

## THE ROENTGEN DIAGNOSIS OF THE STOMACH.

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THE Roentgen diagnosis of diseases of the stomach has advanced greatly during recent years. The stages of this advance are marked by the photography of the Rieder meal in 1904, the method of Roentgenoscopy with palpation; the bismuth suspension in and sedimentation by Holzknecht; the test of motility by means of the double bismuth meal by Haudek; and the discovery of antiperistalsis by Jonas. To these names may be added those of Schmieden, Härtlein, and Clairmont. The latter, working in Eiselberg's clinic, has published a report of 100 operations in which there was not a single case of serious error in the Roentgen diagnosis.

At the Surgical Congress of Berlin in 1911, Schmieden, referring to Bier's clinic, asserted that the factors of modern stomach diagnosis were only three in number, viz., the history of the case, palpation, and Roentgen diagnosis, and that laparotomy as a means of diagnosis is now altogether superseded.

I can entirely subscribe to the above statements, merely adding that I consider that the test of the acidity of the stomach is also of great importance. We can never have too many symptoms as an aid to diagnosis.

How often have we seen the clinical symptoms totally contradicted by the Roentgen examination and the subsequent operation, and the cause of obscure symptoms revealed! Those only who have seen the old diagnostic laparotomy replaced by a well-ordered operation, who have seen the symptomatic treatment of inoperable cases replaced by the surgical treatment of gastric ulcer, will realise how great is the debt we owe to Roentgen.

At the last Medical Congress, von Bergmann expressed himself thus: "The members of the Congress can hardly conceive the progress made from day to day in Roentgen diagnosis, and especially in the diagnosis of diseases of the stomach and bowels. And yet we hear the physician without shame confess that he knows nothing of Roentgen diagnosis!" Such a statement from the mouth of a clinician and professor testifies better than any words of mine as to the position of Roentgen diagnosis in internal medicine.

The classical means of physical diagnosis, of great importance in diseases of the thorax, are less so in examination of the abdominal organs. Hence radiology has added but little to the diagnosis of chest diseases in comparison with the assistance it has rendered to the diagnosis of diseases of the abdomen.

In the following pages I have grouped a number of radiological and clinical signs under one symptom-complex, so as to show their true diagnostic value.

\* Condensed from the *Jahreskurse für ärztliche Fortbildung*, Munich, 1911.

## SYMPTOM-COMPLEX I.

1. Bismuth residue after six hours.
2. Normal stomach shadow on the screen.
3. Achylia.

*Diagnosis*: Small carcinoma of the pylorus.

This symptom group is almost always associated with stenosis of the pylorus due to a small carcinoma. There is stagnation and a loss of tone, as evidenced by the bismuth residue, which may, however, be quite a small one. The patient may suffer from little or no disturbance, except loss of appetite. The diagnosis is easy when we reflect that, as long as the pylorus is free, achylia is always associated with *hypermotility*, in which case the stomach would be empty in two or three hours at most. A residue after six hours points indubitably to an organic obstruction of the pylorus. Ordinary atonic delay of gastric evacuation never lasts as long as six hours; the cause must be either stenosis or spasm of the pylorus. It is evidently not the latter, for this is never associated with achylia, but, on the contrary, with hyperacidity.

The above is, therefore, not a mere empirical symptom-complex, but a logical one, and a decided advance in the early diagnosis of carcinoma. Although the recognition of achylia requires the use of the sound, the motility of the organ can only be satisfactorily tested by radiological means. The test of motility by the sound is open to many objections, and does not indicate the cause of the delay, besides being wanting in accuracy. We may, indeed, recognise a residue remaining overnight, but not a residue after four or six hours. It was only by means of the Roentgen examination that Haudek was able to show that almost every florid gastric ulcer was complicated with disturbance of motility due to spasm of the pylorus.

The radiological examination also shows that the new growth is small and operable, since otherwise there would be some defect in shape or extent of the bismuth shadow. Diffuse contracting carcinoma or deep circumscribed scirrhus would also show the symptoms of achylia and loss of motility. This, however, would not give a normal gastric picture, but one showing shrinkage and defective filling. You will see, therefore, that the above symptom-complex gives a very correct idea, not only of the nature and position, but also of the extent of the disease.

