mortem spinal fluid and when the body is well preserved or the fluid obtained early, the results are the same as would have been obtained just prior to death.

6. The gold sol test has the same value in the examination of cerebrospinal fluid obtained post mortem from the lumbar region as ante mortem, and the results may be similarly interpreted for diagnostic purposes.

REFERENCES.

[1] Solomon and Koefod: Experience with the Lange Colloidal Gold Test in 135 Cerebrospinal Fluids. BOSTON MED. AND SURG. JOUR., Vol. clxxi, No. 24, p. 886, Dec. 10, 1914.

[2] Myerson, A.: The Albumin Content of the Spinal Fluid in Relation to Disease Syndromes. Journal of Nervous and Mental Disease, Vol. 41, No. 3, p. 154, 1914.

ENCHONDROMA.

A REVIEW OF THE LITERATURE OF THIS SUBJECT WITH REPORT OF THREE CASES OPERATED UPON BY THE AUTHOR.

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IN a review of the literature of this subject one is struck with the great diversity of opinion, and theories as regards etiology. Also, the difficulties of diagnosis and the many opinions regarding the conservative and radical treatment and prognosis are confusing. Necessarily treatment depends to a great extent on a number of conditions, and particularly upon whether the surgeon is a conservative or a radical man. In the older works on this subject the great preponderance of opinion leans to the view that this is a strictly benign growth, and up to the present time only a few men consider it more or less malignant in character.

Some writers state that a preponderance of osseous tissue makes it benign and gives it the character of an osteoma or exostosis, while others claim the presence of osteoid tissue makes it a malignant type. As regards the etiology of these tumors Virchow, Ziegler, Stengel, and others feel that they spring from remnants or islands of cartilage left in abnormal situations as the result of imperfect fetal development, and especially at the epiphyseal portion of the bone. They feel that rickets is a predisposing factor to the condition.

The three cases about to be described by the author were near joints, and the greater number of the cases looked up all occurred near the joints or at the epiphysis of long bones. Therefore, from this review one would be warranted in feeling that from a clinical viewpoint, at least, this was the most plausible theory.

Whether or not the tumor arises from the periosteum is still a question. Then, again, whether the hard cortex sometimes found is really a part of the tumor or whether it is simply an over-stimulated periosteum is a question.

These tumors are rarely pure cartilage, and even the small ones often show deposits of lime salts, which are easily seen at the time of operation, and they usually show, also, marked disintegration. As to the question of trauma being a factor in causing these growths, one can believe that it might possibly be an exciting cause, as in Case 2, described in this article. Von Recklinghausen has attributed the disturbance in bone formation, which gives rise to such growths, to imperfect development of the blood vessels with faulty nutrition, as the result of an imperfect vascular supply. Koch believes that cysts, which occur from time to time in long bones, frequently arise in enchondromata. Bloodgood states single and multiple central enchondromata are very rare, but undoubted examples have been reported.

Patients with these conditions almost always complain of swelling, and of inconvenience in motion, and not of pain, unless there is direct impingement on a nerve. However, as in Case 1, a very small nodule might occur very near a nerve, causing considerable pain. To make a definite diagnosis of enchondroma clinically is not always a simple task. We know that tumors developing in a young patient, and situated near the epiphysis are most likely either enchondroma or sarcoma. Sarcoma will usually give more clinical symptoms of a malignant growth; symptoms which are well known and definite when present. These growths are also much more rapid in their growth than enchondromata, therefore it seems that the clinical course of the growth would be rather an important factor in diagnosis. Enchondroma is, without doubt, of a very slow and insidious growth, and only when it interferes mechanically, or is large enough to be observed as a distinct tumor, are patients conscious of it. The general health is not impaired and subjective symptoms are absent.

It would seem that with the x-ray we have a fairly accurate adjunct in diagnosis. Cases 1 and 2 were diagnosed by Dr. Walter Dodd as enchondromata, and subsequent pathological examination, after removal, proved them to be such.

Dr. E. W. H. Shenton, of Guy's Hospital, states in a report that the radiograph easily distinguishes the tumor. He feels that one very important point is the very regular outline that we observe in these conditions, as compared with the irregular and ragged way that ossification takes place in malignant conditions.

The line between a benign and malignant tumor is not always a sharp, well-defined one. It would seem that the two classes are not distinct, but rather differ in degree. An apparently benign tumor may show characteristics gradually changing to malignant.

