

MUSCULAR WASTING IN LEPROSY AND ITS PECULIARITIES

S. N. CHATTERJEE, M.B., D.T.M. (Calcutta)

*Leprosy Research Department
School of Tropical Medicine
Calcutta, India*

INTRODUCTION

Wasting of muscles is a common occurrence in leprosy. The usual explanation is that the motor nerves supplying the affected muscles degenerate, the wasting being due to that condition. The method of spread of the infection is from the skin lesion to the mixed nerve trunk through its sensory fibers.¹ The affected nerve first becomes thickened and then gradually degenerates, with fibrosis. This explanation has long been in vogue, because muscular wasting in leprosy is of the same nature as that which is seen after injury of the mixed nerves like the ulnar, the radial, the median, and the lateral popliteal.

There are, however, reasons to think that degeneration of nerves does not take place in every case of leprosy which shows muscular wasting. The mixed nerves supplying the wasted muscles are usually found to be thickened, except in cases where the disease has practically died out. But in other cases, where the muscles and the skin are supplied by separate nerves (not by a mixed nerve), there may be wasting of muscles underlying skin lesions without thickening of the motor nerves supplying them. Here the muscular wasting cannot be explained in the usual way. There are also other findings which cannot be explained on the basis of degeneration and regeneration of motor nerves. Some of these are enumerated below.

(1) Muscles may be wasted but the nerves supplying them may not be thickened. For example, there are cases with tuberculoid lesions on the face and paralysis of underlying muscles (e.g., Fig. 1), but the facial nerve supplying them is not found thickened. Here the skin and the muscles are supplied by two separate nerves, the skin by the 5th nerve and the muscles by the 7th, and there is no possibility of the infection spreading from the skin to the motor nerve via the sensory nerve.

(2) When a mixed nerve like the ulnar is considerably thickened, or when there is a nerve abscess in it, the muscles usually supplied by that nerve ordinarily show signs of wasting. But in some such cases wasting is not found.² The reason for this difference is not known.

(3) Muscular wastings and deformities are said to be irreversible.

¹This refers to tuberculoid cases. In lepromatous cases the infection becomes generalized, and the nerve trunks are apparently infected from the blood stream; otherwise the process is similar.—EDITOR.

²The author submitted three pictures to illustrate this statement, showing normal hands despite the existence of lesions. One lesion was a tuberculoid patch on the forearm, the others abscess of the ulnar. Since none of those lesions would show in reproduction, they have not been used.—EDITOR.

But correction of deformities in leprosy cases by physiotherapy and other measures sometimes occurs (^{1, 2, 5-19}). The actual mechanism of recovery in these cases is unknown.

(4) It was reported by Chatterjee (^{3, 4}) that, after decapsulation of the ulnar nerve, deformities of hands became less in some cases soon after the operation. In an early case of deformity of the little and the ring fingers, the correction was complete soon after an exploratory operation to make a smear from the ulnar, which was found positive. It is inconceivable that a nerve will regenerate so soon after the operation on its sheath.

(5) Sometimes deformities and paralyzes appear suddenly in a phase of lepra reaction, and disappear after the subsidence of the reaction. The theory of degeneration and regeneration of nerves does not explain this phenomenon, because regeneration takes a much longer time.

(6) Incidentally, it has been observed that when one hand of a patient is wasted and the other is normal, the wasted hand feels cooler than the normal hand, particularly in the winter season. It has also been observed that lagophthalmos cases can close their eyes better after massaging of the eyelids. These are vascular phenomena.

It was therefore felt that this subject should be studied in detail. The study was made in two parts. In this paper are reported the results of a clinical study of muscular wastings seen in different parts of the body in relation to skin lesions and involvement of nerves, with pictures of illustrative cases. The illustrations include reproductions of four anatomic charts of the musculature from Gray's Anatomy.³

In the second paper will be reported the results of an experimental study with thermoneedle and galvanometer to determine the temperature of the affected muscles and that of the corresponding unaffected muscles on the other side of the body.

CLINICAL STUDY

For present purposes the body is divided into four parts: (1) face and scalp, (2) shoulder, (3) upper extremity, and (4) lower extremity, according to the location of the lesions. Note is made of the muscular wastings found in these parts, and of the nerves which were found thickened.

1. FACE AND SCALP

The face and scalp are subdivided into five areas according to the site of the original skin lesion: (*a*) forehead, (*b*) eyelids, (*c*) upper part of face, (*d*) lower part of the face and the lips, and (*e*) nose. The musculature of this region is shown in Text-fig. 1.

³The illustrations from Gray's Anatomy (29th edition) are reproduced by courtesy of Longmans, Green and Company.

Nerve supply, face and scalp.—(1) Sensory: The skin of the face and scalp is supplied by the fifth nerve (trigeminal) and the great auricular nerve. Branches of these nerves are often found thickened. (2) Motor: All the muscles of the face and scalp, except only the levator palpebrae superioris, are supplied by the seventh (facial) nerve. I have not found any thickening of this nerve.

When the skin lesion covers the entire face, on both sides, all of the facial muscles may be paralyzed, the face looking like a mask. There is bilateral lagophthalmos and facial palsy. (An example is Case 2 below.)



TEXT-FIG. 1.—Musculature of the face and scalp, right lateral aspect. (From Gray's Anatomy, 29th edition, by permission.)

Nerve supply, forehead.—When the skin lesion is on the forehead, there is usually paralysis of the frontal belly of the occipitofrontalis muscles. The forehead remains motionless when voluntary movement is attempted. When the patient is asked to raise his eyebrows he is unable to do so on the paralyzed side, and as a result the lines on that side remain smooth, whereas on the unparalyzed side the skin is thrown into transverse wrinkles.

Nerve supply, eyelids.—When there are lesions on the eyelids or on the adjacent parts, there is usually paralysis of the orbicularis oculi. As a result there is lagophthalmos and overflow of tears.

Nerve supply, upper face.—When the lesion is on the upper part of the face, there is sometimes paralysis of the levator labii superioris, the risorius, and the zygomaticus. The patient is unable to show the teeth on the affected side, and there is no elevation, eversion or raising of the angle of the mouth on that side when he attempts to grin or to laugh.

Nerve supply, lower face and lips.—When the lesion is so located there is, in addition, paralysis of the buccinator and of the orbicularis oris and other muscles of the lips. Paralysis of the buccinator causes difficulty in mastication and in blowing, and paralysis of the orbicularis

oris causes difficulty in closing the lips so that the patient is unable to whistle. In advanced cases there is dribbling of saliva and of food, and articulation of the labials is impaired.

Nerve supply, nose.—When the lesion is on the bridge of the nose there is sometimes paralysis of the dilators and compressors of the naris. As a result, the ala nasi do not move on respiration, and the nasal aperture of the affected side cannot be dilated or contracted at will.

Illustrative Cases

CASE 1 (M.F., 4170), Fig. 1.—A thick, active tuberculoid lesion covers the right side of the face and involves the eyelids. There is right lagophthalmos and facial paralysis, because of which the patient is unable to close his eye or to draw the angle of the mouth to show his teeth properly. Nerve thickening: right great auricular, 3+.

