Opinion is still divided on the manner of lymphatic spread from a primary carcinoma to a distant lymph node. According to the conception perhaps most prevalent among pathologists, extension from the primary to the secondary site occurs by uninterrupted propagation through the intervening lymph channels. The well known investigations of Handley (1) on the spread of carcinoma of the breast contributed largely to the acceptance of this view. Handley summarized his own conclusions with the statements that "carcinoma spreads centrifugally in all directions from its point of origin by permeation of the lymphatic plexuses" . . . and "the embolic theory of dissemination is only true for exceptional cases."

Long before his treatise on the subject, however, a similar conviction in the minds of surgeons had led to various radical operations, such as the Halsted amputation of the breast, calculated to prevent recurrence of carcinoma by removal not only of the primary and secondary growths, but much of the intervening tissue as well, in a single block.

In later years there has been considerable opposition to Handley's view, and surgeons and pathologists alike have repeatedly called attention to the fact that recurrent carcinoma, while common in the regional lymph nodes, seldom occurs in close relation to the intervening lymphatics. In the recent text of Willis (2) the conclusion is reached that most lymph node metastases "owe their origin to detached tumor emboli carried to the glands in the lymph flow"; also that "the suggestion that early cancerous lymph nodal deposits arise not embolically but by continuous lymphatic permeation from the primary tumors is certainly erroneous." Willis based his argument not only on an extensive review of the literature but on his own repeated failure to find evidence of cancer in serial sections between carcinomas of the breast and metastases in the draining lymph nodes.

A more conservative stand has been taken by Ewing (3), who wrote: "In general it appears probable that the rapidly growing epidermoid or glandular carcinomas disseminate chiefly by lymphatic embolism, while slowly growing and recurrent tumors, especially in the skin, often
extend by continuous permeation.'" In his own experience Ewing was repeatedly unable to find any traces of invaded lymphatics connecting carcinomas of the breast with affected axillary nodes, and he was equally unsuccessful in cases of cancer of the tongue and penis.

For investigation of this problem carcinomas of the skin of distal parts of the arm and leg, accompanied by metastases in the regional lymph nodes, would seem especially suitable, because of the length and definite character of the intervening lymph channels. A case of squamous-cell carcinoma on the arm, in which a thorough examination was made by serial sections through a length of 40 cm. between the primary and secondary growths, is here recorded. Another case, of epithelioma of the lower leg, was similarly examined, but as there was no gross evidence at operation of metastases in the inguinal lymph nodes, the results are not considered of sufficient significance to report. In the latter case no lymphatic growth was found proximal to the carcinoma.

The first case is presented in detail particularly for its clinical bearing. As Ewing says: "The theory of continuous permeation is of fundamental importance in surgical procedure."

**Case History**

P. M., a white man fifty-nine years of age, entered the Billings Hospital of the University of Chicago, Dec. 22, 1930. On the extensor surface of the right wrist, extending from the styloid process of the ulna to the thenar eminence, was a flat, ulcerated growth with raised margins, measuring 10 × 9 cm. The lymph nodes in the right axilla were enlarged. The diagnosis was carcinoma of the wrist with metastases to the axillary lymph nodes.

On Dec. 24, 1930, the arm was amputated by Dr. D. B. Phemister, at the junction of the lower and middle thirds, and the right axillary lymph nodes were resected. The patient recovered, and prompt healing of the stump occurred. During the next two years he continued apparently well, without evidence of metastasis. In his last examination in the Billings Hospital, on October 11, 1932, there were no signs of recurrence of the carcinoma in the stump of the arm, nor was there any enlargement of structures in the axilla. The patient had no cough. He was beginning to lose weight, however, and somewhat later symptoms of internal metastasis became evident. The patient was not seen again by members of the hospital staff, and a definite history was not obtainable. He died March 1, 1933, twenty-six months after amputation of the arm, the symptoms, as described by the family, warranting the diagnosis of metastatic carcinoma of the bones. No autopsy was made.

**Histological Study:** The amputated arm was fixed in Zenker's fluid by injection through the main arteries, and sawed into twenty-seven consecutive blocks 1.0–1.5 cm. thick, from the wrist to the upper end. The accompanying photograph (Fig. 1) shows the specimen following fixation. The flexion indicated, and the contraction of the upper arm muscles, were unavoidable results of the action of the fixing fluid. Several months were devoted to the embedding, which was begun with 1 per cent celloidin. Blocks at the wrist end averaged 5.5 × 6.5 × 1.0 cm. and those taken from the elbow and upper arm 9.0 × 11.0 × 1.5 cm. Sections of approximately 30μ thickness were cut on a sliding microtome with a ten-inch knife. Several sections were cut from each block and stained with hematoxylin and eosin. Sections from the wrist and most of the forearm were mounted in balsam between lantern slide plates measuring 8 × 10 cm. The remaining sections were similarly mounted between glass plates of the same thickness, with outside dimensions of 10 × 12 cm.

1 The difficult technical work involved was carried out by Mrs. Virginia King of the Department of Pathology.
Examination of the sections yielded the following information. The growth was a squamous-cell carcinoma with large, deeply staining, oval nuclei at the periphery, and with large prickle cells with abundant cytoplasm, frequently undergoing keratinization, in the central regions. On the ulcerated margin were polymorphonuclear leukocytes and masses of bacteria. Blocks 1 and 2, from the wrist, contained carcinoma with definite extension into the lymphatics. In block 3 a few cells thought to be from the carcinoma were seen in the subcutaneous perivascular lymphatics. Considerable granulation tissue was present at the site corresponding to the carcinoma in the previous blocks. In the 4th and 5th blocks traces of granulation tissue persisted. No carcinoma cells could be seen. In the 7th block, the first block with large muscle trunks, a scattered lymphangitis was discovered, several lymphatics being plugged with polymorphonuclear leukocytes. The reason for this was apparent in most of the succeeding blocks, in the presence of many partially encysted Trichina larvae. A severe myositis, due to these parasites, was found in the muscles of the upper arm. The lymph nodes of the elbow were in view in blocks 22-24. Many sections were cut from these blocks and no carcinoma was seen, nor was any carcinoma found in the blocks from the upper arm. Aside from the trichinosis, the only abnormality observed was a thickening of all the arteries and arterioles, with apparent increase in muscular and elastic tissue in the media, and fibrosis of the intima, without atheroma or calcification.

Both forearm bones were examined for carcinoma. The two bones removed from each of 15 blocks in the forearm were decalcified and sectioned. No trace of carcinoma was found in any part of the bone or in the numerous periosteal lymphatics.

The axillary lymph nodes were invaded by nodules of carcinoma cells corresponding in type to those seen in the wrist. In the sections examined, coming from several nodes, no carcinoma was seen in the afferent lymphatics outside of the nodes.

**SUMMARY AND CONCLUSIONS**

In a case of squamous-cell carcinoma of the wrist, with metastases in the axillary lymph nodes, cross-sections were studied from blocks cut serially through the wrist, forearm, elbow, and lower third of the upper arm. No carcinoma was seen in the lymphatics or in any other structure of the arm, above a point 1 cm. proximal to the proximal end of the tumor. Granulation tissue reaction to the tumor was evident for an additional distance of 2 cm. In the absence of further evidence of present or past carcinoma between the primary growth and the axillary lymph nodes, it could only be concluded that in this case, whether this is the general rule or not, the growth in these nodes resulted from metastasis by lymphatic embolism rather than continuous extension in the lymph channels.
REFERENCES