quite distinct from the new tissue about it. If silk were ever absorbed, one would suppose that it would be so at the end of two and a half years. The silk in the gross specimen was adherent to the dense fibrous tissue about it and moved with it.

It should be noted that the proliferation of new "tendon," i. e., true tendon tissue, comes wholly from the peritendineum, which is the all-important structure. The importance of the presence of this structure can be observed by noting the contrast between Figures 5 and 6.

CONCLUSIONS

1. Tendon transplantation *per se* is at times useful.
2. Tendons lengthened or reinforced with silk are better in that they are not only stronger, but also can be used to greater mechanical advantage.
3. Silk or linen thread is an excellent material to use to lengthen tendons in suitable cases.
4. The growth of new tissue will penetrate and permeate the silk only slightly (in some cases not at all), and does not absorb it.
5. When the peritendineum and tendon sheath have been removed, some foreign body is essential for regeneration, to serve as a director for the new growth.
6. With the sheath and the peritendineum present and sutured, no foreign body need be inserted. In this case the new growth is true tendon tissue.
7. Without the presence of the sheath and the peritendineum, no true tendon tissue can be regenerated. Such tissue is merely fibrous tissue, lacking elasticity and subject to stretching.
8. The new "tendons" are apt to be larger and stronger than the resected ones, especially when silk has been used to replace the resected portion.
9. Provided the sheath and peritendineum are preserved and function allowed early, adhesions may not occur. Without the sheath, adhesions may and do occur much more frequently.

234 Marlborough Street.

FURTHER ACCOUNT OF A PREVIOUSLY REPORTED CASE OF THE ISCHEMIC PARALYSIS AND CONTRACTURE OF VOLKMANN

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At the 1906 meeting of the American Medical Association, held in Boston, it was my privilege to present a communication on the ischemic paralysis and contracture of Volkmann, reporting at length a typical case which had come under my observation some twenty-two months previously. The history of this case¹ will not be repeated here. The patient remained in the Denver City and County Hospital for some six months, being under the neurologic care of Drs. Edward Delehanty and S. D. Hopkins. I saw him frequently. In December, 1906, sixteen months after he was first seen by me, he reentered the hospital in the service of one of my colleagues. At this time the median and ulnar nerves were freed² at the

upper part of the forearm. At a later day the flexor tendons were lengthened at the front of the wrist. According to recent, carefully obtained statements from the patient, these operations did not improve his condition. The forearm and hand became hard, fibrous, atrophied; the fingers and hand came down into a useless claw.

This patient consulted me again in my office Jan. 2, 1912. He said that during the last three or four years the limb had become more and more painful, the fingers and thumb more and more fixed. He desired advice regarding the removal of the hand, saying that it seemed to him to be a painful, useless, hopeless member.

Examination.—The right forearm and hand were markedly atrophied. The circumference of the affected forearm at its middle was 5½ inches; at the same point at the opposite side the circumference was 9 inches. The interosseous tissues of the hand and forearm seemed to form a hard, fibrous mass. The skin of the forearm and hand was of a bluish-red color; that of the opposite side was normal. The forearm and hand were cold to the touch: the opposite side was warm. Flexion and extension at the elbow were complete. The forearm bones were fixed in nearly extreme pronation; they could not be rotated. There was a trace of motion at the wrist, but there was no motion whatever of the fingers or thumb; these were fixed in extreme flexion, the thumb being doubled under the fingers (see illustration). The end of the thumb touched the skin of the hand and the thumb-nail was turned in and under. There was a chronic, trophic ulcer of the little finger. The

Condition of limb Jan. 2, 1912. This picture may be contrasted with that in the author's original paper (see Note 1).

middle finger was dark, bluish-black, this condition having appeared within a day or two previously.

