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ROENTGEN DEVELOPMENTS DURING THE WAR

The Science of Roentgenology like all other divisions of the Medical Science has received wonderful impetus during the war from which we seem to be emerging with slow but certain steps.

A National Emergency always inspires men to endless endeavors. The Roentgen division of the Army Medical Corps seems to have been a center around which a full share of scientific advance was accomplished.

The Central Allies must have known that they possessed less fighting material and fewer men than the Entente Allies long before they signified their desire for an armistice. They evidently hoped to effect a combination of science and efficiency in the production of a powerful individual fighting unit. In other words, they hoped they might win the war by the collective might of supermen.

History teaches that the defeat of armies means interference with or destruction of governments. In this war, as in probably no other, has the very existence of the governments of the civil world been in jeopardy. Consequently, the people of every Nation whether at war or neutral have put forth concentrated efforts in the way of producing a superman in arms.

Almost miraculous strides in scientific achievements have been manifested in both contesting sides. In one very important phase, however, little or nothing has been accomplished. The problem of the control of body nutrition has not changed. If the Central Allies had been able to solve more successfully the problem of the supply of food, their supermen would undoubtedly have been able to hold on much longer.

The roentgenologist representing one of the most technical and highly specialized branches of medicine have under the stress of war solved problems that might have been years in the future waiting for solution. The result of these changes are apparent in several ways:

1. The number of physicians entering the field of roentgenology is rapidly increasing.

2. The number of roentgen technicians has also been greatly increased.

3. Apparatus was improved along lines of simplicity, economy and efficiency with unheard-of rapidity.

The physicians who have had the short but intensive training of war roentgenology will undoubtedly utilize the roentgen rays more frequently than ever before. Many will adopt roentgenology for their life work in peace times. Physicians in almost every division of military medicine will come to know and appreciate more keenly the value of the roentgen rays in their specific branch of medicine and will continue to utilize as well as to develop their use in their respective fields of endeavor.

The technician has proven forever the validity of his claim for a position along side the physician during war as well as peace. The physician who specializes in roentgenology will not be confused with the trained technician by his brother in other branches of medicine. The distinction is as specific as that of the orgal surgeon and his highly trained nurse assistant. It is evident beyond question that the division of roentgenology in the A. M. C. would have suffered terribly if it were to depend entirely upon roentgenologists for its efficiency. The same is true in civil practice as in war. The roentgen technician is a necessary factor in the field of roentgenology.

The development of apparatus adapted to military emergencies fell very largely to the students of physical science. In this regard, they have performed a very large and useful work in the domain of roentgenology. I will not attempt to point out the many new features developed by these scientists other than to mention the improvement in roentgen tubes, transforming and generating apparatus, especially in the way of size, weight, simplicity of construction and manipulation together with economy and speed in production; all features far in advance of the apparatus used in civil practice before the war.

Roentgenology is one of the youngest divisions of the science of medicine and in the past has occupied a somewhat anomalous position. Its margins are now being clearly defined and it is hoped America's roentgenologists may soon be assembled in an organization powerful in numbers and the spirit of democracy which has characterized America's scientific organizations. When this has been accomplished, we may hope to establish a section in the American Medical Association.

B. H. O.

On April Ninth, Nineteen Nineteen, at Shreveport, La., The Louisiana State X-Ray Association was organized with Dr. Amedee Granger of New Orleans as President, Dr. J. A. Gorman of New Orleans as Vice President, and Dr. S. C. Barrow of Shreveport as Sec.-Treas.

The association will hold two meetings each year, one regularly in New Orleans and the other at place of meeting of the Louisiana State Medical Society.

Nineteen members made up the charter roster, considerable enthusiasm marked the meeting and much good is expected to be derived.

The Victory Loan

It is common thought for all Americans to be debating how we may best commemorate the triumphant conclusion of this great and terrible war.

We naturally pause at the thought and silently and almost unconsciously thank the Great Almighty for the preservation of the America we love.

We hold with true reverence the thought of the dawn of a new world dedicated to the everlasting foundation pillars of mercy, justice, peace and love.

While our brothers were in uniform facing the deadly gas and shell of the enemy, we gave freely of America's abundance to their support. Now in the hour of Victory the bugle sounds the call of duty, alike to all true lovers of America.

Men of America love to prove themselves a National asset.

Every Liberty Loan has been formulated successfully.

Our fighting men have accomplished their undertaking and now we face our government's hour of need in the crowning of a victorious peace.

The bonds of the Victory Liberty Loan will be negotiated. As an investment they are both desirable and safe. Every citizen recognizes in them an avenue through which he may serve the Nation.

A bond in your pocket entitles you to salute Old Glory with a supreme sense of proprietorship.

Roentgenologists will need but the opportunity to discharge their obligation in the Victory Loan and thereby further strengthen their alliance with the Great Union of American Citizenship.

B. H. O.

THIS PAGE WILL BE GIVEN IN EACH ISSUE OF THE JOURNAL FOR ANY SPECIAL ANNOUNCEMENT THAT THE PRESIDENT OF THE ORGANIZATION MIGHT HAVE FOR THE MEMBERS OR THE READERS.

To the Readers of the JOURNAL:

One of the most important as well as encouraging phases to be noted in the trend of roentgenology is the evidence of growing interest and enthusiasm manifested in local roentgen organizations. Roentgenologists in the past have occupied a somewhat anomalous position but there have been rapid changes in this regard and we are now coming to work in a field with a well defined horizon. The roentgenologist is now standing on his own responsibilities, and rather than to be carrying out a line of treatment indicated by a physician working in another branch of medicine, is directing the care of the case and as pointed out by Dr. Emil Beck at the recent roentgen meeting in Detroit, the roentgenologist must secure the coöperation of the surgeon where advisable to assist him in the care of the cases in order that he may institute roentgen therapeutics most effectually. With the roentgenologist occupying a true and well defined position, his identity as a physician is not being sacrificed in connection with his work and when the proper organization is consummated he will be in position to secure the recognition granted any physician who has specialized in any of the various branches of the medical science.

The advances in roentgenology are following one upon the other with great rapidity. It may be said that it is one of the most recent additions to the various branches of the medical science. Because of these conditions, together with the fact that almost every roentgenologist is developing new additions to some phase of roentgenology, it behooves us then to check our ideas frequently with those of our fellow-workers.

There is probably no branch of medicine more in need of special societies. Roentgenologists generally have come to recognize the virtue of these associations with the result that new local societies are being formed and the general organizations are being rapidly strengthened. It is certain evidence of true growth to see such enthusiasm and splendid feeling of fellowship as was manifested at the recent meetings in Detroit, Kansas City and Omaha. The meetings planned by the Texas Roentgen Society as well as other local societies of the West and South will undoubtedly be equally well attended and of the same practical value as have characterized these meetings so far.

The Omaha Roentgen Society is doing much for roentgenologists in the middle West. Judging from the numbers in attendance, the plate exhibit, the scientific program, the commercial exhibit together with the congenial and democratic spirit so prevalent, leads one to believe that Omaha is one of the most wide awake roentgen centers in the United States.

The officers of the Western Roentgen Society feel greatly inspired by the trend of these events. The handwriting on the wall is certain evidence of the growing demand for a large and influential organization. We believe that it is this spirit which actuated the formation of the Western Roentgen Society and explains its almost phenomenally rapid growth. The present officers propose to foster this spirit in every way possible and through the agencies of the Journal, the counselors, the membership and program committees to further perfect the organization to the glory of the science of roentgenology.

Pres. O. H. Mc C.

CHEST INCONSISTENCIES

Alden Williams, M. D.
Grand Rapids, Mich.

It is nowadays to be granted that the Roentgen method may confirm other physical findings, and may assist in the clearing up inconsistencies and complications. The knowledge of lung condition which can be obtained by the stethoscope, and the effect of lesions upon the breath sounds is truly remarkable, but if instead of having to mentally construct a lesion, which is producing the changes from normal sound, we look at lesion shadows which have been fastened by light and silver, it seems a great help. It seems also an added boon to be able to study these lesion-shadows later and stereoscopically turn the patient over at leisure and back again.

If Roentgen diagnosis were as accurate in chest work as in the detection of urinary calculus, or fracture pathology, there could be no question as to its value, and just as much dependence could be placed upon it. Unfortunately it is not so generally dependable or exact, especially as it depends so largely upon the personal practice of technique and upon interpretation, and knowledge of pathology on the part of the roentgenologist.

A roentgen chest examination is most applicable in two groups of cases. First Confirmatory in a positive clinical case, with addition of the information of the exact location, extent and character of the lesion. In the second it serves to help either positive or negative diagnosis, in a case of inconsistent physical signs and doubtful history, and negative sputum.

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* Read before the Fourth Annual Meeting Western Roentgen Society, Chicago. November 20-21-22, 1918.

Dr. Pfhaler of Philadelphia, a very conservative roentgenologist, holds that the roentgen lesion shadow will appear in the apex before physical signs are heard with the stethoscope. Also he claims the roentgen dictation of the extent of the disease is always greater than that made by the man who uses the stethoscope.

Dr. Cole was the first man to observe small millet sized shadows, which he termed tubercles, and which he claimed to coincide with the conglomerate microscopic tubercle. He did not attempt in finding one or two of these spots to diagnose tuberculosis, but when he found patches or groups of tubercles placed in the usual distribution of tuberculosis, then he gave it due weight.

Others go still farther than Cole, and attempt to interpret a pre-tubercular shadow, a hazy fan shaped area in the parenchyma at the termination of exaggerated lines of a bronchial trunk shadow, which is usually the vertebral going to the apices or the first or second interspace trunk. It is supposed to represent the effect of congestion, and exudation resulting from the early tubercular process. Dunham has proved that such appearances have later developed into undoubted evidences of tuberculosis. Anatomically, roentgenologists now recognize three manifestations of the disease, at least in the earlier stages. (1) Hilus, (2) Peribronchial infiltration, and (3) parenchyma spots around the end of the bronchioles.

The roentgenographic appearance of the lesion in the hilus structure presents nothing typical of the disease, nevertheless the roentgenogram has its distinct value when it shows an enlarged hilus shadow or perhaps a comma shadow and can be co-related with consistent symptoms.

Peribronchial infiltration refers to the thickening along the sub-division of the bronchial tubes, going upward and outward, or down from the hilus and now and then having extended out into mottled margins. The real logical diagnosis in peribronchial tuberculosis probably should be primarily a clinical one. At least there should be a suspicious consistent symptom complex to aid in the final roentgen conclusion. If physical examination or symptom complex is suspicious, such roentgenographic appearance should be confirmatory. If there is a positive report of tubercle bacilli in the sputum, then roentgenographic appearance can be considered as locating the extent of the lesion. Lesions in the parenchyma are frequent in the stages of early tuberculosis. Individual or conglomerate tubercles, in the region around the bronchioles and their terminations change the appearance of the fine line shadows of the normal. This roentgenologic manifestation is considered typical and does not always need an etiologic or clinical diagnosis or need a suspicious symptom complex to warrant its decision. It is true we get small shadows similar to individual tubercle spots in other pathology, but their distribution is not hard to differentiate.

The roentgenogram is now accepted of real value in the doubtful cases, and in the fairly well advanced cases, in order to determine complications, and chronicity. The determination of activity of tubercular process may depend upon differentiation of slight shadow density. The discussion still goes on concerning density of an active lesion being slight, and mottled and usually with conglomerate tubercles, and that of an old chronic lesion being fibrous with denser change: and even calcification and amount of fibrosis would assist in deciding chronicity, while clinical symptoms being of more value in the determining activity.

In considering the future of a tubercular patient, it is important to find out the number and severity of lesions, such as fibrosis, consolidation, calcification, cavity formation, bronchiectasis, etc., that have resulted. If an extensive fibrosis shows up in the roentgenogram, one may expect to follow this up with a typical tubercular history of long duration, as we know there is nothing about fibrosis in itself typical of tuberculosis alone. Whether a cavity is necrosis of a consolidated area or whether it is the dilatation of terminal bronchus can possibly be decided upon by location and surrounding pathology and stereoscopic accuracy.

I am free to admit that this review only emphasizes the theme notes, "The motive," of recent roentgen discussions. May even be quotations without honor given to those to whom honor is due.

A little over a year ago I decided to keep better records of all chest cases. My idea was to co-relate history Roentgen findings, other physical findings, and follow ups (not an original idea at all), my number of cases in this small group being only one hundred. This series is too small to yield any bold conclusions, but to me long before the year of work was over there developed some interesting inconsistencies which suggested a report.

At the Municipal Sanatorium we have handled every case of the series of one hundred in regard to history, physical examination, Roentgen technique, reduction record and follow ups exactly alike in order to chart and check up the findings as systematically as possible. Our history blanks included the meagre usual sixteen questions in regard to childhood history, family history, occupation, previous illness, present illness, weight, cough, sputum, fever, chills, sweating, pain, hemorrhages and former bacilli record.

The physical examination was made in each case and reported under case number, before the roentgen examination was made. The plates were studied and dictated without reference to the physical record. The stereoscopic bromide reduction was filed attached to the symptom record sheet. The comparison was made with the usual one hundred column chart. The cross comparison was checked up in terms of the history point, roentgen findings, etc., for each case. The conclusions arrived at by adding up notations in columns brought out to me some abnormal inconsistencies worthy of noting. The consistent physical sign and roentgen findings were in the main as expected. The one hundred cases were of the usual "miscellany". Suspected cases seeking denial or confirmation. Suspicious cases to be confirmed and cases on the way to the city sanitarium and old cases leaving the sanitarium. This group of cases then would be expected to show a high percent of advanced tuberculosis and did so—48 percent. Many cases previously called tuberculosis were proved negative, doubtful or other pathology, 27, quite a number of doubtful cases proved positive (nineteen). The usual amount of the other pathology was uncovered.

Other Pathology Than Suspected Tuberculosis Found in Group

Heart cases (without tuberculosis)	5
Pleurisy (probably non-tubercular)	2
Lung abscess (post pneumonic)	2
Pneumoconiosis	2
Lime Metastasis	1
Probable yeast (or other similar infection)	2
Bronchiectasis (non-tubercular)	2
Hodgkins disease	2

A fair surprise came in the large number of previously classified early cases that showed mid-stage pathology (8). The usual abundant admission of tuberculosis in the family was present (29). The expected consistent loss of weight was noted, average 15 1-3 pounds. The usual large relative number admitting hemorrhage was verified 24 and usual history of fever 48, and pain 54, night sweating 44, was checked up. Interest was taken in the small number of admissions of childhood frailty (6), and few admissions of gland trouble.

Ten of the one hundred admitted having previously had typhoid. If an attempt at verification could be made here, I am sure this would be amended—for probably many of these cases were previous attacks of tubercular infection.

We are led to believe that symptomatically advanced pulmonary tuberculosis does not exist without fever, coughing, pain and sweating, and here is where greatest inconsistency charted up.

Number of group of 48 advanced cases not admitting pain...... 9
Number of group of 48 advanced cases not admitting fever..... 5
Number of group of 48 advanced cases not admitting night sweating 12
Number of group of 48 advanced cases not admitting coughing.. 4
Number of cases showing inappreciable loss of weight.......... 4

In other words 21 of 48 advanced cases gave *inconsistent* history of illness; or in other words 21 roentgenographically typical advanced cases gave atypical symptomatic history.

One Hundred Cases of Suspected Pulmonary Tuberculosis
September, 1916, to November, 1917

1. Cases previously verified by sputum test, and "rayed" for prognosis....................................17
2. Cases previously called tuberculosis which proved negative, doubtful, or to be other pathology...................27
3. Doubtful cases proving positive as seen by the Roentgen Ray 19

1. Average age...............................33 yrs., 4 mo.
2. Average duration of illness to time of x-ray examination............................2 yrs., 2 mo.
3. Number in the 100 cases giving history of childhood frailty 6
4. Number giving history of typhoid fever..................10
5. Number giving history of pneumonia.................... 9
6. Number giving history of surgical tuberculosis............ 6
7. Number having had tuberculosis in family history.........29
8. Average loss of weight..........................15 1-3 lbs.
9. Average amount of sputum daily...................½ oz.
10. Cases giving history of hemorrhage or of hemoptosis......24
11. Cases giving history of fever............................48
12. Cases giving history of pain.............................54
13. Cases giving history of night sweats 48

Number of advanced tuberculosis in series of one hundred as stated before..48
Those of 48 giving typical history...........................27
Those of 48 giving inconsistent history......................21

Number of advanced cases not admitting pain	9
Number of advanced cases not admitting fever	5
Number of advanced cases not admitting night sweats	12
Number of advanced cases not admitting coughing	4

I think the complications found in verified group of 48 were about as found in the usual statistics.

Mediastinal abscess	1
Pathological pneumothorax	2
Cavitation	20
Fibroid cases	31
Unilateral rapid	4
Effusion in pleura	7
Unilateral fibroid	2
Bilateral rapid	9
Cardiac dilatation	2
Pericardial effusion	1
Pneumoconiosis	1
Hodgkins disease	1

CONCLUSIONS

1. In a series of advanced cases one may expect many interesting complications, some of which are found only by the Roentgen method.

2. Where diagnosis of suspected tuberculosis comes from many sources, quite a large percent of error will be found.

3. Cavitation will be found in almost 40 percent of advanced cases.

4. One-third of the advanced cases may have atypical history in regard to pain, fever, coughing, and sweating.

5. Fever is the most reliable symptom.

6. The roentgen-ray picks up cases in a doubtful class and labels them early.

7. The early case by the stethoscope often proves to be a mid-stage case by the roentgen ray.

8. There were 10 1-10 percent cases called tuberculosis

which were put back in doubtful class or thrown out of the tuberculosis class.

9. Age of this series is rather advanced because of the large number of sanitarium cases, and exclusion of children.

10. And may explain the rather long average duration of illness.

11. Few admissions of childhood frailty.

12. Many histories of typhoid fever and pneumonia.

13. Large percent (33 1-3) of tuberculosis in family.

14. Roentgen study may not always be necessary in every case, but if it holds possibilities of now and then reclassifying a case and helping in the prognosis or the management then the case should not be denied the help.

15. 21 of 48 advanced cases gave inconsistent chest history and the emphasis of this study belongs here. No dogmatic opinions should be drawn from case history alone.

16. The best interests of the patient are served by cooperation between the competent physician and roentgenologist, as you have heard before.

DISCUSSION

Dr. William J. Butler, Chicago: I was asked the other day to discuss Dr. Williams' paper on inconsistencies of the chest, and I felt very much pleased to hear that he was going to read such a paper, but much displeased when I was invited to open the discussion on it. I know very little about roentgen study, and since listening to the doctor's paper I was undecided in my own mind as to whether he was discussing inconsistencies or directing attention to some of the gross errors we may make in dealing with patients.

Dr. Williams has directed our attention to some of the peculiar heresies of tuberculosis with which I agree fully, and that the conditions in patients are overlooked entirely by the absence of certain symptoms or signs which we would ordinarily expect to find, and which make examinations incomplete or unsatisfactory. On account of a lack of certain symptoms or physical signs we may overlook tuberculosis in the chest.

Dr. Williams spoke about cases being discovered in which the patients had no cough. That is a very true statement, and it is not an uncommon thing to find a patient with the whole lobe of a lung involved, and still no cough or, at least, a cough of any consequence to attract one's attention. There may have been a previous period of cough, and then a subsidence of it. He also draws attention to the fact that some of these patients did not have fever. I did not quite catch the point made by the previous speaker (Dr. Smithies), because we all know that tuberculous cases will run sometimes for a period of weeks and even months without temperature, so far as our own observations are concerned. These patients may have a subnormal temperature for the greater part of the time we see them, and still we may find on physical examination and also from the report of the roentgenologist that there are extensive changes taking place in the lung.

In regard to the other manifestations that the doctor called our attention to, we also see cases not infrequently without sweats, and still they have extensive changes that are very active at the time.

In regard to the physical findings in comparison with the roentgen findings, I really believe that there will always be more or less differences of opinion in regard to the results of either one. The physical findings we know are frequently unsatisfactory in cases of very active tuberculosis, and not always in the early period. We also know we frequently find very little evidence of tuberculosis in a tuberculosis patient, and still the roentgenogram may show extensive findings, and justly so, because we know the changes are not always in line with the physical findings. In general they usually are, but not always.

Again, we will often notice cases that are doubtful as described by the doctor, in which one is guessing and another is guessing as to whether this or that particular patient has tuberculosis or not. We are unable to find sufficient physical findings and are unable to satisfy ourselves that the clinical symptoms are sufficiently marked to make such a diagnosis, and still the roentgenologist may call our attention to the fact there are changes there, and we are sometimes inclined to take a contrary view that they are not present because we cannot find them. This is not the proper attitude to take. Personally, I have always been disinclined to believe that the roentgenologist could demonstrate to his mind with satisfaction what we ordinarily understand to be an incipient tuberculosis. Of course, our interpretation of what an incipient tuberculosis may be varies with different clinicians. Many of us look upon incipient tuberculosis as a case presenting symptoms in which we cannot find changes sufficient to satisfy ourselves to call it tuberculosis, or in which we find such slight changes as to cause some doubt in our minds, particularly in the absence of any laboratory findings to substantiate it. I do not know what the roentgenologist can do in that matter. I would like to be shown that he can demonstrate what is sometimes spoken of as incipient tuberculosis. On the other hand, I think the clinician is frequently a little arbitrary in his attitude, because we are inclined to take the position, if we cannot demonstrate it, it does not exist, which is entirely wrong. Sometimes we may fail to find changes indicative of a lung process, and still there may be there definite changes.

In regard to the question which the doctor mentioned of cases without lung changes, I think the *x*-ray has proved of great value to us in demonstrating pathology in the lungs in general. In cases of abscess of the lungs, for instance, we recognize it as a valuable aid in arriving at a diagnosis, and also in a study of the mediastinum the roentgen ray has been an invaluable help to us. Sometimes we find that the *x*-ray men do not agree with our findings in the mediastinum, and I think we can well afford to set aside our views on the mediastinum when the x-ray man does not sustain them, because if we are dealing with mediastinal findings that are positive, they are almost invariably sustained by the x-ray findings.

I recall a case in line with Dr. Williams' paper as regards the presence of fluid in the chest and still we were not able to withdraw it by the aspirating needle. We had such a case a few years ago at the Cook County Hospital of a girl who had flatness over one side of the chest. We thought there was fluid present and we inserted a needle and were unable to withdraw it. Dr. Crane demonstrated fluid in the chest under the fluoroscope, and still we were unable to withdraw any fluid after a dozen or more additional attempts. Why, I do not know, because we used a good sized caliber needle, and still we were unable to get fluid. Undoubtedly it was present, and we were unable to persuade the members of the family to have a rib resection when we could not withdraw fluid.

I want to express my great pleasure in having heard Dr. Williams' paper, because I know he has done a great deal of good work on this subject, and I want to thank him for it.

