

LEPROSY REVIEW.

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EDITOR

R. G. COCHRANE, M.D.

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E. MUIR, M.D., has recently been appointed Medical Secretary of The British Empire Leprosy Relief Association, and General Secretary-Treasurer of the International Leprosy Association. He was until lately Leprosy Research Worker at the School of Tropical Medicine and Hygiene, Calcutta.

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Editorial

Our readers will be interested in the account by Dr. Armstrong of his visit to Nigeria. Dr. Armstrong is one of the two Medical Officers the Association is assisting to maintain in West Africa, in order that they might devote their time to leprosy.

There are a few points in the article on Nigeria on which we wish to comment. Dr. Armstrong is correct when he says that the chief hope for controlling the disease appears to be in efficient segregation of all open cases, but then he goes on to say "This can only be done by having a settlement which patients are willing to enter at the beginning of the disease." We certainly feel that settlements should, as far as possible, be reserved for early open cases of leprosy with some prospect of recovery and for children in the active stages of the disease. We consider that the treatment of active cases among children, and the prevention of the disease in the young, are the keys which will ultimately open the way to the control of leprosy. While it is true that for many years the officers in control of settlements will, for humanitarian and other reasons, be compelled to admit not only advanced cutaneous cases, but destitute sufferers who need to be cared for, yet we feel that the sooner the indigenous peoples can be educated to look after the hopeless case along similar lines to those which are being worked out in India, the more effectively will leprosy be controlled. The idea of "leper villages" is not altogether unsound, although the old type of village came under condemnation on account of the suffering involved in leaving the poor wretches to the torture of a living death. While settlements will remain an essential in any efficient scheme for the control of leprosy, other methods will have to be devised, suited to the particular needs of the country concerned, if this problem is to be reduced to manageable proportions.

Dr. Armstrong advocates marriage in settlements. While no hard and fast rule can be laid down, for conditions vary in different countries, we feel that the marriage of the inmates may create more problems than it solves.

Dr. Rao in his contribution puts into a modern setting an age long problem concerning the difference between neural and cutaneous leprosy, especially in connection with relapses in the apparently arrested case. Impey⁽¹⁾, that great South African leprologist of the last century, believed that neural leprosy was the result of a "poison," as he called it,

acting on the nerves, for he says "The spots, (anaesthetic) are due to the poison entering the general circulation and acting upon the terminal branches of the cutaneous nerves, and not, I imagine, to the presence in the skin of the bacilli themselves; though, as might be supposed, these may, after the cutis has become weakened by their virus, actually invade this tissue." Hansen⁽²⁾ discussed this question in his book published in 1895, and stated, "In the nodular form, whether the bacilli are present in millions or millions, the eruptions or auto-infections are frequent; in the maculo-anaesthetic form, where their number is comparatively insignificant, the eruptions are rare. Does this difference between the two forms depend on the difference in the virulence of the bacilli? This readily suggests itself, but if so, the virulence is capable of very rapid changes."

Rao puts forward his reason for supporting the hypothesis of a neurotropic virus, which should be carefully studied. If leprosy can develop 30 and even 40 years after an individual has left an endemic focus, it is not unreasonable to assume that an apparently arrested focus may be reactivated years later if conditions are suitable. Until further proof is forthcoming we prefer to accept Hansen's explanation, that whether the individual shows the neural or cutaneous form of the disease depends on the individual's resistance, that is, on the soil (tissue resistance) rather than on any peculiarity of the bacillus. To quote Hansen, "The virulence of the bacilli seems to depend, not so much on any constant character of their own, as on the soil in which they live."

It will be noted by our readers that Dr. E. Muir, of the Calcutta School of Tropical Medicine, is taking over the Medical Secretaryship of the Association from October 1st. Dr. Muir will edit the new volume of the Review from January, 1936. We should like to express our sincere thanks to all those who have contributed to the Review during the past six years, and to those in all parts of the world who have expressed their appreciation of this journal we are grateful, and we are convinced that under Dr. Muir's editorship the Review will become increasingly useful and valuable to those who are anxious to keep in touch with modern advances, and have not the time to read the more technical journals.

(1) Handbook on Leprosy by S. P. Impey, M.D., M.C., J. & H. Churchill (1896), p. 61.

(2) Leprosy in its Clinical and Pathological Aspects, by Hansen & Looft, translated by Norman Walker, M.D., F.R.C.P., John Wright & Sons, Ltd., Bristol (1895), p. 79.

(3) Ibid idem, p. 79.

Change of Secretaries.

The British Empire Leprosy Relief Association has been particularly fortunate in the key appointment of secretary. The good work of Mr. Oldrieve from 1923 to 1929 in organizing the early work has recently been described in my article on the first decade of the Association in Vol. V, 1934, of this Review, together with the work of our first whole time Medical Secretary, Dr. Cochrane, from 1929 to 1934, who is now leaving us to take up field work as medical officer in charge of the Lady Willingdon Leprosy Colony in Madras. In this province our Indian Council is doing more work than in any other area in treating cases at the very numerous clinics, as described in a recent issue of this journal. In addition to his good work during his extensive tours in Africa, India and Ceylon, already described in the article mentioned above, Dr. Cochrane has rendered a great service by his recent tour in the West Indies and British Guiana, and the Colonial Office has taken up the consideration of his many valuable suggestions for organising work in those colonies with a view to reducing and eventually stamping out leprosy. Dr. Cochrane was unfortunate enough to be taken ill recently and to have to undergo an operation, from which he is making a good recovery, and he hopes to be able to sail for India without delay. The best wishes of all his colleagues will go with him in his new sphere of work, which will afford him better opportunities of making a further mark in leprosy work than he can do without extensive clinical experience of the disease.

We are still more fortunate in being able to obtain the invaluable services of one of the foremost leprosy research workers in the world in Dr. E. Muir, who has been whole time leprosy research worker in the Calcutta School of Tropical Medicine ever since its foundation in 1920, working under the endowment fund I raised, subsequently supplemented by the successful appeal of Lord Reading, when Viceroy of India, for our Indian Council. Dr. Muir was the first to confirm my discovery that the injection of soluble preparations of chaulmoogra and hydnocarpus oil is a far more effective method of treatment of leprosy than the former oral administration of the nauseating oils themselves, and I was fortunate indeed in getting him to continue my researches under much more favourable conditions when I had to retire from the Indian Medical Service under the age rules just when the Calcutta laboratories were ready to start

work. His width of view, insight and patient work have resulted in far reaching advances, which have been of incalculable value in placing the dreaded leprosy within the pale of preventable and curable diseases, using the latter term in its popular sense. The use of creosoted pure hydnocarpus oil and ethyl esters prepared by his simple method have furnished effective treatments at a cost within the reach of all. The importance of the stress he has laid on the treatment of all complicating debilitating diseases to increase the resisting powers of the patients is universally recognised. The surveys he organized throughout India have revealed the true nature and extent of the leprosy problem and enabled hundreds of leprosy clinics to be opened to treat some 100,000 cases a year, mostly in an early stage, at a minimum cost; and this in turn has led to the recent development of following up the patients to their houses and arranging for the home isolation of the infective cases in order to strike at the root of the problem by stopping new infections. Dr. Muir has completed over 30 years' service in Palestine and India, where he laboured as one of the most successful and hard working of medical missionaries up to 1920. Our Association is very fortunate in being able to make use of his unrivalled experience in the cause that he has so much at heart.

L. ROGERS.

Account of Visit to Leprosy Institutions in Nigeria.

H. C. ARMSTRONG.

I ARRIVED at Port Harcourt on Sunday, 4th November, 1934, and left on the 4th of December. From Port Harcourt I travelled to Uzuakoli and stayed with Dr. Todd until November 16th, and then left for Itu, staying with Dr. Macdonald. During my stay at Uzuakoli I spent a week-end at a new Government settlement at Ossiomo in the Benin Province.

UZUAKOLI.

This settlement is supported from the local native administration funds under the direction of the Primitive Methodists, who supply the Medical Officer.

There are nearly five hundred inmates and the approximate cost per head per year is just over four pounds. No maintenance is paid to the patients, but the settlement

supplies them with food daily. Most of the food is grown on its farm, and the remainder is obtained from the surrounding farmers at a very cheap rate. The cost per head for the food works out at about 1.4 pence per day.

The settlement is laid out in small two-roomed houses constituted of swish and stick and roofed with grass.



These houses are occupied by 4 patients. The layout of the town is in parallel streets in three groups for male, female and married quarters. The general arrangement has been copied from Itu.

There is no attempt made to segregate different types into different camps, but as far as possible a nodular case would room with a nodular patient in the same stage.

The other buildings consist of (1) Medical Officer's bungalow, servants quarters and stores, (2) Office, (3) Three houses for the non-leprous African staff, (4) "Clean" babies house, (5) Laboratory with stores and dispensary, (6) Hospital with 8 male and 8 female beds, (7) Operating theatre. At the edge of the settlement there is a small dispensary with a hospital of 4 beds for non-leper patients. In the settlement there are sheds for the following occupations:— (1) Carpenters, (2) Black-smiths, (3) Soap makers.

For the social side there is a library, (open twice a week); two churches—Roman Catholic and Primitive Methodists; Scout and Cub headquarters; schools for children during the day and for adults at night.

The healthy staff consists of—two male nurses who also help in the laboratory and non-leper dispensary, one general labourer, and one dispenser.

The leper staff consists of four male temperature clerks, six dressers, four teachers and ten police.

The water supply is from a fresh clear running stream which has been dammed, situated equidistant between the male and female town.

The latrines are in the form of shallow trenches dug daily and covered up after use.

The patients receive weekly injections of the usual anti-leprotic type. Leprotic reaction cases are admitted at once to hospital.

ITU.

The settlement at Itu is situated on the Cross River about four miles from the village of Itu. It consists of approximately 1,600 inmates and their houses, similar to those at Usuakoli, and are divided into male, female and married quarters.

The healthy staff comprises the Medical Officer, (Dr. Macdonald) Mrs. Macdonald, a trained nurse who undertakes the usual duties of a hospital matron and also trains the hospital nurses, Mr. Patterson, Inspector of Works and Farm Manager, and Mrs. Patterson, who is Superintendent of the School. There are also two Africans who assist in the office and dispensary.

The leprous executive staff is paid from the funds of the settlement, and consists of twenty police, eleven canoe men, fifty temperature clerks, ten female and eight male nurses, eight gardeners, and four headmen of companies who collect for the poor. There is also one inspector of the poor, three chiefs, one printer, twelve teachers, two engineers for electrical work, six washerwomen, two firewood men, two cooks for hospital patients and two incinerator men.

The rest of the population is engaged in various trades either of a productive or constructive type, also when any member receives an injection he must put in five hours work, e.g. on farms for the settlement in return for his treatment.

The occupations followed by inmates include private store-keepers who buy and sell their produce at the evening markets in the settlement, canoe builders, a blacksmith, an umbrella repairer and a goldsmith. The tailors have their own sewing machines, but if employed by the settlement for making such things as uniforms for police, nurses etc., they are paid 1/6 per day for work done, and 1/- per day for the use of their machine. The settlement also buys the fish caught by the fishermen at market price, less 20%.

Only a small percentage own their own farms. The majority are communal, producing yams, cassava, potatoes, corn, beans and ground nut. The cassava is made into a flour called garri, and twenty women are employed at this work. They are engaged on contract and the garri is sold in the market to other patients, or is bought by the settlement, some being used in the hospital for poultices. The communal farm also produces lemon grass, women being employed for planting, cutting and steaming the grass. This is collected and placed in a large boiler, steam is passed in at the bottom and escapes at the top, passing into a cooling

chamber which, after being undisturbed for an hour, contains the lemon-grass oil at the top and water underneath. The water is then run off and the oil is collected. This oil has a market value in England of about 4/- per lb. and cost of production is 1/- per lb. The extraction plant was bought for about £80 from a scrap iron yard on the Clyde bank.

The palm oil industry employs the greatest number of patients, who are divided into gangs for (a) planting young trees, (b) climbers—for cutting the fruit, (c) transporting the fruit to the extracting sheds, (d) extracting oil. All the work is done by contract and workers receive full market price for oil, less 20% which goes towards the settlement expenditure. This amount averages just over 1/- per head per week.

Just before leaving Itu it was proposed to plant half an acre of roses and to extract the oil by steam similar to the lemon grass method. The object of this is to provide work for the deformed, who would be able to pick roses. It is not expected that this industry will be on a paying basis.

The building trade employs six men permanently for sawing timber. They are paid so much per plank. There are also ten "bush" carpenters, who receive about 1/6 for a door and frame and 9d. for a window frame. These articles are sold to the settlement and to any buyer from the surrounding districts. The majority of the houses in the settlement were built by farmers during their off-season. The houses are made from swish, (*pise de terre*) and stick with a grass roof, and accommodate four people each. This work usually employs 16 men and the time taken is about one week per house. They receive £1 per house.

The settlement also has a small cement block making machine which employs four men. These blocks are sold to the Scottish Mission for building churches, schools, etc.

There are three men employed looking after the herd of goats owned by the settlement. The herd has lately been much improved by importing European he-goats. The milk is used for feeding the babies in the "clean" babies house, and also for patients in the hospital. I formed the opinion that most of Dr. Macdonald's success in dealing with leprotic reactions was due more to the liberal supply of clean milk than to any of the medicines commonly used.

There are seven large canoes with expert paddlers. These are hired by Itu traders for transporting cargoes up and down the Cross River.

During the off season for farming the local District Officer hires gangs of men for drainage and road making. Mr. Patterson, the Inspector of Works, produces odd jobs to be done every day, and so anybody left over from other occupations has some work found for him.

The social and educational side of the settlement is well organised. The school contains 150 children who attend school from 8 a.m. to 11 a.m. and work in the gardens around the European bungalows from 2—4 p.m. There are night classes for adults, male and female, on alternate evenings, who learn to read and write in their own language. When they are proficient in reading they are presented with a Bible printed in their own language. This has proved to be a great incentive to learning. The Bibles become their sole property and are given by the Scottish Mission, independently of the leprosy settlement.

The school staff consists of 12 male teachers who undertake the day and evening classes, but when children reach a certain standard, they then help the older people to learn the alphabet, acting as pupil teachers. The school organises a Scout and Girl Guide movement. They meet once a week with occasional field days. Their uniforms are made by the tailors in the settlement. The male children form the nucleus of the settlement's brass band, which meets three evenings a week, and once a week a concert is given. The band plays during Church service and is also employed at the weekly cinema programme given by Mrs. Macdonald.

There are two churches—a small Catholic one and the Church of Scotland which is the chief church of the settlement. This church is built on the side of a hill and seats 1,300 people, having cost only £130 to build. The seats, altar and pulpit are all made of beaten mud highly polished. The school children constitute the greater part of the choir. From its service collections the church supports eight poor.

The recreational activities include tennis and football. There are four tennis courts made of beaten ant-hill ground up and rolled into the surface. The inmates make their own racquets of solid wood. The Macdonalds give them balls and coach them in the game. There are two grass football grounds. This game is not organised but they can play in the evenings from 4.30 p.m.

Babies born in the settlement are at once removed from their parents to the "clean" babies house. If the mother's condition permits, she comes up to the nursery four times a day. She has to wear a gown with a slit for the breasts and gloves, while the baby is attired in a bag with only the

head showing. This provides for the minimum amount of contact between mother and child. These children are kept in the clean babies house for three years and if free from all signs of infection they are discharged to their parents' native village and arrangements are made for the relatives to take care of them.

Treatment is carried out twice a week. All patients when coming for their injections bring with them their temperature chart, so that leprotic reactions may be noted at once. The usual standard treatment is for a new case to have, on admission, a course of worm treatment (ol. chenopod: & carbon tetrachloride) and then a course of quinine. They then receive a three months treatment of avenyl twice weekly, after that, they are given one of the usual anti-leprotic drugs. At the end of every three months course, they receive another dose of worm mixture. There is a well equipped operating theatre where many major operations are carried out each year. The operation for a radicle cure of hernia appears most popular and also does away with the fear of operations for other conditions. All ulcer cases are regularly explored for necrotic bone.

Latrines are of the shallow trench type and are dug daily. When I was showing one of the laboratory staff—an inmate—the proper method of examining faeces, I was struck by the number showing ancylostrome eggs.

The water supply is by pipe line to each town. This pipe leads from a tank situated at the highest point in the settlement. It is filled by a hydraulic ram from a fast running stream. Incinerators are the usual "bush" type, circular in shape and constructed of beaten mud. They are also roofed.

OSSIOMO.

This settlement has just been constructed by the Nigerian Government. When I visited there it was in charge of a Medical Officer and a European Sanitary Inspector, who also had been in the Nigerian P.W.D.

The houses were constructed of cement blocks with corrugated iron roofs. The plan was a ground floor block containing 10—12 rooms, each room to accommodate two patients. There were separate rooms for male and female patients. The other buildings in the settlement included stores, a hospital for twelve patients, an operating theatre, a dispensary and treatment sheds.

There were approximately four hundred patients and most of their time was taken up in bush clearing. So far

the farms and industries have not been organised. Treatment is similar to that of Itu.

The sanitation is by means of pan latrines, emptied twice daily into Otway fly proof pits. The water supply is from clear streams and springs at the edge of the settlement. Incinerators are constructed of cement blocks of the Horsfel type with drying sheds on either side.

In this settlement there were also large cement baths for administering sulphur baths to patients with scabies and a large disinfector of the Serbian barrel type with downward displacement of steam.

This settlement has now been handed over to three R.C. Mission ladies, two being doctors and one a trained nurse.

When visiting the settlements run by the Missions I was impressed by the attitude of the inmates. The Government settlements compare less favourably with them. This may be due to the mental effect of their different occupations combined with the psychological influence of religious teaching. One must face the fact that the present day specific treatment of leprosy is not entirely satisfactory and it is quite possible that a close analysis of statistics would show that there were quite as many "cures" from non-treatment as from specific treatment. The chief hope for controlling the disease appears to be in efficient segregation of all open cases. This can only be done by having a settlement, which patients are willing to enter at the beginning of their disease and not, as often happens, when they have been driven out from their villages by their countrymen on account of their deformities and foul smelling ulcers. When once in the settlement, their time should be fully occupied with industry and farming in the mornings and afternoons, and in the evenings with mental and recreational activities, so that they have no desire to return to their native village. Marriage should be permitted but care should be taken to remove the infants and bring them up under the best hygienic conditions obtainable. When patients are engaged in any work they should receive a fair wage, so that they can regard themselves, not as outcasts, but as self-supporting decent citizens.

The work also increases their bodily resistance to the disease and so increases their hope of a cure. To give a dole or maintenance to able-bodied patients is inadvisable, because the patients refuse to work at farming or any industry except when they wish to fill in a few hours. It

also destroys morale in the settlement and leaves the Medical Officer without the most important treatment that he can prescribe for the disease and that is healthy out-door exercise.

The original idea at Ho. of giving maintenance so that patients might increase their ordinary diets was excellent, but experience shows that the whole sum is not spent on food. It has often been spent on the maintenance of other relatives in outlying villages.

I wish to acknowledge the help and kindness shown to me during my visit to Nigeria by The Honourable Director of Medical Services, Lagos, and Dr. Thomson, the Deputy Director, Medical Service, and the Surgical Specialist at Port Harcourt for arranging my transport and helping me through the Customs. Also Dr. Todd, of Uzuakoli, for accommodating me in his bungalow during my stay at his settlement, and Dr. and Mrs. Macdonald, of Itu, for their numerous acts of kindness and help. I also desire to acknowledge thanks to the Honourable Director of Medical Services, Gold Coast, for permission to undertake these visits to Nigeria.

(Printed by permission of the Director of Medical Services, Gold Coast, and the Director of Medical Services, Nigeria.)

Leprosy in South America.

WEBSTER E. BROWNING.

IN GENERAL.

LEPROSY is a disease that is essentially human and follows the great migratory movements of population as caused by military or commercial operations. It has been known in Africa, China and India for thousands of years, but the place of its origin still remains obscure. It appears to have been known in south-east Europe as early as 350 B.C., having been brought from Asia, and its existence in Great Britain in the seventh century is recorded. It increased greatly in Europe during the Middle Ages, especially during and after the Crusades, but declined in the fourteenth century, after the Black Death in 1349. It appeared in Spain, according to one authority, about 60 B.C., probably brought by the soldiers of Pompey who were returning from their campaigns in Egypt and Syria.

Two decades ago the total number of those suffering from leprosy in the world was estimated at 2,000,000. More

recent statistics give the number as 3,000,000. Moreover, since there are two or three incipient cases in existence for every typical advanced case, the grand total of those infected with the bacillus of Hansen may easily reach the staggering total of 5,000,000, or one to every 370 of the entire population.

There is no record of the existence of the disease in South America before the arrival of Europeans. It is also a well-attested fact that, even to-day, among the native Indians of the far interior of the continent, where they have had little or no contact with outsiders, the disease is unknown. Its appearance, therefore, in this continent, must be attributed to the presence of foreigners, especially those who came from Spain and Portugal in the sixteenth and seventeenth centuries, or, as slaves, from the jungles of Africa.

EARLY EFFORTS TO COMBAT THE DISEASE.

The first leprosarium in the New World, so far as may be historically determined, was established near the beginning of the seventeenth century in Cartagena, a city in what is now the Republic of Colombia. It was at first located in the centre of the city, but, in view of the urgent protests of the people, was later removed to the summit of a near-by hill. There a lazarette, modelled after those in Europe in the Middle Ages, was organized. In the beginning it was simply a site on the hill, open to the wild beasts of the jungle or to any person who cared to enter. It had no hospital, no houses, no church and no school for the children. It was simply a collection of poorly constructed huts to which the cases found in the city were driven in order to rid the populace of their presence.

However, a priest, Peter Claver by name, who also did much for the slaves of that time, became interested in the unfortunates who formed this little colony and decided to dedicate his life to the bettering of their physical and spiritual condition. He did a great work and deserves to rank with Father Damien, of Molokai, although his performance was much less spectacular and has the added disadvantage of being shrouded in the mists of history.

TYPES OF THE DISEASE IN SOUTH AMERICA.

Physicians who specialize in the treatment of leprosy in the various countries of the continent state that all types of the disease are to be found. The most common are: (a) the pure skin type, going on to the formation of nodular

thickening, (b) the pure nerve type, with thickening of nerve trunks and affection of the dermal nerve endings, producing anesthesia and muscular atrophy, and (c) the mixed type, with symptoms belonging to the other two. The mixed type is the most prevalent.

PREVALENCE OF THE DISEASE IN SOUTH AMERICA.

While this paper deals especially with the problem of leprosy in South America, it should be stated, before entering on a detailed study of the situation in the various countries, that the disease abounds, also, in the islands that rim the continent to the north, in the Caribbean Sea, and in Central America and Mexico. There is also a comparatively small number of cases in the United States of America, probably about 1,000 in all, most of whom have entered from surrounding countries. But, in that country, the disease tends to disappear, or is maintained only by infiltration from neighbouring countries.

The ten Republics and the three foreign colonies that occupy the territory of South America will now be mentioned separately and a few facts given in regard to the extent of the disease in each, beginning with those that lie along the Spanish Main.

Venezuela, with a population of about 3,000,000 has several thousand leprous inhabitants, of which number only a few hundred are cared for in some degree in the two official leprosaria. One of these institutions is just outside La Guayra, which is the port for Caracas, and the other is inland near Maracaibo. The writer found very little interest in the disease among the physicians of Venezuela and the colony which he visited presented a most dismal aspect. Evidently, little or no attempt is made to treat the complaint, there is no obligatory segregation, and the patients seemed resigned to death and their final transfer to the large cemetery, near which one had to pass in order to reach the leprosarium.

Colombia, whose population reaches almost 8,000,000, has a very large number of cases of leprosy, the reported number varying according to the nationality of the physician who makes the report. National dermatologists state that there are only 4,000 to 5,000, although their own statistics locate over 4,000 in the leprosaria, while foreigners have declared that the total number of lepers must reach at least 30,000. Probably the latter number is more nearly exact, although no reliable statistics have been given.



Showing some of the Children now in the Pirapitinguy Government Colony, Sao Paulo, Brazil. 1,500 will ultimately be accommodated here.



Paraguayan lepers in old quarters at Asuncion. Visitors in dark coats, (left to right) Dr. W. E. Browning, a Paraguayan doctor and Dr. John N. Hay.

By kind permission of the Mission to Lepers.



Modern buildings
in the cottage
style line this
street in the new
section of the
Pirapitinguy
Colony, Brazil.



Site of new Farm Camp, replacing crowded quarters in
the City of Asuncion.

Women's Ward
in Curupaity,
one of Brazil's
Leprosaria.



There are three leprosaria in the country. One of them is located in the valley of the Tocaïma river near Bogotá, the capital, and has about 3,000 inmates. A second is near a place called Santander del Sur, on the right bank of the Magdalena river, and reports about 1,000 patients; while the third, called Cano de Loro, is on an island in the bay of Cartagena, with about 200.

Considerable interest in the disease is manifested by the physicians of the country, and the Government provides for the care of the sufferers who care to go to the colonies. But, again, segregation is not enforced and it is not unusual to meet cases on the country roads or in the streets of the cities. One gets the impression, in Colombia as elsewhere, that the physician is glad to have a chance to study the disease professionally, but that he has little or no interest in the recovery of the patient. It would be very costly to provide chaulmoogra oil for so many patients, and the colonies, located so far from the urban centres, offer little attraction to the average physician. The colonies of Colombia appear to be—as was the case of the first one established in Cartagena—merely centres to which the sufferers may go or are driven, where they are cared for to some extent, but receive very little expert attention and treatment.

Ecuador, which lies along the west coast of the continent, with a population of about 2,000,000, has many cases of leprosy, possibly several thousand, but no statistics are available. There is one small leprosarium near Quito, the capital, situated almost on the equator, which is used principally as an experimental station for the medical students of the university, who are supposed to visit it once a year for the purpose of studying the disease. Another is located near Cuenca, a city of 40,000 inhabitants. This appears to be merely a tract of country to which the cases are driven when the disease has so disfigured them that they cannot be allowed to walk the streets of the city, and there is no statement available of medical assistance or other care given them.

Peru and *Bolivia* do not consider leprosy one of their major problems, inasmuch as those suffering from the disease, whose number is unknown, are generally to be found in the warmer regions, in the basin of the Amazon, and, thus, far from the centres of population. Probably the disease has crept up the slopes of the Cordillera de los Andes from the plains of Brazil, where, as we shall see, it is exceedingly prevalent. It is known that leprosy generally follows the

great river systems, and this is probably another proof of this accepted fact.

Chile alone, of all the countries of South America, is free from leprosy on its mainland. There is a small colony on Easter Island, which belongs to Chile, a thousand miles out in the Pacific, but it is only occasionally that a case is found in the country itself, and care is taken that the disease does not spread. This is due to the fact that Chile is shut off, on the north, by a great desert, through which lepers could not travel; on the east by the high Andes, so that they cannot cross from Argentina; and on the west rolls the wide Pacific. The cold lands to the south, around Cape Horn, make the presence of leprosy impossible. Moreover, the sanitary authorities of the nation are very careful in their revision of all incoming passengers by train or steamer, and it would be difficult to pass their minute inspection. An occasional case of elephantiasis may be found and although this is not generally classed as true leprosy, yet the sufferer is segregated and cared for by the sanitary authorities until his death.

Argentina, whose population is around 12,000,000, has a large and constantly increasing number of cases of leprosy, but it is not possible to secure an exact census. Some national writers put the number as high as 10,000, others declare that it does not exceed 4,000, while a recent publication states that, according to the Ministry of Foreign Affairs, "a census reveals that there are in the country 2,500 leprosy persons, of whom only 250 are cared for in corresponding institutions". Undoubtedly the former figure is altogether too low, and the latter is too high. There is but one leprosarium in the country, and that is a ward in one of the hospitals for contagious diseases in Buenos Aires. At the close of 1934 there were in this ward, by actual count, 110 men and 48 women.

The disease is especially prevalent in the provinces that border the Parana river—Corrientes, Entre Rios and Santa Fé—but there are also many sufferers in Chaco, Misiones, and Formosa, and no inconsiderable number in Buenos Aires, in addition to those in the ward of the hospital cited. An expert in the treatment of this disease who visited Buenos Aires some years ago, declared that the group cared for in the ward referred to constituted one of the most saddening sights he had seen in all the world. Men and women, in separate connected buildings, are crowded into a

small space with no entertainment or employment which would tax their ingenuity or free their minds from their condition. Argentina, so far advanced in all other matters that pertain to social legislation, has been slow to recognize the peril to her future in the presence of so many cases among her rapidly increasing population. She has done exceedingly little in the prophylaxis of the disease, and but few physicians interest themselves in its therapeutics.

A few years ago plans were drawn for a magnificent building to be erected on an island in the Parana river, in the far interior of the country. This building was actually erected, but, on account of strong protests from people round about, was, in the end, dedicated to other purposes. The plan, now, it is said, is that each province should take care of its own lepers, but no attempt seems to be made in this direction. Meanwhile, the disease spreads with alarming rapidity and is quickly becoming a major menace to the public health.

As a contrast to the apathy of public officials it should be said that a large number of ladies, representing the highest social circles, formed, about five years ago, a society for combatting the disease, known as the *Patronato de Leprosos*. A considerable sum of money has been collected by personal and public contribution, and the fact that ladies of this class of society are interested in their unfortunate fellow citizens is encouraging and makes one hope that in the future the Government itself may be spurred into action.

Uruguay, the smallest of the South American Republics, which lies just across the River Plate from the great province of Buenos Aires, Argentina, has, in a population of about 1,500,000, more than 500 cases of leprosy, according to the most recent computation available. Formerly, about 25 were cared for in two tumbled-down huts in the grounds of one of the hospitals in Montevideo. Due to insistent urging, in which the medical students finally joined, a new and sufficiently commodious ward has been erected, in which both men and women, in separate departments, are now given light occupation and are properly looked after. About thirty men and ten women are thus cared for at the present time.

Paraguay, the Mesopotamia of South America, whose population is estimated at 800,000, has not less than 4,000 cases of leprosy and the number may reach 10,000. It is said that in the interior, but little visited by foreigners, there are villages in which almost everyone is affected with leprosy.

Fortunately this brave little country, which defended

itself against the attacks of a much more powerful neighbour, giving to that defence its total man-power and draining its financial resources, has awakened to the peril that lurks in the presence of so many lepers among its people and, in the midst of so many other serious pre-occupations, is taking steps to curb the evil.

A Presidential Decree has recently set apart a beautiful tract of land, of about 2,500 acres in extent, in the interior of the country, which is fast being developed as a model colony. The more than 100 sufferers from the disease who had been crowded into filthy quarters in the city of Asuncion have now been transported to this colony; new buildings are rapidly going up, and it will not be long before a very large number of cases will be gathered together under its auspices. The colony is under the direct supervision of an experienced European-trained Christian physician, who works under the counsel of a small committee in Asuncion. This committee is active in securing funds for the bettering of the conditions under which the inmates are obliged to live, and also in maintaining contact with officials of the Government.

In a short time this colony should develop into a model institution of its kind, thus serving not only Paraguay but all this part of South America. Due to help given by the American Mission to Lepers and friends resident in Buenos Aires, a number of milk cows, mules for heavy work on the farm, tools, fowls of different kinds, and many other useful articles and special equipment have been provided, and the patients are happy and improved in condition.

Brazil, the only country of Portuguese speech in South America, with a population of almost 45,000,000, in an area greater than that of the United States of America, has more cases of leprosy than any other country in the Western Hemisphere. According to the latest official estimates available—and they are but estimates—as quoted by the President of the Brazilian Mission to Lepers, there are not less than 50,000 cases in Brazil.

In some States, the average of positive cases is more than 4 per 1,000, which is unusually high. Moreover, the official census includes only those who have presented themselves for treatment, or who, in some way, have become known to the medical fraternity, and the popular estimate, made by those in a position to know, would greatly increase the total. Some declare that there are 75,000, and others go still higher. Physicians who specialize in the treatment of the disease

have declared that their country might well be re-named "Leperland," so numerous are the cases that have come under their personal observation.

But, if Brazil has more of these sufferers than any other country in South America, it has also done and is doing more than any other to combat the disease and prevent its further spread. There are many leprosaria in the various states, and the medical fraternity is alive to its responsibilities. The State Boards of Health, the Federal Board of Health, and other official groups are interested and active. There is a "Brazilian Mission to Lepers," which, with other private organisations is doing its part to prevent further spread of the disease, and, at the same time, care for those now afflicted.

GENERAL CONCLUSIONS.

Leprosy is widespread throughout the continent of South America, and is fast becoming a menace to public health, Chile being the only Republic in which no cases are found.

Because of the lack of exact statistics it is not possible to make a definite statement with regard to the total number of sufferers in the continent. One official organization, in a position to secure exact information, after a study of the situation, announced that there are 300,000. Others would reduce the number to 50,000. The writer believes that 100,000 would be as nearly exact as it is possible to determine.

A few countries pride themselves on laws that make segregation obligatory, and others have none. In no case is such a law enforced. Physicians, as a general rule, do not rank leprosy as a major menace. Consequently, but few specialize in its treatment or advocate its prophylaxis. All types of the disease exist, the mixed being most common.

In a few cases, as in Paraguay, the national government is awakening to its responsibilities and is dictating measures calculated to care for those who are now leprous and prevent the spread of the disease.

For some time to come, help from outside, such as is given by the American Mission to Lepers, will be needed to stimulate local interest. Physicians and governments are occasionally interested in the disease, but there is much need of help for those who have contracted leprosy, in the bettering of conditions under which they live and in the introduction of modern methods in the promotion of colonies.

Relapses in Leprosy

*With Special Reference to the probable existence of a
Neurotropic Virus form of Mycobacterium Leprae.*

G. R. RAO.

INTRODUCTION.

A PERUSAL of the literature on leprosy reveals a remarkable paucity of papers dealing with relapses in leprosy. This is probably because the question of cure of the first attack itself is as yet unanswered. Leaving aside the early or moderately advanced neural cases, in whom any relapse is easy to detect, and the cutaneous cases that have been once rendered completely bacteriologically negative by adequate treatment but have relapsed, in which case also, it is easy to detect relapses by ordinary clinical and bacteriological examinations; we have to consider the probability of relapses in very advanced neural cases with disabling deformities and other trophic lesions.

Prior to the International Conference on Leprosy held at Manila in January 1931, it was widely believed that when disabling deformities had set in and there were no other neural or cutaneous signs to testify to the activity of the disease, leprosy had died out from such cases, and consequently such purely deformed and disabled cases were designated as "Burnt-outs." But, this conception of the mutilating stage of leprosy seems to have received a challenge from sceptics, in consequence of which it was decided by the conference to drop out of use the term "Burnt-out," and substitute for it "Disease arrested with deformities." Our knowledge of the actual mechanism of causation of these deformities and trophic ulcers and absorptive bone lesions, is still incomplete. We appear quite satisfied when it is explained that they are essentially "trophic" in nature; but we do not know how these trophic lesions are actually produced. Is it not possible that besides the trophic factor there is some other factor that helps to produce these lesions?

One frequently sees a sickening recurrence of trophic ulcers in the same limb or in another limb, even in cases that had received appropriate surgical treatment for their previous ulcers with immediately satisfactory results; and it is very difficult to explain why in some cases there should be a progressive involvement of the metatarsals or meta-carpals, necessitating repeated operations. Two cases with exactly similar ulcers are operated upon, and the necrosed bone or

bones removed, and they heal up. One of these returns sooner or later with a recurring ulcer in the same limb. Injury to the periosteum covering the adjacent bones, during the previous operation, or constant pressure exercised on the devitalised limb while walking or performing any other natural act, may explain such recurrence. But these alone do not explain why there should be a recurrence after a long interval and a progressive involvement of, say, one metatarsal after another, even involving a bone so distantly situated as not to have been injured by a previous operative procedure. Are we to understand that the separate bundles of trophic fibres for the several bones in a limb tend to be affected in succession?

Muir 1933 (1) has recently advanced a very rational hypothesis to explain the production of early neural lesions of the cutis and subcutis in which the familiar acid fast bacillus of Hansen is either not seen or is very scarce. Is it unreasonable to suppose that the same neurotropic (or neurophilic as Muir prefers to term it) virus form of *M. leprae* which causes the primary neural lesions, may persist in the affected nerves or other tissues, and take a share in the actual production of the trophic lesions?

That this supposition is not altogether untenable will become evident when one considers the fact that similar trophic lesions appear either as a terminal event in many highly advanced cutaneous cases who have naturally or by appropriate treatment come down the curve of the disease, or even while they are still on the top of the curve in the C3 stage. A study of the C3—N3 cases, shows that while one part of the body is teeming with millions of bacilli (acid-fast) in nodules and infiltrated areas, another part of the body, say, a foot, shows a typical perforating ulcer. It is hard to believe that the familiar acid-fast bacillus can or does cause two entirely different types of lesions at the same time in the same case, even after allowing a broad margin for the natural differences in the structure of the skin and the nerves; and their respective powers of showing a cellular response to the presence of a foreign invader. Our credulity is still further taxed, when we find that purely neural cases with no acid-fast bacilli detected in any lesion previously, begin to show them when they pass on to the cutaneous stage, and we are told that these acid-fast bacilli were probably lying dormant somewhere in the system prior to their appearance in the newly formed cutaneous type of lesions. Gass and Rishi (1934) (2) have produced evidence to the contrary,

by their failure to find a single acid fast bacillus in the bone-marrow of purely neural type of cases. If the reticulo-endothelial system is the stronghold of the bacilli as is supposed, then why are they not detected in the bone-marrow which forms an integral part of the R.E. System, in the purely neural cases? No significant difference in the trophic lesions shown by a purely N3 case and that shown by a C3—N3 case, is noticed, so far as the lesions are concerned. How can one then explain that the paucity of bacilli in the nerves of the former and the abundance of bacilli in those of the latter, can both cause the same type of trophic lesions?

On the other hand, it would be perfectly rational to explain the appearance of the acid-fast bacilli in the neural cases passing on to the cutaneous type (N1—C1 cases) by supposing that these bacilli represent the modified or resistant forms of the hypothetical neurotropic virus form of *M. leprae*. And the appearance of trophic lesions in highly active advanced cutaneous cases with myriads of acid-fast bacilli all over the body, can also be explained by the supposition that the neurotropic virus form is concerned with the trophic lesions as well as the earlier primary neural lesions, while the acid-fast form is associated with the leprotic (cutaneous) type of lesions. This tentative explanation is further strengthened by the following observations—(a) No acid-fast bacilli have so far been found in the affected nerves in the earlier stages, whereas when the same nerves begin to react, a few acid-fast bacilli can be seen in smears taken from the sheaths of such nerves (b) purely neural lesions like anaesthetic or hypopigmented areas with no acid-fast bacilli detected in them, when passing on to the cutaneous stage, begin to show a few acid-fast bacilli (c) in the so-called tuberculoid type of cases with well marked erythematous granular and raised lesions, sometimes all over the body, even as many as ten clips from ten such lesions have been examined without finding a single acid-fast bacillus in any one smear.

These observations lead one to believe that the familiar acid-fast bacillus, is probably not the primary form, but that it is a modified or resistant form of some other (ultra-microscopic?) organism, as yet undetected. The assumption of acid-fast characteristics, as well as the secretion of "gloea" to bind the bacilli into masses, may all represent defensive attempts on the part of the bacilli to withstand the onslaught of the phylactic powers of the body, and may be analogous to the formation of cysts by *entamoeba histolytica* when the medium becomes unfavourable.

In this connection, it may be germane to recollect that there are still some sceptics who deny that the acid-fast bacillus is the causative organism of leprosy. The absence or extreme scarcity of the acid-fast bacilli in purely neural lesions in the earlier stages and in the "tuberculoid" type of cases, furnishes the "raison-d'être" for such denial. Further, even the familiar acid-fast bacilli have so far resisted all attempts at cultivation "in vitro," and clinical experience testifies to their extreme pleomorphism. Thus, it is not uncommon to find in a smear taken from the nodule of an untreated C3 case, uniformly stained rods, beaded and curved or straight rods, and a group of coccoids all in the same field or in different fields. Hoffman 1933 (3) has given an excellent description of these different forms in which the acid-fast bacillus may be present and has suggested that the granular forms might represent either resistant or degenerating forms, and the coccoids might be analogous to spores, or they may be an evolutionary phase of a still smaller ultramicroscopic organism. Denney 1934 (4) has also described the extreme pleomorphism characteristic of the Hansen's bacillus. The view that the granular and coccoid forms are signs of degeneration, is no longer adhered to by several experienced workers. Similarly, the opinion that these differences are due to varying staining techniques, is also no longer tenable, because even with the same technique in the same smear, taken from an untreated case, such pleomorphic forms are encountered. Similarly even in cases which are clinically observed to be rapidly advancing and show no signs of retrogression, such pleomorphic forms of *M. leprae* are found. This shows that the acid-fast bacillary form is very probably a stage in the life-history of the virus of leprosy, and that it is by no means the primary stage.

Unless we postulate the existence of a virus form of the organism, it appears to me impossible satisfactorily to explain the occurrence of (a) relapses in cases that were purely neural and were rendered symptom-free by prolonged and adequate treatment; (b) the successive occurrence of trophic bone lesions in some cases in whom no acid-fast bacilli have ever been found; (c) the absence or extreme scantiness of acid-fast bacilli in well-marked "tuberculoid" type of cases; (d) the occurrence of trophic bone lesions in C3 cases while they are still on the top of the curve, with myriads of acid-fast bacilli, and in C2 and C1 cases with comparative paucity of the same acid-fast bacilli, there being no significant difference in the trophic bone lesions shown by either the

purely neural (N3) cases, or the highly advanced cutaneous and neural (C3—N3 cases) and the moderate and mild cutaneous and secondarily neural (C2—N3 and C1—N3 cases); (e) the occurrence of relapses in the so called "Disease arrested with deformities" type of cases, after a fairly long interval, after their disease was declared arrested, by a competent worker, and during which interval there was no reasonable chance of at least some of them getting re-infected or developing a reinfection.

MATERIAL FOR STUDY.

In 1931, four of the so called "burnt-out" cases of leprosy, had to undergo an amputation of one of their legs for septic foot. A few months after amputation, though they appeared to be in good general health they all showed active signs of leprosy with new lesions, and one of them became a C1 case also. This was recorded by the present writer's colleague, Roy (1932) (5). The occurrence of these relapses served to disturb our complacent attitude towards these so-called "burnt-out" cases, and the present writer thought it necessary to examine them carefully with a view to detecting further cases of relapse. Twenty-six cases showing a reactivation of the disease were detected, and of these 20 were selected as definite cases of relapse, after a careful enquiry into their clinical histories, and after studying their previous charts very carefully. While considering this subject the belief that a non acid-fast form could alone explain these relapses was strengthened. Although these relapses were detected and studied in 1932, the publication of the findings was delayed on account of the fact that Dr. Muir, who was very much interested, took biopsy material from all the lesions with a view to comparing their histopathological features with those of the primary lesions. Dr. Muir has put forward the hypothesis that a neurophilic form of *M. leprae* may be present, and similarly Hoffman (Idem) has also suggested that such unrecognised forms may exist.

CAUSES OF RELAPSE.

All the relevant particulars regarding the relapsed cases are given in the table appended. It will be noticed that in most of the cases, septic feet or hands necessitating operations, with a fairly long stay in the hospital, both for the septic condition as well as for the associated illnesses, was the main predisposing factor. Excepting two males and two females, all the rest showed neural lesions such as new hypopigmented patches or hypopigmented and erythematous patches of the zone type. The two former showed cutaneous

(leprotic) type of infiltrated lesions on the face or in the nose, from which acid-fast bacilli were found in fairly large numbers.

An analysis of the sex incidence of these cases brings out the interesting fact that thrice as many females have relapsed as males, their respective numbers being 15 and 5. This shows that the naturally weaker sex have a greater tendency to relapse. Most of the females were past middle life and it is a point worth noting that they were very probably in the "climacteric" period when these relapses occurred. The metabolic disturbances incidental to this critical period in the life of women when superadded on to other minor ailments such as a short attack of malaria or a septic finger or toe, may probably induce relapses. On further analyzing the predisposing causes, we find that in one female they were multiple, "septic foot," "pregnancy and delivery," and "lactation," etc. In 12 out of 20 cases,

Serial No.	Name.	Sex & House No.	Declared Disease arrested on	Relapse detected on and the type of lesions shown.	Interval between relapse and arrest (Approx.)		Causes of relapse as ascertained from Hospital charts and Clinical History.	REMARKS
					yrs.	mths.		
1	Abed Arjun ...	M 17	3/3/32	5/5/32 N	0	2	Septic feet and gastric complaints for 3 or 4 months.	Probably almost all of these cases had hook-worm.
2	Lilu Lakhpati	M 7	5/3/31	3/3/32 G	1	0	Dysentery Hook-worm for about a month.	
3	Behari Boaz ...	M 17	5/3/31	3/3/32 G	1	0	Septic feet and Malaria for a month.	
4	Jugal ...	M 24	22/11/30	15/4/32 N	1	4	Septic hand, bleeding piles, dysentery and hook-worm.	
5	Kartik...	M 2	19/1/31	15/2/32 N	1	0	Septic foot.	
6	Rajobala ...	F 2	25/11/30	4/3/32 N	1	3	Septic foot.	
7	Salomi...	F 9	18/3/31	15/3/32 N	1	0	Malaria and Bronchitis.	
8	Sudha Sushila	F 10	12/3/31	15/3/32 N	1	0	Malaria.	
9	Bilasi ...	F 14	25/11/30	18/3/32 N	1	3	Septic foot and Malaria.	
10	Sabina...	F 18	29/11/30	1/4/34 C ₁	1	4	Malaria.	
11	Gunabati ...	F 18	27/11/30	1/4/32 N	1	4	Septic leg (amputated) and Nephritis?	
12	Monibala ...	F 19	25/11/30	5/4/32 N	1	4	Septic foot.	
13	Podda ...	F 19	12/3/31	5/4/32 N	1	0	Malaria.	
14	Muchni ...	F 20	28/11/30	5/4/32 N	1	4	Septic feet, pregnancy delivery and lactation?	
15	Mukti Mariam	F 21	25/11/30	5/4/32 N	1	4	Septic foot and Malaria.	
16	Mini Mariam ...	F 22	25/11/30	1/4/32 N	1	4	Prolonged fever and diarrhoea.	
17	Karuna Khenti	F 22	27/11/30	8/4/32 N	1	4	Senility.	
18	Podu ...	F 24	25/11/30	8/4/32 N	1	4	Septic foot.	
19	Arun Bala ...	F 25	27/11/30	9/4/32 N	1	4	Septic foot for 2½ months.	
20	Phulmani ...	F 25	25/11/30	9/4/32 C ₁	1	4	Nothing could be ascertained.	

M=Male. F=Female. Yr.=Year. Mths.=Months. C=Cutaneous. N=Neural.

including the one female just mentioned above, septic feet or hands with or without other illnesses such as gastric disorders, nephritis, bronchitis, and malaria, were mainly responsible; while malaria (with hookworm probably) was definitely incriminated in three cases. Prolonged fever and diarrhoea was the cause in one case, malaria with bronchitis was blamed in another, and dysentery or bleeding piles with septic hand and hookworm in a third; of the remaining two cases in which no definite predisposing cause could be ascertained, one could be reasonably attributed to senility. On the whole it is evident that some debilitating factor or factors, have been in operation for a fairly long time and they have caused the relapses.

DISCUSSION.

Do these cases come under the category of relapses or re-infections? This is an important point for consideration. Except in one case in which the relapse occurred, two months after he was declared definitely "disease-arrested (with deformities)," in all the other cases the period that elapsed before the relapse was detected after they were once definitely declared as "Disease-arrested with deformities," varied from 1 year to 1 year and 4 months. This period falls short of the accepted minimum incubation period for leprosy, which is 2 years; and hence these cases cannot be considered as "Re-infections," unless we are prepared to believe that the incubation period can be considerably shorter for re-infections in those who once have had the disease in any form, neural or cutaneous. If such re-infections are possible, then, considering the fact that we have about 300 cases or so, of the "disease arrested with deformities" type, most of whom suffer now and then from trophic disturbances of the feet or hands, living side by side with cutaneous (open) cases, the incidence of re-infection should be almost universal in them. On the contrary, a study of the leprolin-response of the "disease-arrested with deformities" type of cases, using both the leprolins (Hansen's and Stefansky's) and carrying out the readings strictly according to Muir's technique (Muir (1933) (6), has shown that they have a fairly strong acquired resistance to Hansen's bacillus, and therefore cannot be considered to have got any special susceptibility to re-infection. That very few cases should have occurred under the conditions outlined just before, is itself a point in favour of these cases being relapses.

Of the 20 cases of relapse, only four showed the acid-fast bacilli in their new lesions, while the rest (16), showed chiefly

neural type of lesions which were negative to acid-fast bacilli even on repeated examinations. It cannot be denied that the causative organisms of leprosy in whatever form and however few they might be, are present in such neural lesions. The very fact that we cannot find them in the familiar acid-fast form, even on repeated examinations, shows that they exist in such lesions in a hitherto unrecognised form, and it is suggested that it is a neurotropic virus form. And the finding of the bacilli in four other cases of relapse that showed a few cutaneous type of lesions, indicates that there is a definite relationship between the unrecognised neurotropic virus form and the familiar acid-fast form, the latter very probably representing a resistant form of the former, the assumption of the acid-fast characteristic being a defensive attempt on the part of the virus. With regard to the habitat of the virus in these cases, it is possible that it might have been lying dormant in the affected nerves, lymphatics and in other parts of the reticulo-endothelial system.

CONCLUSIONS.

(1) The probable existence of a hitherto unrecognised non-acid-fast neurotropic virus form of *M. leprae* is deduced from a consideration of :—

(a) the absence of the acid-fast bacilli in neural lesions as well as in the affected nerves in the earlier stages; (b) the presence of the same in reacting nerves and in neural lesions passing on to the cutaneous type (N-G); (c) the absence of the acid-fast bacilli or their extreme scantiness in the so-called "tuberculoid" type of lesions; (d) the occurrence of trophic lesions in purely neural cases (secondary neural cases N3) as well as in cutaneous cases of varying degrees while they are on the upward trend of the curve or when they are descending the curve of the disease, in the former, with no acid-fast bacilli or very few of them, confined to re-acting nerves; and in the latter, with abundant acid-fast bacilli (c) the recurrence of trophic bone lesions, after long intervals involving distantly situated bones.

(2) The virus form probably persists even in the "Disease-arrested with deformities" type of cases for a pretty long time, and can cause relapse of active signs with a reactivation of the disease, when the general health is sufficiently lowered by some debilitating factors, operating for a fairly long time.

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Psuedo-Reaction in Leprosy due to Gonorrhoea.

DONALD P. DOW AND JOHN S. NARAYAN.

AMONG the diseases coincident with leprosy gonorrhoea is one of the most common and yet one of the most neglected. Being impressed with the importance of the disease as a complicating factor in the ordinary treatment of the inmates here, we were led to open a venereal clinic in the hospital. During the past year we have treated a great many cases and were interested to find that gonorrhoea either acute or chronic was ten times as common as syphilis. We are convinced that after treatment of the gonorrhoea many patients make rapid progress in their leprotic treatment, but in this paper we wish to draw attention, not to gonorrhoea or its treatment which are quite well known, but to a complication of the disease which is very liable to be overlooked, especially in leprosy, namely gonorrhoeal arthritis with its accompanying signs and symptoms. From our experience here we are led to believe that a proportion of so called lepra-reactions are in reality gonorrhoeal in nature.

Gonorrhoeal-arthritis is now generally regarded as due to a metastasis, the gonococcus being carried by the blood stream to the affected joint. The condition is more apt to occur in chronic gonorrhoea, or at any rate in the later stage of an acute attack, but it may occur, especially the poly-articular variety, as early as the third day.

Two varieties are met with (1) Acute (2) Chronic.

1. *Acute.* The acute type may manifest itself as :—

- (a) An acute arthritis occurring in one joint only, though it may occasionally occur in two or three. The joint is swollen and tender, the skin surface red and shiny, and the joint affected acutely tender on movement and palpation.
- (b) A poly-arthritis generally sub-acute, and affecting chiefly the smaller joints of the hand and foot. The joints are tender, but not so red and swollen as in the previous type.
- (c) A diffuse arthralgia with no clinical signs in the joint itself but the affected joints are painful, and the pain is flitting.

2. *Chronic.* The chronic type may manifest itself as :—



A STREET IN THE MEN'S VILLAGE, ITU LEPROSY COLONY.



AN OPEN-AIR SERVICE AT ITU LEPROSY COLONY.

(SEE DR. ARMSTRONG'S ARTICLE, PAGE 155)

By kind permission of the Church of Scotland.



GROUP OF "SYMPTOM FREE" PATIENTS AT DICHPALI.

By permission of "The Kingdom Overseas."

- (a) A hydrops articuli usually affecting the knee joint. The affected joint is swollen and tense but not painful.
- (b) An osteo-arthritis due to fibrinous exudate with subsequent adhesions.

The acute types are more common during the acute or sub-acute attacks of gonorrhoea; the chronic types follow a chronic infection of the posterior urethra or prostate.

With the chronic manifestations of gonorrhoeal infection of joints we are not at the moment concerned, but we wish to illustrate by the following series of cases the similarity between acute and sub-acute gonorrhoeal arthritis and lepra reaction.

Case A.E., Male, age 35 years, C.1., was admitted to the ward with left ulnar nerve reaction and slight pain in the wrist joints on 15-11-33, and was treated with ephedrine, salicytes, and gelsemium; the nerve pain was relieved, but this was followed by tenderness and pain in all the joints. The above drug treatment did not give relief and the patient was in excruciating agony. No local application brought any relief. He denied gonorrhoeal infection; but he was examined, and a smear taken was found to be positive for gonococci. Since the case was now regarded as one of gonorrhoeal arthritis, two injections of atophonyle 10 c.c. each were given intravenously bi-weekly, and an alkaline mixture orally, and after one week all the pains in the joints disappeared. The swelling of the right knee did not however subside; so we later drew off 8 c.c. of yellowish fluid. Two weekly injections of hexamine, grains 5, dissolved in 5 c.c. distilled water were given intravenously. The patient was relieved of his pains and was discharged from the ward on 1-1-34. He has been given urethral irrigations and prostatic massage because of urethral discharge. The patient later admitted that he had been infected 8 years before by direct contact and a year later his leprosy developed.

Case C.M., Male, age 40, C.2., frequently suffered from skin reaction accompanied by pains in the joints of the hands and feet. He volunteered a history of gonococcal infection 6 years previously, and a year subsequently developed leprosy. There was an abundant discharge of pus per urethram. The fore-skin was enlarged, swollen and oedematous. There was burning sensation and difficulty of micturition. This man developed a skin reaction and joint pains. Routine treatment of lepra reaction was without effect on the joint pains.

On being treated for gonococcal arthritis the joint pains subsided and he was discharged well. The anti-gonococcal treatment was continued.

Case C.V., male, age 26, N.1., was admitted to the hospital on 8-11-33 with no history of venereal disease, but Kahn 4 plus, therefore he was put on anti-syphilitic treatment under which he did well. This patient was admitted to the wards on 4-12-33 complaining of joint pains generally. He denied the possibility of gonorrhoeal infection, but in view of the number of cases of arthritis simulating lepra reaction we insisted on an examination when a copious discharge of pus per urethram was found, and the prepuce was swollen and tender; a smear was highly positive for gonorrhoea. Anti-gonococcal treatment cleared up the condition.

Case B, male, age 28, C.1., shortly after admission complained of pain in both knee joints which were regarded as leprotic in nature, but treatment along ordinary lines was of no avail; therefore he was examined for gonorrhoea and a urethral discharge of pus was found. He admitted gonococcal infection 6 years before, and a year later developed leprosy. The treatment of the gonorrhoea cleared off the joint pains.

Case O.K., male, age 40, C.2., was admitted on 30-7-33. He was getting the usual leprotic treatment, but after 3 months he complained of knee joint pains which he attributed to the anti-leprotic injections. Treatment of this affection on anti-leprotic lines was without any benefit. He gave no history of gonorrhoea, but during the examination of a batch of patients for gonorrhoea he was discovered to have a copious urethral discharge. Therefore anti-gonococcal treatment was given with very beneficial results. Later he admitted gonorrhoeal infection 5 years previously, followed by leprosy $1\frac{1}{2}$ years later.

All of the foregoing cases were complaining of symptoms referable to leprosy in a reacting stage and there are a great many such cases which we are treating here. The first three cases all had signs of an acute lepra reaction (fever, malaise, joint pains, body pains with rise in sedimentation index) while the last two were of a more chronic nature but they also had some signs and symptoms referable to the disease for which they were admitted here.

CONCLUSIONS.

From our observations we are led to believe:—

1. The gonorrhoeal arthritis with its accompaniments is far more

common than is generally supposed and may very easily be mistaken for lepra reaction.

2. Untreated gonorrhoea seems to persist for long periods in many people and while we have doubts that many of the patients here have been reinfected we believe that the disease persists in a sub-acute form for a surprisingly long period.

3. Almost every patient whom we have treated gave the history of leprosy having manifested itself within two years of the gonorrhoeal infection and we are led to wonder if the debility which frequently follows such an infection has not sufficiently lowered the resistance of the patient to allow the leprosy to become clinically manifest, for in none of our cases were we successful in eliciting a history of any other debilitating disease.

4. In some cases here of true lepra-reaction we find that the patients make no progress whatever until the coincident gonorrhoea is treated. But immediately that is done the repeated reactions to which such patients are subject subside, and progress commonly takes place.

A Method of Improving Treatment with Esters.

E. S. R. ALFRED.

THE prevailing method during the past three years of giving iodised esters was to give increasing doses twice weekly over a period of twenty weeks (or roughly five months), then intermitting for one month; this was followed by a further twenty weeks' treatment followed by a further four weeks' rest. In a straightforward case, the initial dose would thus be 1 c.c.; this was given once; then 2 c.c. twice, 3 c.c. four times, 4 c.c. four times, 5 c.c. six times and 6 c.c. for the rest of the course. After the interval, the initial dose was 2 c.c.; this was given twice, then 3 c.c. four times and so on as in the first course. Every suitable case was put on esters and the treatment was pushed. It was common experience to find lepra reaction setting in if specific treatment with esters was pushed to any undue extent. It was also commonly found in other cases that a patient remained well so long as he remained on esters injections, and that as soon as a rest was ordered signs of activity and/or reaction cropped up.

From my observations on the result of fluorescein treatment as instituted by Dr. G. A. Rylie at Sungei Buloh (part of which was published in the *International Journal of Leprosy*, Vol. 2, No. 2, April 1934), I was of opinion that

fluorescein has a definite place in the armamentaria against lepra reaction. A few cases were therefore put on fluorescein injections during the rest or interval obtaining at the end of 1933. These were all cases that had been activated or were definitely showing signs of a mild lepra reaction as a result of esters medication. The solution of fluorescein was freshly prepared for each occasion with distilled water, sterilised by boiling and filtered. An obvious improvement was noticed as a result of fluorescein treatment. The use of this drug was extended in the June "interval" of 1934, and in addition, phthalic acid was exhibited for a collateral group of cases—a total of 173 cases being put on both drugs. Owing to shortage of drug, the majority of the cases so tried were similar to those mentioned above; only a comparatively small number was put on as a sort of control for the above. The results were again definitely satisfactory. The conclusions tentatively come to were that this treatment prevented the onset of reaction in a number of cases, or at least prevented a reaction from becoming worse, but accelerated recovery; and that this method of combining esters medication together with an "interval" treatment with fluorescein gave better results from the patient's general health point of view than esters medication alone. Also that fluorescein was the easier drug to use. Parenthetically, to the query as to why mild reaction need be treated at all, it may here be answered that the great majority of the patients at Sungei Buloh are Chinese, and that the reaction seen in them here is of a comparatively severe and intractable type.

It was therefore decided to try this "interval" treatment on a still larger scale and as a routine measure in December 1934. Thus 339 cases were so treated—310 with fluorescein and 29 with phthalic acid. The treatment consisted of four to six injections of a 2% solution of fluorescein given in 10 to 20 c.c. doses twice weekly, or four to six injections of a 1% solution of phthalic acid given in 10 c.c. doses twice weekly. The results assessed at the end of the year were as follow :—

	Total treated	Much improved	Improved	Stationary	Worse
Fluorescein ...	310	14	247	35	14
Phthalic acid ...	29	—	15	8	6
Total	339	14	262	43	20

Comparative figures of cases on esters injections, etc. for 1933 and 1934 follow :—

	1933	1934	Increase for 1934 expressed as a % of 1933
Number of cases on esters injections ...	671	1289	92%
Number of esters injections given ...	24374	44452	82%
Number of reactions severe enough to be treated in Hospital ...	197	321	63%

The type of case treated in 1933 was generally of a better physique than that in 1934; that is, the 1,289 cases of 1934 include practically every one in the Settlement except the decrepit and senile cases and the groups on experimental treatments, whereas the 671 cases of 1933 included only those of better physique—there was then a larger number of cases on Tai Foong Chi and other or no treatment.

That the increase in the number of severe reactions (63%) has not been more, but has remained in proportion to the increase in the number of cases treated (92%) and the increase in the number of injections given (82%), I attribute if not entirely at least in great part to the institution of this “interval” treatment. The above are not infallible criteria, but under the circumstances the best available.

The following tentative conclusions may be made :—

1. Better results are obtained when esters are exhibited and followed by an “interval” treatment with fluorescein, than when esters are used alone.

2. Reaction can be averted by the use of fluorescein after a period of esters medication. That is to say, “interval” treatment may be considered a sort of prophylactic treatment for lepra reaction.

3. This may be due to fluorescein raising the treatment-tolerance level of the tissues for esters.

4. Needless to say, previous conclusions drawn on fluorescein medication hold good; *viz* :—

- a results may vary according to the brand of fluorescein used;

- b the solution must be freshly made, sterilised by boiling and filtered;

- c fluorescein is the easier drug to use in a large series of cases than phthalic acid.

On the Use of Fluorescein in the Treatment of Leprosy

JOSE M. M. FERNANDEZ AND SALOMON SCHUJMAN.

IN a preliminary report on the action of certain dyes in leprosy, Gordon A. Ryrie (1)—Medical Superintendent of the Federal Leper Settlement, Sungei Buloh—presents the results obtained with the use of several dyes in the treatment of leprosy.

One of the writers during his stay in the above mentioned colony, had the opportunity of talking with Ryrie about his researches and examining some patients who had apparently improved with this new method of treatment.

Desiring to have a personal opinion about the therapeutic value of such medication we have tried it on some patients in the Carrasco Hospital.

On March 1934 we started our researches trying three different kinds of dyes, trypan blue, eosin and fluorescein. In the present paper we shall report only the results obtained with the use of fluorescein.

TREATED CASES.

We treated 32 patients, the majority of them being advanced cases. With the exception of three cases, all others had previously received chaulmooga oil derivatives. Clinical and bacteriological conditions of every case were carefully charted before and after treatment. Periodically we controlled the sedimentation rate and examined smears for the *M. leprae*.

PLAN OF TREATMENT.

According to Ryrie's advice we prepared the following solution:—

Fluorescein Gübler	2 grammes
Sodium bicarbonate	2 grammes
Distilled water	100 c.c.
(filtered, sterilized)			

We always used a solution freshly prepared daily which we protected against light.

We started with a dose of 5 c.c. intravenously, repeated twice a week. Afterwards we always administered 15 and even 20 c.c. twice a week without any trouble. Simultaneously with intravenous injections, we have infiltrated intra-dermally the cutaneous lesions with the same fluorescein solution repeated once a week and occasionally twice. With nearly

Case.	Type.	Length of Treatment.	TREATMENT.		RESULTS.				
			Dose.		Bacteriological Changes.		Clinical Changes.	General Condition.	Sed. Index.
			Intravenous.	Intradermal.	Before T.	After Tr.			
1. A.A. 28 yrs.	C ₂ N ₁	11 weeks	21 inject.=200 c.c.	2 infiltr.=10 c.c.	(—)	(—)	None.	Improved	34-59-52-52
2. Bel. 20 "	C ₂ N ₂	11 "	21 " =200 "	2 " =10 "	(—)	(+)	"	"	30-28-26-21
3. Blo. 43 "	C ₃ N ₁	10 "	14 " =180 "	2 " =7 "	(++)	(++++)	Improved.	"	54-42-41-46
4. Ben. 40 "	C ₃ N ₂	10 "	15 " =208 "	3 " =12 "	(++++)	(++++)	None.	Stationary.	140-133-118-109
5. Ber. 22 "	C ₂ N ₁	14 "	14 " =180 "	—	(+)	(+)	"	"	44-46-6
6. Bot. 29 "	C ₃ N ₁	10 "	12 " =140 "	4 " =20 "	(++++)	(++++)	"	"	57-108-93
7. Gal. 19 "	C ₂ N ₁	15 "	10 " =110 "	—	(++++)	—	"	Improved.	22-43
8. Bor. 29 "	C ₃ N ₁	9 "	19 " =173 "	6 " =40 "	(++)	(++++)	Worse.	Worse.	133-120-128-134
9. Bor. 66 "	C ₃ N ₁	10 "	9 " =133 "	2 " =8 "	(++)	—	None.	Stationary.	121-63-135
10. Bur. 42 "	C ₂ N ₁	10 "	17 " =198 "	6 " =24 "	(—)	(—)	Worse.	Worse.	49-29-48
11. Car. 56 "	C ₂ N ₂	10 "	12 " =115 "	—	(+)	—	None.	Stationary.	8-6
12. Min. 59 "	C ₂ N ₁	13 "	15 " =208 "	—	(++)	(+++)	"	"	111-57-96
13. Mat. —	C ₂ N ₁	14 "	10 " =108 "	—	(+++)	(+++)	"	"	145-155-141-155
14. Pet. —	C ₂ N ₁	11 "	17 " =201 "	—	(+)	(+++)	"	Improved.	45-62-53-50
15. Per. —	C ₃ N ₂	11 "	9 " =90 "	4 " =18 "	(+++)	—	"	Stationary.	45-121
16. Van. —	C ₃ N ₁	10 "	17 " =200 "	4 " =20 "	(++)	(+++)	"	"	113-121-96
17. Vas. 29 yrs.	C ₂ N ₁	10 "	15 " =200 "	1 " =5 "	(—)	(—)	Improved.	Improved.	93-99-79
18. Gig. 38 "	C ₂ N ₁	11 "	10 " =123 "	3 " =15 "	(—)	—	None.	Stationary.	9-56-35
19. Gio. 30 "	C ₃ N ₃	10 "	15 " =193 "	—	—	—	"	"	137-140-130-134
20. Ghi. 32 "	C ₂ N ₂	10 "	16 " =182 "	—	(++)	(+++)	"	"	90-91-86-70
21. Vit. 44 "	C ₃ N ₁	7 "	12 " =146 "	5 " =20 "	(+)	—	"	"	58-16-56
22. Cas. 42 "	C ₂ N ₁	9 "	13 " =156 "	1 " =3 "	(++)	—	"	"	54-113-117
23. Car. 32 "	C ₃ N ₁	9 "	8 " =93 "	1 " =5 "	(+++)	(+++)	Sl. Improved.	Improved.	53-88-80-95
24. Chi. 46 "	C ₃ N ₁	10 "	18 " =200 "	6 " =26 "	(++)	(+++)	"	Stationary.	16-31-16
25. Fer. 63 "	C ₂ N ₁	10 "	18 " =200 "	—	(++)	(++++)	None	"	49-26-26-22
26. Fal. 33 "	C ₃ N ₂	9 "	15 " =192 "	3 " =12 "	(+)	(++++)	"	"	116-86-93-91
27. Gaz. 38 "	C ₃ N ₂	10 "	17 " =200 "	3 " =15 "	(++++)	(++++)	Worse.	Worse.	92-81-66-58
28. Gon. 36 "	C ₃ N ₂	11 "	13 " =194 "	1 " =3 "	(+++)	(+++)	None.	"	153-138-100-112
29. Gom. 27 "	C ₃ N ₁	12 "	13 " =200 "	1 " =3 "	(++++)	(+++)	"	Stationary.	73-57-83-80
30. Giu. 43 "	C ₃ N ₂	12 "	14 " =190 "	6 " =24 "	(+++)	(+++)	Sl. Improved.	"	53-54.
31. Moa. 28 "	C ₃ N ₂	14 "	16 " =195 "	1 " =5 "	(+++)	(+++)	None.	Worse.	119-131-136-138
32. Mon. 49 "	C ₂ N ₁	11 "	8 " =100 "	—	(—)	(—)	Sl. Improved.	Improved.	20-8-8-16

all the patients under treatment we reached a total dose of 200 c.c. in a period varying from 10 to 14 weeks.

The medication was well tolerated in every case. The only precaution we advised patients was to avoid direct sunshine immediately after the injections. Many of the treated cases were out-patients who returned home directly after the injections without any discomfort.

THERAPEUTIC ACTIVITY.

Clinical Changes: Twenty-three out of the thirty-two cases did not show any clinical improvement when the course ended. Five cases showed a slight improvement and in only one patient the improvement was marked.

In three cases the cutaneous lesions were benefited by intradermal injections. In three other cases (ob. 10-8-17) we observed on the contrary that patients became worse, as the lesions became more infiltrated and active. In one case (ob. 10) some new lesions appeared during treatment.

Bacteriological Changes: We did not observe any favourable bacteriological change in the lesions, even in those intradermally infiltrated. On the contrary, as Ryrie states, we verified a marked rise in the bacillary content of the lesions.

Histological Changes: A histological study of the lesions was made before and after treatment of intradermal infiltration with fluorescein without noting any change.

Influence of Treatment in the General Condition: In 8 cases an improvement of the general condition was observed. The weight, strength and appetite increased. In 5 cases the general condition failed, while in all the other treated cases no change was seen.

INFLUENCE ON THE COMPLICATIONS.

Lepra Reaction: In another paper we reported our experiences about this subject (2). We will only state here that according to our own experience, the use of fluorescein in the treatment of lepra reaction is not as encouraging as other workers assert.

Eye Complications: We have tried this dye in several cases of acute iritis with good results. We have reported in another paper (3) our experience with it.

CONCLUSIONS.

1. Using fluorescein in the treatment of leprosy according to Ryrie's method we have not obtained the favourable results observed by other workers.

2. This treatment seems to suit certain forms of acute iritis consecutive to lepra reaction.

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Prognosis in Leprosy.

E. MUIR.

(Reprinted from "*Leprosy in India*," Vol. VII, April, 1935).

INTRODUCTION.

THE more a disease is dreaded the more important is a reliable prognosis. Leprosy is not a fatal disease. In northern India the majority of clinically diagnosed cases never progress to the more serious forms of leprosy, and cause little or no physical inconvenience. But fear of the severer forms and of the well-known deformities may cause mental depression and distress which may in itself predispose to the increase of the disease. On the other hand a hopeful prognosis, when founded on reliable data, is often a most valuable asset in helping towards recovery.

DETERMINING FACTORS.

The important determining factors in making a prognosis in leprosy may be summarised as follows:—

The degree of natural resistance, which may possibly vary in individuals, though definite proof of this is lacking.

The age factor. The resistance to leprous infection is low during the first few years of life.

The general health. The more chronic and non-toxic an infectious disease is the more relative importance does this factor assume.

Depressed immunity due to hyperinfection.

Acquired immunity as the result of small (subliminal) infections.

1. *Natural resistance* to leprosy is strong in healthy adults. Human leprosy has never been transmitted to experimental animals as a progressive disease, and their high resistance is apparently shared by healthy human adults. As

in most other infectious diseases the degree of natural resistance to leprosy is probably greater in some subjects than in others, apart altogether from the state of their general health. It has been stated by some writers that this natural resistance not only applies to the individual, but also that in areas where leprosy has for a long time been endemic the more susceptible races are gradually eliminated and that thus a race immunity is evolved. While this may possibly be argued from the analogy of certain other diseases, there is but little actual direct evidence in its support.

2. Natural immunity is most markedly influenced by the *age factor*. In early childhood the natural resistance to leprosy is very low. Our recent surveys in Calcutta and in the Bankura District of Bengal show that children who have lived in close contact from their earliest days with infectious relatives or servants, in households where special precautions were not taken, seldom escape the disease; and the majority develop the severe infectious cutaneous type of the disease. Older children and adults exposed apparently to the same infection commonly either escape the disease or develop mild non-infectious lesions of the neural type.

Children infected in the first few years of life often show the 'juvenile' type of the disease. Slight depigmented macules with roughening and keratosis of the surface of the skin appear on different parts of the body from time to time, but bacteriological examination of these lesions is generally negative. About the age of puberty these macules may disappear permanently with recovery of the patient, or they may develop and show the cutaneous and infectious type of the disease; much depends upon the general health as the determining factor.

3. The majority of those infected after the susceptible age period—say after the tenth year—escape the severe and infectious type of the disease. If however the general health is severely depressed, or is even slightly depressed for a long period, the cutaneous (severe) type of the disease may develop. Such depression of health may be caused by a variety of causes: complicating diseases, dietary errors, pregnancy, etc.

4. *Hyperinfection*.—Another cause of weakened resistance to leprosy is of a more specific nature, viz. the increase of the infection in the body beyond a certain degree. Thus a vicious circle is produced, the bacillary concentration facilitating the further increase of bacilli and paralysing the mechanism which would arrest that increase.

5. *Acquired specific immunity*.—In contrast to the above, is the effect of small infections, which generally tend to increase or supplement the natural resistance. Thus, in patients who have passed the age of increased susceptibility and are in fairly good health, contact even with highly infectious cases may, with or without the appearance of mild leprous lesions of the neural type, develop an acquired immunity, as shown by the leprolin test (described below). Even in healthy young children this specific immunity may be formed, provided that contact be not too frequent and the degree of infection be not too great.

While large infections diminish resistance, small infections increase resistance. Among healthy adults, there therefore tends to be a considerable hiatus between what we term 'resistant' and 'non-resistant' cases. In the former the disease frequently dies out or remains stationary for long periods of years without showing any tendency to increase; in the latter it tends to progress.

The hiatus between the resistant and non-resistant case may however be broken down by anything which impairs the general health. The infection often spreads in the peripheral nerves with or without any clinical signs. As however the number of bacilli increases, the hyperinfection factor comes into play and still further reduces resistance, so that the skin (which is naturally more resistant to the infection than the nerves) becomes infected, and the cutaneous type of leprosy develops.

ESTIMATION OF RESISTANCE

In determining the resistance of the patient we chiefly rely upon the clinical and bacteriological examination. In addition however the *leprolin test* is of considerable value in distinguishing between specifically resistant and non-resistant cases, and the *erythrocyte sedimentation test* in estimating the general resistance.

The Leprolin Test.— This test, first used by Mitsuda and more generally adapted by Hayashi, is of immense value in testing the degree of natural and acquired immunity and the degree of depressed immunity due to hyperinfection. There is not room here to go into the details of the test, so a short description must suffice.

In the modified form of the test used in Calcutta two leprolins are used: (a) a suspension of ground up human lepromatous material (Hansen leprolin), and (b) as a control a similar suspension of omentum, spleen, and liver of rats

suffering from advanced rat leprosy (Stefansky leprolin). These two suspensions contain respectively *M. leprae* and *M. leprae muris*, mixed with tissue debris. They are sterilised by heat and standardised so that they give equal reactions when 0.2 c.c. of each is injected intradermally in human subjects who have not been infected with leprosy. These leprolins when injected into the skin produce within a week or two at the sites of inoculation small nodules having the consistence of a pea, and varying in size with the degree of resistance; the greater the resistance the larger is the nodule formed.

In young children and in those with bad general health the reaction to both leprolins is weak or negative. In those who have acquired resistance due to small infections with leprosy, the reaction to Hansen leprolin is increased and appears stronger than that to Stefansky. Where however hyperinfection has taken place, and the bacilli have increased in the body, the reaction to Hansen leprolin is weak or negative, though in adults whose general health is otherwise good the reaction to Stefansky leprolin may be as strong as in non-lepers.

The Erythrocyte Sedimentation Test.—This test has been found of great value in estimating the general resistance of leprous patients. As a rule steady improvement takes place in patients whose sedimentation index is consistently low; i.e., whose erythrocytes when tested at regular intervals always sediment slowly. Almost all pathological and physiological conditions which cause increased rapidity of sedimentation also lower the resistance of the body to leprosy.

Physical development.—As in tuberculosis so in leprosy physical training is of great importance. In the former disease this has to be carried out slowly by carefully graduated exercises. In leprosy physical training can be carried out more rapidly as vital organs are seldom involved. As the muscles become firm the erythrocyte sedimentation index is in many cases gradually found to diminish (i.e. the cells fall more slowly), and progress towards recovery becomes more rapid. In lazy patients or in those who will not take sufficient exercise, improvement seldom takes place whatever treatment be used.

The mental equipment of the patient.—In a disease like leprosy which requires a painful form of treatment often extending over several years the mental condition and character of the patient are of vital importance, especially as the main part of the treatment (that of keeping himself

physically fit) depends upon the intelligent persistence of the patient.

MAKING THE PROGNOSIS.

Prognosis in connection with leprosy may be conveniently divided under three main heads:—

In infectious contacts (contacts with infectious cases) without signs of the disease, what is the likelihood of leprosy developing?

In those in whom leprosy has developed, and definite signs are present, what are the chances of recovery, how long will it take, what are the chances of relapse, will recovery take place with or without deformities and disablement?

How long should treatment be continued after active signs have disappeared, and how long should the patient be kept under observation?

1. *Infectious contacts*.—We use this term to indicate those who have been in contact with infectious cases of leprosy, but who have not so far shown any signs of leprosy.

In making a prognosis the most important point to be ascertained is the age when contact first took place. If this was within the first few years of life, and especially if there was prolonged and close contact with a highly infectious case, then, even though several years may have passed since then and no signs of the disease have been noticed, it is possible that a generalised infection may have taken place which will show itself sooner or later. In such cases the leprolin test is of great value. If the reaction to Hansen leprolin is stronger than that to Stefansky then the prognosis is good, as it indicates enhanced resistance to *M. leprae*. In such cases if there had been any considerable leprosy foci in the skin or peripheral nerves they would have induced cellular reaction and shown themselves clinically, and no slight bacillary foci are likely to survive long in such resistant cases, as they would be phagocytosed.

If the reaction to Hansen leprolin is negative, or weaker than that to the control, the prognosis is unfavourable. In such cases careful clinical examination with the aid of a suitable light will often reveal macules which had escaped notice before; or careful and repeated bacteriological examination of the skin or mucous membrane will show acid-fast bacilli.

In addition to these cases we have the 'juvenile' type of leprosy. The age factor, referred to above, lowers the resistance to the disease, and thereafter the hyperinfection

factor steps in and maintains the lowered resistance. The absence or obscurity of clinical signs is due to the state of symbiosis set up in the non-resistant tissues of the body, the cellular and other responses which are responsible for the appearance of lesions being at a minimum. If the general health of the child is poor then the possibility of general infection having taken place is considerably enhanced.

In the case of healthy adults who have been in contact with infectious cases and show no signs, the prognosis is as a rule much more favourable. If a considerable period has passed since contact took place then definite signs of the neural type of leprosy would probably have declared themselves if infection were present in the body. But here too the leprolin test is of great value.

In adults who are or who have been in a poor state of health, the danger of the infection developing is much greater. If there is a history of severe or prolonged disease or of other predisposing conditions during the interval since contact took place, if the sedimentation index is high, and if the reaction to Hansen leprolin is negative or weak as compared to the control, then a very guarded prognosis is necessary; re-examinations of the patient clinically and bacteriologically may reveal positive signs sooner or later.

Contact with leprous cases (whether infectious or not) frequently gives rise to '*leprophobia*'. This is particularly common in doctors who have treated cases of leprosy, but whose experience of the disease is meagre. Some light macule due to leucoderma, seborrhoea, tinea or some other skin disease is mistaken for a leprous lesion; or neuritis, connected with a septic condition elsewhere in the body, is mistaken for a leprous nerve condition. If the patient is in good health and his suspected lesion is clearly not leprous, then a definite negative diagnosis may set his mind at ease. Often a form of neurasthenia centres round this phobia, and the patient takes leave from his work and spends his time brooding over his supposed ailment. In such cases it is important to have the leave cancelled; assuring the patient that there is no danger of leprosy, and the return to absorption in work may be sufficient to clear up the neurasthenia.

2. *Patients with leprous lesions.*—In making a prognosis the important points to ascertain are the degree of infection and the special and general resistance of the patient to the disease. All patients should be divided into resistant and non-resistant groups. In doing this it is important to go carefully into the medical history of the patient especially

with regard to predisposing causes; also the general appearance, bacteriological examination, and the extent of the lesions may give a clear indication. The leprolin and sedimentation tests are of great value.

The following table gives the main distinction between resistant and non-resistant cases as seen in Bengal :—

Resistant.

One or only a few macules with anaesthesia to light touch, and with marked erythema; thickening and induration of the skin either through out the lesion or at the margin.

Thickening and tenderness of the sensory or mixed nerves connected with the macules.

Generalised infection of the skin is never present, the disease of the skin being confined to a few macules.

Lesions grow slowly or remain stationary for long periods, often for years.

Bacteriological examination of the skin shows few or no acid-fast bacilli.

There is strong reaction to Hansen's as compared to Stefansky's leprolin.

Non-resistant.

More numerous and widespread and flatter lesions without marked erythematous thickening or induration, the margin merging with the surrounding skin. Erythema less marked. Hypopigmentation is more noticeable.

Nerve thickening as a rule not marked.

In advanced cases skin involment may be widespread, covering the whole body, with no appearance of macules. While in some of these cases there is noticeable thickening and nodulation, in others it is difficult to recognise the presence of disease on inspection though bacteriological examination shows widespread infection.

New lesions continually appear and macules grow rapidly in size and coalesce, until almost the whole skin is involved.

Bacilli are found in lesions of the skin and nasal mucosa in greater or smaller numbers.

Reaction to Hansen's leprolin is absent or very weak.

In resistant cases the prognosis is excellent provided the patient remains in at least moderately good general health. The lesions should disappear under treatment in a comparatively short time (a few weeks to a few months); and the danger of relapse, once all signs of active disease have disappeared from the skin and the nerves, is very small, provided that the patient's general health is maintained.

In non-resistant cases the prognosis is much more doubtful. If the general health is good, or if under suitable treatment it becomes good, and especially if the sedimentation of erythrocytes is slow, then a favourable though guarded prognosis may be given. The period of treatment necessary will however be much more prolonged. In many cases of low resistance a definite prognosis should be delayed until there has been time to observe the progress made under

general and special treatment. The effective treatment of complicating diseases, along with the carrying out of a strict régime of careful diet, active and suitable exercise and regular habits, is often found to bring about within a few months, or it may be in one or two years, improvement up to a certain point, after which the patient progresses steadily towards recovery, though several years may be necessary to get rid of all active signs.

The question of recovery, with or without permanent lesions and deformity, is an important one for the patient. The earlier treatment is begun and the more carefully it is carried out, the less likelihood is there of the development of trophic lesions of the hands, feet, and face. Carefully planned physical exercise is very important in this connection. Nerve reaction in the ulnar and peroneal nerves, which so commonly results in claw hand and drop foot, seldom occur in patients with firm well-developed muscles. In most cases a certain amount of anæsthesia and, if the larger mixed nerves have been involved, of trophic changes in the small muscles are likely to persist. These should not be mistaken for active signs of disease.

3. The length of treatment and the period of observation necessary after the cessation of treatment are matters of extreme importance. Treatment is frequently stopped far too soon, and relapse follows causing disappointment to the patient and loss of confidence in the treatment of leprosy.

In non-resistant cases clinical appearances are most deceptive. Lesions will often disappear due to the effect of complicating diseases, the resultant depression of cellular reaction to *M. leprae* giving a false appearance of improvement. Bacteriological examination should be carried out thoroughly and repeatedly till the results become negative in smears taken from all parts of the body, before the disease is declared quiescent. The disease should have remained quiescent for at least two years before it is declared arrested. Thereafter the patient should remain under observation for several years until the reaction to Hansen leprolin becomes stronger than that to Stefansky leprolin. The reason for this prolonged observation period after routine bacteriological examination has become negative is that, though bacilli may be absent from the skin and nasal mucosa, they may still remain present in the peripheral nerves.

In resistant cases the necessary period of treatment and after-observation is much shorter. In most of them bacteriological examination is negative from the beginning or only

very few bacilli can be found in the lesions. In resistant cases the criteria of quiescence and arrest must therefore be based chiefly upon clinical appearances; (a) lesions are flattened out, so that the finger on passing along the surface from the normal skin to the lesion cannot detect any raised margin, and the skin picked up between finger and thumb feels no thicker than the healthy surrounding skin; (b) thickened nerves lose their tenderness on pressure or percussion, and became reduced to their normal size; (c) no new lesions appear, and the original lesions no longer increase in size; (d) the areas of anæsthesia, though not entirely disappearing, remain stationary in size; neither increasing nor diminishing.

SUMMARY

1. A reliable prognosis in leprosy is important because of the dread in which the disease is held, and because mild, easily arrested resistant cases are apt to be confused with and bear the stigma attributable to the more serious incurable and infectious forms of the disease.

2. The degree of general and specific resistance of the patient is all-important in making an accurate prognosis. The methods of determining the resistance by clinical and bacteriological examination, with the aid of the leprolin and erythrocyte sedimentation tests are described.

3. The danger to young children in contact with infectious cases is discussed.

4. We described the methods of determining the length of treatment and how long the patient should remain under observation after the disease is *arrested*.

Annual Report for 1934 of the Bengal Branch of B.E.L.R.A.

(Reprinted from "*Leprosy in India*," Vol. VII, April, 1935).

A BRIEF SURVEY OF PAST WORK.

THE Indian Council of B.E.L.R.A. was formed in 1925. The Bengal Branch was formed in 1926, and in this year there were 11 leprosy clinics in the whole of Bengal. In 1927 a Leprosy Propaganda Officer was appointed by the Bengal Branch and he began to visit the different districts of Bengal with a view to getting leprosy clinics started. The following approximate figures indicate the increase in the number of public leprosy treatment centres maintained by local authorities in Bengal. Before 1927—11, 1927—16, 1928—23, 1929—30, 1930—34, 1931—39, 1932—57, 1933—72, 1934—99; there are in addition

about 65 private clinics run by industrial concerns for their employees. There are now clinics in 22 out of 28 districts of Bengal. This increase is very largely due to the work of the Branch. In 1930 a survey party of five doctors was appointed and since then simple leprosy surveys have been carried on in all the districts of the province. The propaganda officer and survey party have organised classes for instruction of doctors in the districts they have visited and carried on propaganda work for the instruction of the general public. This survey work has shown that leprosy is endemic in every district of Bengal, and that in some areas it is highly endemic, the incidence probably being as high as 7%. On the average over the whole province the incidence of leprosy appears to be about 1%. Up to 1933 the work of the Branch was extensive rather than intensive. 1934 saw a change in the policy of the Branch. The survey party instead of spreading its efforts over the whole province have undertaken concentrated work in the most highly infected district of the province. This work is described later. Some more widespread work is being maintained, the propaganda officer and his assistant visiting many different parts of the province every year. In the recent work of the Branch emphasis has been laid on the importance of prevention, by isolation of infectious cases, and an attempt is being made to make this measure an integral part of anti-leprosy work.

THE WORK DURING 1934.

The work of the Branch lies chiefly in two directions. First a Chief Propaganda Officer (Dr. B. N. Ghosh) and an Assistant Propaganda Officer (Dr. S. K. Das) and a clerk are employed in order to further anti-leprosy work in any part of Bengal. Secondly there is the special leprosy work and investigation centre in Bankura area where there is a party of three doctors and five field assistants working under Dr. K. R. Chatterji. These two spheres of work will be described separately.

1. *Propaganda Officer's work.*— D. B. N. Ghosh has given courses of lecture demonstrations in the following medical schools:—Mymensingh, Dacca, Calcutta, Chittagong, Jalpaiguri. Dr. Ghosh spent one month and carried on survey work in Agartala (Hill Tippera). He and Dr. Das surveyed one union board in the Faridpur district. He spent several weeks visiting the clinics in the Duars, and two months visiting the clinics in the Jute Mills area. Three months he spent in Calcutta and with Dr. Das and Dr. Sen

in collaboration with the authorities concerned examined the workers of the Garden Reach Workshops, Calcutta Tramway Co., all the stall holders of sweetmeat and tea shops in two wards of the Calcutta Municipality.

Dr. Ghosh and Dr. Das also examined the railway workers at Parbatipur. He also visited Birbhum, surveyed one union board and attempted to initiate anti-leprosy work by methods similar to those used in Bankura. A district leprosy board was formed with the District Magistrate and Health Officer as Chairman and Secretary, and an attempt is being made to organise effective work.

In December Dr. Ghosh visited the Asansol Mining area where most excellent anti-leprosy work is being done by Dr. L. Sen, Chief Sanitary Officer, Mines Board of Health. There is a central leprosy board with divisional branches most of which run their own clinics. Dr. Ghosh attended meetings of divisional branches, visited the clinics, and gave lectures to sanitary inspectors, local leprosy assistants, and vaccinators. One segregation camp is in existence in the mines area and another one is being planned in which it is hoped to segregate the infectious cases of a group of villages. Dr. Ghosh and Dr. Sarkar also carried out a small survey in the Hooghly district.

During the year Dr. Ghosh and Dr. Das visited 117 clinics in different parts of Bengal.

Dr. Ghosh and his assistants in various parts of Bengal examined 38,636 people, of whom 776 were found to be suffering from leprosy, giving an incidence of 2%. Six new clinics were opened by these workers.

One difficulty has again been encountered during the year's work. One medical officer of a railway, whose workers have been examined, has stated that under the railway rules all sufferers from leprosy, even if they are not infectious cases, should be dismissed from their employment. We think that the dismissal of non-infectious cases would be a very unfortunate result of our survey work.

2. *The work in the Bankura District.*—In last year's report reference was made to the initiation of concentrated anti-leprosy work in the Bankura District of Bengal. The objects of the establishment of this centre are as follows:—

1. By a study of leprosy in families and villages to find out the factors influencing the prevalence and spread of leprosy in the district.
2. To organise anti-leprosy work in the district by means of local anti-leprosy committees. These

committees organise work on a voluntary basis in two ways : (a) by establishing centres for the treatment of leprosy cases; (b) by arranging for isolation of infectious cases either in their homes or outside the village.

A systematic survey of 150 villages of different unions of Bankura, Raipur, and Simlapal thanas was conducted and the result of the survey is as follows :—

1. More than 78% of villages are affected with leprosy.
2. 1 in every 6 families harbours leprosy cases.
3. 4.1% of the population are lepers, or in round figures an estimate of 45,000 lepers in the district is not unjustifiable.
4. On an average 2 of every 5 lepers are infectious and 1 in every 5 lepers is highly infectious. There are approximately 18,000 infectious lepers in the district, of whom about 9,000 are highly infectious cases.
5. The following five principal castes, in each of whom more than 1,000 persons were examined, showed the following rate of infection :—

Caste			Families examined	Families affected and %	Persons examined	Persons affected and %
1.	Mahomedans	...	175	62 or 35.4%	1,013	80 or 7%
2.	Tili	...	235	58 or 24.6%	1,399	71 or 5%
3.	Bauri	...	582	106 or 18.2%	2,859	136 or 4.7%
4.	Brahmin	...	327	55 or 16.8%	2,000	62 or 3.1%
5.	Goala	...	459	52 or 11.3%	2,535	62 or 2.4%

The highest number of families and persons affected is among the Mahomedans.

Enquiries regarding the possibility of preventive work have elicited a favourable response from 59 union boards of 15 thanas. Out of these 59 union boards, 41 have already started active work in various forms. In 11 union boards leprosy treatment clinics have been opened where more than 650 patients are treated by local volunteers. 8 more clinics are under construction. It is expected that they will be completed soon. In almost all the union boards which have responded, isolation of highly infectious cases is in progress. Up till now more than 100 highly infectious cases have adopted isolation.

It is being realised more and more that leprosy cannot be controlled by treatment alone. Treatment is necessary, and a large proportion of cases may be expected to recover. But infectious cases during the many years that they are

under treatment may continue to infect the younger generation, unless they be effectively isolated.

One exceedingly important point has been emphasised by these investigations, viz. that young children are particularly susceptible to leprosy infection, and that the majority of those infected in early childhood develop the severe and infectious form of the disease. On the other hand the majority of those infected in later life develop the less serious non-infectious type of leprosy. Therefore, whatever steps are taken to control leprosy, the chief stress should be laid upon the isolation of infectious cases from young children.

Another important lesson learned from the Bankura Scheme is that village communities can be induced by concentrated propaganda to isolate voluntarily their infectious cases. This propaganda must however be based upon a local investigation of the spread of the disease in the village. When it is explained to the villager how leprosy has spread in his family or among his neighbours from generation to generation, he is quick to appreciate the danger to himself and to his children, and will take all possible means to avert this danger.

It is still too soon to foretell to what extent the work accomplished will prove permanent. It is clear however that if leprosy is to be controlled at all it must be by isolation of infectious cases. It is calculated that 40 per cent. of all cases are infectious. There are therefore probably about 400,000 infectious cases in India. Obviously these cannot all be segregated in institutions. The cost would be prohibitive even if all could be induced to enter institutions. The only alternative therefore is local voluntary isolation, and this must be carried out either by single village or by groups of villages. By the word 'voluntary' is meant that compulsion is not applied from without the unit. The compulsion of local public opinion is however of vital importance in securing isolation and this can be set in force only by special propaganda and the gradual education of public opinion.

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