

# The American Journal of Roentgenology

Edited by P.M. Hickey, M.D.  
Associate Editor, F.C. Zapffe, M.D.

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|                                                                                                                        | Page |
|------------------------------------------------------------------------------------------------------------------------|------|
| The Roentgen Diagnosis of Gastric Ulcer - - -<br><i>By R. D. Carman, M. D., Rochester, Minn.</i>                       | 233  |
| Chronic Typhoid Periostitis - - -<br><i>By H. W. Dachtler, Toledo, Ohio</i>                                            | 252  |
| Roentgenograms - - -<br><i>By William H. Stewart, M. D., New York City</i>                                             | 259  |
| The X-Ray Equipment and Work in the Army at the<br>Present Time - - -<br><i>By Capt. William A. Duncan, U. S. Army</i> | 268  |
| The Possibility of Estimating Dosage and Penetration -<br><i>By W. S. Newcomet, Philadelphia, Pa.</i>                  | 276  |
| Editorial - - -                                                                                                        | 279  |
| Applicants for Membership - - -                                                                                        | 280  |
| Abstracts - - -                                                                                                        | 282  |

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## THE AMERICAN JOURNAL OF ROENTGENOLOGY

Editor, P. M. Hickey, M. D., Detroit  
Associate Editor, F. C. Zapffe, M. D., Chicago

VOL. I

NEW SERIES, APRIL, 1914

No. 6

### THE ROENTGEN DIAGNOSIS OF GASTRIC ULCER

By R. D. CARMAN, M. D., Rochester, Minnesota.

The value of the Roentgen-ray as a diagnostic aid in gastric ulcer has in my opinion been greatly underestimated. Until recently. I shared the orthodox belief that only a moderate percentage of ulcers of the stomach could thus be demonstrated, but the diagnostic percentage herein quoted has convinced me that the Roentgen-ray has no apologies to offer in this line.

Last September in a paper before the Indiana State Medical Association I ventured the statement that the Roentgen-ray was perhaps worth 65 per cent., in the diagnosis of gastric ulcer, and that this percentage would probably be materially increased in the future. In confirmation of this I may say that from September first to March first, 1,983 patients were examined at the Mayo Clinic by the Roentgen-ray for gastro-intestinal lesions. At operation forty-seven of this number were found to have gastric ulcer and 39 of the 47 were diagnosed as such upon radiologic signs, thus giving the Roentgen method a value of 83 per cent. Duodenal ulcers, which are regarded by some as gastric, are not here included.\*

I have heard clinicians remark that the Roentgen-ray is of considerable help in carcinoma of the stomach but of little aid in ulcer. In my opinion the relative value is

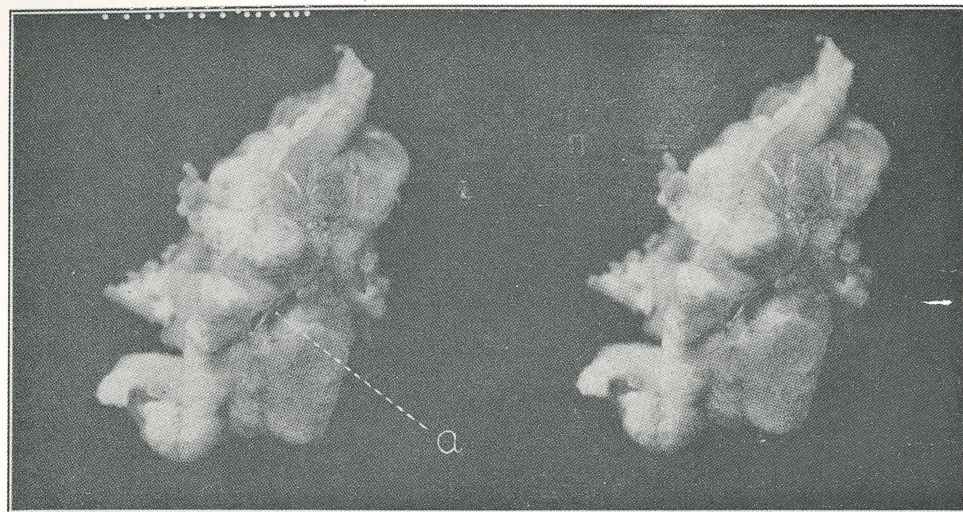
the reverse, so far as the clinician is concerned. In carcinoma he often finds a palpable tumor, food remnants, Oppler-Boas bacilli and evidences of obstruction as diagnostic aids. In ulcer he has little else than the anamnesis to guide him, which is notoriously uncertain. Hence any method that will give concrete data in ulcer is of distinct value. For the surgeon, on the other hand, the Roentgen-ray not only increases the percentage of correct diagnoses of cancer, but also furnishes some information as to resectability and the prospective operative requirements. The diagnosis of ulcer is further important from the fact that an ulcer often shows carcinomatous cells and its diagnosis is therefore in many instances equivalent to an early diagnosis of carcinoma, at a time when surgery can be the first instead of the last resort.

#### TECHNIC

The lack of a uniform technic for gastro-intestinal examinations is perhaps accountable for some diversity of opinion among radiographers. In England an effort is now being made to standardize methods and the endeavor will meet with general approval. Whether the movement succeeds or not it is highly important that the individual operator have a rather steadfast routine in order to give him a constant basis for comparison.

\*Carman. "Radiologic Signs of Duodenal Ulcer with Special Reference to Gastric Hyperperistalsis." Jr. A. M. A., March 21, 1914.





Figs. 1x, 1y. Case 96805. Two illustrations, X and Y. X is a stereoscopic view of the removed specimen, showing the ulcer at "a." Y is a photomicrograph, magnified 4 diameters, of a cross section through the ulcer. Note that destruction extends down to musculature but not into it. This excavation is the niche seen at "a" in roentgenogram Fig. 1z. "f," ulcer base; "g," intact mucosa.

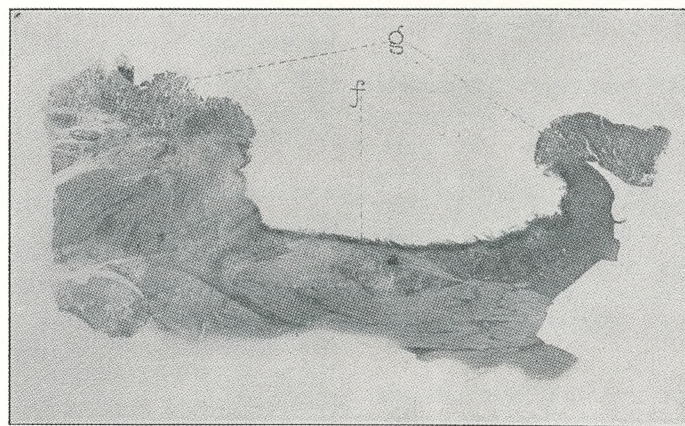


Fig. 1y. See legend Fig. 1x.

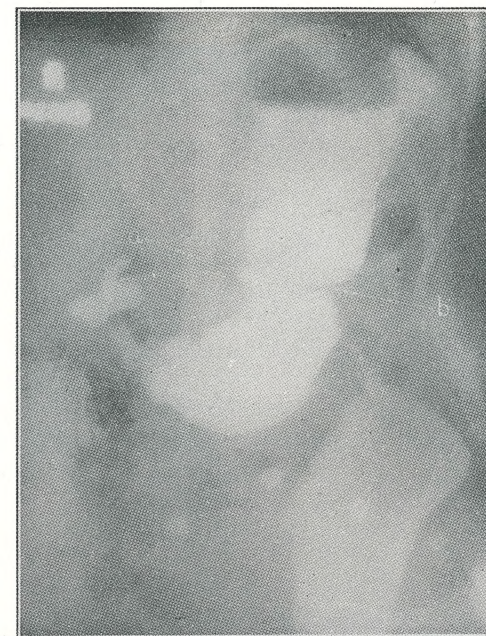


Fig. 1z. Case 96805. Callous ulcer on lesser curvature posterior wall. Contact ulcer size of a lead pencil on anterior wall. Posterior ulcer deeply calloused and recently perforated, covered with thick mat of adhesions. While two ulcers were present, only the one on the lesser curvature, posterior wall, gave radiologic signs, as here shown. "a" Niche. "b" Incisura. No six-hour residue.

Our technic\* may be defined as the combined fluoroscopic and skiagraphic examination with the double opaque meal. Barium sulphate is used in the six-hour meal and at the time of examination the patient is given bismuth subcarbonate in water followed quickly by bismuth subcarbonate in potato-starch pap.

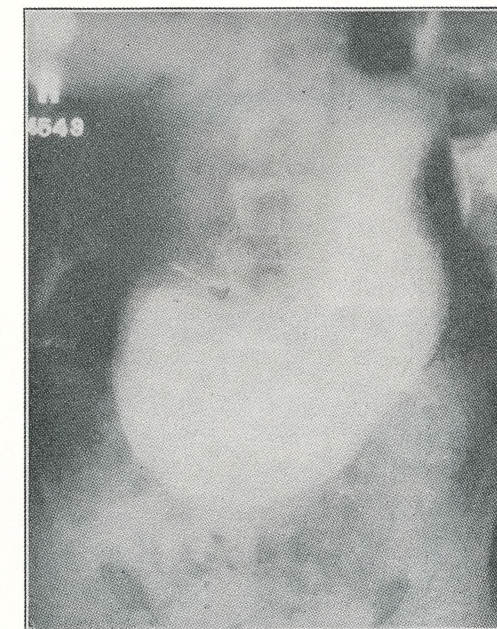
I am a strong partisan of the screen and believe that its employment is absolutely requisite to a satisfactory inspection of the digestive tract. So-called "serial radiography" is by no means an efficient substitute, no matter how many plates are made, or how much language is devoted to a description of the eccentricities they reveal. The only valid objection to the screen is the

\*This may be found in detail in "The Roentgen Ray as an Aid in the Diagnosis of Gastric Cancer and Ulcer." The Journal of the Indiana State Medical Association, November, 1913.

possible danger to the operator, but with up-to-date protective apparatus I believe this danger is practically nil.

During the screen examination which rarely requires more than five minutes, often less, the behavior of the stomach to palpation, respiration and variations of abdominal pressure, its mobility and peristaltic activity are all carefully observed from different angles. When it is completed, plates are made if desired, with the patient either prone or standing, usually the latter.

As first used, the six-hour meal originally contained bismuth. The six-hour limit for normal gastric evacuation, while arbitrary, was well sustained by experience. Since barium sulphate leaves the stomach more



Figs. 2x, 2y, 2z. Case 94543. Ulcer lesser curvature, at incisura angularis. Contact ulcer on posterior wall, adherent to liver and pancreas. Three views are shown, X, Y and Z. In X, directly anteroposterior, no definite signs are seen. Y is a moderately oblique view showing irregular indentation of greater curvature at "b." Z, extremely oblique view, showing crater of ulcer at "a" and more pronounced incisura at "b." The wave-like, irregular incisura is the result of the multiple ulcers. All three plates, X, Y and Z, were made at one sitting in rapid succession. Stereoscopic view of specimen shown in Fig. 2w.



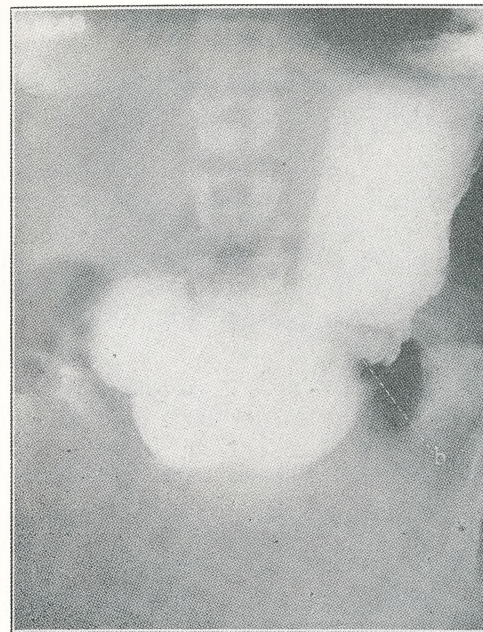


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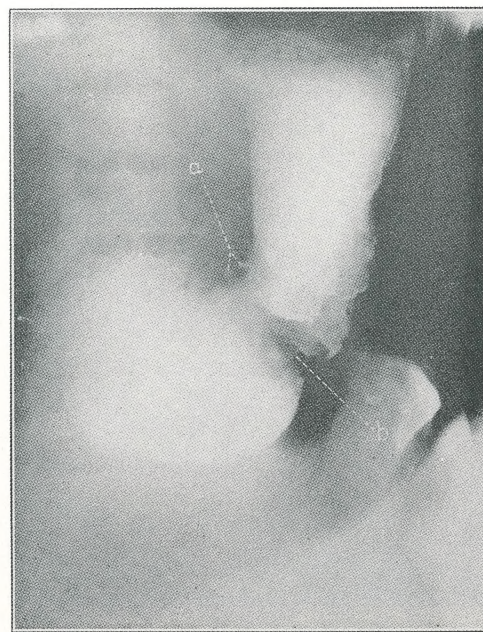


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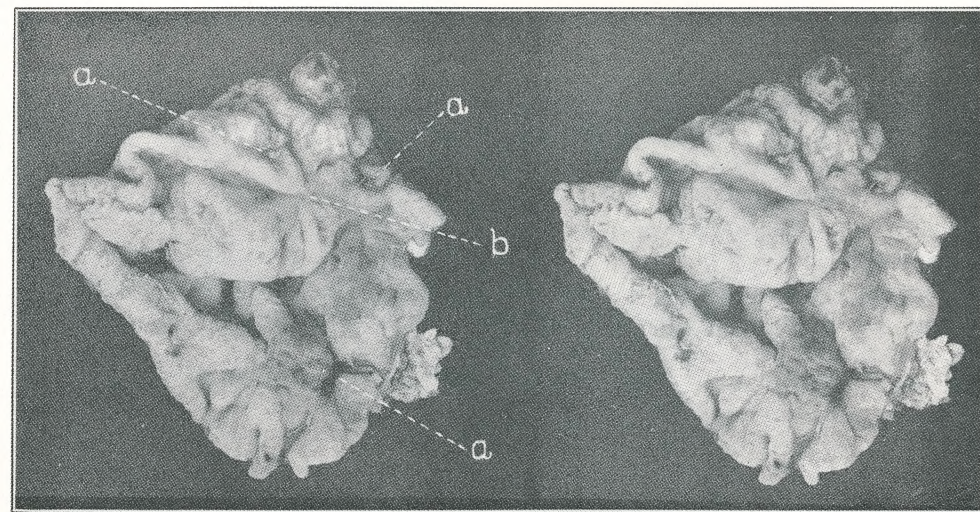


Fig. 2w. Case 94543. Stereoscopic view showing multiple ulcers. Mucous membrane folded irregularly. Ulcers seen at "a." Healed ulcer at "b." Roentgenograms shown in Figs. 2x, 2y and 2z.

rapidly than bismuth, a barium residue after six hours is even more significant than a bismuth residue. The employment of the six-hour meal is more convenient both to patient and operator than hourly examinations beginning with the taking of the first meal. It is not very important to know whether the stomach is emptied in two hours or four, but it is necessary to learn whether a liberal time limit for evacuation is exceeded. The fluidity of the bismuth water and its small amount favor certain features of the examination, while the bismuth-supporting property of the potato-flour pap and its palatability make it a desirable medium for complete filling.

#### VARIETIES OF ULCER

As seen at operation, four classes of gastric ulcer may be distinguished: (1) Small, exceedingly shallow mucous erosions

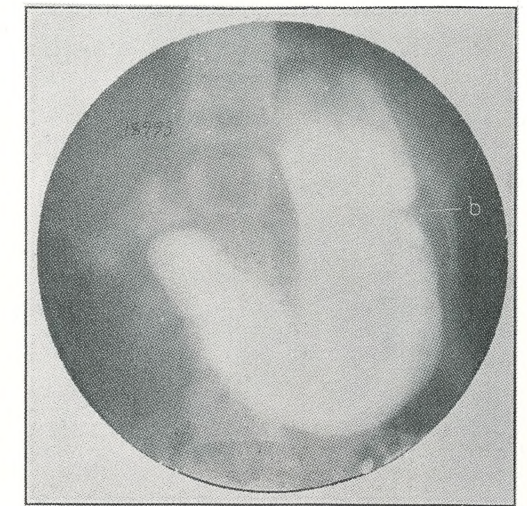


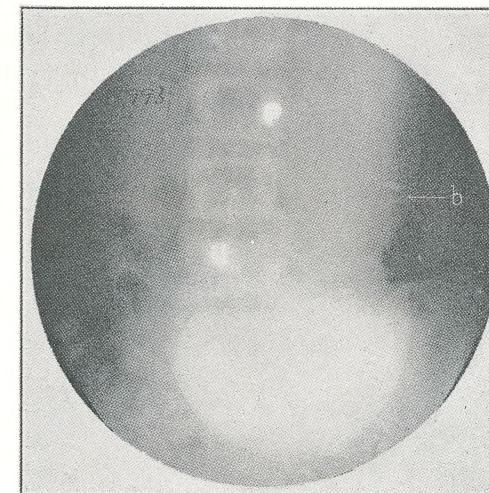
Fig. 3y. See legend Fig. 3x.

and slit-like ulcers, (2) penetrating or callosus ulcers with relatively deep craters, (3) perforating ulcers with or without accessory cavity-formation, and (4) very early carcinomatous ulcers.

Of these four classes, the first—the small, shallow, mucous erosions—offer the greatest difficulty of roentgenologic detection. They are either superficial denudations or mere slits in the mucosa, incapable of holding enough bismuth to make a visible niche. Unless accompanied by an incisura or a six-hour rest their presence will hardly be even suspected, much less positively determined.

The penetrating ulcers which have burrowed more or less deeply into the gastric wall, show a definite crater, which may be either quite round, oval or irregular. The degree of facility with which this crater can be seen as a niche by the Roentgen-ray depends upon its size and location.

Perforation of an ulcer and a continuation of the destructive process into an adjacent organ or tissue results in the formation of an accessory cavity. Those that I have seen were either in the liver or pancreas. None, shown later by operation, failed to be visible on screen and plate.



Figs. 3x, 3y. Case 18993. Ulcer size of a twenty-five-cent piece high on posterior wall, near lesser curvature, adherent to pancreas. Two views are shown, X and Y. X shows incisura at "b," in the secretion zone; note hypotonicity of stomach. Y was taken immediately after X, and was made with the patient prone. It shows the incisura more plainly than in X, illustrating the advantage of the prone position for radiographing high incisuræ in hypotonic stomachs. The incisura was present at two different examinations, resisted vigorous palpation and was not affected by an antispasmodic. No niche was seen.