Amputation.—Dr. George B. Packard, professor of orthopedic surgery in the University of Colorado, and Dr. Howell T. Pershing, professor of neurology in the same institution, were asked to see the patient in consultation. Both agreed that amputation of the limb was necessary and salutary. The limb was therefore amputated at a point a little above the middle of the forearm (St. Luke's Hospital), Jan. 3, 1912. No tourniquet was used. The skin on division retracted but little. All tissues between the skin and the bones were fused into a hard, shrunken, fibrous mass; these tissues failed to contract in the slightest on division. The radial and ulnar arteries squirted moderately and were easily picked up and ligated. The interosseous artery bled slightly. With no inconsiderable difficulty these fibrous tissues were pushed up from the bones and the bones divided, leaving ample covering. It was impossible to recognize any nerve-tissue in the face of the stump. Ordinary suture without drainage. Smooth healing. There was moderate pain in the stump after operation; this disappeared at the end of a week. At this date (March 24, 1912) the stump is sound and in all ways excellent.

I was in doubt as to whether a good stump could be obtained where the division was made, but it was obtained and I am gratified that it was possible to preserve the upper part of the forearm.

The amputated portion was handed to Dr. Ross C. Whitman, professor of pathology in the University of Colorado, whose report is as follows:

1. THE JOURNAL A. M. A., March 2, 1907, p. 750.
2. See later report made on this same case by L. Freeman, Tr. Am. Surg. Assn., 1907, p. 288. Case report No. II. Notation made to avoid duplication. A procedure apparently first advised by Hildebrand (Deutsch. med. Wchnschr., 1905. Lexer-Bevan, General Surgery, p. 505). In my original paper I believe that I was myself in error in giving the impression that improvement had followed operation.

REPORT OF PATHOLOGIST

Gross Appearance of Specimen.—A right hand from an adult; amputated 6 or 7 cm. above the carpus. There is a linear trophic ulcer on the palmar surface of the distal phalanx of the little finger, 1.2 by 0.2 cm. The hand is in a rigid posture, which cannot be overcome by any reasonable force, with all the fingers flexed at all joints, but most at the metacarpophalangeal joint.

Dissection.—The radial and ulnar nerves cannot be found. The radial artery is found without difficulty. It appears to be slightly smaller than normal, but the walls are not thickened. The tendons and synovia at the wrist are apparently normal. They can be moved freely over the joint by alternate traction above and below the joint. Obstruction to motion does not lie in either the superficial or the deep tendons crossing the wrist. When the palmar fascia is divided the contracture persists. All the superficial muscles of the hand are apparently markedly degenerated. The color is pale, translucent, brownish-yellow, the consistency soft, pasty. Dissection of these muscles is begun at the little finger. A piece of muscle tissue is removed from the hypothenar eminence and ulnar edge of the hand for examination. In this muscle fibers cannot be distinguished with the naked eye. The long flexor tendons of the little finger are then liberated in their entire length, but without releasing the contracture. Disarticulation of the finger at the carpometacarpal joint equally fails to release the contracture. Further dissection of the soft parts on the anterior surface of the fingers uncovers tissue which is redder and firmer than the other muscles. A portion removed for examination appears to consist of muscle tissue mixed with dense, resistant fibrous tissue. Division of this tissue partly, but not completely, releases the contracture. Division of all the soft tissues on the anterior surface of the finger, down to the bone, results in complete relaxation. The red tissue is probably not muscle, no muscle being normally found at this point.

Division of the long tendons and palmar fascia of the ring finger also fails to release the contracture. The knife is then inserted under the skin on the anterior aspect of the proximal phalanx and the soft tissue divided to the bone. The contracture then freely relaxes.

The superficial muscles of the thenar eminence form a pale, pulpy, translucent mass about the size of a lead-pencil, but smaller at the center than near the bony attachments. There is hardly a trace of color. A portion is removed for examination. Division of this muscle does not affect the posture of the thumb. Beneath is found, as in the little finger, a small mass of redder firmer tissue, the flexor brevis pollicis, tense and apparently firmly contracted. When this is divided the contracture relaxes. Finally, the knife blade, turned on the flat, is inserted close to the bone on the anterior aspect of the proximal phalanx of the middle finger. The soft tissues are then slit away from the bone. The contracture relaxes easily and completely.

Microscopic Examination.—The vessels are everywhere normal. No nerves are found at the wrist or elsewhere which can be clearly recognized as such. In a number of sections (stained with hematoxylin and eosin) are found bundles of connective tissue surrounded by a sheath, suggesting a nerve in cross-section, but no axis cylinders or myelin can be made out. The red tissue from the deep tissue of the thumb and little finger consists of dense fibrous connective tissue, with fully developed collagen fibrils and considerable fat, but the vessels are still rather large and thin walled. The muscle removed from various areas, as already indicated, shows a varying amount of connective-tissue increase. In certain areas the connective tissue is fully developed, with few vessels, in every respect identical with fully developed scar tissue. In other areas the process of connective tissue proliferation is still in active progress. In these areas the nuclei are of fibroblast type, lying in a delicate stroma devoid of collagen, and with abundant large thin-walled capillaries which branch and anastomose in every direction, and frequently show "vessel tents." In certain areas the connective tissue seems to be made up almost exclusively of these capillaries. The muscle fibers themselves are everywhere degenerated, but most markedly so where the

connective-tissue increase is most marked. The fibers are shrunken, usually present a wavy outline, and for the most part are devoid of cross-striations. Longitudinal striation, when present at all, seems to be exaggerated. The fibers are frequently broken up into rather coarse granules. In the areas where the connective tissue is least advanced, the muscle fibers are similarly more normal in structure, the cross-striation being at times intact, or at times extending across the fiber, but with a break in the line, recalling a geologic "fault." This appearance is particularly striking in sections stained with Mallory's phosphotungstic acid hematoxylin. When the striæ disappear they do so first at the periphery of the fiber. The tissues from the ulnar side of the hand show in general a more advanced degeneration of the muscle fibers, which are here scanty and separated by broad areas of connective tissue. Even here, however, a very few cells show traces of cross-striation. Their outline is wavy, and the fibrils run in a variety of directions, sometimes even crossing one another at right angles.

Dr. Whitman further says:

From the histologic study of this amputated limb it would seem probable that in this particular instance the changes were due to the combined effect of the anemia on the muscles and nerves. Whether this is so in the average case of the so-called Volkmann's ischemic paralysis and contracture can only be determined by the study of a considerable number of cases.

I do not know whether it is my unenviable fortune to be the only one who has amputated for this condition. I do not seem to find record of other amputations, although surgeons who have contributed to the literature of this subject say that in given instances amputation may become necessary. Of this I do feel certain: that in this particular case I know of no way in which the condition of the patient could have been improved. I believe that the original injury irreparably damaged the muscles, and, perhaps, the nerves. I may be mistaken in this, but on careful review of the course of this patient for nearly seven years this is my belief. I am conversant with the orthopedic, non-operative measures which have been thoughtfully and carefully set forth by Robert Jones, Reginald Sayre and others. In general I believe that such orthopedic management is the best which we at this time possess, but I venture the thought that this would have been without avail in the particular instance which forms the subject of this communication.

Fourteenth and Stout Streets.

MENINGEAL CARCINOMATOSIS

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During the lifetime of the patient the presence of carcinoma was not suspected, either in the meninges or in other organs, and after death the unaided eye could not discern it. It was revealed only by microscopic examination.

REPORT OF CASE

History.—Mrs. G., aged 62, widow, had been ailing on and off for several years with gout. For ten years she suffered with flatulency, but had never been seriously ill. Six weeks previous to Dr. W. W. Kerr's first visit, the patient began to suffer from headaches; these were at first slight, then gradually increased in severity and constancy until on October 31 her sufferings became so intense that she was unable to leave her bed. For seven or ten days previous to taking to bed, she complained of intense pain in both lumbar regions, which was greatly relieved by the use of a hot iron. The headaches during these six weeks were described as general and were unassociated with vomiting or disturbances of vision. At no time during her illness had she any stiffness of the muscles of