I may suggest a modification, or rather an addition, to the above Roentgen examination. The achylia may be diagnosed radiologically by the aid of one of Schwarz's "fibrodermic capsules." We may consider that achylia is indicated if such a capsule is not digested and destroyed in five hours or less.

## SYMPTOM-COMPLEX I (A).

1. Bismuth residue after six hours.
2. Normal shadow of the stomach.
3. Fibrodermic capsule intact after five hours.

*Diagnosis*: Small carcinoma of the pylorus.

When using Haudek's method of examination six hours after the bismuth meal, we may estimate the time that the stomach has been empty by observing the position of the bismuth column in the intestines. In achylia after six hours the small intestine is empty, and the head of the column has reached the splenic flexure of the colon; while in normal cases the head of the column would be in the ascending colon and the tail in the last part of the ileum. Hypermotility of the large bowel is almost always associated with achylia. Hence the diagnosis may be made pathologically without the use of the sound, although with somewhat less certainty.

## SYMPTOM-COMPLEX I (B).

1. Bismuth residue in stomach after six hours.
2. Head of the bismuth column in the hepatic flexure.
3. Normal stomach shadow.

*Diagnosis*: Small carcinoma of the pylorus.

The examination of the stomach for such a symptom group as the above has been greatly simplified by Haudek's method of the "double bismuth meal," a method which was evolved in my own laboratory. The patient has taken a Rieder meal at 7 a.m., and at 1 o'clock he comes to the laboratory. A previous test meal has shown the presence of achylia. We see at a glance that there is a residue in the stomach, and that the head of the bismuth column is in the splenic flexure of the colon. We at once suspect carcinoma. The second Rieder meal is now given, an aqueous suspension of bismuth. The form, position, size, and evacuation, of the stomach are shown to be normal, and the radiological examination is complete.

The symptom-complex would also appertain to an old callous ulcer with achylia, the achylia being due to alteration of the mucous membrane, and the loss of motility to invasion of the pylorus. Such a case, however, is very rare, and would show a snail-shaped stomach with transverse and longitudinal contractions, and displacement of the pylorus to the left.

We must also bear in mind the possibility of the diagnosis being obscured by the injection of morphia at the time of the examination, by chronic morphinism, or pyloric spasm due to morphia. In all these cases we might have a bismuth residue remaining after six hours, with a completely normal stomach shadow.

## SYMPTOM-COMPLEX II.

1. No residue after six hours.
2. Marked defect in the gastric shadow.
3. Horn-shaped stomach.

*Diagnosis:* Carcinoma. No stenosis. Inoperable.

We have come across a whole series of these cases which showed no clinical symptoms except anorexia and some loss of weight. The patients have derived little or no benefit from gastro-enterostomy.

The marked defect in the gastric shadow shows clearly the presence of a tumour, but this tumour is inoperable. Haudek has shown that when the stomach has lost its hook form from contraction, and has attained the horn form, it is no longer capable of complete resection.

The horn form of the stomach can only be due to one of two causes—hypertonicity or shrinkage. The first of these is ruled out by the nature of the case, since the tone of the gastric wall would be necessarily impaired by the commencing cachexia. When the palpable tumour is small, we may be sure there is something else behind; we may be sure that the shrinkage is due to some widespread cancerous infiltration which renders the total resection impossible. On the other hand, when the stomach retains its ordinary physiological hook form, we may consider the case to be operable, even when there is considerable defect of the stomach shadow, as in cases of medullary carcinoma.

## SYMPTOM-COMPLEX III.

1. No residue after six hours.
2. Marked defect of the stomach shadow in the  
pars media or the pars pylorica.
3. Hook-shaped stomach.

*Diagnosis:* Carcinoma of the stomach. Operable.

Of course, in considering the advisability of operation, other factors must be taken into consideration—viz., the presence of adhesions and the occurrence of metastases.

## SYMPTOM-COMPLEX IV.

1. Small residue after six hours.
2. Sensitive pressure-point over the stomach.
3. Normal stomach shadow.

*Diagnosis:* Simple gastric ulcer.

This diagnosis is fairly certain and simple. In all cases of gastric ulcer there is always a certain amount of loss of motility. Haudek has never found an *ulcus ventriculi* without this delay in the evacuation of the organ, and no case of spasm of the pylorus without some lesion of the stomach wall.

As regards the pressure-point, it is not enough merely to find a sensitive

point somewhere in the epigastrium; but we ought to demonstrate radiographically that the pressure-point falls on the lesser curvature of the stomach, where an ulcer is most frequently situated, and that it moves with the stomach by pressure or indrawing of the abdominal walls (Jonas). This complete diagnosis requires much experience both in radiology and in palpation; happily, there are a number of other symptoms which confirm the diagnosis. These are—

1. Antiperistalsis.
2. Displacement of the pylorus upwards and to the left.
3. Snail form of the lesser curvature.
4. Stable transverse contraction.
5. Changing transverse contraction.

The picture somewhat resembles that of the callous penetrating ulcer, whose most certain sign, however, is the presence of a diverticulum communicating with one or other of the neighbouring organs.

#### SYMPTOM-COMPLEX V.

1. Small bismuth residue after six hours.
2. Pressure-point.
3. Displacement upwards and to the left.
4. Snail form of the stomach shadow.

*Diagnosis:* Old contracting ulcer on the lesser curvature of the pars pylorica.

#### SYMPTOM-COMPLEX VI.

1. Small bismuth residue after six hours.
2. Pressure-point and resistance in the pars media.
3. Transverse contraction of the pars media.
4. Diverticulum without air bubble in the smaller curvature, immovable.

*Diagnosis:* Callous ulcer of the small curvature of the pars media.

Even when a sensitive pressure-point is absent, the combination, hyperacidity with a small residue after six hours, is almost characteristic of ulcer. At all events, Haudek has sought in vain for an ulcer without spasm of the pylorus, or for a case of six hours' delay of the bismuth residue without serious alteration in the gastric wall.

#### SYMPTOM-COMPLEX VII.

Large sickle-shaped bismuth residue after six hours.

*Diagnosis:* Old stenosis of the pylorus, due to ulcer.

This symptom, which is recognisable at the first glance on the screen, is due to dilatation and secondary atonic alteration of the musculature, with great loss of motility. The complex may be resolved into two groups.



## SYMPTOM-COMPLEX VII (A).

1. Large residue after six hours.
2. Dilatation.
3. Loss of tone.

*Diagnosis*: Old ulcer-stenosis.

The above symptoms, however, say nothing as to the character of the lesion—whether a simple, a florid ulcer, a callous ulcer, or a carcinoma on the base of an old ulcer or scar. To decide this question, we have to consider other symptoms as follows:

## SYMPTOM-COMPLEX VIII.

1. Large sickle-shaped residue.
2. Marked defect in the filling of the pars pylorica.

*Diagnosis*: Carcinoma on the base of an old ulcer, with stenosis.

This picture is much more common than might be suspected. It was not known until recently that advanced stenosis of the pylorus, with dilatation and paralysis, might exist without vomiting or other severe symptoms. Vomiting may set in later, not from the stenosis, but from the commencing carcinoma. The signs of dilatation and vomiting, and the previous history of ulcer, all point to stenosis of the pylorus, and do not in any way interfere with the indications for operation.

## SYMPTOM-COMPLEX IX.

1. No bismuth residue after six hours.
2. Marked defect in the shadow of the pars pylorica or pars media.
3. Transverse constriction of the greater curvature.

*Diagnosis*: Carcinoma on the basis of an old ulcer. No stenosis.

## SYMPTOM-COMPLEX X.

1. Stomach empty after six hours. Head of the bismuth column at the splenic flexure of the colon.
2. Shortening of the stomach.
3. Congestion at the cardia.

*Diagnosis*: Carcinoma of the pars cardiaca.