CASE 2 (P.D.), Fig. 2.—An advanced case (for contrast with others of the series) in which an ill-defined maculoanesthetic lesion had covered the whole of the face and forehead. The face has a mask-like appearance, due to paralysis of the facial muscles. Bilateral lagophthalmos and pinched nose. Nasolabial folds flattened. Nerve thickening: none found.

CASE 3 (G.M., 4345), Figs. 3a and b.—An ill-defined maculoanesthetic lesion had covered the right side of the forehead, involving the

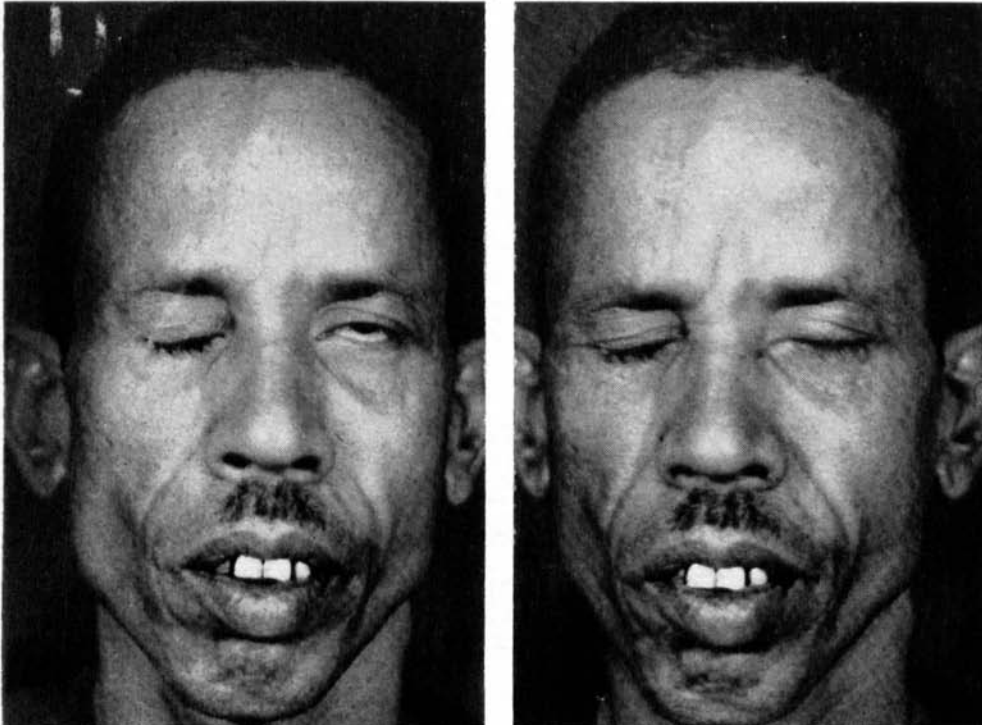


FIG. 1 (Case 1).—A thick, active tuberculoid lesion (reactional?) has affected closure of the right eye and control of the mouth on that side.

FIG. 2 (Case 2).—Effects of a maculoanesthetic lesion that had covered the entire face and forehead, causing mask-like appearance of face and bilateral lagophthalmos. (A very marked case, in contrast with the others of the series.)



FIGS. 3a and b (Case 3).—A maculoanesthetic lesion covered the right side of the forehead and the eyelids. (a) Slight right lagophthalmos, the eyelids being wider apart than the left. (b) The patient is unable to close the right eye completely.



FIGS. 4a and b (Case 4).—A minor tuberculoid lesion covers the left side of the forehead, the eyelids, and the side of the nose. (a) Paralysis of the orbicularis oris, slight of the occipitofrontalis. (b) Improvement of the lagophthalmos immediately after massage of the eyelids.

right eyelids and part of the face. Slight paralysis of the right orbicularis oculi, with slight lagophthalmos and lacrymation. Anesthesia of eyelids. Nerve thickening: none found. (a) Right eyelids are wider apart than the left, because of which the cornea is more exposed than on the other side. (b) The slight lagophthalmos prevents the patient from closing the eye completely.

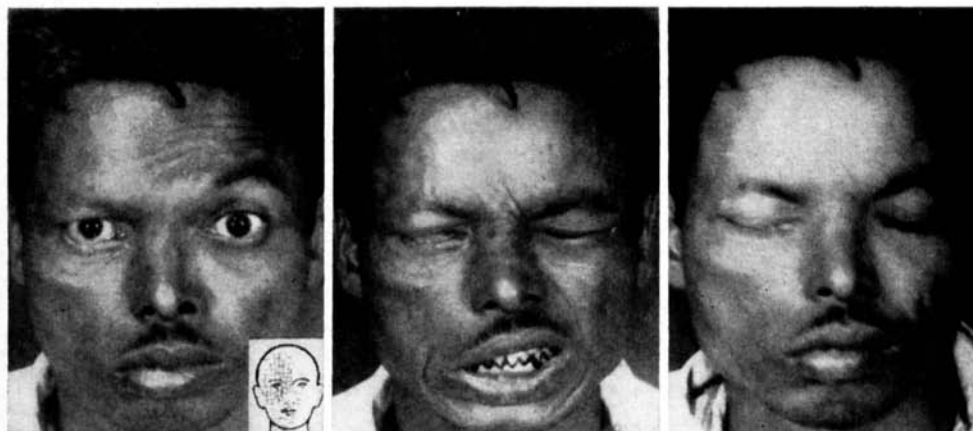
CASE 4 (B.C.S.R., 4376), Figs. 4a and b.—A minor tuberculoid lesion had covered the left side of the forehead, left eyelids, and nose. Nerve thickening: left great auricular, 3+; left supraorbital, 2+. (a) Paralysis of the left orbicularis oculi and slight paralysis of the left frontal belly of the occipitofrontalis. (b) Improvement of strength in the orbicularis oculi immediately after massaging the eyelids; the patient was then able to close his eye.



FIGS. 5a and b (Case 5).—Effect of maculoanesthetic lesion covering the forehead and eyelids on the right side (inset). (a) Paralysis of the occipitofrontalis and orbicularis oculi. (b) Improvement of the latter after massage.

CASE 5 (R.S., 4339), Figs. 5a and b.—A maculoanesthetic lesion (inset) covered the right side of the forehead and the right eyelids. Nerve thickening: none found. Paralysis of the right frontal belly of the occipitofrontalis and right orbicularis oculi, with lagophthalmos. (a) The patient was unable to raise the right eyebrow or close his eye. (b) Improvement in strength of the orbicularis oculi immediately after massaging of the eyelids; the patient was then able to close his eye.