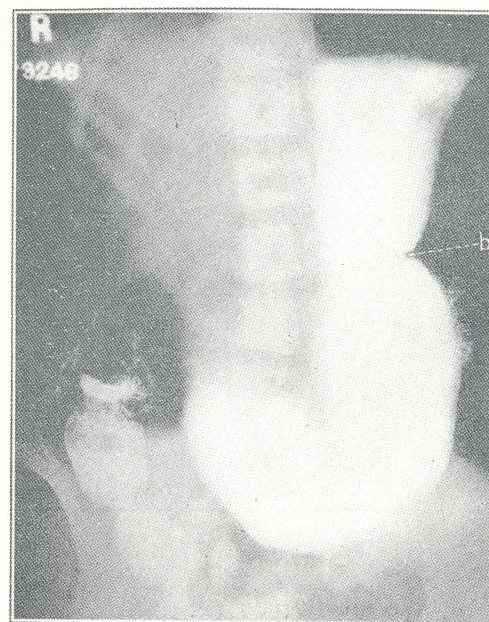


Fig. 4. Case 23248. The incisura seen at "b" was produced by band of adhesions. No ulcer was present, although diagnosed radiologically as gastric ulcer. The incisura survived vigorous palpation and antispasmodics, and was present at a second examination.

Perforation may, of course, occur without the production of a pocket. In this event the radiologic signs are like those of callous ulcer, plus, in some instances, the distorting effect of adhesions.

The very early carcinomatous ulcers are not, as a rule, distinguishable macroscopically from non-malignant ulcer. Their roentgenologic signs are not different from those of penetrating or perforating ulcer.

The positive radiologic diagnosis of gastric ulcer can only be based upon the presence of one of two signs, namely: the niche, or the accessory pocket.

Other signs which are corroborative but not diagnostic of themselves are: (1) the incisura, (2) hour-glass stomach, (3) residue in the stomach after six hours, (4) lessened mobility, (5) localized pressure-tender point, (6) delayed opening of the pylorus, (7) acute fish-hook form of the stomach with displacement to the left and

down, (8) gastric hypotonus, and (9) anti-peristalsis.

### THE NICHE

The term "niche" I shall apply for convenience to the visualized crater of a callous penetrating ulcer, an excavation wholly within the wall of the stomach.

The niche, which shows as a various-sized, bud-like projection from the contour of the bismuth-filled stomach containing no occluded gas and emptying with the stomach, is the most frequently occurring pathognomonic sign of ulcer. As an ulcer may exist in any part of the stomach it follows that the niche may also be found anywhere, but those that I have seen thus far were either on the lesser curvature,

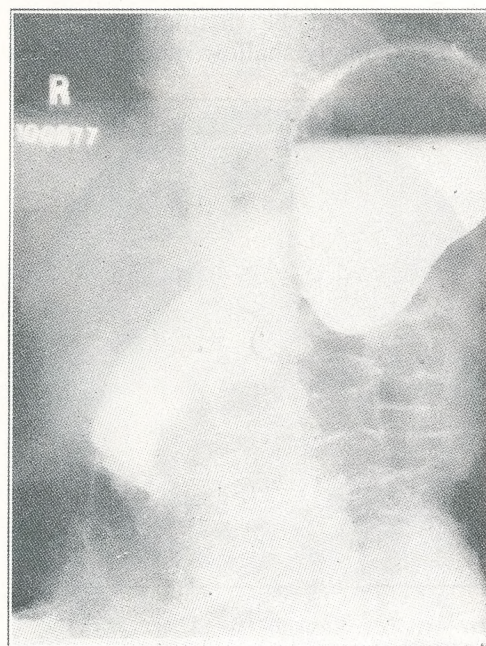


Fig. 5. Case 100277. Spasmotic hour-glass stomach which persisted in spite of palpation. No anti-spasmodic was given. X-ray diagnosis: "Probable ulcer, high on lesser curvature." At operation an ulcer of the duodenum, the size of the head of a lead pencil, was found on the anterior wall just below the pylorus. The case illustrates the danger of over-confidence and the necessity of taking every precaution to eliminate spasmotic conditions simulating organic lesions.

usually above the incisura angularis, or on the posterior wall. As a rule, a niche can be moved about with the gastric wall by palpation. While the niche is often regularly crescentic in outline, it may sometimes be quite irregular. The size may vary from a mere fleck to a considerable recess. It is worthy of note that a niche may be demonstrable without extremely deep penetration of the ulcer. Figure 1-y is a photomicrograph of a section through an ulcer in which penetration did not extend beyond the submucosa, yet the niche was plainly seen as shown in Figure 1-z.

When situated upon the vertical portion of the lesser curvature, a niche will usually show plainly in the antero-posterior view. When seated in the pars pylorica detection is hampered by peristaltic activity and by the difficulty of obtaining any but an antero-posterior view. If located on the posterior wall of the vertical portion of the stomach an oblique view is necessary to discover it. This view should never be omitted in any examination. Careful observation should be made while the stomach is filling, as a very small niche may be hidden or partially obliterated by gastric distention.

Bismuth in the bulbous duodeni and bowel beyond, adjacent to the stomach contour, especially the lesser curvature, may superficially imitate a projecting niche, but palpation will readily show the difference. Distortion by spasm may sometimes, though not often, produce a localized, apparent pouching, resembling a niche. Spasm generally disappears after energetic massage or upon re-examination, but in any strongly suspicious case an antispasmodic should be given.

### THE ACCESSORY CAVITY

The accessory cavity, as previously stated, occurs as a result of perforation of the ulcer and an extension of the ulcerative process into adjacent structures, producing an excavation in the tissues outside the stomach. If situated high up, ulcers of the

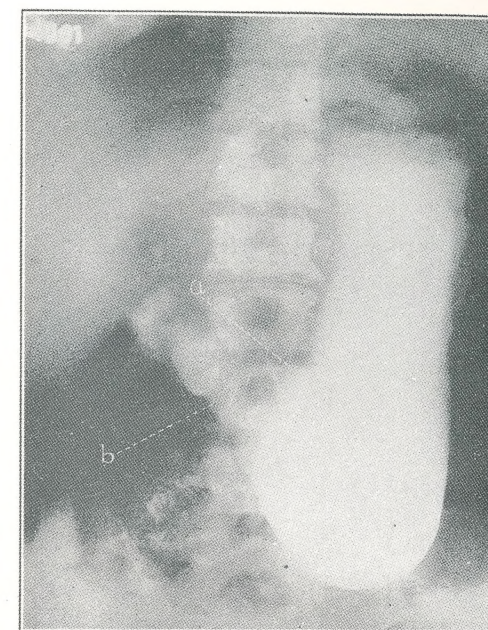


Fig. 6. Case 94561. Two ulcers of the stomach. First, a calloused ulcer with a great deal of thickening, three-quarters of an inch above pylorus, on posterior inferior wall. Second ulcer on lesser curvature, one inch to right of incisura angularis. Note bulging of stomach at "a." Marked prepyloric contraction at "b," corresponding to the location of the first ulcer. No six-hour residue.

lesser curvature or anterior wall are apt to perforate against the liver, while those lower down and on the posterior wall may invade the pancreas, forming in either event a distinct cavity.

I have purposely omitted using the term "diverticulum" generally employed by roentgenologists to describe cavity-formation by perforated ulcers, because in a strict anatomic-pathologic sense a diverticulum must have the same lining-cells as the organ from which it springs. Inasmuch as an ulcer begins with destruction of these cells the production of a true diverticulum by an ulcer is hardly possible.

As pointed out by Haudek, the bismuth-filled pocket shows the same fluid and air strata as the stomach. It lies outside of and distinct from the opaque shadow of the stomach.





Fig. 7. Case 20799. Large ulcer, lesser curvature, carcinomatous. The carcinomatous condition is indicated radiologically by the large size of the ulcer-crater at "a." All such cases would, however, be ordinarily diagnosed as ulcer.

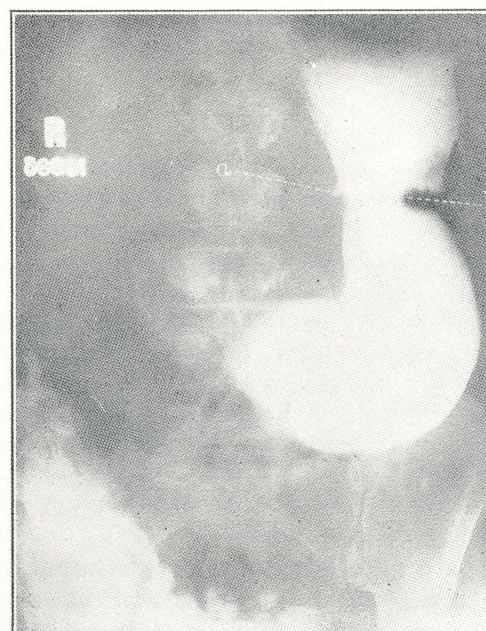


Fig. 8. Case 19835. Callous ulcer with niche and incisura. "a" Bismuth filled crater. "b" Incisura.



Fig. 9. Case 18813. Ulcer four inches above pylorus on lesser curvature. Crater size of a nickel. "a" Bismuth filled crater. "b" Slight indentation on greater curvature which was seen moving toward pylorus.



Fig. 10. Case 95011. Large callous ulcer, lesser curvature. Bismuth filled crater easily seen at "a." No six-hour residue or incisura.

While usually spherical in outline the pocket may sometimes be irregularly shaped. Commonly it is immovable by palpation and is tender to pressure, giving a sense of resistance.

Those that I have seen ranged in diameter from one to three or four centimeters. A six-hour rest in the stomach is often associated with pocket formation. Bismuth often remains in the cavity after the stomach is empty. A recess in the liver moves with respiration, while one in the pancreas does not, and the more anterior situation of the former is shown by an oblique view. Organic hour-glass stomach usually but not invariably accompanies accessory cavity-formation.

### INCISURA

Next in importance to the niche and accessory cavity, comes the incisura. Though

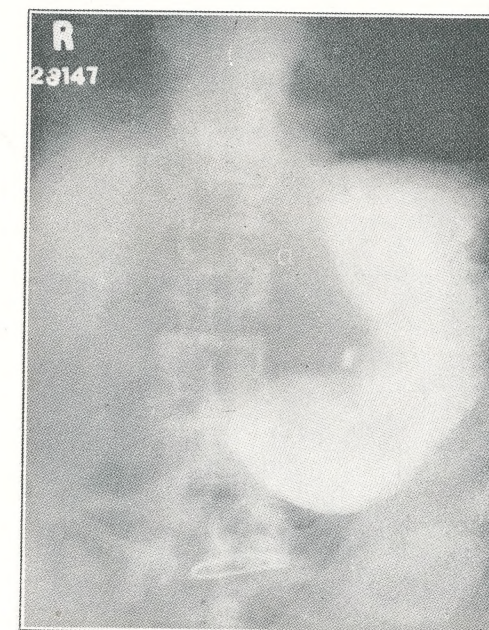


Fig. 11. Case 23147. Ulcer posterior wall, perforating into body of pancreas, with a crater the size of a twenty-five-cent piece. This is a perforating ulcer without accessory cavity-formation. Shown to be malignant microscopically. There was a small six-hour residue in the stomach. The bismuth filled crater may be seen at "a."



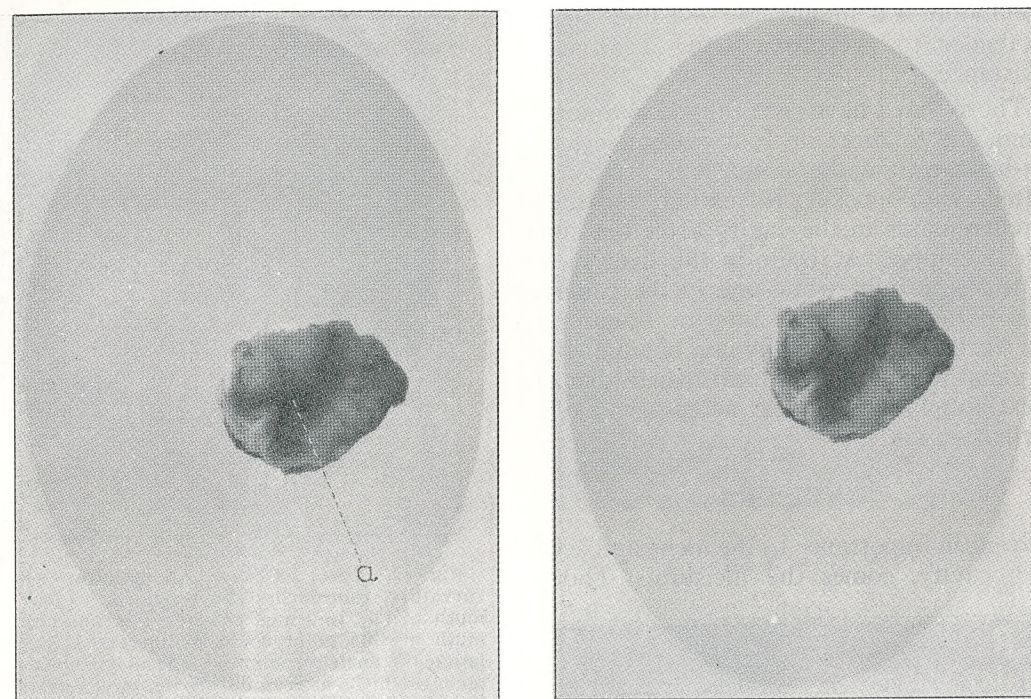
Fig. 12. Case 100795. Callous ulcer on lesser curvature, four inches above pylorus. Fleck of bismuth at "a" indicates crater. The amount of bismuth at this point could be increased by manipulating the gastric contents. The diagnosis was based upon the niche as seen during the screen examination. Stereoscopic views of specimen shown in Figs. 13x and 13y.

not pathognomonic, the incisura is perhaps the strongest contributory sign of ulcer. Exploited as one of the earliest practical radiologic indications of ulcer it has received copious discussion in the literature.

The incisura is an indentation of the gastric wall opposite an ulcer. Its production is ordinarily believed to be due to irritation of an ulcer causing a spastic contraction of the circular muscle-fibres in the plane of the ulcer. It may also occur in association with the scar of a healed ulcer. Theoretically it may occur anywhere in the stomach and be seen on either curvature. Practically the vast majority are found on the greater curvature and most commonly in the vertical portion of the stomach. Occasionally they may be seen in the pars pylorica.

Incisurae have considerable variation in width and depth. They may be so deep as almost to bisect the stomach or so shallow





Figs. 13x, 13y. Case 100795. Two stereoscopic views, X and Y. In X note wide open slit at "a." In Y niche seen in cross section. Roentgenogram shown in Fig. 12.

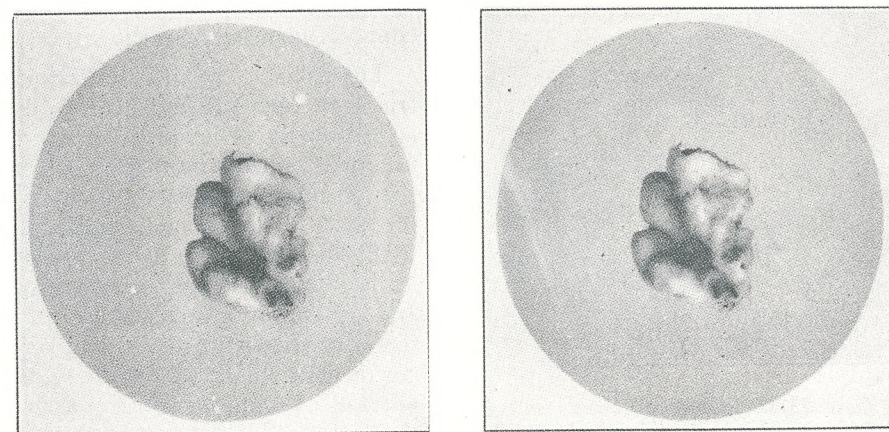


Fig. 13y See legend, Fig. 13x.

as merely to dimple the curvature. This difference in depth is doubtless sometimes due to the angle of observation. Each of two ulcers, even though closely situated, may have its separate incisura. The outline of an incisura is commonly sharp and regular but some irregularity may occasionally be noted. In one of my cases in which a large, broad, irregular, wave-like incisura occurred, in association with a single niche, multiple ulcers were found at operation. (Fig. 2-z.)

Recognition of an incisura is not difficult as a rule. The stomach should be watched during the process of filling; after repletion an incisura may be more or less concealed by overlapping of its borders. Overlapping may be so marked that gentle pressure may be necessary to visualize the indentation. The patient should be turned about to per-

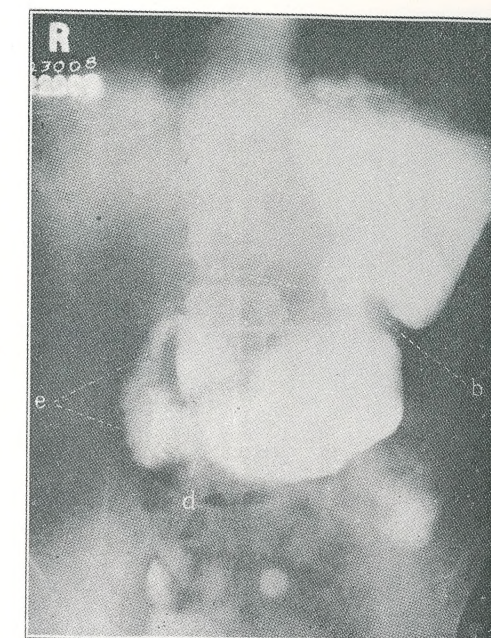
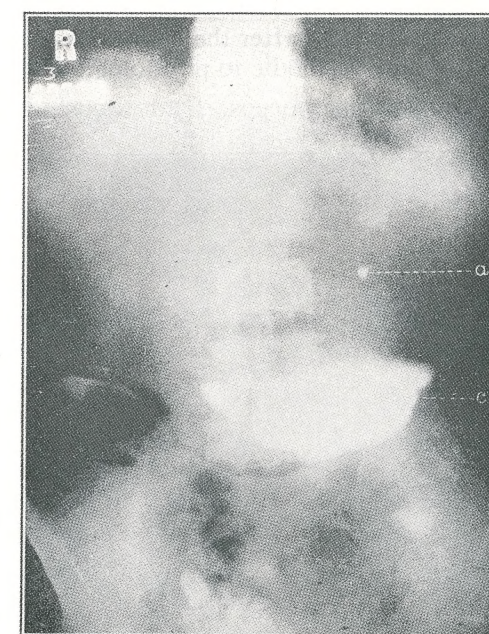


Fig. 14y. See legend Fig. 14x.

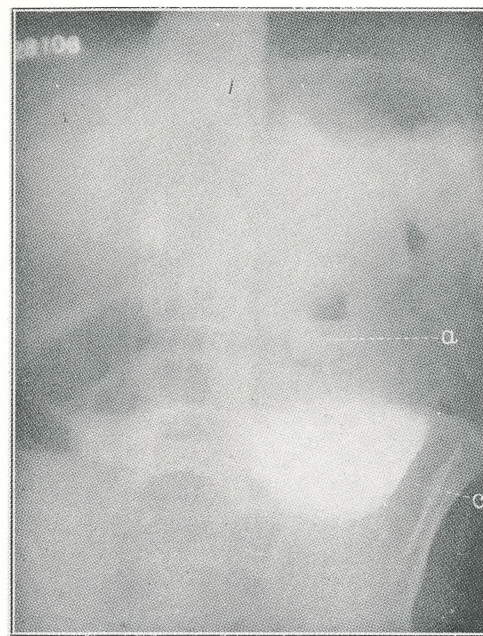


Figs. 14x, 14y. Case 23008. Ulcer of lesser curvature, pars media, which has perforated into liver, forming a small pocket. Two views are shown, X and Y. In X is seen a small six-hour rest in the pocket at "a," and large residue in the stomach at "c." In Y is shown the filled stomach with pocket at "a," incisura at "b" and hour-glass constriction. "d" pylorus. "e" duodenum.

mit oblique or lateral inspection of the gastric contour. An incisura high up in the vertical portion of the stomach may lie wholly in the secretion-zone above the opaque meal and thus escape notice (Fig. 3-x). Hence the bismuth should always be forced upward by palpation during screening. To show such an incisura on the plate, radiography in the prone position may be necessary. In the pars pylorica an incisura is less readily distinguished because of peristalsis. The diaphragm should be actively employed in studying this region.