Symptom 1 indicates hypermotility of the organ, due to hypo-acidity or anacidity. It should be confirmed by a second examination three hours after the bismuth meal. Symptom 2 indicates a diffuse contraction, and indicates carcinoma. With an ulcer this contraction is more unequal and not so diffuse. Symptom 3 speaks for the aggressive tendency of the disease. The

achylia is a contra-indication of ulcer, as is also the cardiac stenosis. The tumour is, of course, inoperable.

The above symptom-complex could only be confused with two other primary affections—achylia and spasm of the cardia. The achylia, being associated with hypermotility, could only be due to lack of stomach contents, cardiasthenosis, wasting from inanition, gastro-entero-anastomosis, or pyloric insufficiency. On the other hand, pure cardiac spasm without dilatation is usually associated with hyperacidity.

#### SYMPTOM-COMPLEX XI.

1. Stomach empty after six hours. Head of bismuth column in the ascending colon.
2. Stomach shadow normal.
3. Pressure-point moving with the duodenum.

*Diagnosis:* Ulcus duodeni.

#### SYMPTOM-COMPLEX XII.

##### *Normal Stomach.*

1. Stomach empty in six hours. Head of the bismuth column in the ascending colon.
2. Stomach shadow normal.
3. No increase of peristalsis; no antiperistalsis.
4. No sensitive pressure-point.
5. HCl normal.

This is the picture of the normal stomach. In no case showing these signs have we found anatomical alteration on operation or post-mortem examination.

We must always remember that the less the number of positive symptoms, the greater the care necessary in the Roentgen examination, and the greater the reserve in the expression of a diagnosis. We may say, however, that hitherto we have met with no case of serious alteration of the gastric walls without some corresponding alteration in the symptom-complex.

1. *Motility.*—Haudek's method of the double bismuth meal has at one step promoted the motility test to the first place in the Roentgen examination of the stomach. The patient is examined six hours after the first bismuth meal. The first glance gives us a rough measure of the motility of the stomach. Another valuable indication is given by comparing the size of the residue in the stomach with the amount which has passed into the intestines. The residue is *large* if all or the greater portion of the bismuth meal is retained in the stomach. If one-half is retained, the residue is said to be *medium*; while if a visible remnant only remains, the residue is *small*. Even if the stomach is empty, the position of the head and tail of the bismuth column in the colon will give us valuable indication as to the normal or hypernormal motility of the stomach and intestines.

2. *Gastric Tone*.—In an otherwise normal abdomen, the tone of the stomach wall is indicated by the form of the organ and the distribution of its contents. In the atonic stomach the contents lie entirely in the caudal sac, while the pars media is more or less collapsed. The normally tonic stomach appears to embrace its contents, and is always filled up to the pars cardiaca whatever the amount of the ingesta.

3. *Size of the Stomach*.—In the erect posture the normal stomach reaches down as far as the umbilicus. Increase in length is usually congenital, whereas ptosis is due to atony. An increase of size in all dimensions is due to dilatation and loss of tone from stenosis of the pylorus, aerophagy, or the distension of the stomach with gas for diagnostic purposes.