Dr. Frank Smithies, Chicago: In the five minutes allotted for discussion I can only comment on the nice distinction which Dr. Williams has brought out regarding chest inconsistencies, and from his paper I judge that these inconsistencies, particularly with regard to tuberculosis, rest in the difference between the clinical opinion and the roentgen opinion. This is an old story and similar to the difference between the surgical and medical cure of ulcer of the stomach, and it probably will remain an old story until a certain type of teamwork is established between the roentgen laboratory and the clinician. There must be certain reasons why there are these inconsistencies in the chest. In the first place, it is well to state that in my personal experience I regard a roentgen examination of any particular case, especially of the chest, as having about the same relative importance as a blood count in a case of anemia. The count may give the diagnosis, and likewise the chest plate may give the diagnosis and practically tell all about the case. But there is a large group of anemias in which the differential blood count only corroborates or amplifies a certain type of clinical investigation. It is the rule in the majority of clinics to make the physical examination first, note down the findings, and send the patient for roentgen study. In my opinion it would be better if every physician made a roentgen study of the case first, and then have the findings submitted to the clinician before he makes the physical examination. In this way it is possible to attract particular attention toward certain pathology which is demonstrated in shadows by the roentgen plate. It seems to me also, that there are other reasons for these inconsistencies. We have seen a great many of them during the examination of registrants for the army. It is surprising how many plates are brought to us with a diagnosis of pulmonary tuberculosis, based entirely upon certain shadows, and it is quite astonishing to notice how many of these cases, when studied from a clinical standpoint, by serological test and other viewpoints, reveal absolutely no evidences of either inactive or active tuberculosis. Very likely some of the men who are using oldtime gas tubes for making plates are unacquainted with the great number of shadows which the Coolidge tube shows. The softened rays of this tube undoubtedly bring out more of the architecture of the lung than did the old tube, and consequently this massive shadowgraph is interpreted as meaning tuberculosis. So eminent a man as Pancoast has said that it is not possible by means of study of shadows to tell whether or not a lesion is tuberculosis, and whether it is active or inactive. In tuberculosis there, roentgenologically, are many so-called characteristic lines for the distribution of shadows, fans, commas, and so on. If these are interpreted by a roentgenologist who, as Dr. Crane has emphasized or proposed, has had clinical training they amount to something, but if they are interpreted from plates made by a man who attempts to make diagnoses, solely from plates, there is great danger of making mistakes. We expect a lot from roentgen plates. Usually not enough plates are made. If one could have dozens of plates made by the roentgenologist he could doubtless obtain more definite information, particularly as regards the diaphragm action. Stereoscopic plates are generally necessary in order to return the most information. However, there is frequently the question of expense to consider. The average patient cannot afford to have a dozen plates made, or the hospital cannot afford to make them, and thus we are often forced to try and make a diagnosis on an insufficient number of plates. Furthermore, fluoroscopic study of the chest is frequently neglected, particularly fluoroscopy of the diaphragm which is not rarely a beautiful index of lung disease both with respect to extent and type. It is uncommon to have a report sent from a roentgen laboratory which outlines or describes the activity of the diaphragm in relation to lung pathology. Frequently, not until the extensive pathology is shown on the plate, is there any comment made with regard to the diaphragm.

Dr. Williams has related a number of instances in which there was no fever, and yet there was apparently abnormal accumulation of thoracic shadows shown roentgenologically. Many of these, I am sure Dr. Williams is quite convinced, represent various forms of peribronchial conditions which are not altogether primarily due to lung disease. They have their origin in chronic nose or throat infections, or they represent accumulations of organic dust, as in silk workers or cotton workers, or inorganic dust in those who smoke, in those who work in stone quarries or other such places. Such are particularly common in smokers who smoke a great many cheap cigars. Such individuals almost always show a large accumulation of peribronchial shadows or shadows in the peribronchial lymph glands. Many a young man comes to us showing marked shadows about the hilus, on whom we deliberate for a long time as to whether or not he has tuberculosis. These shadows generally represent dust accumulations as the result of excessive smoking or are accumulated by being in smoky atmospheres. Unless there are clinical manifestations of disease, or there is significant history, I am particularly conservative about interpreting lung shadows and thorax shadows as indicating tuberculosis.

Another possible inconsistency is that quite frequently the lesions demonstrated in the lung are not primary nor do they represent all of the disease present. A carcinoma or tumor of the lung or mediastinum may be secondary to malignant disease of the gall-bladder, the liver, or from some other portion of the body. Similarly, extensive thoracic shadows may occur as Dr. Crane has suggested, from calcium deposits in chronic bone disease. There may be other disturbances of calcium metabolism, which lead to these deposits in and about the lung, so that we have to be very careful in making a diagnosis of pulmonary disease from the thorax picture alone.

We have all enjoyed Dr. Williams' slides and his summary, and I wish I had something of value to add to it.

Dr. Williams (closing the discussion): I find myself in substantial agreement with all that has been said, consequently my closing remarks will be very brief.

Ever since Ann Arbor days, it has always pleased me to hear Dr. Smithies get up and balance things up. We need in every community a self-appointed balancer, and the man to do that must be a man of wide learning and of a great deal of literary ability. Dr. Smithies keeps track of the roentgen literature, as well as of the surgical and medical literature. If you doubt that and should read a paper that is a little off from the consensus of opinion, and then listen to what the doctor says, you will be convinced.

Recently there has been some literature on pneumoconiosis with a challenge to the roentgen men along the same line as the doctor has mentioned, and it is well for us to bear this in mind. The reason why I showed these cases and called them advanced tuberculosis was because there was no doubt we had the bacillary findings and we had the checking up from the medical men. I agree with what has been said that we must be very careful on account of dust and smoke, or we will make more mistakes perhaps than the clinician.

91 Monroe Avenue.

SOME OBSERVATIONS IN ROENTGENOLOGY OF THE CHEST

W. WALTER WASSON, M. D.
Denver, Colorado

I offer you this paper for your consideration with considerable hesitancy as there has already been a great deal written on radiography of the chest. My observations, however, do not warrant the technique in general use, nor bear out the conclusions obtained. I shall deal chiefly with the technique and its relation to the earliest pulmonary lesions.

A number of pathologists and roentgenologists have described the earliest lesion of the lung as seen at autopsy by the microscope and the *x*-ray and are admirably summed up by Hulst. "The distal portion of Dunham's Fan is probably made up of acinous nodular foci of Nikol, the central induration obscuring the nodules and accounting for the clouding. The rosettes of millet seed size nodules, softer and earlier, may stand for islets of mottling, so strenuously insisted upon by most others, as an earlier and even more characteristic sign. The leaves (mottling) which hide the branches in Spring and Summer, after falling, leave the bare branches standing out boldly as against clear sky when healing has taken place. Viewed after this manner the acinous nodular focus assumes preëminence as the prototype and becomes the keystone which finishes and supports the whole pathological arch and the key to the crypto-roentgenogram." The conclusions are rather uniform. If we are to be of value to the internist we must be able to portray these lesions upon the *x*-ray plate with a high degree of uniformity and accuracy.

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* Read before the Fourth Annual Meeting Western Roentgen Society, Chicago. November 20-21-22, 1918.

There are certain natural advantages in this portrayal which should spur us on to greater endeavor. We are dealing with air, fluids and solids, all of which have their own resistance to the passage of the roentgen rays. We therefore have a great deal of contrast in our plates and should, under favorable conditions, be able to show the tiny lobular nodes and areas of congestion. These nodes and acinous congestions are surrounded by other air cells and thus brought into bold relief. The pleura and the connective tissue septa around the smallest lobules quickly thicken under the slightest irritation and offer resistance to the roentgen ray. The lymphatic drainage along the bronchi into the hilus glands undergoes similar changes.

We have natural obstacles to overcome. The muscles of the back and the breasts in front obscure and hold the patient away from the plate. The chest is barrel shaped and gives us overlapping of structures. A great many patients are dyspneic and others do not know how to properly control the diaphragm and suspend breathing. Especially is this true in children and here the *x*-ray is of vital importance. Again, the mediastinal structures are not fixed in position and change these relations in the recumbent and erect positions, with the heart beat, and with each inspiration and expiration. The heart pulsation is not under control of the patient and is transmitted to the great vessels and the arteries passing out along the bronchi. Under fluroscopic examination this may be seen to be a considerable movement and is transmitted not only to the mediastinum but also the hili, adjacent lung and bronchi. This is especially true where there has been some mediastinitis. If we are to stop this motion and obtain an accurate study of these regions we must cut our exposure to about 1-10 of a second. One member of this society has said that a movement of 1-50 of an inch can be detected by the eye. Another difficulty is in the marginal areas where there is lessened proportion of lung to surrounding muscle.

To overcome these difficulties one must have fine detail of soft structures and speed. Dunham realized the necessity of speed when he advised that "if you expose more than two seconds you will not get good results". But I found it difficult to really stay down to two seconds and not punish my tubes. Manipulations of the milliamperes and voltage avail nothing. Plates with intensifying screens were not satisfactory. Broad focus tubes were still less desirable. I then turned to the double intensifying screen and films and found that I could greatly reduce my exposure, use a soft tube and obtain clear detail of the soft parts. I have been using this technique for one year and find that it blends itself to many possibilities. Dr. Knox of London agrees when he says that a chest picture taken in less that 1-10 second has little diagnostic value. Using a plate and single screen he takes chest pictures in 1-100 of a second. I feel that he must punish his tubes and I have not found it practical. Perhaps in the near future, with the aid of our engineers, we can equal this with safety. The difficulties in this technique are many, as we have not the latitude. An over-exposure, giving us good ribs, but no soft tissue detail. An under-exposure giving tuberculosis to be laughed at by the internist. Improper development can do the same. As a reward for our painstaking care we can obtain, with uniformity, in the most difficult case, an accurate portrayal of what the pathologists tell us we should expect. In checking a good many hundred cases in private practice and for the Medical Advisory Board of Denver, I find the closest relation between the physical, clinical and roentgen ray findings. However, we cannot always make bacterial diagnoses and certainly the clinical and physical findings are of the greatest importance. A satisfactory film should showclear detail of the hili, bronchi, terminal bronchi and interlobular septa.

Conclusion. We then must not content ourselves with a diagnosis of hilus widening, peribronchial thickening and studding. We should proceed to a more detailed study of the bronchial walls, lobular nodes, acinous congestions and lobular septa.

Lantern Slides

No. 2672. Miss A. Normal chest. Septal and fine linear markings with no thickening or studding. No congested patches. Bronchial bifurcations can be distinguished from lymphatic nodes.

No. 2583. Dr. J. This is a known case of quescent pulmonary tuberculosis. Dr. Waring was unable to find any evidence of activity either in physical examination or clinical. Note general increase in septal and fine chonchial markings with scattered lymphatic nodes. Also changes at hili. No congested patches seen.

No. 2755. Mr. C. Over-exposure. Cutting out fine detail of soft structures. Another fim taken showed fine areas of congestion on both right and left. Clinical findings confirmed second film.

Miss K. Showing five areas of studding and congestion in right apex. Showing what we should look for in Dunham's fan. Slight moisture on physical examination.

No. 2639. M. Case of Advisory Board. Overlooked on physical examination. Second examination in quiet room with attention called to certain areas, confirmed x-ray findings.

No. 2641. Mrs. J. Old quescent infection. Showing interlobar pleuritic thickening, increase of septal markings with drainage into hilus.

No. 2774. R. W. Showing glandular infiltration at hili. 1 second exposure. Next slide taken 1-10 second shows less breadth of bronchi.

No. 2342. W. S. Bronchiectasis involving especially upper trunk on right. Short exposure and fine detail essential here. Bronchial walls are only structures involved.

No. 2242. Mrs. B. Mediastinal abscess probably due to broken down gland. Some involvement of lungs.

No. 2655. Mrs. W. Miliary tuberculosis. Note old lesions with congestion of air cells and septa. Thickening along bronchi not formed. Borne out clinically but not by physical findings.

No. 2681. Mr. C. Man 50 years old. Metastatic carcinoma following schirrous crcinoma of right nipple. Resembles miliary tuberculosis but has not old lesions nor congestion of air cells. Has more septal thickening with changes along hili and bronchi.

No. 2672. This is not a good slide. Advisory Board. Only dullness on physical examination. Pneumokinosis resembling both miliary tuberculosis and carcinoma. More hilus change with patchy densities. Hard to differentiate in early stages.

No. 1191. Mr. B. Heart lesion with passive congestion engrafted on old pulmonary lesion.

No. 1551. Advanced pulmonary tuberculosis. All stages of pathology seen.

DISCUSSION

Dr. Alden Williams, Grand Rapids, Mich.: Mr. Chairman: I am very glad indeed to have a paper of this sort presented by a member of the Western Roentgen Society, and feel that this paper should be given precedence over some of the others in publication. I feel that Dr. Wasson has hit the point, and nailed it, that some of us have been working over. A little over a year ago in an effort to get this fine detail, and against the advice of friends doing this work, I attempted to get my chest plates in one-fourth second. I had to go back to two old German screens that had some stains on them, but I found that my one-fourth second pictures at sixty-four inches were better for detail and I have followed that out for a year. I must admit, however, that I can't produce lantern slides that will show what the Doctor has shown. I must also admit that I cannot produce on the original plates what the Doctor has shown, and of course if I can't do it there I can't produce it on the slides.

I wish this paper could be put in the next Journal so that men who are striving for this end can get some assistance. Some of the men in the American Association are not satisfied with the detail they are getting in chest work.

Dr. A. W. Crane, Kalamazoo, Mich.: Mr. Chairman: This paper brings up a question that I would not like to pass over without comment, and that is—can the roentgenologist tell from his plate whether or not a tuberculous area is active. On our plates we find in more than 90 per cent. of cases evidence of tuberculosis. In watching the work of some very skillful internists we have been impressed at times with the fact that they find tuberculosis in an anatomical rather than in a clinical sense. In looking over our chest plates we will find that the evidences of tuberculosis in a large percentage of them is in the nature of anatomical deposits in patients without clinically active tuberculosis. To make a diagnosis of tuberculosis from such plates may be a very serious matter, if the patient or the attending physician believes what we say. It is not the presence of tuberculous deposits but the activity of the lesion which is of importance and I think there are very few roentgenological signs of activity. The more rapid the exposure the finer the detail and the larger the number of suspected tuberculosis cases. Because there are very few signs that we can rely upon to show active tuberculosis, the best way in which activity can be determined is by adding the clinical examination; not a single examination, but often by watching the case over an extended period. I think the roentgenologist should be careful about giving out a diagnosis of tuberculosis but he may often say there are "tubercular deposits in the lung". There are many pitfalls and if we claim to diagnose active tuberculosis regularly from the *x*-ray plate alone we will keep alive the immemorial discussion between the roentgenologist and the clinician.

Dr. M. B. Titterington, St. Louis: Mr. Chairman: It has been impressed upon me for a long time that the necessity for teamwork between the roentgenologist and the physician is more important in chest work than anywhere else. I must confess that I am unable to tell from the plate whether the lesion is active or not. We must depend either upon clinical signs or upon the internist's report.

I see lesions frequently that I think are active. I cannot give the reason why I think so and cannot explain it to anyone else. I am afraid to say that they are active because I am not sure that I can tell as to the activity and must depend on the internist. It is the old question of teamwork and that is he only way we can get at it successfully.

Dr. O. H. McCandless, Kansas City: Mr. Chairman: I am not competent to discuss the lung question that Dr. Wasson has shown so beautifully. In defense of the western men, I feel that they have a great opportunity to check up these cases of lung troubles. In the institutions in the west, especially in the institutions controlled by organizations, they have their mortuary records and can determine accurately these statistics from their clerical records. They keep track of these patients from every standpoint and have data relative to the patients' general condition that we do not take or care to look after. Those men are classifying their cases very much as a surgeon classifies past operative breast malignancies; a certain percentage will live a certain length of time, and certain other cases a certain length of time. They have statistics on several thousand cases and can speak with definiteness and conviction born of long experience. Their accuracy is within reasonable bounds, unquestionably. The question of altitude, of living, etc., bears a definite prognostic relationship in these cases. Many of the cases that show lesions of trivial importance today would, if put into a dusty overall factory succumb to tuberculosis. The environment is of great importance, in considering the comparative severity and activity of the condition, and its probable risk to the patients. The living conditions, history and that sort of thing bears a definite relationship to the subject. So we are confronted with a tremendously elastic class of conditions, and if it is discussed or considered it seems to me the locality, altitude, and certain other definite factors should be taken into consideration relative to the probable recurrent activity in the future. We do find these lesions, but the question of reporting tuberculosis to the patient should be left to the internist who refers the patient to us. Your data should go to him in as definite and positive a way as you can make it, in the light of your experience. He can then coördinate the data which he has relative to the patient's nervous system, relative to the living conditions and the locality in which the patient lives, thus furnishing intelligent diagnosis and prognosis.

Dr. Benj. H. Orndoff, Chicago: I consider it a compliment to be asked to make a few remarks on this important subject. However, it has been handled so ably, that I feel there is little left for me to say. In addition my attention has been diverted so frequently from the scientific program that I can scarcely collect my thoughts for discussion. I might say that one important point in this case is the apparent lack of nomenclature and classification for Roentgen findings of the chest, that will permit of universal adoption. It would certainly be a great addition to the science if such could be formulated. The essayist shows that he has been a great student of the subject, and that he has attained a technical result which has made possible the deductions which he has recorded. The recording of Roentgen findings must not be confused with recording a diagnosis. The Roentgenologist is probably very seldom in position to render a diagnosis from his findings. A Roentgen report comprises a brief record of evidences of pathology appearing on the screen or roentgenogram. Many findings indicate inflammatory reaction in the lung and do not suggest anything definite with reference to their specific character of inflammation.

I will be greatly pleased to see this article when published that I may take the privilege of studying it more carefully, as I feel there is much in it for me to learn.

Dr. Walter I. LeFevre, Cleveland: Mr. Chairman: I have enjoyed the paper and the discussion. I have not used the double film in chest work but I have in sinus work and find it just as superior in sinus work as the Doctor does in chest work. I think you will all agree that working with the screen and the plate in the old way we do not get the same clear work. In using the double screen that is overcome; one screen overcomes the mottling of the other screen and you get a nice, clear film that is not possible otherwise.

Dr. W. Walter Wasson, Denver: Mr. Chairman: I have enjoyed the discussion of my paper very much and feel that I agree with all of you. I agree with the doctor who says we can't tell when there is activity. If you will remember, I said in the paper that we cannot make bacterial diagnosis, but we can coöperate with the internist, with the clinician, and all together we should be able to get the diagnosis. I agree with Dr. Orndoff when he says that we should have a better nomenclature. I do not feel that any of us are able to describe our plates intelligently. We all see more than we can get language to describe. I think the Society would do well to proceed along these lines and try to get a better nomenclature. I do think that if we will pay more attention to the detail in the plate we will get a better diagnosis. I hesitated to give you this paper for several reasons. You will encounter a great deal of difficulty if you take up the double screen work in the chest. You will get so much detail that you will at first be confused and the internist will laugh if you tell him tuberculosis is there. But if we will spend time in getting these plates and make a study of it we will make a definite advance in the diagnosis of pulmonary lesions. I tried this method for a year before I gave it to you on account of the difficulty which I encountered. In the beginning I overlooked cases which had a large amount of involvement, and it has only been through the coöperation of the internists in Denver that I have been able to work out the pathology as I see it. The cases that I showed you were practically all cases from the west and middle west. We have very few native cases in Colorado. I have seen cases discharged from the Army with the diagnosis of tuberculosis, in which clinically it was not there and judging from the *x*-ray it was not there. We have used this method entirely in the Advisory Board work in Denver of which Dr. Holden is chairman. We ran through six thousand cases and have had none sent back from the cantonments with tuberculosis.

REPORT OF THE DEPARTMENT OF ROENTGENOLOGY, U. S. ARMY BASE HOSPITAL, CAMP LEWIS, WASH.

Frederick E. Diemer, M. D., Capt M. C., U. S. Army

The Roentgen Laboratory at the U. S. Army Base Hospital, Camp Lewis, Wash., was opened October 10th, 1917. The Commanding Officer, Medical and Surgical Chief, realized the importance of a thorough study of every case and consequently gave us permission to use as much material as necessary. They were especially anxious to grant this when it was clearly demonstrated that the best clinician could be materially assisted by our study.

To begin with we should state that approximately thirty per cent of the men mustered in at this Camp were subjected to more or less thorough *x*-ray study, particularly of the chest. To date (Jan. 1, 1919) there have been 123,950 men mustered in at this wonderful cantonment. 40,460 individuals were gixen *x*-ray examinations by either plates, films or screen, 23,130 of this number being subjected to fluoroscopic chest examination. The latter number depended on clinical findings and personal and past family history, being done rather routinely and in a wholesale manner. As many as 350 chests were averaged daily for 10 or 12 days of the draft arrival each month. Our banner day totaled 420 individuals screened, our banner month 4206 chests screened. We were prompted to make a very extensive chest study because of the rumor that every man inducted into Military service would be subjected to an *x*-ray chest examination. This, of course, proved not feasible because of the lack of officers to make a reliable chest interpretation for the vast number of men inducted. We determined to examine a considerable number and after a great many starts and re-starts realized the great advantage of the Fluoroscope. One does not hear what one expects to hear in all cases thru the stethoscope, especially if one is in a great hurry and there is more or less noise to interfere. A subsequent examination of an obese man, apparently healthy, showing an enormous tubercular excavation with marked fibrosis, convinces one of the value of combined x-ray study and clinical reëxamination.

We soon realized our lack of adequate space as allowed in the standard plan for x-ray laboratories and prevailed upon the Camp Utilities Department to allow us a small space at the Mustering Office. We installed here an outfit particularly for Fluoroscopy, and were thus able to carry on the extensive work in chest examinations. Many cardiovascular studies were made by methods of observation, ortho-diagrams and various systems of measurement. The planimeter was used in heart silhouette area estimation and many measurements were taken in the normal for every height, age, and weight to establish our standards.

Pulmonary Tuberculosis—Our conclusions based upon 23,130 fluoroscopies and many thousand roentgenograms are as follows—Tuberculosis of the lungs is suspicioned even in the incipient stage by careful x-ray study alone but in conjunction with clinical examination the diagnosis is decidedly more reliable.

Activity of the tubercular process is suspected from x-ray study alone but should not be considered definitely established unless clinical findings are positive. Absolute establishment of activity can be made by the x-ray alone only in case where an active excavation is demonstrated. About twenty per cent of the cavities were suspected by the clinicians but not definitely demonstrated.

So called healed tuberculosis is very liable to light up on least provocation. A man with healed tuberculosis should not be admitted for full service in the Army. Apparently the germ, in these cases, is always present and only quiescent.

Aortitis and aneurism of the aorta are readily detected by Roentgenology but are very liable to be overlooked by the clinician. The clinical findings of Aortitis are very indefinite particularly in young men before the aortic insufficiency presents the most marked signs being confined to the accentuation changes, in the aortic second sound.

Definite ideas of the valve abnormalities can be estimated by the *x*-ray, especially in the aortic and mitral disease, due to typical configuration of the heart silhouette. Degrees of dilatation and hypertrophy can be estimated if a penetrometer is placed upon each cardio-roentgenogram and an exact routine technic used by the manipulator. This is possible only after many normals are studied.

Respiratory Infections—An extensive study of pneumonia and respiratory infections was made during the recent epidemic of "Flu". Almost every case admitted to the hospital was either plated or screened. Many cases of mild parenchymal involvement were detected and classed as broncho-pneumonia. These were subsequently verified by the clinicians. The degree of parenchymal envolvement in the pneumonias, especially the broncho-pneumonias, with the consequent degree of symptoms and physical findings should receive a more careful consideration in the text books.

Gastro Intestinal—Extensive gastro-intestinal studies have been made. During this period 577 complete examinations have been made and every abnormality found. Many colonic injections were made. The patulency of the appendix was carefully studied by Lt. R. D. MacRae. About 60 healthy normal men were given a barium meal and subsequently screened until the barium had passed. The characteristics of a normal appendix was in this manner, determined. We concluded that an appendix that retained barium after the bowel was cleared was abnormal, but could not be classed as chronic appendicitis. It is rather a dependence where fermentation and putrefaction is favored with consequent absorption of end products and systemic manifestations, a so-called focus of infection.

The Technic-personnel—The enlisted men are rotated from one section of the Department to another in order to give that varied experience necessary for efficient work. Men are usually started with the office section and then in turn take up the dark-room and photographic work and finally the Radiographic section. This latter section we have considered of utmost importance. It had been under the direct supervision of Lieut. J. M. Moore, who has trained our manipulators. We have tried to have at least four first class manipulators available at all times. In order to have a first class repair and trouble man available, we sent a Non-Commissioned Officer for a two months course of instruction at Camp Greenleaf. The entire personnel is under the direct supervision of a Sergeant first class whose duties are varied. He attends to issuing of passes, keeps stock, takes the blame for everything and keeps the unnecessary crowd back from the Roentgenologists, besides acting as personnel secretary. He must receive a great deal of credit for what success has attended our work.