True incisurae must be differentiated from the normal incisura angularis and incisura cardiaca, from the indentation of the greater curvature where the left costal arch crosses it, from the effect of adhesions and from spasm. The deep incisura angularis in the angle of the lesser curvature and the shallow incisura cardiaca on the greater curvature are familiar to the roentgenologist. Slightly less familiar is the depression on the greater curvature beneath the left costal arch. Commonly this indentation is broad,





Figs. 15x, 15y. Case 23106. Ulcer lesser curvature perforating into pancreas with pocket formation. Two plates, X and Y, are shown. In X, very small fleck of six-hour residue in pocket at "a" with strata of secretion and gas above. Large six-hour residue in stomach at "c." Y shows filled stomach with accessory pocket "a" entirely outside shadow of stomach. There was also an ulcer of the duodenum which was not recognized radiologically. This is not surprising, since it is very difficult to show double lesions.

shallow and obviously not a true incisura. However, I have occasionally seen this indentation so narrow and sharp that I was uncertain whether it was a genuine incisura or not. Lifting up the lower pole of the stomach tends to narrow and deepen such an indentation and thus add to the uncertainty. In fact this sort of manipulation may easily produce an apparent incisura in almost any stomach and should be avoided. Palpatory pressure should be directly backward and not upward if an incisura is being sought for.

An adhesion band may constrict the stomach in such fashion as to simulate an incisura. Figure 4 illustrates such a case. Small indentations about the pars pylorica due to adhesions from a pericholecystitis

are not likely to be mistaken for true incisurae because of their multiplicity and the accompanying fixation. The most annoying imitations of true incisurae are those produced by spasm. The latter often have an appearance and position identical with the former. Their spasmodic character is evident if they move toward the pylorus. Even though stationary they may be assumed to be spasmodic if they relax and disappear upon vigorous palpation or after the administration of an antispasmodic. The belief is held by some that non-permanent incisurae may sometimes be caused by small or shallow mucous erosions but decisive proof is as yet lacking.

It follows that a true incisura should be subjected to and withstand the following tests: (1) It must be constant and stationary, (2) it must be present when the stomach hangs normally, (3) it must survive vigorous palpatory manipulation, and (4) it must persist after the patient has been given an antispasmodic to physiologic effect.

For this latter purpose I am accustomed



Fig. 15y. See legend Fig. 15x.

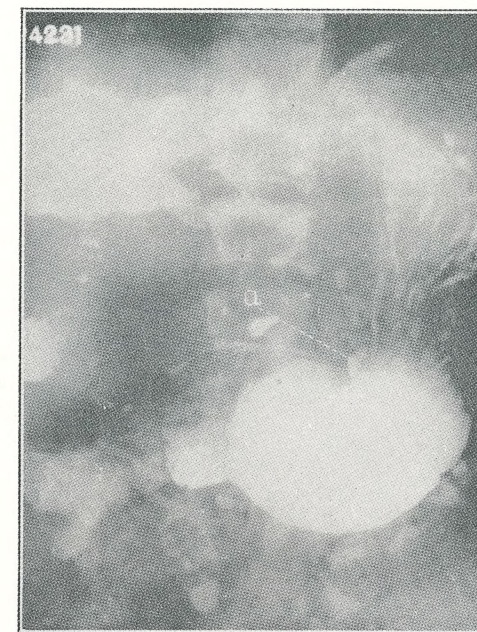


Fig. 16. Case 94231. Large, perforating ulcer lesser curvature. Niche seen at "a." No. 2 six-hour residue. No incisura present.

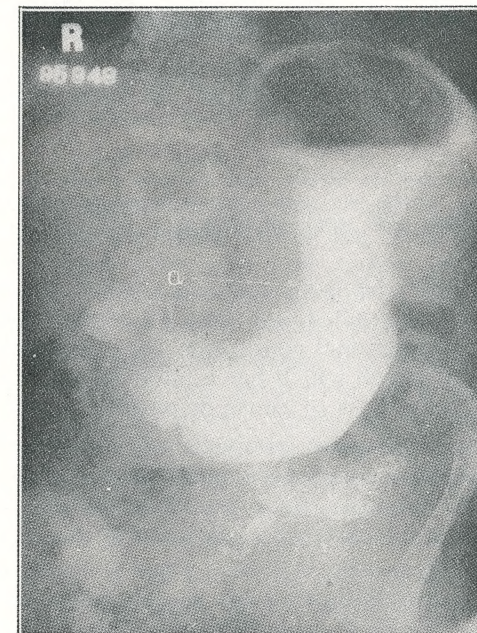


Fig. 17. Case 95948. Ulcer, posterior wall, lesser curvature; crater size of a penny. Ulcer of duodenum, just below pylorus. The ulcer of the stomach was diagnosed on the small niche seen at "a." The ulcer of the duodenum was diagnosed on hyperperistalsis, not seen in plate but present during screen examination.

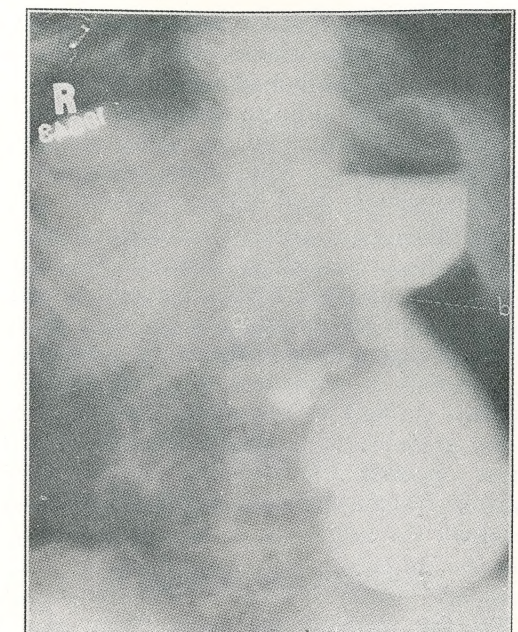


Fig. 18. Case 19843. Ulcer on posterior wall, six inches above pylorus, many adhesions. Hour-glass stomach. Crater size of a nickel. The lower pouch comprises about two-thirds of the stomach, the upper pouch about one-third. Niche seen at "a." Hour-glass constriction at "b."

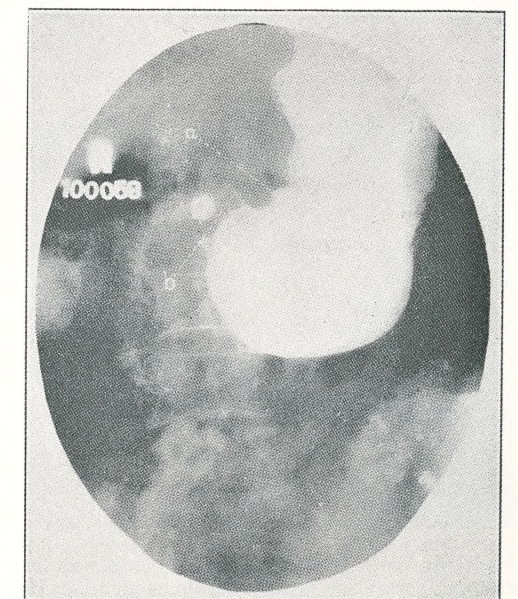


Fig. 19. Case 100058. Perforated ulcer on lesser curvature. Excavation about the size of a five-cent piece, adherent to pancreas. Excavation is shown at "a." Prepyloric irregularity due to adhesions at "b." Large residue after six hours; no incisura



to prescribe tincture of belladonna in ten-drop doses, three times daily for two or three days or until flushing of the skin or disturbed vision indicate further intolerance. There is no objection to using atropine hypodermatically. The screen examination with the opaque meal is then repeated.

The diagnostic value of an incisura which fulfills these conditions depends upon the coincidence of other signs. I would hesitate to base a diagnosis upon an incisura alone. If associated with a niche, as it sometimes is, it assists in confirmation. Less convincing but entitled to respectful consideration is the presence of a definite pressure-tender point opposite the incisura, or the association of an incisura with a six-hour residue.

### HOURL-GLASS STOMACH

To the surgeon the term "hour-glass" signifies a biloculation of the stomach by an organic constriction. To the roent-

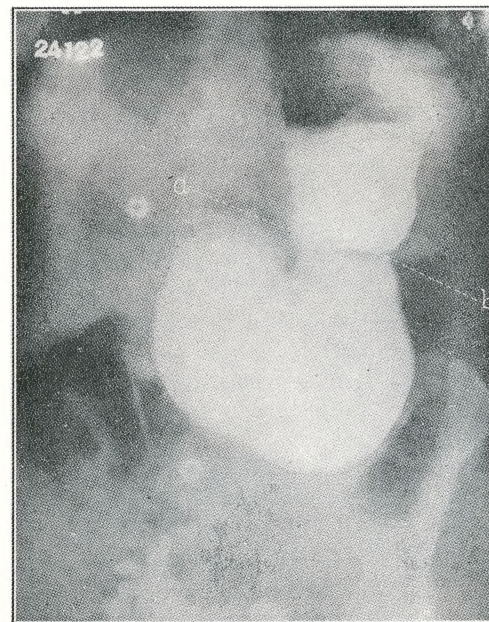


Fig. 20. Case 24122. Large callous ulcer, lesser curvature, posterior wall, high up under liver. Crater of ulcer as large as a nickel. Extensive adhesions to liver and spleen. Residue noted in stomach after six hours. "a" Crater. "b" Incisura.

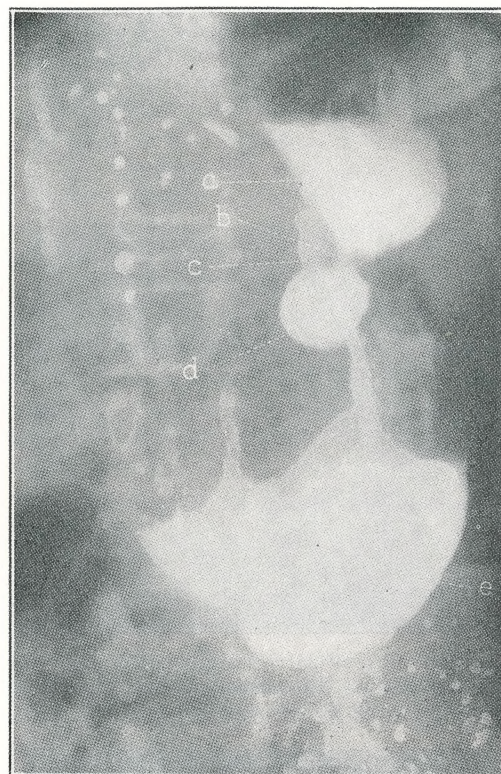


Fig. 21. Case 18393. Ulcer perforated into liver with accessory pocket-formation. Hour-glass stomach. "a" Upper loculus. "b" Hour-glass constriction. "c" Occluded gas in pocket. "d" Bismuth-filled pocket. "e" Lower loculus. Residue was found after six hours both in pocket and lower loculus. After the latter was completely emptied the pocket still contained bismuth.

genologist the word has less specific meaning, being applied not only to organic but also to functional conditions, thus including every stomach which has a bilocular appearance, regardless of cause or permanence.

The hour-glass stomach of ulcer may result from, (a) incomplete segmentation by an incisura, or (b) constriction by adhesion bands from a perforating ulcer.

The hour-glass produced by an incisura may not be found by the surgeon owing to relaxation by the anesthetic. On the screen or plate it shows definite division into two chambers with a short canal joining them, the canal being usually near the lesser curv-

ness and regularity of the projecting mass and by its behavior to palpatory shifting during the screen examination.

Functional or spasmodic hour-glass, due purely to reflex spasm, may exactly simulate the hour-glass of ulcer (Fig. 5). Therefore no hour-glass stomach should be deemed organic until the tests for spasm previously mentioned have been applied. Nor are these tests invariably conclusive, for I have seen a spasmodic incisura and hour-glass persist after belladonna had been given.

### RESIDUE

A distinct residue from the six-hour meal, amounting to an eighth or more of the quantity taken is a relatively common accompaniment of gastric ulcer. Its most

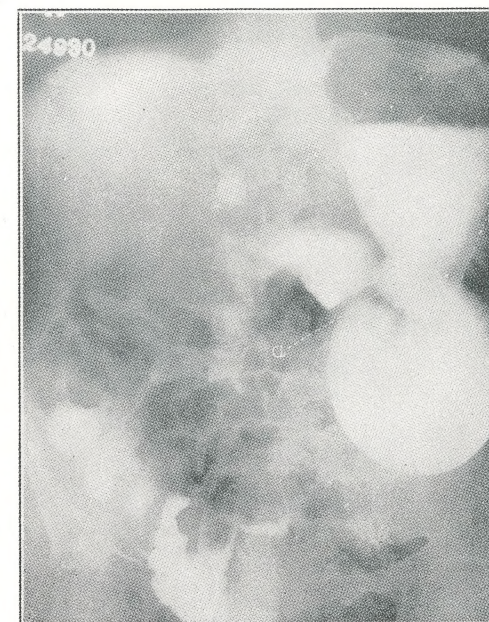


Fig. 22. Case 24930. Large perforating ulcer lesser curvature, size of a silver dollar, adherent to transverse colon and pancreas. Ulcer may be malignant. "a" Bismuth-filled crater. "b" Broad, shallow, irregular incisura. Acute fishhook stomach with displacement to the left and down. No six-hour rest.

ature, thus giving the stomach a B-shape. This B-shape may also be the result of adhesions from a perforating ulcer, with or without pocket-formation. However, I have seen one or two cases with a pocket in which the canal joining the loculi of the hour-glass was long and rather centrally placed. An hour-glass produced by adhesions will, of course persist at operation.

The organic hour-glass of carcinoma is occasioned by the projection of a tumor-mass into the gastric lumen or by infiltration and contraction as in scirrhous carcinoma. The carcinomatous hour-glass usually shows characteristic irregular filling defects. The canal uniting the chambers is generally longer than that seen with ulcer, and often has a median situation in the gastric axis, resulting in an X-shape.

The hour-glass form caused by the pressure of a tumor extrinsic to the stomach is usually determinable by the smooth-

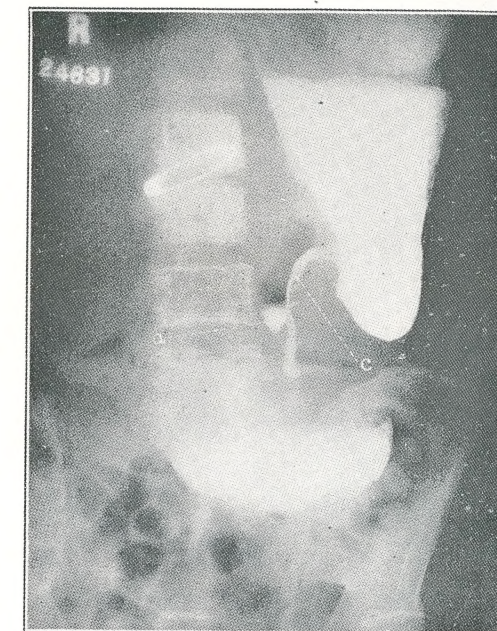


Fig. 23. Case 24631. Perforated ulcer on lesser curvature. Pocket formation in liver. Hour-glass stomach; constricted area rough and irregular and about 2½ or 3 inches in length. This is indicated at "c." At "d" is shown a stream of bismuth trickling into the lower pouch, along the lesser curvature. "a" shows bismuth in pocket with occluded gas above it. The size of this pocket, as shown on the original plate, is about ½ by 2½ inches.

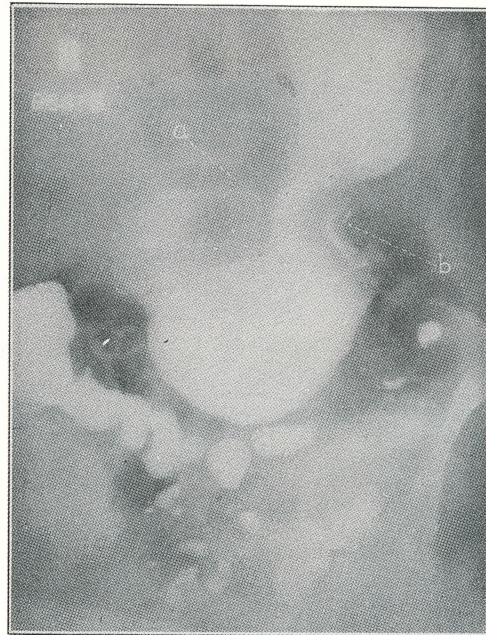


common cause is the pylorospasm which frequently accompanies ulcer, but in the case of an ulcer at or near the pylorus organic obstruction from scar contraction may be responsible.

A six-hour rest is by no means an exclusive indication of ulcer, since it may occur in any obstructive condition, including carcinoma, duodenal ulcer, and pericholecystic adhesions as well as reflex spasm from conditions outside the stomach.

### LESSENERED MOBILITY

More or less fixation often results from perforating ulcer. But fixation may ensue from any perigastric inflammation. Besides,



Figs. 24x, 24y. Case 96415. Large, indurated ulcer on posterior wall of stomach near lesser curvature, as large as a fifty-cent piece. Many adhesions posteriorly. Two roentgenograms, X and Y, are shown. In X, a direct antero-posterior view, there is seen a slight bulging of the lesser curvature, corresponding to the niche at "a," and a rather deep, broad, somewhat irregular incisura on the greater curvature at "b." In Y, an oblique view, the niche is seen more prominently at "a," while the incisura is shallower, but shows an overhanging upper segment.

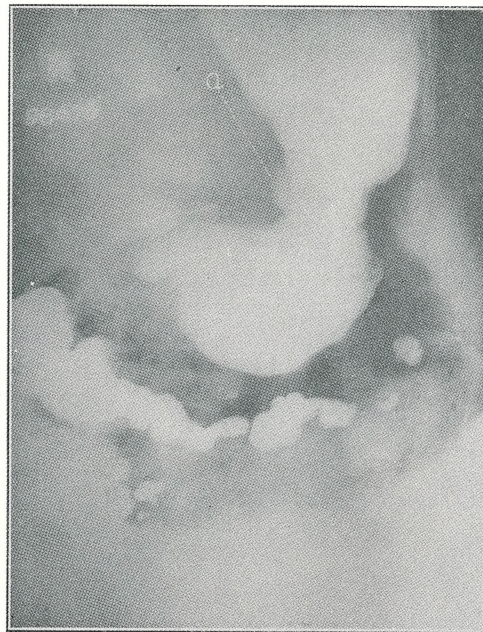


Fig. 24y. See legend, Fig. 24x.

satisfactory determination of the actual mobility of the stomach depends considerably upon its form, tone, and position, and the relative relaxation of the abdominal wall.