A general diminution of size in all directions is met with in inanition

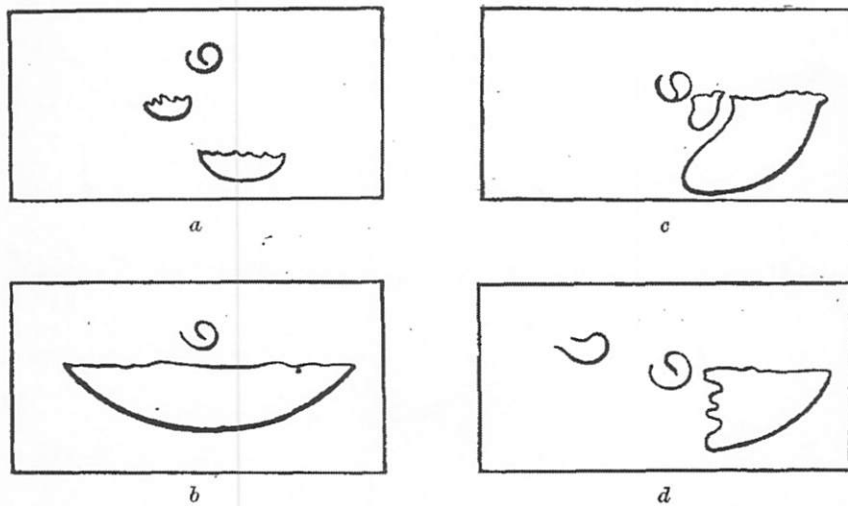


FIG. 1.—BISMUTH RESIDUE AFTER SIX HOURS, SHOWING ITS POSITION WITH REGARD TO THE UMBILICUS. (HAUDEK.)

*a*, Small residue—spasm or slight stenosis of the pylorus. *b*, Large residue, extending to the left of the umbilicus—uncompensated pyloric stenosis. *c*, Medium residue to the left of the navel; snail form; the end of the greater curvature well defined and sharply rising; pylorus drawn over to the left by shrinkage of the lesser curvature—ulcer of the pylorus. *d*, Medium residue displaced to the left; margin rising abruptly, but notched and toothed; no displacement of the pylorus and bulb duodeni—carcinoma.

from stenosis of the œsophagus, gastro-enterostomy, or pyloric insufficiency due to hypo-acidity. Great shrinkage occurs in cases of infiltrated carcinoma. Apparent dilatation of the aorta may result from loss of tone, from manual pressure or the pressure of a tumour, or the presence of gas in the bowel.

4. *Transverse Contraction*.—The drawing in of the stomach as if by a string occurs chiefly at the greater curvature. This is due to the fact that the ulcer causing the contraction usually occupies the lesser curvature, and in the erect posture the weight of the ingesta is on the greater curvature. In this case the narrowed part, or isthmus, of the canal lies close to the lesser curvature. The "hour-glass stomach" is almost invariably due to gastric ulcer, or carcinoma on the basis of an old ulcer. Carcinoma without previous ulcer gives a broader band of contraction.



These transverse contractions and folds of the stomach may be either temporary or permanent. The intermittent type is associated with floridity of the accompanying ulcer, while the permanent type may coexist either with a florid ulcer or a cicatrix. In the former case there will be diminished motility and a sensitive pressure-point.

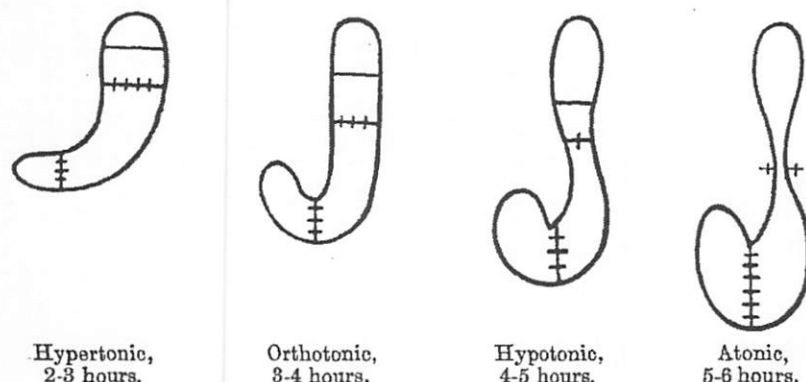


FIG. 2.—TONIC DIFFERENCES IN THE FORM OF THE LOADED STOMACH WHEN ERECT IN THE MALE. (E. SCHLESINGER.)

The snail form of stomach is due to shrinkage of the lesser curvature, and the drawing upwards and to the left of the pars pylorica (Schmieden and Hartlein). It is due either to ulcer or carcinoma, but more frequently to the former, so that the snail-like form is usually a sign of ulcer.



FIG. 3.—DIFFUSE INFILTRATING CARCINOMA INVOLVING THE CARDIA AND NEARLY THE WHOLE OF THE STOMACH WALL. (HOLZKNECHT AND JONAS.)

Marked shrinkage of the stomach. Insufficiency of the pylorus. Stenosis of the cesophagus.