CASE 6 (P.K., 4347, Figs. 6a, b and c.—A maculoanesthetic lesion covered the right side of the forehead and the right ear, and the eyelids, the nose and the side of the face (inset). Nerve thickening: none found. Paralysis of the frontal belly of the occipitofrontalis, right orbicularis oculi, muscles of the right side of the face, and of the dilators and compressors of the nostrils. (a) The patient was unable to raise the right eyebrow. There was drooping of the lower eyelid, paralysis of the



FIGS. 6a, b and c (Case 6).—Effects of a maculoanesthetic lesion that had covered most of the right side of the face (inset). (a) Inability to raise right brow. (b) Inability to close the right eye or to draw up the angle of the mouth. (c) Improvement of eye muscle after massage of the lids.

angle of the mouth and of the dilators and compressors of both nostrils. (b) Because of paralysis of the orbicularis oculi and of the levator oris and zygomaticus the patient was unable to close his eye or to draw the angle of the mouth upwards and laterally. (c) Improvement in strength of the orbicularis oculi after massaging of the eyelids, the patient being then able to close the affected eye.

CASE 7 (B.S., 3531).—A tuberculoid lesion had covered the lower part of the left side of the face and lips, and there was a similar lesion on the left ear. Nerve thickening: left great auricular, 2+. Paralysis of the left buccinator caused difficulty in mastication, and dribbling of food while eating. Because of the affection of the orbicularis oris, the patient was unable to whistle.

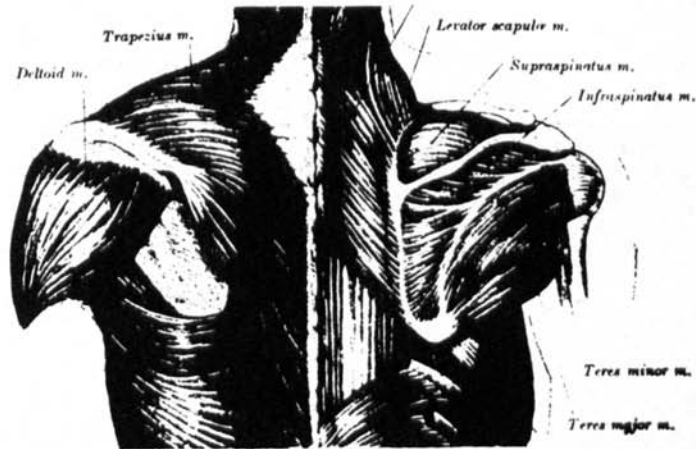
CASE 8 (K.K., 3122).—A subsided tuberculoid lesion on the left ala nasi had left anesthesia of the site. Nerve thickening: none found. Paralysis of the muscles of left ala nasi; patient unable to dilate or contract that side. Measurements of nostrils when dilated: right, 9 mm; left, 7 mm.

2. SHOULDER

This area is subdivided into the (a) scapular and (b) deltoid regions. Muscles of these regions are sometimes found wasted. The musculature of the shoulder is shown in Text-fig. 2.

Nerve supply, scapular region.—(1) Sensory: The skin of this part is supplied by the posterior branches of the lateral cutaneous branches of the intercostal nerves. These nerves are sometimes found thickened. (2) Motor: (a) The accessory nerve and the third and the fourth cervical supply the trapezius. (b) The suprascapular nerve supplies the supraspinatus and infraspinatus. (c) The subscapular nerve supplies the teres major. (d) The circumflex nerve supplies the teres minor. Nerve thickening: none found.

Nerve supply, deltoid region.—(1) Sensory: The skin is supplied by the supraclavicular nerves, which are sometimes found thickened. (2) Motor: The deltoid is supplied by the circumflex nerve, which has not been found thickened.



TEXT-FIG. 2.—
Musculature of
the shoulders
and upper back.
(From Gray's
Anatomy, 29th
edition, by per-
mission.)

Illustrative Cases

CASE 9 (P.C.M., 3919), Fig. 7.—A tuberculoid patch covers the left shoulder, scapular region, and arm. Nerve thickening: none found. Slight wasting of the muscles of the left shoulder and the scapular region. The shoulder is flattened, and there are depressions due to muscular wastings. The scapular ridges are more prominent than those of the other side.

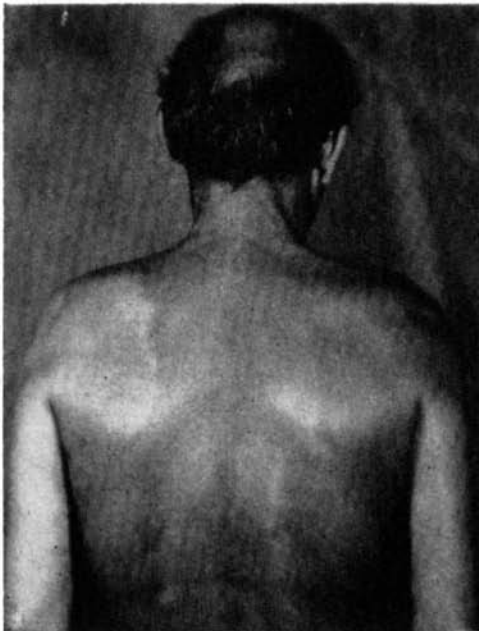


FIG. 7. (Case 9).—A tuberculoid lesion on the left shoulder, scapular region, and arm. Wasting of the shoulder muscles has caused flattening and depression in places, with increased prominence of the scapular ridges.

CASE 10 (M.G.M., 2828), Fig. 8.—A maculoanesthetic lesion covered the shoulder and scapular region on the right. Nerve thickening: right supraclavicular, 1+. Wasting of the scapular muscles has caused a depression, and there is slight flattening of the shoulder due to wasting of the deltoid.

CASE 11 (D.C.A., 3959), Fig. 9.—Maculoanesthetic patches covered both scapular regions and shoulders (inset). Nerve thickening: none found. Wasting of the right scapular muscles has made the body ridges stand out prominently.

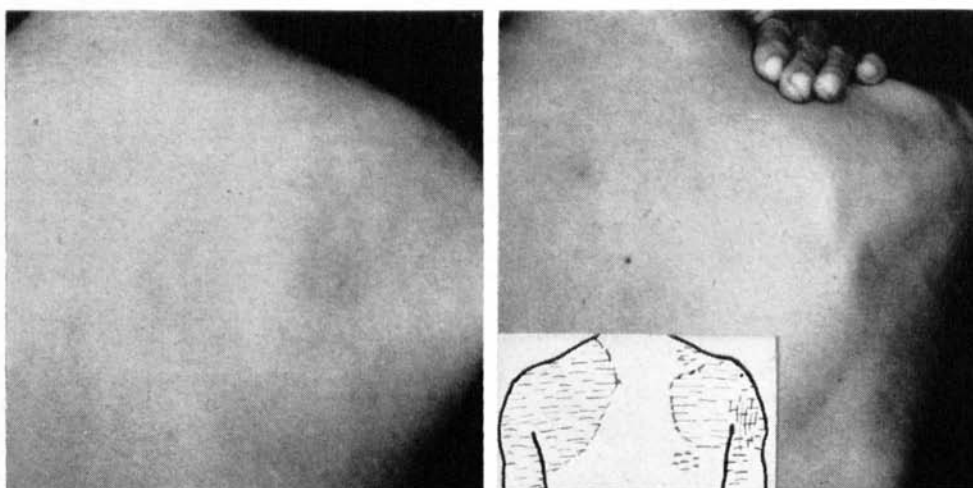


FIG. 8 (Case 10).—A maculoanesthetic lesion that covered the right shoulder and scapular region has caused muscular wasting over the scapula, seen as a distinct depression.