The fact that distinct enchondromata do recur after operations is no indication that the diagnosis is wrong. It seems to the writer that the two factors may enter into this condition. One is, as Bloodgood states, "An incomplete removal of benign tissue, with the exception of angioma, is always followed by re-formation of a tumor from residue left behind, and the chance of malignant change in the residue is greater than in the undisturbed benign lesion." The other condition is that which might be called a recurrence, but which may be due to a very small nodule overlooked at the time of examination. The writer feels that this was the fact in Case 1, where a small overlooked nodule grew, rather than a recurrence of the tumor took place after primary removal. As can be seen by the x-ray, it is only by extreme rotation of the arm in this case, that this small nodule situated in the musculo-spiral groove could be made out.

Treatment. All surgeons, of course, will readily agree that a radical removal is indicated. What to do with a border-line case is, of course, difficult to decide, but it would seem, when practicable, the patient should always be given the benefit of a conservative operation. In estimating whether or not the conservative treatment gives the desired result, we must, of course, see the difficulty of drawing conclusions from the results of a large number of surgeons, of varied technic and training, in this particular branch of surgery. It must be conceded that the surgeon most used to bone work is best able to cope with this condition.

In operations on this condition, the gross pathology gives a picture in experienced hands that leaves little doubt usually as to its diagnosis.

All surgeons know that very often the clinical picture of a condition does not coincide with the pathological picture. For instance, all orthopedic surgeons know, that they find knee joints which at time of arthrotomy show clinically a tuberculous lesion, but pathologically they give no indication of such a condition. These knees are followed, and later they come to excision, leaving no doubt as to their being typical tubercular knees, both by their clinical course and condition at time of excision. The writer believes that more and more, orthopedic surgeons are depending for diagnosis, in many of the bone lesions, on what their clinical experience teaches them.

In consideration of the above, and as Bloodgood further states, "In bone lesions the mutilation of amputation is so great and chances of a cure of any doubtful lesion, should it prove malignant, are so slight that the most conservative operation should be done."

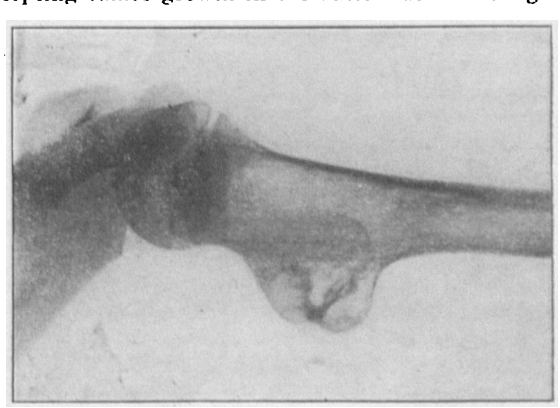
The writer feels that the conservative operation is indicated in the great majority of cases.

Virchow reports a case of enchondroma of the scapula, where the tumor was removed seven times, and the patient finally recovered. We must concede that the patient was far better off after seven conservative operations, still possessing his arm, than after the extensive radical operation of amputation. The author believes that the majority of surgeons are too quick to assume a recurrence of an operated tumor, as indicating malignancy. A simple recurrence in absence of other symptoms, as Virchow has shown, can do no particular harm, and conservative surgery is indicated. The loss of a limb means much to any individual, and the surgeon should be very judicious in his decision, in operating in these conditions. The majority of the cases when not too large, can easily be reached. The skin incision should be generous, and one will find that by very careful separation of the muscle fibres and rotation of the limb, the mass is readly reached without cross-cutting important structures.

Some authors have advanced the theory that these tumors start from the periosteum; the writer has a different opinion from some operators. A few surgeons state that the enveloping capsule can be opened and the enchondroma shelled out. The author cuts down when practicable, frees all the muscular attachments, does not open the capsule, cuts around the entire base of the growth, removing capsule and all. Some of these are very dense, and in order to be removed in toto, a sharp chisel and mallet are necessary. The base is then scraped with a very sharp bone curette and the whole cleaned thoroughly with 95% carbolic, followed by alcohol. The whole is covered as well as can be with fascia, then if the separation of the muscles has been done carefully, the fibres readily come together, and are held in place by chromic catgut and the skin closed with silkworm gut.

