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THICKENED NERVES IN LEPROSY IN RELATION TO SKIN LESIONS

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INTRODUCTION

It was once the teaching that in a case of leprosy one should feel for thickened ulnar nerves. With the evolution of knowledge has come realization that the ulnar nerve is not necessarily thickened in every case, that other cutaneous nerves than the ulnar may be involved, and that those supplying an affected part are more liable to be thickened than others. These facts are not generally recognized and doctors examining for nerve thickening frequently palpate the ulnar nerve alone, and that only behind the elbow.

Nerves are involved by leprosy in two ways. In the ascending type the infection spreads from the skin lesion to the nerve supplying it. In the metastatic type bacillary emboli from skin lesions may be carried in the blood stream, lodge in the *vasa nervorum* in different parts of the body, and ultimately cause thickening of those nerves. The ascending type is commonly found in neural leprosy, and the metastatic type in advanced cutaneous leprosy.

Nerve thickening is usually attended with tenderness, tingling, burning sensation, lightning pains, etc. During the process of fibrosis which follows inflammation of nerves these symptoms gradually subside and ultimately disappear. Sometimes, however, the thickening is followed by caseation and abscess formation.

CLINICAL STUDY

In the present paper, without taking up controversial points and without discussing the involvement of the nervous system in general, we shall deal with thickening of superficial nerves based on the clinical findings in 3,079 cases diagnosed as leprosy out of 3,800 cases examined. Thickened nerves were found in 1,024 instances, or 33 per cent of the leprosy cases. One nerve only was thickened in 482, while the majority, 542, had more than one thickened. Nerve ab-

cesses were found in four cases, in one of which they were multiple, there being two abscesses in the right musculo-spiral nerve (Plate 1, fig. 1). The wide possibilities of cutaneous nerve involvement are illustrated in Table 1, in which are listed the various nerves found affected and the number of times they were involved.

TABLE 1.—Frequency of thickening of various cutaneous nerves in 1,024 leprosy cases with nerve enlargement.

Name of nerve	Times involved	Per cent ^a of cases
Ulnar	583	56.9
Peroneal	548	53.5
Great auricular	189	18.9
Radial	98	9.6
Antibrachial cutaneous	28	2.7
Supraorbital	17	1.6
Femoral cutaneous	15	1.5
Sural nerve	14	1.4
Intercostal	12	1.2
Saphenous	8	— 1.0
Brachial cutaneous	8	— 1.0
Palmar median	8	— 1.0
Supraclavicular	7	— 1.0
Infrapatellar	5	— 1.0
Supratrochlear	4	— 1.0
Cervical cutaneous	3	— 1.0
Musculo-cutaneous	2	— 1.0
Smaller occipital	2	— 1.0
Mental	2	— 1.0
Infratrochlear	1	— 1.0
Auriculo-temporal	1	— 1.0
Long thoracic	1	— 1.0

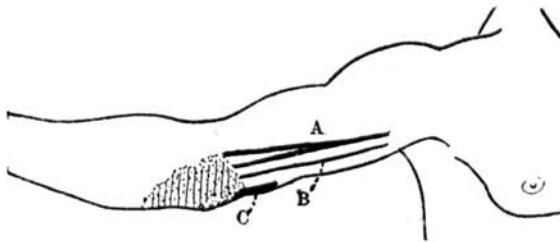
^a Percentages of the 1,024 cases with nerve thickening, not of the 3,079 leprosy cases.

The first sign of affection of a nerve is tenderness. There may not be any appreciable thickening, but on pressure the patient feels a tingling sensation that passes into the affected part of the skin. Gradually thickening becomes apparent. Sometimes this cannot be felt by palpation, but percussion over the patch causes acute pain, indicating that the underlying nerve is inflamed. In the more advanced condition the affected nerve becomes thick and cord-like, and it may stand out prominently, especially if the skin is stretched. However, unless the possibility of a thickened nerve in connection with a leprosy patch be kept in mind this condition is likely to be missed in many cases, for usually it is detected only by careful examination.

RELATION OF NERVES TO SKIN LESIONS

Thickened nerves usually are found in relation with skin lesions which show superficial anesthesia. As regards this relation there are several possibilities:

1. The nerve supplying such a patch may or may not be thickened.
2. When there is thickening this may be of the main trunk, or only one branch, or both (Plate 1, fig. 4).
3. More than one branch of the same nerve may be involved (Plate 1, fig. 3).
4. More than one nerve trunk connected with the affected part may be thickened (Text-fig. 1).