5. *Defect in the Stomach Shadow.*—Defects in the stomach shadow may be due to mere defects in the filling of the stomach ventricle, or to a tumour of the stomach wall or of some neighbouring organs. To distinguish between these, the best means at our disposal is the use of an aqueous suspension of bismuth. In Fig. 5 we have three varieties of such defects in the shadow of the bismuth meal.

6. *Peristalsis*.—The peristalsis of the stomach has for long engaged the attention of the radiologist. Recently Jonas, working in my laboratory, discovered the phenomenon of antiperistalsis. According to Haudek, antiperistalsis is always associated with a serious anatomical lesion of the pars media or pars pylorica, stenosis, ulcer, erosion, or carcinoma. A single wave

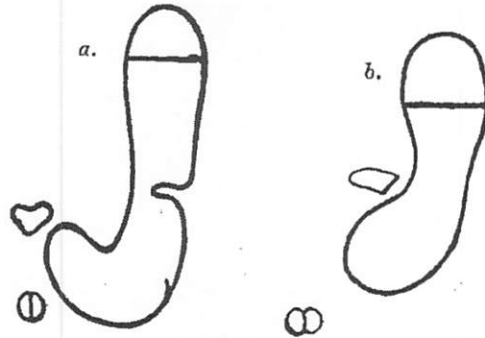


FIG. 4.—*a.* TRANSVERSE CONSTRICTION OF THE GREATER CURVATURE. *b.* SNAIL FORM DUE TO LONGITUDINAL SHRINKAGE OF THE LESSER CURVATURE.

of contraction in a direction opposed to the normal is sufficient to establish the presence of this most important symptom.

*Increased Peristalsis* is an indication of pyloric stenosis in its early stages, before the commencement of paralysis and dilatation. It may, however, be merely due to hyperacidity. The contractions begin high up, and the wave of contraction is higher than normal. A number of contractions are seen

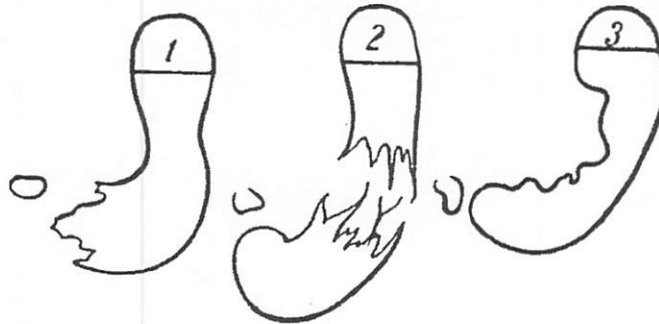


FIG. 5.—1. DEFECT IN THE FILLING OF THE PARS PYLORICA. 2. DEFECT IN THE FILLING OF THE PARS MEDIA: HOOK FORM OF STOMACH. 3. DEFECT IN THE NEIGHBOURHOOD OF THE LESSER CURVATURE: HOUR-GLASS STOMACH.

almost cutting across the organ, giving an appearance almost like the haustral segmentation of the colon.

*Diminished Peristalsis*.—This may be the result of an abnormal amount of acid at the commencement of digestion. It may also be caused by an excess of oily matter in the food. The peristalsis is stimulated by mechanical pressure, but rapidly dies away. The frequency of the peristalsis is also of importance. We may one day habitually count the pulse of the stomach contractions as we do now that of the heart.

*Technique.*—The technique which has rendered possible these improvements in Roentgen diagnosis has not been altered to any considerable extent.

In the Roentgen diagnosis of diseases of the stomach, the most important rôle must, without doubt, be assigned to Roentgenoscopy. Since the invention of the "distinctor" or "compressor," the screen examination has lost even the appearance of danger to the operator. The compressor is used instead of the operator's hand to press down the fluorescent screen, and thus assist in the development and distinctness of the Roentgen picture.