Having averaged examining one hundred individuals daily, we have had to employ a personnel in the office of one Non-Commissioned Officer and at least three men. Our cross index, separate file for pneumonia, gastro- intestinal reports and our check on the number of patients sent from each ward, keeps one man busy. Typing reports takes the time of another, while routine office correspondence and editorial work employs one man. All men are taught by means of outlines to take routine histories but two men are employed for this work and plate filing. Two men are assigned to the dark room at all times. A technician is always available for emergency work since two sleep in a barracks near by which has phone connection with the Laboratory and the Receiving Ward.

We have a very complete photographic section and separate dark room. Many lantern slides and hundreds of portraits photographs for illustrating publications and lectures by the Offices, were made. Our cameras are of the best make and consist of a 5 x 7 triple extension portrait camera for copying, reducing and enlarging and a 5 x 7 Press Graflex for rapid exposures.

The Radiographic section routinely examine spines, fractures and heads stereoscopically in addition to a posterior-anterior or lateral flat plate. All sinus plates are stereoscopic except the frontal and sphenoid. First chest examinations are stereoscopic if the screen reveals the least abnormality. Subsequent examinations, except for fluid, are made on the flat plate. We have made a very extensive study of empyema, some cases receiving as many as thirty chest examinations. Genito-urinary studies are stereoscopic particularly for pyelograms. Lately we have employed a 25% solution of Sodium Bromide for pyelo- and cystograms. This method has been extremely satisfactory.

Medical service—We havê made for this service some extensive studies, as mentioned before. Influenza, Tuberculosis, Pneumonia, Empyema, Measles, Scarlet Fever, irritable hearts and all valvular abnormalities have been radiographed and screened in wholesale quantities. Many Gastro-intestinal studies have been made both of normals and abnormals and cases in great numbers have been sent directly to the *x*-ray Department from the Receiving or the Observation Wards. In these cases carbon copies of notes taken in the Fluoroscopic dark-room were returned immediately with the patients and if a plate was taken it was treated as an emergency and a report made the same day. In this manner a rapid diagnosis was possible and the patients could be correctly distributed to the various Medical Wards. Sella Turcica examinations were made in many so called idiopathic neuresthenics and epileptics, and the significance of the hypertrophic clinoid process studied.

An adverse report is given in all fracture cases until the reduction is anatomically, rather than functionally correct. These cases have been radiographed repeatedly until the results were satisfactory. Special stress in our reports has been laid on displaced weight bearing axis, angulation, and thrust. Our coöperation with the orthopaedic service has been very gratifying and our daily Orthopaedic-Roentgen clinic very interesting. In connection with the Orthopaedist we determined that a soldier suffering with a Perthe's hip, could not qualify for full service, no matter how willing the man was. The same is true of abnormal semi-lunar cartilages, calcaneal spurs and incorrectly treated ankle fractures. Many types of vertebralizations, sacralizations, large 5th lumbar processes and abnormally placed and inverted, low and high setting sacrae do not of necessity inconvenience or incapacitate the subject for full Military Service.

The Ear, Nose and Throat Service—The Officers in charge depend a great deal upon the Roentgen findings in sinus and mastoid pathology. Mastoids, as well as sinusses, are reëxamined after operation.

Treatments—Very little Roentgen treatment has been attempted on account of the lack of transformer space and time. In the neighborhood of 4500 Ultra-violet "Sun" treatments have been given for the skin service with the admirable Alpine Lamps, of which we were assigned three by the Manufacturer.

Dental—We attempted to radiograph every crowned tooth in the 91st Division and for several weeks devoted abont an hour per day to rapid wholesale teeth examinations. As many as 80 consecutive patients were examined at one appointment. We have had films with very slow emulsion and many hundreds of these have been made, practically all being made with the Coolidge tube. In this connection we have studied root canals both before and after filling.

Idiosyncrasy—In many thousands of exposures we have temporarily removed the hair in six cases, all sinus and mastoid examinations. Two men received mild temporary burns after exposure with the small radiator type Coolidge tube while making dental radiograms. Roentgen idiosyncrasies are rarely found. Protective facilities for the staff has been ideal and no ill effects have been suffered by the fluoroscopists even after working several hours per week, except in one instance. In this case the operator was in the fluoroscopic room three hours in examining one hundred and twenty chests. An acute Roentgen shock manifest by nausea, vomiting, extreme fatigue and intense headache was produced, which lasted for four weeks and was accompanied by a high degree of neurasthenia. This happened at the beginning of our work while we were yet slow with the examinations. Frequently the Fluoroscopists complain of extreme fatigue and lassitude acompanied by slight headache but there has been apparently no bad effects upon the eyes or the blood. We have had frequent complete blood counts. The hemoglobin is high—90% to 96%, the differential and whites are normal and the reds are high over five million. No skin abnormality has been suffered except in the case of one operator, whose feet gave considerable trouble which was apparently an eczema and which eventually healed leaving only slight thickening and roughening of the skin of one foot with no indications of keratyosis.

Resume of the Work

Number roentgenograms, including dental films	30,120
Number exposures, including fluoroscopies	58,685
Number patients, roentgenographed and screened	45,503
Number chest fluoroscopies	23,130
Number gastro-intestinal fluoroscopies	2,900
Number gastro-intestinal studies	577
Total number individuals examined	40,460
Number men mustered in Camp Lewis, Wash.	123,950
Number commissioned officers on duty	4
Number non-commissioned officers	1 to 4
Number enlisted men	6 to 10

We have made many examinations which revealed no abnormality but consider that one examination which discovers an unsuspected condition and establishes the diagnosis easily compensates the War Department for the expense of very many negative ones.

The Roentgen Department has primarily caused the rejection of many men and assisted materially, secondarily, in the rejection of many more.

In conclusion we wish to thank the Commanding Officer, the chiefs of the various services, and the President of the Tuberculosis Examining Board for their co-operation and support.

X-RAY WORK OF THE BUREAU OF STANDARDS—PROTECTIVE MATERIALS

FOUR PLATES

N. Ernest Dorsey, Physicist
Bureau of Standards, Washington, D. C.

Mr. N. E. Dorsey, Bureau of Standards, Washington, D. C.: Mr. President, ladies and gentlemen: Before telling you of the Bureau of Standards' work on *x*-ray protective materials I wish to say a few words regarding the *x*-ray work of the Bureau.

An *x*-ray equipment was first installed at the Bureau in July, 1917—about 16 months ago. Owing to war conditions this was an unfortunate time for beginning a new line of work. The work has consequently progressed slowly and frequently has had to give way to work of more immediate military importance. Little time has been available for a careful study of the many problems demanding our attention; indeed the only problem yet studied to any extent is that of *x*-ray protective materials.

The necessity for studying and testing these materials became evident in the spring of 1917, when in planning for its *x*-ray equipment, the Bureau requested a number of dealers in *x*-ray supplies to submit bids on lead glass, the bids to be accompanied by a statement of the quality of glass that would be supplied. The only statements of quality that were forthcoming were to the effect that the glass would afford "adequate" or "sufficient" protection. Such statements are of little value; protection that is "sufficient" or "adequate" under one condition may be far from sufficient or adequate under other conditions. In order to obtain information regarding the kind of lead glass being offered the public, the Bureau then placed with

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a number of dealers in different parts of the country small orders for "best quality lead glass for x-ray protection". When the glasses obtained on these orders were tested it was found that we had succeeded in getting two pieces that were just about as good as ordinary plate window glass. The protection afforded by them was equivalent to that of about 1-500 inch of lead. On taking the matter up with the dealer from whom these glasses had been obtained, he expressed surprise and regret, and promptly replaced them. He advised us that he had obtained the glass from an importer especially for the Bureau's order, and that he thought he was sending the Bureau something especially good. In dwelling upon this worthless material I do not intend the least reflection upon the dealer's honesty; personally, I think that he was ignorant of the fact that he was furnishing worthless material. But it is an example of what one might have got in 1917 when ordering good lead glass. This is not a solitary instance. Since this glass was obtained the Bureau has received for test other glass of a similarly worthless kind.

The other glasses obtained on the Bureau's orders in 1917 differed but little among themselves and afforded a protection equivalent to about 0.5 mm of lead.

In testing x-ray protective materials at the Bureau the absorption of the material is compared with that of metallic lead. As all commercial protective materials owe their protective power almost entirely to the lead contained in them the ratio of the absorption of the material to that of lead will be practically independent of the quality of the x-ray beam employed in making the comparison. Any change in the quality of the beam will affect equally the observed absorption of the material and of the lead. This was verified experimentally by using various spark gaps (from 3 to 9 inches), and various filtrations (0 to 3 mm. of aluminum). In realizing the method at the Bureau a stepped lead scale, or "echelon", is built up of lead foil. This is placed alongside the material to be tested and a simultaneous radiograph is made of the two. Care is taken to cut off all radiation that might otherwise pass between the echelon and the material. It is easy to determine from the radiograph which step, or which two steps, of the echelon produce most nearly the same effect as the material. By means of a suitable optical system—two prisms are used at the Bureau—it is not very difficult to determine whether the effect of the material is (1) midway between that of two steps, (2) somewhat nearer to one than to the other, or (3) very near that of one of the steps. It is thus possible to divide each step into 6 approximately equal parts. The "lead equivalent" of the material is thus obtained, the thickness of the steps of the echelon being known.

You are interested in knowing how closely this can be determined. Six roentgenograms of the same material were taken and the plates were read by two observers, one experienced, the other inexperienced. The readings were as follows:

Experienced	*Inexperienced*
0.45 mm.	0.50 mm.
0.46 "	0.45 "
0.47 "	0.47 "
0.44 "	0.46 "
0.46 "	0.47 "
0.42 "	0.41 "
0.45 "	0.46 "

For the experienced observer the greatest difference between the readings of any two of the 6 plates is just a shade over 10%, for the inexperienced observer it is about 20%.

The lead equivalent alone gives no indication of the quality of the material, a thick piece of poor glass may have the same lead equivalent as a thinner piece of good glass.

In order to obtain information regarding the *quality* of the material, divide the lead equivalent by the thickness of the material, both expressed in millimeters. This gives the lead equivalent per millimeter of thickness of the material. As a shorter expression is needed for this quantity we have suggested that it be called the "protective coefficient" of the material.

The protective coefficients of the glasses obtained in the spring of 1917, the two worthless pieces excepted, varied from 0.09 to 0.11, the mean being 0.10. That is, these glasses afforded a protection equivalent to metallic lead of 1-10 the thickness of the glass.

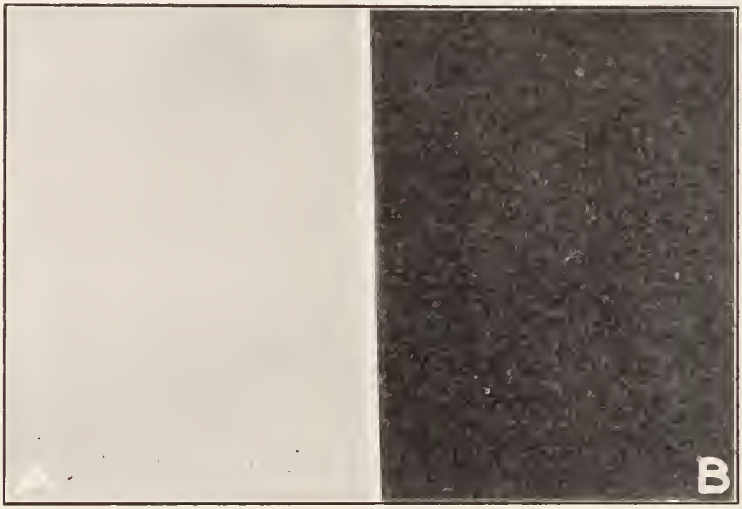
In the summer and fall of 1917 specimens of lead rubber were obtained from a number of dealers. These specimens did not differ very widely in quality and had an average protective coefficient of 0.23.

The Bureau then requested manufacturers of lead glass and of lead rubber to endeavor to produce improved materials. Their response has been most gratifying. Many improved specimens have been received. Good quality plate lead glass with a protective coefficient of 0.18—80% over what the Bureau obtained in the spring of 1917—has been received, likewise pressed glass with a coefficient of 0.20 and a piece of rough glass with a coefficient of 0.35 have been received. Lead rubber with a coefficient of 0.48 has been received.

As the protective coefficient increases, both the thickness and the weight per unit area needed to afford a given protection decrease. In order to ascertain the relation between the protective coefficient and the weight per unit area required for a given protection, the density of many of the specimens tested was determined.

(Exhibited and discussed slides.)

The Bureau of Standards is at the beginning of its *x*-ray work. It hopes ultimately to include the study and testing of all apparatus and supplies used by x-ray workers. To the extent of its facilities the Bureau wishes to serve you—both roentgenologists and manufacturers—in every legitimate way. The Bureau desires your assistance; e. g., you can assist the Bureau (a) by encouraging the sale of protective materials on the basis of guar-



anteed quality, expressed numerically in terms of lead; (b) by bringing to our attention any difficulty you may have in obtaining satisfactory materials, and by advising us of the names of such parties—if there be any—as habitually deal in unsatisfactory materials; (c) by bringing to our attention any marked improvement in apparatus or supplies; (d) by advising us of lines of testing, investigation, or improvement that will be of importance to you; (e) by bringing to our attention your own work bearing upon standardization or improvement of apparatus, materials, or methods.

In short, the Bureau of Standards desires your coöperation in securing improved materials, improved apparatus, improved methods and practices, and in combating errors and misconceptions.

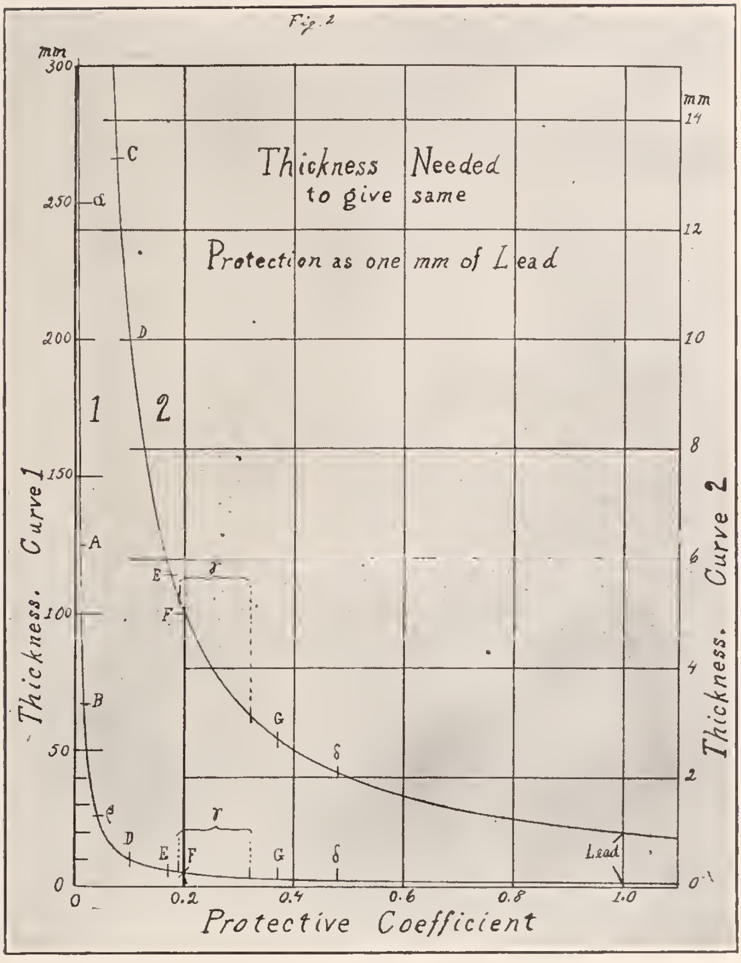


Fig. 2
Thickness Needed
to give same
Protection as one mm of Lead
mm
Thickness. Curve 1
Thickness. Curve 2
1
2
Protective Coefficient
Lead

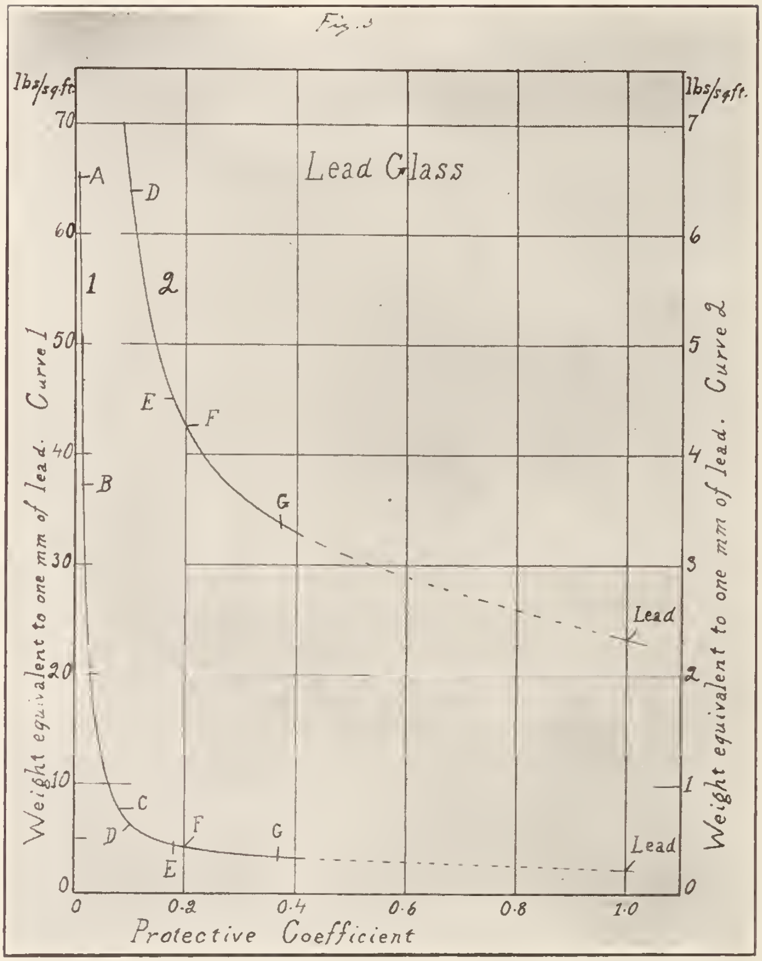
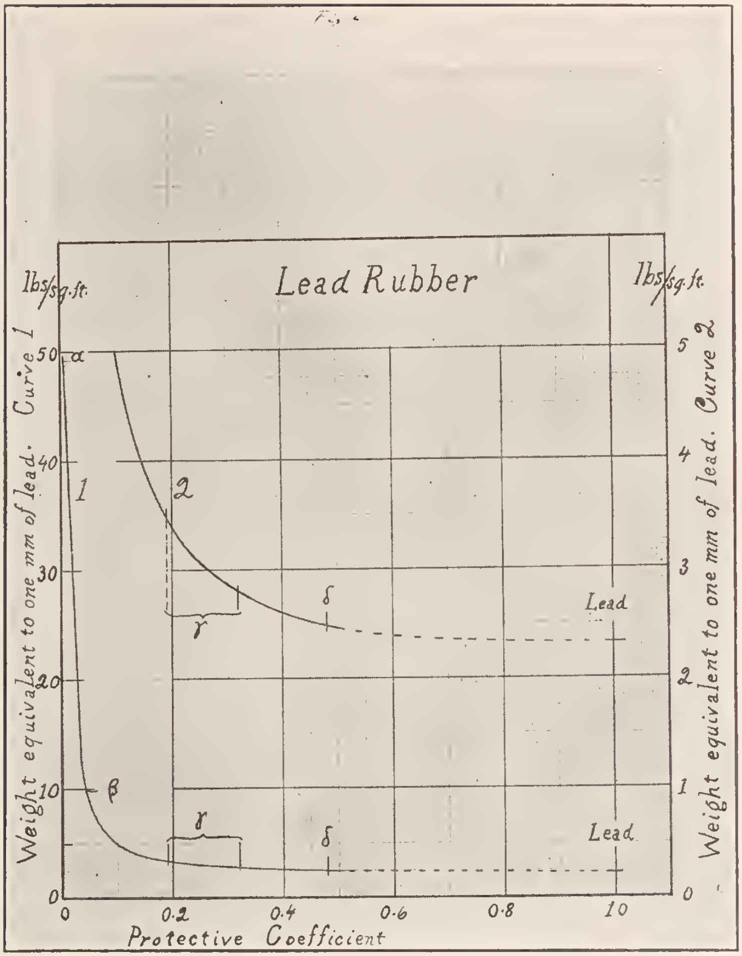


Fig. 3
lbs/sq.ft.
lbs/sq.ft.
Lead Glass
Weight equivalent to one mm of lead. Curve 1
Weight equivalent to one mm of lead. Curve 2
Lead
Lead
Protective Coefficient


Lead Rubber
lbs/sq.ft.
lbs/sq.ft.
Weight equivalent to one mm of lead. Curve 1
Weight equivalent to one mm of lead. Curve 2
Protective Coefficient
Lead
Lead
0
0.2
0.4
0.6
0.8
1.0

A SELF-RECTIFYING, GAS TYPE, X-RAY TUBE

F. J. Farrelly
Hartford, Conn.

The transformer universally adopted in this country for radiographic, fluoroscopic and treatment work is of a type in which the high tension alternating current is rectified by mechanical means. Attempts have been made to use the current from a transformer without a rectifying device, depending upon the resistance of the tube to hold back the inverse wave.

The limits of rectifying high tension alternating current in a vacuum chamber depend upon the heat of the anode. When an anode is first heated it gives off ions or positive electricity. This continues for a certain period depending upon the degree of vacuum and temperature of the anode. If the pressure is lowered and the temperature of the anode increased, the anode will cease to give off ions or positive electricity but will give off electrons or negative electricity. No doubt, when an x-ray tube is rectifying the alternating current, at this critical stage, the anode loses its positive charge and does not attract the cathode stream. When this stage is reached ionization is very rapid at the two terminals of the x-ray tube and resistance lowered and consequently both waves enter the tube and x-ray ceases to be generated.

Prior to 1904, Rollins, in addition to the induction coil, used a closed-core transformer for taking radiographs.

Gaiffe of Paris manufactured a closed-core transformer for all classes of x-ray work, using two valve tubes in series and a liquid resistance to suppress the inverse wave.

There have been on the market for several years Trans-

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formers having no mechanical means to rectify the current but dependent upon the resistance of the tube.

Coolidge designed an outfit, now being used by the U. S. Army as a field unit, in which the Coolidge Self-Rectifying Tube is used to rectify the high tension alternating current. The construction and operation of the Coolidge Self-Rectifying Tube is similar to the ordinary Coolidge Tube, except that the target in the former consists of copper and tungsten and has attached to it a copper rod which is connected to an external radiator used to withdraw the heat from the target. In order to have the Coolidge Self-Rectifying Tube rectify properly and be useful for radiographic and fluoroscopic work, care must be taken, when operating, that the focal spot does not get hotter than the tungsten spiral. The transformer operating the Coolidge Self-Rectifying Tube delivers a current of 10 milliamperes backing up a 5-inch spark.

The new Self-Rectifying, Gas Type, *x*-ray Tube can be operated from transformers of a 2 to 5 K. W. capacity. It has been found that a 5 K. W. transformer, operated in connection with the tube, is sufficient for all classes of *x*-ray work. A 5 K. W. transformer operated in connection with the new Self-Rectifying, Gas Type, *x*-ray Tube, is equally as fast as a 10 K. W. transformer the current of which is rectified by a revolving switch, and a 2 K. W. transformer, depending upon the new tube has been found as fast as a 5 K. W. transformer, depending upon a revolving switch for rectification.