TEXT-FIG. 1.—Thickening of several nerves connected with an erythematous anesthetic patch on the right elbow. A, medial and dorsal branches, antibrachial cutaneous; B, medial brachial cutaneous; C, ulnar.

5. The thickening may or may not be in proportion to the extent of the lesion. The nerve supplying a small lesion may be enormously thickened, or that of an extensive lesion may be only slightly involved.
6. The nerve supplying an affected part may be normal while that of an adjacent portion may be thickened (aberrant findings).
7. The portion of the nerve adjacent and proximal to the patch may not be thickened while a part further up the trunk is involved.
8. In the metastatic type the nerve lesion may not correspond to the part of the skin affected. There may be thickening of the ulnar nerves but no anesthesia or other signs of leprosy in their distribution.

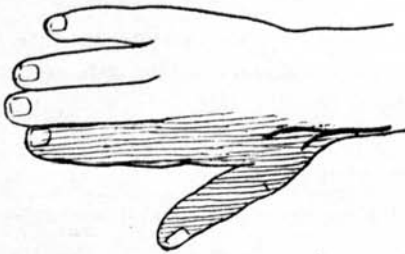
THICKENED NERVES AND DIAGNOSIS

The diagnostic importance of a thickened nerve is great, and it is rightly said that in an early case the two cardinal signs are superficial anesthesia and a thickened cutaneous nerve. In our experience the majority of cases come at an early stage. In most instances some sort of indigenous medicine has been used before they come which has disfigured that part, or an ulcer has formed, or the part has been accidentally burned and only a scar is left. In such cases super-

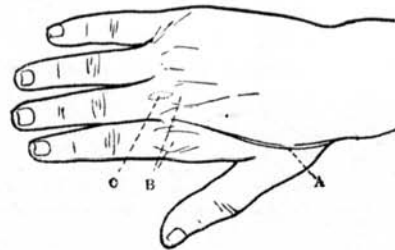
ficial anesthesia may not be diagnostic, but if a definitely thickened nerve is found in connection with a suspected patch a diagnosis can be made which otherwise might be difficult. The following illustrative cases will elucidate this point:

Case 1, Bhole.—The left index finger had been pricked by a thorn one and one-half years ago, and an erythematous patch appeared at the place. In the center of the patch there was an ulcer, with anesthesia around it. There was a question whether the anesthesia resulted from the ulceration and scar formation, but the left superficial radial nerve was found thickened. The thickened nerve is shown at the point of the pencil in Plate 2, fig. 1.

Case, 2, Mrs. Sen.—A fish-bone entered her right thumb and was extracted by operation. Anesthesia followed this. Off and on blisters and ulcers appeared over the part, and the thumb became erythematous. It was difficult to say whether the anesthesia was the result of operation or not, but as the superficial radial nerve was found thickened and tender the diagnosis became clear. The patient made rapid improvement under antileprotic treatment.



TEXT-FIG. 2.—An enlarged nerve (right superficial radial) above an anesthetic area which without it would have been of doubtful diagnosis. (Compare Plate 2, fig. 2.)



TEXT-FIG. 3.—A thickened right superficial radial nerve (A) entering an area which showed no gross change but was slightly analgesic (B) and from which a biopsy specimen (C) contained acid-fast bacilli.

Case 3, Raghunandan.—Because of loss of sensation over the left foot, the patient applied some indigenous corrosive medicine which caused ulceration, leucoderma resulting later. Slight anesthesia was found over the affected part. We felt inclined to think it non-leprotic until the sural nerve was found thickened, and on being pressed a tingling sensation passed down to the skin lesion (Plate 2, fig. 3).

Case 4, Ali Hossain.—The patient, a fitter by occupation, had traumatic injury of his right index finger 5 years ago, followed by a feeling of anesthesia. Five months before he attended the dispensary an ulcer appeared on that finger; this healed, leaving a scar. Signs of injury were evident. Anesthesia was found over the right index finger and thumb. It was a problem whether this was due to the injury, but the right superficial radial nerve, with two dorsal branches, was found thickened and tender (Plate 2, fig. 2, and Text-fig. 2).

Case 5, S. Mukherji.—There was a hypopigmented patch on the left side of the forehead of 12 years duration, with a thickened supraorbital nerve. The right superficial radial nerve was thickened, but there was no pigmentary or definite sensory change in the skin of its distribution except that the pain of a pin-prick was diminished over the knuckles of the right index and middle fingers. Acid-fast bacilli were found in a section of skin from the base of the right middle finger. Had the thickened nerve not been detected there would have been no reason to suspect a leprous lesion (Text-fig. 3).

