THE RÔLE OF THE CENTRAL INSTITUTION IN THE TREATMENT AND CONTROL OF LEPROSY.

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Preface.

The delay in presentation of this thesis, investigation relative to which was completed in 1930, when the writer relinquished his appointment as physician-superintendent to the Lady Willingdon Leper Settlement at Chingleput, South India, has been due to the fact that it was deemed proper to trace the subsequent histories of the cases submitted, a procedure which is of very considerable importance in assessing the permanency of value of antileprotic measures and one which has been made possible by the courtesy of Dr. D. F. Baxter, presently medical officer to the Settlement, who has kindly supplied the relevant data after re-examination of the patients. Each case has thus been followed up for a period exceeding two years.

To Lady Willingdon, Vicereine of India, whose kindness and enthusiasm made the inauguration of the Chingleput Settlement possible, the writer respectfully dedicates this brief account of the activities and development of the Institution, the first of its kind in India.

April, 1933.

INTRODUCTION.

The aim of the following study is to present some modern conceptions in the treatment and control of leprosy, from the view point of, and with special reference to, experience gained while the writer was physician-superintendent to the Lady Willingdon Leper Settlement, the largest of its kind in Southern India. This institution, Government owned, was completed in 1924 and its management was almost immediately thereafter vested in the Mission of the United Free Church, now Church of Scotland.

In October 1924 I was privileged to commence charge of the Settlement during a period when great advances in the treatment and control of the disease were being made. The experience of organising the Institution provided me with every opportunity for studying the leper problem and for taking an active interest in the progress of events during my superintendence of six years. My interest has thus in no small measure been stimulated in the large scale control of leprosy, and my work has furnished administrative ideas, the exposition of which forms an integral part of the thesis. While bearing particular reference to the problem as experienced in India, it is hoped that the conclusions stated will apply equally to other leprotic centres.

Historical Note.

It will be of interest very briefly to review the history of the disease, before passing to the clinical notes and to the consideration of the administrative desiderata.

To leprosy belongs the distinction of great anciency, and reference to the disease occurs in Egyptian and other writings circa 1350 B.C. The children of Israel knew it and Moses, no less great a sanitarian than a statesman, held

definite views regarding its prevention.

Known in South India as 'Kusterochia' leprosy is described in the Vedas of 1400 B.C.

Japanese historians noted the disease in 1200 B.C., and there are Chinese records dating back to the second century B.C.

Greece appears to have received the infection from Africa during military campaigns and thence, after involvement of Italy, the disease spread, via Germany and France, to England in the seventh century. Scandinavia was later attacked and in the middle ages came the zenith of incidence. There can be little doubt that the Crusades played a notable part in determining the path of the malady.

The fourteenth and fifteenth centuries saw a rapid decline of leprosy in Europe, almost to vanishing point, although, with the discovery of the West Indies and of America, new foci were being established in the Western Hemisphere in which, prior to the arrival of Europeans, the aborigines enjoyed freedom from the disease. It is not insignificant that the early European pioneers sailed from Spain and Portugal at a time when these countries were in the grip of the scourge. An immensely potent factor in determining the western advance of the disease was the African slave trade, whose victims were drawn from the intensely leprotic areas of tropical Central Africa, which still shows the highest leprosy rate in the world.

For the relatively recent extension of the disease to Australasia, Chinese immigrants are blamed. At the present day, though of world-wide distribution, leprosy takes its heaviest toll in tropical lands.

Clinical Note.

Leprosy is a chronic disease due to infection by the Mycobacterium leprae of Hansen. Though generally recognised to be produced by access of the organism to a susceptible individual, it is realised that close and prolonged contact, together with lowering of resistance of the subject, are necessary for successful transmission.

Rogers, in the course of analysis of 700 cases, finds that of 25 per cent. house infections, 11 per cent. occurred in tropical climates where they must have been almost all room - and most probably bed - cases; and if we take two-thirds of the 11 per cent. to have been such, bed infections rise to at least one-third of the total. The significance of these figures is clear.

The exact manner of infection is not yet thoroughly understood, although it seems highly probable that the organism may be conveyed by several agencies. Nasal secretions of lepers presenting skin lesions frequently contain the Hansen bacilli in enormous numbers, as do the discharges from ulcerated nodules. The leper's surroundings are therefore soon contaminated and transmission by air, soil, water or food cannot be excluded. Entry may occur through the nasal mucosa but it is considered that the majority of cases commence by skin penetration presumably at abraded points. Close observation of the initial lesion in Indian children has led the writer to conclude that leprosy commences at the site of inoculation.

Aetiology. Acid fast, and with a strong tendency to pleomorphism, the mycobacterium varies in appearance according to the clinical phase through which its host is passing. In the early infectious stage of the disease it is typical - a straight or slightly curved rod of length 4 microns. During a severe reaction due to treatment or other cause, the bacilli may break up and show granular

changes. The writer's experience suggests that such changes are degenerative since they occur almost invariably in cases improving rapidly under treatment. Animal transmission experiments have so far failed, and expert opinion considers that leprosy is truly specific for man. Efforts to cultivate the bacillus have so far been unsuccessful even by experienced technicians and Fraser and Fletcher,(10) criticising some reported successes, mention it to be curious that they have consistently failed to culture the organism.

The incubation period of leprosy is uncertain. Rogers instances the case of an American lady in whom a red spot, which ultimately became anaesthetic and in which the Hansen bacillus was demonstrable, developed three months after her arrival in Hawaii.(29) Ehlers, however, has pointed out that a very long incubation period may rather be a long latent period; and early and only slightly discoloured anaesthetic patches may escape notice for years and so later exacerbations of the disease be mistaken for its appearance.(29) In the writer's view incubation periods of several years are far from uncommon though it must be remembered that the existence of natural immunity may prevent for all time any development of the malady, even after inoculation. Conversely, lowered resistance speeds the onset.

The symptomatology of the disease is variable and while early signs in persons of meagre intelligence may escape notice, the developed lesions are unmistakable. Early manifestations of leprosy include vague nerve disturbances and anaesthesia with or without thickening of superficial nerve trunks. Depigmented patches are common, as is anhydrosis, while infiltrated erythemas and thickened ear lobes are of frequent occurrence. As the disease progresses, analgesia, muscular paralysis and trophic changes are the rule while in the late stages leontiasis may be gross and severe cases

may show nodules on many parts of the body.

Clinical Types. It has been a general custom to place cases of leprosy in one of three groups, neural, cutaneous and mixed, the latter including examples in which there are both nerve and skin manifestations. Each type seems to enjoy certain geographical preponderance. More recently, as evidenced by the findings of the Leonard Wood Memorial Conference,(15) there has been a tendency to adopt a more finely graded classification. Many of the distinctions suggested appear to the writer to be largely academic and of slight importance from the prognostic and administrative aspects. Narrow classifications of leprosy play little part in this thesis and for such clinical data as will be submitted, the older grouping will be adhered to.

Neural leprosy, presumably non-infective, and in which no bacilli are clinically demonstrable, produces nerve disturbance, leading to trophic change and deformity. In the cutaneous form of the disease the Hansen bacillus is recoverable from the lesions, while the mixed type may present cases in which lesions of both kinds are present. Another mixed type of lesion is that in which the central zone presents morbidity of neural type but is bacteriologically negative, while at the same time organisms are demonstrable in the erythematous periphery. Some workers affirm that all cutaneous cases have their origin in nerve and are thus mixed from the outset, but the writer is satisfied from his clinical observation of many cases that cutaneous leprosy may exist in the complete absence of nerve symptoms. While it is recognised that pathological changes of a slowly progressive nature may be present it is submitted that such changes cannot be taken into account in any prognostic assessment since the clinician must base his outlook

purely on his findings. Strictly cutaneous cases, bacteriologically positive, and showing no signs of nerve involvement, have been noted to remain in this state throughout a long course of treatment. The primary lesion in such cases is most usually a raised red patch.

Nerve leprosy is apparently dependent on the invasion by the bacillus of the superficial nerves, to which its activities are restricted. The nerves most commonly affected are ulnar, peroneal, and great auricular (see photograph No. 24) and the first symptom is commonly abnormal sensation in the area of distribution of the affected nerve; it may include numbness, tingling, and vague neuralgic pains and is not unusually succeeded by the development of patchy anaesthesia. Depigmentation is a later or occasionally concurrent phenomenon, though since the change is rarely absolute, hypopigmentation seems a better term. Anhydrosis of the affected area may be a prominent feature and with the advance of the disease increased pressure on the nerve sheath produces injury. Anaesthesia increases, deep pressure sense is lost, muscular paralyses supervene, and drop-wrist and the like are local expressions of the morbid changes. The eyelids may similarly be affected. Facial paralysis produces the mask-like features and bone absorption and trophic ulceration are ultimate results.

Cutaneous leprosy, on the other hand, is characterised by the presence of diffuse areas of thickened skin which may appear on any part of the body. The patches are raised and erythematous and are commonly noted on extensor surfaces especially over prominences. Anaesthesia is not a feature of the lesions. As the disease progresses nodule formation may occur on, or apart from, the thickened skin and the mucous membrane of the nose is subject to ulcerative extension, if indeed it is not already attacked. Swelling of the

eyebrows, thickening of the ears and infiltration of the cheeks together produce the leonine facies of the fully developed case which, exhibiting bacilli in the corium, is infective. The cases classed as mixed may present the features of both neural and cutaneous involvement.

Diagnosis. Little need be said regarding diagnosis which depends on recognition of the signs and symptoms detailed in the foregoing note. It is well to remember that demonstration of the bacilli in preparations from lesions is the confirmatory feature in cutaneous cases and that anaesthesia, occurring alone in centres of lepra endemicity, is almost diagnostic. Ziehl's method is employed for smears, decolorisation being practised with 5 per cent. sulphuric acid. The leprolin reaction is valued by some.

It will be most appropriate first to consider the general scheme of treatment adopted at the Chingleput Settlement. Evolved on a basis of standard antileprotic measures, it has been modified to suit the particular demands upon it.

THERAPEUTIC ROUTINE AT THE LADY WILLINGDON SETTLEMENT.

As in tuberculosis, the main emphasis in the treatment of leprosy must be laid upon the improvement of the general health of the patient. The past history of the subject, his diet, habits of life and social environment must carefully be reviewed; and a thorough examination made to detect any chronic accompanying disease. Such inquiries are particularly relevant to leprosy, since it would seem in my experience of treatment of the disease that lowering of the natural defensive forces of the body leads to marked advance; and their maintenance at a high level does much to defeat attack by the mycobacterium.