The new Self-Rectifying, Gas Type, *x*-ray Tube will rectify a current as low as 10,000 volts and as high as 90,000 volts, showing a clean cut hemisphere.

Several manufacturers have built a special transformer to operate this tube. Each manufacturer has developed a technique to operate this tube with his special machine. The results obtained by the different manufacturers vary within certain limits, due to the particular way each respective transformer is constructed. From a number of tests made in the last two months, these manufacturers are convinced that the newly developed transformers, in connection with the new Self-Rectifying, Gas Type, *x*-ray Tube, will do all the work done by the old style transformers in which the current is rectified by a revolving switch.

In developing the new Self-Rectifying, Gas Type, *x*-ray Tube, we have made it possible for a physician who would ordinarily purchase an induction coil or a high frequency coil, to avail himself of a small transformer at a comparatively small cost and place him in a position to enlarge the scope of his work. A high frequency coil is hard on tubes and no *x*-ray tube has been developed that will work satisfactorily with same. The induction coil is limited as to the work it will perform and the acid interrupter is always a great source of trouble.

The new feature in this Self-Rectifying, Gas Type, *x*-ray Tube, consists of a glass sleeve attached to the anode or positive side of the tube thus forcing the current to enter the center of the bulb and changing the flow of the current into new paths. The rectifying effects in this tube are very remarkable. Although it will rectify when the anode is red hot and the vacuum low enough to see the cathode stream, there are a few limits and conditions under which it will not rectify. These conditions are (1) over-voltage and (2) over-heating of the target.

Practically the same conditions are encountered in this new tube as in the Kenotron Valve and in Liquid Rectifiers, that is, the tube, after being exhausted, must be seasoned by gradually passing from a weak to a strong current into it before it is ready for continuous service.

As previously stated, the tube will rectify even though the target is red hot, yet, if the target is heated by continuous operation, using a strong current, and then the current stopped and quickly thrown on again, the tube will not rectify. It will, however, rectify if a current of half strength is applied immediately after it has been stopped.

With the new Self-Rectifying, Gas Type, *x*-ray tube, all radiographs can be taken very quickly and without hardly increasing the heat of the target above room temperature. For fluoroscopic examinations it requires only a few milliamperes which will not heat the target or cause the vacuum to lower. If, for some reason, the tube is operated until the target is over-heated, or if the vacuum is lowered through the regulator, it requires only a few seconds to bring the resistance back to a desired point. The vacuum cannot be destroyed by any means (unless the tube is punctured) but that it can be brought back to a degree that it will be useful for the class of work requird. This action is quite different from the regular gas type transformer tube, which when over-regulated has to be laid aside or re-exhausted.

Heretofore no gas type tube has been manufactured by which the operator has as complete a control of the vacuum as in this new Self-Rectifying, Gas Type, x-ray Tube. It is difficult at this time to state definitely just how this control is obtained. When using an ordinary gas type transformer tube in connection with unrectified Transformers, it requires some time to adjust the vacuum to a point so that the milliamperes and resistance are about right for taking a radiograph, and as the same type of current is used in the new Self-Rectifying, Gas Type, x-ray Tube, the flexibility of control must be due to the glass sleeve within the tube.

In our estimation, the self rectification is due to the manner in which the current is led into the tube. The glass sleeve in the new tube, no doubt, causes the current to flow in a direct path to the cathode. While other types of gas tubes will rectify, yet they are very uncertain because the resistance of the tube must be a certain value to effect rectification. In using the ordinary gas tube for rectification, the current travels along the inner wall of the bulb and the positive ions, in attempting to reach the cathode, form electrostatic fields which seriously interfere with rectification.

According to Thomson, 90% of the ions travel from the target to the cathode along the inner wall of the bulb and 10% in a direct line to the cathode. In the new Self-Rectifying, Gas Type, x-ray Tube the positive current is liberated directly behind the target and no doubt, the amount of ions travelling along the wall of the bulb are reduced and compelled to travel in a direct line to the cathode. If the ions do not reach the glass wall, no doubt, a number of electrostatic fields are eliminated and a resistance maintained around the target and cathode causing a suppresion of the inverse wave.

Some of the Advantages of This Tube Are

(1) The short time and low milliampere seconds in which radiographs can be taken satisfactorily.
(2) The reduction in capacity, bulk and price of transformer.
(3) The elimination of moving parts.
(4) The elimination of noise while operating.
(5) No need of expensive and special wiring to make connection.
(6) The long life of the tube, warranted by the reduction of electrostatic fields.
(7) The elimination of an interrupter when the tube is used from an induction coil on A. C. current.
(8) High penetration.

DISCUSSION

Mr. Kelly: At about the time of the discovery of x-rays, the electrical engineers of America were divided into two camps, those advocating alternating current and those advocating direct current. At that time one of our prominent engineers said, "Why not use the electric current as the Lord created it?", meaning the alternating current.

With few exceptions it is a fundamental principle in dynamo electric machines that the current as generated is always alternating current. Machines delivering direct current generate alternating current which is commutated into direct current by means of a mechanical device, the commutator. Power stations which supply alternating current deliver the current just as generated in the machine. Those delivering direct current generate it in machines very much like those which generate alternating current, and in fact, the current is generated as alternating and is mechanically changed into direct current by means of a commutator interposed between the armature where the current is generated and the supply line.

This fundamental principle of dynamo electric machines which supply us with electric power is to be contrasted with the specific requirement of an x-ray tube, namely, that the current must flow in one direction only through the tube.

Direct current as supplied by the power house is of too low a voltage to excite an x-ray tube. Alternating current as supplied by the power house may be very easily raised to the desired voltage for exciting an x-ray tube by means of a step-up transformer, but it will still be alternating in character.

The problem of exciting an x-ray tube therefore resolves itself largely into one of changing the character of the current supplied on the one hand or so constructing the x-ray tube that the alternating current unmodified except as to voltage may be applied direct to the tube, and the characteristics of the tube will select the current only when flowing in the proper direction, and leave off the current when it reverses.

In the early days of the application of the x-rays the induction coil was quite commonly used. It was in no sense free of the fundamental principle outlined, that is, of delivering current in both directions. Manufacturers resorted to both means of having the current flow in but one direction through the tube. Series spark gaps and valve tubes having an asymmetrical resistance were interposed between the x-ray tube and induction coil in order to suppress the current in the wrong direction. The x-ray tube also was so constructed that it had a low resistance when the current was flowing in the right direction and a high resistance when the current was flowing in the wrong direction. This was done by constructing a glass sleeve extending over the anode. In that respect I differ from Mr. Farrelly whom I understood to say it was a new feature. It is quite old and almost universally used in x-ray tubes of European construction.

In the modern type of machines for exciting an x-ray tube, the alternating current is raised in voltage from the supply line by means of a step-up transformer. It is still alternating in nature as delivered by the secondary at approximately 100,000 to 150,000 volts. There is no attempt to suppress the current in either direction but it is allowed to flow "as the Lord created it".

There is, however, a device which we call a rectifying switch interposed between the high tension alternating current and x-ray tube. Its function is to automatically commutate the alternating current into direct current before it is supplied direct to the tube.

The x-ray tube described by Mr. Farrelly appears to be a commendable endeavor to find a new application for an old principle.

Mr. F. J. Farrelly: I agree with Mr. Kelly that x-ray tubes having glass sleeves over the anode were sold in this country years ago. In fact almost all of the foreign tubes had glass sleeves and some American manufacturers made their tubes the same way.

The object of placing these glass sleeves over the anode was to collect scattered rays and partly help to eliminate inverse current. Manufacturers of transformers who depended upon the x-ray tube to rectify the high tension alternating current tested such tubes and found that they would not rectify satisfactorily. In experimenting to develop the self-rectifying tube we made several tubes with a glass sleeve covering the anode and found that they would work satisfactorily for four or five minutes only and then would cease to take the current.

The cause for not taking the current was due to the fact that they did not rectify the high tension alternating current. The negative pulse entered the tube on the positive side and on leaving the anode the negative current decomposed the tungsten and copper and deposited them as an oxide on the inner wall of the bulb. When any tube reaches this stage it is difficult for the current to pass into it. The vacuum of such tubes is always high and no matter how much regulating they receive the vacuum cannot be lowered to a point where the current will flow freely. A short glass sleeve covering only part of the anode shank will produce self-rectification.

ROENTGEN DIAGNOSIS IN RELATION TO CLINICAL TEAMWORK

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Assistant Professor of Surgery, Rush Medical College
Surgeon to Frances Willard and Cook County Hospitals
Chicago, Illinois

Mr. President, Members of the Western Roentgen Society: First of all, permit me to express my appreciation for allowing me to appear on the program of your Society. It indicates that medical men and roentgenologists must meet on common ground.

The role and scope of the roentgenologist as a technician and physicist, without application to medicine, is very limited. His significance, however, is unlimited when considered as a member of a diagnostic team in medicine. A medical team is an association of a group of medical individuals who lend their efforts, jointly, with one common scientific object in view. Medical teams can be briefly classified in two classes: those coöperating in hospitals and those outside of the hospitals. From my personal observation, I have come to conclude that only those teams work sincerely and effectively who are members of an endowed hospital, or of a hospital associated with a well endowed university. The hospitals which are run for profit, or those poorly endowed, can never hope to have a medical team of any value. The medical teams outside of the hospitals, those who consult each other occasionally, never succeed in obtaining a complete coöperation. When we consider that the largest percentage of the human population is struggling for a modest existence, the problem of an effective team, as a factor in medical diagnosis, is really

* Read before the Fourth Annual Meeting Western Roentgen Society, Chicago. November 20-21-22, 1918.

an economic one. Up to the present time, there are only two classes of people who can hope to obtain a complete coöperative diagnosis: those who are proven by the social welfare departments of various medical institutions to be hopelessly poor, or the very rich. The working and middle class, who live, at best, within their means and, usually slightly above, can never hope, under the present system of society, to obtain coöperative medical service. Occasionally they strain themselves in consulting two or three specialists, including the roentgenologist, with the result that they obtain, at great sacrifice, an assembled diagnosis, which lacks the completeness of a well organized team. The most ideal and most complete medical team I have been able to observe, in this country, is the Mayo Clinic. It has, however, so out-grown itself that an intimate coöperation of the members of the staff is difficult at times. In spite of these difficulties, William J. Mayo, an unusual organizing genius, has always kept the idea alive that the success of the institution depends upon intimate diagnostic contact, frequent and extensive consultation, and, above all, a good fellowship,without which successful coöperative work is impossible.

The problem of the roentgenologist is a part of the vast problem of the medical profession which, while making vast progress scientifically, neglects, at times, its practical application to everyday life.

Medicine of the future must be coöperative in type, it must not be prohibitive in cost, and must be brought within the reach of every sick man or woman. I wish to make it very emphatic that *x*-ray as an aid in diagnosis is, up to the present time, a luxury, which the average man cannot afford, and it behooves this, or any other Society, to attempt to solve the economic feature of the problem. Medicine has a definite social aim, and, unless the medical profession considers it as such, or it becomes a function of the State—which is the best thing to hope for—it will lack the scientific genuineness and will never fulfill its object.

Viewing the question from a purely medical standpoint I wish to state that my conception of a successful team work necessitates well trained men in their respective specialties. A roentgenologist must, in my opinion, be a well trained physician and, the latter must be well trained in roentgenology. The non-medical x-ray technician has no place in medicine, except as an assistant to a medical roentgenologist. The effort of the x-ray profession to legislate the x-ray practice is quite legitimate and, can be very simply solved, by prevailing upon the health boards of various states to consider the practice of x-ray as a medical practice and bring it within the scope of the Medical Practice Act. Why should a layman be allowed to give deep x-ray treatments and not be permitted to prescribe calomel?

On the other hand, the x-ray training of the average doctor must be improved. The course in roentgenology must be made an integral part of the course in physical diagnosis and taught besides in conjunction with each specialty. Dr. Fred C. Zapffe, in an analysis of seventy-two medical schools of class "A" and "B", found no record of the subject of roentgenology in twelve schools. There are very few schools with a definite separate department of roentgenology and, even those, devote an insufficient number of hours for the teaching of the subject. Dr. Zapffe recommends twenty hours of actual didactic teaching, and additional teaching in conjunction with clinical work. William Dieffenbach of New York recommends sixty-four hours of didactic work. I believe that the only way the medical profession can master the subject is to have a fair working knowledge of x-ray in the medical schools, and aim to improve their knowledge after graduation.

Every hospital of every size and account should have weekly or semi-weekly conferences at which the coöperative members of the staff, internes and roentgenologists should jointly read and discuss the patient's history, the x-ray features of the case, physical findings, laboratory findings, the pathology *in vivo,* as found by the surgeon, or the post mortem findings. How many hospitals to your knowledge coöperate in this ideal way? In the majority of cases the roentgenologist hears only incidentally of the outcome of a certain case. The internes show a classical indifference to the x-ray, and are concerned only to the extent that the attending man requests it. After leaving the hospital, the practitioner has only a slight acquaintance with x-rays and, because of lack of time, he very seldom takes the trouble to witness any of the screen work done on his patients. The medical men know very little of roentgenology and the medical roentgenologist, as a rule, is only a mediocre doctor.

The most ideal method for mutual edification and most conducive to a final or approximate diagnosis is the scheme resembling the group study established at the St. Luke's Hospital of San Francisco, where several departments intimately coöperate to establish a diagnosis.

The so-called "open hospital," in which all licensed practitioners bring their cases and manage them single handed, is in reality nothing more than an expensive medical hotel, in which coöperation is either not desired, or if called for, is half hearted and very costly to the patient.

Having attempted to emphasize that a doctor needs more roentgenological knowledge and the roentgenologist more medical information, let us see to what extent does the x-ray assist in medical diagnosis. The x-rays have opened new fields in diagnosis, have clarified many obscure ones, and have very materialy shortened the time usually required for a diagnosis. The American school, or the direct school of x-ray, proving by definite physical features, lesions as they actually exist in human tissues, has, in many instances, revolutionized medical diagnosis, particularly in the gastro-intestinal tract. In some instances, however, it has given the roentgenologist a sense of diagnostic independence, which makes the immodest roentgenologist feel that his findings have priority over the medical opinion. It also tends to reduce the diagnostic acumen of the medical man. The sense of independence of either medicine or roentgenology is pernicious. The keen diagnostician of olden times who strained his imagination and utilized his experience to establish a diagnosis, without laboratory or *x*-ray assistance, was both useful and picturesque.

As valuable and conclusive as the direct method of *x*-ray diagnosis may be, the province of diagnosis still belongs to the physician. The most striking example of a diagnostician was the late J. B. Murphy, who taught the medical profession of America that diagnosis can be either definitely or tentatively made by taking a very detailed history of the case, and by interpreting every feature in the light of pathology. The doctor who has no tentative opinion in a given case and expects the general laboratory and *x*-ray laboratory to make the diagnosis for him, has no place in medicine. The laboratory and *x*-ray departments will never be a fair substitute for the human brain.

While it is true that *x*-ray information is absolutely indispensable in medical diagnosis, it is left to the doctor to suspect pathological conditions. The roentgenologists make the just claim that they can diagnose, with a fair degree of certainty, early pulmonary tuberculosis, before there are any physical or stethoscopic findings. A good history, however, will suspect tuberculosis before either physical or *x*-ray findings are present. Take, for example, the splendid description of Landouzy of France of his clinical type of tuberculosis: the young man or woman with fair skin, frail frame, freckles, long red hair, and a few other definite features described by him. The type just mentioned is a potential tubercular type and the doctor is able to suspect him long before he actually developes tuberculosis as revealed by *x*-ray findings, and may save him from disaster.

The medical diagnosis of the future must be made very early. It must be a sort of "prophylactic" diagnosis. In neurology the diagnostician must be able, by interpreting the history and the early findings, to have a definite opinion of his case long before there are physical findings betrayed by *x*-rays. In diagnosis of diseases of the chest he must also have an early clinical intuition long before fluoroscopic or plate evidence may suspect the condition. The same thing applies to the diagnosis of conditions of the gastro-intestinal tract, particularly early in carcinoma. The universal attempt in medicine today is to diagnose tuberculosis and cancer in the pretuberculous and precancerous stage. Of late, a great deal of *x*-ray evidence was collected in visceral syphilis. Must the profession wait for *x*-ray evidences of visceral syphilis before it can make a diagnosis of lues?

Wouldn't it be disastrous for a doctor to wait for *x*-ray findings in acute osteomyelitis or other bone lesions in which the early pathological changes are purely molecular and cast no shadows in the *x*-ray picture?

The greatest desirability for coöperation is, in my opinion, in the diagnosis of diseases of the abdomen. With all the advances of the direct method of *x*-ray, both medical men and roentgenologists must admit, frankly, that there are a great many cases in which the diagnosis is many times only "probable", or "doubtful". The bulletins of a good many first class surgical clinics still list their abdominal cases as "exploratory of gall bladder and duodenum", or "gall bladder and stomach", or "stomach, gall bladder and appendix". The stumbling block in abdominal diagnosis is still located, in what Dr. Woodyatt calls the "upper abdominal triangle", the angles of the triangle being the gall bladder, the pyloro-duodenal junction and the appendix.

I merely cited these examples to show the difficulty in arriving at a final diagnosis from any single method. If the time would permit, I could also show the inability of the clinician to establish a diagnosis without the aid of the *x*-ray and other laboratory methods.

Diagnosis has its difficulties and limitations and, irrespective of the advance of medical science and roentgenology, there will always remain a margin of error. The *x*-ray, as an independent method of diagnosis, has a limited field of application. In conjunction with other diagnostic methods, however, it has unlimited possibilities and must be regarded as the most valuable diagnostic addition to medicine in the last twenty-three years.

DISCUSSION

Dr. Paul Eisen, Chicago: *Mr. Chairman:* Dr. Schrager's paper, like many others that have been read here in the last few days, is ample proof of the necessity of coöperation between the roentgenologist and the other members of the profession. I need not dwell on this point. Another question, however, is, how can we make this coöperation successful and why is it often a failure? When I became interested in *x*-ray work and was about to set up as a roentgenologist I was timid about it, but nowadays I take pride in the fact that I call myself a roentgenologist. I have had sacrifices in the practical application of roentgenology in the past and had to leave it to others to recognize that their work was better the more proficient they were. I was glad to be able to confine myself to roentgenology and in that way become efficient in that subject. I have had the good fortune to work with men everyone of whom was further advanced in the knowledge at that time than I. I have learned the most from the youngest members here. It is the open mind, the listening to the other fellow's opinion, which will be of greatest value in roentgenology. In going into the work it is the man who seeks knowledge, the knowledge that he wants, that will succeed.

In using the word "diagnosis"—I hate the word "diagnosis.'' We have our roentgenological findings, the same as the pathologist, and the more we show them up the less necessary is it for us to use the word ''diagnosis''. The diagnosis becomes so evident. In very many cases it is true the roentgen ray diagnoses—I need only mention fractures and foreign bodies. On the other hand, the roentgen rays are very deceiving if we take their evidence alone. Time and again cases come to the hospital and show only roentgen findings and the doctors want them operated upon, whereas there is no clinical evidence to show that the patient is really suffering from anything which the roentgen findings show up. They are healed, healed lesions in the lungs or in the viscera giving very definite roentgen findings. The thing is to find out what the patient is suffering from and relieve his condition and not to work on something which we find.

I was very glad to hear in one of the papers day before yesterday that we can find all the roentgen findings of duedenal ulcer and still the patient not have the ulcer and, on the other hand, have a patient with a definite duodenal ulcer and the findings be undetermined. In other words, if we have positive findings let us coöperate with the others. If our findings are not positive we should never use the word ''negative''. We all know that osteomyelitis never shows in the beginning and this is also the case in pneumonia. The findings may be negative, but the patient goes on to pneumonia. If we have positive findings let us be very careful in their interpretation. Doctor Hubeny showed up the many pitfalls, and it is only when the symptoms the patient complains of coincide with the roentgen findings that we may go ahead.

In conclusion, my teacher, Dr. Allan Koehler, stated that if the roentgen findings are confirmative of the clinical findings they should be accepted as such, and if not confirmative no conclusions should be drawn.

APPARATUS

Montford Morrison, Physicist
Chicago

The scope of this paper is to cover the technical characteristics of Interrupterless and self-rectifying x-ray tube apparatus, which information has not been exposed heretofore from an engineering standpoint.

Before the selection of apparatus, one must carefully predetermine the range of work he wishes to do and the magnitude of the factors he wishes to employ, i. e., the maximum parallel spark gap and the maximum energy output he desires. There are so many differences of opinion among operators of x-ray machines about the magnitude of these factors for various different work it would be folly to suggest which is preferable, but I can suggest some satisfactory methods of determining the suitability of a machine for certain work without exhaustive operation with x-ray tubes.

Concerning the transformer proper in Interrupterless x-ray machines, there are a few points to be brought out with which one may judge the relative qualities of this piece of apparatns. For instance, the maximum output of a transformer may be judged by a simple test, requiring only an additional voltmeter. This is called a short circuit reactance test in engineering circles and is performed by connecting a low reading voltmeter directly across the primary terminals of the transformer and short-circuiting the secondary terminals of the transformer that ordinarily go to the x-ray tube. Then by starting up the rectifying switch with all the resistance cut into primary circuit, the resistance is gradually cut out until the milliamperemeter reads some value, say 100 milliamperes; the voltage reading is taken on a primary circuit. This means that it takes this many volts to put the indicated number of milliamperes to the secondary circuit without any output whatever, and therefore this number of volts must be subracted in order to obtain the useful volts at the primary when this load is in the secondary. It can be very easily seen that this is a means of measuring the wasted volts in the primary, and therefore the less number of volts wasted, the higher the output of the transformer.

A transformer that will stand heavy sparking, that is, flaming across the secondary terminals, is not necessarily a transformer with a large output; it may be or may not be, and usually is not. This gives no idea of the output of a transformer. Heavy milliampere output means nothing unless the parallel back-up spark is very accurately known.

SPARK GAPS AND KILOVOLTMETERS

The question is often asked, what is the proper method of reading a spark gap, whether the flame value or the first spark over should be used, and whether kilovoltmeters are more accurate or not?

This can be answered by explaining that there is 20% difference in spark gap readings, due to differences in percentage of humidity and different barometric pressures with all the personal equation omitted. This means that the operator may get 5 inches today and 4 inches some other day for the same *x*-ray tube output, but it may be said that the most satisfactory way of reading the spark gap is to have a gap that opens beyond the sparking voltage, and pull it in, and when the operator is able to read 5 consecutive values which do not vary more than 1-8 inch, he is reading the spark gap properly regardless of whether it flames or sparks. This flame or sparking depends upon the type of control and the amount of ohmic resistance in the circuit, and it is different for high values than it is for low. Kilovoltmeters although may not necessarily check with the spark gap, (and they do not unless there is some compensating reactive voltage from the primary circuit in the voltmeter circuit) they will, nevertheless, give consistent readings which are just as valuable when once established.

RECTIFYING SWITCH

There has been much said about the exact number of degrees that a rectifying switch should rectify. Even if this were set to some particular mechanical value, the number of degrees actually rectified would depend upon the voltage rectified and the current both for a high voltage as the property of jumping earlier and later, therefore winding the arcs effectively; and heavy currents have the property of widening the rectifying arcs effectively by the current breaking out, so to speak.

There has been a popular conception that just the peaks of the waves should be used. Some years ago A. W. Hull invented a machine that gave an absolutely constant direct current and with the aid of an *x*-ray Spectrometer he determined exactly the quantity of each different degree of hard or soft rays obtained with this apparatus, and then put the same tube on a machine which utilized a sinusoidal voltage with all of the values from zero to maximum, and to zero again. And by carefully plotting these out he found that these two curves were exact duplicates when the energy factor between the constant direct current and the sinusoidal was included, showing conclusively that the wave shape had no perceptible effect on the spectrum which means get all of the wave you can.

