

1947. Government grants for building and for staff amounted

to £3,420. The total cases treated at Government and mission settlements and hospitals numbered 1,569. The total estimated cases in the territory was placed at about 8,000. Additional accommodation was provided by Government, but it is still inadequate.

1949. Government leprosaria at Luapula and at Kawambwa raised their number of cases by 51 to reach 270, and the total treated, including 1,289 in mission settlements, reached 1,714 by the end of the year. Government capital and recurrent expenditure reached the sum of £10,990. Sulphetrone was obtained during the year and finance provided for larger supplies in 1950.

1950. The sulphone treatment was started in 1950, but it was too early to assess the results. ' The outlook is more hopeful than ever before, and the elimination of the disease is now well within the bounds of possibility."

This year is noteworthy for a survey of the incidence of leprosy in Northern Rhodesia in preparation for an active campaign to reduce leprosy. This is dealt with below and illustrated by the data in the Table on page 51. It may be noted here that Ross Innes agreed with the now generally accepted view that " This living with children by leprosy cases is the very root of the reason for the persistence of leprosy amongst African tribes." High atmospheric humidities (due to heavy yearly rainfall combined with high temperatures) were associated with high leprosy incidence, and a graver type of the disease, together with overcrowding in the houses.

1951. Sulphones were increasingly used this year. " A comprehensive policy for tackling the leprosy problem in the Territory is being formulated." Regional leprosaria, Government and mission institutions, under experienced medical staff, will be utilised for this purpose.

Discussion. The above notes for 1942 record the first noteworthy advance in Northern Rhodesia following a tour by the BELRA Medical Secretary. Three colonies had been established for leprosy patients, and three more were under construction, all under the control of missions. In 1946 it was recorded that there is enormously more leprosy in this area than the hospital figures suggest. In 1950 sulphone treatment was commenced with good results.

Survey. In 1950 Ross Innes carried out a survey and estimated the total number of leprosy cases at 20,000, or 12.6 per mille of population. Infective lepromatous cases constituted 20.4 per cent. of the total cases, or a total of 4,080. Moreover, 60.7 per cent. of the discovered cases were living with 896 healthy children. This close contact he regarded as " the very root of the reason for the persistence of leprosy among African tribes."

The medical report for 1951 records that " A comprehensive policy for tackling the leprosy problem is being formulated " with the supply of regional leprosaria, together with Government and mission institutions under an experienced medical staff.

OMISSION FROM EAST AFRICAN MEDICAL REPORTS OF REFERENCE TO THE ESSENTIAL CONTROL MEASURE OF REPEATED EXAMINATION OF CONTACTS.

The importance of this essential method is indicated in para. 4 of the histological introduction. It is the key to the great reduction of leprosy incidence in Nauru Island and, on a large scale, in South-East Nigeria above recorded, so needs to be emphasised once more in connection with the present efforts to reduce the incidence of leprosy in East Africa on the lines of its successful use in Nigeria.

PROSPECTS OF CONTROLLING AND REDUCING LEPROSY IN BRITISH EAST AFRICA.

It remains to consider the present prospects of anti-leprosy measures in East Africa. Among the advantages are the more effective action of sulphone therapy over hydnocarpate injection treatment of the last three decades in producing rapid clinical improvement and reducing the infectivity of advanced lepromatous cases admitted to leprosaria. This advance will facilitate the removal of the great source of infection of children and young people from their houses, for the sake of effective treatment now available at low cost. Moreover, larger funds are available from the Colonial Development and Welfare Fund and from BELRA resources freed from use in Nigeria.

On the other hand, the enormous extent of leprosy infected areas in East Africa, together with varying incidence of the disease, will increase the administrative and financial difficulties of what amounts to a modern crusade against the crippling and deforming disease of leprosy. Moreover, the density of the population of East Africa varies from 5.5 per square mile in Northern Rhodesia to 55.5 in Nyasaland. Ross Innes has also repeatedly stressed the greater incidence of the disease in low lying, humid, rather than in more elevated dry areas. This is in accordance with the world-wide high leprosy incidence in hot and heavy rainfall areas pointed out by the writer in 1923.