The treatment of leprosy thus becomes primarily that of predisposing conditions such as dietetic errors, unsuitable housing, lack of exercise, secondary infections or co-existing diseases, which are depressors of the defensive mechanism; and finally direct treatment of the disease and its sequelae.

The therapeutic routine carried out at Lady Willingdon Leper Settlement may therefore conveniently be dealt with under the following heads.

1. General management of the patient.
2. The specific therapeusis of leprosy.
3. The treatment of co-existing disease with special reference to syphilis.

1. The note upon general management of the patient is most satisfactorily inserted in the section dealing with the Institution, and will be found there.

2. The Specific Therapeusis of leprosy. A word must in the first place be said regarding the rise of anti-leprotic remedies.

Horror and fear of leprosy have from the earliest times led to the segregation of cases, and the almost complete eradication of the disease in England by the 15th century exemplified the success by which the practice of segregation was attended. There was, however, no record of success in treatment and even the dawning of the 20th century saw little actual therapeutic advance despite the labours of such workers as Unna, Neisser, and Hansen. Heiser in 1914, exhibited chaulmoogra oil parenterally, using the mercado mixture of resorcin in chaulmoogra and camphorated oils, in order to overcome the nausea attendant upon oral administration, and while not the sponsor of this efficacious though painful treatment, he was the first to adopt it on the large scale.

To Rogers,[33] however in 1916, are due the modern antileprotic drugs since he first introduced the subcutaneous and later intravenous injection of soaps of the fatty acids of chaulmoogra oil. His impressive results directed the attention of leprologists to the possibility of arrest of the disease. Hydnocarpus oil, physiologically and chemically almost, if not completely, identical with chaulmoogra, has now very largely replaced the latter as the basis of antileprotic treatment, and seeds of the plant are exported to many parts of the world for planting purposes, Africa, in which leprosy is still a grave menace, being a notable purchaser. Hydnocarpic acid, one of the lower of the hydnocarpic fatty series is definitely more active than the corresponding chaulmoogric acid. Sodium gynocardate, also introduced by Rogers in 1916, has the important demerit of producing blocked veins, due to endophlebitis, after a few injections, and its use has largely been abandoned.

Work upon the derivatives of antimony, arsenic, copper, gold and silver has not been productive of advance. Mercury has come somewhat to the forefront through the agency of its organic derivative mercurochrome ("soluble 220") from which promising results have emerged in connection with control of the lepra reaction. The use of mercurochrome as a therapeutic agent has been disappointing. With iodine, whose part in leprosy treatment has been played for many years, we shall have to deal later.

It is now known, in contrast to what was before believed, that the active principle is vested in the fatty acids of lower melting point, and not in those higher in the series, in so far as chaulmoogra and hydnocarpus oils are concerned. A further advance was the adoption of the ethyl esters of the specific oils and these are still a sovereign remedy. In 1925 Muir[19] introduced the subcutaneous injection of

pure oil expressed cold from the fresh ripe seeds of Hydnocarpus wightiana with 4 per cent creosote added as a preservative. From this time onwards both esters and oil came to be used extensively in treatment. Rogers, however, attached to sodium gynocardate, cast about for a drug which would not produce vein-blocking and ultimately introduced Alepol, a sodium-fatty-acid combination of hydnocarpus, which may be used intramuscularly, subcutaneously or intravenously.

Preparation of drugs.

1. Hydnocarpus wightiana oil. This oil, obtained by cold expression from the ripe fresh seeds, is filtered and preserved by the addition of 4 per cent. doubly-distilled creosote. Sterilisation at 120°C. for half an hour renders the preparation suitable for injection.

2. Ethyl esters of hydnocarpus oil. The esters used may be prepared either by the cold or hot process. All cases under review in the present work, with very few exceptions, were treated with esters of cold process manufacture, rationale of which will now briefly be noted. It is not thought needful to specify technical details, which are available for those interested in a publication listed in the bibliography.(18)

Preparation of Esters.

The oil is treated with a sulphuric acid-ethyl alcohol mixture, care being taken to prevent charring. On exposure to sunlight, reaction proceeds and esters rise to the top. Some 20 days may be required for complete esterification. Funnel-separated esters are then washed with water and emulsified by addition of sodium carbonate. The emulsion having been broken with sodium chloride over a period of three days, the water and salt are removed and the esters allowed to stand in glass for a week or so, by which time impurities have gravitated to the bottom. Final filtration and autoclaving render the product suitable for use.

Therapeutically the esters were never employed in the pure state at the commencement of treatment but were diluted with a proportion of olive oil which was gradually diminished as treatment proceeded until pure esters could be tolerated. Creosote proved a convenient preservative.

Three strengths of the esters were employed in the routine treatment and are of percentage composition as indicated below.

Here, and in subsequent portions of the thesis, the treatment adopted at Lady Willingdon Settlement will be referred to as the Tirumani treatment which is original in certain of its phases though based on the recommendations of Muir.

(A).	Ethyl Esters of Hydnocarpus	50cc.
	Olive Oil (fatty acid free)	50cc.
	Creosote (doubly distilled)	4cc.
(B).	Ethyl Esters of Hydnocarpus	75cc.
	Olive oil (fatty acid free)	25cc.
	Creosote (doubly distilled)	4cc.
(C).	Ethyl Esters of Hydnocarpus	100cc.
	Creosote (doubly distilled)	4cc.

3. Alepol. In powder form this preparation contains sodium salts of a selected fraction of the lower fatty acids of Hydnocarpus oil. A 2 per cent concentration of the drug made up in 0.5 per cent watery solution of carbolic acid was used, the whole being sterilised for injection.

Dosage.

At the time of opening the Settlement, until early in 1927, the general treatment adopted was by subcutaneous infiltration of the pure hydnocarpus oil for cutaneous and mixed cases and infiltration of ethyl esters of the oil mixed with an equal quantity of olive oil for nerve cases, since the esters were inclined to cause reactions considered dangerous to the patient. It was noted also that the more severe reactions were most apt to occur in cutaneous cases:

it was found in addition that the pure oil was milder in its action. As trial proceeded two facts of importance were elicited with regard to ester treatment: in the first place serious reactions did not occur in any case in which ester dosage was carefully controlled with respect to temperature and general resistance of the subject. Secondly, carefully controlled reactions of slight degree were distinctly beneficial. Rogers,[33] in discussing the chemotherapy of chaulmoogrates and hydnocarpates respectively, considers that the ability of these preparations to cause dissolution of the fatty coats of the mycobacteria, and so to free their antigens, warrants their use in the production of successive mild reactions. The two conclusions just noted caused me to abandon the pure oil injections and to evolve what I have termed the Tirumani course for the general routine treatment of leprosy. Alepol appeared on the market in 1927 and having tested the drug and proved its suitability for intravenous injection, I incorporated it in my standard course; subsequent results fully justifying its inclusion.

The Tirumani Course.

Treatment is commenced with the "A" (50 per cent. olive-oil-ester) mixture, the initial dose being 1 cc. followed by subsequent doses each increasing by 1 cc., until a 10 cc. dose is reached. The 10 cc. injection is repeated on five successive occasions. Ester "B" (75 per cent. ester-oil mixture) now replaces that just described. The commencing dose is 1 cc. and again increase occurs in this amount until the final dose of 10 cc. is arrived at; ten injections of maximal dose are given. In the concluding phase of the course mixture "C" (the pure ester) is employed in primary dose of 1 cc. and final dose of 10 cc., the increases being once more

by 1 cc. quantities. Ten maximal injections are given. The average interval between injections, which are made bi-weekly, is three days.

The ester treatment is immediately followed by a course of intravenous injections of alepol commencing with 0.5 cc. and increasing at each injection by a like amount until the full dose of 10 cc. has been given. There are ten successive repetitions of this last dose and the patient is then given a rest for seven days having completed what I term the first period of treatment consisting of four courses. At the end of the rest period treatment is resumed, this time with the "B" ester. The initial dose is 1 cc. and it is increased at each session by 1 cc. until 10 cc. are given. There are ten repetitions of this dose as in the first period of treatment. The second course employs the pure ester and is succeeded by a second series of alepol injections ~~as already~~ *to be* described. With the completion of the second period of treatment a further rest of seven days follows. Should additional treatment be necessary it is supplied by a course of the pure ester succeeded by alepol each in the dose ~~already~~ *to be* noted. A further week's rest follows. The fourth and final period of treatment consists in the sole administration of alepol, which is continued with appropriate rests until the patient may be classed as a disease arrested case. The subjoined tabular statement may serve to emphasise the points at issue. The Tirumani treatment was completely efficacious in the Settlement.

Average Inter-injection Period Three Days.

	Course.	Preparation employed.	Dosage.
FIRST PERIOD.	No. 1.	Ester A. (Olive oil 50%) (Ester 50%)	1 cc. rising by 1 cc. increments to 10 cc., the latter repeated on 5 occasions.
	No. 2.	Ester B. (Olive oil 25%) (Ester 75%)	As above but 10 cc. dose repeated on 10 occasions.
	No. 3.	Ester C. Pure Ester.	As for course No. 2.
	No. 4.	Alepol.	0·5 cc. rising by 0.5 cc. increments to 10 cc., the latter repeated on 10 occasions.
REST OF ONE WEEK.			
SECOND PERIOD.	No. 1.	Ester B.	As for course No. 2, First Period.
	No. 2.	Ester C.	As for course No. 3, First Period.
	No. 3.	Alepol.	1 cc. rising by 1 cc. increments to 10 cc., the latter repeated on 10 occasions.
REST OF ONE WEEK.			
THIRD PERIOD.	No. 1.	Ester C.	As for course No. 3, First Period.
	No. 2.	Alepol.	As for course No. 3, Second Period.
REST OF ONE WEEK.			
FOURTH AND FINAL PERIOD.		Alepol.	As for course No. 3, Second Period. To be continued with one week rest between courses until cure is established.

The above scheme is subject to certain modifications when employed in the treatment of leper children, in whose case repetition of maximal doses in the First, Second and Third periods of treatment is considered neither necessary nor desirable.

Technique.

The method par excellence is that of subcutaneous infiltration which may be made either under the lesions, so as to produce the local effect, or into the outer sides of, say, the thighs, to elicit a general response. My method is a combination one and introduces half of the dose by each route, a different lesion being chosen on each injection day. All-glass 10 cc. syringes are employed as they can readily be cleansed and sterilised. Needles of medium bore are the most suitable since too fine an instrument renders injection laborious, while coarse needles occasion considerable pain. To infiltrate an area the needle is inserted to the hilt, care being taken to keep it parallel with the skin, and the drug is expelled as the syringe is slowly withdrawn. The needle is almost removed from the skin but instead of being allowed to emerge, is directed to a new angle and re-introduced, when a further supply of drug is injected -- and so on until the barrel is empty: in this way thorough infiltration is procured.