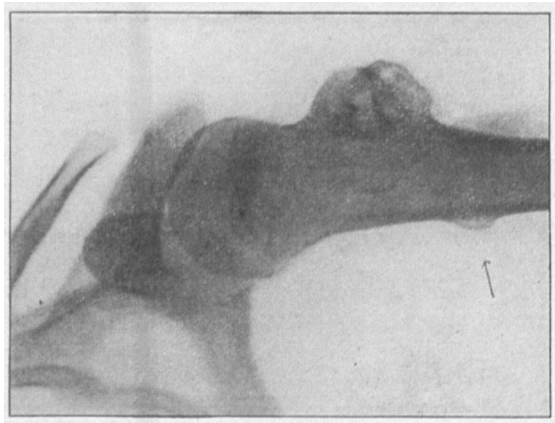
Case 1. *Family History.* Negative. Age 11 years.

Past History. Child has always been well excepting tumor growth in the outer side of the right upper end of the humerus. Seen by the writer in consultation 20 months ago. Two years previous noticed a swelling of the right shoulder in about the middle of the deltoid muscle. Was seen by an eminent surgeon, who operated, and removed the growth; had been well for a period of 1½ years,



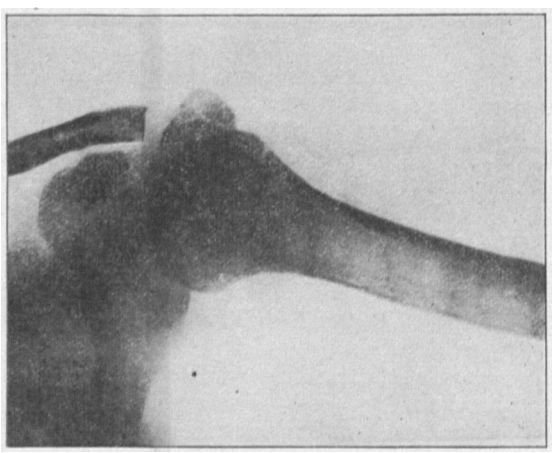
Case 1.—Plate 1.

Roentgen examination of right humerus. Plate reveals a tumor on the outer and posterior surface of humerus about one inch from the epiphyseal line. Roentgen diagnosis: Enchondroma. Dr. Wm. Dodd.

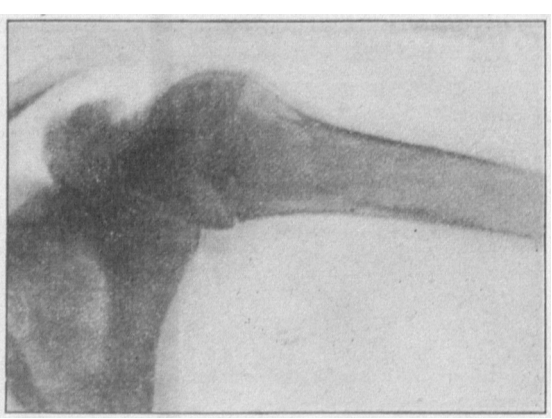


CASE 1.—PLATE 2.

Arm in marked rotation showing second lesion on inner aspect of humerus. This plate illustrates the importance of taking all such cases in various positions. Arrow points to small nodule.
Dr. Wm. Dodd



CASE 1.—PLATE 3.
Dr. Wm. Dodd.



CASE 1.—PLATE 4.

Same case taken by me twenty months after operation with arm in same relative position as two pictures of same case. It shows no pathological or abnormal condition. Dr. Wm. Dodd.

when the swelling was again noticed, and thought to be in about the same location.

Physical Examination. At time patient was seen by the writer a large rounded mass, about the size of a goose egg was felt at about the region of the centre of the deltoid muscle. Small nodule also felt in the course of the musculo-spiral nerve; incision about four inches long had been made in the external posterior aspect of the arm. Case had been seen at one of the large institutions and had been advised to have arm amputated at the shoulder. Patient then seen by the writer, who advised x-ray and conservative operation for removal of the tumor.

Operation. Incision six inches long, beginning at the tip of the shoulder, made in the skin, fascia cut and the fibres of the deltoid muscle, at its upper portion, separated down to the tumor mass. The arm having been rotated outwardly, the base of the tumor was cut into with chisel; the arm then rotated inwardly, forcibly, the under border of the tumor was cut into in a similar way. The tumor was removed and base curetted and only a thin shell of good bone left. In order to reach the smaller tumor on the musculo-spiral groove, the arm was forcibly rotated inward, a careful dissection made between the external head of the triceps and the outer border of the deltoid, down to the nerve. The nerve located, held away by blunt dissector, and the small tumor, on the edge of the groove, easily made out, carefully recovered by very sharp curette. The parts replaced and the arm outwardly rotated. The base of the large tumor was then carefully covered with fascia, muscle fibres brought together with catgut and the skin closed with silkworm gut.