### TENDER POINT

A sharply localized pressure-tender point over a niche is of confirmatory value. If limited to an area on the curvature opposite an incisura, but with no niche or accessory pocket existing, suspicion of an ulcer is increased, but a diagnostic opinion should be cautiously given. To be of any value at all a pressure-tender point must be narrowly circumscribed, as the majority of persons have more or less tenderness in the epigastrium.

### DELAYED PYLORIC OPENING

Delayed or scant opening of the pylorus during the period of examination, showing pyloric spasticity or irritability, is not infrequently seen with gastric ulcer. This sign

is of trifling significance, however, as it may occur in numerous other conditions. Further, a full, free and early flow through the pylorus may accompany ulcer, as I have noted more than once.

### THE ACUTE FISHHOOK

An acutely flexed, fishhook form of the stomach, with displacement to the left and down, noted early as a minor radiologic sign of ulcer, has, I think, received more prominence than it deserves.

The "snail-form" of Haudek, (Fig. 6), an extreme degree of flexion due to scar-contraction on the lesser curvature, is of some importance, but corroboration by other signs is necessary to a positive diagnosis.

### HYPOTONICITY

Gastric hypotonus occurs sufficiently often in conjunction with ulcer to deserve mention, merely, however, as a contributory sign, which is not to be taken too seriously.

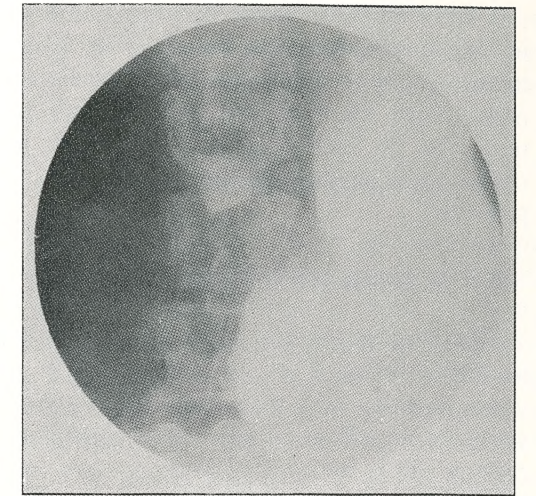


Fig. 25. Case 17318. Small ulcer on lesser curvature, one and a half inch above pylorus. There was a small residue after six hours and a prepyloric shadow-defect indicating an organic lesion. No incisura. Photograph of the ulcer, shown in Fig. 26, explains the absence of a visible niche.

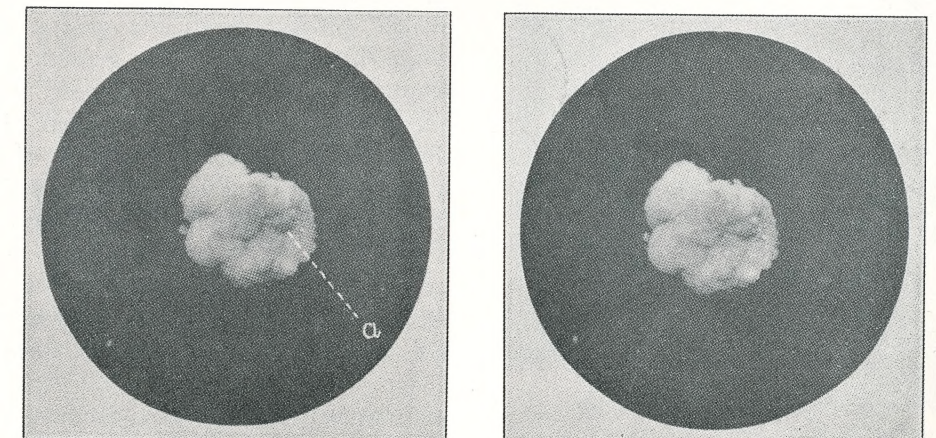


Fig. 26. Case 17318. Stereoscopic view of a slit ulcer, excised specimen. Slit seen at "a." The character of the ulcer explains the absence of a niche from the roentgenogram shown in Fig. 25.



## ANTIPERISTALSIS

I have thus far seen nothing distinctive in the peristalsis associated with gastric ulcer. Antiperistalsis has been occasionally noted with ulcer at the pylorus, but this may also be seen now and then with any obstructive organic lesion at or near the pylorus.

## ULCER AND CARCINOMA

The roentgenologic signs of ulcer differ so much from those of carcinoma in the vast majority of cases that differentiation requires no effort at all. For example, a callous ulcer with niche and incisura, or a perforating ulcer with pocket-formation has no radiologic resemblance whatever to a well-developed carcinoma, either scirrhous

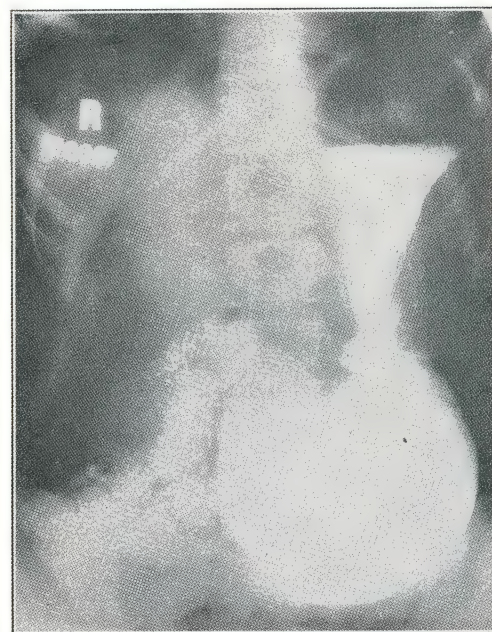


Fig. 27. Case 100081. Large, indurated gastric ulcer involving the lesser curvature about four inches from pylorus. Crater size of a ten-cent piece. Niche corresponding to crater plainly seen on lesser curvature. More or less hour-glass constriction, mostly spasmodic.

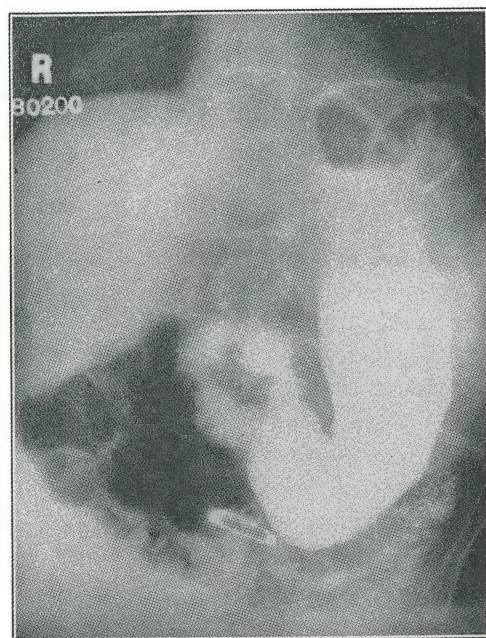


Fig. 28. Case 80200. Ulcer size of a twenty-five-cent piece, lesser curvature,  $1\frac{1}{2}$  inches above pylorus. Considerable induration around the ulcer. There was a number two residue on a scale of four after six hours, with the prepyloric filling defect here seen. Diagnosed radiologically as "lesion at the pylorus."

or medullary, and such cases make up the bulk of those patients coming for Roentgen-ray examination. In a general way ulcers always project from the gastric contour, while in carcinoma the growth with its resultant irregularity extends into or encroaches upon the gastric lumen. Between the typical ulcer and the typical carcinoma, however, there is a small percentage of cases in which roentgenologic differentiation is impossible. These are the border-line cases, in which carcinoma cells are found in the ulcer. In such instances the Roentgen signs are chiefly those of ulcer and such a diagnosis is likely to be rendered. At operation the nature of the lesion is usually not determinable macroscopically.

Extreme size of an ulcer-crater as shown by a very large niche should make one sus-

of its spectacular effect, arrive at diagnoses which are 100 per cent. clinical, but give the Roentgen-ray credit therefor and thus foster the impression that the Roentgen-ray alone will elucidate the most recondite lesions.

## VALUE OF SIGN GROUPS

In this analysis I have endeavored to emphasize the niche and the accessory pocket as being the only conclusive signs of ulcer. Next in order I would place the incisura, the hour-glass stomach and the six-hour residue. An incisura that has withstood the above mentioned test, occurring with a six-hour rest in the stomach, is, in the writer's opinion, sufficient evidence upon which to make a radiological diagnosis of gastric ulcer. This opinion would, however, be greatly strengthened if a second examination furnished the same evidence.



Fig. 29. Case 101487. Ulcer high on lesser curvature. Hour-glass contraction. Many adhesions. The hour-glass stomach persisted after an anti-spasmodic and was present at a second examination. Small residue after six hours. No visible niche. In this case there was also an ulcer of the duodenum, not diagnosed.

picious of malignancy, a fact which I have had impressed upon me by experience. A niche three centimeters or more in diameter is apt to show microscopic signs of carcinoma (Fig. 7).

Differentiation of pyloric ulcer from pyloric carcinoma is most difficult. Here, in either event, the only radiologic signs may be a six-hour rest and an atypical irregularity of contour, and the roentgenologist can only say with certainty that a lesion exists.

A correlation of his findings with the clinical data may justify an opinion that one or the other condition is present.

As I have repeatedly urged heretofore, this correlation should be made in every case. But I have small patience with clinicians who, using the Roentgen-ray because



Fig. 30. Case 15614. Large, callous ulcer, size of a twenty-five-cent piece, involving the lesser curvature, 3 inches above pylorus. No radiologic signs except a small six-hour residue.



## CHRONIC TYPHOID PERIOSTITIS

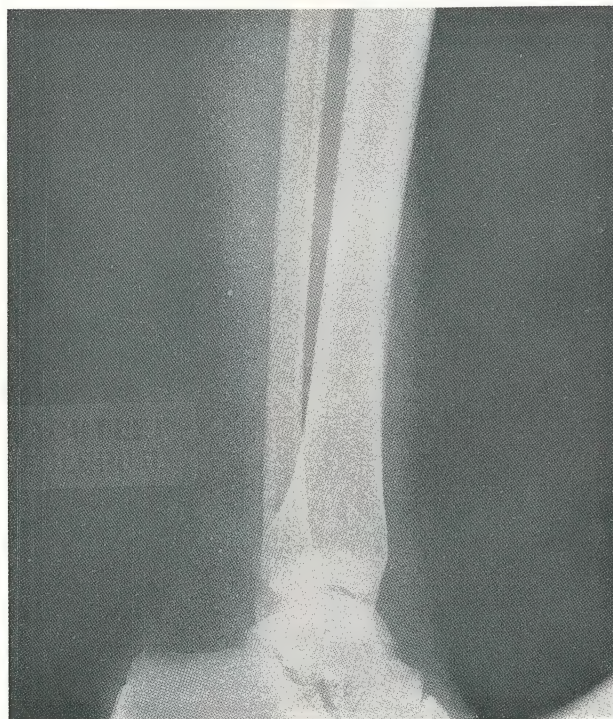
By HARRY W. DACHTLER, Toledo, Ohio.

In reviewing my cases of chronic periosteal inflammation seen in the last three years some cases are found which cause me to conclude that not all cases formerly diagnosed as syphilitic were due to that infection.

Considering only one other infection, that from the typhoid bacillus, although doubtless others are to be reckoned with, let us

involved, both the bone marrow and periosteum harboring the germs with more or less latency. In typhoid the bone marrow has been found to contain the bacilli in large numbers without clinical manifestations.

In syphilis bone involvement occurs only in the late stages of the disease and in congenital cases. In typhoid the bone lesions



CASE I. Miss H. V. Right Leg.  
Taken Mch., 1909. Age 22 Years.  
Note Typical Typhoid Periostitis.

consider briefly some points of similarity of the two diseases.

Both typhoid and syphilis are general infections, the bacillus typhosis and the treponema pallidum being widely distributed by the blood and lymph streams.

In both infections the bones are frequently

which usually occur during the late stage of the active infection have been observed months and years afterward. Finney states that the typhoid bacillus may be latent in the bone marrow for long periods and cause bone or periosteal inflammation after years of quiescence. Adami says that the bacillus

typhosus is especially apt to set up a somewhat restricted and localized periostitis, sometimes showing itself long after the active infection has passed.

From the foregoing may we not expect the late bone lesions of typhoid and the periosteal bone changes in syphilis to have some common characteristics. A search of the literature and our own cases reveals the following:

1st. Periosteal inflammation is the most common characteristic.

2nd. Multiple lesions are frequent.

3rd. Bilateral involvement is not uncommon.

4th. The tibia is the bone most frequently involved.

These common characteristics and our own cases lead us to conclude that careful attention to the clinical history as well as the Roentgen findings will be necessary if we are to avoid errors in interpretation in

certain cases which formerly to me seemed so clear that I hardly considered the possibility of being mistaken.

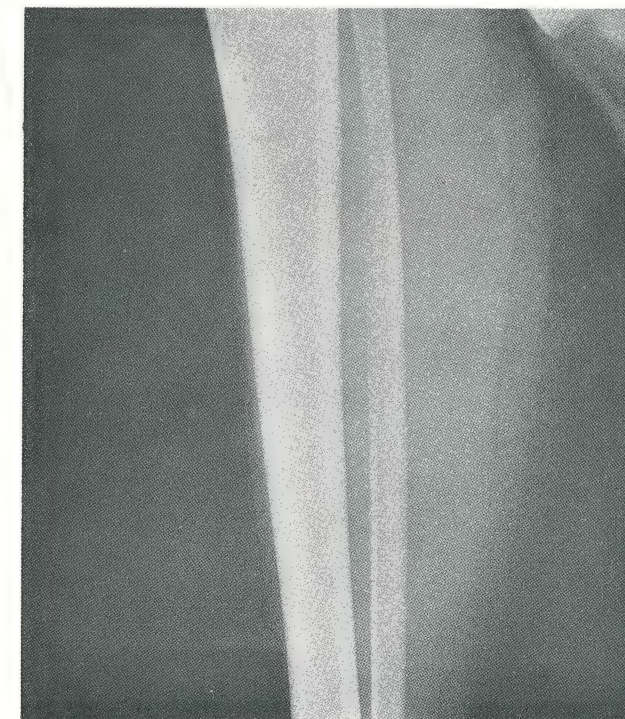
The clinical histories of the following cases are given in detail and the Roentgen plates exhibited.

Case II will be reported first as it was this case that first drew our attention to the possibility of having misinterpreted the cause of the bone changes in Case I.

Mrs. J. H. first seen in June 1912. Age 44. Married at 18. Four children all healthy, youngest 15 years old. No miscarriages.

F. L. and W. at 60. Mother died at 38 in labor. One brother died at 21 of diphtheria. Three brothers living and well. One sister died at 35 of pneumonia. No sisters living.

No T. B. C., cancer or paralysis. Typhoid at 32. Was in bed for two months and unconscious for 24 days. A few weeks



CASE I. Miss H. V. Left Leg.  
Taken Mch., 1909. Age 22 Years.  
Note Normal Bone Picture.



after getting up she had a lump the size of a walnut develop on the right shin and another on one rib. These troubled her for about two years and finally cleared up without operation. During the last four years she has had intense frontal headaches, continuous day and night; also sharp pain in her hips. No heart, stomach, lung or bowel symptoms.

Temperature normal, pupils react to light, patellar reflexes normal. Red blood count

Roentgenogram of the sinuses negative. Roentgenogram of the clavicle unsatisfactory due to slight movement. Roentgenogram of the right tibia shows thickening in middle of anterior cortex tapering off toward both ends. Left tibia shows thickening on anterior margin for two thirds of its length with roughness at the lowest part of the thickened area. Both tibiae show narrowing of the medullary canal back of



CASE I. Miss H. V. Right Leg.  
Anteroposterior and Lateral Views.  
Taken Sept., 1913. Age 26 Years.

5,000,000. White blood count 11,000. Lungs, heart and abdomen negative. Numerous scars on both arms from treatment by injections. Tibiae rough, right markedly so. Right thumb stiff. Right clavicle enlarged in middle third, also enlarged and tender near the sterno-clavicular articulation. Tender mass in the right axillary region.

the areas of periosteal new bone building indicating a reacting osteitis. X-ray diagnosis syphilis.

July 1912 a Wasserman by Dr. Levison was negative.

During 1910 before coming under our observation she had been given a course of mercury by injection lasting several months but without benefit.

During July, August and September 1912, she was given sixteen injections of typhoid vaccine, the first a half dose, the balance full doses of 1000 million.

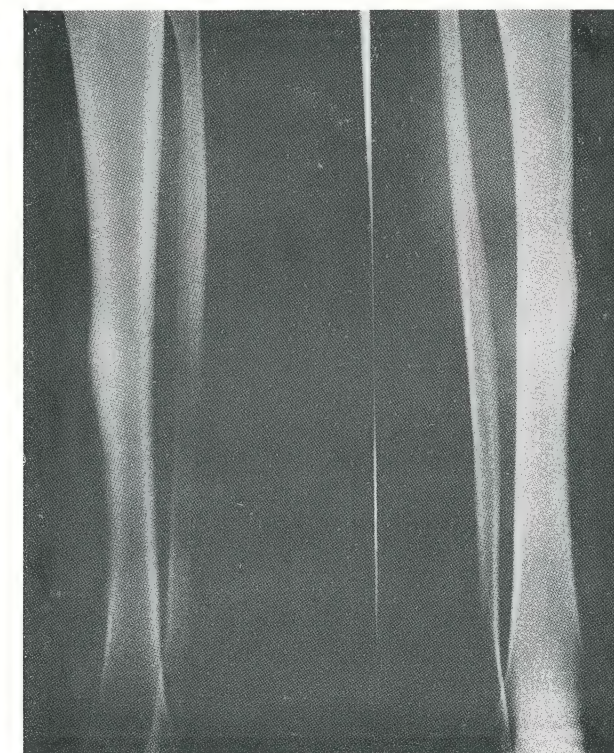
During the course of these injections the headaches disappeared and the pain and tenderness in the limbs and clavicle were relieved. February 1913 patient reported relief from all symptoms. When last seen in September 1913, there had been no recurrence of symptoms. Roentgenograms of the tibiae at that time showed no marked change in the bone picture.

#### CASE I.

Miss H. V., first seen by me in March 1909, aged 22 years. At that time she was convalescing from an attack of typhoid. She was taken sick about the first of the year and ran an uneventful course without unusual symptoms. Her right leg above

ankle had been hurting her for three weeks and for one week there had been pain in the left leg at about the same location. Roentgenograms of both legs were made. The right tibia on its anterior margin showed a small area of rarefying osteitis and periosteal inflammation at the point of tenderness. With this exception the bone picture was normal. The left tibia was normal. The next day an incision three inches long was made through the periosteum which was found raised and the bone curetted. As it was quite soft a small plug was removed with a trephine and the bone marrow was found to be softened. Closed without drainage and healed by first intention.

In April 1912 patient again consulted a physician as she was feeling badly and had so much pain in her legs that it interfered with her work. Physical examination was negative except that both tibiae were found



CASE I. Miss H. V. Left Leg.  
Lateral and Anteroposterior Views.  
Taken Sept., 1913. Age 25 Years.



