Classification of Leprosy According to Immunity A Five-group System¹

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The current official classification of leprosy, which is that adopted by the Madrid Congress of 1953 (3) is generally acceptable to most people. It is realized that a continuous spectrum exists between the two polar groups, and that, whereas the number of intermediate points is unlimited (19), a total of three groups is generally convenient. Nevertheless, many workers would like to see modifications introduced. A few would prefer the simplicity of a two group system (9). More would like to have an additional group near the tuberculoid end of the scale to delimit the stable from the less stable patients. Others require a corresponding group at the lepromatous end to delimit the pure lepromatous patient for the purpose of therapeutic trials, although the need for this is not always appreciated. Furthermore, it seems likely that a more accurate classification of all patients who are the subject of research investigations would eliminate an ubiquitous source of confusion.

There is, therefore, an urgent need for a greater measure of flexibility in our method of classification if it is to serve the needs of all who study and treat leprosy. It is proposed that this would be attained by a dual system, as follows:

(1) A general purpose system, primarily clinical in definition, such as the Madrid classification.

(2) A system with stricter criteria for definition and at least five groups for the use of research workers and all who have full facilities for the investigation of leprosy. A TT-LL system was described briefly in 1962 to meet these requirements (17), and the generally favorable response of those who have used this method prompts us to think that it might have wider application if given a more definitive description and illustrated by photographs. This we now do, and at the same time we present the results of further experience.

PRINCIPLES

It is generally recognized that the essence of the tuberculoid-lepromatous classification is the resistance of the patient to his infection (2.4, 12, 17, 18). If this is accepted, the primary aim in classification must be to define grades of resistance. Resistance cannot be observed or measured, but it is legitimate to think that it can be assessed indirectly by reference to the following:

The lepromin test. This is an immunologic test that is directly indicative of host resistance [for a review see Rees (15)]. It is perhaps less reliable in children than adults.

The stability of the patient. It is reasonable to think that a patient with a high degree of resistance, who maintains this resistance under adverse circumstances, has a higher degree of immunity than one apparently similar to start with, who subsequently loses his resistance. Correspondingly, we may conclude that the patient with no apparent immunity, who fails to develop any sign of resistance even when his bacterial load has been reduced by therapy, is lower down the immunologic scale than another apparently similar patient who develops signs, however, of active resistance after treatment. It follows that stability at the upper pole can be tested only in untreated patients, at the

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lower pole by therapeutic test.

The response to treatment. The diminution in numbers of bacilli following the administration of bacteriostatic drugs is an index of the host-parasite relationship, since it is left to the patient to destroy and eliminate bacilli. The results accord well with other indications of resistance.

Of these tests, stability is applicable to the poles, the lepromin test to the upper range of the spectrum, and the response to treatment to bacteriologically positive patients. On this basis each of the observable characteristics of leprosy, clinical, histologic and bacteriologic, can, if desired, be correlated indirectly with the resistance of the patient under controlled conditions. The definition of the TT-LL groups, although it owes much to previous experience, has been amplified as a result of controlled trials of this nature.

TERMINOLOGY

Just as there is need for flexibility in classification, so there is need in terminology also. Broad loosely defined terms are required for the region of the poles and also for the intermediate zone between them, besides another set of terms for strictly defined groups. In this paper we have used the terms tuberculoid, lepromatous and borderline (⁴) in the broad sense, for lack of any generally acceptable alternative and without prejudice to their use on other occasions in a more restricted sense. And we have used the designations TT and LL for the polar groups and BT, BB and BL for the intermediate groups as defined below.

Indeterminate here indicates that after full investigation a patient in whom leprosy has become manifest is nevertheless unclassifiable in any of the above groups because the differentiating features are not yet developed. Such patients would usually become classifiable if the infection were allowed to progress.

METHOD

Since 1955 attempts had been made to classify all untreated patients entering the Jordan Hospital on a five-group system, using existing knowledge of clinical and his-

tologic criteria, together with the lepromin test and bacteriologic index. The progress of these patients was then followed during their period of treatment by serial biopsies at six-month intervals, the bacteriologic response being assessed primarily by means of the biopsy index. It was noted that progress rates became slower as the spectrum was descended in the direction of lepromatous. Eventually it was decided to check the various criteria that had been used for classification before treatment against the subsequent rate of progress during treatment with sulfones. In 35 bacteriologically positive patients the following histologic criteria were each correlated with the progress rates: foam cells, large globi, epithelioid cells, Langhans giant cells, lymphocytes, plasma cells, fibroblasts, a clear subepidermal zone, the cellular cuffing of nerves, and infiltration of nerves. Similarly the initial bacteriologic indices were correlated with subsequent progress. The clinical classification as a whole was correlated with the progress rates but not the individual clinical features. In a small number of bacteriologically negative patients the histologic and clinical classifications were correlated with the lepromin test and in a general sense with the outcome of treatment.

As a result of this retrospective analysis the five groups, or points in the spectrum, were defined in terms of those criteria for which there was a correlation with progress rates; other criteria were subsequently disregarded. These definitions were then put to test in a prospective trial undertaken at the Medical Research Council Research Unit at Sungei Buloh, Malaya. In 1958, 47 untreated bacteriologically positive patients were classified by us and subsequent progress rates while on sulfone therapy were judged from biopsy indices. For this purpose serial biopsies were made in pairs at six-month intervals over the next two years, the specimens being sent to us at London. The criteria of definition were again correlated with progress rates, and at the same time any alteration of classification (instability) during treatment was noted and accepted as evidence for or against the validity of the original classification. As a result of this reassessment a few small amendments were made to the original definitions. Experience gained since the publication in 1962 has confirmed the validity of this system and no further amendments have been found necessary.

The patients at the Jordan Hospital were of many races. Those at Sungei Buloh were predominantly Chinese, although there were some Malayans.

The biopsy index (16) is the product of the fraction of the dermis occupied by granuloma (which depends on the severity of the infection irrespective of the classification) and the bacterial index in the granuloma (which in general is a function of the position in the spectrum). The biopsy index is, therefore, an approximate index of the bacterial load, but it is the bacterial index that is quoted in the definitions of groups given below. The latter is based on a $6 + \text{logarithmic scale } (^{16})$. Any patient was accepted for the trial provided his initial biopsy index was at least 1.0 (the maximum is 6.0). Thus very early or light infections were excluded. The biopsy index is half arithmetic, half logarithmic. This defect is not as important as it might be, since the logarithmic component, with rare exceptions, does not alter during the first two years of treatment at least. As already stated, it is approximately constant for each group. Thus the biopsy index is a valid means of comparing bacterial numbers within a group, although it gives relatively higher values in the tuberculoid than in lepromatous groups. It is, of course, important that serial biopsies be taken from the same lesion, or, if that is not possible, from comparable lesions, and it is desirable that lesions should be examined by biopsy in pairs. We have rarely found that there was any difference in classification from one biopsy to another, except, of course, that a badly chosen biopsy might prove indeterminate while another was classifiable. The morphologic index was not thought to be relevant to the present study. Further details of methods used are given in the earlier publication (17).

DEFINITIONS OF GROUPS

Clinical. TT. The classic lesion of tuber-

culoid leprosy is a large erythematous plaque with a sharply raised outer edge which slopes gradually toward a flattened center, and with a rough or pebbly surface which is dry, hairless, and sometimes scaly. It is markedly anesthetic except on the face, where sensory loss may be absent or difficult to detect (Fig. 1). Lesions are few, often single, and although commonly present on the face or limbs may be anywhere apart from scalp, axillae, groins and perineum. A thickened peripheral nerve is usually palpable in the vicinity of a lesion, and thickening is likely to be gross and irregular.

In some cases the first lesion is a macule which is either erythematous or hypopigmented, has a dry, hairless surface and a



FIG. 1. **TT**. This is a well defined lesion, broad at the periphery and flattened in the center. The surface is dry and irregular, and there is marked anesthesia. Note the involvement of the three vaccination marks in the leprous process.



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FIG. 2. **TT.** Tuberculoid leprosy involving the left superfield peroneal nerve. The first symptom was pain and hyperalgesia over the dorsum of the foot. Note the gross thickening of the nerve. No other nerve was involved.

well-defined outer edge, and shows sensory impairment. Sometimes the earliest clinical manifestation is in a single peripheral nerve, giving rise to pain, visible nerve swelling (as in the great auricular nerve or superficial peroneal nerve, Fig. 2) or some other evidence of nerve damage such as anesthesia, analgesia, hyperalgesia, or muscle weakness. Damage is likely to be confined to one nerve, or two at the most (⁸). Similarly, the early manifestations of borderline leprosy may be purely neuritic in some cases (⁷), but nerve involvement is multiple.

BT. The lesions, whether macules or plaques, resemble tuberculoid leprosy in appearance and sensory loss, but can be differentiated by the fact that they are not so large on average, are more numerous, their surface is less dry, outer edges are less clear-cut in parts, hair growth is less affected, and thickened nerves, while tending to be more numerous, are not grossly or irregularly thickened (Fig. 3). Small satellite lesions are sometimes present near the periphery of larger lesions (Fig. 4). We consider that the "low-resistant tuberculoid leprosy" described by Leiker (¹³), falls within our BT group, for he admits that it "logically fits in between typical tuberculoid leprosy and borderline leprosy" and that the lepromin reaction is "positive but not strongly so" (¹⁴).

BB. Here the lesions are intermediate in number and size between tuberculoid and lepromatous, show a moderate degree of anesthesia, and some exhibit the typical "punched-out" or "hole-in-cheese" appearance. These lesions are either irregularly shaped erythematous plaques with vague outer edges and an oval hypopigmented center that looks as if it had been punched out (Fig. 5), or they take the form of a raised erythematous oval or circular band with well-defined outer and inner edges (Fig. 6). As in BT leprosy, small satellite lesions may be present (Fig. 7).

BL. Lesions tend to be numerous and to



FIG. 3. **BT.** Note the dry and tuberculoidlike appearance of the lesions. Yet they are too numerous for TT leprosy, some are too small, anesthesia is not so marked, and there is multiple nerve thickening.

give a superficial impression of lepromatous leprosy, especially as the patient may exhibit macules, plaques, papules, and nodules by the time of reporting, but on closer inspection certain distinguishing features can be observed. The lesions are not numerous enough for the length of history; although multiple, their distribution is not truly bilaterally symmetric over all affected regions; some plaques tend to be too large and to be anesthetic in parts; some nodules are "dimpled" in the center (Fig. 8); and some plaques have a punched-out appearance (Fig. 9) and lesions are not so shiny and succulent in appearance; thickened peripheral nerves are usually present when skin lesions first appear, whereas they appear late in the LL type; and finally there are no obvious lepromatous features such as madarosis, keratitis, nasal ulceration, saddle-nose deformity, and leonine facies.

LL. The early lesions are macules or papules; they are multiple, distributed bilaterally and symmetrically, and always erythematous irrespective of skin color. Macules are small, with vague edges, and often difficult to see unless viewed in a good light. They have a smooth and shiny surface, are not anesthetic or anhidrotic, and later may appear slightly hypopigmented when seen on dark skins. No thickened peripheral nerves can be palpated at this stage unless there has been evolution from a previous borderline phase, in which



FIG. 4. **BT**. These lesions could be mistaken for TT leprosy. Yet they are too numerous, anesthesia is not so marked, small satellite lesions can be seen near the left nipple, and there is multiple nerve thickening.



FIG. 5. **BB.** Note the medium size of the lesions, their vague outer edges and punched-out centers.

case not only will there be some thickened nerves on palpation but there may be one or more areas of hypoalgesia of the skin, particularly on the anterolateral aspect of the thigh or outer aspect of the upper arm. As the disease progresses, new macules and papules appear, while older ones become plaques and nodules respectively; thus all four types of skin lesions may be present in any one case (Fig. 10). Edema of the feet and lower legs is commonly present, and later causes the legs to feel hard and the skin over them to look shiny and waxy. As the disease advances there is diffuse thickening of the facial skin giving rise to deepening of the lines on the forehead and thickening of nose and ears, i.e., leonine facies, and there may be thinning and eventual loss of eyebrows and eyelashes. Other later developments include nasal ulceration, saddle-nose deformity, leprous keratitis and iritis, loss of upper central incisor teeth, and bone changes in hands and feet (Fig. 11). In the male testicular damage causes atrophy with consequent sterility, impotence, and gynecomastia. These changes are encountered only in the LL group. This group also differs from the others in that symptoms of a pure neuritic phase do not occur, and the first manifestations are dermal as described.

In the late stage peripheral nerves undergo hyaline degeneration or fibrosis leading to anesthesia and muscle wasting in hands and feet.

Indeterminate. This is a purely macular condition; plaques and nodules never occur. The macules are usually hypopigmented and few in number, and slight impairment of sensation may be present. The diagnosis of this group is discussed by Currie (⁵).

Histology. The differential features of the mature granuloma in each group are as follows. The descriptions refer to skin, but lesions in other tissues are essentially similar.

TT. Foci of well developed epithelioid cells, with or without Langhans giant cells, are encompassed by a zone of dense lymphocyte infiltration (Fig. 12). The granuloma extends up to the epidermis without



FIG. 6. **BB.** Note the typical lesions on the thigh and the large annular lesion around the left elbow. In these lesions the raised band at the periphery has well defined outer and inner edges.



FIG. 7. **BB**. Note the annular nature of the lesions, the well defined outer and inner borders of the raised band at the periphery, and the satellite lesions.

an intervening clear zone. Nerve bundles are seldom recognizable within the granuloma, and silver impregnation shows a greatly diminished innervation. Acid-fast bacilli are not found.

BT. The cytology and composition of the granuloma are usually indistinguishable from those of TT. The best point of distinction is that there is a clear subepidermal zone, although it may be very narrow. The granuloma is differentiated from that of the BB type by the focalization of the epithe-

lioid cells by a peripheral zone of lymphocytes, or by the presence of Langhans giant cells, which are sometimes numerous. Nerve bundles within the granuloma, if recognizable, are generally grossly swollen and infiltrated (Fig. 13), and innervation is much diminished. Acid-fast bacilli are scanty .(0, 1, or 2 + in the granuloma; usually 1 to 3 + in affected nerve bundles).

BB. The essential characteristic is the presence of epithelioid cells diffusely spread through the granuloma, and not focalized by zones of lymphocytes. The epithelioid cells are well developed, though not usually so large as in tuberculoid leprosy (Fig. 14). Langhans giant cells are absent. Lymphocytes may or may not be present; if present they are diffusely spread. Nerve



FIG. 8. **BL.** The facial nodules give an impression of lepromatous leprosy, but the points in favor of BL grouping are: (1) the tendency for the nodules to "dimple," (2) the well-demarcated plaque across the bridge of the nose, (3) the normal-looking skin between the nodules, (4) the absence of thickening of ear lobes, (5) the absence of madarosis, and (6) the absence of keratitis or iritis.

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FIG. 9. BL. The lesions on the thighs are suggestive of lepromatous leprosy, as they are small and multiple, and have a bilaterally symmetric distribution. But there are several lesions that have the characteristic "punched-out" appearance of borderline leprosy and make a diagnosis of the lepromatous type untenable.

bundles show moderate Schwann cell proliferation, but they are usually recognizable without much difficulty. Acid-fast bacilli are typically 3 or 4 +.

BL. There are 2 types: (a) The granuloma is composed of histiocytic cells that show a definite tendency to evolve in the direction of epithelioid cells, although they cannot be classed as epithelioid cells (Fig. 15). There is no foamy change. Lymphocytes are usually scanty. (b) The host cell of the bacilli is a histiocyte that sometimes shows a tendency to foamy change, although large globi are not produced. The granuloma is differentiated from that of LL by areas of dense lymphocyte infiltration. Characteristically these cells are present either as perineural cuffs, or else they occupy a whole segment of the granuloma in which they outnumber the host cells of the bacilli by about 2 to 1 (Fig. 16). In both types of BL granuloma acid-fast bacilli are usually 5 +.

Both in (a) and (b) nerve bundles are often nearly structureless as a result of



FIG. 10. LL. Note the consistent small size of the lesions, and bilateral symmetry of their distribution.

damage in an earlier phase of the infection, but they do not show increased cellularity.

LL. The granuloma is composed of histiocytes that show a varying degree of fatty change, with the production of foam cells and, eventually, globi (Fig. 17). Multinucleate globi or heavy foamy changes are found only in LL. Lymphocytes are usually scanty; if present they are diffusely spread. Nerves may show some structural damage but not cellular infiltration or cuffing. Acidfast bacilli are typically 5 +.

Before this stage of maturity is reached the granuloma is composed of macrophages (Fig. 18). The very early stage of an active LL lesion, which is not often seen except at the beginning of a relapse, shows



FIG. 11. LL. Note the shortening of the fingers, the scarring, and the bending of the little fingers. The patient was a mechanic with neglected lepromatous leprosy, and the injuries were due to a combination of analgesia and carelessness.

a predominance of spindle shaped cells that resemble fibrocytes in appearance although they ingest bacilli (Fig. 19). Here, as in the macrophage stage, acid-fast bacilli are most numerous, averaging 6 +. The spindle cells, however, are still relatively undifferentiated, and although such cases as that in Figure 19 usually behave as LL, they have been known to revert to BL.

Indeterminate. The histology may not be helpful, being indistinguishable from that of chronic dermatitis. The absence of incontinence of pigment³ in indeterminate leprosy is sometimes a differential feature. Lymphocytes and histiocytes are localized around skin structures. Fibrocytes are often increased. Perineural cuffing or increased cellularity in a nerve bundle, if present, is typical of indeterminate leprosy. Bacilli are absent or very scanty.

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It will be seen that there are three histologic indications of resistance to the infection: 1. The cytologic form of the host cell of which the granuloma is predominantly composed. The presence of well-developed epithelioid cells is of great prognostic significance irrespective of all other findings.

2. The number of lymphocytes present. Lymphocytes, however, only have immunologic significance when they are densely packed throughout some part of a granuloma, or on its periphery, or around a nerve bundle. A group of lymphocytes at the center of a granuloma for some reason seems not to be significant; moderate numbers of lymphocytes may be present in erythema nodosum leprosum.

3. The amount of cellular infiltration in nerve bundles, or Schwann cell proliferation. The two may be hard to distinguish under the light microscope.

The presence of a cell-free subepidermal zone was found to be of value in distinguishing BT from TT, but not in the classification of other groups in all of which the zone was clear unless it was compressed by the pressure of the granuloma.

No correlation could be found between the presence of plasma cells or fibroblasts

³ "Incontinence of pigment" is loss of melanin from the cells of the basal layer and its accumulation in the dermis.



FIG. 12. **TT/BT**. Epithelioid cell granuloma focalized by a zone of lymphocytes. X 300.



FIG. 13. BT. A grossly swollen nerve bundle, destroyed by cellu'ar infiltration. (In TT, nerves in a granuloma are usually destroyed beyond recognition.) X 300.



Fig. 14. **BB.** Epithelioid cells are well developed, but they are not focalized by lymphocytes. Langhans giant cells are absent. X 300



Fig. 15. BL. The granuloma is composed of cells that are beginning to differentiate in the direction of epithelioid cells. X 300.

and prognosis or effect of treatment; these cells are not helpful in classification, although plasma cells are characteristic of some lepromatous reactions. For this same reason it was not thought worthwhile to include fat or edema among the histologic criteria to be tested. Large amounts of fat are a feature of the lepromatous end of the spectrum, but fat occurs also in tuberculoid reactions (⁶), and edema is mainly indicative of a reaction or predisposition to react. However, a large amount of edema in a granuloma may be significant; on rare occasions it is the only histologic indication of the BB group (Fig. 20).

The type of BL case characterized by numerous lymphocytes is common in East and West Africa but seldom seen in Malaya, where the alternative form, with partially developed epithelioid cells, prevails. In Malayan patients an intermediate stage between LL and BL is relatively common. The granuloma is composed of undifferentiated histiocytic cells (Fig. 21) and is difficult to classify.

As already mentioned, all biopsies were made from a pair of lesions, and it was quite exceptional to find any difference in classification, as defined above, between the two lesions. A number of experienced observers have emphasized that the histologic characteristic of borderline leprosy is the mixture of tuberculoid and lepromatous features either in different lesions or in the same section. We disagree with this, though we have observed such an admixture on rare occasions. It seems to us that in general the cell types of which a granuloma is composed are remarkable more for their uniformity than for any resemblance to the two polar types in combination. On the whole they display a nice gradation of morphology to suit their position in the spectrum, although the presence of lymphocytes and neural infiltration also have to be taken into account in assessing classification.



FIG. 16. BL. (Alternative pattern). The slightly foamy host cells are obscured by dense infiltration of lymphocytes. X 300.

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FIG. 17. LL. Early foamy change and globus formation. X 300.



FIG. 18. LL. Macrophages. This type of granuloma, in which there is as yet no foamy change, is the one in which bacilli are most numerous. X 300.



FIG. 19. Probably LL. The earliest cell type, seen in relapsing patients, is the fibrocyte. Differentiated cells, if any are present, are scanty. Such cases are usually LL, but have been known to develop into BL. X 300.

LEPROMIN TEST AND BACTERIAL INDEX

The results of the lepromin test and the Bacterial Index of skin smears can be tabulated:

	Lepromin test	Bacterial index
TT	2 or 3 +	0
BT	1 + or - ve	0 - 2 +
BB	— ve	2 - 5 +
BL	— ve	4 - 5 +
LL	— ve	5 - 6 +
Indetermi	nate $+$ ve or $-$ ve	0
		(occasionally
		(1 +)

Both Dharmendra (bacillary) and Mitsuda (integral) types of lepromin have been used. Mitsuda reactions less than 3 mm. in diameter were counted as negative. The lepromin test was thought to be the best single means of classification at the tuberculoid end of the scale.

THE CLASSIFICATION OF NEURAL LEPROSY

It has been mentioned already that thickening of nerves appears early in tuberculoid leprosy, and later in the course of lepromatous infections. Pure neural infection in which there is as yet no apparent skin involvement is more likely to be seen, therefore, in tuberculoid than in lepromatous leprosy, although we have observed such cases in all groups except LL.

Clinically it can be said that neural leprosy is likely to be tuberculoid if there are only one or two thickened nerves, and borderline if there are several. The nerves are often grossly thickened in TT, less so in the borderline groups. The presence of a nerve abscess is indicative of TT or BT. The lepromin test is frequently of value in these cases, its assessment being the same as in leprosy of the skin. But for certain classification within the TT-LL scale it is often necessary to make a nerve biopsy, especially in the borderline part of the spectrum.



Fig. 20. **BB.** A rare and atypical pattern in which the granuloma is nondescript but edema is profuse. Fat is almost absent, X 300.



FIG. 21. BL or LL. An intermediate stage. The granuloma is composed of undifferentiated histiocytic cells. X 300.

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This is not always feasible.

The histology of nerves is essentially the same as for skin except that caseation may be seen in the former but never in the latter. It only occurs in the TT and BT groups. The cytologic reaction is the same as that in the small nerve bundles of the dermis, which has already been described for each group. Bacilli are somewhat more numerous than in a dermal granuloma of the same group.

RESULTS

As already indicated, the definitions given above were evolved by reference to the bacteriologic response to therapy, to the stability of the polar groups, and to the lepromin test, each of which was taken to be a measure of the resistance of the patient on which the system of classification was based. The results of these tests as applied to the TT-LL groups in their final form are of some interest.

Bacteriologic response. The mean rate of fall in the biopsy index in 54 patients classified as LL was 30 per cent for each six months of treatment; in 17 BL patients it was 64 per cent, and in six BB patients it was 95 per cent. BT patients show no significant difference from BB in their progress rate. Further details are given in the earlier publication (1^7) .

Correlation of clinical and histologic findings. There was complete agreement on the grouping of 56 out of 82 patients. There was minor disagreement (a difference of one group) in 21 patients, and serious disagreement concerning a difference of two groups in five. When there was disagreement, one method or the other often provided a fairly emphatic answer. We agree with Alonso and Azulay (¹) that histology is essential for the accurate classification of borderline leprosy.

Stability. It has been found by experience that TT and BT patients are stable with treatment, as would be expected. We have no first-hand information about their stability in untreated patients, although TT at least is assumed to be stable. BB patients are thought to be liable to progress toward LL if untreated: BL patients definitely do so. With treatment, BB and BL

cases sometimes move in the direction of tuberculoid, although never beyond BT. This movement is often accompanied by a clinical reaction, although its nature and the change of classification are apparent only histologically and by the lepromin test. LL cases are stable with or without treatment.

The instability of the BL groups under treatment renders it unsuitable for therapeutic trials, although there is often a useful number of bacilli present. ENL reactions occur only in LL patients.

Geographic distribution. As would be expected, the distribution of the five groups varies in different localities and among races. Thus on the available figures the LL to BL ratio of patients at the Jordan Hospital and Sungei Buloh is as follows:

Eurasian	7.5/1
European	5.5/1
Indian	4/1
Chinese	2.5/1
Malayan	2.5/1
Negro .	1.5/1

On the basis of the Madrid classification the great majority of BL patients would be classed as lepromatous. Thus the lepromatous group includes a proportion of BL cases which varies greatly from one region to another.

DISCUSSION

Having made a serious effort to establish a logical basis for the classification of leprosy within the limitations of the methods available, and to test the possible criteria to be used for definition, we have obtained results that are in close accord with previous usage. At the tuberculoid end of the spectrum we cannot claim to have made a significant contribution. Much attention has been given in the past to the stability of tuberculoid patients, which is probably a good guide to resistance, and our knowledge here is based chiefly on experience gained before the introduction of therapeutic drugs. Now that it is unethical to observe patients without treatment, it seems to us that there is much to be said in favor of the lepromin test as the primary guide to the classification of tuberculoid patients.

At the lepromatous end of the spectrum the methods we have used have justified themselves by making it possible to amplify the histologic criteria, which have never yet been defined by any international congress and on which there has been much room for error $(^{11})$.

Here our conclusions are based to a considerable extent on the rate of fall of the biopsy index as a reflection of the immunologic state of the patient. The validity of the index in this context has been discussed under METHOD. In general the rate of fall, expressed as a percentage of the index at the time, is constant for each class of leprosy throughout the period of treatment, and this constant is much higher for borderline than for lepromatous leprosy. It is true, of course, that the absolute rate of fall in bacterial numbers is perhaps smaller for borderline than for lepromatous patients, since absolute numbers are much smaller. Nevertheless, there is reason to think that it is not the absolute rate of fall that is immunologically significant, since it declines steadily throughout treatment when the immunologic state should, if it alters at all, be improving. Any movement is toward tuberculoid. Certainly it can be said in favor of our method that the results obtained with it make sense.

But above all it seems to us important that there should be an accepted basis for classification. The earliest classification of leprosy, as would be expected with a subject that was poorly understood, was a descriptive one (neural or dermal, macular or nodular). As the concept of lepromatous and tuberculoid evolved, it became appreciated that this was essentially a matter of the patient's resistance to infection. It is interesting that Klingmüller (10) in his authoritative treatise of 1930 makes no mention of classification, but he quotes Wade and Rodriguez (20) as thinking that the occurrence of maculoanesthetic and pure neural forms was indicative of immunity, and Jadassohn as believing that the transition from the nodular (lepromatous) to the neural form had the same significance. More recently the principle that the fundamental basis of the classification of leprosy is immunologic appears to have

become generally accepted (2, 4, 12, 17, 18), although it is by no means always acknowledged. Thus, as far as we know, it has never been referred to in any report of any international committee on classification (the Rio Round Table on Borderline Leprosy excepted) (4). As far as the clinical classification is concerned, it has never been seriously questioned whether it is a matter of description and convenience, in which case any manifestation of the disease would be eligible for consideration as a group, or whether it is a matter of interpreting in clinical terms the resistance of the patient, in which case there can be no other object than to place each case as nearly as possible at its appropriate point on the immunologic scale. It is not possible, as some writers have proposed, to make immunology the basis of classification while seeking something different for its object. Nevertheless, if immunology is the root of the tree, its fruit is the knowledge of infectivity, prognosis and management of the patient. This is all that could be expected, but it remains important not to confuse the end result with the primary basis, which is immunity, or with the means, which for many people is clinical. Much argument would be avoided by a decision whether the clinical classification was to be descriptive or systematic. For the research classification the choice is clear.

SUMMARY

The tuberculoid-lepromatous classification of leprosy is recognized to be an expression of the patient's resistance to the infection. As such its object must be a statement of his resistance.

Resistance can be assessed by the lepromin test, and indirectly by the therapeutic response in bacteriologically positive cases, and by the stability of the infection if it is at one of the poles in the spectrum. The conclusions drawn can in turn be correlated with the clinical, histologic and other features that are suitable for the definition of groups.

On this basis five groups, or points in the spectrum, have been strictly defined. This system is intended for the use of research workers and any who have full facilities for the investigation of patients. It complements the simple clinical classification that is needed by others.

RESUMEN

La clasificación de lepra tuberculoide-lepromatosa es aceptada como una expresión de la resistencia del, enfermo a la infección. Debe considerarse por lo tanto, como una declaración de la resistencia del paciente.

La resistencia puede medirse por la prueba de la lepromina e indirectamente por la respuesta a la terapeútica en casos bacteriologicamente positivos, y por la persistencia de la infección en un extremo del espectrum. Las conclusiones obtenidas pueden, a su vez, relacionarse con las características clínicas, histológicas y otras que son posibles de agruparse.

Sobre esta base cinco grupos, o puntos en el espectrum, se han definido estrictamente. Esta clasificación está orientada para el uso de los investigadores y para quienes tengan amplias facilidades para la investigación de los enfermos. Complementa la simple clasificación clínica que es necesaria por otros.

RÉSUMÉ

On reconnaît que la classification de la lèpre en tuberculoïde et lépromateuse est l'expression de la résistance du malade à l'infection. De ce fait, le but de cette classification doit être d'émettre un avis quant à la résistance.

On peut apprécier la résistance par le test à lépromine et aussi, indirectement, par la thérapeutique dans les cas bactériologiquement positus, et d'après la stabilité de l'infection si cell-ci est située à l'un des pôles du spectre. Les conclusions qu'on en tire peuvent alors être mises en relation avec les caractéristiques cliniques, histologiques ou autres que l'on estime utiles pour définir les groupes.

Sur cette base, cinq groupes, ou jalons sur le spectre, ont été exactement définis. Ce système est proposé pour venir en aide aux chercheurs et à tous ceux qui ont facilité entière pour l'examen approfondi des malades. Il complète la classification clinique élémentaire qui sert aux autres.

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