Regarding the cross arm and disc types of rectifying switches, it may be said that the cross arm switch is capable of rectifying heavier currents more efficiently and possesses a smaller moment of inertia than the disc, which means that the switch will follow fluctuations in freqnency and voltage more readily than a disc type, although the disc type has the advantage of taking np less room and will give satisfactory results on the ordinary operation.

MOTOR AND ROTARY

Two very important features in the *x*-ray machine are the motor and rotary. The synchronous motor should be one which would follow variations in frequency as well as fluctuations in voltage. Like the rotary, the size of the synchronous motor may not be a judge of its operating characteristics. This is particularly true with the rotary. Years ago it required a rotary in the neighborhood of 600 pounds to give satisfactory operation in high power machines; today approximately one-third of this weight will give better operation and better standing up qualities. This is due to a lot of original design that has been done on these machines with special reference to their application on *x*-ray loads.

CONTROL APPARATUS

We have five types of control; resistance, inductance, auto-transformer, induction regulator and generator field control. The last two have not come into general use on account of their expensiveness, but they give very desirable kinds of control.

Regarding the suitability of the first three mentioned, it can be said that with the auto-transformer hot cathode tubes more nearly realize their working condition, and with resistance or inductance type of control the gas tube more nearly realizes its ideal working condition. It looks as though, if one has to choose, the resistance control would be the choice, because any kind of tube could be operated on it. If one can afford both on one machine it will certainly be found money well spent to have both.

Self-rectifying tube apparatus is just coming into the market now, and there probably is not much to be said about it, as only very small power machines, about 500 watts, are now offered for sale.

I might say here, though, that metering from the alternating current side, that is kilovoltmeters, etc. will be a proposition entirely different from the present machine, and although I have gone into this extensively and have a great deal of information concerning this, I feel that it is of no particular interest here now, but will be glad to give it some day when the self-rectifying tube is of general interest.

3300 Douglas Boulevard.

Dr. Walter I. LeFevre, Cleveland: I have enjoyed all of these papers and think the Society is to be congratulated on having these men come to us and give these interesting talks.

Mr. Morrison stated that he would have a volt meter on his machine and then recommended a Kilovolt, or spark gap meter. Would he have two separate meters, or would he use the Kilovolt or spark gap meter for both purposes I use a Kilovolt meter on one machine and like it very much, and would like to know whether we can obtain a correct reading spark gap meter for a given machine, or do we have to test it out ourselves In working the spark gap meter I have found that if you want to use 40 m. amperes, to back up a five-inch spark, adjust the control to get that reading, then bring rheostat back to a low number, and read the spark gap meter. Then in the future simply adjust to this low number, the higher voltage will be in the same ratio. This saves your tube for it can be run indefinitely without injury.

Mr. Montford Morrison, (replying to Dr. LeFever): The voltmeter to which I referred is a separate meter.

The Kilovolt meter could be taken off, but I referred to a portable meter that could be carried around and used for testing, in case of trouble with the machine. For instance, we often have cases where the conduit in the building has a little wire practically grounding the circuit. The operator does not know this is there and we don't either, but if he had a voltmeter he could read the voltage between one side of the line and the iron pipe and the other side of the line, and we could tell him whether the trouble was there or somewhere else. The kilovolt meter does not read in volts; it has a scale but ordinarily you can't read it in volts. Any meter put on a transformer will give you a value any time which is practically the same, provided the other conditions are the same. If you have a Coolidge tube on a certain button and the volt meter reads a certain value, if you get the volt meter to read that same value each time and the other meter reading the same each time you may repeat your settings. It may be 150 or 175 or 180, but if you determine that it is a five or a six-inch spark it will be the same each time if other conditions are the same. You can't take a meter off hand and put it on a machine and expect it to read with a high degree of accuracy. In order to get a kilovolt meter to read with a high degree of accuracy it has to be compensated, which doesn't mean anything to you but is our way of expressing it. The secondary back up is not a direct function of the primary voltage.

Dr. I. S. Trostler, Chicago: About two years ago, when purchasing an outfit I had an uncalibrated volt meter connected in the primary circuit with the control, with the idea of calibrating it myself as a spark gap meter. I found it was an easy matter to do this by taking a definite setting with a constant amount of current through the filament in the Coolidge tube, to get an accurate setting. I calibrated that for three to nine inch spark gaps and, with the same amperage through tube filament and the same control settings, except for an occasional line drop at certain times of the day, I can reproduce the same spark gap with those settings and have my spark gap meter read the same, day after day and week after week. It has been a most valuable adjunct to my apparatus.

RELATION OF ROENTGENOLOGY TO PREVENTIVE DENTISTRY

Dr. Harold O. Hansen
Chicago

The Roentgenogram is becoming each year, more of a necessity in the Dental office, and with the Oral Hygiene movement rapidly developing, the demand is becoming still greater.

In the beginning, the Roentgenogram was employed to detect broken off roots, impacted and unerupted teeth. Later as the knowledge of local infections became more widely known, the use was extended to root canal work. The uncertainty and dissatisfaction of work on pulpless teeth, has led to more serious thought and consideration for the welfare of the patient, who, has been subjected to long tedious root canal operations, the result of which, has been at best doubtful.

To avoid these unpleasant features we have directed our endeavors along other channels and find our only solution of the problem in Preventive Dentistry, which is the preservation of the original tooth structure.

In the normal mouth which contains a full complement of teeth it is estimated that there is approximately twenty-two square inches of peridental membrane surface. Outside of the dangers to which one is subjected by infections around the apices of teeth, the condition of the peridental membrane is the best indication of the safety and cleanliness of the Oral cavity.

The Roentgenogram affords the only means of studying this attachment and for this purpose we need fine detail and more definite angles than ever was needed in routine

* Read before the Fourth Annual Meeting Western Roentgen Society, Chicago. November 20-21-22, 1918.

dentistry. It is necessary to develop a technique with uniform results. For this purpose in my opinion there is but one type of machine and one kind of tube. When one becomes accustomed to studying radiographs of this class they are more qualified to properly interpret them. These exposures are made with a definite spark gap and milli-amperage. So many dental pictures are made with machines which have not the capacity to properly expose a positive film so the negative or fast films are used with a great sacrifice of bone detail. Nearly three fourths of all dental pictures are taken on high frequency outfits necessitating the use of these fast films. Altho this shows an effort on the part of the dentist to improve, it is nevertheless a great handicap, as these pictures are unsatisfactory even for the experienced Roentgenologist to interpret, and for the unexperienced are almost useless. Fortunately however, with the demand for high grade radiographs the manufacturers are producing more efficient machines and the use of the other types should be discouraged.

With the desire for better Roentgenograms and a more careful study of the same, has been created an almost new profession, which has for its purpose the abolition of all irritation and infection for the Oral cavity, and putting the mouth in condition to be kept clean. These men should be properly called Oral Hygienists; and the time is rapidly approaching when dentists will divert their time from routine dentistry, to this new field. This grand movement is here to stay and already its momentum is so great that it would be impossible to stop it, and will yearly increase until our profession will be looked upon as the greatest in the healing art.

Dentistry was created to fill a long felt want; but the only object of dentistry was to restore lost parts, and any benefit that was derived systemically was accidental and merely an incident compared with the replacement of lost teeth.

Dr. Mayo a few years ago at a meeting of the Chicago

Dental Society made the statement that the next great step in medical progress in the line of preventive medicine must be made by the dentists, and added the question, "Will they do it?"

Dr. Mayo saw the great possibility and his only reason for asking "will they do it" was due to the fact that dentists as a class are so absorbed in their routine restoration work, that to change their line of thought to a higher and more noble pursuit is a slow process. I can answer Dr. Mayo's question and say "they will do it", but there must be a complete revolution of ideas in the dentist's mind and he must begin to treat cause instead of effect.

Professor Pickerell, in a recent article, lays emphasis on the interdependence existing between various physiological functions and urges upon us the necessity of widening our outlook when dealing with diseased conditions of the mouth and teeth. The disorganization or loss of function of one organ will assuredly lead to the disease of another in the same or allied system.

The mouth is the greatest harbinger and the most extensive breeding place of all pathogenic micro organisms, and here is the origin of nearly all contagious and infectious diseases.

The fact that mouths of each generation are poorer than those of the preceding generation has caused great alarm, and conditions can only change when the organized efforts of the Oral Hygiene men educate the public to demand dental services which will tend to abolish this deplorable state of affairs, and when there is created in dentistry a full realization of its responsibilities. Then dentists will be saving lives instead of teeth.

Most individuals have a great regard for personal cleanliness and very religiously attend to these duties, but the mouth, the most important portal of entrance of micro organisms, is sadly neglected. To give one some conception of the tremendous number of bacteria in the mouth, Dr. W. Parker Harrison, of Brighton, England, records in the

British Dental Journal of May 1915 the following experiment.

Each of twelve tooth brushes was used once, rinsed ten times in a tumbler of water, and after standing for twelve hours all the bristles were removed with sterile forceps and the organisms counted in the usual way. In eight out of the twelve cases more than a million organisms were found, such a quantity of bacteria is comparable with the number of organisms found in sewerage, which is twenty-six million per cubic centimetre, and in one sixth of the counts made on sterile tooth brushes, used only once, the number on the brush exceeds this. The volume of liquid held by a tooth brush that has had the superfluous water flicked off, as was done in these experiments, is not nearly as much as I. C. C., which renders the comparison all the more to his disfavor of the tooth brush.

These experiments were carried out by the patients suffering from peridental diseases, but it was also found by four experiments on an apparently healthy mouth, that almost as large a number of bacteria were left on the tooth brushes.

The above experiments allow a statement that the millions of tooth brushes in this country are in a most disgusting and septic state; a condition of affairs especially to be deprecated and if possible alleviated; where septic processes are in operation in the mouth, the pyogenic organisms left on the tooth brush today are reinoculated into the mucuos membrane of the mouth tomorrow.

When we consider the large percentage of men disqualified for army service in all its branches, and in the more special lines, such as Aviation, nearly 95% are rejected as physically unfit, only one man in twenty physically balanced for this service. This fact alone should startle the medical profession and prompt them to analyze the underlying cause, and institute ways and means of abolishing to a great extent this percentage of physically unfit; and the mouth, the fountain head of infection, should receive the first attention.

A study of these facts should not alarm us, it should inspire hope. By ignoring the truth or by refusing to look into it because of the grim depression which accompanies the contemplation of this state of affairs merely betrays our unfitness to deserve a better fate.

Medical men as a class are not interested in Dentistry so do not acquaint themselves with mouth conditions, and so do not realize what class of work is conducive to mouth cleanliness. The only way to be sure is to remove all infection.

The maintenance of a clean mouth precludes the possibility of the rise of secondary pathologic phenomena, which menace, not only the health, but the very existence of the individual.

The secondary phenomena which includes some of the most serious lesions known to pathology, have now been proven to be dependent in primary force within the oral cavity, to an extent heretofore undreamed of.

It is obvious that we can no longer consider proposed dental restorations in the light of primary function; but to look beyond this and consider it with relation to the formation of focal infections, and general systemic effect.

When we find that a certain type of restoration cannot be accomplished without the formation of possible foci, we must definitely eliminate that type of restoration. When we find that it invariably produces a derangement of cell function and a lowering of tissue resistance, that type should be considered obsolete; no matter how thoroughly it fulfills the esthetic and functional requirements.

Pulpless teeth have been looked upon with doubt ever since the advent of the Roentgenogram and more and more are we beginning to realize the fact that that they are dangerous and should never be left in the mouth. The fear dentists have of being called radical has kept them from openly announcing their stand on this subject. But in my humble opinion the radical man is the one who allows his patients to carry infected area of unknown and uncertain virulence, capable of doing inestimable harm, thus jeopardizing the health and happiness of this individual. He is the radical one as the conservative man always plays safe.

Medical and Dental literature has been filled with articles on this subject and many have reported results which seemed encouraging, but one cannot build on a weak foundation, and those same teeth which seemed to improve under treatment and apparently were safe, have become reinfected haemolytically due to the fact that the area over a root apex will not remain sterile for any definite period of time or by any method of treatment.

Dr. Gilmer made this statement recently at a meeting of the Chicago Medical Society, "I extracted a large number of pulpless teeth and secured streptococcus viridans from almost every case. Alveolar abscesses, when some of the apical peridental membrane has been destroyed may be cured temporarily by sterilization of the root canal, but it is for a very limited period, because there will be reinfection sooner or later; the organisms being carried to the dead cementum by the blood stream."

The pulpless teeth should always be looked upon as a foreign body within the bone. No dentist is justified in allowing them to remain in the mouth even though they are well camouflaged by gold crowns and other unpardonable appliances, which are always a direct irritation, unclean and help maintain a luxuriant mouth flora.

If only a small percentage of devitalized teeth were infected we would still be far from justified in allowing them to remain and jeopardize a patient's health merely for the sake of a tooth. Infection is measured by quality and not by quantity and some of the larger areas discernible about root ends, may be causing less systematic disturbance than a small area unnoticed by the *x*-ray, which may be a very virulent infection. The Roentgenogram at best is only a shadowgraph and is never a clear photographic expression of a pathologic condition. Altho the best diagnostic means available and a great blessing, still should not be relied upon too much.

Health is the greatest blessing man can have and when one deliberately and intentionally neglects to remove infection he is as much a criminal as the man who takes life. Before the introduction of the Roentgenogram into Dentistry one felt justified in allowing these broken down undesirable teeth to remain as they were ignorant of the dangers attached to this neglect, but now, no one is excusable and anyone who will casually examine a Radiograph and pass an opinion as to whether a certain dead tooth is or is not infected, is doing a great harm. One is merely guessing and has no positive scientific assurance of this fact. I will be glad to present a paper at some future time showing the change both in the numerical and differential blood count brought about by properly cleaning up a mouth.

One of the prerequisites for an oral hygiene man is that he must have an ideal. The man that has no ideal, no matter what his occupation, is dangerous, and the man that pretends to have an ideal and does not live up to it, is a hypocrite.

Our ideal, is a mouth free from bacteriological, mechanical, and chemical irritation, and one which the tissues of the mouth are normal in every respect and each tooth surface highly polished and free from restorations of any description.

There should be no decay, as it only means neglect either on the part of the patient or the dentist. Without the initial introduction of caries into tooth structure there would be no dead teeth. If half the concentration and effort which is devoted trying to make one dead tooth safe, was spent in prevention, there could be ten teeth made beautiful, safe, and free from decay. Most patients have a limit on both the time and money they can spend on dental services and too often, this time and money is spent on dead teeth and the good ones neglected until they are decayed and broken down in a similar manner.

There is no individual who cannot get along no matter how many teeth they have extracted as they can be replaced by some sanitary removable appliance, with better results, from the standpoint of the patient's health. This necessitates the removal of pulpless teeth together with those afflicted with pyorrhea beyond the point where they can be saved.

Mechanical irritation is caused by fixed bridgework, crowns, and overhanging margins on fillings, especially the amalgam filling, and should never be used.

Chemical irritation includes the bacterial plaques made up of food particles bound together with the mucin of the saliva, and finds lodgement between teeth and around unpolished overhanging margins of fillings; causing decay, due to the disintegration of the enamel by lactic acid formed by the decomposition and fermentation of the mucilagenous plaques. This is, however, too long a story for discussion here.

We are often asked by dentists, "How can we meet the requirements of the oral hygienists?" The answer is always the same. Remove all devitalized teeth, never place crowns or fixed bridgework in the mouth, and never put in amalgam fillings. Devote your time to preventive work.

When this is done there will be a feeling of satisfaction that the conscientious man is entitled to enjoy.

1553 W. Madison St.

DISCUSSION

Dr. O. E. Lanphear: These clear, clean slides and the able papers on Dental-Roentgenology are an inspiration to me and beyond criticism. Roentgenographic localization of a needle or a root by the use of a piece of metal held at the point of puncture or at the mouth of a fistula, by means of adhesive tape, establishes a point from which to measure. Unless this precaution is taken, it might be difficult for the clinician to find the offending particle.

One can elaborate upon this method by having the piece of hard metal, the shape of an arrow, cut from thin unyielding metal, lying in a given direction and plane, held in place over the fistula, on dry gums by Collodion, while the part is Radiographed in intersecting planes. The nearer the intersection approaches a right angle, the more definite the position of the foreign particle.

For the clinician's convenience, in an edentulous mouth, we establish a position with a fixed block on which to bite. To this block we attach the metal arrow in juxtaposition to the fistula, then two exposures are made as before. The operator can then replace the block for measurements, getting the same information he would were the arrow held in a fixed position over the fistula, on the dry gums, by collodion.

The localization and delineation of impacted third molars by Dr. Simpson's superior technique is the finest thing I have ever seen. It was both clever and skilful. He gives the clinician clear, first hand information.

I agree with Dr. Hanson when he says, "Three-fourths of the fast dental films are poor," but in my opinion, the fast film is maligned.

There are many possibilities of errors in the wide range of technique where the element of time is the predominant factor, as in nervous children, the fast film will often show superior results.

DIAPHRAGMATIC HERNIA*

TWO PLATES

O. H. McCandless, M. D.
Kansas City, Mo.

Various visceral displacements into the chest cavity are described under the terms "eventricia diaphragmatica" (Petit 1790), "false hernia," "evisceration," "true hernias," (the true hernias characterized by enclosure in a sac) and "eventration."

The organs found in the chest, recorded in the order of their frequency by Lichtenstern were, stomach, transverse colon, omentum, small intestine, spleen, liver, pancreas, and kidneys.

Two relatively constant symptoms are reported, dyspnoea and cyanosis. Scaphoid belly and changes in chest contour may occur.

Various auscultatory and percussion phenomena, obviously, obtain. The condition may be confused with pneumothorax, subphrenic abscess and thymic engorgement.

Scudder mentions two, probably authentic, cases diagnosed without the use of the *x*-ray prior to 1912 (no clinically diagnosed cases being reported since) although accidental discoveries at operation and in the deadhouse probably total over one thousand cases (III).

Thus the subject on the diagnostic side becomes solely Roentgenological. A resumé of the literature would seem to place the order of frequency in the left side, about seven cases being reported on the left to one on the right.

In presenting bibliography I have placed citations of cases accidentally discovered in the first group. The second group embraces those in which a diagnosis was made.

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GROUP ONE

(II) Dorris and Landis. Cite one case.

(III) Eppinger has collected twenty-one right and fifty-three left side cases. Of six hundred and fifty-two cases he recorded seventeen cases of eventration. Much space is devoted to developmental problems and clinical diagnosis.

(IV) Kelley refers to the subject but reports no cases. Of the six cases reported by Scudder (VI), a clinical diagnosis was made in two. (Citations of the others are included in Group Two.)

(VII) Vogel reports one autopsy.

(VIII) Caley publishes in Keen's Surgery a collection of two hundred and thirty-two cases with a relative frequency of two left to one right side.

(IX) Blacker Birnbaum refers to Tillman's thirty-seven left and five right sided cases.

(X) Lichtenstern refers to collection of sixty-five left and twelve right.

(XIX) Davis reports five cases discovered on the operating table. No mention is made of an attempt to use the *x*-ray. .

(XXII) Levit reports two cases discovered at operations; one containing liver and small intestine and one containing omentum.

GROUP TWO

(XX) Balfour reports Roentgen diagnosis of stomach in chest. Operation disclosed two ulcers in stomach.

(XXI) Mercade reports one case, in which Roentgenogram was made for shrapnel which had penetrated chest wall. The projectile had entered the stomach, which was visualized in the chest cavity.

(I) Dawns published LeWald's case which was operated successfully and symptomatically cured.

(III) Eppinger reports one case showing Roentgenogram by Pancoast; also a plate of Dr. D. R. Bowen's case described under *Eventration of Diaphragm*.

(V) McCleave reports a case, publishing a Roentgenogram of barium filled colon in chest. Roentgen examination by a technician.

(VI) Scudder published four Roentgen plates of hernia from files of the late Walter S. Dodd at Masschusetts General Hospital.

(XI) Stein's case of eventration of diaphragm was published with accompanying Roentgenograms by Dr. Turley from Michael Reese Hospital files.

(XIII) Stroem reports several cases diagnosed by means of x-ray. No plates were published. (It is unfortunate that he failed to note more particularly the number of cases he had.)

(XIV) Seibert reports one case operated after Roentgen diagnosis. No plates were published.

(XVII) Belansligui shows adult with part of colon in left thorax. Roentgen diagnosis made.

(XVIII) One case is reported in Policlin Roma, the x-ray being used. A part of colon and some omentum was found in the chest cavity. Author's name omitted in abstract.

CASE REPORT

The case here presented, L. L. M., age seven weeks, white, parents normal. The child was normally developed except "dry birth". Labor from eleven P. M. until four A. M. The child was well formed except tongue tied (requiring three-fourths to one hour at each nursing after tongue was freed).

There was noted a slight epigastric bulge, cold perspiration, difficult breathing, slight constipation, paroxysms of dyspnoea, tympany over right chest, and a fullness over normal liver region.

The patient was referred to writer's laboratory by Dr. E. A. Burkhardt on December 4, 1918. A barium meal in mother's milk was given at one-thirty P. M. Fluoroscopic and plate examination at five P. M. showed stomach contents retained except small amount visualized in the small bowel surrounded by gas, occupying the right chest cavity, displacing the normal chest contents entirely to the left half of chest. The heart was against the left chest wall.

The clear gas filled bowel convolutions showed a sharply defined path through the diaphragm to the right of the normal liver area.

At the eighteen hour period the stomach and small bowels were found empty, the colon being visualized on the pelvic floor.

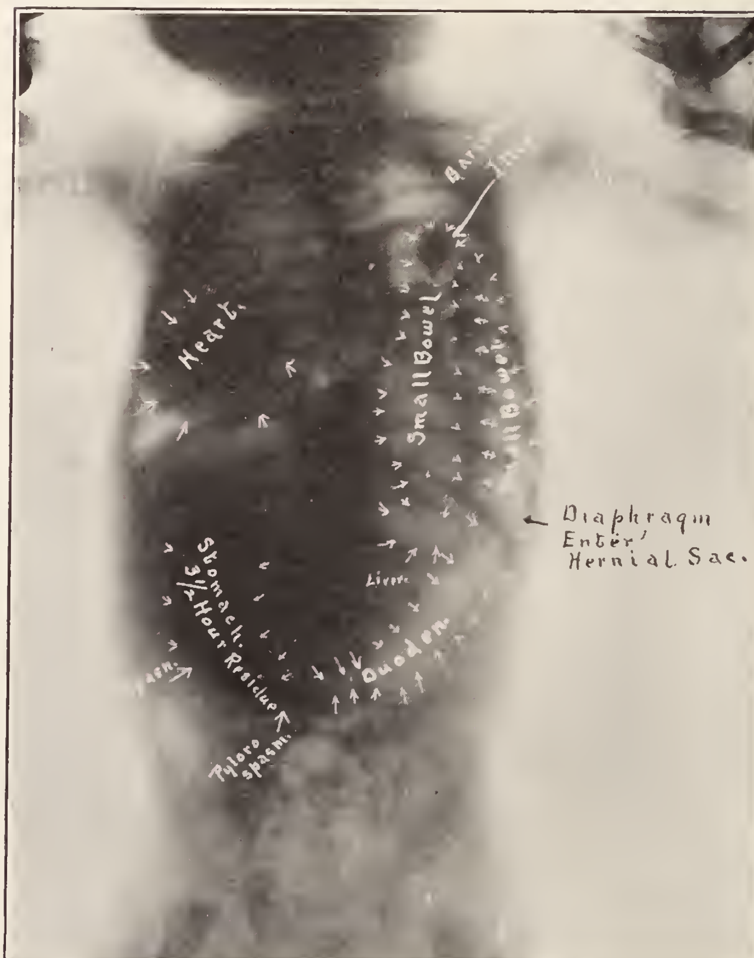
Roentgen Conclusions: Stomach normal shape, size and location. Ninety per cent. retention at three hour period due to pyloro spasm. Small bowel entering chest cavity through diaphragmatic opening along right chest wall.