FIG. 9 (Case 11).—A maculoanesthetic lesion had covered both shoulders and scapular regions (inset). Prominence of the body ridges due to muscle wasting of the right scapular region.

CASE 12 (R.H., 1154), Fig. 10.—A small subsided tuberculoid lesion had been present on the left shoulder (inset), the site slightly hypopigmented. Anesthesia still present. Nerve thickening: none found. A depression of the lesion site due to wasting of the muscle.

3. UPPER EXTREMITY

The upper extremity is subdivided into four areas: (*a*) arm, (*b*) elbow, (*c*) forearm, and (*d*) hand. The musculature of the elbow and forearm is shown in Text-fig. 3.

Arm.—Wasting of the muscles of the arm is rarely seen. I have no case to include in this series.

Nerve supply, elbow.—(1) Sensory: Branches of the medial and posterior antebrachial cutaneous nerves, which are often found thickened. (2) Motor: The radial nerves supplying the following muscles of the elbow have not been found thickened: (*a*) triceps, (*b*) brachioradialis, (*c*) anconeus, (*d*) extensor carpi radialis longus, (*e*) extensor digitorum, and (*f*) extensor carpi ulnaris. On the other hand, the ulnar

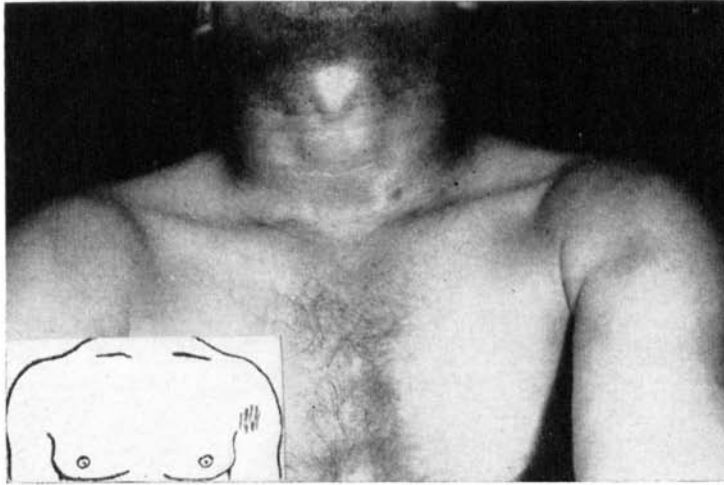


FIG. 10 (Case 12).—A small tubercloid lesion anteriorly on the left shoulder (inset) resulted in hyperpigmentation of the skin at the site, and depression due to muscular wasting.

supplying the flexor carpi ulnaris is commonly thickened.

Nerve supply, forearm.—(1) Sensory: Antebrachial cutaneous nerves, often found thickened. (2) Motor: (a) Ulnar, commonly found thickened; (b) median and (c) radial, thickening was common.

Nerve supply, hand.—(1) Sensory: (a) Ulnar, (b) median, (c) radial. Thickening of the ulnar is very common; of the others less com-



TEXT-FIG. 3.—The superficial muscles of the elbow, forearm and hand, posterior aspect. (From Gray's Anatomy, 29th edition, by permission.)

mon. (2) Motor: (a) Ulnar, (b) median, (c) radial. Wasting of the muscles supplied by the ulnar is a common finding. That due to affection of the median, particularly wasting of the thenar muscles and of the radial, causing wrist-drop, is occasionally seen.

The usual type of wasting of the muscles supplied by the ulnar is illustrated in Figs. 13-15. The unusual type of wasting is illustrated by certain of the other cases shown.

Illustrative Cases

CASE 13 (M.G., 3624), Fig. 11.—A maculoanesthetic lesion on the right elbow and upper part of the forearm. Nerve thickening: right ulnar, 1+; radial, none. Wasting of the muscles of the elbow, particularly of the radial side (brachioradialis and anconeus), causing depressions and making the bones prominent.



FIG. 11 (Case 13).—A maculoanesthetic lesion had covered the right elbow and the upper forearm. Muscle wasting, particularly on the radial side, has caused depressions, making the bones prominent.

CASE 14 (R.C., 2314), Fig. 12.—A minor tuberculoid lesion on the left elbow and upper part of the forearm. Anesthesia (but no skin lesion) on the ulnar side of the hand and lower part of forearm. Nerve thickening: left ulnar, 2+; radial, 1+; medial antebrachial, 2+. Wasting of the muscles of the elbow and ulnar side of forearm; none of the

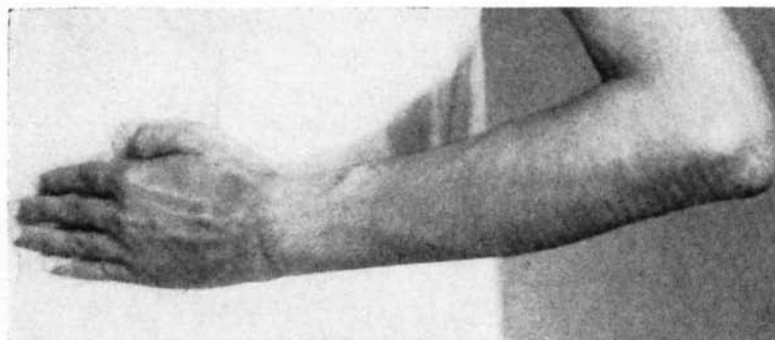


FIG. 12 (Case 14).—A minor tuberculoid lesion on the left elbow and upper part of the forearm has caused wasting at the elbow and ulnar side of the forearm, but none of the lower part of the forearm or hand.

lower part of the forearm or of the hand. Measurements around the forearm 3" below the olecranon: right, 9"; left, 8.5".

CASE 15 (M.B., 4288), Fig. 13.—An ill-defined maculoanesthetic lesion covered the left elbow, forearm and hand. Nerve thickening: left ulnar, 2+; radial not thickened. Wasting of the muscles of elbow (both ulnar and radial sides), and of the forearm and hand. Depressions in the radial side of the elbow due to muscular wasting. Measurements around the forearms 2" below the olecranon: right, 9"; left, 8.5".

CASE 16 (A.D., 4252), Fig. 14.—A maculoanesthetic lesion covered the ulnar side of the dorsum of the left hand, the little and ring fingers, and the ulnar side of the middle finger. Another similar lesion covered the left elbow (not included in the photograph). Nerve thickening: left

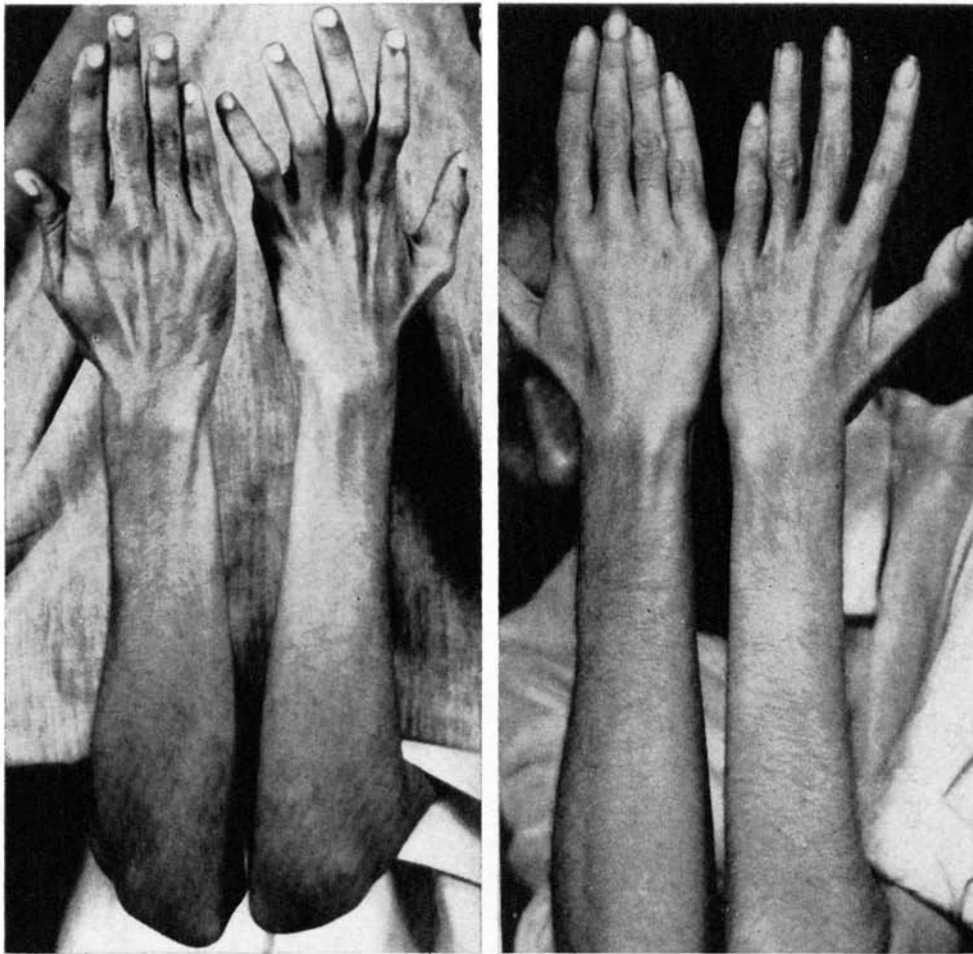


FIG. 13 (Case 15).—An ill-defined maculoanesthetic lesion involving the left elbow, forearm and hand caused wasting of the entire region and deformity of the hand. Depressions on the radial side of the elbow.

FIG. 14 (Case 16).—Effects of maculoanesthetic lesions on the ulnar side of the left hand affecting the little and ring fingers. Wasting of the entire region, with flattening of the forearm, and affecting the hand.

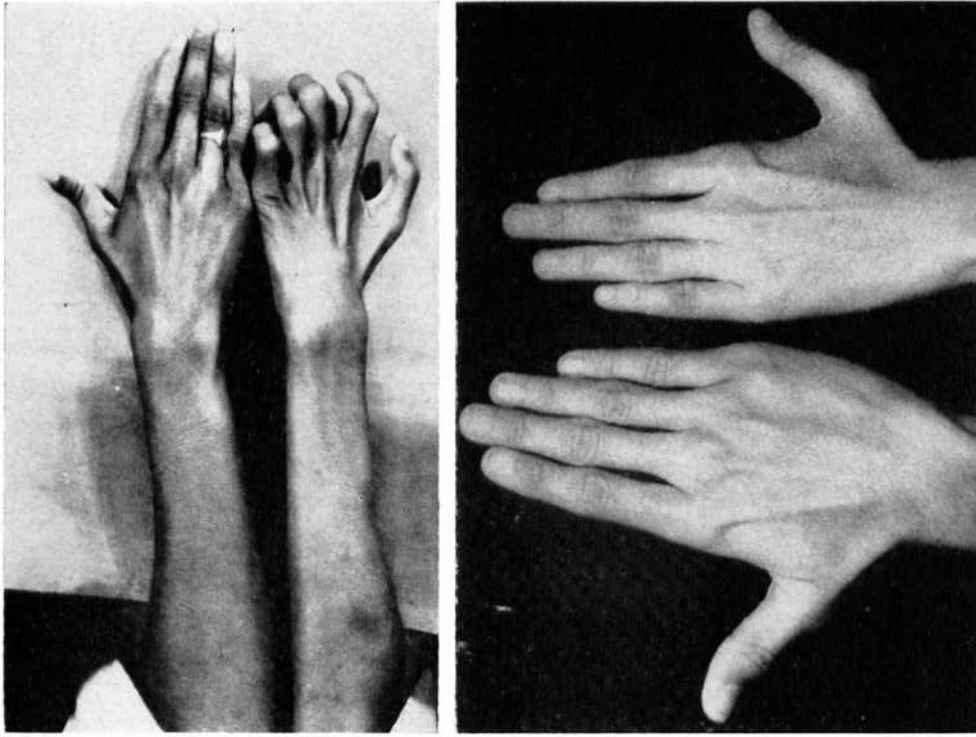


FIG. 15 (Case 17).—A maculoanesthetic lesion covered the entire left extremity, from the elbow to the hand (elbow not shown). Flattening of the forearm and muscle wasting of the hand, with deformity.

FIG. 16 (Case 18).—A subsided tuberculoid lesion had affected the left hand and forearm. Generalized thinning of the hand, unlike the muscle wasting seen in ulnar neuritis.

ulnar, 2+. Wasting and deformity of the hand. Wasting and flattening of the forearm (both radial and ulnar sides), the bones standing out prominently. Measurements around the forearms 4" below the olecranon: right, 8"; left, 7".

CASE 17 (S.P.M., 4202), Fig. 15.—A maculoanesthetic lesion covered the left elbow, forearm and hand. Nerve thickening: left ulnar, 3+; radial, 1+. Wasting of the muscles of the left elbow (not shown in the photograph), forearm, and hand, with flattening of the forearm and prominence of the bones. Measurements around the forearms 3" below the epicondyle: right, 7.5"; left, 6.5".

CASE 18 (N.C.B., 4340), Fig. 16.—A minor tuberculoid lesion, now subsided, covered the left forearm and hand. Nerve thickening: left ulnar, 1+. Generalized thinning of the hand, unlike the muscular wasting seen in ulnar neuritis. Measurements around the hands (excluding the thumbs): right, 7.5"; left, 6.5".

CASE 19 (S.A.H., 4092), Fig. 17.—A subsided tuberculoid lesion was located at the base of the left index finger. Nerve thickening: left radial, 1+ superficial radial, 2+; median, 1+. There is slight atrophy of the muscles at the site of the skin lesion, causing slight flattening.

CASE 20 (N.D., 3492), Fig. 18.—A tuberculoid lesion, now subsided, had covered the distal part of the left index finger. Nerve thickening: left radial, 1+, superficial radial, 2+; median, 1+. Generalized wasting of the distal part of the finger. Here, as in the preceding case, the muscular wasting was unlike that usually seen, being strictly localized in the area of the skin lesion.

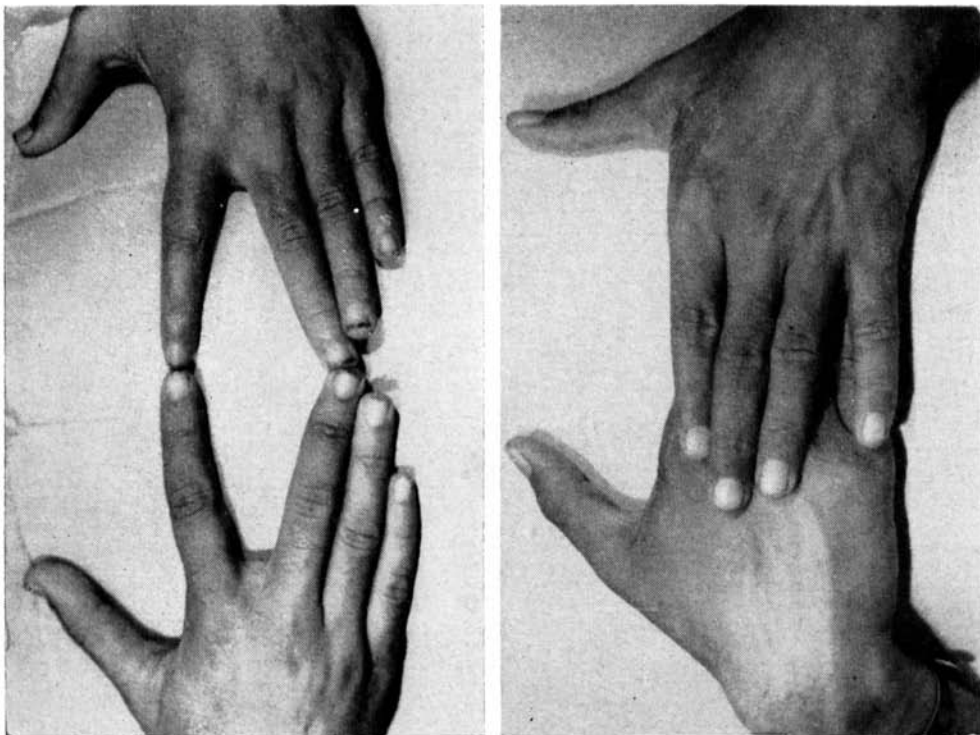


FIG. 17 (Case 19).—A subsided tuberculoid lesion had been present on the base of the left index finger. Muscular wasting at the site, with slight flattening.

FIG. 18 (Case 20).—A subsided tuberculoid lesion had covered the distal part of the left index finger, leaving muscle wasting confined to that part of the finger.

4. LOWER EXTREMITY

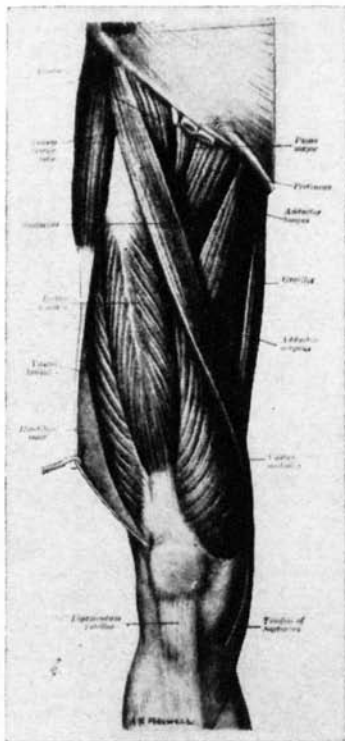
The lower extremity is subdivided into four parts: (a) thigh, (b) knee, (c) leg, and (d) foot. The musculature of the front of the thigh and knee is shown in Text-fig. 4.

Nerve supply, thigh.—(1) Sensory: Femoral cutaneous nerves, which are commonly found thickened. (2) Motor: Femoral nerve supplying the quadriceps femoris; this nerve has not been found thickened.

Nerve supply, knee.—(1) Sensory: (a) Infrapatellar, and (b) branches of the femoral cutaneous. These nerves are commonly found thickened. (2) Motor: (a) Femoral supplying the quadriceps femoris and the sartorius, (b) lateral popliteal supplying the tibialis anterior and extensor digitorum longus. These nerves are not found thickened when the skin lesion is limited to the knee.

Nerve supply, leg.—(1) Sensory: (a) Musculocutaneous, very commonly thickened, and (b) lateral cutaneous of the calf, (c) saphenous, (d) sural, which are sometimes thickened. (2) Motor: (a) Lateral popliteal supplying the dorsiflexors of the foot and ankle, thickening very common, (b) muscular branches of the musculocutaneous supplying the peroneus longus and the peroneus brevis, sometimes found thickened.

Nerve supply, foot.—(1) Sensory: (a) Musculocutaneous, (b) saphenous, (c) sural. These nerves are often thickened. (2) Motor: (a) Lateral popliteal supplying the dorsiflexors of the foot and ankle and the extensor digitorum brevis, commonly found thickened, as is wasting of the dorsiflexors of the foot causing foot-drop; (b) muscular branches of the musculocutaneous supplying the peroneus longus and the peroneus brevis, usually found thickened.



TEXT-FIG. 4.—Musculature of the front of thigh and knee. (From Gray's Anatomy, 29th edition, by permission.)

Illustrative Cases

CASE 21 (R.N.G., 4231), Fig. 19.—A tuberculoid lesion covered the lower part of the left thigh (anterolateral side) and the knee. Nerve thickening: left infrapatellar, 2+. Wasting of the muscles of the lower part of the left thigh, causing a depression. Measurements around the thigh 5" above the upper margin of the patella: right, 4.5"; left, 14(-)".

CASE 22 (B.K.G., 3109), Fig. 20.—A maculoanesthetic lesion near

the inner side of the right knee. Nerve thickening: none found. There is a depression of the lesion site, due to muscular wasting.

CASE 23 (J.C.G., 4071), Fig. 21.—A small tuberculoid patch, now



FIG. 19 (Case 21).—A minor tuberculoid lesion covers the lower part of the left thigh and knee, with muscle wasting causing a depression on the thigh.



FIG. 20 (Case 22).—A maculoanesthetic lesion on the inner side of the right knee caused wasting of the muscles there.

subsided, had occurred on the outer side of the left knee. Anesthesia present. Nerve thickening: none found. A depression at the site of the skin lesion due to muscular wasting.

CASE 24 (S.S., 4052), Fig. 22.—A subsided tuberculoid lesion had covered the lower part of the left thigh and knee. Nerve thickening: left infrapatellar, 1+. Wasting of the lower part of the thigh. That of the knee made the patella and patellar tendon stand out prominently. Measurements around the thighs 3" above the upper margin of the patella: right, 12.5"; left, 12".



FIG. 21 (Case 23).—A small tuberculoid lesion on the left knee, subsided, caused wasting on the outer side which resulted in a depression there.