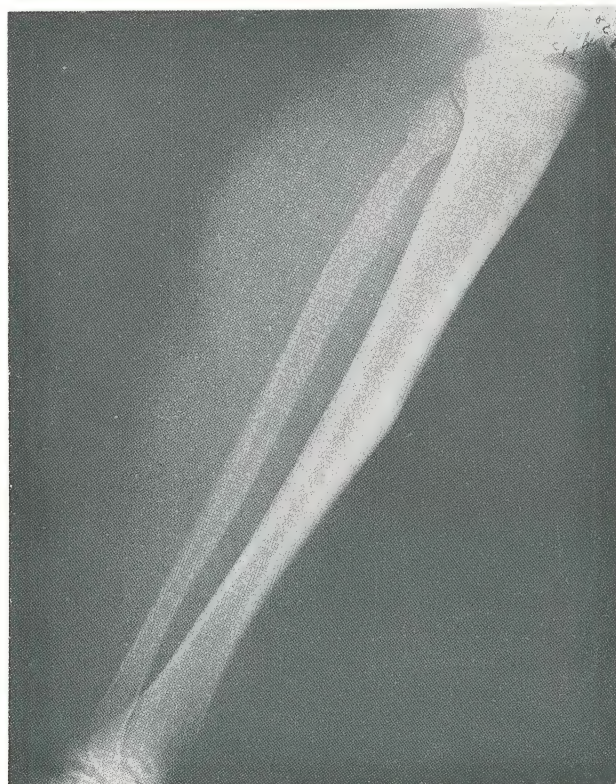
to be irregularly swollen and tender and she was referred for Roentgen examination.

The plate of the right tibia shows in the lower third marked symmetrical periosteal new bone formation surrounding the shaft. In the antero-posterior view a small dark area about 5 mm. in diameter probably marks the trephined area. In the upper part of the tibia another marked area of new bone building is seen on the posterior and outer aspects but not entirely surrounding the shaft. The Roentgen finding suggested syphilis but as there was nothing in

the patient's intolerance of mercury. During the early part of July she was given typhoid vaccine in full doses, the last injection being given on July 15th. Three days later she reported that the pain in her legs was much better. There had never been any relief during the anti-syphilitic treatment.

She was next seen in December 1912 on returning from Boston. While there she had sought medical advice and again been referred for Roentgen examination.

Under date of December 8th, in a communication to Dr. Daniells the following



CASE II. Mrs. J. H. Right Leg.

her personal history to substantiate it it was thought to be of congenital origin.

A Wasserman by Dr. Levison at this time was negative but she was given anti-syphilitic treatment. This was continued until in June but no improvement was noted and treatment was discontinued on account of

report was received from her physician:

"Miss H. V. has on both tibiae periosteal swellings which clinically are identical with the nodes of syphilis. I could find nothing else about her that would confirm that opinion. The X-ray plates, however, show unmistakable evidence of syphilitic disease

both in the opinion of the radiologist and myself. The Wasserman reaction was also slightly positive marked by a single plus. Of the diagnosis I think there can be no doubt. As to the explanation, I believe she is a victim of inherited disease and is one of those rather unusual cases that show the disease first in adult life." She was given an injection of neo-salvarsan on December 6th, and referred back for a continuation of the anti-syphilitic treatment. In concluding the doctor says, "I believe anti-syphilitic treatment will cure her legs."

On December 20th another Wasserman by Dr. Levison was negative.

From our experience with Case II and on looking up the record of her first Roentgen examination made by myself which showed only, to my mind, a typical typhoid periostitis and osteitis, I thought perhaps her condition was due to a chronic typhoid in-

fection and advised the further use of typhoid vaccines, treatment to be continued for some time. (See Stone's report, Journal A. M. A. on the treatment of typhoid carriers.)

To this the patient consented and the first injection was given in March 1913 and has continued at irregular intervals since.

She was last seen Sept. 20th, 1913, and the final plates of her series taken. She reports that the pain in her legs has entirely ceased and she feels well.

Several features of this case are particularly interesting. When nearly 23 years of age following the typhoid she showed unmistakable evidence of periosteal infection which clinically seemed to be of typhoid origin. There was no evidence of the bone changes found three years later at the age of 26 on which the diagnosis of congenital syphilis rested. There has never been any



CASE II. Mrs. J. H. Left Leg.



other evidence of syphilis except the slightly positive Wasserman reported from Boston. Three Wassermans by Dr. L. A. Levison, one before and two after anti-syphilitic treatment, were negative. In our judgment the anti-syphilitic treatment given which did not relieve the symptoms should have resulted in a positive Wasserman in the presence of syphilis.

I am well aware that I have not absolutely proven that the bone changes in Case I are due to a typhoid infection and not to syphilis but I think the clinical facts are of great significance.

This paper will have served its purpose if it calls attention to the fact that the bone

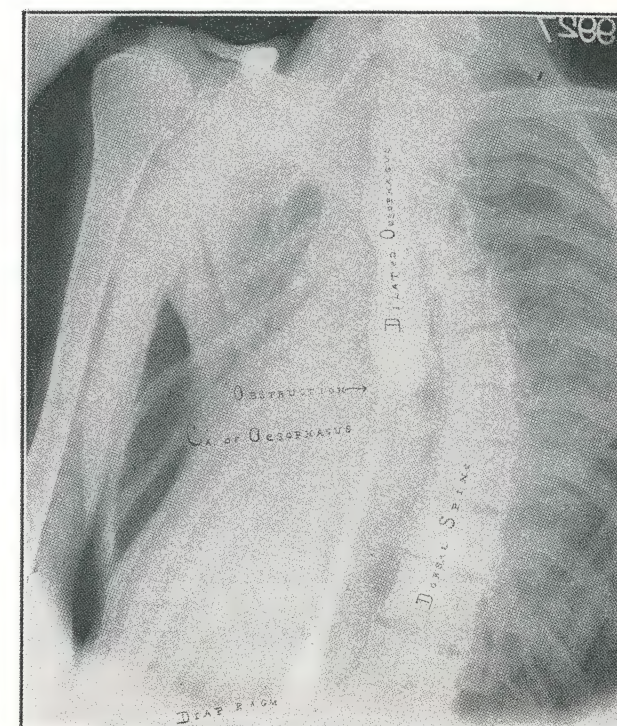
changes present in bone and periosteal inflammation are characterized not so much by the type of infection as by its virulence and that no hard and fast rules can be laid down regarding the bone changes found in any given infection.

A careful study of the Roentgenograms of Case I taken during the acute condition and again three years later can hardly fail to be of interest.

In closing I wish to express my thanks to Drs. L. A. Levison and R. P. Daniells for the assistance given me in the study of these cases and their permission to report them at this meeting.

## ROENTGENOGRAMS

By WILLIAM H. STEWART, M. D., New York City.



HERMINE T., Palhamdale Avenue, New Rochelle, N. Y.

AGE: 67 Years. Married. NATIVITY: Germany. OCCUPATION: Housewife

Admitted to German Hospital December 30, 1912.

**CLINICAL HISTORY, ETC.** Five months before admission, experienced difficulty in swallowing. Solids would seem to "stick in throat" and would be at once regurgitated. No nausea or vomiting. No pain. Fluids and bread, if taken slowly and well masticated, went down without difficulty. No cough. Voice hoarse. Lost a great deal of weight in last few months; does not know how much. No blood in material regurgitated. No carcinoma in family.

**PASSING OF OESOPHAGEAL BOUGIES:** Obstruction encountered 12-13 inches from teeth. No bleeding followed.

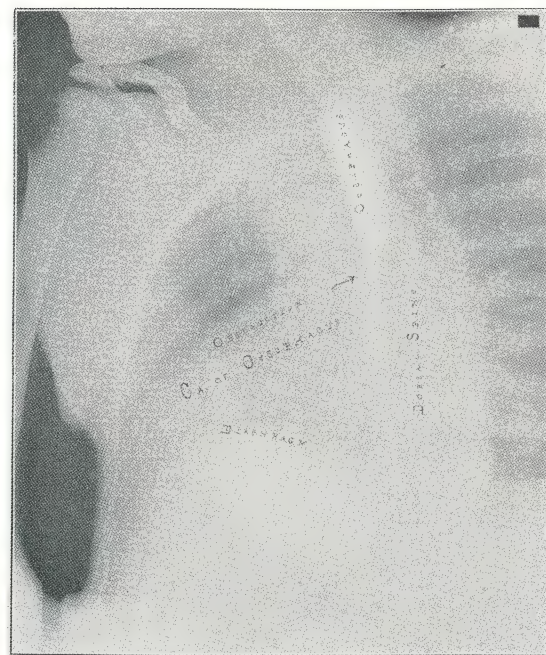
**RADIOGRAPHIC FINDINGS:** Jan. 3, 1913, Ca. of oesophagus at about a level with the eighth dorsal.

**OPERATION:** Jan. 4, 1913, Gastrostomy. March 14, 1913, Oesophagectomy. Findings: Tumor found to be posterior to the arch of the aorta, slightly smaller than one inch in diameter. Diagnosed as Carcinoma.

**ANATOMICAL DIAGNOSIS:** Squamous celled epithelioma of oesophagus.

**RESULT:** Discharged May 28, 1913.





ANNA M., East 53d Street, New York, N. Y.  
AGE: 51 Years. Married. NATIVITY: Russia. OCCUPATION: Housewife.  
Admitted to G. H. November 15, 1912.

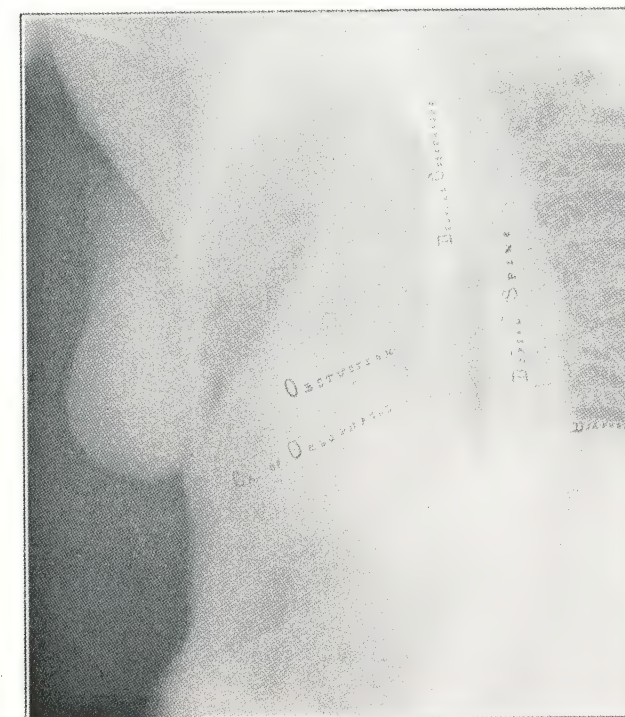
CLINICAL HISTORY, ETC. Began to lose appetite, especially for meat, about 1-2 years ago. 2-3 months before admission noticed that she was less able to swallow solids than usual. This condition steadily increased until about one week before admission had almost absolute stenosis. Would regurgitate food five to ten minutes after swallowing; no blood in regurgitated food; usually large quantities. Sister dead of Ca. of stomach.

OESOPHAGEAL BOUGIE PASSED NOV. 15, 1912. Obstruction encountered 30-32 cm. from teeth.

RADIOGRAPHIC FINDINGS: Constriction in the lower third of the oesophagus, beginning at about the level of the eighth dorsal and extending downward to the tenth dorsal where a total disappearance of the bismuth shadow is noted and would indicate almost complete obstruction from that point to the cardia. The irregular outline of the shadow would incline me to believe that we are dealing with a case of malignancy.

OPERATIONS: Jejunostomy, Nov. 18, 1912. Revision Jejunostomy, Dec. 7, 1912.

RESULT: Patient died Dec. 15, 1912.



SARAH P., E. 4th Street.  
AGE: 55 Years. NATIVITY: Russia. OCCUPATION: Housewife. Service of Dr. Torek.

CLINICAL HISTORY: Duration of illness, two years. Previous to that time was perfectly well. Began with difficulty in swallowing until she could take only semi-solid and finally fluids. Has been taking fluids for last five months. Has had a sticking pain in chest for four months. No fever. No chills. No urinary symptoms. No cardiac or respiratory symptoms. Lost about twenty pounds weight, also strength.

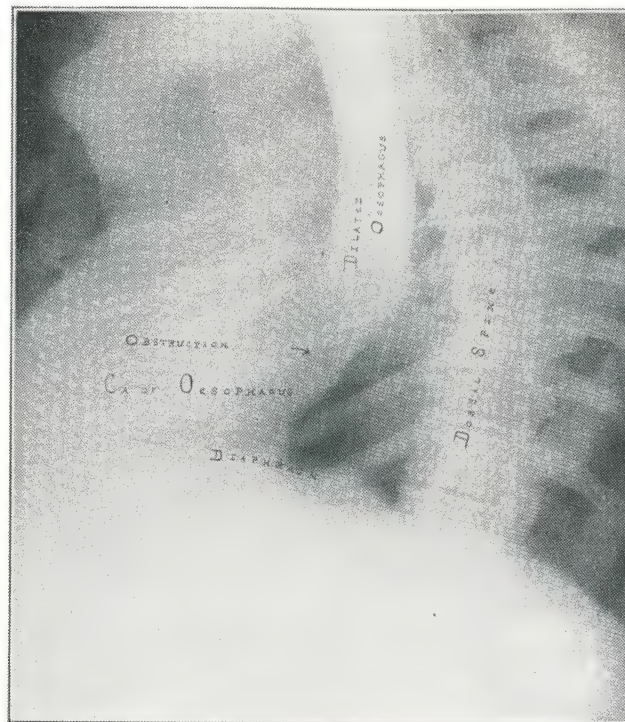
RADIOGRAPHIC FINDINGS: Constriction,

suspicious of carcinoma, in oesophagus, at about eighth dorsal.

OPERATION: Sept. 11, 1913, Gastrotomy. Oct. 6, 1913, Thoracotomy, Excision of Carcinoma. Findings: Hard mass was felt, similar to carcinoma, occupying the lower third of the oesophagus, but did not involve the cardia.

Oct. 8, 1913—Patient still in hospital. Condition good.





CHARLES McD., Varick Street, Jersey City, N. J.  
 AGE: 45 Years. Widowed. NATIVITY: Ireland. OCCUPATION: Retired Policeman  
 Admitted to G. H. September 3, 1913.

CLINICAL HISTORY: Duration about five months. Previous to that time he was perfectly well. The first thing he noted was difficulty in swallowing solid foods, which would stick half way down to the stomach. This steadily progressed until one month later he could not swallow any solid food. Since past four months he has been able to eat nothing but raw eggs, milk and broth. Has lost about 37 pounds in four months. Appetite poor. No chills or fever. No urinary symptoms. Has slight cough. Bowels regular.

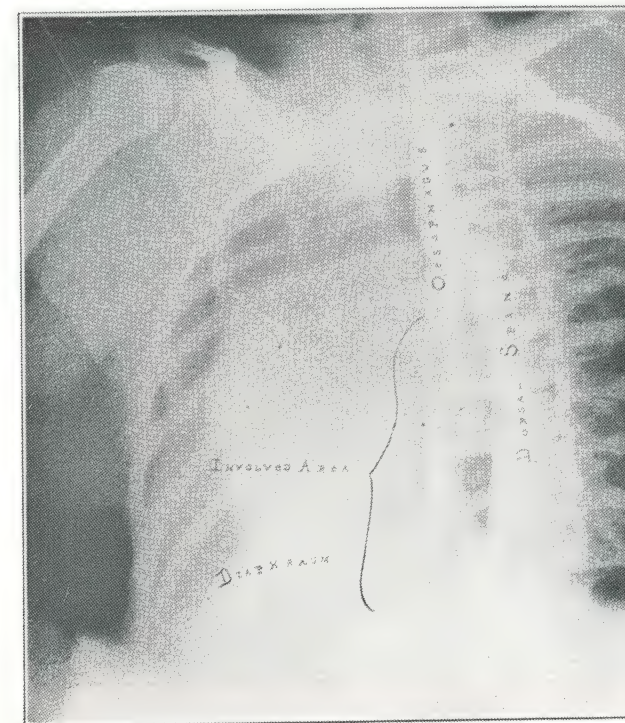
RADIOGRAPHIC FINDINGS: Obstruction to oesophagus at about the level of the tenth

dorsal. The obstruction seems to be almost complete. Case is suspicious of Carcinoma.

OPERATIONS: Sept. 11, 1913, Gastrotomy (Witzel method). Sept. 11, 1913, Resection of Oesophagus. Thoracotomy.

OPERATIVE FINDINGS: A tumor was found in the oesophagus involving the lower third and extended to within about 1½ inches from the diaphragm.

After operation patient lived about two hours. His condition was poor and in spite of stimulation and other post operative measures used to overcome shock, he died.



DORA K., Durmond Avenue, Brooklyn, N. Y.  
 AGE: 44 Years. Married. NATIVITY: Russia. OCCUPATION: Housewife.  
 Admitted to G. H. December 15, 1912.

CLINICAL HISTORY, ETC. About nine months before admission, began to have slight difficulty in swallowing solid foods. Food seemed to stick in chest and went through with difficulty. Condition grew steadily worse. On admission was able to swallow fluids only and these with difficulty. Never vomited or regurgitated. Lost 18 pounds in last six months. Never seriously ill before, except pneumonia three months

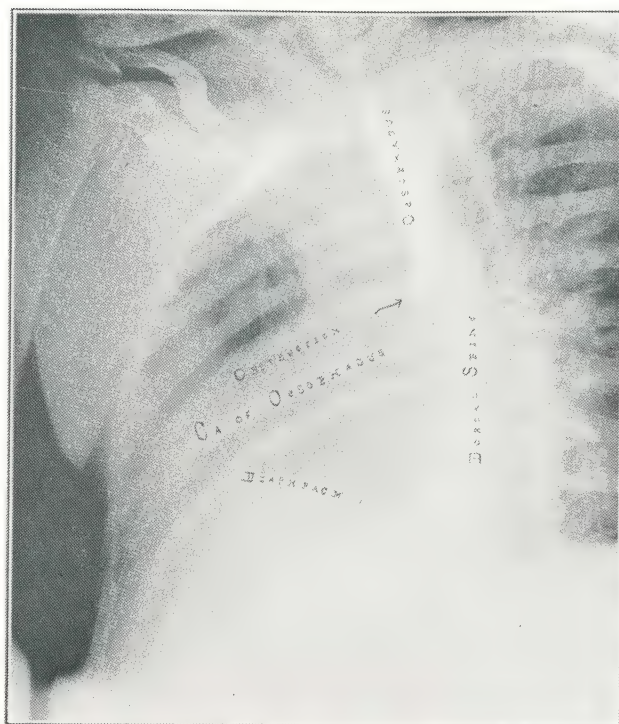
before admission. Family history negative for Ca.

RADIOGRAPHIC FINDINGS: Carcinomatous growth in oesophagus from a level of the sixth to the eleventh dorsal vertebra.

OPERATION: Dec. 17, 1912. Artificial oesophagus taken from greater curvature of stomach. (Jiaun-Roefske).

DISCHARGED: April 16, 1913, before release, improved.





LOUIS H., Bowery, New York, N. Y.  
AGE: 68 Years. Married. NATIVITY: Germany. OCCUPATION: Carpenter.  
Admitted to G. H. March 11, 1913.

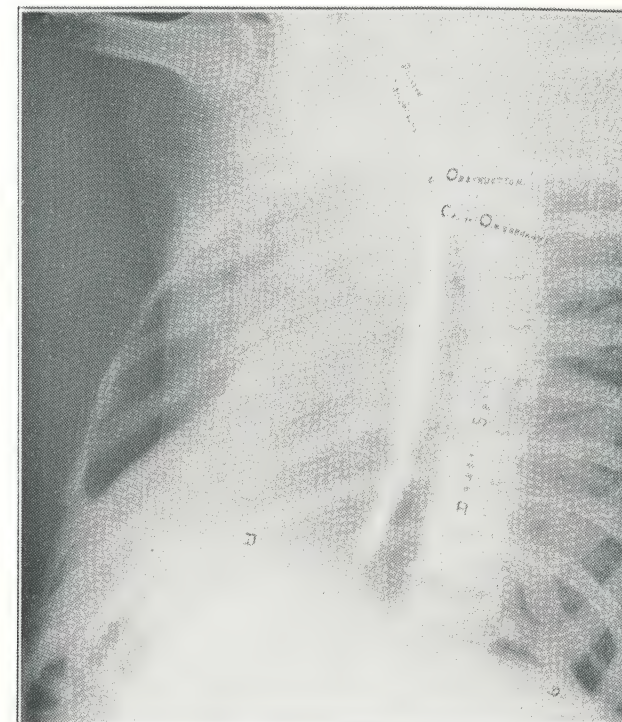
CLINICAL HISTORY, ETC. About 2-3 weeks before admission patient began steadily to have pain (sense of pressure) behind sternum and in lower right anterior portion of chest, after eating. All solid food vomited, but fluids passed on without pain or discomfort. Vomiting occurred almost immediately and only contained the remnants of previous meal. Vomitus has contained dark clotted blood. Lost considerable weight since onset of illness.

PASSING OF OESOPHAGEAL BOUGIES: Meet obstruction at about 12½ inches from teeth.

RADIOGRAPHIC FINDINGS: March 15, 1913, Carcinoma of oesophagus causing obstruction in oesophagus opposite the bodies of the fifth and sixth dorsal vertebrae.

OPERATIONS: March 24, 1913, Gastrotomy. June 3, 1913, Oesophagostomy and oesophago plastic. Findings: Carcinoma of oesophagus from above the aortic arch to well below it, 5 inches in all.

RESULT: Died June 4, 1913, of post operative shock.



CHRISTIAN T., East 88th Street, New York, N. Y.  
AGE: 65 Years. Married. NATIVITY: Germany. OCCUPATION: Musician.  
Admitted to G. H. October 21, 1912.

CLINICAL HISTORY, ETC. From about one year before admission, patient noticed that pieces of meat and other solid foods would seem to stick in throat. Condition became worse, so that on admission even fluids had to be taken in small quantities else they would not pass down. No vomiting, but if patient eats or drinks food in too large quantities a portion is at once regurgitated. Loss of weight, 37 pounds in eight weeks. No carcinoma in family.

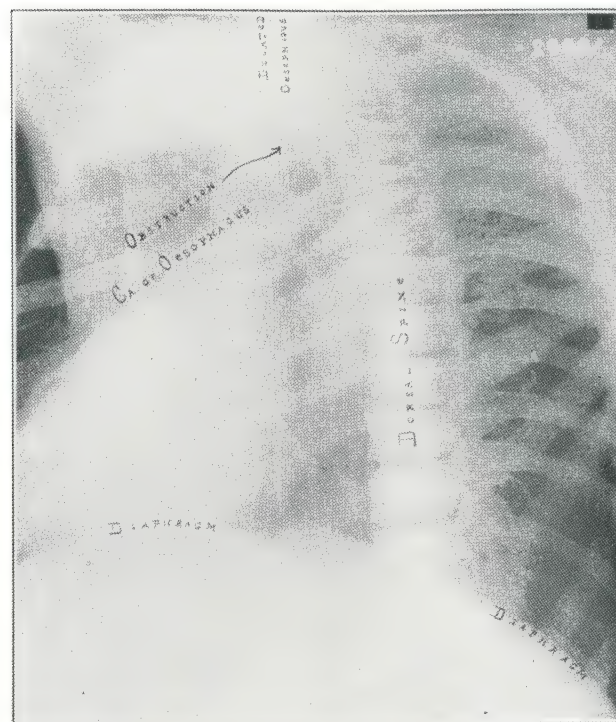
RADIOGRAPHIC FINDINGS: Oct. 23, 1912. Obstruction in the oesophagus on a level

with the third dorsal vertebra. Above this obstruction is marked dilatation extending up to about the level of the seventh cervical. The irregularity of the shadows below the dilatation makes me suspicious of ca.

OPERATIONS: Witzel Gastrostomy, Oct. 24, 1912. Thoracotomy, Nov. 16, 1912. Findings: Oesophageal mass found extending from about 1½ inches below aortic arch, upwards to behind arch. Size about 1½ inches in diameter. Hard. Circular. Nodular.

RESULT: Died Dec. 6, 1912.





WILLIAM W., First Avenue, New York City.  
AGE: 57 Years. NATIVITY: Germany. OCCUPATION: Elevatorman.  
Admitted to G. H. April 10, 1913.

CLINICAL HISTORY, ETC. Three months before admission, noticed slight disturbance when eating; gradually became worse. When patient was admitted he could hardly swallow foods. When he swallowed food it was expelled almost immediately. Had no pain, but felt a lump in throat, just above the upper end of the sternum. Appetite good. Lost 25 pounds in weight in last three months.

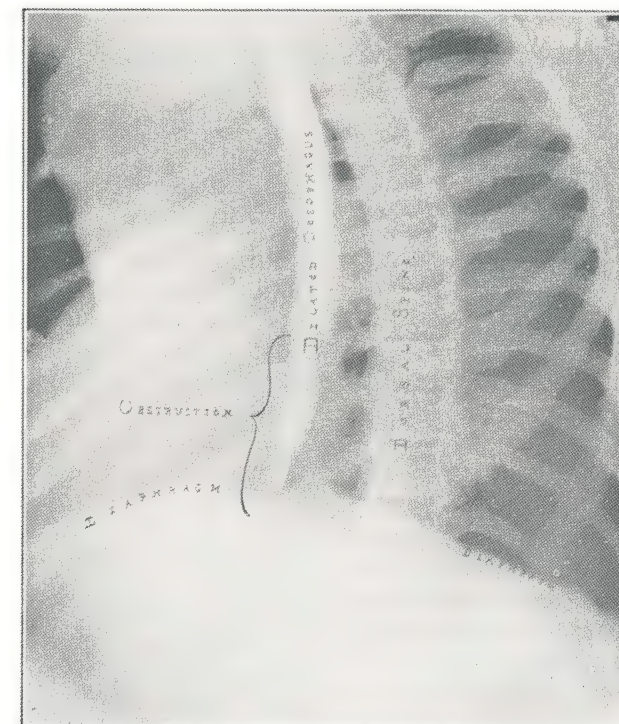
OESOPHAGOSCOPY: May 9, 1913. At a distance of 10 inches from teeth an irregularly shaped, distinctly nodular tumor was

seen protruding into the lumen of the oesophagus.

RADIOGRAPHIC FINDINGS: May 12, 1913. Constriction of the oesophagus at about a level with the border of the third dorsal; this constriction is almost complete, only a small amount of bismuth having passed. Radiographically, the case seems one of Carcinoma.

OPERATION: Exploratory Thoracotomy, May 12, 1913. Findings: A very extensive carcinoma of the oesophagus.

RESULT: Patient died May 28, 1913.



EUGENE P., Ferry Street, Hoboken, N. J.  
AGE: 62 Years. Married. NATIVITY: Germany. OCCUPATION: Fireman.  
Admitted to G. H. July 29, 1913.  
Diagnosis: Carcinoma of Esophagus and Cardiac End of Stomach.

CLINICAL HISTORY, ETC. Three months previous to admission, patient noticed that he had trouble in swallowing foods. This has increased. Could not swallow solid food until bougie was passed. After eating has sense of pressure and choking in chest, which disappears after a time. Has lost some weight; does not know how much.

RADIOGRAPHIC FINDINGS: July 21, 1913. Obstruction to the oesophagus extending from level of the body of the ninth dorsal to the cardia; this portion of the oesophagus

seems narrowed, irregular shaped and contracted. There is also visible considerable change at the cardia. The case is certainly suspicious of malignancy.

OPERATION: July 28, 1913, Resection of oesophagus. Gastrostomy.

ANATOMICAL DIAGNOSIS: Carcinoma of oesophagus or (cardia ?) chronically inflamed pigmented lymphnode.

RESULT: Died July 29, 1913.



## THE X-RAY EQUIPMENT AND WORK IN THE ARMY AT THE PRESENT TIME

By CAPTAIN WILLIAM A. DUNCAN,  
Medical Corps, U. S. Army.

Read by Invitation at the Boston Meeting of the American Roentgen Ray Society.

In view of the fact that in recent years the Surgeon has become more or less dependent upon the information revealed in a well made radiograph, accurate diagnosis and treatment being almost impossible without this aid, it is but natural to expect that it would be necessary to make suitable provisions whereby, in times of war, the Army Surgeon would be provided with this diagnostic aid. If there is one time when the information revealed by the fluorescent screen or the radiographic plate is needed, it must be during times of active operation when hundreds and possibly thousands of injured, a great proportion of which are suffering from gun-shot fractures, are being received for treatment at the various hospitals on the lines of communication in the rear of every army.

In the first place allow me to say a few words as to what is meant by a Portable X-Ray Machine or apparatus as applied to an outfit for use with an army in the field. Many of the members of the Society may expect me to describe some form of light weight coil outfit which can be carried from place to place by hand. If so, you will be disappointed. As applied in this paper a Portable X-Ray Machine for field use refers to an apparatus of high power and necessarily of great weight designed to withstand the abuse incident to wagon transportation, exposure to the elements and rough handling naturally expected under field conditions.

It is only during the past four years that definite steps have been taken in this matter by the Medical Department of the Army. However, during that time rapid progress has been made towards providing a prac-

tical and efficient portable X-ray outfit for use with troops in the field.

It is to be remembered that this matter is still in the experimental stage. The machines so far constructed, pictures of which I expect to show on the screen, are all experimental, being the product of various manufacturers who have worked along general lines suggested by the Surgeon General's Office. The particular object of this paper will be to show to the Society, by means of a series of lantern slides, just what has been accomplished. However, in order that you may in a measure gain some idea of the nature and extent of the problem the Medical Department is attempting to solve, it will be necessary for me to first outline briefly a few of the factors which must be considered in the design of an outfit of this type. I will then describe briefly a number of the more important parts of these experimental outfits and give the requirements of each part as determined by experiments thus far conducted.

IN THE FIELD, AT WHAT POINTS CAN AN X-RAY OUTFIT BE UTILIZED TO ADVANTAGE? Some claim that an outfit to be of any great service must be one which can be operated on the actual firing line, while others consider its proper place as the Field Hospitals located immediately in the rear of the engaged forces. But if one will remember that during actual operations these stations are merely to provide temporarily for the comfort of the sick and injured, applying such temporary dressings as may be required to prepare a patient for transportation to the larger and more or less stationary hospitals in the rear, it can readily be seen that there is little use, if any, for an

X-Ray Outfit at these advanced points. Most of the operative work will be done, and practically all of the permanent dressing will be applied at the stationary, evacuation and base hospitals established in the rear of an army. It has therefore been decided that Portable X-Ray Outfits for field use should be designed with this idea in view. As some of these units frequently change their location it is essential that the outfit be so constructed that it can readily be moved with the sanitary unit to which it belongs. But, since these larger units move slowly and are usually well provided with means for transportation it is not so important that the weight of the apparatus should be reduced to the minimum as would be the case if it were designed for use at the rapidly moving sanitary units at the front.

WHAT WILL BE THE CHARACTER OF WORK REQUIRED OF AN X-RAY OUTFIT UNDER FIELD CONDITIONS? Considering the conditions existing during actual war, the great number of injured, the conditions under which operative measures will be carried out and the necessity for doing work in the shortest time possible, it is believed that an X-ray Machine would be used almost exclusively for the following purposes:

- 1st. To discover the presence of a foreign body.
- 2nd. To discover the nature and extent of fractures.
- 3rd. To determine the position of a fracture after a dressing has been applied.
- 4th. To make permanent radiographic record of the injury or injuries existing in certain special cases.

The first thought would suggest that the localization of foreign bodies would be one of the most important functions of such an outfit. But if we remember that in the great majority of cases, under field conditions, foreign bodies are best treated by being left alone, it will be seen that accurate localization will not be attempted nor will it be particularly desired. At any rate special at-

tachments for localization work have not been considered of sufficient importance to warrant further complication of the Portable Machine to provide them.

WHAT WILL BE THE AMOUNT OF X-RAY WORK A FIELD MACHINE WILL BE REQUIRED TO HANDLE? There will naturally be a large number of cases requiring examination, foreign bodies and fractures forming such a great proportion of the injuries. Therefore, in order to take care of this work a rather powerful outfit which can be operated more or less continuously should be provided. The equipment should include appliances for handling a large number of radiographic plates, films or papers within a short time, while the stock of photographic materials should be rather extensive.

WHAT TYPE OF MACHINE, COIL OR TRANSFORMER IS BEST SUITED FOR AN OUTFIT OF THIS PARTICULAR KIND? It has been decided that the interrupterless type of X-ray Machine with its high tension transformer is preferable to the coil. They are more powerful, simple in construction, easy to operate and when provided with certain attachments are particularly well suited for the character of work required under field conditions. Induction coil outfits when operated by expert radiographers turn out excellent plates. However, expert care is required to keep them in running order, while outfits of this type are too delicate for the rough handling and severe exposure to which Portable Machines will be subjected in the field.

All X-Ray Machines require an electric current to operate them. This can be secured from power plants, storage batteries or provided by special generators operated at the point the current is to be utilized. FOR THIS PARTICULAR TYPE OF OUTFIT ON WHAT SOURCE SHALL WE DEPEND FOR OBTAINING CURRENT? It is frequently possible and always desirable to locate the larger hospitals attached to a field army near towns and cities near the scene of actual operations, for at such points supplies of all kinds are



more readily accessible, while electric current can often be obtained for lighting and other purposes. When hospitals are so located a special Portable Outfit would not be absolutely necessary as an ordinary stationary X-Ray Machine could be installed. But conditions will arise which require the establishment of these sanitary units in isolated points where an electric supply is not available. An outfit suitable for such conditions must be equipped with the necessary attachments for generating the electric current required. This is only possible when it is

doing moderately rapid radiographic work.

3. Each outfit must be furnished with all accessories necessary for turning out a large number of radiographic plates or prints and for making fluoroscopic observation.

4. It must be well constructed, durable and with as few parts as possible to be lost or to get out of order.

5. Its weight should be kept as low as is consistent with radiographic efficiency; maximum weight not to exceed that which

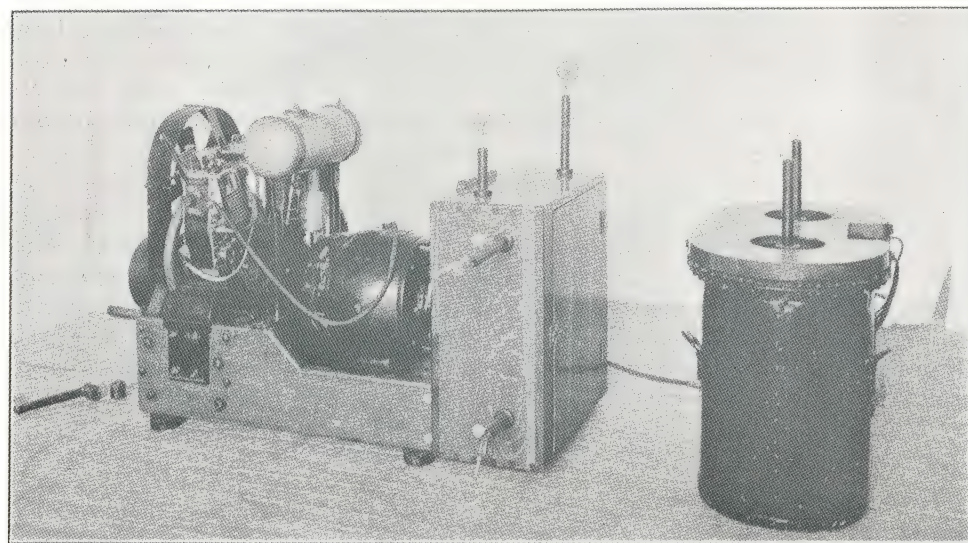


FIG. 1.

equipped with a positive acting engine driving a suitable generator. Storage batteries cannot be depended upon for numerous reasons.

Keeping in mind the points outlined above we find that a Portable X-Ray Machine suitable for use with troops in the field must conform to the following general requirements:

1. It should be self-contained, furnishing its own power or generating the necessary electric current so that it can be operated at any time and at any place desired.

2. It must possess sufficient power for

can be transported in the ordinary four-mule escort wagon.

6. It must be so constructed that it can be readily knocked down for transportation and quickly assembled when required. The containers must be designed for convenient handling and must be very strong to resist the hard usages incident to field conditions.

7. The number of separate containers into which the outfit is packed for transportation should be the least possible, while definite places must be provided in which each part of the outfit can be securely packed.

8. As the unit for army transportation

is the four-mule escort wagon, the containers for the outfit should be of such size that they will conveniently pack in such a wagon.

9. Containers when packed should be as light as possible, the maximum weight of any one container not to exceed 450 pounds, else it cannot be conveniently handled.

10. The entire outfit, in mechanical and electrical construction, should be as simple as possible so that it can be assembled and operated by any one having a fair mechanical knowledge.

Five outfits conforming more or less closely to the requirements outlined above have been constructed for the Department, and while these outfits differ considerably in the details of their construction, still the principle is the same in all of them. The variations in the details of these machines are due, as stated, to the fact that these machines are really experimental and the makers have been free to develop their individual ideas as to the mechanical and electrical details of their outfit and its equipment. All the machines so far constructed have been tested out to determine their efficiency, particular care being taken to observe mechanical defects in each apparatus that the defects may be corrected in outfits constructed in the future. Three of the five machines have been installed at Army Posts, where other X-Ray Machines were not available, and have been used with more or less satisfaction to do all the radiographic work required at these posts. They are still in serviceable condition after having been in use from one to two years.

A brief general description will be given of these machines. Being of the interrupterless type all are familiar with the essential parts which are the same as are found in any stationary apparatus, i. e. generator, transformer, high tension commutating switch and tube connections. The field appliance instead of depending upon a power plant or storage battery for operating current is provided with a gasoline engine driving a suitable generator thus developing the electric current required. The engine is di-

rectly connected with the shaft of the generator, which it drives, while on the opposite end of the generator shaft is mounted a rotary switch or high tension commutator. This commutator rotates near or in contact with four collecting brushes or terminals by means of which the high tension alternating current from the transformer is changed into a uni directional current suitable for operating an X-Ray Tube. Near the commutator and the high tension terminal plate, a suitable transformer is placed, its primary being connected with the generator from which it receives a low tension alternating current, while its secondary terminals are connected with special terminals on the terminal plate just referred to. From the latter plate conductors for the tube circuit pass out. The above is the outfit proper for developing the current required for operating an X-Ray Tube. To complete a Portable Outfit numerous accessories are provided such as operating table, tube holders, X-ray tubes, fluoroscopes, intensifying screens, dark rooms, developing tanks and trays, X-ray plates, photographic papers and all of the developing and printing materials required.

These outfits weigh from 1100 to 1800 pounds. It is evident, therefore, in order that they may be conveniently handled in and out of an army wagon that they must be constructed so that they can be knocked down and packed in several containers, the weight of a container, when packed, not to exceed that which can be handled by four or five men. A weight of about 450 pounds is the maximum allowable, for if this amount be exceeded the packed container will be subjected to exceedingly rough treatment.

It has been found that at least six containers are necessary for packing these outfits, as follows:

A box for the engine.

A box for the generator.

A high tension transformer, suitably boxed.

A box for X-Ray Tubes and accessories.



A lead lined box for photographic plates, etc.

A gasoline tank carrying supply of gasoline.

The numerous accessories provided with each outfit must have special containers or definite places must be provided for them in the containers above noted. Considerable ingenuity has been shown in the packing schemes adopted by the various manufacturers. The last outfit made for the Depart-

scription of a few of the more important parts of these outfits.

**THE ENGINE:** Gasoline engines of from three to ten H. P. have been utilized, some being high speed and air cooled while others are low speed and water cooled. The high speed, air cooled engines offer the advantage that they are lighter than the low speed engines, while the high speed engine permits of the use of a much lighter generator. A high speed motor-cycle engine

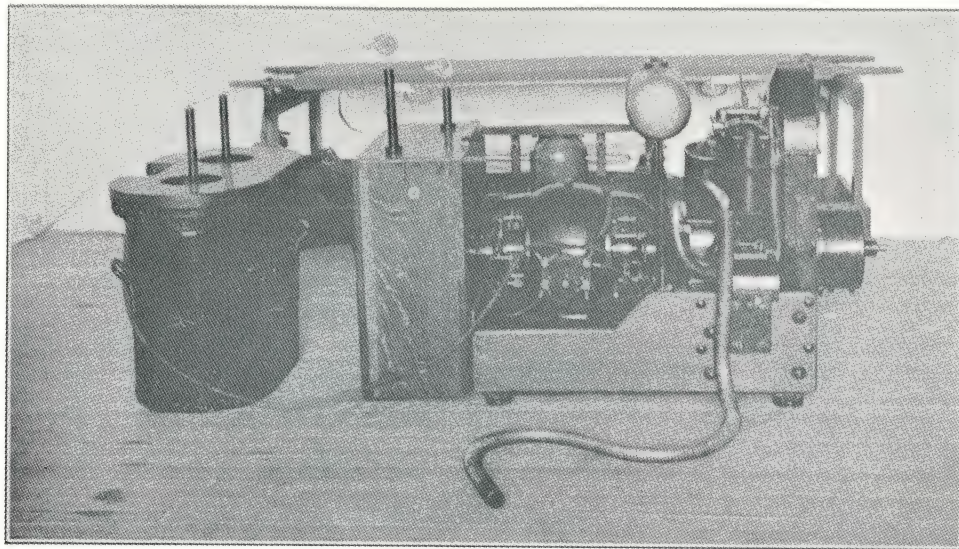


FIG. 2.

ment has all of the accessories packed in the six containers listed above, but in two of the outfits special containers were provided for the numerous accessories thereby increasing the number of units in these outfits while at the same time their weight was greatly increased.

It would possibly be of interest if I could take up the various parts composing the several outfits and describe them in detail as to their construction and method of packing for transportation, but as time will not permit of this I will depend upon the lantern slides to demonstrate these features while I will devote a few moments to a brief de-

was used on three of the Portable machines. This type of engine was considered especially desirable on account of the fact that the particular engine used was taken from a motor-cycle that is a standard in the equipment of certain branches of the Military Service and it was thought that in case of breakdowns repairs could more readily be made and if necessary an engine could be removed from a motor-cycle and utilized to run the Portable X-Ray Machine. Experience has proven that the high speed engines possess certain disadvantages. When they are run at the speed required vibration is very marked, hard to overcome, and even

when reduced as much as possible is still so marked that the parts of the apparatus are loosened and adjustments are disturbed with the result that continual tinkering is required to keep the apparatus in running order. In addition, engines of this type are complicated and require expert care to keep them in running order even under the most favorable conditions.

Low speed, water-cooled, marine engines have been used on two of the Portable Machines and, so far as can be determined at the present time, seem to be best suited for these outfits. The engines are simple in construction, have very few parts to get out of order, can be operated and kept in good running condition by a person of average intelligence, while vibration is much less marked and more satisfactorily controlled. The increased weight of the slow speed engine and the increase in the weight of the generator that is necessary when operated at this slow speed are disadvantages. But since efficiency is the prime consideration it is considered best to use this type of engine even at a sacrifice in the total weight of the outfit. Furthermore, machines of this type can be run for a considerable length of time without overheating and, if desired, can supply current for lighting purposes in the hospital to which they are attached.

An engine of at least 10 H. P. rating is necessary in order that it will not drop in speed when the full load is suddenly thrown on as when an exposure is made. Uniform speed with uniform voltage in the primary of the transformer is essential for satisfactory work. This can only be assured by furnishing an engine with an excess of power. The latest type of Portable Outfit is provided with a 10 H. P. two-cycle marine engine such as is used in the better class of motor boats. A spring starting device is directly connected to the engine shaft by means of which the engine is set in motion.

**GENERATORS:** Generators of from 1 to 3 K. W. rating have been utilized. One of at least 2 K. W. is required for moderately rapid work. The engine and generator

shafts being directly connected and running at the same speed, the power of the generator that can be used is practically determined by the weight of the generator that can be conveniently handled. The last Portable Machine constructed utilizes a 2 K. W. generator running at 900 R. P. M. This weighs, when packed for transportation, about 350 pounds. It is believed that these outfits would be much improved by doing away with the direct connection of the engine and generator shafts, using a belt connection with pulleys instead. This would permit of the use of a generator of much higher rating without increasing the total weight of the outfit. This change would eliminate, to a considerable extent, the vibratory defects noted in the machines that have been built. The generator on these outfits should deliver a 220 volt alternating current, this voltage being well suited for transformer purposes.

**TRANSFORMERS:** High tension transformers of suitable rating must be furnished with each machine and this part should be especially designed to stand rough usage. Both dry and oil transformers have been used. The advantage of the dry type lies in its lighter weight while leakage of the insulating material is not a factor as in the oil transformer. That dry transformer is more likely to break down than one with oil insulation is claimed as a disadvantage. However, experience thus far has not demonstrated any particular advantage of oil insulation over a well constructed transformer of the dry type. Both are in use on these machines and both have stood up well. The last outfit constructed is provided with a transformer in which the windings are imbedded in a paraffine-wax compound.

**THE OPERATING TABLE:** These outfits are designed to use the ordinary hand litter as an operating table, the idea being that patients will be brought to the hospital on these litters and unnecessary handling will be avoided if radiographic examinations can be made while the patient still rests on the litter. Various devices have been constructed for supporting the litter, all having



frames at each end upon which the litter handles rest. Some of these devices fold into a small package for transportation, others are taken apart and packed in various containers. Beneath the litter a tube holder, adjustable longitudinally and laterally, is supported. Thus in all of the Portable Outfits exposures are made from below upward instead of from above downward, as ordinarily made, the fluorescent screen or X-Ray plate resting on the upper surface of the patient. With the large number of con-

increased. Means for both tank and tray development are provided, though it is believed that tank development is the only practical method for use in the field. For loading plates and tray development a dark room is necessary. Where a large amount of work of this kind is to be done it is expected that a suitable dark room will be erected. But for emergency work it is necessary to add a dark room to the equipment of these machines. There are a number of folding dark rooms on the market

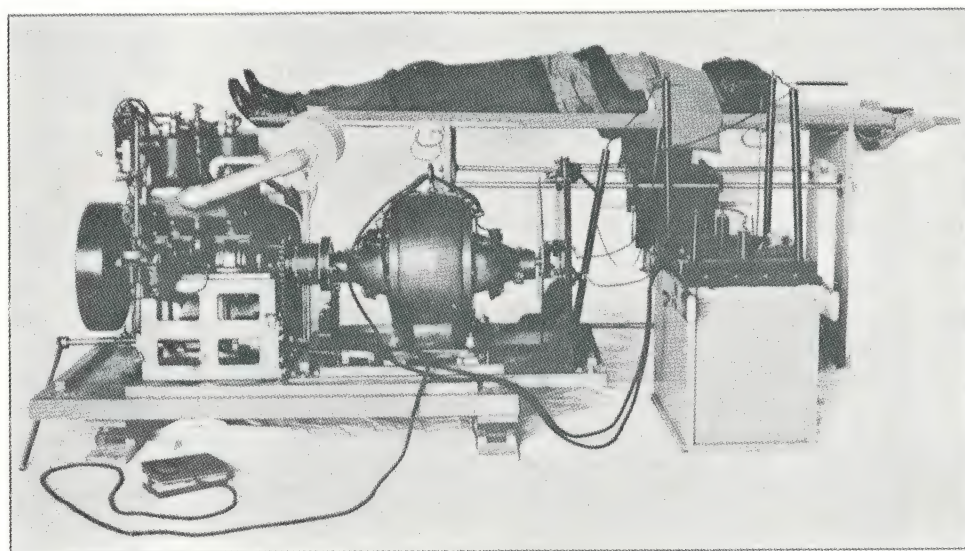


FIG. 3.

tainers which must be furnished for packing these outfits it is thought that one or more of them should be designed for use as an operating table, while means should be provided for supporting the tube holder above the patient. This would widen the range of usefulness of these machines, particularly in regards to localization work.

**PHOTOGRAPHIC MATERIALS, ETC.:** For radiographic work a stock of 8 by 10 inch X-ray plates and envelopes have been furnished. Photographic papers or films, when perfected will replace the plates since breakage will be reduced, while the stock of plates that can be carried will be greatly

and several new ones have been designed lately adapted to this particular outfit. The best appliance is made from one of the packing boxes of the outfit. The box has a removable top, the top and body of the box being painted black on the inside, all joints made light proof. On one side of the box two openings are left through which the arms of the operator may be introduced. Light is excluded by two light proof cones of cloth, one end of each cone being securely fastened around the openings in the box above referred to while the free ends of the cones fit snugly around the operator's arms.

**FLUOROSCOPES:** A fluoroscope has been constructed which permits examination of a part without bringing the examiner into the line of the direct rays. This is accomplished by mounting a mirror back of the fluorescent screen, the principle being the same as on the Cole table. A long hood of light proof material projects horizontally in the same plane as the screen. At the outer end of this hood the examiner's eyes are placed. On looking directly into the hood the fluorescent picture is observed in the mirror mounted just back of the screen. The fluoroscope rests on a patient and when moved as desired the various parts of the body may be examined.

It is well known that the transformer type of X-Ray machine is not particularly suited for fluoroscopic work on account of the danger of burns. In one of the Portable Machines the amount of the current passing in the tube circuit is controlled by means of a special device which allows only a certain number of cycles of the current from the generator to pass to the primary of the transformer. Thus the actual quantity of current passing through the tube is diminished while the potential of the current delivered from the secondary of the transformer is not particularly affected. Experiments are being conducted to determine the efficiency of this attachment.

**PACKING OF X-RAY TUBES FOR TRANSPORTATION:** Tubes are packed in strong boxes, substantial rests, heavily padded with felt, being provided to protect them. When the tube box is closed and ready for transportation the tubes are securely held in a soft bed of felt. Packed in this manner these outfits have been shipped

by freight from New York to El Paso, Texas, without breaking a single tube. Actual field service alone will determine just how much protection this method of packing will furnish X-Ray tubes.

It seems that the ideal Portable X-Ray Outfit of the future will be one in which an X-Ray machine with complete photographic equipment is maintained on an automobile ambulance, the engine of the ambulance being utilized to drive the generator, thus developing the electric current required. However, up until the present time a satisfactory automobile ambulance for field use has not been constructed. Until this is accomplished the Field X-Ray Outfits must be designed for wagon transportation.

I will now show on the screen four of the Portable Outfits constructed for the Medical Department of the Army. A series of lantern slides of each apparatus show the steps to be taken in assembling the outfit for operation. In closing I will state that while it cannot be claimed that the Portable X-Ray Machines thus far constructed are perfect in every detail, yet they have been perfected to such a stage that at the present time, if occasion should demand it, the Medical Department of the Army can place in the field, without delay, five Portable X-Ray Outfits which could be set up and operated at any place however remote from civilization, and that each of these machines, in the hands of one reasonably familiar with radiographic technique, will furnish all the information desired in handling such cases as the Army Surgeon will be called upon to treat.

Two of the outfits referred to in this paper are shown in Figs. 1, 2 and 3.



## THE POSSIBILITY OF ESTIMATING DOSAGE AND PENETRATION

By W. S. NEWCOMET, Philadelphia, Pa.

There are many difficulties to be surmounted before a standard can be adopted for the estimation of the quality and quantity of radiation eliminated from a Roentgen ray tube during a given cycle of time. This communication is intended to present some facts in relation to these various rays, which heretofore seem to have been given but scant consideration. They are the registration of the quality and quantity of Roentgen ray given off during a certain cycle of time. For the measurement of dosage it can be safely said, we have no ideals; while different forms of apparatus have been exploited, none so far has been absolutely satisfactory. The cause of this unfortunate situation is mainly due to our lack of knowledge of the individual quality of the different bundles of Roentgen ray. We have several methods of obtaining the quality of these rays but no means of registering them; while on the other hand we can register the quantity as a total amount, upon one or two given planes or possibly several gradations but not as a whole. In other words, we estimate a dose that simply represents an amount of Roentgen ray radiation upon a given plane with practically no conception of the amount of radiation above or below it. For our practical application the ideal form of apparatus would be some means of easily registering the quality and quantity of these rays during a given cycle of time, with a record that would be permanent. This so far has not been accomplished.

From time to time various complicated and often cumbersome forms of physical apparatus have been tried and recommended but few have ever reached beyond the doors of the laboratories of their inventors and usually the casual inspection of the many

laboratories in this field fails to reveal the presence of any form of apparatus for this purpose. This gives credence to the idea that for some reason they are not popular. Even the more simple forms that depend upon the change of color of some chemical salt or some photographic method are rarely ever observed in actual practice; this gives cast to the idea that they are lacking in their usefulness. They are, however, a means of estimating a certain quantity of radiation. It might be said of all the methods so far advanced for the measurement of dosage, that they usually estimate the total output of the tube with the addition in some instances for several grades of filtration. Their chief defects are the source of error from degeneration of the materials, to some extent from personal equation and, finally, it must be realized that the low rays have a greater chemical effect and therefore a lack of proportion between what might be styled the useful rays, either for the study of the quality of ray given off by a certain tube for treatment or the estimation of the range of useful radiation for radiographic work. Usually the estimation of the usefulness of a Roentgen ray tube for radiographic purposes depends upon the calculation of its hardness with a very liberal variation of time of exposure; but so far we have no unit.

For the physiologic unit, Keinboch has estimated a certain depth of tissue for a certain thickness of metal, and this gives us to some extent an idea of the depth of penetration with the dosage at a given point below the surface and for this reason this method would seem to be of greater value than those depending simply upon surface dosage.

The possibilities for using such a scale are many; it has a very wide latitude of application. Besides using it in obtaining a dosage in our treatment cases, it will serve to correct error in various methods of exposure in ordinary radiographic work; for the correction of our different tubes by making comparisons with a standard good tube such weaknesses as lack of penetration or what might supply the lack of useful radiation in the Roentgen ray tube, are easily found.

It must be realized that there is a wide variation in the degree of latitude between the proportion of the quality and quantity of radiation given off from different tubes, and even from the same tube, and that this balance is made up, to some extent, by development. This most fortunate latitude compensates in a great measure for many of our shortcomings which otherwise would be most disastrous. These facts are no doubt the reason why some are able to produce a very fair radiograph with comparatively poor Roentgen ray tubes yet at the same time there is a certain class of tubes that are absolutely worthless and by some short trial if we can eliminate them it will spare us considerable anxiety.

The ideal method of estimating this dosage would be to have some material that would change color or a series of colors and remain permanent, with a definite degree of variety for the different grades of penetration. This however has not been accomplished and we must depend upon the sensitized film or paper, and while they are troublesome and require some skill for their manipulation the record is permanent, and can be consulted at any time. In this way there is less likelihood of error at the time of application and to some extent it removes the error of personal equation. They have the same shortcomings as the former methods; the reading is entirely a surface read-

ing, it matters not if the plane is an inch or two inches deep; all these methods fail to make any correction for the amount of dosage above or below this given plane, and this would seem to be under many conditions a most potent source of error. It is well known that these low rays are most chemically and physiologically active. These readings are taken for a certain length of time with a tube that has a variable vacuum.

It is also easy to see how a low tube would produce a higher dose activity than a high one. It might be said that these objections could be easily corrected by the frequent reading of a penetrometer or in a rougher way by simply observing the Roentgen ray tube. This must be admitted and there are few operators of experience that cannot judge with a fair degree of accuracy just what a given Roentgen ray tube is capable of doing, but if we are to employ some form of apparatus to register the amount of radiation then why not combine with our dosimeter a penetrometer and make our records permanent, not for a given plane but for the various depths of our penetrometer scale?

The adoption of a standard is a matter for further study, several modifications would be needed depending upon the character of the work. Where the amount of desirable rays is to be estimated for the rapid exposure of a plate a good film should be used, for slower work the bromide paper and for long exposures velox paper may be employed. These photographic materials are as a rule uniform or can be easily tested and obtained at all corners of the earth and therefore the adoption of some peculiar form of paper is not necessary. The part of the technic that must be constant is the development; here the conditions must be uniform and cannot be varied for the slightest variation will lead to considerable error. In regard to degrees for comparison it would seem that the adoption of a wedge, varying



from white to black, marked by given intervals is better than certain squares of grades of color, which often are very hard to match, on account of the peculiar reflection of the light. And until some association adopts some given uniform scale there seems to be

very little use of adding another to the many that have already been advanced by their originators; therefore it was the desire in presenting this short synopsis of this theme to stimulate some work in a field that at present is extremely barren.

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## EDITORIAL

While the medical world is fast taking advantage of the rapidly multiplying uses of the Roentgen ray and patients are receiving the benefits from their application, there has crept in occasionally the unfortunate

influence of commercialism. Anyone who has an extensive consulting Roentgenologic practice is compelled to observe from time to time the use of the Roentgen plate as a final argument for operative procedures or expensive medical treatment which have for their chief use the filling of the pocketbook of the advisor rather than the betterment of the patient. Too often the lack of alignment in fractures of the long bones when graphically shown convinces the patient and his advising friends that plating is necessary without a fair statement of the case from the non-operative standpoint. The sagging of the stomach or colon is frequently presented to the patient as a condition needing radical measures with no investigation as to other factors as impaired function, etc. It is often difficult for the Roentgenologist to interfere if present at these interviews with the patient but if he is to maintain a position as a medical consultant, he must keep before him the highest good of the patient and if necessary actively express the latest medical thought. If he listens in quiet, the patient will infer that he is acquiescing in the opinions expressed and will remember it later when the outcome has been disappointing.