A later report from the referring physician is to the effect that no added symptoms have developed at the end of the twelfth week.

It is with the hope that Roentgenologists may be stimulated to observe closely unusual chest phenomena, especially in infants, and that by so doing the pediatrists and profession at large may use more widely the means at hand for obtaining reports of the condition, thus establishing more accurately its importance in chest pathology, that this case is reported.

Although the case may be referred for chest examination, the routine barium meal should be resorted to on the slightest provocation, thus preventing the dangerous needle exploration, prompting intelligent medical treatment and conserving the child's welfare until surgical intervention may become possible.

We, as Roentgenologists, may well chide ourselves with the fact that we are wholly indebted for our literature on this subject to the general medical profession. Therefore, with the farther hope that this may be the means of stimulating the Roentgen men to compile exhaustive reports on subjects that are essentially Roentgenological and collect them for use in Roentgen publications I furnish such data as our Library Association has at hand.


Heart.
Small Bowel
Diaphragm
Enter'
Hernial Sac.
Liver
Stomach.
3 1/2 Hour Residue
Duoden.
Pyloro
spasm.


Left
Heart is Left
Liver
Stomach
Colon
Sigmoid

A SIMPLE SLIDE RULE FOR COMPUTING X-RAY EXPOSURE*

ONE PLATE

By
Millard B. Hodgson
Research Laboratory, Eastman Kodak Co.
Rochester, N. Y.

In a recent paper by Millard B. Hodgson, he outlined the fundamental factors entering into *x*-ray exposure and developed a formula for expressing these factors arithmetically, so that exposure could be computed easily. The formula developed was as follows:

$$\text{Time (in seconds)} = \frac{\text{Distance}^2 \text{ (in inches)} \times \text{Spark Factor} \times \text{Absorption Factor}}{\text{K (constant of plate)} \times \text{current in M. A.}}$$

or

$$t = \frac{D^2 \times S_f \times A_f}{K \times \text{M. A.}}$$

As stated in the paper in question, the writer did not offer this formula as a rigid form of technique since the special considerations of individual cases often have considerable influence on the method of procedure. The general results obtained from the use of this formula, however, in the hands of relatively untrained workers in the Research Laboratory were such that it was used altogether after a while as a standard guide in exposing for all casualty cases.

The one factor entering into the standardization of exposure which at first glance seems to be of considerable influence and difficult to gauge, is that of thickness of part. It has been found, however, that it is surprising how close to the correct exposure one can come if the effect of those

* Read before the Fourth Annual Meeting Western Roentgen Society, Chicago. November 20-21-22, 1918.

factors which can be accurately measured, such as spark gap, current and distance, is previously determined and an approximate value of the thickness of part is found.

The formula given above has been transferred graphically to a slide rule, an illustration of which is given in Figure I.

In operating the rule, the distance from anode to plate is set opposite the part to be roentgenographed. The number of milliamperes used is then set opposite the spark gap. Exposure will then be indicated opposite the particular material used.

The factor of thickness of part was determined from the result of a rather large number of exposures and is shown in the slide rule by the order in which the various parts of the body are given. Basing such an exposure formula on this system and taking the average value of thickness of part as found in a 150 pound patient, the result is found to be an exposure that is somewhere near correct. Allowing a 50% change for a fifty pound change in the patient will again bring the exposure within the limits of a negative which may be diagnosed.

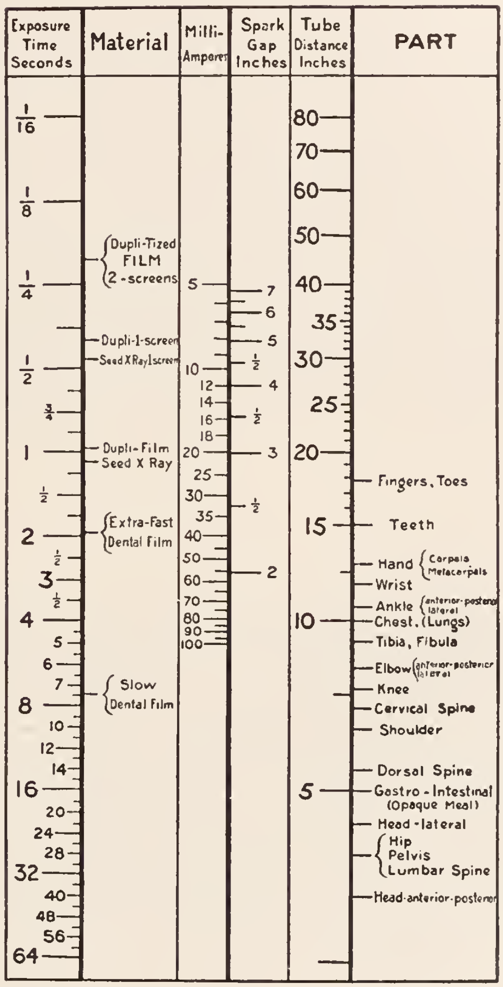
The main value of the rule is in the facility it gives for determining the effect of changes in such factors as spark gap, distance and current. The matter of giving the correct effect of thickness of part does not have to be of a high degree of precision if these other factors are precisely determined. This conclusion, of course, is evident for the less variations we have in any mathematical expression, the less chance there is for error in the computed result.

The other factors in the rule, aside from thickness of part, are of course, mathematically determined for we know rather exactly the effect of varying distances, spark gap, current and material.

Such a rule may be easily calibrated for any type of equipment or for any desirable standard of quality in the negative. To do this, one would simply have to set the rule for the exposure which has been found to be proper for the technique in question and with the sliders set at the various factors used, shift the position of the line indicating the material used till it coincided with the exposure given.

DISCUSSION

Mr. M. Morrison: I understood Mr. Hodgson to say that he got a little lower difference. The spark gap, of course, points only the peak of the wave. It gives a voltage very much like this (illustrating on blackboard). When you measure the spark gap you measure the peak value. In the case of an interrupterless machine with a revolving switch the current looks something like this (illustrating). You can see that the spark gap does not take into consideration the energy under this—the energy is equal to the voltage multiplied by the current. The spark gap only gives the peak value of it and you are minus the difference between this and this (illustrating) when reading with the spark gap, and in substituting this for this (illustrating) you get less output. If it was measured by some volt meter you would get better results.


Exposure Time Seconds
Material
Milli-Amperes
Spark Gap Inches
Tube Distance Inches
PART
Dupli-Tized FILM 2-screens
Dupli-1-screen
Seed X Ray 1 screen
Dupli-Film
Seed X Ray
Extra-Fast Dental Film
Slow Dental Film
Fingers, Toes
Teeth
Hand Carpals Metacarpals
Wrist
Ankle anterior-posterior lateral
Chest, (Lungs)
Tibia, Fibula
Elbow anterior-posterior lateral
Knee
Cervical Spine
Shoulder
Dorsal Spine
Gastro-Intestinal (Opaque Meal)
Head-lateral
Hip
Pelvis
Lumbar Spine
Head-anterior-posterior

A NEW GOGGLE FOR USE IN FLUOROSCOPY*

TWO PLATES

I. S. Trostler, M. D.
Roentgenologist to St. Joseph's Hospital. Consulting Roentgenologist to Children's Memorial Hospital and to The American Hospital
Chicago

That every roentgenologist should protect his eyes by wearing a pair of heavy lead glass goggles or a mask while doing fluoroscopy is admitted by all experienced workers in the field of roentgenology.

It is also acknowledged by busy men in this field—who must frequently go from the dark fluoroscopic room into a much more brightly lighted room—that a pair of dark glasses save much time in getting the eyes in a proper condition so as to see well in the dark.

After becoming tired of repeatedly changing glasses many times in a morning's work, I devised and constructed what seems to me to be a most practical and convenient combination goggle. I attached—by hinges—a pair of smoked glass goggles in front of my lead glasses. While in the darkened fluoroscopic room I have the smoked glasses raised up against my forehead. When ready to light the room I turn the smoked glasses down in front of the lead glasses and preserve all the dilatation of the pupils that is needed for quick resumption of fluoroscopy within one minute if desired.

Those needing correcting lenses may have them cemented inside the lead glasses, so that they may have virtually three pairs of glasses in one.

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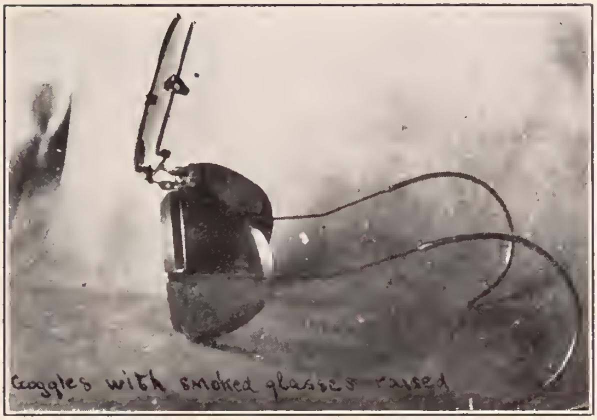
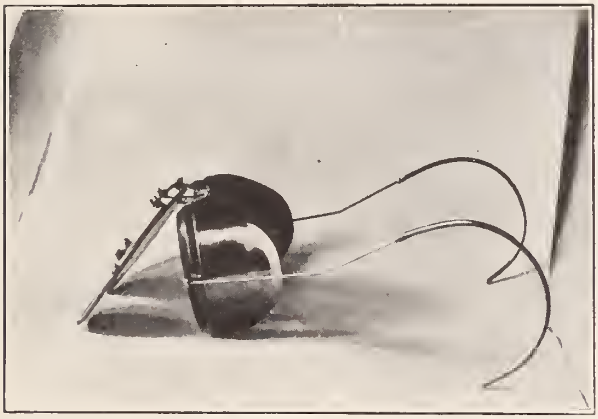
* Read before the Fourth Annual Meeting Western Roentgen Society, Chicago. November 20-21-22, 1918.


Goggles with smoked glasses raised



DIAGNOSIS AND CLINICAL MANIFESTATIONS OF CARDIOSPASM ASSOCIATED WITH DIFFUSE DILATATION OF THE OESOPHAGUS*

SIX PLATES

By

Frank Smithies, M. D., F. A. C. P.
Chicago, Ill.

Associate Professor of Medicine, College of Medicine, University of Illinois, Gastro-Enterologist to Augustana Hospital; Medical Consultant to U. S. Marine Hospital; formerly Gastro-Enterologist at the Mayo Clinic, Rochester, Minn.

Cardiospasm—A condition in which there occur diffuse dilatation of the oesophagus with the maintenance of the normal contour of the gullet, in association with a varying degree of hypertrophy of the cardiac sphincter. The hypertrophy of the cardiac sphincter may be of moderate extent, but when complicated by spasmodic, long continued contraction it results in transient or long maintained, frequently complete, obstruction to the passage of oesophageal contents from the gullet into the stomach. On the other hand the hypertrophy of the cardiac sphincter may be extensive, and this hypertrophy may of itself result in stenosis at the cardia, whether or not it be complicated by associated spasm. It should be definitely understood that the terms ''spasm at the cardia'' and ''cardiospasm'' are not synonymous. Only the latter form of affection includes thickening of the cardiac sphincter combined with diffuse dilatation of the oesophagus. Spasm at the cardia is a transient lesion of itself and is not associated with diffuse dilatation of the oesophagus, until it has been so long existent and of such constant maintenance as to pro-

* Read before the Fourth Annual Meeting Western Roentgen Society, Chicago. November 20-21-22, 1918.

duce oesophageal retention not of a transient nature and with the resultant dilatation of the oesophagus.

The dilatation of the oesophagus would appear to be due to numerous, rather indefinitely understood causes. Rosenheim has suggested as an explanation, primary atony of the muscular coats of the gullet; Kraus considers the condition due to the development of persistent long maintained spasm of the cardia, associated with paralysis of the circular muscles of the oesophagus, the latter resulting from degenerative changes in the vagi. Numerous authors, as for example, Fleiner, Zenker and Sievers, maintain that the dilatation results from a congenital predisposition on the part of the oesophagus; Martin considers a primary oesophagitis as an important factor. In addition, there have been advanced other explanations, *viz.*, kinking of the oesophagus at the cardiac opening; anatomic defects associated with the oesophagus or stomach, such as ulcer or carcinoma; congenital or acquired asthenia. Plummer, following Mikulicz is inclined to the opinion that, in addition to the changes occurring at the cardiac sphincter, there exists some disturbance of the nerve-muscle mechanism of the oesophagus, which permits diffuse dilatation of the gullet, even irrespective of an anatomic stenosis occurring at the cardia. Plummer emphasizes that there are numerous instances where there occur the habit of spasm at the cardia, without anatomic diffuse dilatation of the oesophagus.

In my opinion, it is quite likely, that such lesions as give rise to repeated spasms at the cardia are capable of producing muscular hypertrophy of an over-active and over-worked sphincter, and at the same time this alteration in sphincter reflex secondarily disturbs the neuro-muscular mechanism of the oesophagus above it. The over-worked sphincter apparently becomes capable of maintaining contraction beyond the normal time limits, inasmuch as the stimuli from above leading to the normal alternating cardial contraction and relaxation are delivered in an uncoordinated fashion and at irregular time intervals. The initial spasm at the cardia would seem to be initiated by numerous extra-cardiac stimuli. These stimuli may arise from the central nervous system, from the oesophagus itself, from the stomach, duodenum, gall-bladder, appendix or other abdominal viscera. In some instances, it would seem that they are initiated by psychic upsets. However, it should be emphasized, that cardiospasm is by no means an affection only of psychaesthenic or neuresthenic individuals. While the initial cause of spasm at the cardia may excite a more active response in individuals who are psychically or nervously abnormally responsive to stimuli, yet it should be recognized that in well developed instances of cardiospasm, the lesion which has to be dealt with is an anatomic one and not merely a disturbance functionally. In these patients there is a definite hypertrophy of the muscular cardiac ring and readily demonstrable and frequently persistent generalized dilatation of the oesophagus. It is important that these facts be recognized because upon their realization depends the application of proper methods of treatment. Patients affected with this lesion require more accurate therapeutic procedures than rest-cures, cessation from mental or physical over-activity, quieting medicines, Christian Science, osteopathic hocus pocus and the like.

The anatomic alterations in cardiospasm have already been mentioned, *viz.,* thickening of the cardiac sphincter, long maintained cardiac contractures, often spasmodic, and diffuse enlargement of the oesophagus without gross alterations in the contour of the gullet. The effect of these anatomic changes is to bring about dysphagia, imperfect passage of foods into the stomach and generally some grade of oesophageal retention. The degrees of retention may be marked, the oesophagus frequently containing several pints or liters of unaltered food. The remote effects are those attendant upon malnutrition. The degree of malnutrition may be pronounced and alarming as where malignant stenosis of the oesophagus exists.

MATERIAL STUDIED

During the past seven years, 63 instances of cardiospasm associated with diffuse dilatation of the oesophagus have come under observation. Tabulated records of 41 of these cases are available for study.

Sex—Of the 41 cases there were 21 females and 20 males. This approximate equality of the sex ratio is rather striking in view of the prevalent opinion among practitioners that females are more apt to be affected than males.

Age—The average age for the series was 39.7 years, the youngest case was aged 19 and the oldest 70. It is thus seen that true cardiospasm is a disease common to mid-adult life, the majority of instances occurring between 25 and 35.

Occupation appears to play a very small part as an etiologic factor but the disease appears to be relatively common in those individuals who are both physically and mentally very active. Temperament has been rather unduly emphasized in its relation to the initiation of cardiospasm. While it is true that many of these patients are delicately balanced psychically, yet a goodly number of them are of what one would call of stable temperament.

Ailments previous to the onset of cardiospasm with a few exceptions appear to have little bearing with regards causing the affection. It was noticed in our series that in six instances frequently recurring attacks of bronchitis or asthma were associated with dyspepsia and ultimately with dysphagia. These severe coughing spells might be a not unimportant factor in causing cardiac irritation and neuromuscular fatigue of the diaphragm. There were two instances of gastric ulcer proved by laparotomy, but the cardiospasm was in no way influenced by the operative procedure upon the stomach. In but five instances did shock, fright or acute fatigue precipitate the symptoms. Excessive smoking, particularly of cigarettes, was observed in three cases. This might offer an interesting etiologic suggestion to those who attribute cardiospasm to vagus malfunction.

Mode of Onset—In 12 instances the affection with the associated dysphagia was acute in its inception. In 29 cases (71%), the affection appeared gradually and was not infrequently punctuated by somewhat exaggerated attacks of distress.

Duration of All Symptoms—This averaged for the series 5.2 years and ranged for the individual cases from 3 months to 20 years. The degree of dysphagia or oesophageal retention, not infrequently bore no relation whatever to the time that symptoms had been present. Not rarely, oesophageal retention of as great a degree as 1000 c.c. arose in individuals who had been ill for less than a year.

The duration of the presenting trouble averaged for the series 3.25 years with a range in the individual cases of from 2 months to 20 years.

The *Dysphagia* is rarely painful. Usually there is a sensation of fullness or tension beneath the sternum, a feeling of tightness or a discomfort often described to a crowding of the heart. There may be dyspnoea or cough. The first swallows of food may produce the uncomfortable sensation. It is of diagnostic significance to know that liquid foods are more prone to bring about distress than are solids. In this way the type of dysphagia differs strikingly from that common to anatomic stenosis (ulcer, cancer, caustics, etc.) along the course of the oesophagus. There are instances, however, where the swallowing act at once excites sharp cramp-like pain usually located beneath the xyphoid. The pain may be at first acute enough to cause incapacitation of the patient and then may be followed an intermittent or continuous gripping or binding type of discomfort.

In our series of patients there was constant dysphagia in 39 cases. There was dysphagia to fluids only in 15, to solids only in 17 and to all foods in 19 cases.

Dysphagia is practically always accompanied by vomiting. A fairly characteristic and differential feature of this vomiting is that it is usually sudden, frequently propulsive and very often occurs shortly after the ingestion of food. Liquids are more apt to produce sudden copious emesis than are solids, in fact, the ingestion of soup or fluid at the early part of the meal may bring on spasmodic emesis of such sudden and forceful nature that the individual is compelled to rush hastily from the table to seek relief. This prompt vomiting of liquids is frequently aggravated by the fact that but rarely in general practice is the lesion of cardiospasm recognized. A dysphagia supposedly indicates a liquid diet and this constant attempt at taking liquids is followed promptly by vomiting, lack of nourishment and malnutrition. Solids or partly solid foods are generally well borne, particularly in early development of cardiospasm. The patient frequently finds this out himself and refuses to follow physicians' instructions where liquid diet has been urged. In advanced cardiospasm, practically all the food taken may be vomited within an hour or two following its ingestion.

The vomitus consists commonly of foods whose appearance resembles that of the food taken. It is alkaline in reaction, usually contains much mucus, rarely lactic acid or blood and may have a high bacterial content. At times vomiting is delayed and only when a large meal is taken at night is the emesis produced. At that time food eaten at breakfast or even the night before may be vomited unchanged. Sometimes the vomitus is copious at night and prevents proper rest and sleep. A few cases of even marked cardiospasm do not manifest vomiting but there is constant belching, bad taste in the mouth, eructations of food and frequently copious regurgitation of ill-tasting fluid food or mucus. Sometimes the nausea is pronounced and there is a great increase in the secretion of the salivary glands. Even if food does pass the cardia, the regurgitation of frothy, thick, tenacious mucoid material is annoying particularly when such occurs prominently toward evening. With the vomiting there occur evidences of lack of fluid in the tissues, constipation, diminution of urine, headaches, dizziness and anemia.

In this series of cardiospasm patients 26 vomited daily (frequently many times during the day). In 14 cases retention vomiting was observed. Frequently food (fruit skins, pieces of tomato, meat, etc.) was retained in the lower part of the dilated oesophagus for as long as a week. In eleven of our patients the vomiting was projectile. In such cases it was a common experience that patients began vomiting as soon as food was swallowed, frequently it being necessary for the patient to rush from the table to avoid accident. There was vomiting of blood in three cases. This hematemisis seemingly bore relationship to dilated or varicose veins in the lower oesophagus, although one could not always be certain that ulceration had not taken place in some portion of the oesophageal wall where varicosities were not present. In one case the hematemesis appeared to be definitely vicarious inasmuch as it occurred twice just before menstruation.

Regurgitation without actual vomiting was especially annoying in ten patients. This regurgitation was generally uncontrollable and the regurgitant food mass not rarely very copious in quantity. There were cases in which intermittent regurgitation preceded a period of vomiting.

Other Clinical Symptoms. Weight loss was experienced by all our patients. It averaged for the series 29.9 pounds and ranged in individual cases from ten to as great as eighty-two pounds. The appetite was stated as being lessened or as being poor in 66%. In 8% there was pronounced anorexia.

Bowels. Normal motions occurred in 45%. In the remaining cases there was generally obstinate constipation. This constipation was due largely to insufficient quantities of food or fluid passing the cardia into the stomach and bowel.

SPECIAL DIAGNOSTIC MANEUVRES

A stomach tube passed into the oesophagus usually promotes free food regurgitation about the tube and the spasmodic emesis of much food and liquid through the tube. The tube is generally passed freely as far as the normal cardia and here it meets an elastic resistance occasioned by either the tube impinging on the distended oesophageal wall and depressing its lower sixth or by pronounced contracture of the cardiac sphincter which renders the cardia impervious to the tube. In only a few of the early cases can the cardiac sphincter be forced and the tube passed freely into the stomach, unless the tube is passed upon a silk cord guide or its passage has been preceded by divulsive dilatation.

Unless guided to the cardiac orifice by a silk cord guide, an *olive bougie* passed into the oesophagus traverses the lumen until it meets a resistance at about the average distance of the cardia from the incisor teeth. With a silk cord held loosely, the olive may generally be passed further and the unsuspecting manipulator may fancy that he is well beyond the cardia and the olive lies in the stomach. Forcible pressure under such conditions is dangerous: one case of œsophageal rupture in our experience occurred after the patient had been "dilated by olives" for six months and was later devulsively dilated. At the autopsy it was found that at the lowest point of the dilated œsophageal sac and about two inches from the cardia, there was a denudation of the mucous membrane, marked thinning of the wall of the œsophagus with some peri-œsophageal irritation. The area of the œsophageal attenuation was about the size of a large olive, somewhat depressed and lay in a straight line from the pharynx to the lowest part of the œsophageal sac but was out of the line of the pharynx to the cardia. The guided devulsing dilator passed freely into the cardiac orifice but the increase in intraœsophageal pressure during dilatation was sufficient to cause rupture of the œsophagus at the spot where repeated bouginage had weakened the walls.

Even in obstinate cardiospasm it is generally possible for the *silk cord guide* to pass from the œsophagus into the stomach but at times the maneuver may require several days and the cord passed freely only when spasmodic contracture of the cardia has been minimized by the free use of atropin or belladonna. The olive bougie of large size passes readily to the cardia upon a taut string and moderate pressure forces the sphincter and permits the bougie passing into the stomach. Withdrawal of the bougie may be accompanied by similar resistance. It is usually apparent that the bougie exerts little effect upon a permanent enlargement of the cardiac opening or a permanent relief of the dysphagia. If the patient be examined at different times of the day or upon different days, a variation in the amount of resistance at the cardia may be determined, but it is characteristic of the affection that at every examination there is resistance present.