Uneventful recovery in ten days.

Pathological Report. Tumor shows a fibrous capsule, beneath which is a thick layer of relatively acellular cartilage. The cells become more and more abundant as the bone is neared, until at the edge of the bone, they can be seen in many places arranged in rows at right angles to bone, with in places masses of acellular material between them, in places, small finger-like processes of vascular tissue, in places along the drawing edge between the new formed bone, trabeculae. The marrow has been replaced by delicate connective tissue. Along the edge of the bone the whole suggests enchondromal bone formation. Diagnosis, enchondroma.

Rontgen Report. Two plates taken. One in abduction internal rotation, and the other in abduction, external rotation. About two inches from the articular surface of the right humerus, and on the inner side and posterior aspect, there is seen a distinct tumor. The appearance of this tumor would lead one to believe that it was of cartilaginous origin, as there are marked areas of increased density and others where the density is much less. This is probably an enchondroma. There is no evidence of periosteal sarcoma and it does not look, in any way, like a giant cell sarcoma. Diagnosis, probably enchondroma. Dr. Walter Dodd.

One year and eight months after operation, physical examination shows no palpable enlargements in region of previous growths; no pain, no disability whatever, patient constantly putting on weight, physical condition excellent.

As can be seen in x-ray the humerus shows no sign of operation but looks like a perfectly normal humerus.

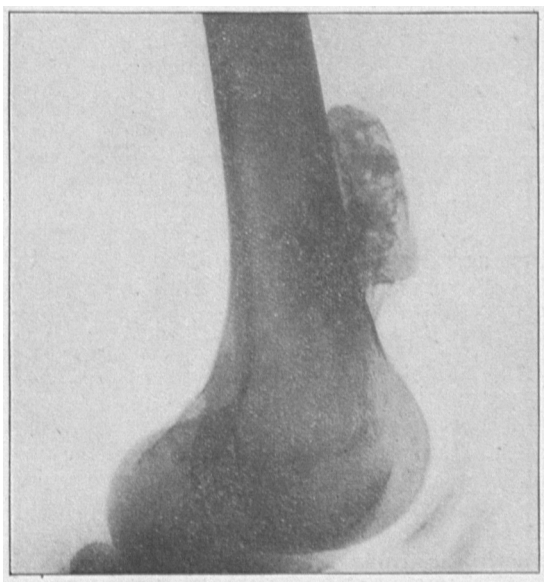
CASE 2. P. A. Age 24. F. H. Negative.

Past History. At age of 16 noticed a lump at the outer and lower end of the femur. Noticed three weeks after playing football; x-ray in 1906, one year after injury showed a small cartilaginous outgrowth about the size of a walnut. Operation advised but refused. Tumor gradually grew larger, pained only after sitting down awhile in a cramped position.

Physical Examination. Fairly well developed

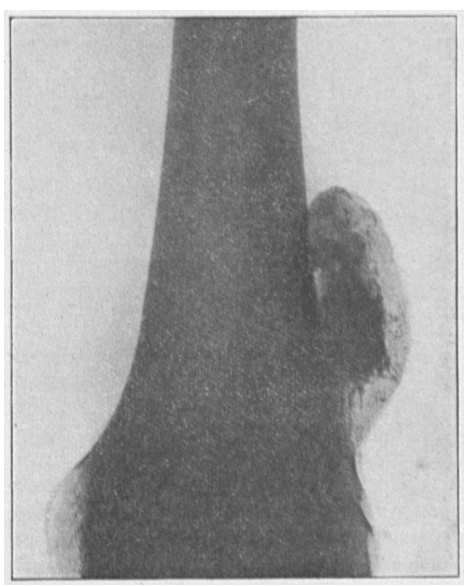
and nourished young man, a rather large, firm swelling felt about one inch external to the outer border of the patella; on motion of the lower leg definite snapping could be felt, no tenderness, operation advised.