In this connection it may be well to append three rules for avoidance of injection pain:-

(a) The esters must never be injected cold, since, under such conditions, cavity formation, muscle tearing and haemorrhage may together produce a sterile abscess. On the other hand the oil should, in its temperature, only slightly exceed that of the body.

(b) The esters must never be injected rapidly; slow expulsion or, better still, fractionation, of the dose will suffice to prevent damage.

(c) A roster for injection sites is an important feature in conservation of the tissues.

Care must always be taken to avoid entering a vein, particularly when oily preparations are employed, since the danger of oil embolism cannot in such cases be over-emphasised.

Alepol is administered intravenously. To prevent vein blocking after a long course of treatment I adopted the method, devised by Muir in 1927[21], of first withdrawing a quantity of blood of volume equal to that of the fluid to be injected, allowing it to mix with the ~~blood~~ drug, and then reinjecting; the underlying principle of this manoeuvre is imperfectly understood. Alepol may be given for relatively long periods under these conditions without appreciable incidence of vein-block. The Tirumani course, by reason of its alternation of intravenous with subcutaneous medication, reduces vein-block to minimal proportions. While the clinic is in session the bottles containing the esters stand in hot water, a procedure which, by lessening viscidity, renders injection more easy, particularly during the cool season. Its employment is necessary in countries whose temperature is insufficiently high to maintain a fluid condition of the drugs. In addition, pain of injection is reduced when solutions are warm.

The syringe is best charged with alepol by puncture of the rubber cap of an inverted container, since otherwise, with the bottle in the erect state, the brisk formation of bubbles on the surface complicates withdrawal.

Frequency of injection is normally bi-weekly but continued high temperature or other unusual symptom necessitates modification either by cessation of treatment or by maintenance of the dose at a constant level, the customary increases being discontinued. Fourteen days should be considered the permissible limit of absence and a new course begun in such cases. Thrice daily charting of temperature is necessary.

The Lepra Reaction.

Not necessarily due to treatment, this phenomenon is characterised by certain definite clinical signs. It is possibly due to protein hypersensitivity, or to a blood stream flood of toxins from the break-down of a massive focus. Fever, headache, joint pains, appearance of fresh lesions and/or exacerbation of existing ones are the cardinal features. Such a reaction during a carefully controlled course of hydnocarpus drugs is not common and occurs chiefly in poorly-fed patients whose general resistance is low. It is much more common and severe when potassium iodide has figured in the treatment scheme, a fact more fully to be noted later. If reaction, however produced, is prolonged and severe it is harmful to the patient and I have found that the ideal in treating leprosy is to keep the patient just under the reacting point. In contrast, I have noted that mild reactions, lasting some 48 hours, are beneficial. When the temperature remains high, the intravenous injection of potassium antimony tartrate, 0.04 gramme, is indicated and defervescence and regression of lesions will be noted rapidly to follow its use. Post-reaction weakness demands a cessation of antileprotic treatment for some weeks and a course of antimony such as that noted in the subjoined table will be found helpful.

Day.	Potassium Antimony Tartrate.	Distilled Water.
1.	0.04 grm.	2 cc.
3.	0.06 grm.	3 cc.
5.	0.08 grm.	4 cc.
7.	0.1 grm.	5 cc.

A second course in accordance with the table may be required. If much neuralgia accompanies the reaction - a feature chiefly of purely nerve cases - a few minims of 0.1 per cent. adrenalin in 30 minims of normal saline is usually effective in alleviating the pain. The Chinese alkaloid ephedrine, given as the

sulphate, in the form of pulvules, is distinctly beneficial, and a single dose of 0.05 gramme has, in my experience, frequently banished the pain in fifteen minutes, though on occasion a second pulvule may be required. These reaction-controlling drugs are essential in leprological equipment both for alleviating suffering and for securing freedom from interruption of the courses.

Counter-irritation has long been recognised as a valued adjuvant to general treatment and full advantage of its benefits is taken by the Tirumani course. Each patient, after bathing, rubs the whole body with crude hydnocarpus oil and is encouraged to do this in the sunlight. While it is doubtful that actual absorption of oil takes place the friction occasioned by the inunction induces a feeling of well-being in the patients who themselves testify to the benefit experienced. Counter irritation was practised also with tri-chloracetic acid, a substance helpful in local treatment of the lesions. Used in three concentrations, 50 per cent., 30 per cent., and 20 per cent. each in distilled water the strongest solution is employed for painting nodules while the weaker solutions prove useful for erythematous and depigmented lesions, the 20 per cent. fluid being particularly valuable for use on the face, where cosmetic effects are important. One application in 10 days is deemed a sufficiently frequent treatment.

Duration of treatment necessarily varies in different cases, but, stated broadly, treatment should be continued until all active signs have been absent for at least six months. The criteria of arrest of the disease are clearly stated in the rules for discharge of Government officials in Madras Presidency and are:-

No new lesions should have appeared for at least six months.

Old lesions should have shown no tendency to spread or other form of activity over a period of six months.

Repeated bacteriological examinations of skin, mucous membranes and lymph nodes on puncture should have proved negative over a period of six months.

These rules have been laid down from the hygienist's point of view but I as a clinician consider that two years would be a more proper limit of safety. It is well to see that such patients should satisfy these conditions before discharge, and re-examination at three monthly intervals for a period of two to three years is a necessary part of the antileptrotic scheme and constitutes an important phase of after-care.

Treatment of Secondary Lesions: and of Co-existing Diseases.

This may briefly be dismissed. Broken down ulcers usually clear rapidly after application of the creosoted esters while trophic ulcers, occasionally yielding to conservative treatment by borated iodoform, may require surgical intervention, if not amputation of limbs. The ultra violet ray furnishes a promising avenue of attack. When neuritic involvement is productive of distress, nerve stretching, performed under local anaesthesia, frequently confers marked benefit; but nerve sheath abscesses require drainage.

Eye complications, always grave in leprosy, must be regarded as urgencies. Cessation of antileprotic treatment is imperative and free use should be made of atropine to prevent adhesions. Dionin-atropine ointment is often of signal value. A prescription which I have employed with success is:

℞

Dionin	gr. ½
Atropinae sulph.	gr. ½
Ung. hydrarg. oxidi flav.	ʒ 1.
Vaselini	ʒ 1.

Sig. Apply as directed.

Leeches to the temple are beneficial. For ectropion with its consequent corneal lesions, goggles are required, and nightly saline compresses make sleep possible.

Dry rhinitis, doubtless simply a local and specialised form of anhydrosis, is relieved by nasal irrigation with hydnocarpus oil preparations after the crusts have been removed by the insertion of glycerinised pledgets of cotton wool. Laryngitis, lighted up to glottis oedema in the course of a reaction, may occasion tracheotomy.

Deformities call for plastic surgery and ear trimming in particular - painless when Muir's clamp is employed - does much to remove the stigma of pendulous lobes. Against limb deformities massage and exercises are valuable prophylactics when commenced early and should form an integral part of any after-care scheme amongst lepers. By their agency both during and after treatment much may be done to minimise the occurrence of crippling deformities which are so distressing a sequel of leprosy.

The rôle of co-existing disease is in many cases a doubtful one and seems to operate chiefly by lowering the resistance of the subject, since specific or appropriate treatment invariably leads to improvement in the leprous syndrome. The co-existence of a disease with leprosy makes it imperative that individual consideration be given each patient and treatment adjusted to meet special needs. The accompanying disease is commonly one endemic in the leprotic area and syphilis, ankylostomiasis, malaria, tuberculosis and the dysenteries may be instanced as examples. Though less important as factors of retardation of treatment certain tropical dermatoses may lead to diagnostic confusion. Worthy of special consideration is the co-existence of syphilis in leprosy since, with our recent advances in chemotherapy, both diseases may be treated con-

currently. The introduction of Muir's Hg.33[20], more lately known as avenyl, led the way. Soluble in Hydnocarpus oil, this drug has proved one of the most valuable remedies at our disposal, a fact which the writer has proved to his satisfaction in a series of some 30 cases subjected to trial at Muir's request. In this connection the Kahn test, deemed more satisfactory in virtue of its greater specificity than the Wassermann reaction, has been recommended as the routine serological procedure in syphilitic lepers. It possesses the additional merits of convenience, cheapness, and simplicity. Avenyl, in the presence of hydnocarpus oil or its esters and creosote, is introduced by the subcutaneous route and produces no reaction. The hydnocarpus-avenyl treatment may be continued until the subject is Kahn negative. Since reaction might prove dangerous in the presence of co-existing disease the aim of the clinician should be to avoid it and for this reason it might be well to consider the use of the pure oil in preference to its esters. In the occasional case where there is intolerance of, or lack of response to, avenyl, a weekly injection of sulfarsenol on a day apart from that of the oil injection may be employed. Sulfarsenol is suitable for subcutaneous medication. Mercurial inunction is a valued adjuvant particularly in the case of children.

Potassium Iodide.

Before leaving the question of treatment, mention must be made of the therapeutic employment of potassium iodide which has long been known to exert special action in leprosy although by reason of its tendency to produce exacerbations it has been used with some hesitation. The ability of iodide to produce a reactive rhinitis is taken advantage of by some to procure nasal secretion for bacteriological examination.

While certain observers consider that the reactions produced when carefully controlled are not harmful, and indeed beneficial, I cannot subscribe to this view, and am convinced that latent tuberculosis is quickly lighted up by the exhibition of potassium iodide. There is one circumstance in which administration of iodide has proved of value and that is when the drug is used as a provocative test of cure and it was the writer's practice at Chingleput to prescribe a course of the following kind which ran concurrently with the last six months of antileprotic treatment. The dose of iodide varies with the type of lesion. All nerve cases and early cutaneous forms began with 5 grs. orally daily, rising by increments of 5 grs. until a dose of 30 grs. was reached. The drug was then pushed bi-weekly by average increments of 30 grs. to a maximal dose of 240 grs., which was persisted with every 3rd day for one month. During this period only one weekly injection of alepol was given in lieu of the customary two. After a rest period of 30 days the bi-weekly 240 grs. dose was resumed for a further month. Alternation of rest and treatment occurred until a six months' course had been completed. Late cutaneous cases receive an initial dose of 1 gr. daily and their maximal dose is 30 grs. Then, by bi-weekly average increments of 15 grs. the final 240 gr. dose is reached. In other respects the course follows that already described. In the case of children the maximal dose is 120 grs. and the course is persisted with for six months. All nerve and early cutaneous cases commence with 2 grs. while late cutaneous receive $\frac{1}{4}$ grain as the initial dose. Among the clinical changes for which careful watch must be kept may be instanced rise of temperature to more than 99°F., persistence of the febrile reaction and weakness. It is necessary to chart the temperature at least thrice daily. Excessive weakness demands cessation of the iodide treatment. The treatment of the re-

action which is indicative of continuance of the disease must be undertaken. When no reaction occurs to the iodide course the fair presumption is that the patient is truly in the disease-arrested state.

The place and function of the Central Institution and its ramifications in which the foregoing treatments are given, must now be discussed.

THE PLACE OF THE CENTRAL INSTITUTION IN THE ANTILEPROTIC SCHEME.

The ideas here expressed are based upon experience gained in organising and developing the Lady Willingdon Settlement. By the term settlement is meant an institution in which community life is as far as possible maximal and residence is obtainable without restraint because of the attractive character of the environment. It must have the best wards as regards comfort and sanitation, the best medical attention must be available and provision of facilities for entertainment is a necessary feature of the undertaking. A settlement should be planned to accommodate 1000 lepers both male and female and sufficient land, probably some 500 acres, should be secured so that plantations, in which the less afflicted may work, are close at hand. Extensive gardens producing fruit and vegetables are an important fund-conserving feature. The settlement best has its own cows. A central hall for recreation, a hospital for acute cases, a dispensary for treatment and an isolation hospital are all demanded, and provision is necessary for the education of leper children. Industries are introduced with benefit and it is possible for the patients to weave and dye fabric, make up garments and so clothe both themselves and their fellows. A laboratory is essential and a good incinerator highly desirable.

A requirement of no mean importance financially is the construction of buildings in which the patients may offer their religious devotions since a successful settlement must be non-sectarian. At Chingleput there were both Mohammedans and Hindus and in other countries still further provision may be necessary.

The Lady Willingdon Settlement, the largest in South India, planned on the lines indicated above, was, at its

foundation, unique, and offers signal opportunities for the study of leprosy, housing as it does large numbers of cases in all stages of the disease. It covers an area of 600 acres allowing ample ground for agricultural activities of all kinds and an impression of the general lay-out may readily be gained from a glance at the panoramic photograph (Photograph No. 1). The Settlement is 35 miles south of Madras and has for a neighbouring village Chingleput, a community of 12,000 inhabitants. The fact that the main South India Railway passes through Chingleput adds greatly to the amenities of the colony. Accommodation for 400 patients was provided in the first instance but through the agency of more recent extensions 600 lepers may comfortably be housed. There are three zones in the colony - tainted, neutral and clean.

The tainted zone has two divisions, a male side and a female, separated from one another by a compound wall along which are situated certain administrative buildings including dispensary, injection block, hospital, school, recreation hall and library. On each side there are small houses for Indians, each containing 2 rooms and accommodating 3 persons per room of one sex. In the male compound in addition there are houses for Anglo-Indian patients, in whose case married people may live together, and a large dormitory for the children.

In the neutral zone are the observation wards, and some offices, and a recent addition has been two sheds for industrial purposes in which patients weave material for clothing and bandages and in which carpentry, smith work and other trades are carried on. It is important to engage instructors in the various trades so that full advantage may be taken of the facilities, though it may happen that certain patients will possess the necessary qualifications. It is desirable that lepers discharged from the institution in the disease-arrested state should have a trade to which they may

turn on resumption of civil life.

The clean zone contains the staff residences and the home for untainted children of lepers undergoing treatment in the settlement, as well as children who have been passed through on completion of treatment.

The site for the institution was chosen because of its isolation, its sparse population, its good water supply from deep wells, and its excellent agricultural facilities. Night soil is disposed of by trenching at a considerable distance from the main buildings. The method I adopted is now briefly noted..

> The trenches are 18 inches deep and 18 inches wide. Night soil to a depth of 6 inches is placed in each trench, and this is covered with earth, as finely powdered as possible, to a depth of one foot. All the soil which has been taken out of the trench ought to be put in again, so that when the trench is completed, a mound is formed. There ought always to be sufficient trenches ready for the reception of 3 days' night soil. The method at Chingleput is to prepare a week's trenches in one row so that the cart can be backed against the trench and the contents tipped out easily. At intervals of six feet, half a foot of solid earth is left, so that we have a trench six feet long ready for each load of excreta, and when the rains come the task of bailing out the water will be simple and rapid. Night soil is removed from the houses to the trenches in carts and in order that these may not return to the settlement filthy, a cement platform is erected, on which to wash and disinfect the carts and a well is sunk in the vicinity. This well will also be useful for irrigation purposes while the ground is under cultivation. A drain leads from the platform to a trench. The dirty water runs into the trench and can immediately be covered with earth.

This method has proved very satisfactory. A large incinerator disposes of soiled dressings and other destructible matter.

A skeleton framework of steel girders built on a cement base can, in the space of a few hours, be converted into an isolation hospital by application of a covering of leaves. When the need for isolation has passed the leaf walls and roof are simply burnt off and the framework, remaining unscathed, is ready for re-thatching when occasion demands its employment once more.

The 600 leper settlers constitute a happy and contented community as they have everything within reason which goes to make their lives as far as possible contented. They have the amenities of village life including a well-equipped store in which small luxuries may be purchased, and extensive recreation grounds. The voluntary system of entry is a pleasant feature and patients offer themselves knowing that they will be humanely and effectively treated by trained physicians and nurses. Once generally adopted the voluntary admission policy will prove far more effective in touching the leper problem than the older disciplinary measures. Labour within the settlement is done as far as possible by the patients and results both in terms of work performed and in maintenance of morale have been most satisfactory. The executive staff is large and includes a medical officer with two qualified Indian assistants, nurses, clerks, compounders, dressers and coolies. The institution is fortunate in that the District Missionary of the Church of Scotland combines his duties with those of the general management of the Settlement at which he resides, and the physician-in-charge is thus relieved of many burdensome matters of a lay nature. At regular intervals physical and bacteriological examinations of patients are made and those showing clinical improvement are separated by degrees from their more afflicted fellows. Bed ridden and temporarily indisposed cases are transferred to hospital.

Management of the Patient.

For the efficient and orderly working of the institution the inmates should render assistance and should be made to feel that their help is necessary and valued, and so the better educated patients are given monitor duties over groups and are responsible for the discipline of their charges. They arrange the personnel for minor tasks and see to the cleanliness

of the houses and their occupants. The choosing of the inmates for the various duties and labours is done by the physician in charge, each patient being medically examined with reference to his suitability for a particular task. The greatest improvement is noted in those who take abundant exercise which improves digestion and tones up the whole body: just as in tuberculosis, exercise liberates toxins, moderate in amount when the exertion is controlled, and Rogers(32) believes that the provision of a system of work in settlements has a threefold value: it provides the exercise required, it supplies occupation for the mind and it is of utmost economic importance in enabling large numbers of lepers voluntarily to be isolated and treated at the lowest possible cost. The psychical effect is produced by change of habit and environment which are often sufficient markedly to improve the patient's condition, and I frequently have noticed that the very fact of admission to the settlement produced benefit, the subject's worries having come to an end. Rest, good food and absence of anxiety each plays its part in raising the general body resistance, and endowing the patient with the 'will to live'. A good library was made free use of by the inmates and the encouragement of musical evenings, lantern displays and dramatic productions proved highly beneficial.

Personal Hygiene.

It was insisted that each patient should bathe regularly and baths were followed by friction, accompanied by inunction of such oils as chaulmoogra, hydnocarpus or gingelly (peanut oil) a procedure which has for its aims the flushing of the skin and the strengthening of the muscles: in addition it sets free minute doses of toxins and so generates a degree of immunity. Scabies and ringworm require treatment and con-

stipation, an expression of debility common in leprosy, is much relieved by saline purges.

The diet of the leper is not unimportant and the writer's diet scale, drawn up in consultation with Colonel McCarrison, is subjoined.

1.	Rice, ragi, cholum or cumbu. (at choice)	18 ozs.
2.	Dhall.....	6 ozs.
3.	Salt.....	¾ oz.
4.	Ghee.....	½ oz.
5.	Tamarind.....	½ oz.
6.	Curry Powder.....	¼ oz.
7.	Vegetables (including onions).....	8½ ozs.
8.	Milk.....	½ pint.

Two ounces of dhall may be replaced twice a week by four ounces of mutton.

Feeding in leprosy has, to my mind, received insufficient attention. Physiologically adequate diet must be supplied perhaps more in leprosy than in any other disease, since physical deterioration is followed by rapid advance of the morbid process, and thus quality rather than quantity must be the watchword.

Finance.

The initial cost of founding a settlement similar to that at Chingleput is necessarily great, but by careful administration and budgeting the running expenses may be so adjusted that the benefits accruing from treatment, coupled with the degree of self support conferred by industry and tillage, will at no distant time balance the primary expenditure.

The total cost per patient per month at the Lady Willingdon Settlement is in the neighbourhood of Rs. 18 (27/-). Of this Rs. 8 (12/-) is spent on food, Rs. 2 (3/-) covers the cost of medicine and the remaining Rs. 8 (12/-) is a house charge and includes the cost of clothing, equipment and overhead charges including salaries. The salaries of the medical superintendent and nurses were met by a separate fund. Examin-

ation of the charge rates of privately aided institutions in India reveals them to be considerably lower than those stated for the settlement, but it must be remembered in this connection that no reckoning is made in the financial statements of the monies contributed by missionary and other activities in the homeland. Moreover, salaries are exclusive, and indeed much of the administrative work, given under missionary auspices, is voluntary. The correspondingly higher charges of the Lady Willingdon institution are therefore accounted for by the fact that expenses are stated fully. In addition to these higher charges of a relative nature there are certain absolute costs exceeding those in other institutions. For these there are very good reasons, which will best be presented in semi-tabular form.

1. The size of the settlement renders the administration that of a village, with consequent increase of expenditure over that required for a hospital or asylum.

2. In accordance with the pursuance of the policy of occupational therapy, equipment, materials and wages for working patients require to be provided.

3. Maintenance of wells arranged to furnish an abundant and wholesome water supply, and cartage of night soil are costly features involving the employment of engines, bullocks and special staff.

4. The scientific dietary of the settlement is naturally more expensive than the non-standardised food of other centres.

5. The most up-to-date antileprotic remedies cannot be expected to be purchasable at the same cost as more crude or less modern preparations.

When these findings are reviewed in the light of the undeniable benefit which work at the settlement is conferring, the writer is convinced that the extra expenditure cannot be voted an improper outlay.

Settlement Organisation.

While this thesis deals in large measure with the work of a functioning institution it is thought that a few suggestions may not be out of place, and indeed of value, to some who may be faced with the problem of establishing a settlement. The use of sub-headings will, one feels, lighten the task of introducing and appreciating the suggestions.

(a) Separation of Caste and Sex. Since complete religious freedom is an essential condition of residence if patients are to be attracted, it is necessary to provide adequate living accommodation for adherents of different religious sects. While in India, Mohammedans and Hindus figure prominently, religious profession must necessarily vary in other leprotic countries, and considerate recognition of the patients' beliefs is required. The provision of edifices in which their observances may be made is frequently an item of expensive nature, since interior decoration, most commonly carried out by the worshippers, does not relieve the management of the institution from the erection costs of the buildings.

Sex separation is of course necessary in the unmarried but the question of separation of the married individuals is a controversial one. At the Lady Willingdon Settlement it was customary to allow cohabitation of Anglo-Indians, but not of Indians, a practice which the writer condemns, but one which was outwith his control. He feels strongly that such

inequality between the races is productive of ill-feeling and had he been given full powers he would have made no such distinctions. Two arguments may be brought forward against cohabitation of the married. Sexual congress will in most cases occasion pregnancy and the child on arrival is early subjected to the risk of the malady. Moreover, completion of pregnancy is followed by rapid deterioration of the mother together with aggravation of her leprosy. A very modernistic principle which can hardly appear repellent to medical readers would be regulated cohabitation with contraceptives. Such a scheme is of course beset with difficulties but is deemed worthy of note.

(b) Children, of whom 10 per cent. of the population of the settlement consisted, were in most cases under 15, and rarely heavily infected. Mischievous equally as normal healthy children, they run about the settlement freely exposed to risk and I feel that the solution of this problem lies in the provision of boarding schools in the remote parts of the settlement or preferably outwith its bounds. After birth it is well to separate the children and to arrange for their nursing by selected women although in the writer's experience no particular risk appeared to be attached to their remaining with their mothers for a few weeks, even although they were puny infants whose powers of resistance were doubtless of the feeblest.

(c) Cripples are sometimes termed 'burnt-out' cases, a phrase which is indicative of their non-infectivity. Of the vagrant type, dirty and aggressive, and occasionally strikingly repulsive, they may retard seriously the smooth conduct of the institution: they are in addition a needlessly grim object lesson to their less afflicted fellows. Their disposal presents a problem which in my view can be settled

only by their maintenance in a separate institution reasonably accessible from the settlement, which policy was actually adopted at Chingleput. The added expense would be justified by the removal of the annoyance which their presence creates.

The Complete Scheme.

If the leprosy problem is to be adequately solved the central institution or settlement, description of which has just finished, is not sufficient and the writer wishes it to be clearly understood that he is strongly in favour of adjuvants to the settlement in the form of out-patient clinics together with a system of periodic re-examination of lepers and also primary examination of those who have been exposed to the risk of infection - in other words the inauguration of leper surveys in the district populations. Certain leprologists consider that out-patient clinics alone are sufficiently active measures in limiting incidence but I do not share this view. Presuming that a ring of subsidiary centres be established with the central institution as their nucleus and headquarters, it is necessary now to detail some elements of the scheme as perfected at Chingleput.

The function of the out-patient clinic is two-fold. It furnishes treatment for the victim and it teaches him the principles of personal hygiene for observation in his home. It may be used in addition to train native helpers in routine technique and it is desirable that the headquarters staff be adequate to deal with the work both of the settlement and of its satellite clinics. Referring of cases to the central institution would become automatic when needful. An administrative difficulty is presented by the co-ordination of a large number of small clinics but this should not be insurmountable. Segregation of actively infective cases in their own homes, always urged by the medical officer of the clinic, is rarely

carried out and it is here that the arguments of those who support a system solely of out-patient clinics breaks down: and I am convinced that a central institution to receive such cases is not merely desirable but essential. In any case the clinics might require to be established in sparsely populated mountainous tracts where transport difficulties would be maximal and the supply of trained physicians minimal, so that once again provision of a settlement, offering uninterrupted observation and therapy, becomes imperative. And not least of the arguments in favour of the establishment of the central institution is that incapacitated lepers must have a reception home in which their distressing lot may at least be ameliorated.

Absence of regularity of attendance at the out-patient clinic, particularly notable amongst the vagrant lepers, militates seriously against the success of the clinic system while, in the settlement, treatment would be regular, residence therapeutically adequate, and, by restraint of infectives, a menace to the public removed. In this latter connection the writer feels that the granting of powers of restraint to superintendents of institutions in terms similar to those of the Leper Act of 1898 amd its subsequent amendments would be helpful. Prolonged treatment may be required in certain cases. The institution provides the best chance of its being given. Adoption of measures of control of the nature of notification, impossible in continents, should be attended by success in island and small colonies.

A possible extension of the outpatient system mentioned last, but by no means least important, is the mobile combined dispensary and laboratory which functions as a moving clinic. By its means treatment in remote districts might be carried out and by employment of its laboratory facilities valuable leper survey work would be possible.

Adrian Stokes, regrettably deceased, proved the sterling value of the mobile laboratory in yellow fever campaigns and there is no reason to doubt that it would be less efficacious amongst lepers.

To summarise, we have a central institution, organised on the lines already described and surrounded by a group of satellite clinics in close touch with, and staffed by, the physicians of the parent centre, communication occurring through the medium of the mobile laboratory which under certain circumstances would itself function as a dispensary, or again as a leper survey unit. As examples of three special extra-mural units which would contribute much to the success of the scheme may be instanced the boarding home for school children, the reception home for neonatal children and the minor settlement for vagrant cripples.

An important phase which has not been touched upon is the value of the central institution as a research centre. Investigation under such conditions must necessarily be almost solely therapeutic, since few medical officers are research bacteriologists and biological work is best done in schools of tropical medicine, but clinical training of young graduates and the provision of refresher courses for their more mature colleagues are matters which may with confidence be vested in the Chief Medical Officer of the settlement. Such a scheme was in force in the Chingleput institution.

Before passing to the consideration of a few points of practical importance it may be noted that they have come to notice as a result of routine at the settlement and are included in the assumption that they may be of value in the management of institution cases.

Some Practical Points.

The question of grading of cases of leprosy on clinical grounds has for some time been a vexed one. It is necessary in the organisation of a settlement's activities to have some plan whereby segregation of closely related types is possible. At Chingleput Muir's Indian Classification was, with certain modifications, adopted. For the appreciation of certain clinical data presently to be brought forward, it will be necessary briefly to explain Muir's grading. Two key letters A and B are chosen, and they signify respectively neural cases (A means Anaesthesia) and cutaneous cases (B means bacilli), the letters also bringing to mind the suggestion of non-infectivity and infectivity. By the use of index numbers degrees of severity are expressed, thus A_1 is an early nerve case and A_2 a fully developed one, B_1 a first stage cutaneous case, B_2 one of moderate severity and B_3 one presenting advanced skin lesions. By a combination of key letters and indices the mixed case is described. Thus A_1B_2 represents an early nerve case with noticeable cutaneous phenomena, and A_2B_1 signifies a late nerve case in which the skin lesions are slight. It will be seen that there is no intermediate grading of nerve cases on the Muir scale and the author, considering this a demerit, classified neural cases as A_1, A_{1+} and A_2, the A_{1+} type conveying the impression of a patient in whom nerve lesions were something more than initial but less than fully developed. This split classification proved of value in keeping records and in the cases shortly to be presented its use will be exemplified. The writer has not seen value accruing from a minute classification and is convinced that by careful use of the terms above indicated, any case of leprosy may satisfactorily be referred to its place in the scale of types.

A short descriptive note regarding admission procedure

may not be out of place: the sufferer comes to the Settlement by appointment or of his own accord. On arrival each case is received in the laboratory and aided by case cards the primary clinical examination is conducted and controlled by such laboratory tests as may conveniently be made on the spot. Broadly it is first decided that the subject is or is not a leper in accordance with the visibility of lesions, or the statement of the patient. When obvious stigmata such as gross skin lesions and pendulous ear lobes are noted, Ziehl-stained smears from lesions and/or snips are prepared and examined. Meanwhile the patient, blindfolded, is subjected to sensation tests both tactile and thermal. On the cards, photographic reproductions of which will be later submitted, the relevant data are entered. Taking together the clinical and laboratory findings it is now possible to refer the patient to a place on the Muir scale and so to decide the part of the Settlement in which he will reside. In so deciding due attention must be paid both to infectivity and to caste. Other important laboratory examinations are those of the urine, those of the blood for malaria and filarial parasites, and those of the faeces for intestinal protozoa. On the Thursday after admission, the day being chosen to meet transport and other arrangements, blood for the Wassermann and Kahn reactions is withdrawn. Should a patient present himself in whom the trifling nature of the lesions precludes the absolute diagnosis of leprosy, use is made of the observation block until such time as classification or discharge is possible. A similar routine applies to the case of children. Once installed in the Settlement the patient makes a bi-weekly pilgrimage to the injection block for his treatment and as he settles down soon enters into the communal life. Should he show aptitude he may be allowed to take part in certain medical duties such as injection and the like, a privilege which is much esteemed.

Armamentarium. A rough guide to the pharmacological and laboratory requirements is here inserted.

Drugs.

Hydnocarpus oil and its esters, trichloracetic acid, potassium iodide, avenyl, alepol, potassium antimony tartrate, adrenalin, ephedrine, sulfarsenol, mercurochrome, creosote (double distilled), alcohol (absolute) and also of varying strengths, iodine, olive oil, (fatty acid free) purgatives and general remedies for minor ailments. Vaccines.

Appliances.

(a) Clinical.

Syringes 10 cc. and 5 cc. all-glass, needles fine and medium bore, surgical emergency instruments, sterilisers, spirit stoves, enema apparatus, ward and bedside equipment.

(b) Laboratory.

Microscope, microtome, incubator, paraffin embedding oven, autoclave, Koch steriliser, centrifuge, ice box (refrigerator if electric current available), micro-slides and cover glasses, culture media, stains and other reagents.