These disadvantages may necessitate the essential yearly surveys of the population, from amongst whom infective cases have been isolated in leprosaria, or in leprosy villages used for this purpose in Nigeria, being restricted in areas of low incidence to the examination of the occupants of houses known to have harboured leprosy patients and their relations and other close contacts. The earlier cases can be treated in special dispensaries, as in Nigeria, or on

a particular day each week at district hospitals and dispensaries, at a low cost. During the last few years East African annual medical reports record that many leprosy patients are now clamouring for such treatment, and will travel miles to obtain it. These are all matters to be decided by the leprosy specialists who have recently been appointed to East African territories.

FURTHER RESEARCH WORK TO IMPROVE THE TREATMENT OF LEPROSY.

The recent great advances in the treatment of leprosy must not be allowed to blind us to the fact that we still lack the ideal drug, or combination of drugs, as now used in the treatment of tuberculosis due to acid-fast bacillus closely allied to that of leprosy. Several promising anti-leprotic drugs are now being tested and more are likely to crop up.

The suggestion of the writer in 1948 for the use of a combination of hydnocarpate injections—for some thirty years the most effective treatment of early cases of leprosy—with sulphones on account of the greater bacteriocidal action of hydnocarpates over sulphones, has now been confirmed by the following investigators:

E. Muir (1950) tried the combination of remedies, at the writer's suggestion, at the large Indian leprosarium at Purulia. He gave sulphetrone orally, and at the same time injected hydnocarpus oil intradermally under the leprotic lesions on one side of the body only, and found the injections speeded up the local diminution of lepra bacilli on the injected side.

Tolentino (1950) also tested this combination of drugs, and he came to the conclusion " that sulphone drugs gave the best results in resolving leprous lesions, and that the chaulmoogra-sulphone combination produces the greatest bacteriological improvement."

R. Cochrane (1948) reported that in two years trial of sulphones in early lepromatous cases none had become bacteriologically negative. Yet 50 per cent. of 165 such cases became negative under adequate doses of hydnocarpus oil.

P. Laviron and L. Lauret (1950) also endorsed the suggestion of Rogers that a combination of sulphones and hydnocarpus oil should be used in the treatment of leprosy.

American leprologists have had the longest experience of sulphones in leprosy at the National Leprosarium in the U.S.A. It is therefore important to note that F. A. Johansen and P. T. Erickson (1950) records relapses after sulphone treatment had been discontinued, and they advised continued small doses after apparent recovery.

Moreover, F. A. Johansen and P. T. Erickson also recorded that " the relapse rate among the patients for whom the sulphone therapy was discontinued was 45 per cent."

Further researches on sulphones and other new drugs, as well as in the bacteriocidal effect of combinations of drugs is therefore indicated. The new leprosaria now being organised in East Africa, one of which already has 2,500 patients, many of them early ones, can afford facilities for such researches on an adequate scale.

SUMMARY

1. The writer's method in 1925 of controlling and materially reducing the incidence of leprosy in any country is once more outlined.

2. These measures are dependent on the establishment in 1917 of an effective treatment of the early stages of leprosy by the injection of hynocarpates and other such suitable preparations. Its successful use in Nauru Island in 1927-34 has now been confirmed on a large scale in Nigeria.

3. Small-scale trials of modern anti-leprosy measures during the last three decades in British administered East African territories, and in the Rhodesia group, are summarised in view of the present large scale measures now being organised in this vast area.

4. The importance of sulphone treatment in advanced infective lepromatous cases during the last decade is emphasised, and its value in obtaining their voluntary isolation is pointed out.

5. The necessity for further research to obtain a reduction in their toxicity, and to enhance the bacteriological action of sulphones and for careful trials of other promising drugs and combination of drugs is indicated. Recent work on the greater bacteriocidal action of hydnocarpates, and their combined use with the sulphones, is summarised and further trials of that and other combinations of remedies indicated.