Operation. Jan. 15, 1914. An incision about six inches long at antero-external aspect of the lower third of the thigh, and careful separation made down to the tumor mass. The tumor, as can be seen by x-ray, started from a small base, branched upward and outward. At the lower half of the tumor, the capsule of the knee joint seemed to be adherent; the tumor was therefore taken out in small sections by a Rongeur forceps and the capsule of the joint carefully pushed forward, as portions of the tumor were removed. This was done in order that capsule of knee joint should not be opened unnecessarily. The entire base carefully curetted, swabbed out with 95% carbolic, followed by alcohol and muscles stitched up.



Case 2.—Plate 1.

Internal lateral view shows a tumor somewhat anterior to the shaft. The character of the shadow indicates that it is made up of cartilaginous areas as well as areas of true bone. This plate shows the pedicle from which the tumor springs.
Dr. W. Dodd.



Case 2.—Plate 2.

Anterior view shows a tumor the base of which is one inch above the epiphyseal line, tumor is distinctly irregular and of irregular density. Roentgen diagnosis is enchondroma.
Dr. W. Dodd.

Discharged from the hospital in 10 days, wound healed. Weight bearing in three weeks, patient at present, twelve months after operation, states he never would have known he was operated upon, he feels so well, and all the former stiffness of the muscles that he had before operation had completely disappeared.

Pathological Report. Large, dense, bony and cartilaginous tissue from the femur measuring 4.5 x4x3 C. M. Section disclosed large masses of cartilage, in which occur, in places, groups of young, closely packed cartilage cells. Elsewhere the cartilage exhibits necrosis, the cells either absent or showing only shadows of nuclei. The connective tissue received with specimen shows in places a high grade hyaline disintegration, the process not suggesting metaplasia of connective tissue into cartilage. Among the fragments occur masses of necrotic cartilage which have undergone autolysis. Diagnosis, Enchondroma of the Femur.

X-Ray Report. Case II, Plate 1. Anterior view shows a tumor the base of which is one inch above epiphyseal line, tumor mass is distinctly irregular and of irregular density. This tumor shows the distinct bony pedicle from which it springs. Plate II, Internal Lateral view shows same tumor and is somewhat anterior to shaft. Character of the shadow indicates that it is made up of cartilaginous areas as well as areas of true bone. Diagnosis Enchondroma. Dr. Walter Dodd.

Case 3. Age 18.

Family History. Mother was in the Hospital five months ago for a goitre; father died of T.B. three years ago; history otherwise negative.

Present History. Has always been well.

Past Investigation. Five years ago, first noticed a lump on the inside of the arm, about the size of a marble. There was no pain at any time. The tumor grew steadily and upward, motion of the arm was limited more and more. The patient could not lift more than 50 pounds. On raising the arm there was no pain but there was a drawing sensation.

Physical Examination. Well developed and well nourished young man, rather apprehensive; no pain in motions of the arm; on palpation a tumor mass was readily felt in the axilla at upper end of the humerus.

Operation. An incision beginning at the tip of the coracoid process down along the inner border of the deltoid, to about the middle of the arm. A separation made between the two heads of the biceps, and dissection made down to the humerus; the whole arm rotated forcibly outward and the tumor readily presented itself. The tumor presented the usual smooth, shiny, cartilaginous appearance of these growths, was somewhat firmer than the usual enchondroma and readily removed. Contained areas of lime salts and necrosis. The tumor removed, base thoroughly curetted with 95% carbolic acid, followed by alcohol. The wound closed in the routine way. Patient discharged from the hospital in two weeks. At present, seven months from operation, has no inconvenience whatsoever. Pathological Diagnosis, Enchondroma.

REFERENCES.

[1] Tubby, A. H.: Deformities and Diseases of the Bones and Joints.
[2] Sutton, J. B.: Tumors, Innocent and Malignant.
[3] Andreas, F. W., M.D., F.R.C.P.: System of Medicine.
[4] Simmons, Channing C.: Tumors Originating in Bones, American Practice of Surgery, Vol. 3.
[5] Cathcart, Charles W.: Essential Similarity of Innocent and Malignant Tumors.
[6] Mungham, W. D.: New York Medical Journal, May 31, 1914.
[7] Richardson, W. G.: Enchondroma of the Manubrium Sterni, Bristol Medical Journal, May 10, 1913.
[8] Priamare, Alexander: Annals of Surgery, 1912.
[9] Dubreul' Arch. d'ant. men. Par. 1913-1914, xv, 53, 51.
[10] Bloodgood: Annals of Surgery, Philadelphia, 1913.
[11] Shattock, S. G., and Balleuse, C. A.: General Pathology of New Growths.
[12] Keene's Surgery, Vol. 1.
[13] Goldthwait, Painter and Osgood: Bone and Joint Diseases.
[14] Hamilton, John B.: Lectures on Tumors.
[15] Gowley, John W. S.: New York Medical Jour., Oct. 13, 1888.
[16] Duplay and Gazin: Les Tumeurs.
[17] Shenton, Edw. W. H.: Disease in Bones and Its Detection by X-ray, Guy's Hospital, 1911.
[18] Adami and McCrae: Text-book on Pathology.
[19] Additional references consulted but not referred to.
[20] Stengel: A Text-book of Pathology.
[21] Ziegler: General Pathology.