FIG. 22 (Case 24).—A subsided tuberculoid lesion had covered the lower part of the left thigh and the knee. Wasting of the muscles of both thigh and knee, the latter making the patella and its tendon prominent.

CASE 25 (B.N.M., 1428), Fig. 23.—A maculoanesthetic lesion covered the left knee and upper part of the leg. Foot-drop. Nerve thickening: left lateral popliteal, 1+. Wasting of the muscles of both sides of the leg has made the shin bone prominent. Measurements around the legs 5" below the lower margin of the patella: right, 13"; left, 12".

CASE 26 (L.D., 4107), Fig. 24.—A maculoanesthetic lesion covered the right thigh, knee, leg, and foot. Foot-drop. Nerve thickening: right lateral popliteal, 1+. Wasting of the muscles of the knee, of both sides of the leg, causing the shin bone to stand out prominently, and slight generalized thinning of the foot. Measurements around the legs 7" below the lower margin of the patella: right, 10.75"; left, 12".



FIG. 23 (Case 25).—A maculoanesthetic lesion had covered the left knee and the upper part of the leg, causing foot-drop. Wasting on both sides of the leg has made the shin bone prominent.

FIG. 24 (Case 26).—A maculoanesthetic lesion extended from the right thigh to the foot, causing foot-drop and extensive wasting, with prominence of the shin bone.

DISCUSSION

When a motor nerve degenerates after injury, all the muscles supplied by it waste within a short time. In leprosy, however, the muscular wasting is very slow and progressive, and it has other peculiarities. The infection (in tuberculoid leprosy) spreads from the skin lesion to the sensory nerve supplying the area and from there to the related mixed nerve trunk, the ulnar, radial, median, or the lateral popliteal. The nerves first become thickened, and later the muscles supplied by them waste.

Usually there is coexistence of the muscular wasting and the thickening of these mixed nerves. Sometimes, however, in spite of the same amount of nerve thickening, the muscular wasting may be absent. The reason for this difference is not clear. In the same cases muscular wasting and paralysis may appear later, but the actual mechanism of this development is not known. If this is due to degeneration of the motor nerve, it is not clear how there can be correction of deformities in some of these cases after physiotherapy, nerve decapsulation, and other medical measures. It does not explain the sudden appearance of paralysis and wasting in the phase of lepra reaction, and recovery of those conditions after subsidence of the reaction.

Nor does it explain muscular wastings in cases in which the motor nerves supplying only the muscles, like the facial which supplies the

facial muscles, are not thickened. Here the skin and the muscles are supplied by two separate nerves, and there is no possibility of the infection spreading from the one to the other. In the absence of such a possibility of spread of infection, and in the absence of any actual thickening of the motor nerve, would it be correct to say that the muscular wasting is also due to degeneration of the motor nerves supplying these muscles?

There is also another departure from the usual findings. In case of thickening of a mixed nerve like the ulnar, even with a small skin lesion in its distribution, usually all the muscles supplied by the ulnar waste sooner or later. But in the case of a pure motor nerve only the muscles underlying a skin lesion waste, while the others supplied by the same nerve escape. For example, when the skin lesion is strictly located on the forehead, only the frontal belly of the occipitalis muscle is paralyzed. When the lesion is more extensive and covers also the eyelids, there is in addition paralysis of the orbicularis oculi but no paralysis of the facial muscles (e.g., Fig. 5). When the skin lesion covers entirely one side of the forehead and the face, there is paralysis of the frontal belly of the occipitofrontalis, the orbicularis oculi and the facial muscles (e.g., Fig. 6). Where there is no lesion on the forehead but only on the face and the eyelids, there is paralysis of facial muscles and of the orbicularis oculi but no paralysis of the frontal belly of the occipitofrontalis muscle (e.g., Fig. 1). When the skin lesion is only on the ala nasi, the dilator and compressor muscles of the nose are paralyzed but not the other muscles supplied by the facial nerve.

The facial nerve also supplies the tongue and the ear. If it be really affected it is not clear why hearing and taste are not affected in cases with paralysis of the facial muscles. Lagophthalmos is common, but in no case is the facial nerve found thickened. It is inconceivable that in all of the cases, the facial nerve should be fibrosed and therefore not found thickened. In Figs. 1 and 4, with tuberculoid skin lesions, the great auricular nerves were considerably thickened; it is not possible that only the facial nerve should be fibrosed while the other was thickened. Moreover, it has been observed that lagophthalmos cases could close their eyes better after massaging of the eyelids (Figs. 4-6). This could not have been possible had there been actual degeneration of the facial nerve.

Localized muscular wasting underlying skin lesions is also seen in other parts of the body. For example, muscles of the shoulder and scapular regions are sometimes found wasted (e.g., Figs. 7-9), but the nerves supplying them are not found thickened. There may be a skin lesion on the elbow and the muscles underlying it may waste (e.g., Figs. 11 and 12). All the muscles of this part, excepting the flexor carpi ulnaris, are supplied by the radial nerve. But the nerve which is usually found thickened is the ulnar. When there is a large lesion covering the

whole of the forearm, there may be wasting of all the muscles supplied by the ulnar, radial, and median, causing flattening of the forearm, but the only nerve thickened may be the ulnar (Fig. 13).

The ulnar type of wasting of the muscles of the hand, and thickening of the ulnar nerve, are the usual findings in leprosy. But sometimes there may be generalized thinning of the hand (Fig. 16) and only the ulnar nerve may be found thickened. This kind of generalized muscular wasting of the hand cannot be explained as due to ulnar neuritis. Sometimes there is localized wasting of muscles of the hand underlying small skin lesions without any thickening of the corresponding motor nerve (Figs. 17 and 18).

Although they are not very common, muscular wastings are sometimes seen in the thigh when there are skin lesions over the site (e.g., Fig. 19). Here the wasted muscles are the quadriceps femoris, but the femoral nerve supplying them is not found thickened. Similarly, muscular wasting is seen in the knee when there is a skin lesion over it (Figs. 20-22), but the nerves supplying the muscles of this part are not thickened. In the leg the usual finding is wasting of the dorsiflexors of the foot, and thickening of the lateral popliteal nerve when there are skin lesions on the outer side of the leg and on the dorsum of the foot. But when the skin lesions are more extensive and cover both sides of the leg, we found muscular wastings on both sides (Figs. 23 and 24) and thickening of only the lateral popliteal nerve. The wasting of the muscles of the inner side of the leg cannot be due to degeneration of the lateral popliteal, which does not supply these muscles. The medial popliteal nerves supplying these muscles are not found thickened.

Therefore I believe that there is some other cause for the muscular wastings seen in leprosy. It has been noticed, as said, that in the winter season the wasted hand of a patient feels considerably cooler than the normal hand at the same time. This indicates lessening of the blood supply in the affected hand. It has also been observed that in case of an active tuberculoid lesion on the face and the eyelids there is no lagophthalmos in the beginning, when the lesion is quite warm to touch, but as the lesion subsides and becomes less warm (i.e., when the blood circulation lessens) lagophthalmos gradually appears. On the other hand, cases with lagophthalmos can close their eyes better immediately after massaging of the affected eyelids, as has been shown. Massaging of the eyelids can only improve the blood circulation of the parts massaged. All these facts point to one thing, and that is the wasting of muscles in leprosy has some relation with their blood supply. That matter will be considered in my next report.