The drugs and appliances stated in the foregoing table are in the main essentials and the necessary additions must depend on several factors, notably the funds available and the particular preference of the medical officer in charge. Bacteriological reagents should, where possible, be purchased in 'soloid' form and it must be remembered that the abnormal temperatures of the tropics may play havoc with volatile reagents which must therefore be specially stoppered and kept in the shade. Ammonia freezing mixtures are often of great value in preserving such chemicals. Incubators and kindred apparatus are best oil-heated.

THE CAMPAIGN.

The difficulties experienced in a campaign are mainly topographical and racial. Methods of organisation which are effective in the densely populated areas of India and China, prove quite unsuitable for the widely separated communities of Africa. In addition, the more primitive the race, the greater is the difficulty in persuading sufferers to present themselves for treatment. The progress made in the understanding of the leper problem during the last few years made it highly desirable if not necessary to press for a scheme of co-ordinated teaching in leprosy of an international character and the attack is now directed against the disease rather than its victims. In considering the main difficulties which arise, India may be taken as typical of most countries where the disease is prevalent. Ignorance of the malady and fear of possible consequences on the part of the public are perhaps the chief obstacles to be overcome, while inexperience of the medical profession in early diagnosis is hardly a less important factor. Practitioners have had little opportunity as students for the study of leprosy and they not infrequently doubt the efficacy of modern anti-leprotic procedure. Poverty weighs heavily on the greater proportion of the people of endemic centres such as India and the cost of treatment for these sufferers is prohibitive. The problem of transport over great distances can scarcely be over-stressed.

No less serious a drawback, though one of a different nature, is the difficulty of ascertaining the number and distribution of lepers and the writer, while medical officer to the Chingleput schools, was perturbed by the number of cases which emerged at routine inspections of the children; and neither the little victims nor their parents appeared to have any suspicion of the presence of infection. A medical man is required to detect such cases and it is well known that the Indian census

takers, laymen in all instances, recognise only advanced grades of leprosy: surveys show that the census figure falls far short of the actual number of lepers. Mindful of these difficulties we may consider the features of an antileprotic scheme under the following heads:

A. Education of the public and also of the medical profession.

B. Organisation of investigation regarding the extent of the disease in all areas.

C. Provision of ample and convenient facilities for gratuitous treatment. Distribution of cases is best made in accordance with the following scheme:

(1) Infectious cases with extensive lesions are to be treated at the Central Institution.
(2) Early and bacteriologically positive cases should be treated at the Central Institution until they become negative as regards bacteriological findings and thereafter kept under supervision.
(3) Early and bacteriologically negative cases should be treated at the out-patient dispensaries.

Further suggested data are outlined in the findings of the Leonard Wood Conference[15] but are hardly relevant to our present purpose: they may be perused by those interested.

As regards the educative phase of the campaign it is strange that only recently has leprosy been deemed worthy of co-ordinated scientific investigation but with rapid advance, old prejudices are fast losing ground. Propaganda amongst the public must consist in explanations of the hazards and methods of avoidance of the disease and in the inculcation of principles of personal hygiene in the afflicted. To this end it cannot too strongly be stressed that leprosy is not an incurable malady and may by appropriate treatment be arrested sufficiently to permit resumption of occupation. Such a message imbues the sufferer with hope and does much to eradicate

the feeling of shame which has so long been a deterrent to the securing of attendance for treatment. Of prime importance is the assurance that the obviously leprous are not necessarily the greatest community danger but that in many of these burnt-out cases the disease has run its course leaving in its train mutilation but no risk to others: rather conversely, is the early case, in whom the untrained eye can detect little evidence of the disease, the real menace. Lepers themselves should be informed that in certain instances the disease is non-infective and such knowledge possibly may dissuade persons from concealing lepers in their homes. This information must of course be given with care lest some, falsely reassured, might harbour infective persons in their midst and so defeat the aims of the campaign. The difficulties arising in connection with employers of labour often present a serious problem.

After opening an out-patient clinic at Lady Willingdon Settlement, I discovered that many employers would not allow their employees to continue with their work while undergoing treatment, though every assurance had been given that the cases were not infectious; nor would they give them any guarantee of re-instatement on completion of treatment. These people were therefore compelled to become inmates of the Settlement, where they had proper food and attention, or become out-patients without work or pay, and existing only with difficulty. Such cases provide a very strong argument for the provision of hospitals for certain non-infective cases.

If out-patient treatment has to be the order of the day for non-infective cases, something will have to be done to convince employers that all types of leprosy are not transmissible. The very name of leper is usually sufficient to procure dismissal no matter what arguments are brought to bear, and the alternative to the leper is beggary. Even if the employer is convinced that the case is non-infective he wants to know how long the treatment is going to last and whether the patient is

going to be as fit for work as he was before. He wants a prognosis and it is quite proper that he should be given such.

Side by side with the publication of these important facts there must be a vigorous attempt to promulgate elementary laws of cleanliness and sanitation in absence of which leprosy flourishes. It will be well also publicly to stress the fact that the disease is not hereditary and that early, if not immediate, separation of the infant from its leprous mother will ensure its future health. The hygiene of the railway train demands consideration and the provision of separate coaches for leper passengers is an important desideratum in transport. With the advent and development of flying as a means of travel, the possibility of aerial transmission of leprosy to new lands must not be forgotten.

Education of the medical profession presents few difficulties and consists simply in the arrangement of refresher courses for graduates and in the inclusion of leprosy teaching in the medical curriculum. Prominent features of the training must be instruction in early diagnosis, in modern therapeutics and in the methods of propaganda. Such training was undertaken by the writer at Chingleput both on behalf of practitioners and government officials. In the absence of the trained physician propaganda breaks down. The employment of skilled lay lecturers is worthy of trial.

The acquisition of a leper census cannot be obtained through the medium of the ordinary census officer and two solutions of the difficulty are possible. Trained laymen may be employed or junior medical officers may be pressed into the service. The actual treatment of the disease is carried out by a system already noted and the chief difficulty experienced here is that of tracking those lepers who live off the beaten track, and who are thus really minor foci of epidemicity. They must be reached by the mobile dispensary in the absence

of an out-patient clinic. Once the settlement has become known the patients will flock for treatment and I have had to turn away as many as 20 patients in a single week from lack of accommodation. It is regrettable that such a state of affairs is common throughout India. We must, then, render treatment readily available by the multiplication of settlements and their adjuvants, and treatment must be free, otherwise the poverty-stricken masses gain no benefit from the scheme however efficient it may be. The leper asylum in which the hopeless are segregated is a melancholy, if not effete, institution.

Legislation has in the past directed its attention to the segregation of lepers, with doubtful success, and numerous acts have been passed. The attempts failed largely owing to the reluctance of the native police to interfere with lepers, and, in addition, the maintenance of leper gaols was a heavy burden on the community. It cannot in fairness be said that legislation has appreciably aided the fight.

At the present day most must be hoped from the work done by missionaries and from the rapid and valuable therapeutic advances which are being made. Fortunately the intimate bacteriology of the disease, though still doubtful, is relatively unimportant in constructing a campaign. It is possible that the Government may still be brought to realise its obligations to the leper and be led to support unrestrictedly the efforts of workers in this thankless field. The outlook for the future is bright and one feels that the leper is coming to regard the central institution not as a last refuge but as the avenue to health. There is, finally, a matter to which relatively little attention appears to have been turned, namely, the invention of a word to replace 'leprosy' a term which conjures up feelings of revulsion, if not dread. The writer believes that the employment of a less pointed term would do much

to ameliorate the leper's lot. Perhaps some such term as 'Hanseniasis' or the Indian 'Kushta' would better suffice, since the impression of a loathsome disease would not so immediately be conveyed. The finding of an alternative for 'leper' is a much more difficult problem.

It is proposed at this point to insert a series of cases which, though not covering the ground of the therapeutic investigations carried out, are nevertheless thoroughly representative of the work done, a complete survey of which would be needlessly burdensome to the reader. In presenting the cases the data submitted are designed principally to exhibit length of, and response to, the Standard Tirumani treatment which was evolved at Chingleput. Originally the cases were charted on special cards, photographic reproductions of which are appended. In recording the lesions a graphic system of representation was employed and the signs chosen were:

Superficial anaesthesia. 

Depigmentation. 

Erythematous patch. 

Infiltration. 

Nodule formation. 

The example cases use for their classification the Indian key letters and indices, and the final result in each instance is that emerging at the end of two to three years, periodic examinations having been made during that time. The detailed remarks concerning primary and other lesions have been omitted, since they are not thought to be relevant to the purpose of the case presentation, the aim of which is to show the value, and permanency of effect, of the Tirumani treatment. The penultimate section of the thesis presents the general conclusions from the work, together with a list of references.

A brief series of photographs illustrative both of settlement activities and clinical features of Leprosy terminates the study.

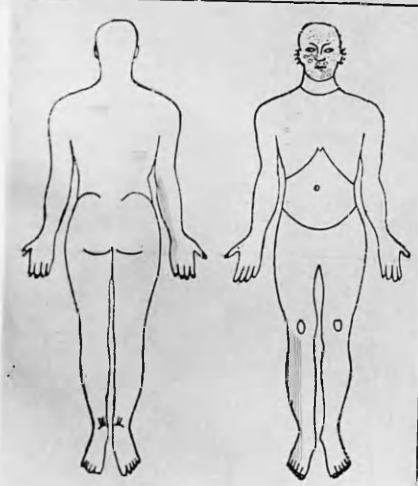
LADY WILLINGDON LEPER SETTLEMENT.

CASE CARD.

Case No. C 172
Treat. No. 787
Type $A_1 B_3$
Caste. Hindu
Bl. No. 10

Name. A. Aroke
Age. 35
Sex. Male
Occupation. Railway Guard

Address. Thiruvalambur
Alapakkam.
Date of Admission. 16. 7. 26
Date of Discharge. 18.12.28 (Symptom FREE)



PHOTOGRAPH (on admission.

HISTORY.

Family History. No history of Leprosy

Predisposing Cause. Syphilis

Initial Lesion. Erythematous Patch of right cheek

Progress of Disease. Other raised erythematous patches and nodules gradually spread over face and ear; outer side of right leg and arm became anaesthetic

Date of 1st Exam. 21. 8. 26

Duration of Disease. 2 years

[illegible] positive

Sumar. [illegible] positive

Kahn. [illegible]

Wassermann. positive

PHOTOGRAPH ON DISMISSAL

Remarks on Discharge.

This patient, on each occasion of re-examination during a period of 2 years subsequent to his discharge remained symptom-free and at his FINAL examination was classed as a "disease arrested" case.

Photographic reproduction of the case record card employed at the Lady Willingdon Leper Settlement. Both face and reverse sides of card are displayed.

The photographs show the improvement in condition as a result of treatment.

CASE PRESENTATION.

The cases which now follow are arranged in clinical progression commencing with early nerve, then passing, through varying degrees of severity, to skin cases, and finally presenting examples of advanced mixed leprosy.

A_1 (early nerve)

K.I. male shopkeeper, aged 19, admitted 6.7.27, infection having begun three years before. Had in addition hookworm disease. His uncle was a leper. Chief symptom anaesthesia. Blood Wassermann, Kahn, and nasal smears negative. Stools positive for hookworm ova. After one year eight months of standard Tirumani treatment, with uninterrupted progress, he was discharged symptom free on 3.3.29. Three years later classed as disease arrested.

Result: Disease arrested.

A_1.

T.W. male, schoolboy, aged 10, admitted 1.1.28, after $1\frac{1}{2}$ years' illness. He had in addition syphilis and his mother was a leper. Both Blood Wassermann and Kahn were positive but nasal smears were negative. Chief symptom anaesthesia. After one year's standard treatment with very rapid progress he was dismissed on 1.1.29 symptom free. Three years later classed as disease arrested.

Result: Disease arrested.

A1.

M.H. male shopkeeper, aged 28, was admitted on 9.2.28 with a history of one year's illness and presenting anaesthesia of right leg. He had in addition malaria, and his mother was a leper. All pathological findings, with the exception of presence of plasmodium vivax in the blood film, were negative. Treated for one year eight months without event, he was discharged on 9.10.29 symptom free. Classed as disease arrested 3 years later.

Result: Disease arrested.

A1.

V.P. a male electrician, aged 23, was admitted on 5.2.29 having had leprosy for six months. His admission symptom was anaesthesia of right foot and left forearm. His father died of leprosy. Pathological findings were negative and coexisting disease was absent. After one year's treatment with rapid progress he was dismissed on 6.2.30 symptom free. Subsequent examination up to two years showed disease still arrested.

Result: Disease arrested.

A_1.

E.S.A. a housewife, aged 36, admitted on 10.2.27, after 6 months' illness showed dorsal anaesthesia of both hands. Blood serologically negative. Smears negative. No coexisting disease. One year and ten months' uneventful treatment secured her dismissal, symptom free, on 7.12.28. Three years later she was still free.

Result: Disease arrested.

A_1.

B.R. a police constable, aged 47, entered the settlement on 2.11.27 with a history of more than a year's illness and suffered from slight anaesthesia and depigmentation of left arm. Examination of blood revealed coexistence of malaria and syphilis. One year and ten months' treatment with slow but uneventful progress led to a symptom free dismissal on 16.9.29. At three years a disease arrested classification was made.

Result: Disease arrested.

A_{1+} (more advanced nerve leprosy)

A.G. a schoolboy, aged 13, came to us on 31.8.26, having been stricken when he was eleven. There were rather generalised anaesthetic patches and depigmentation and he suffered much from scabies. Pathological findings were negative. A rather long course of treatment, lasting three years and five months, was accompanied by exceedingly slow progress, and the boy was dismissed on 6.1.30 without obvious symptom. At three years his disease was still arrested.

Result: Disease arrested.

A_{1+}

C.R.N. a male student, 20 years old, was admitted on 28.4.27. There was a history of three years' morbidity. The clinical findings were anaesthesia both of right arm and right leg. The peroneal nerve was slightly thickened. He had in addition syphilis and malaria. Blood serologically positive and plasmodium falciparum found. Two years and nine months' treatment was required and after slow progress he was dismissed on 10.1.30 with slight permanent anaesthesia of the left foot. After three years his condition was unchanged.

Result: Disease arrested.
Slight permanent Anaesthesia.

A1+

K.K. a 20 year old tailor, entered the settlement on 6.6.26 with a two years' history and presenting anaesthesia of arm and buttocks with thickening of the ulnar nerve. Pathological findings negative and there was no coexisting disease. Two years and six months' treatment with slow recovery led to dismissal on 31.12.28 there being slight permanent anaesthesia of left little finger. In three years no change.

Result: Disease arrested.

Slight permanent
Anaesthesia.

A1+

N.N. police constable, of 33 years, was admitted on 14.5.27 having been ill for more than one year and presenting anaesthetic patches both of face and trunk. There was auricular nerve thickening. The blood was serologically negative but plasmodium falciparum was present. During his course of treatment lasting two years and seven months his progress was rapid until December 1927 when a vigorous reaction occurred. His after progress in his weakened state was necessarily slow. Dismissal symptom free occurred on 1.12.29 and disease was still arrested three years later.

Result: Disease arrested.

A1+

P.S.R. farm labourer, aged 22, was admitted on 20.12.26. He had been ill for 3 years and there was a history of maternal leprosy. Trunk and leg anaesthesiae were his symptoms and there were no coexisting diseases. Two years of treatment with only slow progress secured a symptom free dismissal on 13.1.29. Three years later there had been no recurrence.

Result: Disease arrested.

B1 (early skin)

S.A.K. police constable, aged 28, came first on 17.5.26. He was a syphilitic and had been ill for a year and a half. A raised erythematous patch of right shoulder was his lesion. Blood Wassermann and Kahn reactions were positive and smears from ear snips were positive for M. leprae. Two years' uneventful treatment secured dismissal, symptom free, on 4.5.28. Disease was still arrested in three years.

Result: Disease arrested.

B_1

A.J. a carpenter, aged 37, admitted 29.6.27, having raised erythematous patches on buttocks and in addition kala azar. Blood serologically negative. Smears from patches positive but nasal smears negative. Leishman Donovan bodies were present in blood films. Twenty months of treatment produced rapid improvement and the patient was in the symptom free state by 7.2.29. Three years later disease still arrested.

Result: Disease arrested.

B_2 (moderate skin involvement.)

D.F. railwayman, aged 27, was admitted 26.8.26. He had a leprous cousin. There was no co-existing disease. Clinically he had infiltration of the ears and raised patches on both arms. Blood Wassermann and Kahn reactions were negative but ear snip smears were positive. Two years and four months' treatment produced a slow though uneventful recovery and dismissal was secured on 17.12.28. Three years later the disease was still arrested.

Result: Disease arrested.

B_2.

T.N. a police constable, 40 years old, came in on 4.8.26 with nodules on face and ears. He was in addition luetic. Blood Wassermann and Kahn reactions were positive as were smears from ear snips. Three and a half years' treatment was interrupted in 1927 by a severe reaction. A symptom free dismissal took place on 30.2.30 and two years later there was no change.

Reaction: See Photograph No. 26.

Result: Disease arrested.

B_3 (Advanced skin).

P.H. a male student, aged 25, admitted 6.8.26 with leonine facies. The condition had taken five years to develop and syphilis also was present. Blood Wassermann and Kahn reactions were positive. Both ear snips and nasal smears showed M. leprae. Three and a half years' treatment with slow progress rendered the patient symptom free. He was discharged on 6.1.30 and two years later gave no evidence of disease.

Result: Disease arrested.
See Photograph 19.

B3

K.P. a coolie, aged 33, entered the settlement on 4.7.25 with completely generalised erythetmatous patches which had taken five years to develop. Paternal death had been from leprosy and the patient suffered in addition from bacillary dysentery. Serologically the blood was negative although nasal and lesion smears were positive. Four years' treatment was required and progress was slow but steady. Both at dismissal on 16.7.29 and at subsequent final examination three years later patient was symptom free.

Result: Disease arrested.

A1B1 (Early mixed)

S.R.N. postal clerk, aged 31, was admitted on 10.8.27 with raised erythematous patches on the chest and slight anaesthesia of left forearm. The disease began three years before admission. Smears made from ear snips were positive but those from nasal mucous membrane proved negative. No syphilis was detected by blood tests. The patient was discharged symptom free after one year and ten months of uninterrupted treatment. Three years later the disease was still arrested.

Result: Disease arrested.

A_1B_1

C.M.K. a medical student, aged 19, came to the settlement on 3.3.28 with nodules on arms, and anaesthesia. He had in addition amoebiasis. Blood Wassermann and Kahn negative. Lesion smears positive. Almost two years' treatment was required and a reaction occurred towards the end of his first year. After symptom free dismissal on 15.1.30 he remained clear.

Result: Disease arrested.

A_1B_1

C.R. a painter, 42 years old, was admitted on 15.8.26 with skin leprosy of the left arm and anaesthesia of the right leg. Serologically his blood gave evidence of syphilis, and lesion smears from the cheek were positive. Primarily slow and later rapid, his progress led to dismissal on 22.3.29 symptom free. Three years later disease still arrested.

Result: Disease arrested.

A_1B_1.

A.B. a schoolgirl, aged 10, admitted on 4.4.27, had patches on cheeks and shoulders with anaesthesia of left little finger. Ankylostomiasis and scabies were coexisting diseases and a fraternal death had been due to leprosy. The only positive pathological finding was that of the presence of M. leprae in lesion smears although Ankylostome ova appeared in the faeces. Slow progress was made during almost three years of treatment but a symptom free dismissal was secured on 6.2.30. At three years she was still clear.

Result: Disease arrested.

A_1B_1.

V.R.P. a coolie, aged 30, came in on 3.11.26 with slight infiltration of ears and anaesthesia of right groin. Hookworm disease was a complicating factor. Lesion smears were positive but there were no other laboratory findings. Two years' treatment was required to procure dismissal symptom free on 20.10.28. Rather more than two years later a relapse occurred and January 1931 saw the return of the patient to the settlement for treatment. Redischarged in 1932, the patient left as a disease arrested case.

Result: Disease arrested.
Relapse.
Disease finally arrested after a further year of treatment.

A_1B_2. (Moderately advanced mixed).

N.R. a postal clerk, aged 32, was admitted on 2.8.26 with advanced face lesions and anaesthesia of the left arm. Scabies was well marked. Lesion and nasal smears were positive but serological tests of blood negative. Three years and two months of treatment procured a symptom free dismissal on 29.10.29. At two years patient was still symptom free.

Note. This patient could not be followed up so fully as the others owing to his death from acute nephritis early in 1932.

Result: Disease arrested. Final observation not possible owing to death from intercurrent nephritis.

A_1B_2.

J.M. a housewife, 26 years, came in on 9.7.28 with nodular leprosy of the face and nerve signs on the left leg. She had infection also by ascaris lumbricoides. Lesion smears were positive. Other laboratory findings negative. One and a half years of uninterrupted treatment with good progress made symptom free dismissal possible on 8.12.29. At three years disease arrested.

Result: Disease arrested.

$A_{1+}B_{2}$. (Fairly advanced mixed case).

K.S. a farmer, aged 26, came to the Settlement on 7.12.26, with infiltration of the cheeks and anaesthesia of both legs. He was in addition luetic, as was evidenced by positivity of Wassermann and Kahn reactions of the blood. Lesion smears were positive. Three years and two months' treatment was required, progress being slow until the Wassermann reaction was reverted. Dismissal came on 4.2.30 with slight permanent anaesthesia of left foot. Almost three years later, disease arrested.

Result: Disease arrested.
Slight permanent anaesthesia.

CONCLUSIONS.

1. By the employment of Hydnocarpus ester treatment, cases of Leprosy, other than those of A_2 type, may be brought to the disease arrested condition and discharged as such.

2. Potassium iodide is a valuable provocative in testing for efficacy of treatment as a preliminary to dismissal of patients. It must be used with caution in tuberculous subjects.

3. Lepers who are in addition syphilitic show retarded progress until the blood Wassermann reaction has been rendered negative by antiluetic treatment.

4. Avenyl, soluble in Hydnocarpus oil, is a remedy of sovereign value in the treatment of syphilised lepers.

5. The effective attack of the leprosy problem demands the foundation of a Central Institution in which severe cases would be resident patients, and in which the less afflicted, by industry and tillage, might support themselves besides providing a small financial surplus to assist in maintenance of the undertaking.

6. The Central Institution or Settlement requires, for its efficient functioning, the establishment of out-patient clinics under the control of, and staffed by, the physicians of the parent centre.

7. Antileprosy propaganda should endeavour to point the fact that not all forms of the disease are infective and that employment of disease-arrested lepers may be supported without fear of personal or other risk. Leprosy should be described as a curable, and not as a hopeless, malady.

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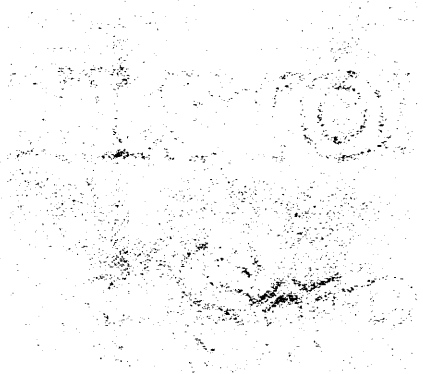


1. Panoramic View of Lady Willingdon Leper Settlement.

2. General View of the Settlement.
The Side for Male Patients.

3. General View. The Side for
Female Patients.

4. A Typical Settlement House. Each house accommodates six persons and has in the centre an open court-yard which may be seen in the photograph.

5. A Typical House in the Married Quarters for Anglo-Indian Patients.

6. The "Clean Home". Untainted children and those rendered symptom free by treatment in the Settlement are boarded here.

7. Religious Observance in the Settlement. The Hindu Temple.

8. The Mosque for Mohammedans.

9. The Recreation Hall. The religious Services for Christians are conducted in this hall.

10. The Injection Block. All patients parade here twice weekly for the systematic treatment. A Dispensary for minor ailments was also conducted in this building.

11. The Hospital for acute illness, and for the bed-ridden.

12. The Framework of the Infectious Diseases Hospital. Easily assembled when it was desired to employ the hospital, the covering was of thatch. See p. 26.

13. Interior View of Laboratory with native helpers at work.

14. Esters forming in sunlight outside the laboratory.

15. A native injector at work. Alepol is in process of administration, and its inverted container may be seen on a stand to the left of the photograph.

16. The Industrial Sheds in which occupational therapy is undertaken.

17. Interior View of the Industrial Sheds.

18. Industrial Therapy. Lepers clearing scrub in the jungle outside the Settlement.

1.

2.

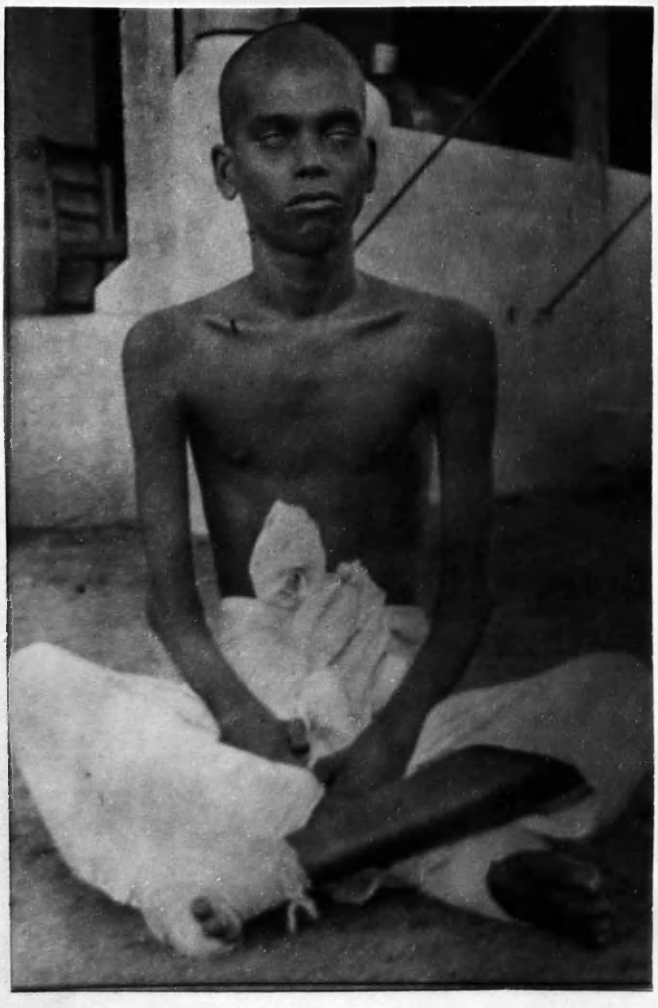
3.

19. Serial photographs of a case under treatment to show the effect of ester therapy.

20. Cutaneous Leprosy of Nodular Type.

21. Advanced Mixed Leprosy.

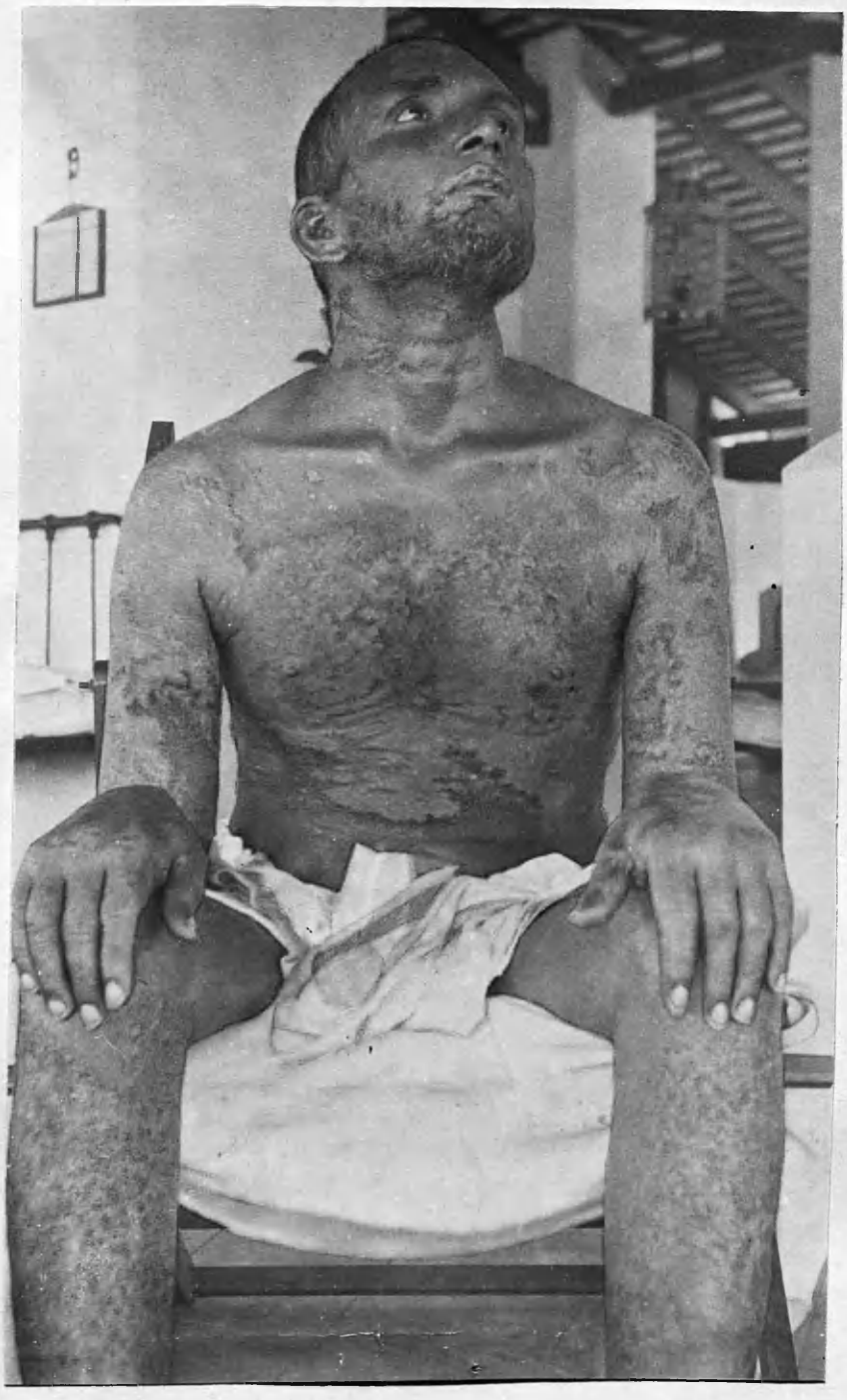
22. Characteristic Nerve Leprosy. Paralysis of orbicularis oris



23. Characteristic Nerve Leprosy. Paralysis of orbiculares palpebrarum, producing inability to close eyes completely.

24. A classic case of thickening of the greater auricular nerve.

25. Very Early Nerve Leprosy. The initial skin lesion, a depigmented patch, was also anaesthetic and is indicated in the photograph by the arrow.



26. The Lepra Reaction. Exacerbation of the erythematous lesions was produced.