THE STUDY OF DISTURBANCES OF THE STOMACH.

BY H. F. HEWES, M.D., BOSTON.

[From the Clinic of the Massachusetts General Hospital.]

(*Concluded from page 373.*)

Here we have a symptomatology which is suggestive of hyperacidity, either simple hyperacidity, or ulcer wth hyperacidity, the symptom complex of duodenal ulcer. The finding, however, is typical of chronic gastritis and showed a low acidity. X-ray examination here was negative, an argument for the absence of any organic cause for the gastritis. The stomach in reacting to disturbance of any kind is apt to give similar symptoms in very different types of disease or disturbance. With this fact in mind, and a knowledge that the most aggravated stomach symptoms, worse than those often seen in even advanced cancer, may occur as part of a neurosis, or as secondary to gall bladder trouble, syphilis, acidosis or anaemia, we should go very slowly in making a positive diagnosis of any special type of a stomach disease from the record of symptoms alone. The conditions which most commonly give a history of symptoms suggestive of organic stomach disease, are gall bladder trouble, appendix trouble, adhesions from old appendix or surgical operation, syphilis and nerve conditions. Often these conditions can be distinguished from actual stomach disease by the physical examination. If not the tube examination or the x-ray examination should make the distinction in many cases. In some cases of these outside conditions, abnormal findings by special methods, as hypersecretion, by tube, or incisura, or abnormality in peristalsis by x-ray similar to the findings in ulcer or cancer may occur. This is especially the case with adhesions involving the stomach. Here there is cause for confusion, but though we may thus be confused in a positive way even with the use of our special methods of research between ulcer or cancer and outside conditions as causes of stomach trouble, we should not be confused where these findings are negative. Organic stomach disease should show some sign besides the record of symptoms, blood or stasis or hypersecretion or an abnormal sediment, by tube or abnormal feces findings, or abnormality of some kind by x-ray, one or the other, and it is a safe plan not to make a positive diagnosis without some such sign or some other definite physical sign, as a tumor or an extreme anemia.

A class of cases which has given me much trouble in the past, is the condition of stomach disturbance associated with neuroses or nerve debility. Often the symptoms in such cases are very aggravated. We find often a long duration of symptoms, with much vomiting and much loss of weight. Here the apparent nerve character of the patient may help diagnosis, but a more important factor is the absence of positive signs by tube or x-ray.

The ptosis cases are another class of difficult cases. Here also we find a lack of positive physical signs save the ptosis signs, which discriminate them from conditions of organic trouble. There have been too many of these nerve cases and ptosis cases operated upon in the past through lack of proper investigation of the case, and a faulty diagnosis. I do not mean to say that ulcer and cancer of the stomach do not exist without giving positive objective signs of some sort. There is doubtless a stage in all cancer cases where no sign is present, but since a history of marked stomach trouble is so common in conditions other than organic stomach disease it is a good plan to keep the rule of not going too far in diagnosis of organic conditions without objective signs.

Another danger in stomach work already emphasized by me, is seen in the misleading character of x-ray findings which occurs fairly often. As a result of my experience up to the present I am very slow to make a positive diagnosis of organic stomach lesion, in many cases by an abnormal x-ray finding alone, that is, when the abnormal x-ray finding is the only abnormal objective finding.

There are cases where we are safe in going by an x-ray finding plus a history without other objective findings, as, for example, where a clear diverticulum is present, or where a nine-hour bismuth residue with absent sphincter is present, but there are, as stated, many abnormal x-ray findings which in some cases actually represent the effect of cancer or ulcer, which may be present with no stomach lesion, or with other conditions. I have seen too many cases operated upon the verdict of the x-ray alone, when good judgment based upon a study of the case by other methods in addition to the x-ray, might have changed the diagnosis. Here is a case in point: