

Thesis

ON
Leprosy.

With special reference to its

Prognosis, Treatment and Prevention

by

Robert G. Cochrane

M.R.C.S. (ENG), M.B., Ch.B. (GLAS), M.R.C.P. (LOND)

D.T.M. & H. (ENG).

ProQuest Number:27660801

All rights reserved

INFORMATION TO ALL USERS

The quality of this reproduction is dependent upon the quality of the copy submitted.

In the unlikely event that the author did not send a complete manuscript and there are missing pages, these will be noted. Also, if material had to be removed, a note will indicate the deletion.



ProQuest 27660801

Published by ProQuest LLC (2019). Copyright of the Dissertation is held by the Author.

All rights reserved.

This work is protected against unauthorized copying under Title 17, United States Code
Microform Edition © ProQuest LLC.

ProQuest LLC.
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106 – 1346

L E P R O S Y

With special reference to its Prognosis, Treatment and Prevention.

INTRODUCTION.

As a result of a two year's tour of investigation for the Mission to Lepers, the writer has had the unique experience of visiting all the most important centres for the treatment of leprosy in India, Burma, Siam, Borneo and the Philippine Islands. During this period over 10,000 cases of leprosy, in all stages, have been examined and advice as to treatment, etc., has been given.

In such a tour an unprecedented opportunity has been afforded to see the results of the latest methods of treatment, and to meet and in some cases work with some of the foremost leprologists of the day.

It is felt that one of the chief stumbling-blocks towards advance in the field of leprosy is the isolation of many of the workers. Because of such isolation, statements are continually being made which may be perfectly true when applied to a part of the subject, but do not bear investigation when related to the whole.

The object, then, of this Thesis is to bring the whole subject under review, correlating where possible the different views held at the present time and attempting to point out the reasons for certain deep-rooted differences of opinion. The need for such an attempt is manifest when one comes into touch with many authorities and as many different opinions. In such a vast problem, effecting almost every country in the world, it is

imperative that workers should view the problem in its right perspective.

In this Thesis I shall first refer to the history of the disease, its aetiology and diagnosis, and then deal in greater length with the main part of my theme, the Prognosis, Treatment and Prevention of this malady.

HISTORY.

"La lèpre est une affection aussi vieille que le monde", stated a French authority very truthfully. ⁽¹⁾ In the Croonian Lectures of the Royal College of Physicians in 1924, ⁽²⁾ Sir Leonard Rogers has given an excellent summary of the present views as to the origin of the disease. With regard to the origin of leprosy, tradition has it that the cradle of leprosy is to be found in the upper reaches of the Nile, for Lucretius in his *de Natura Rerum* makes reference to the birth of the disease:-

"High up the Nile midst Egypt's Central plane
Spring the dread leprosy and there alone." ⁽³⁾

Rogers states in the Croonian Lectures - "that Munro in articles in the *Edinburgh Medical Journal* 1877-79 refers to an Egyptian record of 1350 B.C. of leprosy among negro slaves from the Sudan and Dafur, which is interesting in view of the present high rates in Central Africa." "The first reliable records of its (i.e. leprosy) spread relate to the invasion of Europe through Greece about 350 B.C., probably by the armies of Darius, while those of Pompey carried it to Rome in 62 B.C. Galen mentions it in Germany in 180 B.C., and it had spread all over Western Europe by the 9th century." This is of interest because there is a wide-spread belief that leprosy was

Ref. 1. "Lepra", Vol. III p.39.

2. "Annals of Tropical Medicine & Parasitology." Vol. XVIII p.267.

3. "Text Book on Diseases of the Skin." Wilson, 1898.

introduced into Europe by the return of the Crusaders. Undoubtedly leprosy greatly increased during the 11th - 13th centuries. After the Black Death (1348) the disease gradually died out, and as Monro points out this was largely due to the measures for the segregation of lepers that were enforced. It is in just those countries that neglected strict segregation that leprosy still lingers, such as Scandinavia, the Baltic States, Turkey and Greece. With regard to the spread of leprosy, Rogers continues - "While the disease was declining in Europe, it was carried to the Western Hemisphere by the Spanish and Portuguese invaders, and later by extensive negro slave trade from the very parts of Central Africa which still show the highest leprosy rates."⁽¹⁾ All evidence seems to show that the aboriginal Indians were free from leprosy. The Chinese Nation has played a prominent part in the spread of the disease and the outbreaks of leprosy in the Pacific Islands and Hawaii, according to Jeanselme, were the result of the introduction of leprosy by such immigrants.⁽²⁾ The latter authority brings forth a considerable amount of evidence to show that leprosy was introduced into Burma, Siam and the whole of Malay and the Malay Archipeligo, by the Chinese, but at the same time he emphasises the commercial and economic value of the Chinese; the prosperity of the larger towns solely depending on their enterprise (toutes les transactions commerciales son concentrées dans la main des Chinois, ce sont ceux qui font la prospérité des grandes villes de l'Extrême-Orient qui sont les intermédiares indispensables entre les indigènes et les colons Européens).⁽³⁾ Jeanselme continues - "Depuis des siècles un important courant d'émigration s'est établi de la côté Chinoise

Ref. 1. "Annals of Tropical Medicine and Parasitology." Vol. XVIII p.268.

2. "Annals of Tropical Medicine & Parasitology." Vol. XVIII p.268.

3. "Lepra", Vol. III p.188.

Jeanselme "Les Courants d'emigration et l'expansion de la lepre". (Gazette des hopitaux 19 Avril 1902).

vers l'archipel indo-malais où de nombreux coolies Chinois travaillent dans les plantations et dans les mines de Java, de Sumatra, et le Bornéo. Or de l'avis des observateurs, autorisés l'établissement de tout nouveau centre Chinois est suivi à brève échéance de l'apparition ou de la recrudescence de la lèpre dans la région."(1)

Such statements as Jeanselme makes with regard to the importance of the Chinese in the spread of leprosy was forcibly impressed upon me in my travels in Malaya and Borneo. Everywhere the preponderance of Chinese lepers was striking. The same statement can be made with equal truth with regard to the lepers of that cosmopolitan town of Bangkok. The importance of taking cognisance of this fact was emphasised in a report I presented to the Government of British North Borneo in January 1926, in which I stated "that there are continually entering into the country lepers who should be discovered. It is suggested that all immigrants, especially Chinese, should be put into a detention camp for 24 hours where a thorough inspection could be carried out before they were allowed to land. Estate coolies are examined again separately and therefore in their case this should not be necessary. All Medical Officers who examine estate coolies should be advised as to the importance of examining for this disease."

It is seen therefore that the chief centres from which leprosy spread are in those very countries where the incidence of the disease is highest, viz. - Africa (especially the equatorial belt from W. - E.), China (particularly the S.W. Provinces of Kwantung and Fukien) and to a less extent India.

Ref. 1. "Lepra", Vol. III p.189.

Jeanselme "Les Courants d'emigration et l'expansion de la lèpre." (Gazette des hopitaux 19 Avril 1902).

AETIOLOGY.

In 1874 Hansen discovered a bacillus, which ultimately was accepted as the causal organism of the disease. The bacillus of leprosy is classified in the same group as the other acid-fast bacilli, namely the group of mycobacterium. The group may be considered to consist of the micro-organisms causing tuberculous disease in human beings, cattle, horses, birds, etc. A sub-division of this group embraces several acid-fast germs which are present in diseased tissue in enormous numbers and are extremely difficult to differentiate in artificial culture. In this sub-division is included the mycobacterium leprae and the mycobacterium rodentium. Many attempts have been made to cultivate the leprosy bacillus, but up to the present time none of the many organisms cultivated have been proved to be mycobacterium leprae. Kedroski, Clegg, Rost, Williams, Duval and Bayon, have all thought that they had succeeded in cultivating the organism, but in the majority of cases their claims have not been substantiated. Fraser and Fletcher⁽¹⁾ in an exhaustive paper give evidence that the acid-fast bacilli which have been isolated are contaminations and conclude that "they had consistently failed to obtain a culture of leper bacilli."

In smears the mycobacterium leprae shows a pleomorphic form. The typical form is a uniformly staining straight or slightly curved rod from 1 micron to 8 microns long. In addition, one frequently sees small fine granules which are not as acid-proof as the rest of the bacterium; at times peculiar hyaline breaks can be detected in the rods. Not infrequently the

Ref. Fraser & Fletcher. "Bacillus Leprae - Has it been cultivated?" Lancet
Vol. II, p.918. Sept. 1913.

bacillus is broken up into small coccoid bodies, and sometimes the longer forms are seen with one end tapering and the other thickened or club-like. Various explanations have been put forward to explain these appearances. Some consider that the granules and the breaking-up of the rod-like bacilli into the coccoid form are signs of degeneration; others consider that such appearances are evidences of spore formation. It is to be noted that in the lesions which are not progressive, and in those patients where the disease is diminishing under treatment, the bacilli is more pleomorphic than in those conditions in which there are signs of active spread and multiplication of the bacilli.

The transmission of the disease from man to lower animals has been equally unsuccessful, nothing more than local lesions at the site of inoculations appearing. The analogous disease in rats is not transmissible to man. There is one instance on record where Marchoux⁽¹⁾ inoculated a rabbit, a guinea-pig and six rats with an emulsion of spleen pulp from a leper and five rats became infected. In another instance, the same worker reports a series of investigations in which he isolated from a Haitian⁽²⁾ an acid-fast bacilli differing from *M.B. leprae*, and named it *M.B. pulviforme*. As he was able to infect rats with injections from the spleen pulp of the case, he suggested that this might be an example of rat leprosy occurring in a human being.⁽³⁾ Apart from this scanty evidence there is no proof that human leprosy can be transmitted to rats or vice versa, although the two diseases bear a close relationship.

- Ref. 1. Marchoux. Tropical Diseases Bulletin Vol. XXII p.213.
 2. Idem. Ibid. Vol. XVIII p.407.
 3. Idem. Ibid. Vol. XX p.825.

THE THEORY OF CONTAGION.

Leprosy, because of its slow, mutilating course, has been looked upon with special loathing all down the ages. Innumerable hypotheses have been put forward to explain its occurrence. From the earliest times the leper has been secluded from his fellow men, not always so much from fear of contagion, but sometimes from the conviction that leprosy was a punishment inflicted by Diety. Underlying all the early beliefs with regard to the transmission of leprosy, it was the thought that in some way the infection could be passed on from one individual to another; that is, the theory of the contagiousness of leprosy crept into man's thinking very early. The early Biblical writings contain elaborate instructions with regard to the segregation of lepers and from a perusal of these accounts there is no doubt that the patriarchs were convinced of the communicability of the disease.

In the early middle ages the danger of contagion was prominent, as shown by a Writ of Edward VI directed to the Sheriff of Essex.⁽¹⁾ "Whereas we have heard that Johanna Nightingale is a leper and is commonly holding intercourse with the people of the aforesaid county and mingles with them both in public and private places to the grievous injury and the manifest peril of the aforesaid inhabitants, etc." If the diagnosis of leprosy was made, the leper underwent a gruesome ceremony, the significance of which was that the leper was dead to the world, and as such could no longer claim the rights of citizenship. At the close of the ceremony, which was a religious one, the priest addressed the leper in these words - "While you

Ref. 1. Charles Mercier. "Leprosy Houses & Mediaeval Hospitals." Glasgow Medical Journal Jan. 1915. p.7.

are diseased you will enter no house, no inn, no forge, no mill, nor in the common well or fountain will you drink water, or wash your clothes. You will not eat except by yourself or with other lepers. You will enter no church during service, you will mingle with no crowd. When you speak to anyone you will stand to leeward. You will always use your gloves and will touch no rope without them. You will touch no child, not even your own, and you will return to your cabin every night!" Thus we see in the minute precautions taken to protect the public in the middle ages that there must have been a conviction that leprosy was in some way a transmissible disease.

The theory of the contagiousness of leprosy has been held almost universally except for a short period in the 19th century, when that of heredity gained sudden prominence as a result of a book published by Danielson and Boeck in 1898, but as Rogers points out⁽¹⁾ their theory was based on inconclusive evidence. About the same period (1863) Hutchinson entered the lists as an anti-contagionist and propounded the "Fish" theory of leprosy, claiming an aetiological relationship between leprosy and the eating of badly cured fish, or of food contaminated by a leper. The latter theory need not be considered seriously as it has no exponents at the present time. During the same decade, a Commission of the Royal College of Physicians made the following pronouncement - "that leprosy was not contagious or communicable", but in 1876 Hansen, and in the next decade, many French authorities refuted the hereditary theory. With the exception of the Indian Leprosy Commission of 1891, whose influence was counteracted by Vandyke Carter in his classic book "Leprosy and Elephantiasis",⁽²⁾ the leprosy conferences

Ref. 1. Sir Leonard Rogers. "The Spread and Probably mode of infection and Prophylaxis of Leprosy." British Medical Journal, June 1922. p.987.

2. Vandyke Carter. "Leprosy & Elephantiasis ." (1871)

of the last three decades have supported the infectiousness of leprosy. Therefore, whatever the other aetiological factors are, one of the most important ones is close and prolonged contact and in support of this Rogers stated, with regard to the analysis of a series of cases, "We find at least 70% of the infections took place as a result of living in the same house with a leper, usually for a considerable time", once more emphasising the fact that long and close contact with a leper commonly precedes infection.⁽¹⁾

In the vast majority of cases admitted into the Purulia Leper Home (Bihar, India) a history of close contact can be obtained, but I am unable to give definite figures. The following cases illustrate the importance of contact:-

1. Female (age about 35) who had never been abroad, contracted leprosy. This woman's husband had been in the East and there acquired leprosy.

The patient came into intimate contact with her husband over a period of some years. A year after her husband's death she noticed a raised patch on her arm and then a few months later a macular eruption appeared and along with this numerous vesicles. The patient was examined and the diagnosis of leprosy made.

Abraham, in Allbutt's System of Medicine, relates the following two cases illustrating the acquirement of leprosy through contagion:- (2)

(A) "An Irish soldier returned from India with fully developed leprosy. For a year and a half his brother slept in the same bed with him and wore the leper's clothes after the latter's death. Three years later this brother, who had never been out of the United Kingdom, manifested leprosy and died of it."

- Ref. 1. Sir Leonard Rogers. Annals of Tropical Medicine & Parasitology. Vol. XVIII 1924. p.284.
 2. Phineas S. Abraham. "Leprosy". System of Medicines (Allbut & Rolleston) Vol. II, Part II, pp.666-657.

(B) "A man suffering from leprosy acquired in Tonkin died at Strassburg in 1904. In 1902, his nephew, aged 19, who had never resided out of Urbach, a leprosy free area, presented himself at the clinic with leprosy. His uncle had lived in close association with the lad for two months."

These cases are illustrative of the importance of close contact, as the only possible source of infection were known relatives. There was no chance of any other means of infection, for the patients had never been in an endemic area; therefore the acquirement of the disease by means other than contagion are eliminated in these cases.

While convinced that one of the main etiological factors in the acquirement of leprosy is close and prolonged contact, yet the following cases, which have occurred in my own experience, tend to show that contact is not the only etiological factor in the transmission of leprosy. In two of the cases about to be recorded the disease was acquired in absence of evidence of contact. In the other two cases, although contact of prolonged nature was recorded, yet the disease did not develop.

Case I. In a certain oriental town I was asked to see a case in consultation. The history given was that the doctor, who was a friend of the patient, noticed that his friend's face was blotchy and that his eyebrows and ears showed marked signs of thickening. The doctor, having suspicions, advised him to undergo a special examination. When I saw the patient I noticed his face, especially his eyebrows, were thickened as a result of raised infiltrated patches, and that the lobes of the ears were enlarged; in addition he had both isolated and coalescing macules on his back and an

area anaesthetic to superficial touch about two square inches on the posterior aspect of the arm near the elbow. The case presented all the characters of well-advanced skin leprosy, and the diagnosis was subsequently confirmed by bacteriological examination. The patient was a European and the director of a commercial concern; as can be gathered from his position he was an intelligent individual. The patient could trace no source from where he could have acquired the disease. The only history having any bearing on the present illness was that twelve months previously the patient had an accident while motor-cycling and grazed his arm, and it was at the site of the old injury that he noticed the first lesion. In addition, the patient said he had been in a poor state of health for over a year.

CASE II. An educated Anglo-Indian woman presented herself for examination because of a patch on her left arm; this proved to be a typical depigmented patch of early nerve leprosy. The only history of importance was that twelve months ago she had an attack of Kala-azar and six months after, when she was debilitated by this disease, the signs of leprosy appeared. She attributed the infection to an insect bite of great severity, because it was about six months after that the lesion appeared at the site of the bite.

CASE III. While examining a batch of lepers which were being transferred to the institution I was inspecting, I came across an elderly blind Indian, age about 50, who had extensive leucoderma. He had been sent to a neighbouring leper asylum as suffering from White Leprosy - a term applied to leucoderma in India, and had been in the institution for over three years. In addition, he was very anaemic, as a result of ankylostomiasis. During all

the time he was in the aylum he came into contact with very infective cases of leprosy, and because of his physical infirmity was utterly dependent on them, yet I could detect no signs of the disease and discharged him. He was subsequently sent to an institution for the Blind.

CASE IVX. While I was making a routine examination of all the inmates of a certain leper Home, I came across a woman who did the cleaning work in the institution. About a year previously, she had come to the asylum with her husband, who was an advanced nodular leper, and was in a dying condition. This woman had for some years lived with her husband who was a very infective case. Since the death of her husband she has been provided with separate quarters, but carries on her work in the Home, coming into contact with all the leper women of the institution. When examined, the woman appeared to be healthy, and I could find no evidence of leprosy.

In view of these cases and many others, where prolonged contact has not resulted in infection, there must be other etiological factors to consider.

AGE.

For many years controversy centred round the question of the possibility of the heredity of leprosy, but as a result of the mass of evidence that has accumulated, the conclusion generally maintained is that the disease is not hereditary in the ordinary sense of the term. The evidence gathered in the Homes for the Untainted Children of lepers of the Mission to Lepers in India and the East, proves conclusively, if further evidence was needed, that, Provided a child is separated from its parents at an early age, it should

not acquire leprosy. This is the more remarkable for workers in the Philippines have recently demonstrated that, in a certain percentage of cases (about 26%) the mycobacterium leprae can be found in the umbilical cord of the infant, and in the placenta of the mother.⁽¹⁾ While the disease is not hereditary and has not been proved to be congenital, yet evidence clearly shows that the age of incidence is an important etiological factor. Vandyke Carter, as long ago as 1871, laid stress on the importance of the age of the individual, and the following table reproduced from his book lends support to this view.⁽²⁾

Age at commencement of leprosy.	Male (%)	Females (%)
From birth to 10	4.7.	20.0
" " " 20	26.7	29.3
" " " 30	33.9	17.2
" " " 40	20.8	17.2
" " " 50	9.4	3.4
" " " 60	4.1	1.7

From an analysis of over a thousand cases McCoy gives the following figures:-⁽³⁾

Age	1-5,	6-10,	11-15,	16-20,	21-25,	26-30,	31-35,	36-40,	41-45
No. of Cases	8	56	163	204	143	114	78	89	44
Age	46-50,	51-55,	56-60,	61-65,	66-70,	71-75,	76-80,	81-85	
No. of Cases	28	41	26	18	18	3	3	1	

Such figures support the statement that "after the first year the susceptibility of children increases very greatly, and between the ages of three and twenty this susceptibility is comparatively great. After 20 the body becomes less susceptible."⁽⁴⁾

- Ref. 1. Rodriguez. "Early Leprosy in Children of Lepers." Philippine Journal of Science, Vol. XXXI, No. 2. Nov. 1926. p.125.
2. Vandyke Carter. "Leprosy and Elephantiasis." 1871. p.152.
3. McCoy. "Practice of Medicine in the Tropics". Byam & Archibald, Vol. II. p.1167.
4. Robt. G. Cochrane. "Leprosy with special reference to Prognosis." R.A.M.C. Journal, Dec. 1926. p.423.

In this connection I would point out that figures up to the age of 30 are reliable, but after that age they cannot be relied on, for all have had experience of lesions persisting unaltered for 10, 20, or even in one case in my own experience, for 40 years. I have never been satisfied in the cases I have seen and examined that an individual has acquired the disease after the age of 50.

Pre-disposing Factors.

In all chronic diseases the natural bodily resistance plays a greater part in resisting infection than it does in acute diseases. In taking histories of lepers, one is constantly struck with the importance of such factors as syphilis, chronic malaria, un-hygienic living, etc. In fact, lowered bodily resistance, next to close contact, seems to be one of the most constant etiological factors. The following cases met with in my own experience illustrate the importance of such factors.

CASE V. A patient was diagnosed as a nodular leper. The history was that some years previously she had attended a relative of hers who was a leper. She remained healthy for three years; at the end of this time she became pregnant, and after the termination of her pregnancy, she developed leprosy.

CASE VI. A well-to-do Indian gentleman asked me to see him with regard to his disease. He told me he had been treated for leprosy for some six months. The patient was extremely obese, took no exercise and as he was wealthy, he scarcely moved hand or foot to help himself. In addition, there was a history of sexual and other excesses. No history of actual contact with lepers was elicited.

CASE VII. A student was admitted to one of the Homes of the Mission to Lepers as a paying patient, and stated that his disease developed during a period in which he had chronic malaria. The patient was a well-marked case of nodular leprosy and could give no evidence of contact with lepers.

In this connection Muir states "Many facts might be quoted to prove that healthy human beings, like the lower animals, are insusceptible to leprosy, that although the bacilli may be present in the body, some predisposing cause is necessary before they can begin to increase in numbers and produce signs." The same authority quotes a case of leprosy developing during convalescence in enteric fever, and "as the patient recovered her strength the patches began to fade in colour and became flattened out to the level of the surrounding skin."⁽¹⁾

In the light of such evidence it must be concluded that any lowering of resistance by disease, pregnancy or un-natural living are important etiological factors.

METHODS OF DISTRIBUTION OF THE MYCOBACTERIUM LEPRAE.

Workers have endeavoured to demonstrate that the mycobacterium leprae exists in the earth in the vicinity of the dwellings of lepers, but there is no conclusive evidence that this is a source of infection. Kaurin, after numerous experiments, failed to find the bacillus in the earth or in the dust and air of rooms inhabited by lepers. At the Almora Leper Asylum the Leprosy Commissioners (Indian Commission 1891) obtained 100 cover glass preparations from earth taken from the banks and paths on which the lepers

Ref. 1. Muir. The Predisposing Cause of Leprosy. Lancet, Jan. 24th, 1925. pp. 169-171.

were in the habit of sitting and walking. In seven of the preparations only were bacilli found and the number of those found were ten. At Tarn Taran Asylum 450 similar specimens were taken, but no bacilli were found. Water from tanks in Bombay in which lepers bathed also gave negative results.⁽¹⁾ Muir concludes from clinical evidence that the bacilli may enter the skin through wounds of the feet; the bacilli presumably being in the ground. He also cites a case where he concludes that the bacilli entered through the skin of the knee, as the result of coming into contact with floor-matting which had previously been used by a leper. No experiments were done to prove the existence of bacilli in such situations.⁽²⁾ Workers have not been able to bring forth evidence of the existence of the *mycobacterium leprae* in food. There has been a great deal of work done on the possibility of the disease being spread by insects and investigators have succeeded in a few cases in finding the bacilli in flies; occasionally in the mosquito, more often in the bed-bug. Leboeuf⁽³⁾ concludes that the transmission of the disease may occur through infected flies depositing their faeces on the nasal orifices or on cutaneous wounds. Rogers summarizes the statistics of bed-bug infection and gives the following figures:-⁽⁴⁾

Total bed-bugs fed on lepers	302
Number of Positive results	30 or 9.9%
Total bed-bugs caught on, or in beds of lepers	566
Number of Positive results	5 or .88%

The evidence with regard to intradermal parasites is more conclusive.

- Ref. 1. P. Abraham. "Leprosy". Albutt's System of Medicine. Vol. II Part II, pp. 669, 670.
2. Muir. "The Spread of Leprosy throughout the Body." Indian Journal of Medical Research Vol. II, 1923-24. pp. 244-249.
3. Leboeuf. "Dissemination du Bacille de Hansen par la Mouche domestique." Bull. Soc. Path. Exot. 1912. Vol. V, No. 10, pp. 860-868. (Abstract Tropical Diseases Bulletin Vol. I, p.558.)
4. Rogers & Muir. "Leprosy". p. 99.



Early depigmented patches.

A.B.C. Sites of old scabies scars.

(Dr. Rodriguez's case.
Kindly supplied by
Dr. Wade of Culion)

Scabies is a common infection of lepers and one can readily understand the infection being carried from an infective leper by means of the acarus scabei, the parasite carrying into the skin a comparatively large number of bacilli. In this connection it is interesting to note that the Siamese have a saying with regard to leprosy, that a leper is ordinarily not infective, but people must beware of a leper infected with scabies. Much evidence has been published on this subject; recently Rodriguez reported three cases where there was evidence of the initial lesion being at the site of a scabies scar, and concluded that mites may become bearers of a sufficiently large number of bacilli to determine an infection in a new host.⁽¹⁾ In CASE III related in this paper there seems to be evidence of transmission by an insect bite. The conclusion come to is that either as a result of abrasions set up in consequence of scratching after an insect bite, or the carrying of bacilli into the skin by such parasites, as the acarus in certain instances, the disease may be transmitted by such means.

Having discussed the possible methods of distribution of the organism in the external environment, one must now review the possible sites of distribution of the disease from an infected leper. It has been proved without doubt that the nasal discharges of lepers suffering from skin leprosy contain the bacilli in large numbers. In addition, any ulcerated surfaces from such cases are highly dangerous. The bacilli have not been definitely isolated in the faeces, and the Philippine workers state that they have never seen lesions in the intestine, and therefore the possibility of the bacilli passing out in

Ref. Jose Rodriguez. Early Lesions in Children. Philippine Journal of Science No. 1926.

the faeces is remote. Cases have been reported where the bacilli have been found in the vaginal discharges. In one case in my own experience I found groups of acid-fast bacilli in a smear from a swab taken high up in the Vagina in a young un-married leper girl. The seminal discharges frequently contain large numbers of bacilli and the penis is not infrequently the site of cutaneous lesions.

While there are still factors in the etiology of the disease that have not been elicited, the chief factor seems to be close and prolonged contact with lepers who are discharging the bacilli from their bodies. In the absence of such prolonged contact, children and young adults, and those whose resistance has been lowered by disease, or un-hygienic living, seem to be in the greatest danger of acquiring the disease. One must conclude that sexual intercourse with lepers plays a part in the etiology of the disease, for the contact involved is of the closest; and secondly, syphilis, one of the strongest pre-disposing causes, may be transmitted by such means.

Transmission of the disease by water, food and contaminated soil cannot be definitely excluded. There is little direct evidence of insect vectors, yet in susceptible individuals such means of transmission cannot be ignored. It can be stated, however, that a healthy man, provided he does not come into close contact with the disease, should not acquire leprosy; but if an individual's resistance is lowered by ill health or by any other means, a small invasion of bacilli from any source may be the starting-point of the infection. Workers have shown that in some cases the bacilli can be found in the fluid aspirated from lymph nodes of healthy contacts. It is legitimate

to conclude, I think, that the mycobacterium leprae may lie latent in some tissue space or lymphatic gland, and if at any future date the health of the patient is lowered, the disease may then manifest itself. This, then, is a possible explanation of the long incubation period of the disease, which may extend from a period of three to six months⁽¹⁾ or to as long as forty years.⁽²⁾

The methods of dissemination of the mycobacterium leprae have been discussed and the possible sources of entrance into the human body reviewed. The question that now arises is how is the infection disseminated in the human body?

Methods of spread throughout the body.

Much evidence has accumulated in support of the theory that leprosy commences locally by the introduction of the bacilli through an abraded area of the skin and that the nerves supplying this area are affected as a result of an ascending infection. This theory was first propounded by Dehio and has recently been emphasised by Muir, who states "that the bacilli pass up the afferent nerve endings inside the sheath of Henle."⁽³⁾

In support of the statement that leprosy commences as a local lesion at the site of infection, Rodriguez⁽⁴⁾, from a study of the early lesions of leprosy in children, concludes that such a mode of onset is common and says "that as a result of my own observations among children I am inclined to believe that a primary lesion was present in the majority of the children (75%) who have become definitely leprous." In a large number of cases in India there is a definite history of an initial local lesion, this lesion showing

- Ref.1. Rogers (Sir L.) "Incubation period of Leprosy." Indian Medical Gazette, 1924. Feb. Vol. 59, No. 2, pp. 65-68.
2. Walker (Sir Norman). "A Case of Leprosy treated by a Vaccine prepared from a nodule from the patient's arm." Lancet, 1924. Sept. 13. pp. 542-543.
3. Muir. "The Spread of Leprosy throughout the Body." Indian Journal of Medical Research. Vol. II, 1923. p.251.
4. Rodriguez. "Early Leprosy in Children". Philippine Journal of Science, Vol. XXXI, No. 2, Oct. 1926. p.135.

itself most frequently as a depigmented patch, but in some instances as an area of anaesthesia, or both depigmentation and anaesthesia may be associated together. From the initial lesion the disease may spread to the nerves by an ascending infection, to the skin by lymphatics, or become generalised by being disseminated by the lymphatic stream, or by entering the general circulation via the blood stream.

It is known that certain diseases affect the nervous system through the perineural lymphatics, viz. the poliomyelitic group of diseases. The explanation that this is the route of infection in leprosy is not generally recognised. It is, however, accepted that the peripheral nerve tissue is the most susceptible to the attack of the *mycobacterium leprae*. The may, of course, be attacked through the general lymph stream, the initial focus being in some lymph node. Marchoud and others have brought forth evidence that the *mycobacterium leprae* can be isolated from the lymph nodes of seemingly healthy contacts. While it is usual to obtain the history of an initial lesion in cases in India, yet in the Philippine Islands it is not unusual to find that the first clinical signs of the disease are multiple raised red bacillus-bearing patches. Trauma or some other cause which produces a devitalization of the tissues may be the determining factor in the appearance of the clinical lesion.

As has been stated, the peripheral nerves seem to be the most susceptible to the attack of the *mycobacterium leprae*. It is only when the bacilli have multiplied in large numbers that the skin becomes attacked.



1. Marked enlargement of nerve of advanced leprosy.
(Left)
2. Atrophic fibrous nerve-cord in so called "burnt-out"
(naturally arrested) case.
- 3) Show bilateral abscess formation.
- 4) (Lepra-reaction).

Kindly supplied by Dr. Wade
of Culion.

LESIONS IN LEPROSY.

(a) Lesion in the Nerves. The lesions in the nerves in leprosy consist of a perineuritis. The nerve cord becomes first thickened and swollen and the nerve strands are separated and embedded in leprosy granulation tissue. The bacilli can be easily demonstrated in the affected nerves. The pressure of the leprosy granulation tissue leads to a pressure-atrophy of the nerve bundles; the first to be affected are the sensory fibres. If the disease continues the motor fibres also become affected; ultimately the whole nerve is destroyed. The destruction of the nerve is a gradual process, and it is interesting to note that it is epicritic sensibility which is first lost. The sensations disappear in the following order:- 1. Fine temperature sense and sensations to slight pain (pin-pricks). 2. Fine superficial touch sense. 3. Gross pain and temperature sense. 4. Loss of deep pressure sense. Joint sense is lost very late in the disease, if at all.

In the early stages, if the disease is efficiently treated, the nerve fibres regenerate, and regeneration follows the course that has been described by Head & Rivers after section of a peripheral nerve. If, however, the disease is untreated, the presence of the leprosy granulation tissue leads to excessive fibrous tissue formation, which in the process of contraction completely destroys the nerve, leaving a thin, hard, whip-like cord, which on examination is found to consist largely of fibrous tissue, with little or no nerve tissue; at this state bacilli cannot be demonstrated.

(b) Skin Lesions. The *mycobacterium leprae* is found in the corium.

The type of lesion varies with the layer in which the bacilli are situated; that is, whether the lesion is in (1) the Papillary layer, (2) Interfollicularly, or (3) Sub-follicularly. This partly explains why the skin lesions in leprosy are protean in their manifestations.

Nodular leprosy is seen as the result of a severe local re-action, resulting from bacillary emboli being lodged in the capillaries of the corium. At this stage the bacilli can frequently be demonstrated in the blood-stream, especially is this the case during the periodic febrile bouts (lepra reaction.)

(c) Lesions in other organs. In Skin leprosy, especially in the nodular variety, the bacillus can be demonstrated in the lymph-nodes. The leprous granulation tissue is found to occupy the periphery, leaving the sinuses fairly free. The commonest nodes to be affected are the axillary, inguinal and iliac glands. The bacilli can frequently be demonstrated in the mesenteric nodes, and I have isolated them from the peribronchial nodes.

The bacilli can be demonstrated in the liver and spleen in large numbers, but they seldom give rise to a macroscopic lesion.

In the testis the bacilli are found in large numbers, the tubules are separated by leprotic granulation tissue, which is loaded with bacilli. Ultimately extensive fibrosis sets in, destroying the testicle completely. This explains the sterility and impotence of the nodular leper. The bacillus is very rarely found in the ovary.

(d) Lesions in the Lung. I have never seen a lesion in the lung and the Authorities at Cullion, as a result of many thousands of autopsies, deny the presence of such lesions. Four cases have recently been reported,⁽¹⁾ but as

Ref. 1. Muir. "The Spread of Leprosy Throughout the Body." Indian Journal of Medical Research. Vol. II. 1923. p.257.

these cases did not come to autopsy, it is impossible to exclude leprotic ulceration somewhere in the respiratory tract. Such a lesion is common and would explain the presence of leper bacilli in the sputum.

(e) Respiratory Tract. The Trachea is commonly affected in advanced leprosy; the leprous granulation tissue ultimately leads to fibrosis, and not infrequently complete obliteration of the lumen of the trachea results. Lesions in the mouth and nose are extremely common.

(f) Eye Lesions. Bacilli may be present in the cornea, producing a keratitis or a localised nodule. In this situation they may spread to the uveal tract or any other part of the eye. The lesion ultimately leads to complete destruction of the eyeball.

(g) Central Nervous System. The bacilli have been reported in the anterior horn cells of the spinal cord and also in the brain, but any lesions in the central nervous system are pathological curiosities.

COURSE OF LEPROSY.

The usual conception of leprosy is that there are three types - (1) Nerve, (2) Nodular, or Skin leprosy, and (3) Mixed leprosy. Strict adherence to such a classification tends towards erroneous ideas, because the various types of leprosy are dependent, as in most diseases, on the resistance of the body and on the virulence of the invading organism. As the mycobacterium leprae has never been inoculated into animals, there is no criterion of the virulence of the organism. In the untreated individual, the disease follows, in most cases, a typical course, passing through the various stages and slowly proceeding to its final termination, that termination

usually being mutilation and not death. In India, one is impressed by the frequency of an initial lesion first appearing, then seeing the disease pass through the stages commonly known as nerve, or maculo-anaesthetic leprosy, skin, or nodular leprosy, finally, if the disease runs its complete course, and the patient survives, leaving the patient deformed and mutilated, with end results due to nerve destruction; this stage being the secondary nerve or anaesthetic leprosy. The following is a history of a case running such a course.

CASE VIII.* A Siamese girl noticed ten years ago that she had lost the sense of feeling on the outer side of the arm. Some months later raised reddish areas appeared on the back. Her disease now remained stationary for a number of years. At the end of this period the patient had very severe reactions, and a generalised macular eruption appeared all over her body and her face became swollen. This reaction subsided only to occur a few months later. Such reactions continued periodically for a year or two. When I was in Siam I was asked to see the patient. On examination, the maculae were showing signs of resolution, but there was extensive anaesthesia on the ulnar distribution of both hands, and the nerves were thickened considerably. In addition, there was commencing claw-hand. The disease appeared to have passed through the various stages, leaving end results in the ulnar nerve.

While the above course is very frequently seen, yet there are many factors which modify the course.

FACTORS INCREASING THE SEVERITY OF THE DISEASE.

1. Racial susceptibility. In countries such as the Philippine Islands

* The doctor in charge of this case has recently informed me that as a result of the treatment which I suggested while in Siam the disease has almost entirely disappeared.

and the South Sea Islands, where the disease has been introduced comparatively recently, the severe nodular form is much more commonly seen than the highly-resistant nerve form. In such countries a history of an initial lesion is not infrequently absent; many cases give a history of red raised skin lesions appearing as the first sign of the disease.

2. Individual susceptibility. The following case is an example of the disease affecting a seemingly highly susceptible individual.

CASE IX. A domiciled European was sent up to a hospital in India for diagnosis. The patient complained of an eruption which had been present for about six months; it had appeared gradually and he could not state the exact date of onset. The patient had been pursuing his ordinary duties. His health was fairly satisfactory, except for slight lassitude and a few bouts of fever. When examined he was seen to have numerous blebs scattered over the back and arms; the largest were about 1-2" in length, and situated on the outer side of his arms. These blebs were filled with a sero-sanguineous fluid. In addition, there was slight thickening of the lobes of the ear, and the face presented a blotchy appearance. The case was at first thought to be one of multiple skin sarcomata, but the thickening of the ear lobes, the blotchiness of the face, and induration of the eyebrows, made one suspect leprosy. A bleb was ruptured, and the fluid examined for acid-fast organisms. Smears showed the presence of enormous numbers of *mycobacterium leprae*. There were no signs of nerve-involvement, this being a pure skin case.

3. The presence of a pre-disposing disease. The importance of

concomitant disease in the etiology of leprosy has been emphasised. The following case illustrated the modification of the course of leprosy by the presence of chronic malaria.

CASE X. An Indian male noticed his face become swollen and thickened shortly after several attacks of malaria; this was associated with joint pains and periodic febrile attacks; after these bouts of fever nodules appeared. When examined, he presented the typical appearance of nodular leprosy. The remarkable improvement which resulted when his chronic malaria was treated was evidence of the importance of this factor in his case.

FACTORS DIMINISHING THE SEVERITY OF THE DISEASE.

1. Racial Resistance. In countries such as India, Burma and Siam, where leprosy has been endemic for many centuries, the milder pure nerve form is frequently seen. This is presumably due to the acquirement of a certain degree of Racial immunity.

CASE XI. A Siamese male 5 years previously noticed that the fingers of his left hand had become numb; this was associated with tingling sensations down the arm. Later he developed anaesthesia, and as a result of the loss of pain-sense he burnt himself on more than one occasion. Gradually the muscles of his hand became weak and he noticed his fingers contracting. On examination he was found to have complete left-wrist drop associated with complete anaesthesia. The ulnar nerve was thick and cord-like in consistence, indicating that fibrosis had set in. The condition had remained stationary for two years. There were no other signs of the disease.

2. Individual Resistance.

CASE XII. An Indian male employed at a hill Leper institution had a small area of depigmentation, associated with anaesthesia to superficial touch, on the back of the right hand. This lesion had persisted unchanged, as far as the patient knew, for 40 years. There were no other signs of the disease. The case seemed to be one of spontaneous arrest of leprosy.

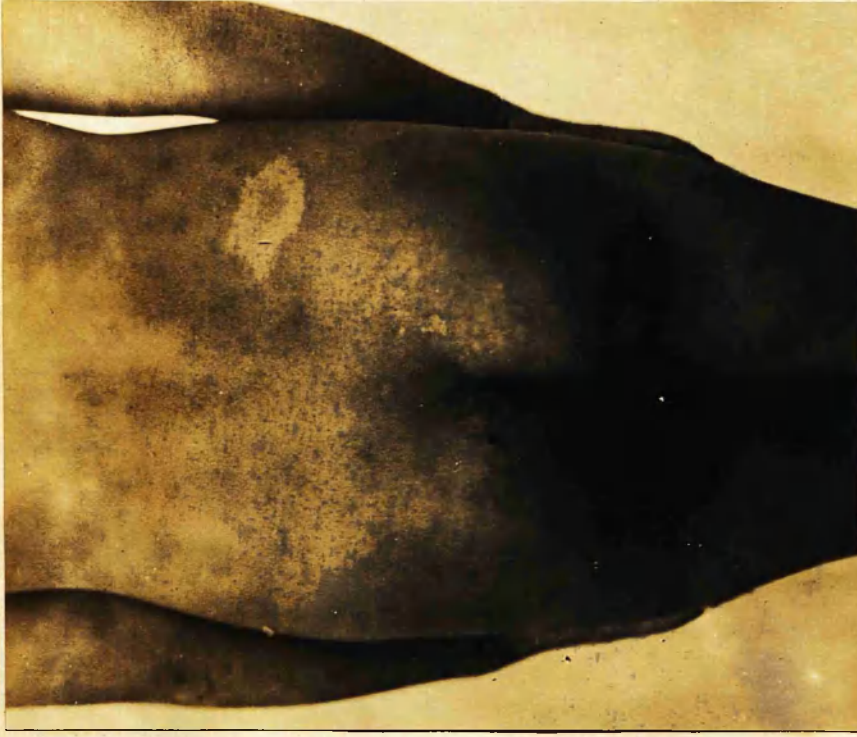
3. Decrease of severity of disease on increase of bodily resistance.

CASE XIII. An Indian woman noticed that her face and ears became thickened after a pregnancy. The doctor diagnosed the case as leprosy. This was subsequently confirmed bacteriologically. Six months later the lesions had disappeared completely. Three years later I visited the district and was shown the case. The patient had the appearance of having had the disease; the wrinkled face and scanty eyebrows were an indication of previous lesions. I could find no active signs of leprosy. This evidently was a case of spontaneous arrest setting in, after recovery from a debilitating pregnancy.

SIGNS AND SYMPTOMS.

The signs and symptoms of leprosy will be dealt with briefly, but this section is included in the Thesis because, as will be pointed out later, it is of the utmost importance in any scheme for the prevention of leprosy to be able to diagnose the early case.

Leprosy in most cases is recognisable long before the classical signs of the disease appear, and frequently, if the advent of these signs is awaited,



Early depigmented patch.

(Kindly supplied by
Dr. Wade of Gullion.)



Depigmented anaesthetic patches.

Note raised periphery on the
patch on left arm. Sign
of commencing skin
infection.

the opportunity for effective treatment has been lost. It has already been stated in this Thesis that in India the earliest signs of the disease are most often signs of nerve involvement; these show themselves in three ways, viz:-

- A. Depigmentation.
- B. Anaesthesia.
- C. Nerve enlargement.

Later, muscular paralysis generally sets in.

A. Depigmented patches. The commonest situations are the cheeks, outer aspects of the limbs, and the buttocks. The patches are light in colour but in a very dark skin may have a coppery appearance. The depigmentation is never absolute, as in vitiligo. In addition, the patches are smooth and not raised, they may or may not be anaesthetic. Areas of depigmentation are one of the most constant signs of early leprosy; it is therefore important to discuss the conditions which may be confused with them. The following conditions must be distinguished from the early lesions in leprosy:-

1. Leucoderma. In the East this condition is called "white leprosy", and not infrequently sufferers from this complaint are considered to be lepers; but the distinction is simple. The lesions of leucoderma differ from the early leprosy lesions in being absolutely white. In addition, leucoderma does not pick out the areas commonly selected by leprosy. The commonest situations are the ⁱtips of fingers, toes and circum-oral regions. The area of involvement varies from isolated patches to the, so-called, pie-bald person or to complete loss of dermal pigment. Leucoderma may be associated with leprosy but other signs of the disease are invariably present.



Leucoderma
(Dr. Muir's case).



Pitryiasis Versicolor.
Simulating a depigmented patch.

2. Pitryiasis Versicolor. This is a common fungoid affection in the East and to the uninitiated the lesions can be readily mistaken for the depigmentation of early leprosy and vice versa. The distinction is easy when once recognised. The lesions of pitryiasis are widespread over the body and do not so characteristically pick out the extensor surfaces. In contradistinction to leprosy, the lesions of pitryiasis are common on the abdomen. In addition, the lesions of pitryiasis have the appearance of yellowish-brown, slightly scaling macules which frequently itch. The colour of the lesion has been aptly compared to café-au-lait. In cases of doubt, scrapings treated with Liquor Potassae (B.P.) will demonstrate the fungus - *microsporon furfur* - and place the diagnosis beyond question. It must be borne in mind that this disease may occur in the leper, but when it does, the contrast between the depigmented patches of leprosy and the lesions of pitryiasis is so striking that the diagnosis presents no difficulty.

3. Congenital depigmentation. Occasionally light-coloured patches in children, especially on the cheeks, give rise to fears with regard to leprosy; and parents may bring their children to a physician because they are afraid such patches may be indications of the disease. High caste Indian children not infrequently present such light-coloured patches; they are generally small in size and most noticeable on the cheeks. As a rule they are not difficult to differentiate, but when in doubt they should be kept under observation.

B. Anaesthesia. This is the commonest, and one of the most certain signs of nerve involvement in leprosy. At first, the anaesthesia is very

superficial, and therefore any method which tests pressure and not tactile sensation will fail to detect the disease. The best method is that adopted by the School of Tropical Medicine at Calcutta. A piece of paper is folded and the anesthetic areas are tested by lightly stroking the skin, while the patient with his eyes shut indicates the area touched with his index finger. As previously stated, appreciation of painful stimuli (pin-pricks) and of slight variations in temperature are affected first, but these can only be tested out in intelligent patients. The areas of skin first affected are found most frequently in the cutaneous distribution of the ulnar and peroneal nerves. The facial and great auricular nerves are often affected early, but in the former paralysis is seen, and not anaesthesia, and in the latter, nerve enlargement takes place early. The depigmented patches are frequently anaesthetic. Commonly hyperaesthesia, paraesthesia, and subjective sensations precede definite anaesthesia.

The commonest cause in the East of the signs described is leprosy, but other possible causes must be eliminated:-

1. Peripheral Neuritis of other origins, e.g. Beri Beri, alcohol, arsenic.

2. Syringomyelia.

1. Peripheral Neuritis. The most important point in the differential diagnosis of leprosy from peripheral neuritis is that in leprosy the knee-jerks are invariably present in the early stage, and even in the late stages with advanced mutilations they are frequently obtainable. In peripheral neuritis there is early loss of tendon reflexes, early wasting and muscular

tenderness. In the East Beri Beri is a frequent cause of peripheral neuritis, but other signs of this disease will be present, e.g., tic-tac/rhythm, oedema, etc

2. Syringomyelia. Superficial tactile sense is rarely lost in this disease; in addition, muscular wasting, the signs of segmental involvement more especially of the cervical region, perhaps signs of sympathetic nerve involvement, tend to make the diagnosis evident.

Cervical rib and the muscular dystrophes should present no difficulty in diagnosis.

C. Enlargement of Nerves. Associated with anaesthesia there is frequently seen enlargement of the superficial nerves. The commonest nerves to become enlarged are the ulnar at the elbow, the peroneal as it winds round the fibula, and the great auricular. The following two cases illustrate the importance of such enlargement:-

CASE XIV. An Indian male complained of a swelling on the inside of the arm. The swelling was found to be associated with the ulnar nerve, was extremely thick, and had the appearance of a neuro-fibroma. It was about an inch in diameter and fluctuation could be elicited. The history given was that a depigmented anaesthetic patch appeared on the outer part of the dorsum of the hand; this was followed about three months later by the appearance of the swelling described above. On the diagnosis of leprosy being made, the patient was frightened and went to another doctor, who, being doubtful of the diagnosis, operated. On opening the supposed neuro-fibroma, a semi-necrotic mass was found in connection with the ulnar nerve, such as is typical of a nerve abscess in leprosy. There were no other signs of the disease; unfortunately the patient disappeared, and his subsequent history



Nerve Leprosy.
(Facial Paralysis.)



Enormously enlarged
Great Auricular Nerve. (Case XV).

was not ascertained.

CASE XV. A Burmese had leprosy for three months as far as he knew. He complained of a swelling in the neck which was found to be an enormously enlarged great auricular nerve; it was as thick as a little finger; the swelling was uniform down to the point where it disappeared behind the sternomastoid muscle, it was hard and tender to pressure but there was no fluctuation. In addition there was a raised erythematous patch over the right eyebrow and another similar lesion at the angle of the nose. On examination of these areas for *mycobacterium leprae* a few were found.

These two cases illustrate the importance of nerve enlargement in leprosy and the possible difficulties in diagnosis.

D. Muscular Paralysis. This is usually seen late in leprosy and by the time this sets in the diagnosis is placed beyond doubt. An exception to this is when the facial nerve is affected. This nerve is commonly the site of leprotic infiltration, and when enlarged as it passes out of the stylomastoid foramen becomes easily damaged as a result of the inflammatory exudate in the sheath. As the facial nerve is almost completely a motor nerve, damage to it is manifested by paralysis. It is unusual for the facial nerve to be the only nerve involved. The lesion is of a lower motor neuron type.

SKIN LEPROSY.

If the early nerve leper remains untreated, he sooner or later begins to show skin manifestations, unless his resistance to the disease is high, then it may become spontaneously arrested, or become localised in one nerve

or a group of nerves and never become generalised.

When the disease has reached the stage of skin manifestations, the mycobacteria leprae have been distributed throughout the body, and the disease has become disseminated. Therefore it is at this stage that the leper most frequently complains of symptoms, which mainly show themselves in vague rheumatic pains, general malaise and periodic febrile attacks, which may last a few days to many weeks, and if severe, reduce the patient's vitality to such a low ebb that he readily falls a prey to some intermittent disease; or he may die as a result of the cachexia, caused by the repeated reactions, the so-called "lepra cachexia" of the Philippine writers. In between the febrile periods the patient may say he feels well and may be able to carry on at his work. I have noticed that if four-hourly temperature charts are kept there is a regular variation of temperature below the normal line between the febrile periods, and I have sometimes referred to this as "pyrexia below the normal line." I have nowhere seen this described, but it seems to me to indicate continued activity of the disease. These sub-normal temperatures so frequent in this stage of leprosy need further investigation. Such symptoms as described are indications that the disease has passed the stage of a local one and has become generalised. The chief signs by which the diagnosis of skin leprosy is made are shown in the actual cutaneous lesions which manifest themselves in two ways, viz:-

- A. Appearance of rashes.
- B. Appearance of nodules.

A. Skin Rashes. These frequently are seen at the periphery of the depigmented patches. As a result of a reaction, perhaps during treatment or because of the presence of some factor which lowers the vitality of the patient, e.g. an attack of malaria - the depigmented patches become red, raised and angry looking, and previously where no bacilli were found they now can be demonstrated in the serum exudate, after making an incision into the peripheral part of the lesion. It is well to remember that skin leprosy is protean in its manifestations, and the following conditions have to be distinguished from the early skin lesions of leprosy.

1. Ringworm. In the East fungoid infections are extremely common and varied, and the circinate lesions of skin leprosy, with the central depigmented areas, are not unlike the lesions of ringworm. The diagnosis rests on the finding of the bacilli in the skin. In this connection it is well to remember that leprosy is not an irritating disease.

CASE XVI. An Indian male was referred to a Mission hospital on account of a circinate skin lesion on the outside of the thigh, which had been diagnosed as ringworm. On examination there was an area of erythema on the outside of the right thigh. The central part was depigmented, the periphery was red but not raised. No bacilli and no anaesthesia was demonstrated. As the lesion was highly suspicious a careful examination was made. No bacilli were demonstrated in scrapings from the nasal mucosa, but as the patient's ear lobes were red and thickened, a clip of skin was excised and examined for *mycobacterium leprae*, which were found in profusion. This case illustrated the care that is necessary if one is to diagnose early cases of leprosy.



Skin rash in Leprosy.

Note raised infiltrated
plaques.

2. Syphillides. When the lesions of leprosy manifest themselves as large indurated plaques, the disease is not infrequently diagnosed as syphilis. The finding of the bacilli in the lesions or in the nose, and the presence of other signs of leprosy, e.g., signs of anaesthesia, or thickening of superficial nerves, are the chief points in the differential diagnosis. It should be remembered that syphilis is a common accompaniment of leprosy and therefore, while a positive Wassermann does not exclude leprosy, a negative one does exclude syphilis.

CASE XVII. While in British North Borneo, I was asked to examine a Chinese woman, who had, as I was told, a syphilitic rash. On seeing the patient it was evident that her case was one of leprosy. In addition, she had extensive indurated plaques over her back and arm, and also thickened ear lobes and eye-brows. On microscopical examination, *mycobacterium leprae* were found in large numbers.

2. Psoriasis. When the lesions show the circinate patches with red, scaly edges, they may be diagnosed as psoriasis. Finding the bacilli in the periphery of the lesions, and the absence of lesions on the head, and the presence of anaesthesia, all tend to make the diagnosis evident.

4. Lichen Planus. The flat-topped plaques of lichen planus are sometimes simulated by leprosy, but the absence of irritation, and the absence of the typical lesions on the mucous membranes of the mouth and tongue and the typical distribution, are the chief points of differentiation.

5. Seborrhoea. In its multifarious forms, Seborrhoea is occasionally

mistaken for leprosy. The invariable presence of lesions on the scalp, and the intense irritation, distinguish it from leprosy.

CASE XVIII. An Indian male was sent to a Hill leper institution as suffering from leprosy. On examination one found that the case was one of extensive seborrhœic dermatitis. There were no lesions resembling leprosy neither was there anaesthesia nor were bacilli found. The affection was most marked on the head, but it was also extensive all over the body, giving rise to a most intense irritation.

6. Lupus Erythematosis resembles leprosy in the selection of the face, ears and hands, and in its circinate spreading character, with its light-coloured central scar.

CASE XIX. An Indian female was sent to a leprosy hospital for diagnosis. She was found to have an extensive lesion of the nose and ears. The lesions on the nose were suggestive of the butterfly-wing distribution of Lupus Erythematosis. Scrapings from the nose and clips from the periphery of the lesions, and the ear-lobes, failed to show the presence of the mycobacterium leprae. There were no other signs of leprosy and a diagnosis of lupus erythematosis was made. Unfortunately the patient disappeared and did not present herself for re-examination.

7. Skin Sarcomata. In certain acute stages, when the lesions of leprosy appear as large vesicles which may become filled with blood, the disease may be diagnosed as Skin Sarcoma. This happened in Case XI of this paper. This is a rare manifestation of leprosy and the acuteness of the lesions make the finding of the mycobacterium leprae an easy matter.



Nodular Leper.

Note enormously thickened ears.

Enough has been said to emphasise the difficulty in coming to a diagnosis of skin leprosy, and therefore any case in a country where leprosy is endemic which shows raised erythematous lesions, should be looked upon with suspicion and carefully examined to exclude the possibility of the case being one of leprosy.

B. Nodular Leprosy. Little need be said with regard to nodular leprosy, as the diagnosis seldome presents any difficulty. The characteristic distribution, the leonine facies, and in addition, the signs of nerve involvement, all tend to make the recognition of this stage of leprosy straightforward.

SECONDARY ANAESTHETIC LEPROSY. In a thesis of this type, little need be said of the late nerve manifestations of leprosy. This stage has been frequently and adequately described by many writers. The characteristic mutilations, which have earned for this stage of the disease the term "lepra mutilans" are obvious, and in addition the almost complete loss of sensations, both superficial and deep, make the disease such that one can hardly fail to recognise it.

DIAGNOSIS.

In the last stages of the disease there is no difficulty in diagnosing leprosy, but by the time this stage is reached the best chances of a complete cure have been lost.

In the section on the signs and symptoms of the disease the question of differential diagnosis was discussed, therefore for the sake of conciseness

only a brief resumé of the chief clinical points which aid in the diagnosis of early leprosy will now be given.

1. Depigmentation. The patches of depigmentation, or more correctly, hypo-pigmentation, occur on the outer sides of the limbs, the face, buttocks and the back. They appear at those places which are subject to contact with clothing, etc.; they often have a characteristic coppery colour and a smooth surface; at first they are not anaesthetic to superficial touch, but later generally become so.

2. Anaesthesia. This may be associated with the depigmented patches but also occurs apart from them. The nerves most commonly affected are the ulnar and peroneal, and it is the area of their cutaneous distribution which should be systematically tested for loss of sensation. It must be borne in mind that the *Mycobacterium leprae* cannot be found in the cutaneous lesions of nerve lepers.

3. Presence of *Mycobacterium Leprae*. As has been stated, the majority of lepers in India pass through the early nerve stages before skin symptoms manifest themselves. A few highly susceptible individuals show skin manifestations without passing through the earlier nerve stages, and in countries where the community has not acquired a high degree of immunity the disease develops so rapidly that the nodular cases are predominant. I have seen all clinical signs of nerve manifestations in the form of hypo-pigmentation and anaesthesia disappear after the patient has had sharp reactions as a result of successive eruptions of rashes and nodules. From this one can readily understand why the connection between nerve and skin leprosy has so often been ignored by writers.

In all cases of skin leprosy the *mycobacterium leprae* can be recovered from either the nasal mucosa or from the cutaneous lesions. I have never been able to demonstrate the presence of the bacillus in the nasal mucosa of pure nerve cases, nor have I ever found the bacillus in the nasal mucosa in the absence of a definite ^{skin} lesion. This fact is one of the strongest arguments to my mind against the nose being the primary source of infection.

Leper bacilli are identified by being arranged in characteristic cigar-shaped bundles, by being acid-fast, and by the presence in the film of numerous red granules the exact significance of these is disputed.

Smegma bacilli are shorter and thicker and there are no granules.

Tubercle bacilli are longer, more slender and always scanty.

Up to the present these clinical signs are the only reliable methods by which an early diagnosis of leprosy can be made. Attempts have been made to discover a specific serological test which could compare in reliability with other tests now in use, but the results so far have not been encouraging, and they are positive only when the disease is moderately advanced, and when it can be readily diagnosed by clinical methods. A brief review of the various serological tests will now be given.

1. Compliment Fixation.

Recently Taylor & Malone⁽¹⁾ have been employing a compliment fixation test using as an antigen a saline suspension of tubercle bacilli (defatted in accordance with Dreyer's procedure). Taylor's results were as follows:-

Nodular leprosy	100%
Anaesthetic leprosy	92%
Mixed leprosy	96%

In addition the writers used two control groups.

Ref. 1. Major J. Taylor & Capt. R. Malone. "Compliment fixation in leprosy".
Indian Journal of Medical Research. Vol. XII, 1924-5. pp.135.

- (1) They tested 14 non-leper, non-tubercular and Wassermann negative cases, and 23 non-leper Wassermann positive sera, all of which gave negative results.
- (2) They also tested sera of 30 cases of tuberculosis but obtained positive reaction in 20% only.

However, this may not exclude the possibility of the reaction being due to manifest or latent tubercle, for tuberculosis in the presence of leprosy might conceivably intensify the reaction. It is a well known fact that in leprosy the incidence of tuberculosis is high, especially in nodular leprosy.

Taylor and Malone claim that their test, in conjunction with the Wassermann will differentiate between syphilis and leprosy, except when the two tests are positive. However, as this test was carried out in cases of three or more years standing, its value in the early diagnosis of leprosy has not been ascertained. Dr. Taylor personally informed the writer that in his opinion this test would not aid in early diagnosis.

Wassermann Reaction.

Lloyd, Mitra and Muir give the following figures⁽¹⁾:-

Wassermann positive in		31.2% of all cases.
do.	do.	15.8% of early nerve cases.
do.	do.	14. % of early skin cases.
do.	do.	38. % of severe skin cases.
do.	do.	67.5% of advanced skin cases.
do.	do.	15. % of late nerve cases.

From these results it is seen that in early cases the Wassermann rate

Ref. 1. Lloyd, Mitra & Muir. "Influence of Syphilis on Leprosy as indicated by the Wassermann Reaction." Indian Journal of Medical Research, Vol. XIV. No. 3. Jan. 1927. pp. 668 & 670.

is no higher than in the ordinary community in India (i.e. about 15%) and this applies equally to the advanced nerve case where the disease has undergone arrest through natural processes. But in skin leprosy the Wassermann reaction shows a greater percentage of positives in proportion to the severity of the symptoms. It is well known that leprosy complicated by syphilis runs a more severe course and therefore it would be expected that the results of the Wassermann reaction would show a higher percentage of positives in the more severe forms of the disease and this is so. Lloyd, Mitra & Muir show that in 100% of early cases the Wassermann reaction became negative as a result of anti-syphilitic treatment and 73.7% of advanced cases became negative after similar courses. From an examination of these results it may be safely stated that in early cases of leprosy all positive Wassermann reactions, especially when tested by the improved technique of Kahn & Kolmer, are due to a complicating syphilitic factor. It can be concluded that a positive Wassermann in skin leprosy is due to syphilis in a great majority of cases, and Pineda⁽¹⁾ has shown that the Wassermann reaction is negative in uncomplicated cases of leprosy in its ordinary phase, but in a certain proportion of cases of "lepra-reaction" without evidence of syphilis or yaws, weakly positive results are obtained. Muir concludes that anti-leprosy treatment has no effect on a positive Wassermann reaction, but an exhaustive series of experiments on this factor alone has not been published. The writer hopes to carry out such an investigation if circumstances are favourable on his return to the East.

The present position therefore with regard to the Wassermann reaction in syphilis is that except during the periods of lepra-fever, this reaction is

Ref. 1. Eloy. V. Pineda. Studies in the Serology of Leprosy I - Wassermann Reaction. Philippine Journal of Science. Vol. XXX. May 1926. p.57.

not positive. To be certain that this conclusion is correct, a group of cases should be taken where the Wassermann, or preferably the Kahn flocculation test should be done before and during a period of lepra-reaction. This, as far as the writer is aware, has not been done.

3. Non-Specific Serum Tests.

Wade⁽¹⁾ has recently made a study of the serum of lepers by means of certain non-specific tests, chiefly by means of the Nitric acid reaction of Brück, which consists of a determination of excessive globulin precipitate formed by Nitric acid in dilute serum. He showed that 78% of all cases have a strongly positive reaction; and anti-leprosy treatment apparently reduced the degree of reaction, it being strongly positive in only 7%, while it is strongly positive in 44% of untreated new cases. In cases where anti-leprotic treatment was unsuitable and where presumably the disease was slowly retrogressing, 27% of cases gave a strongly positive reaction.

This test, however, is a non-specific one and changes in the serum globulin and serum albumen ratio in blood are noticed in other diseases, e.g. Kala-azar. This test cannot be regarded in any way as a specific reaction and the Cullion Authorities conclude that the reaction is of no value in the diagnosis of a particular disease. These results confirm the statement given in the earlier part of this Section, that the clinical signs are the only reliable data on which to base a diagnosis of leprosy. The disease can be certainly diagnosed whenever one of the three cardinal signs are present.

Ref. 1. H.W. Wade. Studies on the Serology of Leprosy II. - Nitric Acid Precipitation (Bruck Method). Philippine Journal of Science. Vol. 30. No. 1. May 1926. p.64.

PROGNOSIS.

The prognosis of leprosy has to be viewed from a slightly different standpoint than is the case in many other diseases. The disfigurement that the disease produces in the later stages, the deformities that so often result, and the social stigma attached to the leper, all make it of utmost importance that something more than a mere eradication of the disease should be the aim. If the cure results in mutilation and physical deformity the position of the patient socially is in no way changed, and he cannot in most cases resume normal life. The emphasis, therefore, should be laid on the necessity of completely arresting the disease without leaving behind any deformity. Such a result will be referred to as an "absolute cure", this term being used for the sake of comparison; bearing in mind at the same time that there is no method yet discovered which gives a sure indication that the disease has been completely eradicated from the body. When the disease has disappeared from the body, leaving behind residual deformities, the word "arrest" will be used.

PROGNOSIS IN UNTREATED CASES.

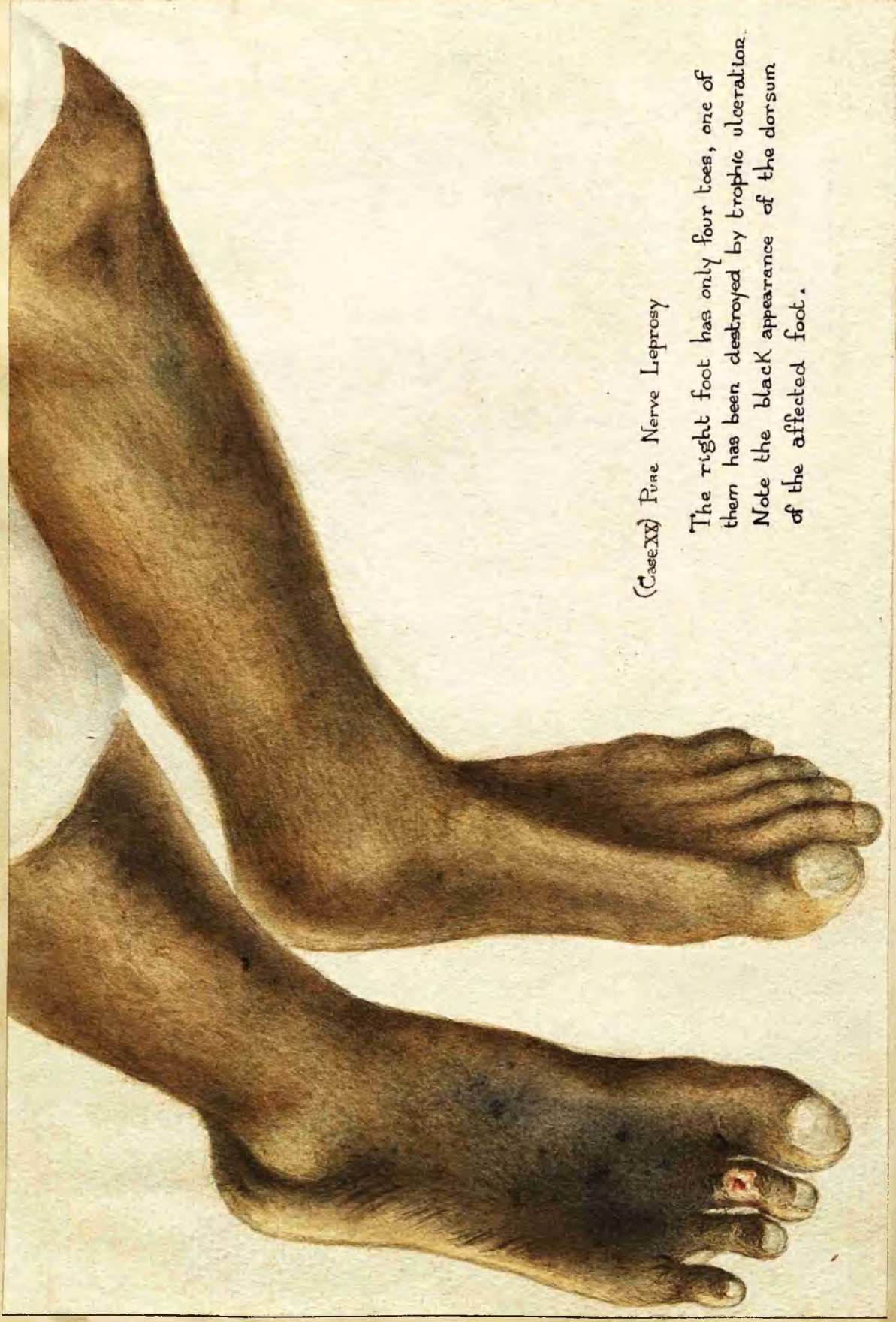
The prognosis in untreated cases is invariably grave, except in the case of a very few; the disease progressing to its ultimate termination, and the amount of mutilation depends on the intensity of the infection. It is difficult to estimate the duration of the disease in untreated cases. Skin lepers, especially nodular cases, generally succumb from lepra-reaction or the cachexia due to many attacks of lepra-fever, or else they die of some inter-current disease such as tuberculosis, nephritis and dysentery. Few



Note - One hand affected, but
the other healthy. This was
the only lesion in the body.

nodular lepers live longer than 10 or 12 years. Should such cases survive, the active signs of the disease disappear and their termination is similar to that of nerve lepers. The ultimate termination of untreated nerve cases is the destruction of the nerves affected by fibrous tissue, resulting in trophic ulcerations and deformities; the so-called "leper mutilans". The patient may live for many years after the disease has terminated in this fashion. Exceptionally, leprosy may become spontaneously arrested without any residual deformity or mutilation. An "absolute cure" in an untreated case is unfortunately very rarely seen. In this Thesis I have recorded two instances of spontaneous cure of leprosy. Case XII was a very early case which became spontaneously arrested. Case XIII was more remarkable because the patient's condition developed very rapidly and she became a well-developed nodular leper, yet the disease disappeared completely without treatment. Out of about 10,000 cases of leprosy which I have seen I have come across in my experience only two authenticated cases of "absolute cure" in untreated lepers. This would be a percentage of about 0.01%. Such an estimate may be too low as instances of "absolute cure" in untreated lepers would rarely come to the notice of a practising physician.

Although "absolute cures" are extremely rare, it is not very uncommon to find certain cases of nerve leprosy advance up to a point and then become arrested. Such a result is most often seen in the pure nerve type, when the disease seems to be localised to one limb. Case XI recorded in this paper is an example of such an occurrence. In this case both the ulnar and musculo-spiral nerves were completely destroyed, the former nerve being reduced to a thin fibrous cord. Presumably the focus of infection had been replaced by



(Case XX) Pure Nerve Leprosy

The right foot has only four toes, one of them has been destroyed by trophic ulceration. Note the black appearance of the dorsum of the affected foot.

fibrous tissue. The following case is another example of such an happening.

CASE XX. An Indian male was sent to a provincial leper home as an early case of leprosy. On examination it was noticed that the patient had only four toes on his right foot; one of them apparently had been destroyed as a result of trophic ulceration. The dorsum of the foot had the black appearance one not infrequently sees associated with advanced nerve leprosy. On examination the foot was found to be completely anaesthetic, both to deep pressure and tactile sensation. No other lesions were present. In countries where the disease is not seen in a very virulent form, this type of case which becomes arrested with but slight deformity is not uncommon, and such cases, although they cannot benefit by treatment, may be allowed, provided social circumstances permit, to carry on in their ordinary employment.

To sum up the prognosis in untreated leprosy, I cannot do better than quote the late Dr. Hansen - "Lepers usually die before the disease has run its course. But in the maculo-anaesthetic form the cure of leprosy is almost invariably the result. What remains, however, after the cure of leprosy is very different. We have occasionally a complete subject with vigour and good health, but usually only a miserable rudiment of a human being, with more or less paralysed and deformed hands and feet, with unclosable eyes, of which the lower part of the cornea is opaque, and from which tears run down over the cheeks, and with paralysed facial muscles unable to close the mouth, so that saliva constantly dribbles from it. Such cases may however live long and reach great ages, if under such circumstances this can be looked upon as any advantage. ---- In nodular leprosy, the bacilli in the leprous products breaks up into granules which finally disappear and there remains of the leprous product only a scar in which nothing leprous can be recognised. Occasionally this takes place in all the affected parts, and there remains



Last stage of Leprosy -
Disease naturally arrested, but
terrible mutilations remain -

Lepros. Mutilans.

only a widespread anaesthesia, the result of the nerve affections; and in the maculo-anaesthetic form this is the regular termination of the disease. In both cases the leprosy is completely healed."⁽¹⁾

PROGNOSIS IN TREATED CASES.

It is very difficult to give judgement on the prognosis of leprosy in general, for much depends on the stage at which the patient presents himself, his general health and many other factors. To estimate the percentage of "absolute cures" in all cases under treatment, the best idea can be gathered from a study of the results from the large leper homes. Dr. Wilson of Korea⁽²⁾ states that 30% of all cases coming to his home have been discharged as apparent cures. The average duration of the disease in his cases was only 3.3 years, and further, the majority of cases were of the acute nodular variety and therefore would respond more readily to treatment than the more slowly progressive case which is so common in India. However, this percentage is higher than that obtained at other homes, and therefore I am doubtful whether the 30% of apparent cures are "absolute cures" or merely arrested cases with some slight residual deformity or anaesthesia. Dr. Wade⁽³⁾ of the large Leper Colony at Cullion (Philippine Islands) estimates the recoveries of all cases at 15-20%. The cases at the Cullion Leper Colony are mostly of the advanced skin type. Dr. Kerr⁽⁴⁾ of Dichpalli, India, states that 19% of all cases have become symptom-free in 1926. From these figures and as a result of my own experience, an average estimate of the "absolute cures" in unselected cases of leprosy, when treated under proper conditions, is about 10-12%. When this figure is compared with the estimated 0.01% in untreated cases, it is seen that the introduction of the improved treatment has altered

- Ref. 1. Hansen & Looft. "Leprosy in its Clinical and Pathological Aspects."
Trans. by Norman Walker (1895)
2. Leprosy in Korea. Journal American Medical Association 1926, Oct. 9.
Vol. 87, No. 15. pp.1211-1212.
3. H.W. Wade & C.B. Lara. Proceedings of Royal Society of Medicine.
April 1927. p.1018.
4. Isabel Kerr. Proceedings of Royal Society of Medicine. April 1927,
p.1012.

the outlook for lepers considerably.

PROGNOSIS ACCORDING TO THE STAGE OF THE DISEASE.

It is convenient to describe three stages in leprosy.

1. Invasion period, when the body has acquired no immunity to the invading organism.

2. Stage of commencing immunity.

3. Stage of subsidence of the disease.

1. In the very early stages, that is, those cases which show signs of the disease in the form of a few depigmented patches or a slight loss of superficial sensation, an "absolute cure" should result if treatment is effectively carried out. It is during this stage that treatment must be carried out with care, avoiding excessive reactions, for any severe reaction is liable to break down an isolated focus of bacilli; as the body has not acquired any sort of immunity the disease may undergo a serious exacerbation as the following case illustrates:-

CASE XXI. An Indian male entered a leper home for treatment. The diagnosis was made on clinical examination, the patient having numerous depigmented patches over his back and outer sides of his arms. In addition there was anaesthesia along the distribution of the ulnar nerves. While under-going treatment it was noticed that after each injection there was a slight rise of temperature, but this was not thought to be serious, and the dose of the remedy (Hydnocarpus ester and 1% Iodine) gradually increased. Forty-eight hours after one of these increments the patient developed high fever and the previous areas of depigmentation became red and raised and

bacilli were demonstrated in the lesions for the first time since admission. Undoubtedly injudiciously increasing the dose ushered in a severe reaction and the disease rapidly spread, as the body had not acquired immunity. Acute disease and any substance that will produce protein shock will have the same effect on a patient in this stage of the disease.

It can be said, however, that an "absolute cure" should result in 80 - 90% of all early cases, provided that their treatment is undertaken carefully.

2. Stage of commencing immunity. In this stage, the patient, who is generally a skin case, has had a series of reactions during the course of the disease, and the body has acquired a relative immunity and is able to destroy any bacilli which may be liberated into the circulation. Therefore any treatment which will produce a reaction will tend to benefit the patient. The following case is illustrative of marked improvement following severe reactions.

CASE XXII. An Indian male had been in a leper institution for about one year; his condition was fairly advanced, he had a considerable amount of anaesthesia and a few nodules scattered over his body. In addition mycobacterium leprae were demonstrated in the nasal mucosa. The patient contracted smallpox and when he recovered from the latter disease it was noticed that the skin manifestations had entirely disappeared and the anaesthesia had diminished. The patient continued to improve and ultimately became symptom-free (an "absolute cure").

It is in this stage that the efficacy of any remedy is difficult to

determine, for any treatment which will produce a reaction, e.g. protein shock, therapy, etc., will tend to benefit all patients who are in this stage. Again, if the patient has a severe form of skin leprosy, especially of the nodular variety, the disease will take many months before it becomes arrested, and it is during the process of arrest that secondary deformities and paralysis are liable to occur, and therefore the stigmata of leprosy will ever be apparent. However, with effective treatment about 30% of lepers in this stage should reach the stage of "absolute cure"; some 50% will become arrested with varying amounts of residual disfigurements, while the remaining 20% will probably die of some inter-current disease, or succumb from the result of "lepra reaction". Such an estimate as given can only be rough, for it is difficult to analyse published statistics to this extent, as each physician's ideas of the classification of the various stages of leprosy differ.

3. Stage of subsidence of the disease.

In this stage the disease gradually dies out of the body and as the body overcomes the disease nerve and other tissues are destroyed by the contracting fibrous tissue leaving the patient healed of his leprosy, but mutilated beyond hope of recovery. Treatment will hasten this result but cannot prevent damage already done, and therefore all the cases in this stage of the disease, if they do not die of some inter-current infection, will become arrested with residual mutilations and deformities.

It is seen therefore that, with treatment in the first stage of the disease, some 80-90% of cases should become "absolute cures", while in the second stage it is reasonable to expect 30% of such cures. In the last stage

the patient's sufferings can only be alleviated by treatment and the process of natural arrest of the disease hastened.

The Prognosis in leprosy for those under treatment, therefore, needs careful thought, for it is different in the various stages of the disease. In skin leprosy, especially of the severe type, the prognosis should be guarded for while the lesions are responding under treatment secondary reactions may be taking place which will leave the patient scarred. However, the outlook for the skin leper is very much more hopeful than it was six years ago, because of the increase of knowledge and treatment. Naturally the longer the patient has had leprosy the greater is the likelihood that gross deformity will set in. While the position to-day is very much more promising, yet one must ever keep in mind the fact that leprosy is one of the most deceptive diseases the practitioner is called to deal with, and therefore he should not make the mistake of being over optimistic; but, on the other hand, if there are no grounds for it, he should not be too pessimistic, because the keeping up of the morale of the patient is an important factor in combating the disease.

TREATMENT.

There is as yet no specific remedy for leprosy, but the effort to find a real cure for the disease has been age-long. A rapid review of the more important remedies which have been tried from time to time will now be given. Later the methods which have met with most success in the treatment of leprosy will be fully described.

The earliest records of the treatment of leprosy are to be found in the works of Aretaeus, who introduced his treatment in the second century. He used numerous concoctions for dispelling the depraved humours, ranging from "shavings of an elephant's tooth in one dram with wine" to a compound medicine from vipers, which he says "is to be drunk in preference to all others, for it contains together the virtue of all others." However primitive the physic of Aretaeus was, yet the general treatment he advocated could not be bettered to-day, for he understood the necessity of maintaining the patients' general health. Aretaeus says "the food should be pure, wholesome and of easy digestion and plain, and the regimen in every way well adjusted as regards sleeping, walking and place of residence. As to exercise, running, tumbling and the exercise with the leather bag, all these with well regulated intensity, but not so as to induce lassitude."⁽¹⁾

From the second century to the present time a vast number of remedies have been tried. The following are the most important ones.

1. Metallic Preparations.

Of the metallic preparations that have been most used, the chief are mercury, iodides, and more recently organic compounds of arsenic and antimony. Dr. Radcliffe Crocker, at the end of the 19th Century, advocated mercurial preparations, the chief being injections of mercury perchloride.

Potassium Iodide has been used from time to time, and it has long been known that a small dose of this drug will frequently result in demonstrating leper bacilli in the nasal mucosa when, previous to its administration, they were impossible to discover. One still sees the administration of potassium

Ref. 1. Extant Works of Aretaeus. "Therapeutics of Chronic Infections."
pp. 494-498. Translated for the Sydenham Society by Francis
Addams.

iodide advocated for the purpose of diagnosing doubtful cases; and Dr. Danielssen used potassium iodide as a test for apparent cure. The dangers of this remedy were recognised by Hansen, who stated⁽¹⁾ "that even small doses of Iodine produce new eruptions of leprous tubers or patches."

In order to illustrate the harmful consequences which may follow the injudicious use of iodides, I quote the following case:-

CASE XXII. An Indian male had been in a leper home for over a year and was given a medicine containing Potassium Iodide grs. V. After three doses there was a sudden exacerbaton of the disease, and he experienced one of the most serious bouts of lepra-fever I have ever seen. At the end of these reactions he was weak and ill and took many weeks to regain his strength. As the result of this and similar experiences, all the routine expectorant mixtures I used were prepared without Potassium Iodide.

Arsenic was used by the earlier physicians, and the late Dr. Danielssen used it in the form of Fowler's Solution and came to the conclusion that the apparent good was due to the emaciation produced, but when that was recovered from the nodules regained their previous size.

Within the last few years the organic preparations of arsenic have been widely used and one of the preparations which has received extensive trial is eparsenal (amino-arseno-phenol). Hasson⁽²⁾ first reported good results in a number of cases, but he says "Eparseno action was not always reliable and opinions are contradictory."⁽³⁾ Delamare⁽⁴⁾ and others have reported unfavourably on this preparation, and it is now little used. The chief fallacy in estimating the value of the organic compounds of arsenic is seen in

- Ref. 1. Hansen & Looft - Clinical & Pathological Aspects of Leprosy. Trans. by Norman Walker.
 2. Hasson. - Societe Medicale des Hospitaux de Paris. Oct. 20th, 1922, Vol. 46. 3^E Serie p.1360.
 3. Hasson (James) - Unpublished communication.
 4. Delamare - Sur l'histoire de l'eparseno therapie anti-lepreuse. Progrès Medical, 1925, April 11th, No. 15. pp.535-538.

cases with concomitant syphilis. Any treatment which will improve syphilis will have an indirect result in leprosy; the same remark of course applies to complicating yaws. Hasson, who has used eparsenal extensively, now admits that the favourable results obtained by the use of eparsenal may be due to its action on the spirochaete.⁽¹⁾

Cuprocyanides. These preparations have been used by numerous workers and they seem to be beneficial during the stage of commencing immunity. They apparently cause a general reaction by breaking up foci of the disease. This property of breaking up foci of leper bacilli makes the administration of the drug dangerous in certain stages.

Antimony. Antimony preparations have been extensively used. The workers in the Philippine Islands carried out a series of experiments on the value of antimony medication in leprosy. They came to the conclusion that "antimony appears to be of no real therapeutic value as a means of treating leprosy."⁽²⁾ Muir reports⁽³⁾ that he has found antimony of value in reducing the reactions that occur in leprosy and says that a "few intravenous injections of small doses (0.02 - 0.04 gm.) of Pot. Ant. Tartrate rapidly brings about a cessation of active signs."

2. Sera and Vaccines.

Carrasquilla's Serum. Carrasquilla⁽⁴⁾ was one of the first to advocate serum therapy as a means of treating leprosy. Drs. Thompson & Frank Tidswell⁽⁵⁾ studied his results and came to the conclusion that they had not found his sera to be of any value.

In 1905 Major Rost laid claims to the value of a vaccine (Leproline),

- Ref. 1. Hasson. Unpublished communication.
 2. Rodriguez & Eubanas "Treatment of Leprosy with Antimony". Philippine Journal of Science, Vol. 23, No. 6. Dec. 1923.
 3. Muir Proceedings of the Royal Society of Medicine. Vol. XX. No. 6. (No. 44)
 4. Carrasquilla. Sur la sero therapie de la lèpre. Semaine Med. 1896,
 5. Ashburton Thompson & Frank Tidswell - Serum Treatment of Leprosy. "Lepra", Vol. I. pp. 140-147.

made from acid-fast bacilli from leprous lesions; but Lt. Col. Semple⁽¹⁾ carried out experiments with Leprolin and concluded that defective technique resulting in the contamination of the media accounted for the reactions. When such contamination was avoided the results were negative.

Nastin. The next remedy to receive special attention was Deycke's Nastin, which was a vaccine prepared from acid-fast organisms believed to be a culture of leper bacilli, but subsequently found to be a non-acid-fast streptothrix. By means of fractional extraction with ether a pure fatty substance, Nastin, was produced; this afterwards was mixed with Benzoyl Chloride and called Nastin B., Williams⁽²⁾ and others claimed good results, but Macleod⁽³⁾, Ashburton, Thompson⁽⁴⁾ and others concluded that it was inert.

The latest attempt at cure by vaccine therapy is that of Hasson, who claims to be able to prepare a stock vaccine containing 5 milliards of Hansen's bacillus to which he adds ten milliards of B. pyocyaneus per 2 c.c.s ampoules. The leper bacilli are collected from blisters produced by freezing with CO₂ snow⁽⁵⁾, 2 c.c.s are injected into a vein twice a week. Hasson says - "that after 6-8 injections the lesions, nodules and ulcers break down and processes of healing begin."⁽⁶⁾ The course of ten injections is followed by a rest for a week or more, then another course of injections given. Manson-Bahr⁽⁷⁾ and Graham Little⁽⁸⁾ have recorded favourable results in early cases. Undoubtedly reactions can be produced, but Muir⁽⁹⁾ tested the vaccine out on suitable cases without success. However, as claims of a somewhat startling nature have been made the vaccine should be given another trial. The claim that Hasson makes that his vaccine contains leper bacilli in large numbers needs confirmation by

Ref. 1. Journal of Tropical Medicine, Sept. 1905.

2. Nastin Treatment. "Lepra", Vol. III, pp. 246-262.

3. Macleod (John). Two cases of Leprosy treated with Nastin. "Lepra", Vol. XI. p.270.

4. Nastin Treatment, "Lepra", Vol. III, pp.269-273.

5. Hasson. British Medical Journal, Dec. 4, 1926. p.1034.

6. Hasson. Unpublished communication.

7. Manson Bahr. Transactions Royal Society of Tropical Medicine & Hygiene, (1925

8. Graham Little. Acute Nodular Leprosy cured by Vaccine Treatment.

British Medical Journal, 1926. Vol. II. Dec. 4th, p.1034.

9. Private Communication.

independent workers. This I hope to do when I return to the East, as Dr. Hasson has offered to supply me with vaccine.

During a recent discussion, Macleod, Rogers, Cochrane⁽¹⁾ stated that they considered the results produced by Hasson's vaccine are due to protein shock, Hasson maintaining that his vaccine has a specific curative action.⁽²⁾

3. Vegetable Oils, other than Chaulmoogra.

In the early days Cashew and Garjun oils were used externally in India. Garjun oil is still largely used by the lepers, who claim great benefit, but any good that it may do is probably the result of the vigorous massage resorted to in rubbing the oil into the skin.

When the esters of hydnocarpus and chaulmoogra oil were introduced similar preparations of linseed oil, soya-bean oil and cod liver oil were tested. These proved to have some beneficial properties but were not so efficacious as the hydnocarpus oil preparations and experiments along these lines were discontinued.

Chaulmoogra Oil and its derivatives. Chaulmoogra oil has been used for very many years, and the claim that it is one of the best remedies for leprosy has never been disputed. This oil has had a long reputation in India as a remedy for leprosy. Much evidence of its value has been obtained and in 1916 Hopkins⁽³⁾ published the results of a fifteen years trial of chaulmoogra oil, which were as follows:-

	Cured %	Lesions disap.	Improved	Progress arrested	Worse or died
82 Incipient cases	17	4	24	14	12
88 Advanced	0	0	21	5	71

Ref. 1. Proceedings of the Royal Society of Medicine. April 1927. pp. 1018, 1021, 1025.

2. Ibid.

3. New Orleans Medical & Surgical Journal, 1916. No. 69. p.223.

These figures show that good results were obtained in incipient cases but almost complete failure in advanced ones. The greatest drawback to the oral administration of chaulmoogra oil is the gastric irritation and nausea which follows. Engel Bey in 1911⁽¹⁾ claimed he could overcome this with his preparation of anti-leprol, a specially purified chaulmoogra oil. Favourable results were reported in forty cases. This preparation has never come into general use. Dr. Victor Heiser made a further advance when he treated lepers with the now well-known Mercado-Heiser mixture, consisting of chaulmoogra oil 60 c.c.s camphorated oil, 60 c.c.s. and resorcin 4 gms. Dr. Heiser reported that 11.1% of his cases were apparently cured by this remedy. This preparation caused a considerable amount of pain and in India it was found impossible to persuade patients to persevere with treatment long enough. On this account, Sir Leonard Rogers, working in Calcutta, prepared 3% solutions of Sodium Hydnocarpate and Gynocardate, but they produced thrombosis of the veins when injected. On account of this these remedies were replaced by the ethyl esters of Hydnocarpus Oil by Muir, who continued the researches of Rogers. In 1924 the preparation which was being used was the ethyl ester of hydnocarpus oil combined with 10% Thymol. Thymol was replaced in this preparation by creosote and camphor, but camphor was not recommended by the workers in the Philippines, although workers in Korea continued to use it, combined with pure chaulmoogra oil. In India, however, the following preparation was introduced - ethyl ester of Hydnocarpus Oil 50 parts, Olive Oil 50 parts, Creosote 4 parts. As a result of the favourable reports from Korea of the benefit of pure hydnocarpus oil, experiments were carried out in 1925 in certain centres in India, to compare the relative

Ref. 1. Engel-Bey. "The Treatment of Leprosy, especially by Anti-leprol."
Therapeutic Medicine, January 1911.

value of pure hydnocarpus oil and the ester prepared from the oil. At Purulia I organised a series of experiments on this point. The results were as follows:-

A. Ester of Hydnocarpus Wightiana Oil 50 pts. Olive Oil 50 pts. Creosote 4 pts

Stage of cases.	Symptom free	Improved	Stat.	Worse.
A1. (early pure nerve)		47%	35%	18%
B1. (mild skin)			100%	
B2. (moderate skin)		68%	19%	13%
B3. (severe skin)		56%	33%	11%

B. Hydnocarpus Oil and 4% Creosote.

A1.	8%	42%	19%	31%
B1.		44.5%	44.5%	11%
B2.	2%	49%	41%	8%
B3.		92%	8%	

It should be pointed out that to hold B1. cases stationary is actually an improvement, as they would naturally pass into the B2 stage. The results of these experiments favoured the use of pure hydnocarpus oil and 4% creosote. To assess the value of creosote I asked the medical officer in charge of the Home at Calicut to inject pure hydnocarpus oil alone and the following is an abstract of the report sent to me:- "The number of cases treated were 51, but the number of abscesses produced as a result of using the oil alone was 12.5%."

It should be pointed out that under ordinary circumstances abscess formation should be negligible. In spite of the high abscess rate the medical officer at Calicut stated "from our experience we have no hesitation in saying that the pure oil treatment has been found far superior than the ethyl ester mixture previously used." The patients were then given the pure oil and 4% creosote and the number of abscesses were negligible. As a result of such

experiments the routine preparation in general use in India is pure hydnocarpus Wightiana oil and creosote to the extent of 4%.

It should be pointed out that the hydnocarpus oil derived from the various species of hydnocarpus tree seem to be equally effective. The commonest varieties of hydnocarpus tree from which the oil is extracted are:- Hydnocarpus Wightiana (S. India), Hydnocarpus Anthelmintica (Siam, Burma), Hydnocarpus Kurzii (also known as Teraktogenous Kurzii, or the true chaulmoogra tree) (Burma, Siam, China); in addition the oil extracted from the two species Hydnocarpus Subintegra (Siam) and Hydnocarpus Woodii (Borneo) seem to be effective in treating lepers.

Having now briefly reviewed the more important anti-leprosy treatments which are or were in use, I shall now consider the routine treatment under the following heads:-

1. General Treatment.
2. Special Treatment.
 - (a) Routine.
 - (b) Contra-indications.
 - (c) Complications following injections -
 1. General.
 2. Local.
3. Local Treatment.
4. Treatment of complications and sequelae.
 - (a) Lepra Reaction.
 - (b) Abscesses.
 - (c) Ulcers (Leprotic - Trophic)
 - (d) Tuberculosis and Leprosy.
 - (e) Lardaceous Disease.

1. General Treatment.



Untreated lepers as they
arrive at a leper home.



Note improvement as a result of
care and hygiene.
No specific treatment given.

Leprosy, being a chronic disease and one of long duration, the success of one's treatment depends as much on the maintenance of the patient's general health as on any specific remedy used. In treating the general condition of the patient emphasis should be laid on the following points:-

1. Predisposing diseases. Predisposing diseases play a large part in the etiology of leprosy; they also retard progress. Therefore, until such diseases as syphilis, hookworm and malaria are attended to, the specific treatment has little chance of success. The injections of hydnocarpus oil can be given along with treatment for a concomitant ailment. It is advisable, however, to withhold the injections while courses of N.A.B. are being given, for N.A.B. itself is liable to produce reactions; but during the subsequent mercurial courses, the injections should be carried out.

2. Good Food. A properly balanced diet is of great importance if the treatment of leprosy is to meet with success. The diet should contain plenty of fresh vegetables and fruit; stale and partially decomposed food and highly spiced dainties (relished by natives) must be avoided.

3. Constipation. This is especially stressed because its importance is not generally recognised in the treatment of leprosy. Constipation is common among lepers, and a constipated leper will not readily respond to treatment.

4. Exercise. As in tuberculosis, so in leprosy, this is one of the most important adjuncts to treatment, and therefore great insistence is placed on graduated exercises. Lepers, especially those in the early stages, are not ill men, and therefore can be gradually trained until they can take comparatively violent exercise, e.g. walking until they reach a maximum of 10 to 15



Before treatment.

(Dr. Muir's case.)



After treatment (9 months)

(Dr. Muir's case.)

miles a day. For young adults such games as football and cricket may be indulged in. Physical drill is another excellent form of exercise. Exercise should be stopped before fatigue is experienced.

5. Fresh air. This plays as important a part in the treatment of leprosy as it does in the treatment of tuberculosis.

6. Baths. Warm and cold baths should be given and the patient well rubbed down afterwards. Patients can be taught to rub each other down.

7. Sexual activity. This should be interdicted for it tends to sap the vitality needed to overcome the infection.

2. Special Treatment.

As stated earlier the treatment which has been generally adopted is that of Hydnocarpus Oil and Creosote (4%). I shall confine my attention to this remedy, the technique described differs in no respect if the ethyl ester mixture is used; the latter mixture tends to cause stronger reactions and therefore should be used with greater care.

The best method of administering the oil is that used and advocated by the Calcutta School of Tropical Medicine, the method of subcutaneous infiltration. The technique is as follows:- Use a ten c.c. syringe with a needle of suitable size, and divide the body into eight parts, viz:-

1. The extensor aspect of the left arm.
2. " " " " right arm.
3. " " " " left forearm.
4. " " " " right forearm.
5. The left buttock.
6. The right buttock.
7. The extensor aspect of the left thigh.
8. " " " " right thigh.



Method of subcutaneous infiltration.

Never inject in the inside of a limb or near a bony surface.

Having selected one of the above sites, introduce the needle with a sharp push into the layer between the superficial and the deep fascia (the needle should be freely moveable under the skin) and inject $\frac{1}{2}$ c.c., then withdraw the needle partially until the point is free from fascial entanglements; then introduce the needle in another direction and inject another $\frac{1}{2}$ c.c. Continue thus round an arc of a circle, the original needle puncture being the centre. In this way one should be able to inject 5 c.c.s or more by puncturing the skin once only. Injections are given twice a week, commencing with 1 c.c. (in bad skin cases with $\frac{1}{2}$ c.c.) and going up to 12 c.c., increasing by $\frac{1}{2}$ c.c. each time. During the treatment a watch should be kept on any reactions which may occur. While one cannot lay down hard and fast rules as to the stoppage of the injections during a reaction, yet the following may serve as a guiding principle:- If the temperature persists for more than 24 hours after the injection do not increase the dose; if it keeps up for more than 48 hours, halve the dose, if for more than 72 hours, stop the injections. As experience is gained one will often find that the injection of small doses can be cautiously continued in spite of slight rises of temperature.

Contra-indications.

1. Pulmonary tuberculosis. This is the chief contra-indication to treatment. Hydnocarpus Oil and its derivatives cause severe reactions in those cases which are complicated by tuberculosis and therefore should not be given. Reactions are liable to cause serious exacerbations of the tuberculous processes.

2. Nephritis. Nephritis is a common complication of leprosy and the Cullion Authorities stress the harmful effects that may be produced in such cases with the hydnocarpus oil preparations.

3. Eye lesions. Iritis and Iridocyclitis. If the patient has, or develops during treatment, iritis, or for that matter any inflammation of the component parts of the eye, the treatment should be stopped at once, and the eye lesions treated actively, the injection of hydnocarpus oil not being continued until the eyes have completely recovered.

Dimness of vision. This is a symptom sometimes complained of by patients under treatment with hydnocarpus oil preparations, and is probably a toxic manifestation of the drug. Injections should be stopped and I have found ammonium chloride five grains three times a day to be beneficial.

4. Debility. Treatment with hydnocarpus oil should not be given to the debilitated or emaciated subjects. Sometimes if large doses (above 10 c.c.s.) are continued for long periods the patient begins to lose weight and if treatment is carried on debility rapidly ensues. It is wise therefore when a dose of 12 c.c.s. is reached to return to 5 c.c.s. and begin to work up again; stopping the injections for two or three weeks every few months is sometimes found to be beneficial.

Complications following injections. 1. General.

(a) Immediate. Some patients complain of dizziness, choking and a tight-feeling in the chest immediately after injection; a short rest in the recumbent position is generally sufficient to overcome this. If the ester

preparations are used and a vein is entered, severe coughing generally ensues; this passes off fairly soon and is not as a rule serious. When the oil is used care must be taken to see that the point of the needle has not penetrated a vein. This can be done by pulling gently on the piston of the syringe before injecting the oil. The dangers of fat emboli are not negligible. Most of the immediate complications are unimportant and not a few taken advantage of by the more timid patients as an excuse to discontinue treatment.

(b) Delayed. Frequent complaints of pain and cough accompanied by loss of weight should put the physician on guard against the possibility of activation of a latent tuberculous focus. If the patient complains of the persistence of headache, dizziness and general malaise, the urine should be carefully examined for albumen and other abnormal constituents.

Complications following injections. II. Local.

(a) Complications at site of injection. If injections are given properly there should be no pain after the first few minutes. Continued pain without inflammation or induration may be due to bruising of the tissue as the result of using a blunt needle, or injecting too near bony surfaces or in a part where the skin is tense.

(b) Induration. If more than $\frac{1}{2}$ to 1 c.c. is injected in one spot hard indurated swellings are apt to occur. These should be treated by fomentations.

(c) Abscesses. If too large a quantity is injected into one spot an abscess is liable to follow. This should be aspirated and weak tr. of iodine injected after the pus is withdrawn. Unless very large, or if the pus repeatedly



Before Treatment.

(Dr. Muir's case.)



After Treatment - 6 months

(Dr. Muir's case.)

Note permanent deformity of hands as a result of complete destruction by fibrous tissue of ulnae and musculo-spiral Nerves.

gathers after two or three aspirations, such abscesses need not be opened, as the pus is found to be sterile. If the syringe or needle has been contaminated, any septic abscess which might result should be treated on ordinary surgical lines by incisions and free drainage.

Local Treatment.

Local Treatment of Leprous lesions. Counter irritants of various descriptions have been long used in the treatment of leprosy. As a result of various trials Muir(1) found that the best application for leprosy lesions was trichloroacetic acid.

Treatment of depigmented patches, skin rashes and nodules. All patches should be painted with trichloroacetic acid, diluted 1.5 for the face, and 1.3 for the body. Only a few patches should be painted at a time and the same set of patches should not be treated more than once in ten days. Trichloroacetic acid is a strong irritant and may cause ulceration if used injudiciously. For nodules one in one acid may be used, but only paint a few at a time.

Treatment of Complications and Sequelae.

1. Lepra Reaction. This in its more marked form is called "lepra-fever", and is an important condition which should be recognised by all who treat lepers. It is seen both in treated and untreated patients, but if anything rather more frequently in the former. Treatment tends to break up the bacillary foci and so may precipitate a reaction. Lepra-reaction is generally ushered in by a rise of temperature, and in skin cases especially, fresh eruptions are apt to break out. These may be erythematous, papular, vesicular or nodular, depending on the stage of the disease and the severity of the reaction. When

Ref. 1. Muir (E.) "External Medication in Leprosy." Indian Medical Gazette, 1926. May, Vol. 61. No. 5. p.215.

the attacks are mild and the patient is in the stage of commencing immunity, the sharp fever induced by such reactions is usually beneficial. But in its more severe forms, and especially in the non-immune stage, reactions are harmful and if these are repeated or last, as in some cases for weeks, a definite cachetic condition may set in.

Lepra-reaction does not only manifest itself in fever and exacerbation of skin symptoms, but rheumatic pains, neuritis, orchitis, or adenitis may all be found. The neuritis which is sometimes seen may be very severe, and the nerve may become very swollen and painful, as the following case illustrated:-

CASE XXIII. While visiting a provincial leper home, I was shown a case of severe neuritis of the ulnar nerve. The patient had leprosy for more than a year and he had within the last few months developed a severe neuritis which had resisted all treatment. On examination the right ulnar nerve was extremely swollen and tender at the elbow, fluctuation was elicited, and I decided to operate. An incision 4" long was made over the swelling and the ulnar nerve exposed and completely freed and incision of 3 ins. was made into the nerve sheath, and a small quantity of sero-purulent fluid escaped. The nerve was freed from its sheath and dropped back again and the skin incision sewn up. The immediate result of the operation was relief of pain and by the time I left the tenderness had completely subsided. The subsequent history of the case could not be followed.

The nature of the phenomena called "lepra-reaction" are imperfectly understood; the theory that is most acceptable to me is that put forward by the workers at Cullion, who consider that it is an allergic phenomenon, analagous to the sensitisation phenomena seen in tuberculosis. Another and older theory

is that the reactions are exaggerated stages of the leprous process; but the remarkable lack of toxicity of the bacilli generally is very striking, and it is difficult to conceive that the bacillus can suddenly and sporadically produce real toxins in any great amount. Again, another objection to this theory that the Culsion workers point out is "that in the ordinary phases of the disease the potentiality of pus production is not even suggested, while it commonly occurs in severe lepra-reaction."⁽¹⁾ Whatever the explanation of lepra-reaction, it is important to recognise and treat it.

Mild attacks of lepra-reaction can only be detected by keeping regular temperature charts. Four-hourly records are preferable and injections should be regulated according to the temperature chart. In more severe cases the patient should be put to bed and the bowels well opened with a saline aperient. If headaches, rheumatic or neuralgic pains are severe, phenacetin or aspirin should be given. Large doses of sodium bicarbonate are beneficial, and 10 m. of 1:1,000 adrenalin solution in 30 m. of normal saline once a day sometimes has a marked effect. If the fever lasts for more than a week an injection of 0.02 or 0.04 gms. of Potassium Antimony Tartrate sometimes brings the reaction to an abrupt end. During the acute febrile stages a bland, semi-fluid diet is indicated. If there is accompanying neuritis and the effected nerve is swollen, tense and painful, the nerve sheath should be well opened and the wound closed. The nerve sheath itself should not be closed. Should a nerve abscess develop it should be opened under strictly aseptic conditions and the wound swabbed out with weak tincture of iodine and sewn up without drainage; for if it is drained secondary infections are liable to occur. In chronic lepra-reaction a

Ref. 1. H.W. Wade & J.N. Rodriguez. "A Description of Leprosy, its Etiology, Pathology, Diagnosis & Treatment". (In the Press.)

low grade suppurating adenitis is sometimes present, affecting especially the inguinal glands. These affections are very intractable and can only be treated by constant antiseptic dressings; weak tr. of iodine so useful in the treatment of trophic ulcers is too painful a remedy for extensive use. Complete surgical removal is hardly a practical measure in many cases; however, where possible, operation might be tried.

Treatment of Ulcers.

These are naturally divided into two types:-

(a) True leprotic ulcers.

(b) Trophic ulcers following nerve destruction.

(a) Leprotic ulcers. These are best treated with applications of crude chaulmoogra oil; with careful treatment and with due regard to general cleanliness they generally clear up. Ulceration of the nasal mucosa is sometimes tiresome. The following prescription I have found most useful:-

R.	Camphor	Dramchms	Two
	Creosote	"	Two
	Hydnocarpus Oil	Ounces	One
	Olive Oil	"	Two

S. Two or three drops to be placed in the nose twice a week.

Crusts can be kept from forming by soaking a little gauze in liquid paraffin and applying night and morning.

(b) Trophic ulcers. For small abrasions these can be sealed by applications of tr. benzoini Co after having thoroughly cleansed ^{them} with iodine. Larger ulcers should be dressed with gauze soaked in tr. Iodii mitis, or 1.1000 basic fuchsin. For cleaning up foul ulcers the surface should be cleansed with

hot permanganate solution, dried and gauze soaked in tr. of iodine applied. A useful but more expensive remedy is hydrogen peroxide (10%). The surface of the ulcer is painted with this after preliminary cleansing with potassium permanganate; this is an excellent remedy for the septic conditions which so often follow burns in secondary anaesthetic cases. Hot fomentations and wet dressings are sometimes applied to large foul ulcers in the hope that in this way sloughs will separate more rapidly, but the tissues being so devitalised do not respond to such treatment; instead the surrounding skin becomes oedematous and red and while a few sloughs will separate, yet the hot moist dressings afford a good medium for septic organisms and instead of cleaning up the foul surface the infection spreads to the surrounding tissue, and there is a grave danger of moist gangrene following. The best method of dealing with extensive foul ulcers is to wash the part well in hot permanganate solution. A permanganate bath may be used, but the limb should not be immersed for more than ten minutes; after the bath the ulcerated surface is cleaned up and all sloughs are carefully separated with a pair of forceps, then the whole is well and thoroughly dried, tincture of iodine is then applied to the whole surface, or, alternatively, hydrogen peroxide; the ulcer is then well dusted with a 1.3 boriodoform powder and dry gauze is applied and the limb bandaged. In severe cases four-hourly dressings may be needed. In this way the surface is kept as dry as possible, and the boriodoform acts as an antiseptic and deodoriser.

Many advanced trophic sores become infected with maggots as a result of continued neglect when the patient is outside a leper home. The most efficient way to deal with maggot infection is to kill the maggots with

chloroform and extract them with forceps, and then dress surface with iodine and boroiodoform as described.

Trophic ulceration with sinuses are often seen, and when such sinuses occur in the feet and hands the infection tends to spread down the tendon sheath, and the septic process is hard to control; one fears opening up the whole sinus lest the infection spreads still further. I have found that such sinuses heal rapidly if tincture of iodine is injected along the whole length. This is done every other day till the sinus closes. Because of the complete loss of pain sense in secondary anaesthetic cases, tincture of iodine can be freely used, and being a spirit solution the objection to wet dressings is overcome.

Tuberculosis.

As stated earlier, active phthisis is a contra-indications to chaulmoogra therapy. The ethyl esters of cod-liver oil mixed with iodine⁽¹⁾ can be used; the dose is $\frac{1}{4}$ - 4 c.c.s. Under this treatment both the tuberculosis and leprosy tend to heal, but as such cases are usually advanced, special treatment is of little avail. Sodium Morrhuate (3%) may be used instead of the esters.

Lardaceous disease.

In my experience this is an uncommon complication of leprosy, having only seen one well marked case. The treatment is along general lines. Hydnocarpus oil injections must on no account be given; septic foci, etc., must be carefully treated, and the general health maintained at as high a level as possible. In spite of all treatment the patients tend to get rapidly worse.

Note 1. Formula -

Ethyl Ester Cod Liver Oil	$\frac{1}{4}$ part
Iodine	$\frac{1}{4}$ part
Olive Oil	4 parts
Dose	$\frac{1}{4}$ - 4 c.c.s.

PREVENTION.

All are familiar with the regulations for the separation of lepers which are to be found in the Biblical records. "Unclean, unclean, without the camp shall be his habitation", has been the sentence passed on the leper in many countries. Until recently the only method for the prevention of leprosy which was considered at all efficacious was the method of compulsory segregation. The segregation of lepers combined with an increase of knowledge on the part of the public of the importance of cleanliness, and of hygienic requirements, have been the main factors in ridding the chief countries of Europe of this menace. As pointed out in an earlier part of this Thesis (vide p.3.) it is in just those countries where strict segregation was neglected that leprosy still lingers.

When methods of compulsory segregation were introduced into the countries of Europe, the disease was already on a decline. It can be readily understood, then, that this method succeeded in completing the elimination of leprosy. Impey⁽¹⁾ was the first authority to doubt the practicability of compulsory segregation in countries where lepers existed in enormous numbers. He stated that "the results of the stringent Cape Leprosy Repression Act have not been satisfactory, and that the disease had steadily increased". In 1921 Jose Albert⁽²⁾ reviewed the results of 15 years compulsory segregation in the Philippine Islands, and published the following instructive table.

- | | |
|----------------------|--|
| Ref. 1. Impey (S.P.) | S. African Medical Record. 1918. May 25. Vol. 16. No. 10. |
| 2. Jose Albert. | "Leper Segregation in the Philippines". The Journal of the Philippine Islands Medical Association. Vol. 1. July - Aug. 1921. No. 4. pp. 131-142. |

Number of lepers admitted to the Cullion Leper Colony.

From July - December,	1906	802
Jan. - "	1907	690
" "	1908	1,603.
" "	1909	1,378
" "	1910	930
" "	1911	889
" "	1912	964
" "	1913	795
" "	1914	859
" "	1915	555
" "	1916	966
" "	1917	613
" "	1918	973
" "	1919	551
" "	1920	603

From January to May 1921 384

This writer concludes from a review of these figures that:- (1) "Fifteen years of the experiment in complete segregation in Cullion have not succeeded in reducing the annual number of admissions to any reasonable degree, which might justify the continuation of such a measure". (2) "The Cullion experiment is not based upon our present knowledge of the degree of contagiousness of the disease", and (3) that there is "sufficient reason to condemn the present system of com-

pulsory segregation of all lepers as being unjustified."

While many authorities came to see the futility of endeavouring compulsorily to segregate all lepers in countries where the numbers ran into hundreds of thousands, Muir⁽¹⁾ was the first to propound an alternative method for dealing with the leper problem. After stating that "while leper colonies and hospitals may segregate several thousands of lepers at heavy expense to the rate-payers, they cannot hope to attract many early cases." Muir puts forward a new method of control of the disease when he said "If progress is to be made the problem must be tackled at the fountain head. In other words, those who are in the early stages of the disease must be attracted and brought under treatment before they have had time to become a danger to the community." "This object can only be attained by opening dispensaries in endemic areas and putting them in the charge of those who have had sufficient experience and have been specially trained for the purpose."

In a report issued to the Public Health Department of the Government of Siam, the writer gave the following as the chief reasons against compulsory segregation:-

1. It only brings the easily recognisable leper under control. The early and more hopeful cases remain in hiding; and as early skin leprosy is not easily diagnosed the majority of lepers will remain in the infective stage for a period, of what may be years, before they are segregated.

2. It puts an unbearable burden on a state and entails the expenditure of vast sums of money.

Ref. 1. Muir (E.). "Notes on Transmission of Leprosy". Indian Medical Gazette, 1923. Vol. 58, p.574.

In support of the first reason against compulsory segregation, the census returns for India can be quoted. In 1921 it was estimated that there were 102,000 lepers, but from personal experience I am convinced that this number can be multiplied by eight or even ten before an accurate estimate would be arrived at. In an area in Bihar (India) in which the writer was asked to send in a report concerning a rumour of the great prevalence of leprosy in that district, thirty early lepers, none of whom were entered on the census returns, were picked out at random from a crowd that gathered out of curiosity. Such examples could be multiplied many times.

For support of the second reason one only needs to study the expenditure of the states that advocate compulsory segregation. One sixtieth of the financial budget of the Philippine Islands is expended on leprosy work.

In a lecture delivered by the writer to the Princes and Nobility of Siam⁽¹⁾, the need of efficient methods of prophylaxis was stressed and the following three reasons, which account for the continuance of leprosy, were given:-

1. Imperfect knowledge of the disease on the part of the great majority of the medical practitioners in the country, and therefore their inability to advise and treat the disease.
2. Lack of knowledge as to the exact number of lepers in the country, and distribution and type of leprosy in existence.
3. Lack of knowledge on the part of the general public and so the leper, not knowing that early leprosy can be "cured" if treated properly, will

Ref. 1. R.G. Cochrane. "How to Rid a Country of Leprosy". Re-print of Lecture published by "World Dominion Press", 1, Tudor Street, E.C. 4.

not come for treatment and his friends will not force him to go, because they fear he will be shut up in an asylum and never be liberated.

In view of these considerations, any scheme therefore which is designed to cope with this problem should include:-

1. The training of the Medical Profession (including students) in the diagnosis and prevention of leprosy, and the education of the general public by means of propaganda.

2. Establishment of leprosy hospitals where the early infective case can be treated in an atmosphere which encourages hope.

3. Establishment of out-patient dispensaries for the treatment of the early non-infective cases, and those infective cases which can be efficiently segregated in their homes.

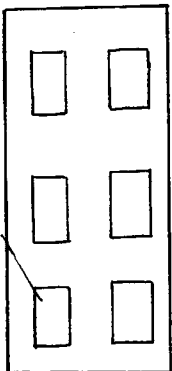
4. The maintenance of a few asylums where the pauper and beggar leper in the advanced stages of the disease can be cared for in a humane manner.

These points will not be considered in detail:-

1. The training of the Medical Profession and General Public. Whatever the scheme is for the prophylaxis of leprosy, there can be no doubt that the general practitioner plays a very great part in the prevention of this disease. It is to the general practitioner that the leper comes first, in a great number of instances, and if he is unable to detect the early signs of the disease, the consequences may be disastrous, not only to the individual, but to the country at large. Therefore there should be courses at suitable centres in the diagnosis and treatment of lepers for practitioners and medical students. Propaganda with a view to educating the general public can only meet with

Unkainted Childrens Compound.

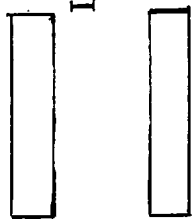
Womens Wards.



Latrines.

Well & Water Tower

Leper mens Wards (Advanced cases)



Workshop (Brass)

Hospital Kitchen

Hospital.

Dressing Station

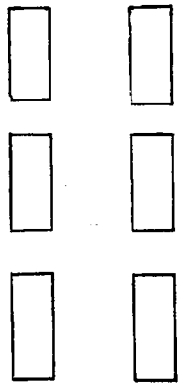
Treatment Hospital and Operating Theatres

Ward for early Cases.

Church

Rough Plan of Leper Home and Hospital (Diagrammatic)

Latrines



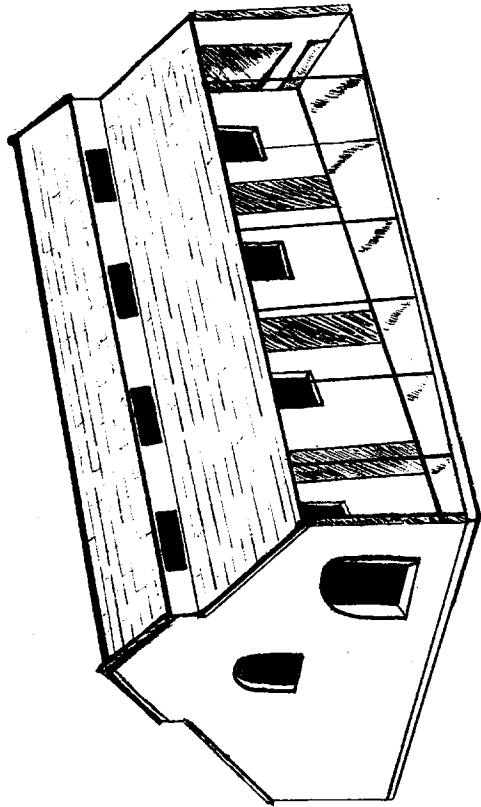
Latrines



Wards for Leipers (Men)

success if there are enough doctors trained who are capable of treating the disease.

2. Establishment of Leprosy Hospitals. Such hospitals should be organised along the lines of tuberculosis sanatoria, where only the cases that will recover and be able to resume normal life again would be admitted. The situation of these hospitals should be carefully selected with a view to providing ample ground which the patients can cultivate, and ample room for games and physical exercises. In addition, an adequate water supply should be available and the site which is chosen should not be on swampy or malarious lands. Too often the spirit of "anything will do" is seen in the selection of a piece of land for such institutions. The buildings should be well built and the patients graded according to the stages of the disease, so that early nerve cases and early skin cases are as possible placed in separate wards. The most suitable type of building is one which is divided into three wards, each ward holding four patients, or the cottage system can be encouraged. There should be a centrally placed hospital for those cases which need special treatment, for example, those suffering from other acute fevers, acute lepra-reaction and also for surgical emergencies. The administration block, chapel, recreation room, etc., should be all conveniently placed. An efficient conservancy system is essential, the best being a water system, linked up with a number of septic tanks. If carefully supervised, trenching of the night soil is satisfactory. The staff should consist of a specially trained medical man, his assistants and nurses. If the hospital is large, it is almost essential to have a fully qualified nursing-sister in charge. There should be an administrative officer apart from



Model Ward

the medical officer. If such hospitals were available, they could also be used as centres for research and teaching.

3. Out-Patient Dispensaries. It is well known that many early cases of leprosy need not be segregated, and, further, it would be impossible, on account of the expense involved, to have a sufficient number of leprosy hospitals to cope with the problem. Leprosy dispensaries or out-patient clinics should be established in all important towns, and in the districts where leprosy is prevalent, a doctor who had special training could be placed in charge and would treat suitable cases. Cases needing special care in treatment could if possible be transferred to the nearest leprosy hospital; advanced cases would be rejected, or, if paupers, sent to the nearest leper asylum.

4. The Place of the Leper Asylum. So long as there are chronic advanced lepers, who in the uncared for state are the most miserable of men, it is a humanitarian duty to have some place where they can find rest and comfort. It is naturally not the best policy to house the early cases along with the late hopeless case, for the psychological effect of continually seeing the end result of the disease is detrimental to treatment. It is not wise to discharge the old advanced, mutilated cases who have become non-infective, because public opinion in the East is not yet prepared to take such cases into society and care for them. Therefore, unless the advanced leper is segregated as far as possible, the pauper and beggar problem would tend to increase. Of course, if an advanced non-infective case can be adequately cared for in his home, there is no object in isolating him.

If such a scheme as out-lined were carried out, the result would be that a complete system would be developed, not only for the care of the crippled,



Model Cottages for Lepers
Chengmai (Siam).



Model Cottages for Lepers.
Chengmai (Siam).

but also for the care of the early case. It must be admitted, however, that only a few countries in the East have facilities so perfected that such a scheme could be set in motion. In India a scheme on the above lines is rapidly being developed. The Mission to Lepers⁽¹⁾ is organising, as far as possible, a leper hospital in each province, so that the early case can be properly treated, and the homes for the advanced cases adequately supervised.⁽¹⁾ The leprosy hospitals will be adequately staffed with facilities for treating out-patients and for training medical men and others. In addition, the British Empire Leprosy Relief Association (Indian Branch) is concentrating on the following points:-

1. Appointment of special research workers.
2. Establishment of out-patient clinics.
3. Training of doctors for these clinics.
4. Propaganda.
5. Survey to estimate the areas of greatest prevalence of leprosy.

Such experiments as are being carried out in India will be watched with great interest, for the Authorities there contend that the method of compulsory segregation can never rid a country of the scourge of leprosy.

As leprosy is frequently a house infection, Rogers⁽²⁾ has pointed out that by carefully tracing contacts the problem could be brought under control. In countries such as South Africa, such methods are feasible, but in India it is almost impossible to keep trace of contacts, and therefore any method devised for this end would certainly break down. Paroled cases should be told to come up for re-examination at frequent intervals; every three months for the

- Ref. 1. R.G. Cochrane. "Final Report on the Medical Work of the Mission to Lepers." Published by The Mission to Lepers, London, W.C. 2.
2. Rogers (Sir Leonard) Proceedings of the Royal Society of Medicine, Vol. XX, No. 6, April 1927. p.1024.



Model Wards. Chengmai (Siam).



Lepers Church. Chengmai (Siam).

first year and at six-monthly intervals for five years. In Africa and countries where conditions are very primitive, such a scheme for the prevention of leprosy is hardly practicable. But in view of the improvement in treatment anti-leprosy work should be so planned that the early, rather than the advanced case, should be encouraged to come. When the local conditions with regard to leprosy have been studied, planning on a larger scale could be instituted.

It will take decades, if not centuries, to rid any country in the East of leprosy. If the ultimate aim of leper work is the education of the medical profession, the attracting of the early leper, and the fostering of an enlightened public opinion, in the course of many years the Leprosy Problem will begin to come under control; and once it reaches this stage, then in a comparatively short time the disease will gradually disappear, for the conditions in the country will be inimical to the spread of leprosy.

* * * * * E N D * * * * *