PROGNOSIS

The nature of the nerve involvement and its duration have to do with prognosis as well as diagnosis. If the thickening is slight and of short duration, and if the nerve is tender, we can expect treatment to result in complete recovery of the affected part of the skin. If the condition is more advanced and of long duration, the nerve very thick and hard—or possibly with abscess formation—recovery of the skin lesion may not be complete; because of destruction of some nerve fibers partial anesthesia may persist. Permanent anesthesia or deformity is likely to occur in longstanding cases, where the nerve fibers are completely destroyed. In such cases the fibrotic nerve is thinner than before and not tender, and even when the patient has been cured of all other signs of the disease the permanent lesions will persist.

Consideration of thickened nerves aids in estimating the time required for treatment, and also serves as a guide in judging when to discharge a case. Early cases with thickened cutaneous nerves usually take more time for recovery than similar cases without any thickening of nerves. Again, if a skin lesion disappears under treatment but the associated nerve remains thick and tender the case cannot be discharged.

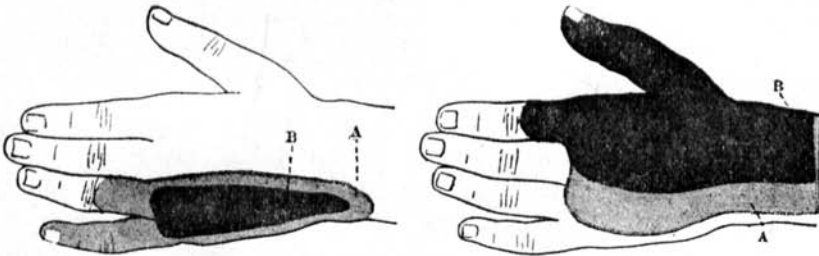
PROTOPATHIC AND EPICRITIC SENSIBILITY

The area of superficial anesthesia is determined by failure of a blindfolded patient to respond when touched lightly, as with a piece of paper. Over this entire area pin-pricks cause less pain than in normal parts, but in parts of the anesthetic area there is deep analgesia, the pain sensation having been entirely abolished. Usually this area is less than that of superficial anesthesia. The following cases illustrate this relationship:

Case 1, Rezak.—There was a patch on the dorsum of the left hand extending over the thumb, a portion of the index, middle and ring fingers, and the radial and part of the ulnar side of hand. The entire area was superficially anesthetic,

but deep analgesia was limited to the radial side. The ulnar and superficial radial nerves were thickened (Text-fig. 4).

Case 2, Gaziruddin.—There was superficial anesthesia on the ulnar border of the dorsum of the left hand, the little finger and part of the ring finger. The area of deep analgesia occupied the central position of the lesion. The ulnar nerve was thickened (Text-fig. 5).



TEXT-FIGS. 4 AND 5.—Showing differences in distribution of superficial anesthesia (A and B) and deep analgesia (B). Illustrating Cases 1 and 2.

Case 3, N. Ghosh.—(a) On the right arm the superficial radial and ulnar nerves were thickened. There was superficial anesthesia on the dorsum of the hand and wrist. Deep analgesia was confined to the wrist (Text-fig. 6). (b) On the left side the superficial radial nerve and the dorsal branch of the ulnar nerve were thickened. There was a small anesthetic lesion on the dorsum of the hand. An area of deep analgesia was centrally placed (Text-fig. 7). (c) Externally on the right foot there was an erythematous, thickened, anesthetic lesion. There was deep analgesia over almost the entire area excepting a small portion along the inner margin. Both superficial anesthesia and deep analgesia were found over the whole extent of a lesion on the third toe, which was also erythematous and thickened. The sural and superficial peroneal nerves were thickened.