The *Roentgen examination* generally establishes the diagnosis. Upon swallowing the opaque meal, it will be seen that possibly a small amount of the mixture passes through the cardia into the stomach. In moderately well established instances of the affection, the cardia then closes and continued ingestion of the opaque mixture results only in filling out the œsophagus. It can then be shown that the œsophagus is uniformly dilated, that its contour is regular, that dilatation occurs along anatomic lines and that its cardiac end down to the hypertrophied sphincter presents no irregularities. In contour, such dilated œsophagus resembles a large lily-of-the-valley leaf or it is somewhat pear-shaped. The dilatation may be enormous and extend so markedly throughout the entire length of the œsophagus that its pressure upon the heart, the aorta or the trachea is readily demonstrable. The cardiac obstruction may be absolute and may be maintained for hours or until emesis or lavage result in an apparently reflex relaxation of the hypertrophied cardiac sphincter. Again in moderately advanced cases, œsophageal retention may be retained from a half to two hours and then the opaque meal passes slowly through into the stomach. Even in these cases, however, one rarely finds that the œsophagus completely empties itself within two to six hours. In the early cases, œsophageal retention may be but partial—one can see spasmodic contractures of the cardia with relaxations associated with intermittent passage of small amounts of the opaque meal into the stomach. The œsophagus will thus empty in a few minutes to an hour. Mild instances of the affection are not generally associated with great sac-like œsophageal dilation.

Roentgenograms should be made with the patient in the semi-lateral or "quartering" position. When plates are made with the patient in this position, the entire œsophageal contour may be delimited. In order to bring out the cardia and the lower portion of the œsophagus it is advisable to have the patient drink as much of the opaque meal as he is able to, then clasp his hands high above his head and take a deep breath. The inspiration depresses the diaphragm and thus generally enables accurate visualization of the lower œsophagus. The best Roentgenograms are made with the patient standing with his right side next to the plate. In the extensive cardiospasms anterio-posterior Roentgenograms should also be made in order to determine the lateral limit of the œsophageal sac and to demonstrate the degree of encroachment of the enlarged œsophagus upon the heart, aorta and lungs. In instances where the cardiospasm is not far advanced anterio-posterior Roentgenograms may fail to even indicate that the condition is present on account of the œsophageal shadow being over-lapped and hidden by shadows of the heart, aorta and spine.

In these early cardiospasm cases even lateral Roentgenograms may not satisfactorily portray the condition unless the exposure be made while the patient is swallowing. If some coarse, irritant food (as for example grated pineapple) be suspended in the opaque meal the degree of obstruction at the cardia as well as the extent of the œsophageal dilatation may be well estimated even where the lesion has not become advanced.

Œsophagoscopy. If the history has been well taken, the case examined thoroughly clinically and the evidence weighed with such as may be obtained from the passage of a guided olive bougie and from the Roentgenograms, œsophagoscopy is generally unnecessary. If there is great dilatation of the œsophagus, œsophagoscopy, unless guided, is apt to prove a dangerous procedure. If one is anxious to obtain ocular proof that the œsophageal mucosa is unbroken and the patient is equally anxious to have the interior of his gullet viewed, then one may carefully lavage out the œsophageal sac, pass the œsophagascope and explore the œsophagus from the pharynx to the cardia. In moderately advanced cases the mucous membrane appears reddened, thickened, œdematous, and congested. Its surface remains unbroken, the lumen is seen to be greatly increased in size, and toward the cardia localized saculation to the right or posteriorly may be apparent. The cardiac ring is generally seen in tight contraction and the orifice rarely visible. Entrance into the stomach even with a guided instrument is generally not possible. In favorable cases spasmodic contractures of the lower end of the œsophagus and of the cardiac sphincter may be glimpsed.

Prognosis. If the cases are properly handled, there is clinical and functional recovery in 70%. Improvement occurs in 20%. In the remainder, persistence of the lesion is the rule, seemingly resisting all forms of therapy. Gastrostomy may be required to save or prolong life. If associated lesions, such as gastric ulcer or malignancy, gallstones, appendix infection or lesions of the cardia or œsophagus itself are present, they seriously limit prognosis unless they have been appropriately treated. Even after the restoration of the cardiac sphincter-action, the œsophagus may remain greatly dilated permitting food retention. However it is surprising how great a dilation of the œsophagus may persist and yet be unaccompanied by troublesome dysphagia, provided the cardiac orifice is patent and the sphincter acts normally.

Dr. Walter S. Lawrence, Memphis, Tenn.: *Mr. Chairman:* I think this is a very valuable contribution and think the subject has been covered as well as it could possibly be done. I was particularly struck with Dr. Smithies' remarks because I have had a somewhat similar experience in suggesting this diagnosis to a general practitioner of considerable note. When I gave him this diagnosis over the 'phone his remark was, "How much digitalis shall I give the patient?" The subject is not as well known as it should be and many mistakes are made in diagnosis. If you mention the subject to ten men, I believe that three or four of them will look at you with an expression which will indicate that they wish to cover some ignorance on the subject.

One or two little things were called to mind by this paper. I suppose Dr. Smithies practices all these things and just took them for granted. It is always better to make the plates with the patient standing semilaterally, for in the lateral position you are apt to get the spine over the esophagus somewhat, the semilateral brings it out better. The fluoroscope is a great aid in the confirmatory diagnosis. It will enable you to avoid the possibility of error in some of these cases. I remember examining a case once where the barium mixture went freely down to the cardia as it usually does and then ran up and down the esophagus, forced by peristaltic and counter-peristaltic waves.

That was in a recent case and could not have occurred in an older case with loss of muscular tone of the esophagus. I made a plate which alone would certainly have been misleading, because at the time the current was snapped on it caught a peristaltic wave, and in the middle of the esophagus was a beautiful, ragged outlined stricture. The plate looked like a malignant stricture at that point as well as the cardio-spasm below, but when examined by the fluoroscope it was clearly seen to be cardio-spasm only.

Dr. I. S. Trostler, Chicago: *Mr. Chairman:* In regard to the paper which Dr. Smithies presents, he has the happy faculty of giving us the meat of any subject he discusses before us, as well as before other organizations, which makes his papers very valuable. I wish to tender my personal thanks and delight at having heard it. It is the tabulations of and comparisons between many cases that help. Many men read a paper of this sort and recite individual, unrelated details, but in this kind of a paper so carefully correlated and tabulated we are able to get the real good and real meat of the subject under discussion.

In regard to what Doctor Lawrence just mentioned about not giving the meal until after he had the light on, I have the patient stand with the glass ready to drink the meal, light up my tube, and at the word "drink" watch it pass from the first mouthful and see where it passes out. I think that is better than to have it held in the mouth, as many of these people can't hold it in the mouth without retching or gagging.

Dr. Frank Smithies, closing: *Mr. Chairman:* I want to thank the gentlemen for discussing this paper so generously. I think the point made by the last speaker is a good one. I believe that we rarely have the trickling through the cardia in our experience, but rather the spasmodic discharge of the contents, whereas in the frankly organic lesions we are likely to observe constant trickling, although this may be in very small amounts.

I think the other points brought out were also good. All of our examinations are carried out in the way that we have found useful to us. We always fluoroscope the patients thoroughly before anything is put into the oesophagus and in this way eliminate an oesophageal cause of dysphagia, as for instance, mediastinal tumor, large heart, aneurysm, or cervical rib. For the oesophageal examination the patient is placed in the semilateral position and observed during the entire time of swallowing. In some of the cases where the oesophageal anomaly was not pronounced, we have found it useful to add a little thickening material to the barium suspension, as for example, shredded pineapple. This works very well. It brings about a little increase of the oesophageal spasm and shows up better any dilatation. The other points made by the discussants were practical and I appreciate them.

FIG. I
Early cardiospasm with moderate dilatation of the oesophagus.
Lateral plate—Leopold Blum, Roentgenologist

FIG. II
Moderately advanced cardiospasm with dilatation of the oesophagus.
Lateral plate—Leopold Blum, Roentgenologist

FIG. III
Typical cardiospasm with diffuse dilatation of the oesophagus
Antero-posterior—Leopold Blum, Roentgenologist

FIG. IV
Well established cardiospasm with extensive diffuse dilatation of the oesophagus.
Lateral plate—Leopold Blum, Roentgenologist

FIG. V
Advanced cardiospasm with universally dilated oesophagus.
Antero-posterior—Leopold Blum, Roentgenologist

FIG. VI
Chronic cardiospasm associated with huge dilatation of the oesophagus.
Lateral plate—J. Johnson, Roentgenologist

Abstracts

A STUDY OF PULMONARY AND PLEURAL ANNULAR RADIOGRAPHIC SHADOWS

By

H. L. Sampson, F. H. Heise and Lawrason Brown

American Review of Tuberculosis, January, 1919, Pages 664-689

The authors point out that many of the annular shadows in roentgenographic plates of lungs are not intrapulmonary cavities but rather intrapleural and are therefore interlobar pneumothoraces and hydro-pneumothoraces. Clutrapulmonary cavities probably always cast a simple rarification or rarification complex on the screen but no single roentgenographic manifestation is pathognomonic. The absence or marked diminution of lung markings inside an area or areas of rarification is the most dependable, and if the size and shape of such an area or areas is taken into account the diagnosis can be made with much accuracy. An area of rarification within an area of consolidation or marked infiltration is also very reliable. Multiple small areas of rarification resembling a honeycomb is also of extreme value.

Annular shadows occurring in normal or only slightly infiltrated lung tissue leave one in doubt as to their diagnostic value. The authors made a detailed study of fifty cases showing such shadows and compared them clinically with fifty similar cases which had no such shadows in the roentgen plate.

Usually, more ray is absorbed within these shadows than in the surrounding lung tissue but sometimes more ray is transmitted. Lung markings are profuse in many of them even when their size is extremely large. The profusion of lung markings, the greater or equal absorption of rays within them, and also the fact that certain of these change their size and shape rapidly, make one skeptical as to their being caused by intrapulmonary cavities. Of their fifty cases, while under observation 18 per cent enlarged, 26 per cent diminished, 14 per cent disappeared, 4 per cent remained of the same size, 20 per cent appeared when previously not noted, and 14 per cent increased and then diminished.

There is considerable variation in the appearance of these annular shadows: at times they are like a ring of dense fibrous tissue, at other times like a circular deposit of fibrinous tissue or they may appear broad and homogeneous like a ribbon. In many instances the lower limit is horizontal and remains so no matter what the patient's position may be, like a fluid level. In some instances it was seen to shift on changing the patient's position, before the fluoroscope. Seventy per cent of these shadows are above the third rib and the rest are scattered everywhere in the lung field. They occurred in 11.8 per cent of four hundred and twenty-three consecutive admissions to the Trudean sanatorium.

Their study led them to believe that annular shadows, surrounding areas of increased or equal absorption of rays occur in patients likely to be suffering from pulmonary softening and indicate a rupture of lung so as to form localized pneumothoraces and hydro-pneumothoraces especially in the great oblique fissures and in the horizontal fissure on the right. These pneumothoraces can seldom be diagnosed clinically and indicate a somewhat graver prognosis. C. G. F.

J. A. Lichty, in *The New York State Journal of Medicine,* November, 1918, in discussing "The Incidence of Peptic Ulcer and Carcinoma in the Duodenum," analyzes records of 486 cases with duodenal disease; 6 of which were malignant and 480 benign, giving a ratio of 1 to 80.

In 780 cases of gastric lesions (reviewed), 240 cases of malignancy and 540 benign cases were found—giving a ratio of 1 to 2¼. In his own cases, the writer finds an incidence of only 1 malignancy to 40 gastric ulcers.

In 1020 cases of ulcer reviewed by Lichty, he found 480 were diagnosed as duodenal and 540 as gastric.

The dictum that carcinoma of the duodenum is most frequent in the papilla of Vater, is strikingly verified by this writer reporting 6 cases of carcinoma of the duodenum—all of which were in the papilla—none being found in the portion of the duodenum where ulcer is usually found. This is well brought out as further evidence against the theory of malignant degeneration of ulcer as the cause of cancer. I. S. T.

EPIDEMIC LETHARGIC ENCEPHALITIS (NONA)

History

The name "encephalitis lethargica" was coined by Economo, who described a group of cases of this disease occurring in epidemic form in Vienna in 1916 and 1917. It is a condition characterized clinically by lethargy or stupor and pathologically by polienceephalitis. Economo also referred to a mysterious condition called "nona" which occurred in Italy and Hungary in the spring 1890. Netter of Paris has pointed out that although this disease is new to present observers, it occurred in epidemic form following the influenza epidemic in 1890 in northern Italy and in Hungary and later made its appearance in the United States in 1895.

The first cases recently noted occurred in England in February, 1918. The disease was variously regarded as botulism poliomyelitis, and some new infection although the bacillus of botulism had not been isolated and there were reasons for doubting its identity with poliomyelitis. The disease was characterized by cranial nerve palsies and fever. The nerves most commonly involved were those supplying the extra-ocular muscles, and therefore the disease came to be spoken of as infectious ophthalmoplegia. Josephine B. Neal of New York recently discussed several cases in the Journal, which fall under this category. At Camp Lee eight cases were observed by L. Pothier; the commonest features in these cases being vertigo, diplopia, headache and slight fever. The spinal fluid was negative for organisms but showed a definite lymphocytosis.

A Report of Two of Eight Cases Occurring at Camp Lee
By L. Pothier, New Orleans

Case I. A private, aged 31; was admitted to hospital January 18, 1919; had had influenza in October, 1918. He noticed diplopia the day before admission and complained of headache, vertigo and costiveness. There was slight fever for twelve days with a gradual clearing up of symptoms. Neurologically the examination was negative except for 6th nerve palsy and nystagmus. Urinalysis—negative. Leukocytes 7,200. Differential, normal spinal fluid, February 4, 1919, showed a slight plus pressure; no organisms but a lymphocytosis (88%). Noguchi and Wasserman tests negative.

Case II. A private, aged 24; admitted to hospital January 31, 1919. A week before admission began to complain of headache, constipation, nausea, diplopia and vertigo. Examination revealed external ophthalmoplegia, exaggerated knee reflexes and a temperature ranging from 98 to 100. Leucocytes—normal. Spinal fluid count revealed a lymphacytosis (92 per cent lymphocytes—8 per cent large mononuclears). Naguchi and spinal fluid Wasserman negative.

Bacteriology

A report recently issued by the Local Government Board of Great Britain with the assistance of the Medical Research Committee recognizes the disease as an infection due to a specific virus. No recognizable organism has been detected in the tissues on microscopic examination. In all the reported cases the cerebro-spinal fluid has been bacteriologically negative. The fluid was clear in most instances but the cell count showed an increase in some cases.

Pathologically

Numerous necropsy reports failed to reveal any specific region of the brain as being affected although there is no doubt that the regio-thalmica and the mesencephalon are as often affected as any other part. Motor cranial nerve nuclei are involved while the sensory nuclei seem to escape. Macroscopically there is no change in the brain tissue. Microscopically there is thickening of the leptomeninges, with exudation or congestion, and the gray matter is seen to be the site of perivascular cellular infiltration.

Clinical Symptoms

The onset is usually gradual, although in some cases the disease has been ushered in by an attack of syncope. The most common characteristics are stupor and symptoms caused by lesions near the nucleus of the third cranial nerve. The temperature may range from 101 to 108. This continues for about five days followed probably by a period of apyrexia. During the prodeomal period we find the most frequent and characteristic signs are lethargy, asthenia, vertigo, diplopia, and headache. Following the prodromata the symptoms become more severe, the patient's face becomes expressionless or masklike and there may be facial paralysis. Nocturnal delirium and rigidity may set in. The commonest sign is ophthalmoplegia.

Dr. A. S. MacNalty, who contributes to the British report, recognizes seven types of cases:

(1) Clinical affection of the third pair of cranial nerves.
(2) Affections of brain stem and bulb.
(3) Affections of long tracts.
(4) Atoxic type.
(5) Affections of the cerebral cortex.
(6) Cases with spinal cord involvement.
(7) Polyneuritic type.

Prognosis

The prognosis is usually better than is suggested by the alarming condition of the patient. In the British report of 168 cases there were thirty-seven deaths. Economo reported six fatal cases out of eleven and Netter of Paris reported seven out of fifteen. The stupor usually extends over a duration of from two to five weeks. Certain manifestations have persisted such as persistent cranial nerve palsy, athetosis, ptosis of right upper eyelid, external strabismus and change in the mental condition of patient.

Treatment

Most authorities agree that no specific treatment is available at present. The patient should be put to bed. Warmth applied to limbs for pain and numbness. Opiates should not be administered. For the transient relief of pressure symptoms lumbar puncture is indicated.

FLUOROSCOPY OF THE CEREBRAL VENTRICLES

[Johns Hopkins Hospital Bulletin]

The lateral cerebral ventricles, when filled with air, can be clearly seen under the fluoroscope; 25 cases have been studied by this method.

The results in adults are equally as good as in children.

By fluoroscopy hydrocephalus can be accurately diagnosed at all stages of its development.

Several unsuspected cases of hydrocephalus have been demonstrated by the fluoroscope.

The diagnosis of a false ventricular hernia (ventriculocele) was made with certainty; because the air from the ventricle could be seen to pass directly into the swelling.

Fluoroscopy of the ventricle has practically the same range of utility as ventriculography, and almost the same results have been obtained. Following the injection of air into the ventricles, both fluoroscopy and ventriculography should be used.

A STUDY OF PULMONARY AND PLEURAL ANNULAR RADIOGRAPHIC SHADOWS

H. Sampson, F. Heise and L. Brown

[The American Review of Tuberculosis]

Since it has been the practice of many observers of *x*-ray plates to interpret all annular shadows as intrapulmonary cavities, the authors of this article attempt to show that these are often pneumothoraces. Intrapulmonary cavities usually cast a rarefication on the plates but whether these are diagnostic depends upon several factors. The absence or diminution of lung markings in an area of rarefication is dependable and more so if the size and position of the areas are taken into consideration. Another reliable factor is a circumscribed area of rarefication inside a marked infiltration. Multiple small areas resembling a honey comb in denser tissue is extremely valuable. The manifestation of annular shadows leaves one in doubt. The profusion of lung markings, the absorption of the ray through the annular shadows, and the frequent change in size and shape, make one skeptical as to their value in diagnosing intrapulmonary cavities. The character of these ring-like shadows varies, appearing sometimes as dense fibrous tissue; again as a circular deposit of fibrous exudate; at other times as ribbon-like and homogeneous. In the last two types the lower margin is often horizontal. Seventy per cent of these shadows are above the third rib, the rest are scattered through the lung field. In the study of fifty cases, chosen at random, the authors have concluded that annular shadows, surrounding areas of equal or increased absorption of the ray occur in patients suffering from pulmonary softening and indicate rupture of the lung. Owing to adhesions only partial pneumothorax results. Pneumothoraces occur in the greater oblique fissure, in the upper part and in the horizontal fissure on the right. They can rarely be diagnosed clinically. In these investigations it was found that in 11.8% of 423 cases these annular rings indicated pneumothoraces.

ROENTGENOGRAPHIC INJURIES DUE TO HYPERSENSITIVE SKIN

[Jour. A. M. A., Feb. 22, 1919]

Walter E. Dandy
Department of Surgery, Johns Hopkins University

The Court of Civil Appeals of Texas reverses a judgment for $2500 that was rendered in favor of plaintiff Harris for personal injuries alleged to have been inflicted on him by the negligent application of roentgen rays to his body by defendant Hamilton for the purpose of treating eczema. The fact was that the plaintiff was severely burned by the roentgen rays while being treated professionally by the plaintiff. The controlling issue of fact was whether the injury was caused by one or more of the acts of negligence alleged by the plaintiff or whether the injuries were suffered because the plaintiff's skin was hypersensitive to the roentgen ray current. The testimony was sufficient to authorize the jury to find that the plaintiff did have a hypersensitive skin and that this peculiarity was the proximate cause of the injury. A physician is not required to take precautions against abnormal idiosyncasy of which he has no knowledge and for detecting of which there is no means. The evidence showed that the defendant did not know of the plaintiff's hypersensitiveness, and that there is no way to ascertain such a peculiarity prior to treatment.

STEREOROENTGENOGRAMS OF THE INJECTED LUNG AS AN AID TO THE STUDY OF LUNG ARCHITECTURE

[The American Review of Tuberculosis]

William Snow Miller

By the use of differential injection masses in the pulmonary arteries and veins the relations of these structures are plainly outlined by stereoroentgenograms.

Even though the pulmonary arteries are uninjected, they can be recognized in stereoroentgenograms as comparatively dense markings along the lateral wall of the bronchi. Under similar conditions the main venous trunk can be made out on the mesial side of the stem bronchus, but in its ultimate distribution its branches are not associated with the bronchi.

In reading *x*-ray plates care should be taken not to mistake linear markings for densities produced by pathological changes.

Ring-like shadows with sharp borders that appear along the bronchi are often due to the plane that the bronchi bear to the observers. When these ring-like shadows are broad with irregular hazy borders they are cast by bronchial cartilages.

This study suggests once more the importance of a knowledge of lung structure for one in interpreting densities cast on the *x*-ray plate.

Town sites are usually a matter of real estate selling. City sites are a matter of physical geography.

Even as the routes of sea-borne commerce are determined by the great circles and the trade winds, so those of trade on land follow water courses, and, above all, water grades. And men, oddly enough, seldom choose wisely when they lay out cities for the future.

Ashtabula and Conneaut and Erie, Lorain and Huron and Sandusky—these are among the older towns on the south shore of Lake Erie, but Cleveland is the great city on that shore, and it was foreordained.

When, in 1796, the Connecticut Land Company sent out its surveyors to choose a town site at the mouth of the Cuyahoga river, neither company nor surveyors dreamed how well they worked. They picked a site because the river supplied fresh water—then—and the bar at the river mouth seemed no great obstacle to the small sailing craft which, they hoped, would some day sail the lake.

And the town they founded now stretches for seventeen miles along the lake shore, covers fifty-three square miles of territory, and is the home of more than eight hundred thousand people. It is the metropolis of Ohio, the greatest city between New York and Chicago, and the city in all the land which has the most diversified industries.

It may have been luck, or it may have been most unusual wisdom, but Moses Cleaveland, who headed that party of surveyors, pitched his camp upon the one spot which had a good harbor, and which had what was infinitely more important, a water grade south and eastward to the as yet undiscovered coal fields of Pennsylvania and Ohio.

The combination of lake frontage with the easiest of

Entrance to John D. Rockefeller's Estate—Euclid Avenue at Superior Avenue

Museum of Art—Located in Wade Park. One of the First Museums to Open Evenings. Perfect "Daylight" All the While grades to the coal fields made Cleveland a steel town, once the wealth of the Lake Superior ore deposits became known. Today, because of it, the city takes high rank in the production of automobiles and tacks, stoves, aluminum, iron, steel, brass castings, bolts and nuts, wire and wire springs and fence and nails, tools, machine tools, incandescent lamps and dry batteries, hoisting and conveying machinery, screws and ships, stoves for oil, gas and coal, metal stampings and hardware of every kind.

Steel leads. More capital is invested in it; it consumes more raw material, and its finished product is more valuable, than anything else that Cleveland makes. The Lake

Cleveland Chamber of Commerce, Overlooking Public Square

Superior district supplies the major part of the ore for the whole nation, and Cleveland takes a large part of this ore.

Cleveland, indeed, has eight great iron ore mining companies, with their own mines and properties in the Lake Superior district. Four out of every five freight boats, built for ore carrying, which ply the Great Lakes, are owned or controlled in Cleveland. In the ore, coal and

Airplane View of Cleveland's Main Business Section
(Courtesy of the Ernst-Eidman Company)

grain trades more than 450 bulk freighters are employed. Such steamers are built here every year by the dozen.