The arrangements for the Cleveland meeting are progressing actively and without doubt it should be a great success. The plate exhibit committee are actively engaged in arranging for what will be the most instructive plate exhibit ever held. It will be properly catalogued which will add to its interest and educational value.



### APPLICANTS FOR ACTIVE MEMBERSHIP IN A. R. R. S.

Following is a list of the applicants for membership in the A. R. R. S. which will be published in the Journal twice before the annual meeting in accordance with the By-Laws.

With the approval of the other members of the Executive Committee I have determined to present the names of all applicants whether complete or incomplete indicating the deficiency in case of those who have not fully conformed to the By-Laws.

It is probable that where the application has been turned in within the specified time and no scientific paper presented or where a letter of recommendation was not presented within the time limit the Executive Committee will consider the applicant eligible if these are presented before the annual meeting.

#### THE FOLLOWING HAVE COMPLIED IN ALL RESPECTS WITH THE BY-LAWS:

- DR. M. J. HUBENY, 31 N. State St., Chicago, Ill. Recommended by Drs. A. Hartung and Hollis E. Potter.
- DR. JACOB WM. FRANK, 114 N. 17th St., Philadelphia, Pa. Recommended by Dr. A. J. Quimby and H. Clyde Snook.
- DR. ERNEST GARDE EDWARDS, La Junta, Colorado. Recommended by Drs. Russell H. Boggs and George C. Johnston.
- DR. ALFRED LUGER, Peter Bent Brigham Hospital, Boston, Mass. Recommended by Drs. Jas. T. Case and Walter J. Dodd.
- DR. J. S. DERR, 335 Candler Annex, Atlanta, Georgia. Recommended by Drs. J. W. Hunter, Jr., and Howard E. Ashbury.
- DR. SAM'L BERESFORD CHILDS, 342 Metropolitan Bldg., Denver, Col. Recommended by Drs. G. E. Stover and Hollis E. Potter.
- DR. WM. B. BOWMAN, 818 Brockman Bldg., Los Angeles, California. Recommended by Drs. Albert Soiland and Edward H. Skinner.

#### APPLICANT FOR CORRESPONDING MEMBERSHIP.

- DR. F. HOWARD HUMPHRIS, 8 W. Chappel St., Mayfair, London W., England. Recommended by Drs. George E. Pfahler and Edward C. Titus.

#### APPLICATIONS FOR ACTIVE MEMBERSHIP WHICH ARE DEFICIENT IN SOME PARTICULAR.

- DR. HAROLD B. THOMPSON, Seattle, Wash. Recommended by Drs. Hollis E. Potter and R. D. Carman. Complete, but application was not received complete until March 21, 1914.
- DR. L. MARSH DOLLOWAY, 120 Nasby Bldg., Toledo, Ohio. Recommended by Dr. P. M. Hickey and H. W. Dachtler. Application received March 20, 1914. No scientific paper presented yet.
- DR. MAX KAHN, 667 Columbia Ave., Baltimore, Md. Recommended by Dr. Albertus Cotton. Only one signature and no letters of recommendation.
- DR. EARL KING, 75 Caroline St., Saratoga, N. Y. Recommended by Drs. Thurman A. Hull and Jas. P. Marsh. No letters of recommendation and no scientific paper.
- DR. FRED B. HALL, 618 Metropolitan Bldg., St. Louis, Mo. Recommended by Drs. E. H. Skinner and R. D. Carman. No scientific paper yet presented.
- DR. WM. ALBERT EVANS, 32 Adams Ave. W., Detroit, Mich. Recommended by Drs. Jas. T. Case and P. M. Hickey. Scientific article not yet submitted.
- DR. A. R. TAFT, Charleston, S. C. Application not signed by members of the Society but a letter from Dr. Robt. W. Gibbes endorses.

- DR. E. S. BLAINE, Cook County Hospital, Chicago, Ill. Recommended by Drs. Hollis E. Potter and Jas. T. Case. Lacks letter of endorsement from Dr. Potter.

- DR. W. T. S. GREGG, Calumet, Mich. Recommended by Drs. A. W. Crane and Geo. C. Chene. No letter of endorsement from local physician. Letters from the signers not received until March 23, 1914.

- DR. ROBT. EMMETT AUSTIN. Recommended by H. Clyde Snook and Dr. Albert Soiland. No letters of endorsement and no scientific paper.

- DR. JOS. FRIEDMAN, 73 W. 116th St., N. Y. Recommended by Dr. Leopold Jaches. Application not signed by two members.

- DR. ANTHONY BASSLER, 21 W. 74th St., N. Y. Recommended by Drs. E. W. Caldwell and G. W. Pfahler. Application received April 9, 1914. No letter of endorsement from local physician or surgeon.

- DR. PHILLIP HOWARD COOKE, 771 Main St., Worcester, Mass. Recommended by Drs. Percy Brown and H. W. Van Allen. Application dated 10/3/13, received 4/22/14. No letter of endorsement either from signers or local physician.

In every instance the applicant or his signer has been promptly notified of the deficiency where one existed.

ALFRED L. GRAY,  
*Chairman Exec. Com.*



## ABSTRACTS

Mueller, Christoph: Physical and biologic fundamentals of the effect of the rays of radioactive substances, especially of mesothorium, and the roentgen rays as a substitute. (Physikalische und biologische Grundlagen der Strahlenwirkung radioaktiver Substanzen, besonders des Mesothoriums und der Ersatz derselben durch Roentgenstrahlen). Muench. med. Wchnschr., 1914, LXI, 134.

Supplementing a former communication, Mueller admits that he valued the deep effect of secondary beta rays too high. But even if the physical effect of these rays can be assumed only for 1 cm. depth of tissue, that does not mean that this is the limit of the biologic effect. The effect of the radiation on tissue is an ionization in the sense that lecithin disintegrates and cholin is split up. This cell poison cholin not only kills the cells in which it is split up, but it is also taken up by the neighboring tissue and manifests there its poisonous effect. In other words, the effect of the rays on a tumor is caused, on the one hand, by absorption of the rays, and on the other by the cholin which originated in the region of the absorption and is taken up by the neighboring tumor masses where it causes a process of disintegration even if these areas of the tumor mass are not sufficiently reached or affected by the irradiation directly.

Only in this manner can it be explained, that very large tumors become necrotic after a not too intensive irradiation, in which case we may be sure that not sufficient rays were absorbed in all parts. In this biologic sense the effect of secondary rays, though physically proved to only 1 cm. depth, may possibly reach to about 4 cm. depth. An effect with radium or mesothorium has not been proved to a greater depth than 4 cm. and not 7 cm. as previously thought.

Even if we admit that the proximity of the source of the rays and with it the

eventual intensive effect of the gamma rays is of importance, this is of advantage only in a limited number of cases, namely, in such cases in which an effect of several centimeters depth is desired without the necessity to consider the covering layers. In these cases the effect is more easily obtained if an intensive beta ray formation is produced by a metal filter. In this manner the same effect can be obtained with less quantity of substance and in a shorter time.

In all other cases where the layers which cover the tumor mass have to be protected, the effect of the secondary rays and the proximity of the source of the rays is of decided disadvantage. Thus the indications for radium and mesothorium in comparison to roentgen therapy are established.

1. For all deeper located tumors and all tumors that lie superficially in which the covering normal tissue layers must not be damaged by the irradiation, roentgen therapy deserves the preference. Up to date no case is known in which radium or mesothorium has caused a deeper located tumor which was covered by normal tissue to disappear; with the roentgenization, however, we can cause quite considerable quantities of tissue to be absorbed without damaging the covering normal layers.

2. Tumors into which or at which radioactive preparation can be placed and fastened, are easier influenced with a therapy with radioactive substances.

3. In such cases the immediate neighborhood of the preparation will have a better effect than with interruption by interposed metal for generating the strong secondary irradiation.

4. The possibility is given to replace or substitute the considerable advantages of the treatment with radioactive substances in the latter cases by roentgenization, which is decidedly much cheaper. Two things are necessary, an apparatus which

produces the strong gamma rays and that the focus or the source of the rays can be brought nearer to the focus of the disease.

Zuckerkindl: Roentgenography of tumors of the bladder (Roentgenaufnahmen von Blasen-tumoren). Wien. med. Wchnschr., 1914, LXIV, 227.

At the k. & k. Gesellschaft der Aerzte in Vienna at the meeting in January, 1914, Dr. Zuckerkindl demonstrated roentgenograms of tumors of the bladder. The first case deals with a carcinoma which distinctly showed defect after collargol filling. The second case concerns a papillary tumor which could only be made visible after the collargol had been let out and the bladder been filled or inflated with air. The collargol had formed a covering over the nut-sized tumor which produced a distinctly visible shadow in the roentgen projection. The tumor was extirpated.

Klein, Gustav: Primary results of combined treatment with mesothorium roentgen rays and intravenous injections (Primäre Ergebnisse der kombinierten Karzinombehandlung mit Mesothorium, Roentgenstrahlen, und intravenösen Injektionen). Muench. med. Wchnschr. 1914, LXI, 115.

In the gynecologic polyclinic in Munich, 48 carcinomata of the vulva, the uterus, ovaries and the cecum were treated with roentgen rays exclusively. Since the middle of August, 27 gynecologic and 12 surgical cases of carcinoma were treated with roentgen and mesothorium therapy and intravenous injections.

The technic is as follows: For inoperable carcinoma, a combination of roentgen rays, mesothorium and intravenous injection. For operable carcinoma, operation, in some cases after preliminary treatment with roentgen rays, followed by prophylactic treatment with roentgen rays, mesothorium and intravenous injection.

That only a small quantity of mesothorium was at disposition proved to be a lucky incident because it saved from giving too large doses.

The treatment is as follows: three to four days' irradiation with mesothorium for one to twelve hours; 1000-4000 mg.-hours. This is followed by an interval of several days when roentgenization is begun and continued for three to five days with moderate doses; two weeks after the first mesothorium application, a second series of it is started. The intravenous injections of radium-barium-selenat were given during the application of mesothorium. After these injections for which also enzytol was used, the patients have to be under close observation because there are sometimes severe secondary symptoms. For fastening the mesothorium tubes, or covering them, gauze impregnated with metallic salts, as vioform, iodoform, or dermatol should never be used, because this may cause a secondary irradiation with burning of the vulva, vagina, etc.

The results have been satisfactory.

Sgalitzer, M.: Roentgenization of malignant tumors (Maligne Tumoren durch Roentgenstrahlen zum Schwinden gebracht). Wien. med. Wchnschr., 1914, LXIV, 226.

The author demonstrates several cases of malignant tumors which disappeared after roentgenization (allgemeines Krankenhaus in Vienna). Very high doses of roentgen rays were applied in a case of a tumor of the lymphatic gland in the region of the left inguinal fossa and the tumor promptly disappeared. A tumor of the right axilla had been removed by operation, but a relapse took place after three months, was then irradiated in three sittings and disappeared. In one case, the mamma was amputated for malignant tumor and a relapse operated on several months later; the second relapse was then successfully treated with roentgen rays. The fourth case was roundcell sarcoma of the breast with proliferation into the intercostal spaces complicated with tumor of the parotis and osteo-sarcoma of the right orbita; the tumors disappeared completely after roentgenization, as did also a carcinoma metastasis of the mamma. The time elapsed after



the treatment without relapse was from 4 to 6 months. Of all roentgenized cases, the tumors disappeared in one-tenth, and numerous cases were considerably improved. The doses were as high as possible and in cases which did not react, such high doses were given as to cause bullous dermatitis ( $50\text{ H} = 100\text{ X}$ ), and the parts which were irradiated under filters were sensitized; thus these tumors were favorably affected; the dermatitis healed after two to four weeks; the author demonstrates two such cases with metastases after carcinoma of the mamma.

**Kirstein, F.:** The roentgen therapy in gynecology (*Die Roentgentherapie in der Gynaekologie*). Berlin, 1913, Springer. 123 pages.

The author gives with this textbook an opportunity for information on all questions concerning the roentgentherapy in gynecology. His own technic is similar to that of Albers-Schoenberg, the so-called Hamburger Technik. First the instrumentation and the technic is described and a special chapter given to the filtration of rays. As to the effect of the roentgen rays, the author inclines to the view that they are influencing directly the uterus and the tumor and that the influence is not originating in the ovaries, or that this is at least very likely. Indication and contra-indication for the roentgenization of myomata are discussed in detail thus: Location, age of the tumor and the patient, necrotic, cystic adenomyomata, complications with diseases of the adnexa, uncertainty of the diagnosis, anemia and diseases of the heart, damage of the skin, sarcomatous degeneration, complications with cancer and ovarian tumor. Of other diseases which generally or individually are conceived as indications are considered: Pruritus and caurosis vulvae, dysmenorrhoea, chronic diseases of the adnexa, inoperable tumors, and osteomalacia. A special consideration is given to the question of embryonic injury. Analogous to animal experiments, the injury to the embryo is thought to be very likely. The author criticizes

relapses and failures and deaths which were published hitherto, and discusses secondary symptoms and permanent results. Statistics of the hitherto published reports are given at the end of the book.

The book is written with careful and circumspect criterium and very instructive.

**Hamm:** Technic and results of radiotherapy (*Technik und Resultate der Strahlentherapie*). Deutsche med. Wchnschr. 1914, XL, 311. (*Aerztever. Strassburg*, XI, 8, 1913).

Hamm reports the results of radiotherapy hitherto obtained at the Universitaets-Frauen-klinik in Strassburg. Mesothorium, which was only for a short time at the disposal of the institution, effected in two women who had been under roentgen treatment for some time, an exceedingly quick regress of the carcinomatous tissue. As a palliative and on account of the easy and comfortable method of their application, the radioactive substances are decidedly superior to the roentgen ray. Two other cases of inoperable carcinoma, which could only be treated with roentgen ray—daily 50-60 minutes for 6-7 days, and after 2 to 3 weeks repetition of the series—have remained stationary, the general condition improved considerably; two women who were carefully treated with small doses of roentgen rays and the beginning of the employment of roentgen rays in the institution for inoperable carcinoma of the cervix have succumbed to the disease after several weeks of treatment; probably an irritation of the cancerous tissue was caused by the too small dosage and led to the fatal end. Intensive doses of hard rays with 60-100 X per diem are therefore a necessity in the treatment of carcinoma.

Far better are the results of roentgentherapy in the treatment of myomata. In six of these cases at the age of 40-50, a complete cure was effected and three who are yet under treatment are considerably improved; one woman, 36 years of age, was given high doses of roentgen rays, but the hemorrhages continued and the tumor grew.

so that she had to be operated on. One patient with giant myoma, who was in menopause for 12 years and who had refused an operation for the last fifteen years on account of severe diabetes, was treated with roentgen rays, after which a shrinking of the tumor was noticed and above all a pronounced improvement of the general condition was manifest. The best results were effected for climacteric hemorrhages of which three cases were treated and cured and for which roentgentherapy is the method of choice today. The irradiation should be performed on three successive days, three fields each, in larger myomata six, seven and more fields. Repetition of such series every three to four weeks. Three series are mostly sufficient. The first series for myoma should be @ 200-300 X to avoid hemorrhage from irritation. With the employment of 3 mm. aluminum filters, no burnings have been observed.

**GUNSETT:** At the same meeting of the society mentioned above, Gunsett reports on radium treatment in France. In 1907, Dominici published his method of ultrapenetrating irradiation and gave with it an inducement to the filtertechnic. Wickham & Degrais used 10-20 mg. radium in filters of 2-3 mm. lead and of the same thickness silver, gold and platinum and had nice palliative results. Then in 1910, Cheron and Rubens-Duval used their method of so-called massive doses with strong filtration. Massive doses are understood as 200-300 mg. radium, with which they effected many clinical cures of cervix carcinoma which have lasted so far  $1\frac{1}{2}$ , 2, 3 and 4 years. An anatomical cure of an inoperable carcinoma of the cervix they reported in 1911 of a woman, who 15 months after the last irradiation died of other causes and in whom at the p. m. autopsy, not the least trace of carcinoma was found. It must be emphasized that Cheron and Rubens-Duval treated almost without exception inoperable cases, which would be of weight in estimating the results of radium therapy.

**Mosenthal:** Roentgenograms of stones of the kidney and ureter (*Roentgenbilder von Nieren- und Uretersteinen*). Deutsche med. Wchnschr. 1914, XL, 361. (*Berl. med. Ges.*, I, 28, 1914.)

Not only the kidney but also the entire urethral course should be examined with roentgen rays. Mosenthal made 1250 roentgenograms of 500 patients with stones and had only 1% erroneous diagnosis or less. The injection pressure should be as slight as possible for pyelographies. The kidney can almost invariably be reproduced by roentgenography. From the reproduction, conclusions may be drawn for the chemical quality of the stones. Two roentgenographies must be made from each side, one each of the urethra and the kidney. A standstill of respiration of less than 20 seconds is required. Double plates must be used, and tubes with Wolfram anticathodes. The roentgenographies are then demonstrated and especially the differential points of diagnosis explained.

**EVLER:** In the discussion, Evler says that the roentgenographies permit a perfect orientation; the size of the shadow of the kidney is of value for the diagnosis, and he emphasizes that a small kidney, when surrounded by much fat may give a large shadow.

**Fraenkel, Eugen:** Anatomic roentgenologic examination of the trachea (*Anatomisch-roentgenologische Untersuchungen ueber die Luftroehre*). Fortschr. a.d. Geb. d. Roentgenstr., 1913, XXI, 3.

The trachea is filled out with a combination of paraffin and iron oxyd and then roentgenized. This material for filling is preferable to other generally-used mixtures, especially the metallic mixture used by Ross, and plaster of Paris, because it reproduces the conditions more accurately and does not cause any artificial expansions. Physiologically, the trachea shows a more or less marked narrowness in the region of the thyroid gland. Under normal condi-



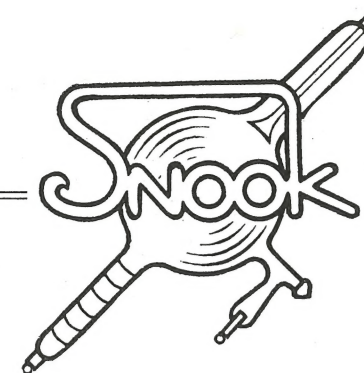
tions, a groove is seen at the point where anonyma and aorta are adjacent. The sabresheath form may be idiopathic without goitre; this is most frequently seen in the male; ossification of the trachea cannot be looked upon as the cause thereof.

Hesse, O.: The act of vomiting of a dog. (Brechakt beim Hunde). Pflueger's Arch., 1914, CLII, H. 1-3.

By roentgenographic reproductions of which splendid examples are given in the article, the author comes to the following conclusions: 1. The act of vomiting of a dog occurs in three acts: The relaxing fundus is filled from the pylorus part of the stomach, and the pylorus part contracts; then the cardia is opened by contraction of

abdominal muscles and the diaphragm and food thrown into the esophagus, where it remains for some time, then the glossis closes and the content of the esophagus is thrown out. 2. By characteristic respiration the food parts are driven up and down whilst they are in the esophagus. During this time the cardia is frequently, though not always, open and the esophagus is relaxed. 3. Antiperistalsis of the stomach and esophagus was not observed. The act of vomiting is not always complete. Frequently the food is only vomited into the esophagus and not to the outside, but slides back to cardia and stomach; even if the food gets outside, the esophagus is not completely emptied, and the remnants get back into the stomach.





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