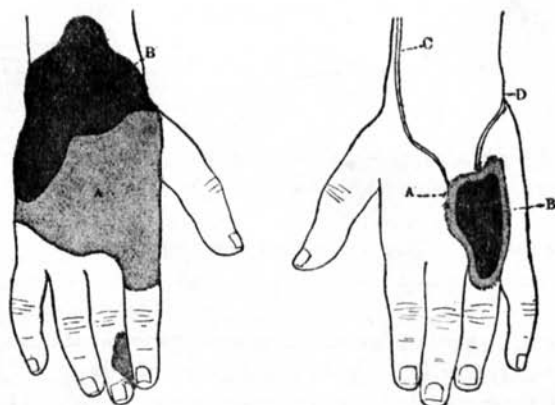
REPAIR UNDER TREATMENT

Repair of affected nerves.—In some cases thickened nerves become thinner and less tender after injections into the skin lesion or into other parts of the body. In other cases, however, the thickening persists even after the disappearance of cutaneous signs and symptoms. In these cases subcutaneous injections along the course of the thickened nerve are necessary to break down the granuloma in the nerve. Two cases will be of interest in this connection:

Case 1, N. Sinha.—The patient had a hypopigmented, anesthetic patch on the flexor aspect of the right forearm, and thickening of the volar branch of the medial antibrachial nerve. The duration was 3 years. He received treatment for 2 years, by which time anesthesia had disappeared, and the part had become quite normal. The nerve, however, was still thickened, and pressure

caused tingling sensations. Sub-cutaneous injections were given along the course of the nerve and it gradually became thinner (Plate 1, fig. 3).

Case 2, K. Das.—The patient had an anesthetic and hypopigmented patch on the left side of the face, and the left great auricular nerve was thickened. He received treatment for four years and the cutaneous signs disappeared, but the great auricular remained thick. Injections were given along the course of the nerve, which gradually became reduced in size.



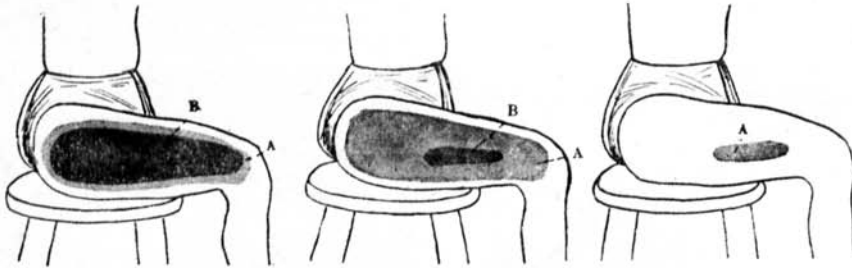
TEXT-FIGS. 6 AND 7.—Right and left hands of Case 3, further illustrating the distribution of superficial anesthesia (A and B) and deep analgesia (B). In Fig. 7, C represents the superficial radial nerve and D the dorsal branch of the ulnar.

Repair of skin lesions.—The healing of skin lesions, whether anesthetic and hypopigmented or erythematous, occurs either by gradual diminution in size of the lesion, or by general fading over the entire area without any diminution in size. These changes are noticeable if the patient is given only subcutaneous injections.

In most cases under treatment the deep sensation reappears before the superficial, the patient beginning to feel the pain of a pinprick before he can perceive a light touch. On the other hand in a small percentage of cases, especially those who receive intracutaneous injections in the skin lesion, superficial sensation returns before the deep one. Two cases will be cited in this connection:

Case 1, N.C.—There was a hypopigmented, anesthetic lesion over the right buttock and the extensor surface of the right thigh, of 29 years duration. Deep analgesia was present over almost the whole area excepting a small portion along the margin (Text-fig. 8, I). After treatment for 21 months superficial anesthesia was still present over the whole area but deep analgesia only in the center (Text-fig. 8, II). After 6 months more of treatment the deep analgesia

had entirely disappeared and the superficial anesthesia persisted only over a small central area (Text-fig. 8, III).



TEXT-FIG. 8.—Showing changes in the areas with superficial anesthesia (A and B) and deep analgesia (B) during treatment.

Case 2, Pashupati.—There was a hypopigmented, anesthetic patch over the right ankle (anterior) with analgesia over almost the whole area excepting the margin. The peroneal and right saphenous nerves were thickened. Right foot drop was present. The duration was 2 years. After 6 months' treatment the anesthesia was as before but there was analgesia only centrally. The extensor muscles of the right foot had regained their normal power. After 10 months the analgesia had completely disappeared, and the anesthesia had diminished.

ABERRANT CLINICAL FINDINGS

Usually the nerves supplying a skin lesion are found thickened. Very exceptionally a patch may be in the distribution of a nerve which is not thickened, while the nerve which supplies the adjacent part is thickened. The following illustrations are given:

Case 1, A.C.D.—The patient had only an erythematous, thickened, anesthetic patch, of one year duration, on the dorsum of his left foot. This was in the distribution of the peroneal nerve, which was apparently normal; on the other hand the left sural nerve was found thickened (Text-fig. 9).