6. New large-scale leprosaria in East Africa are now available for such researches, any success in which hasten the time required to reduce greatly the incidence of leprosy in any country by methods now available. Great Britain is responsible for the largest number of leprosy patients of any country, only one-tenth of whom are as yet receiving the benefits of established treatment.

REFERENCES

MUIR, E. 1950. *Leprosy in India,* **22**, 43.
TOLENTINO, J. G. 1950. *Philippine Med. Assoc.,* **25**, 315.
COCHRANE, R. G. 1948. *Int. Jl. of Leprosy,* **16**, 139.
LAVIRON, P. and LAURET, L. 1950. *Bull. Soc. Path. Exot.,* **43**, 739.
JOHANSEN, F. A. and ERICKSON, P. T. 1950. *Jl. Amer. Med. Ass.,* **144**, 985.
JOHANSEN, F. A. and ERICKSON, P. T. 1950. *Pub. Health Rep.,* **65**, 195.
GRANT, A. M. B. 1934. *Int. Jl. of Leprosy,* **2**, 305.
ROGERS, L. and MUIR, E. *Leprosy,* 1st and 3rd Edit., 1925 and 1946.
ROGERS, L. 1917. *Ind. Jl. Med. Res.,* **5**, 277.
ROGERS, L. 1922. *Brit. Med. Jl.,* **1**, 967.
ROGERS, S. 1923. *Trans. Key. Sae. Trafc. Med. and Hygiene,* **16**, 440.
ROGERS, L. 1948. *Lancet,* **1**, 515.

REVIEWS

International Journal of Leprosy. Vol. 20 (1952). July.-Sept.

Tratamiento de la Reaccion Leprotica (Lepro-reaccion Lepromatosa) con Plasma, by F. Contreras and others.

In the English summary the writers state:—

"In other diseases of a serious nature for which also no effective treatment has been found, treatment with blood plasma or other fractions of denatured blood has been employed. Of the blood fractions it seems that the gamma globulin is the richest in immune bodies and it might be useful in the treatment of the reactions in leprosy. Twenty-two patients with advanced lepromatous leprosy who had frequent lepra reactions were given 85 transfusions of "iso plasma" (plasma from disanaphylactisized calf blood). Tolerance to this treatment was found to be fairly good. Twelve of the patients tolerated the heterologous plasma perfectly. Six had slight side effects of no importance. In four cases there were serious although shortlived ill effects of allergic nature. All patients treated showed improvement. The best results were seen in patients who had nausea, vomiting and intolerance of all kinds of food, which condition yielded rapidly. Persistent and repeated epistaxis also ceased quickly. Great improvement was seen with respect to neuritis, manifestations in the skin and mucous membranes, the general condition, and the fever, which in some instances subsided after the first transfusions while in others its subsidence occurred after the other symptoms disappeared.

Changes in the Anterior Nasal Spine and the Alveolar Process of the Maxillary Bone in Leprosy, by V. Møller Christensen and others.

The first writer noticed a marked atrophy of the alveolar process of the maxillary bone and also atrophy of the anterior nasal spine in 110 of 150 skulls of leprous patients buried in the Naestved, Sct. Jorgensgaard between 1260 and 1540 A.D. in addition to the typical changes in the hands and feet. He assumes that this atrophy is typical of leprosy and calls it "Facies Leprosa." Seven living patients with leprosy were studied and in five X-rays showed atrophy of the ant, nasal spine and all seven showed atrophy of the alveolar process of the maxillary bone but this was probably due to earlier loss of teeth. No changes of sensitivity were found which might indicate that the atrophy was due to neurotrophic disturbance of the bone. They consider that atrophy of the ant, nasal spine may be an early manifestation of leprosy and may be demonstrated by X-ray or palpation.

Specific Tissue alterations in Leprous Skin. 1. Transformation of the Tuberculin reaction in leprous patients into leproma-like lesions, by F. Sagher and others.

In two patients with lepromatous leprosy who had become free of clinical signs of the disease after treatment the intradermal injection of old tuberculin or P.P.D. resulted in the development of persistent dermal lesions. These lesions were indistinguishable from true lepromata both clinically and histologically. Acid fast bacilli, however were not demonstrated in any of the sections but smears from the floor of the excision wounds revealed a few acid-fast bacilli in the first instance and acid-fast granules in the second case.

Changes in the Lepromin and Tuberculin Reactions of Lepromin-Negative Patients after Vaccination with B.C.G., by J. Convit and others.

The writers believe that the prognosis in persistently lepromin negative lepromatous cases can be improved by the previous vaccination with B.C.G. A group of 113 patients with lepromatous leprosy whose lesions had disappeared under diasone or promin treatment were given B.C.G. vaccine. Of these patients 51 were negative to tuberculin and 62 weakly positive. Of the 51 cases negative to both tests 25.4% became positive to lepromin after B.C.G. vaccination, and of the 62 who were negative to lepromin but weakly positive to tuberculin 53.2% became lepromin positive. In a group of 40 patients with the indeterminate form of leprosy who were negative to both tests the lepromin reaction became positive in 87.5%.

A Nonchromogenic culture of an Acid-fast bacillus isolated from the nasal mucus of a leprosy patient; Its virulence for laboratory animals, by H. C. de Souza-Araujo.

This paper describes the isolation and cultivation of an acid-fast coccobacillus obtained from the nasal mucus of a young Brazilian woman leprosy patient. The culture called " Dalva " strain after her produced generalised infection and considerable lesions in guinea-pigs, black mice and cebus monkeys. In the original culture on Loewenstein's medium the germs were predominantly coccobacilli but became bacillary in the lesions in the laboratory animals. The bacilli were strongly positive to the Dubos test, as strongly as the Koch bacillus, but did not produce tuberculous lesions in guineapigs. At first the culture could not be recovered from the experimental lesions but in an addendum to the paper the writer says that in further experimentation a cebus monkey was reinoculated on January 15th, 1952 with a suspension

of a two-month-old culture grown on 5% glycerin-agar and nodules developed which were very rich in acid-fast bacilli. From these growths were obtained on Loewenstein's media similar to the original Dalva strain.

The Mechanism of action of the Sulphone derivatives in Lepromatous Leprosy, by Paulo Rath de Souza and M. de Souza Lima.

This is a very interesting and provocative paper. In their descriptions of the fundamental lesions of lepromatous infiltrations and lepromata they state that both are formed essentially by variable numbers of histiocytic (Virchow) cells assembled together and sometimes forming tumourlike masses. Within these cells are found the agent of the disease, Hansen's bacillus. These lesions do not last indefinitely but undergo regression either after treatment or spontaneously and when complete leave only scars. The Virchow cells in regression are definitely swollen with a pycnotic nucleus and a cytoplasm with a great number of rounded vacuoles of various sizes which give them a foamy appearance. After staining with scarlet red these vacuoles are seen to be filled with lipids. These cells in regression contain few of rare acid-fast bacilli of granular appearance and they may contain no bacilli whatever.

Virchow cells which are not in regression are smaller than those in regression. They have a vesicular nucleus and their cytoplasm is contrary to what is currently believed, is not vacuolated and still less is it foamy. They are fairly simple machrophages of a wide variety of shapes and forms. They are seen teeming with typical bacilli forming globi. The quantity of lipids found is in general inversely proportional to the number of bacilli.

The writers believe that the process of degeneration of the cell begins before the bacillary degeneration. They write, " It is our personal conviction that the Hansen bacillus is a parasite strictly adapted to the histiocyte of human beings in whom the conditions are favourable for the development of the lepromatous type of the disease. The Virchow cell, therefore, actually constitutes the habitat of the Hansen's bacillus and for this reason we think that it can live and multiply, at least substantially, only inside the histiocyte which itself proliferates and is " colonised " by the bacillus. They call this the Virchow cell — " Hansen bacillus complex." They do not deny the existence of a direct action of the sulphone drugs against the Hansen bacillus but they believe that the sulphones act principally on the Virchow cell component in some way altering its metabolism and making its cytoplasm unsuitable for the life of the Hansen bacillus. An identical mechanism is also operative, although not so regularly or effectively,

either when other ways of treatment are applied or in natural conditions when regression of the lesions occurs without treatment. 28/2/53. G. O. TEICHMANN.

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FIRST REPORT OF THE EXPERT COMMITTEE ON LEPROSY.

This is the report of the Expert Committee which met in Rio de Janeiro and Sao Paolo between November 10th and 19th, 1952 and was presented to the World Health Assembly in Geneva.

The report is divided into six sections:—

1. EPIDEMIOLOGY.

Only one aspect of this subject is dealt with, i.e. the infectiveness of the different forms of leprosy. Endorsing the Cairo (1938) report leprosy is divided, from an Administrative point of view, into " open " and " closed " cases according to whether bacilli are or are not found by routine bacteriological examination by the slit method. The Committee do not consider that closed cases play an important part in the spread of the disease though a few bacilli may be found by special concentration methods.

2. CONTROL

The control of leprosy must be undertaken within the general framework of the health administration of a country and not as a disease apart. The aim should be to discover cases as soon as possible in order to stop the spread of infection and give the patient the benefit of treatment. Compulsory isolation has failed as a control measure because many cases are infectious for years before they are diagnosed and because compulsion tends to make patients hide themselves for as long as they can especially during the period during which the disease is most curable. Modern treatment helps to reduce infectivity. For this reason leprosy treatment centres—static and mobile—with central well equipped laboratories for diagnosis are considered essential. Isolation of " open " case only when applied with discrimination and in combination with education and effective treatment retains an important place in the fight against leprosy. The various forms of isolation—domiciliary, village settlements, leprosaria, hospitals for cases needing special treatment and asylums for the permanently crippled are dealt with. Preventoria for the protection of the children of patients is advised. In countries where leprosy is not endemic and shows no tendency to spread notification with surveillance is deemed sufficient.

Possible prophylaxis with B.C.G. was considered. Although recent work suggests that this artificially produced lepromin positivity in healthy persons may be of value as a prophylactic

measure the committee cannot yet recommend its wholesale use as a control measure. They, however, recommend that large scale trials with full controls be made to test its value and to determine the optimum dosage of B.C.G. that may be required.

3. CLASSIFICATION.

The Committee agreed unanimously that the basic criteria for primary classification should be clinical, comprising the morphology of the skin lesions and neurological manifestations together with bacteriological examination of skin lesions and nasal mucosa. The lepromin reaction and histopathology are necessary for division into sub-groups. The committee recommends four forms or classes of leprosy in the primary classification—Lepromatous, Indeterminate, Tuberculoid and Borderline. The last being a malign form, very unstable, almost always positive bacteriologically and generally lepromin negative. It frequently arises from the tuberculoid as a result of repeated reactions.

4. TREATMENT.

The Committee is unanimous that sulphone treatment is superior to all previously used. "Sulphones are believed to be bacteriostatic and prevent the multiplication of bacilli, reducing the intensity of infection to a level at which the protective mechansms of the body can control it. It is doubtful whether the infection is eradicated; relapse is therefore possible." General experience has shown that small doses of the parent D.D.S. have a therapeutic action which is in general no less than that of the larger doses of the D.D.S. derivatives in use. As it can be given orally weekly or bi-weekly it is of great value in mass treatment of leprosy. Treatment with thiosemicarbazones, is recommended as an alternative.

5. IMMUNOLOGY.

A full account is given of the preparation of lepromin antigen by the Mitsuda, Fernandez and Dharmendra methods with recommendations regarding recording reading of early and late reactions.

6. HISTOPATHOLOGY.

As the interpretation of histopathological specimens depends to a considerable degree on the personal judgment of the examiner and as materially different descriptions have been given of identical specimens by different examiners the Committee plan to have a number of identical specimens examined by several leprologists and their reports evaluated by an independent body. This should materially clarify the value and place of histopathology as a basis of classification in leprosy.

27/11/53 G. O. TEICHMANN.