SUMMARY

1. Forty-three leprosy cases were studied with respect to muscular wasting and its peculiarities. It is generally held that in leprosy muscles

waste because of degeneration of the nerves that supply them, but this correlation was not always possible.

2. Two types of muscular wastings are seen. In one type it is associated with thickening of the nerves supplying the muscle, and the wasting is true to its type according to the nerve trunk involved, the ulnar, radial, median or lateral popliteal, all of which are mixed nerves. In the other type the wasting is not associated with any thickening of the nerves supplying the muscles. These nerves being purely motor, there is no possibility of the infection spreading from the skin to them via the sensory nerves and, in the absence of any thickening their degeneration is out of the question.

3. On the other hand, there are some cases with considerable thickening of nerves but without any wasting of the muscles supplied by them. Muscular wasting, therefore, does not depend on the degree of thickening of a nerve, but on some other factor.

4. The theory of nerve degeneration and regeneration does not explain how in some cases paralysis and wasting appears suddenly, in the phase of lepra reaction and disappears soon after the subsidence of the reaction. It also does not explain how correction of wastings and deformities is possible in some cases after physiotherapy, decapsulation of nerves, and other measures.

5. During the study it was noticed that the atrophied parts were cooler than the normal parts, particularly in the winter season. As the temperature of a part depends on its blood circulation, the lower temperature of an atrophied part must be due to lessening of the blood supply to the part.

6. It was also observed that lagophthalmos cases could close their eyes better immediately after massaging of the eyelids, although for only a short time. This could not have been possible had there been actual degeneration of the facial nerve. Massaging only improved the blood circulation of the part massaged.

7. All these observations led me to suspect that there was some diminution of the blood supply of the muscles which later caused their malnutrition and wasting. This matter has been investigated, and will be the subject of my next paper.

SUMARIO

1. Se estudiaron 43 casos de lepra por lo que se trata al desgaste muscular y a sus peculiaridades. Es generalmente aceptado que el desgaste muscular, en la lepra, ocurre por la degeneración de sus propios nervios, pero esta correlación no siempre es posible.

2. Se ven dos tipos de desgaste muscular. Un tipo es asociado con un engrosamiento de los nervios que surte a los músculos, y el desgaste corresponde al tipo de nervio afectado, ya sea el cubital, el radial, el mediano ó el poplíteo lateral, todos siendo nervios mixtos. En el otro tipo el desgaste no es asociado con engrosamiento de los nervios que surten a los músculos. Estos nervios son motores únicamente, y no es posible que la in-

fección avance de la piel hacia ellos por vía de los nervios sensorios, y sin engrosamiento su degeneración no se considera posible.

3. Por lo contrario, existen algunos casos con engrosamiento de los nervios considerable pero sin desgaste de los musculos correspondientes. Se supone entonces que el desgaste muscular no depende en el grado del engrosamiento del nervio pero mas bien en algún otro factor.

4. La teoría de la degeneración y regeneración nerviosa no nos explica como aparece un desgaste muscular ó parálisis en una forma rápida en la fase de la reacción leprosa y desaparece pronto después de la disminución de esta reacción. Tampoco no se explica como es posible la corrección del desgaste muscular y sus deformaciones en algunos casos después de la fisioterapia, decapsulación del nervio ó otras medidas.

5. Durante el estudio se notó que las partes atrofiadas tenían una temperatura menor a las partes normales, particularmente durante el invierno. Ya que la temperatura depende en la circulación sanguínea, la temperatura menor de esta parte atrofiada debe ser por la disminución de la provision sanguínea a esta parte.

6. También se observó que casos con lagofthalmos podían mejor cerrar sus ojos inmediatamente después de un masaje a los párpados aunque por un tiempo corto. Esto no podía haber sido posible en un caso actual de degeneración del nervio facial. El masaje únicamente aumento la circulación sanguínea de la parte afectada.

7. Todas estas observaciones me hacen suponer que hay una disminución de la provision sanguínea de los musculos que posteriormente causa su malnutrición y sus desgaste. Esto se ha investigado y será el tema de mi tesis siguiente.

RESUMÉ

1. Lá dégnérescence musculaire et ses caractéristiques ont été étudiées sur 43 cas de lèpre. Il est généralement admis que la dégnérescence des muscles dans la lèpre est due à la dégnérescence des nerfs qui les innervent, mais cette corrélation n'est pas toujours possible à établir.

2. Deux types de dégnérescence musculaire sont observés. Dans l'un, la dégnérescence est associée avec l'épaississement des nerfs qui innervent les muscles, et la dégnérescence de ceux-ci répond à la distribution des nerfs en cause, le cubital, le radial, le médian et le sciatique poplité externe, qui tous sont des nerfs mixtes. Dans l'autre type, la dégnérescence n'est pas associée avec un quelconque épaississement des nerfs qui innervent les muscles. Comme il s'agit dans ces cas de nerfs purement moteurs, il n'est pas possible que l'infection se communique à eux partir de la peau et par l'intermédiaire des nerfs sensitifs. Dés lors, en l'absence d'épaississement, leur dégnérescence est hors de question.

3. D'autre part, il y a des cas où l'épaississement considérable des nerfs n'est accompagné par aucune dégnérescence des muscles qu'ils innervent. Dés lors, la dégnérescence musculaire ne dépend pas du degré d'épaississement d'un nerf mais bien de quelque autre facteur.

4. La théorie de la dégnérescence et de la régénération n'explique pas la soudaineté éventuelle de la paralysie et de la dégnérescence, ainsi que cela se produit dans la réaction lépreuse, et leur disparition rapide après que cette réaction se soit apaisée. Elle n'explique pas davantage comment, il se fait, dans certains cas, que la physiothérapie, la decapsulation des nerfs, ou d'autres mesures puissent corriger dégnérescence et difformités.

5. Au cours de cette étude, il fut observé que les régions atrophiées sont plus froides que les régions normales, particulièrement pendant la saison d'hiver. Comme la température d'une région dépend de sa circulation sanguine, la température plus basse d'une région atrophiée doit être due à une diminution de l'irrigation sanguine dans cette région.

6. Il fut également observé que les malades atteints de lagophthalmie pouvaient plus aisément fermer les yeux immédiatement après un massage des paupières, encore que cet effet ne dure qu'un temps bref. Cela n'aurait pas été possible s'il y avait eu une réelle dégnérescence du nerf facial. Le massage ne fait qu'améliorer la circulation sanguine de la partie massée.

7. L'ensemble de ces observations me conduit à soupçonner quelque diminution de la circulation comme étant à l'origine de la malnutrition des muscles et de leur dégénérescence. Cette question a été étudiée, et fera l'objet de ma communication suivante.

Acknowledgment.—I am grateful to Dr. D. N. Bose (Asansol) for supplying some of the clinical materials used in this paper.

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