One of the most important points in radioscopic technique is the facility of moving the focus-tube and screen in any direction on the vertical plane. This should be done with one hand, while the other hand controls the size of the diaphragm and the distance of the tube. None of the modern sliding installations permits this satisfactorily. In my opinion, by far the best apparatus is the hanging focus-tube and screen, as designed by myself and

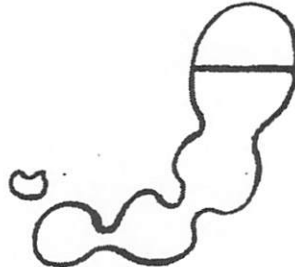


FIG. 6.—INCREASED PERISTALSIS.

my pupils, and made for me by Somner, and more recently by Reiner and Reiniger, of Vienna. The patient leans against a back-board to steady him when pressure is made by the screen on the abdomen. The focus-tube, with its sliding diaphragm and the fluorescent screen, are all suspended from the ceiling, and move freely in any direction. There is no disadvantage in this free pendulum movement, as with a little practice they can be easily fixed in position.

It is of great advantage to be able to place a photographic plate behind the fluoroscopic screen without altering in the slightest degree the relative position of the tube and the patient. The fluoroscopic examination should be a preliminary to the photographic, and the screen should act as a "finder" for the Roentgen tube. The only difficulty is that for skiagraphy the focus-tube should be much softer than for screen examination. With a hard tube and a heavy anode, however, the focus-tube used for the screen examination may be rapidly softened after the screen examination and before taking the negative. This may be best done with an osmo-regulator and a distance-regulating apparatus. For this purpose, in my opinion, the best tube is the Burger Central-Focus-tube. It is used with hard rays for the fluoroscopic examination, and then rapidly softened by the distance regulator till the bismuth shadows become quite black, when the tube will be found the right quality for taking the negative. A plate armed with a reinforcing screen is

then introduced behind the fluorescent screen, and pressed against the abdomen of the patient. The generator for instantaneous work is now switched on, and the negative is taken, while both patient and operator hold their breath. During the whole of the operation the fluorescent picture is seen on the screen, and the exact position and duration of the exposure may be effectively controlled. The weaker coil may then be switched on, and the screen examination may be continued, the tube gradually becoming harder with use.

For screen examination I generally use a continuous-current coil and a Rotax break. A Wehnelt break or high-tension Rectifier heats the tube too much for prolonged fluoroscopic work. For instantaneous skiagraphy I use a Rotax break or a triple Wehnelt. With alternating current I use a transformer to produce a continuous current. For screen examination I use tubes of hardness 7 to 8 Bauer, and for skiagraphy with a reinforcing screen I use a tube with hardness 4 Bauer.

#### COMBINATION OF HIGH FREQUENCY WITH X RAYS.

It is well known that high frequency, which was introduced into France by D'Arsonval, and into America by Tesla, was received with but little enthusiasm in Germany. This position has been greatly altered, however, since the introduction of fulguration, diathermy, and thermo-penetration.

Recently the question of high frequency as an adjunct to Roentgen irradiation has received great attention. In the *Fortschritte auf dem gebiete der Röntgenstrahlen* for October, 1911, is a lengthy and valuable article on this subject by Dr. Emil Lenz, of Berlin. He shows that the hyperæmia produced by high-frequency application partially protects the skin from the ill effects of a subsequent Roentgen irradiation, and also greatly assists the curative action of the X rays. The high-frequency application is made by means of Oudin's condensator electrode, or by MacIntyre's vacuum-condensator-electrode.

In most of the cases reported the region was treated by a high-frequency effluve before, during, and after the X-ray irradiation. For this purpose Lenz has devised a high-frequency electrode of aluminium  $\frac{1}{10}$  millimetre in thickness, which permits the passage of the Roentgen rays.

The previous treatment with the effluve seems to exercise a veritable protective influence on the skin. Doses of 6 Holzkecht units appear to have been given during a single sitting of fifteen to twenty minutes, without any serious reaction of the integument.

The experiments were carried out by dividing the irradiated area into two equal fields, and administering the effluve for five or ten minutes to the right field, leaving the left untreated by high frequency. In every case there was an increase of hyperæmic reaction over the effluved area, with redness and itching, which, however, did not go on to ulceration.

This sensibilising of the skin to X ray by diathermic application bids fair to be of great importance, and we trust that English radiographers will repeat the observations.