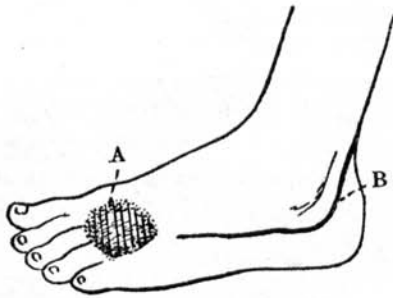
Case 2, B.K.M.—This case gives the opposite picture of the last. There was an anesthetic patch externally on the right ankle, mainly in the distribution of the sural nerve. This had no thickening, while the right superficial peroneal nerve was thickened.

Case 3, S.C.B.—There was a hypopigmented, anesthetic patch on the right little finger, appearing after an attack of smallpox two months before. The right ulnar nerve behind the elbow was thickened, but its dorsal branch was not. Curiously, the superficial radial nerve was thickened, and its thickened dorsal branch could be traced as far as the base of the right ring finger (Text-fig. 10).

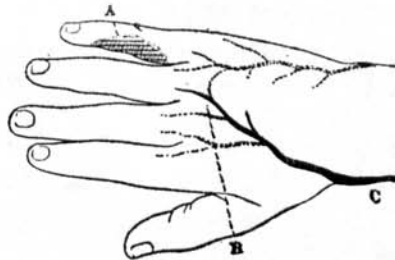
SUMMARY AND CONCLUSION

Observations have been made on thickened nerves in relation to skin lesions as seen in a clinical study of 3,079 cases of leprosy.

The area of deep analgesia is usually less than that of superficial anesthesia. As repair progresses, the anesthesia usually persists longer than the analgesia.



TEXT-FIG. 9.—An aberrant finding, an erythematous anesthetic area (A) in the distribution of the peroneal nerve, with the sural enlarged.



TEXT-FIG. 10.—A similar case, with a hypopigmented anesthetic patch (A) in the distribution of the ulnar nerve, with the superficial radial enlarged.

From the clinical findings it seems that in the ascending type of nerve lesion the infection spreads by lymphatics from the skin lesion. The reasons why the nerves are found thickened in their superficial course, like the ulnar behind the elbow, are that there is space for the nerve to swell, and that because the lymphatics and blood vessels of the part are not under pressure of muscles, stagnation may occur and therefore the infection finds time to work out its course. This also explains aberrant findings in which infection may spread by collateral branches of lymphatics to the nerves adjacent to the skin lesion.

The nerve supplying a leprosy patch should be palpated, as far as practicable, throughout its whole course because only a particular part may be affected, though the whole trunk may be involved. The adjacent nerves should also be examined for any aberrant findings.

Sometimes a case of leprosy with thickened nerves may serve as a living model for the anatomists; even the finer nerve branches of a nerve may be so thickened that their courses can be demonstrated easily by palpation. On the other hand, a nerve may be missed entirely because it has an abnormal course, as when the ulnar is found on the medial epicondyle.

The importance of the nerve findings in relation to diagnosis, prognosis and treatment is emphasized. If the wide possibilities of cutaneous nerve involvement are kept in mind the *diagnosis* of an early case of leprosy is often facilitated, especially when superficial anesthesia is not marked, or when the affected part is burned or disfigured by a local corrosive application. With respect to *prognosis*, the involvement of cutaneous nerves indicates chronicity, and usually the improvement in such a case is slow compared with that in one not so complicated. Finally, a thickened nerve serves to indicate that the disease is still active, and further *treatment* is necessary.

Unless the condition of the cutaneous nerves is noted at the time of diagnosis, and unless the condition of those which were then found thickened is determined at the time of discharge, there is every possibility of discharging a case after the disappearance of cutaneous signs but with a persistent thickened nerve, with the result that the percentage of relapses in such cases will be higher than it should be.

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DESCRIPTION OF PLATE

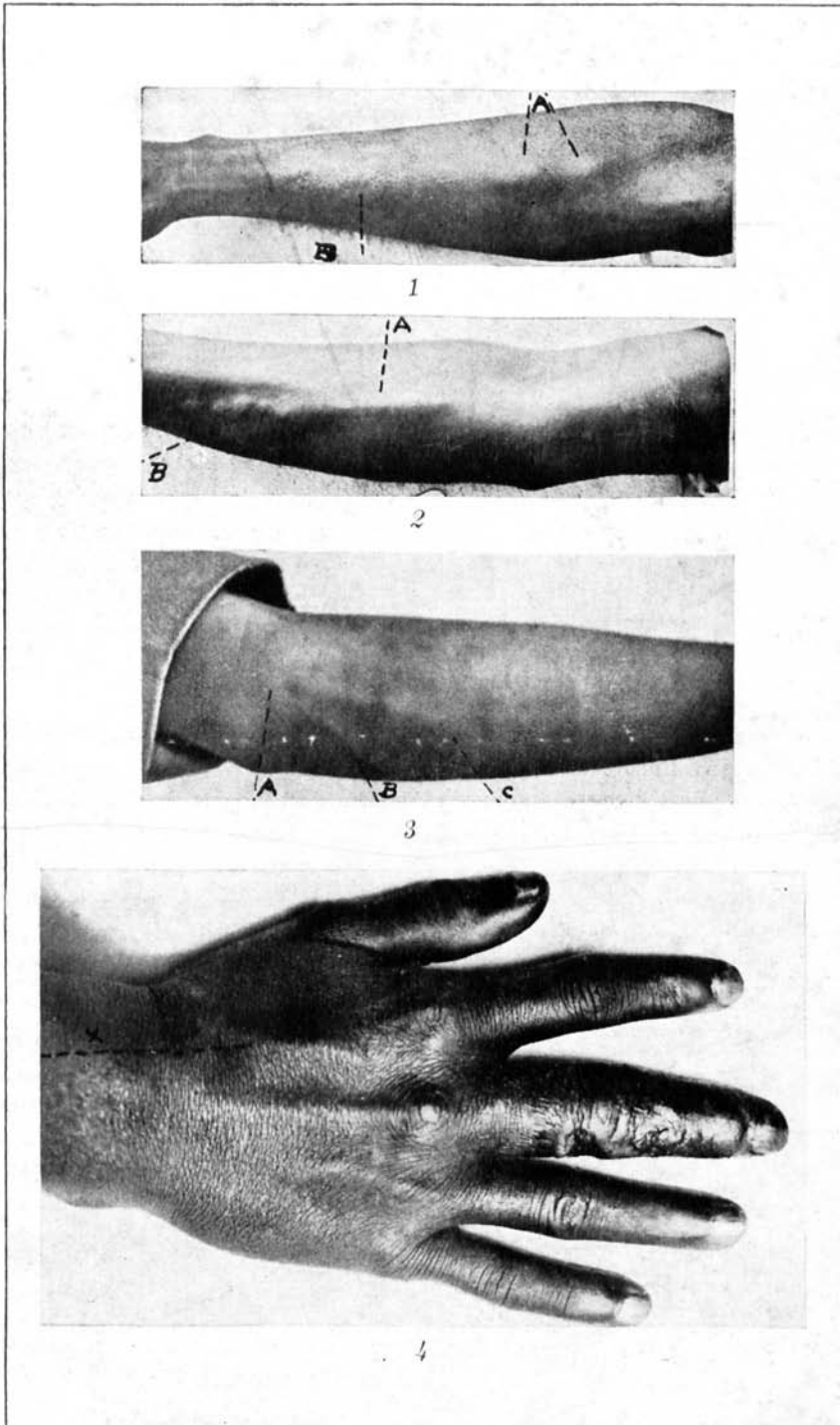
PLATE 1

FIG. 1. Two abscesses (A) of the right musculo-spiral nerve above a hypopigmented, anesthetic area.

FIG. 2. Showing persistent thickening of a nerve after the skin lesion below it has cleared up. At A the right medial antibrachial cutaneous nerve; at B wheals due to intradermal injections in the area which previously was hypopigmented and anesthetic.

FIG. 3. Enlargement of two branches of a cutaneous nerve: the medial antibrachial (A) and its ulnar and volar branches (B and C, respectively). Anesthesia present on the medial side of the flexor aspect of the left forearm.

FIG. 4. Thickening (X) of the dorsal branch of the right superficial radial nerve. On the middle finger an anesthetic area, ulcerated.



DESCRIPTION OF PLATE

PLATE 2

FIG. 1. Showing a scar of the index finger, anesthetic; the diagnosis determined by the thickened nerve (at the point of the pencil).

FIG. 2. Showing an anesthetic scar of fingers, the diagnosis based on thickened nerves above (see Text-fig. 2).

FIG. 3. Leucoderma due to application of a corrosive on an anesthetic area. The enlarged sural nerve (x) is diagnostic.



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