Because of its predominance in steel Cleveland has become the leader in American cities in the matter of things electrical. More than 90 per cent. of all electrical Mazdas made in the country are now produced in Cleveland's plants.

Euclid Avenue Looking East from Public Square

Cleveland got its start as an electrical city more than a generation ago when Charles F. Brush, himself a Clevelander, designed the first arc lamp, and tried it out upon a great mast in the Public Square. It was the first city in America to adopt electric lighting for its streets. Now it is the center of illuminating science for the world.

The National Electric Lamp association has its headquarters here, and its executive offices and laboratories. Nela Park, a beautiful tract of seventy-nine acres, has been called the University of Industry, and it is really that. It is a center for electrical research work, and the reports of its experts have always to do with innovations, improvements and corrections in lighting devices.

Cleveland is, moreover, a center for the production of automobile batteries, generators, vacuum cleaners, electric fans, electric trucks, electric cranes and electrically driven machinery of every kind. It is an automobile city, too.

Garfield's Tomb Erected in Lakeview Cemetery

Expansion of the automobile industry in Cleveland is one of the most notable of its recent developments. The list of cars manufactured here now includes the Winton, White, Peerless, Chandler, Stearns, Grant, Jordan, Abbott, Owen Magnetic and Templar. But the industry in Cleveland has not had a mushroom growth. It has been rapid, of course, but steady, for motor car experts everywhere are alive to the advantages of Cleveland's location and its varied interests.

Cleveland is a leader, too, in the making of automobile parts and accessories. It makes more automobile, wagon

One of Cleveland's Many Ore Docks and Ore Conveyors Along the Cuyahoga River and Lake Front

and carriage springs than any other city in the world, even as it is without a rival in the production of storage batteries, motor cylinders, rims and tubing. It makes frames, axles, bearings, fittings of various sorts, bodies, carburetors, crankshafts, motors, wheels, forgings, stampings and castings. It is estimated, indeed, that of every dollar that goes to the making of automobiles in America, thirty cents is spent in the city of Cleveland.

Cleveland holds, as it has held for years, second place among American cities in the manufacture of women's outer garments. Two business districts, one near the lake and the other on Superior Avenue, N. E., are filled with model factories, and the advanced methods and excellent working conditions of the Cleveland garment trade are recognized throughout the nation.

"City" Hospital (Municipal) Located on Scranton Road, S. W., Cleveland

There are no "sweat shops" in Cleveland. The city stands first in the percentage expended in wages.

Cleveland is a woolen town, too. Its eight woolen mills manufacture annually enough cloth for 2,000,000 suits. With allied industries they represent a capital of approximately $8,000,000.

Cleveland is, moreover, the greatest hardware center in the United States, and one of the greatest paint and varnish centers. It boasts the largest paint factory in the world.

Financially, Cleveland is the fourth city in the United States. The Federal Reserve Bank for the Fourth Federal district is here, and in bank deposits and banking strength it far surpasses its rivals in population. It is, after all, very largely a matter of location.

More than half the people in the United States and Canada live within 500 miles of Cleveland, and more than half

Terminal, Cleveland & Buffalo Transit Co.
The "Seeandbee", the largest and most palatial passenger steamer on fresh water, docks here.

the manufacturing within the borders of the nation lies within the same district. Its lake frontage, its easy access to the coal fields of Ohio, Pennsylvania and West Virginia, its proximity to Ohio's limestone and standstone quarries, and the low cost of water transportation from the Lake Superior ore fields have made its growth inevitable. There are few spots on the continent to which raw materials may be brought with facility along many lines, and few so advantageously situated in the matter of wonderful markets with steady buying power.

Cleveland has been an industrial center for only sixty-one years. In 1858, indeed, it was only the fortieth of American cities, a lake port of no importance and the center of a casual sort of land commerce from territory immediately tributary. In 1914 Cleveland had distanced in the

Edgewater Municipal Bath House and Pavilion, Located in Edgewater Park

race almost every one of its superiors of 1858. And Cleveland is still growing.

There have been spiritual as well as material and physical reasons for Cleveland's growth. In business and in civic affairs there has always been a compelling spirit of coöperation which has gone far toward making the city, despite its heterogenous population, a community in the best sense of that word.

Because of this characteristic in the average citizen Cleveland is usually ahead of sister municipalities. Even as it was the first city to use the arc light, it was first in the adoption of the "Sane Fourth". It was first to develop, in America, the daylight saving scheme, and first to devise the pay-enter street cars and to enforce the "Skip-stop" system for city street cars. It was first, too, of American municipalities to apply to a public service corporation that principle of a limited return upon its investment which has been favorably received elsewhere.

The Warrensville (Municipal) Farm or Colony
These institutions will be visited by the convention delegates.

Cleveland was a leader among American cities in the establishment of a community trust. The Cleveland Foundation, a fund supplied by the gifts of many donors, is being built up in order to further welfare work of real significance to the city.

Cleveland is a leader in the matter of municipal control of street railway lines. The city does not own the system, but it controls it in every detail of operation and improvement, and the rate of fare, adjusted by sliding scale, insures the owners of the property proper return on their investment, and the car riders service at cost.

Cleveland is the center of the paving brick industry for the United States, and, as a result, it is the center of one of the best paved sections in the United States. Cleveland, with its municipal suburbs, has more than six hundred miles of brick pavement. Cuyahoga county, which is known internationally as the best paved rural section in the world, has used brick almost exclusively. Its automobile drives are a delight.

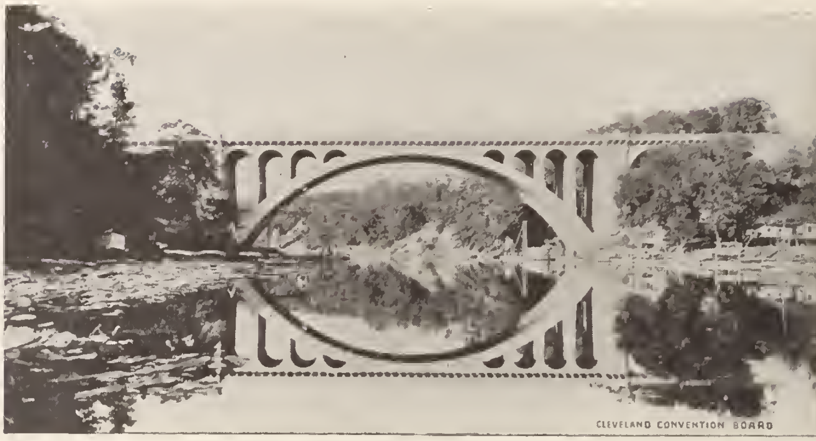
Cleveland's churches were the first in the nation to create voluntarily a controlling federation. An immediate result

Nela Park—The Home of the National Lamp Works of the General Electric Company
Convention program includes a visit to this "university of electricity."

was a notable increase in religious activity and the stimulation of many movements for civic betterment.

In matters of education Cleveland's equipment is of the best. There are 110 grade schools in the city, twelve high schools of which three are technical, nine junior high schools and fifty-seven parochial schools. Cleveland is the seat of Case School of Applied Science, of Western Reserve University (including the College for Women) and of St. Ignatius college. Case alone offers courses in civil, mechanical, electrical, mining, metallurgical and chemical engineering and in physics.

Western Reserve includes schools of medicine, law and dentistry and pharmacy, and courses in education and Applied Social Science. St. Ignatius confers degrees in philosophy, language, history, science and mathematics.



Rocky River Bridge—Said to Contain the Second Largest Span of Reinforced Concrete in the World

Scene in Rockefeller Park
This magnificent boulevard leads three miles to right to Gordon Park and famous Lake Shore Drive.

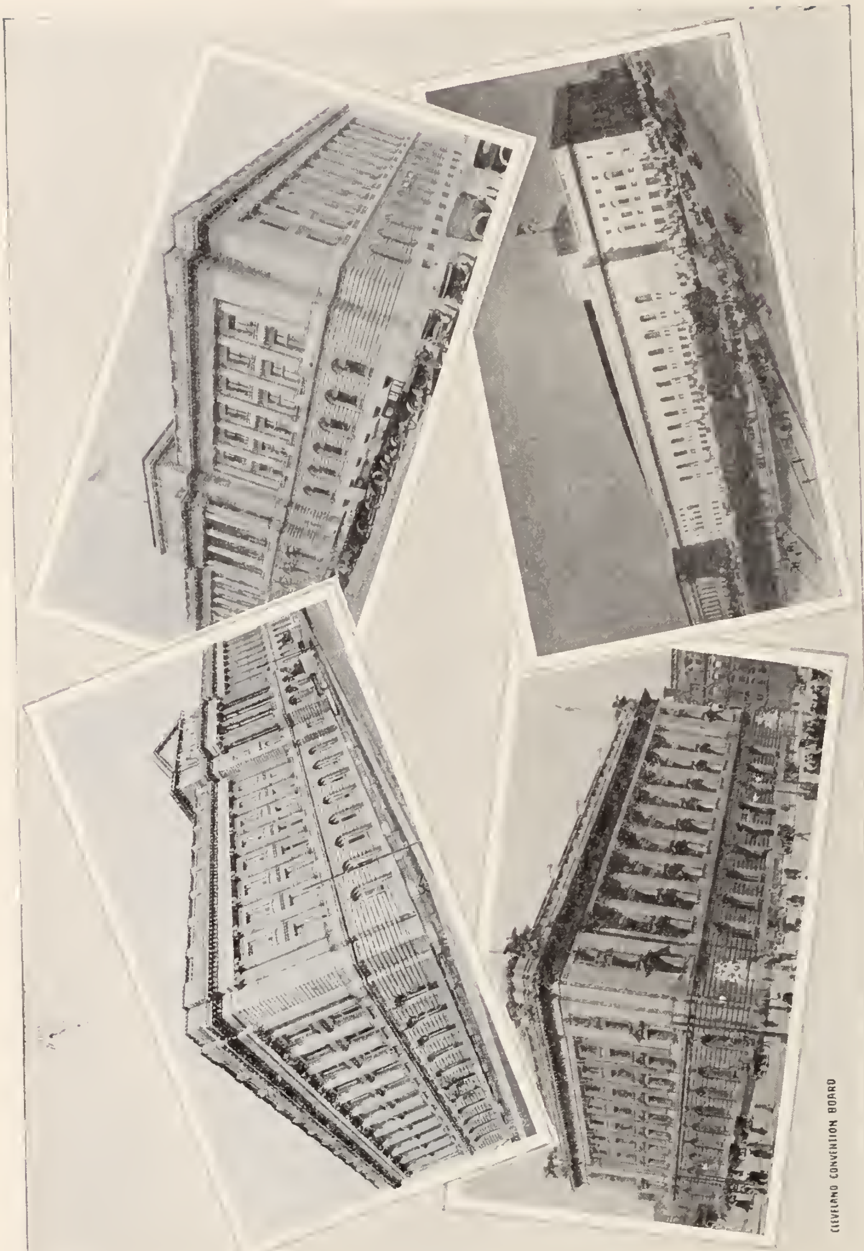
New Superior-Detroit High Level Bridge—Spanning the Cuyahoga River and Valley

Lower deck carries six street railway tracks while upper decks have 45-foot roadway and two 15-foot walks for perestrians. The largest freight vessels on the Great Lakes pass under it without housing top masts. In left center foreground may be seen a coal chute into which coal cars, after being hoisted bodily, are dumped and the coal then falls through the chutes into the holds of the vessels.

The Cleveland Public Library, too, must be classed as one of the city's major educational institutions. It maintains forty-six branches and 590 distributing agencies. In gross circulation of books the Cleveland library is third in the United States. In per capita circulation it is first.

The Cleveland Art Museum, recently erected in Wade Park, is one of the finest in the country.

City planning, and development of a civic center, have received more attention in Cleveland than in almost any other city of its dimensions, and with more profit to city and citizens. Cleveland's "Group Plan" has attracted



City Hall—Cuyahoga County Court House—Municipal Auditorium—Federal Building (Under Construction)
These magnificent buildings form only a part of Cleveland's "Group Plan" of public buildings on the "Mall". The development when completed will represent an outlay of thirty million dollars.

Lakeside Hospital—Lakeside Avenue Near East 12th Street and Overlooking Lake Erie

world-wide attention. Developments on and adjoining the Mall have already passed the $17,000,000 mark and the completed plan is expected to cost the city and county more than $30,000,000.

Already the federal building, the Cuyahoga County Court House, and the Cleveland City Hall have been erected as a part of the Group Plan, and work has been begun upon a new Public Library, a great Public Auditorium, and a jail and criminal courts building.

The Public Auditorium, and the way in which it came to be, are indicative of the way Cleveland does things. The president spoke in Cleveland in 1916, and Clevelanders were chagrined at the lack of an auditorium which would accommodate those who wished to hear him. Mr. Wilson was hardly out of town before the mayor had initiated a campaign for a Public Auditorium on the Mall, citizens and

Shaker Heights Country Club House—One of Cleveland's Many Attractive Golf Club Houses and Courses

civic organizations joined in a whirlwind campaign, and a bond issue of $2,500,000 for such a structure was authorized by an overwhelming vote.

The city's correctional institutions have their own Group Plan, on a great tract of high land without the city's limits. This group comprises a hospital and work-house, and an infirmary situated on a 2200 acre farm, known as the Warrensville Colony. These institutions, as well as Cleveland's municipally owned hospital, are under the jurisdiction of the department of public welfare. The hospital cares for the needs of the sick, while the correction farm, in addition to caring for tubercular patients and other pernicious diseases, functions as its name implies—as a corrective institution in connection with Cleveland's need for law and order. The Warrensville Farm stands as a monument to the generosity and kindliness of the people of Cleveland, affording as it does, a fine sanitarium for tubercular patients, a home for aged and infirm men and women with cottages where old couples can spend their

Hotel Statler—Euclid at East 12th Street
Headquarters Western Roentgen Society Convention, June 5, 6, 1919

last years together, and all the necessary buildings which go to make a city farm complete.

Cleveland is essentially a city of homes. There are no large congested areas, and federal census figures indicate that 35 per cent of the homes within the city limits are the property of their occupants. It is the second city in the nation in this respect.

Cleveland came to be just this kind of a city largely because of coördinated effort, and the major means for this

Public Square, Cleveland

coördination has been the Cleveland Chamber of Commerce.

This organization with a membership of nearly 3,500 business and professional men, contains several internal organizations—Manufacturers' and Wholesale Merchants Board, Convention Board, Retail Merchants' Board, Association of Women's Wear Manufacturers, Association of Motion Picture Producers and Hay and Grain Exchange.

Cleveland has always been a convention town, and it likes conventions. It has known, always, that gatherings of tradesmen, manufacturers, and scientists are good for the city, and that those who attend conventions here if they be interested in modern business and manufacturing development and in civic improvements, are deeply impressed and benefited.

For the accommodation of such conventions, Cleveland is unusually equipped. Three of its best hotels are the largest in Ohio, and a fourth is of but slightly smaller capacity. These hotels, and half a dozen others, are modern, splendidly equipped and centrally located, easily accessible from the city's principal auditoriums. Each, too, is well provided with assembly halls, banquet, registration, committee and private dining rooms, designed to meet the requirements of any convention.

As a convention city Cleveland's location is ideal. Situated midway between the Atlantic and the Mississippi, it may be reached overnight from either boundary. Combination rail and water tickets are available for delegates whose routes parallel the lakes, and the finest and largest passenger steamers in fresh water come to its docks.

Lake Erie's breezes temper the summer heat—which averages only 66 degrees Fahrenheit—and this fact has much to do with Cleveland's popularity as a summer convention city. Its beautiful parks, its forty-two miles of boulevards, its amusement parks of every type; these will afford entertainment for those who ask it out of doors.

ANNUAL MEETING OF THE OMAHA ROENTGEN RAY SOCIETY

The Annual Meeting of the Omaha Roentgen Ray Society was held in Omaha on Saturday, April 5, 1919. Roentgen Clinics were held at St. Joseph's Hospital by Dr. A. F. Tyler and at the University of Nebraska Hospital by Dr. C. H. Ballard. The regular sessions were held in the ballroom of the Hotel Fontenelle.

The morning session was called to order by the President, Dr. A. P. Overgaard, at ten o'clock. Dr. A. F. Tyler of Omaha read a paper on Deep Therapy, and Dr. R. L. Smith of Lincoln gave a cinematographic demonstration of the Massive Dose Method. Both Dr. Tyler and Dr. Smith advocated using the maximum amount of dosage with the minimum amount of filter which could be used with safety to the patient, even, in extreme cases, disregarding, to some extent, the cosmetic effect in favor of the cure.

Dr. B. H. Orndoff of Chicago lead the discussion and said that he had never been able to get up nerve enough to use the extreme dosage advocated by Drs. Tyler and Smith. He suggested that the roentgenologists ask the surgeons to coöperate with them in a new manner—by operating inoperable cancers, removing whatever cancer tissue was possible and leaving the area exposed. This area he suggests covering with adhesive as recently put forward by a Chicago physician for growing skin without grafting, and then administering the masses doses of roentgen ray, thus giving the ray a much better opportunity to destroy the cancer cells. By this method of coöperation and working he believes the percentage of recoveries in the inoperable cases will be greatly increased.

Dr. W. P. Wherry of Omaha read a paper on the Value of Roentgenograms of the Accessory Sinuses of the head.

Dr. Wherry stated that a mere report that the sinuses were clouded was of little value, but stated that by improved technique the roentgenograms could be made of much greater value.

In discussing this paper Dr. H. B. Lemere endorsed the suggestions of Dr. Wherry and urged greater coöperation on the part of the roentgenologists in this work, saying they needed the assistance of the roentgenologist in reading the shadows because he could read those shadows and they could not. Dr. Overgaard suggested for the benefit of the dental men that the same oblique position would give them very good shadows of molar teeth both upper and lower and point out focal infection. Dr. Rainer of Grand Island and Dr. M. E. Vance of Lincoln also took part in the discussion.

The first paper on the afternoon program was by Dr. Boyd Gardiner of the Mayo Clinic. Dr. Gardiner stated that at the Mayo Clinic they used an ordinary dentist chair in taking roentgenograms of the teeth, and outlined the method of placing the films to get the best possible results for the aid of the dentist. He illustrated with a blackboard sketch just how the film should be placed to give the necessary information. He stated that 97% of the people going through the dental department needed extractions. This paper was discussed by Dr. B. H. Harms of Omaha.

Dr. A. L. Smith of Lincoln, Neb., talked on the subject of Dental Infection in Children. He made a very earnest plea that this source of infection be carefully watched, urging the coöperation of the dentist with the child specialist. He pointed out many cases in which dental infection had played a large rôle in the health of the child and in his future welfare.

Dr. J. B. Fickes in discussing the paper urged that the physician follow up his recommendation that the child visit a dentist that he outline the work and work in harmony with the dentist. Doctors Smith and Fickes believe that all pathology should be removed even though it necessitates the early removal of the first teeth, believing that the detriment to the second teeth and to the jaw formation is of much less importance than the undermining of the child's general health by the constant infection.

Dr. W. L. Shearer, Omaha, read a paper going into the question of dental roentgenology from the standpoint of the oral surgeon and covering very completely the lymphatic system and the method by which infection from the teeth is spread throughout the body.

Dr. O. H. McCandless of Kansas City talked on Roentgenology of the Gastro Intestinal Tract. He outlined very fully his method of raying the intestinal tract, and illustrated the talk with lantern slides.

Dr. W. W. Wasson of Denver gave an illustrated talk on Roentgenology of the Chest, going very fully into the findings as shown by the roentgenogram.

Value of the *x*-ray from the Internist's Standpoint was the subject of Dr. A. D. Dunn of Omaha. Dr. Dunn advocated the routine use of the *x*-ray in diagnostic work, but insisted that it was but a single method and that *x*-ray diagnosis is a misnomer. He said that it was a morphological method and that the future medicine lay in physiological and biochemical methods. He urged that the work should be done only by the specially trained and experienced roentgenologists who should provide findings with possible interpretations and not diagnosis.

Dr. B. B. Davis of Omaha discussed the Value of *x*-ray from the Surgeon's Standpoint. He spoke of the surgeon's dependence on *x*-ray as an aid in diagnosis, but he also urged that emphasis be laid on the word "aid" because the surgeon who overlooked his ordinary clinical methods and trusted the *x*-ray alone is headed for destruction. When used in connection with every other diagnostic aid known to the profession Dr. Davis said he would take his hat off to roentgenology as one of the greatest helps known.

Dr. Roeder lead the discussion and corroborated the statements of Drs. Dunn and Davis as to the value of *x*-ray as an aid and stated that he believed that the ratio of its importance was about the same as the ratio of x-ray men on the program which had been prepared by the x-ray men, *i. e.*, one to ten.

A banquet was served at 6:30 at the Fontenelle and the evening session was given over to returned war heroes.

Capt. N. C. Prince spoke on the subject of The Mobile X-Ray Unit on the Western Front, Captain C. N. O. Lear of Des Moines, Iowa, told of his Experience in the First Line Trench Work, and Col. A. E. Merritt of Council Bluffs gave a cinema demonstration of the U. S. Roentgen Field Apparatus, and a Comparison of the Apparatus of the Enemy.

It was gratifying to hear that Germany was using roentgen apparatus of American make, and that they were too antiquated to be recognized by the American doctors. Also to hear Dr. Prince's assertion that French equipment was very bad, and American equipment exceptionally fine.

MEETING AT KANSAS CITY

The Kansas City Roentgen Club held a meeting in conjunction with the Jackson County Medical Cociety, April 1, 1919.

A banquet was served at 6:30 p. m. in the Hotel Muehlbach.

The scientific meeting was called to order by the chairman in charge of the committee on roentgenology, Dr. O. H. McCandless, at 8:00 p. m., in the rooms of the Kansas City Medical Library.

Dr. B. H. Orndoff of Chicago read a paper, "Early Tuberculosis in Children and Adults." Dr. Orndoff's paper and lantern slide demonstration was very interesting and instructive. The pathological, physical and roentgen findings were very ably correlated.

Dr. Bundy Allen read a paper on "X-ray Examination of the Accessory Sinuses of the Head." Dr. Allen's paper was illustrated by the presentation of a large number of dissected dried skull specimens and lantern slides.

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APPARATUS FOR PORTABLE RADIOGRAPHY

W. D. Coolidge

Schenectady, N. Y.

INTRODUCTION

For cases which cannot safely or conveniently be moved to an x-ray laboratory, the need has long been felt, by the medical profession, of x-ray apparatus suitable to conveniently transport to, and operate in, the home of the patient.

In hospital work, also, there is a need for portable x-ray apparatus which can be conveniently taken to, and operated at, the bedside in any private room or ward.

The extent to which such apparatus will be used in the future will depend upon the state of development of the apparatus at the time in question. It will depend upon such factors as the electrical and x-ray efficiency, ease of portability, convenience in handling, controllability and reliability.

The problem is not new, but its importance seems to justify a great deal of careful and extended consideration and research. Although the work of the author and his associates, in this field, is not yet completed and is in many ways imperfect, the following general discussion of the problem and the description of an experimental portable apparatus, together with the considerations which have led to its present form, may be helpful to the advancement of the art.

GENERAL CONSIDERATIONS

The presence or absence of an existing electric lighting or power circuit has, of course, nothing to do with the desirability of having x-ray diagnosis, but it has much to do with the form of apparatus required. For this reason, this section will be treated under two headings:

(a) *Where there is no Existing Electrical Supply Circuit.* In this case, recourse may, at the present time, be had to the "U. S. Army Portable Outfit."[1]

For civilian practice, it is clearly desirable to have something of easier portability than this, and for this reason, apparatus similar to that described below could well be used to replace the instrument box, tube, and tube holding mechanism of the "U. S. Army Portable Outfit."

(b) *Where an Existing Electric Supply Circuit is Available.* This is the condition which has been predicated thruout the following discussion.

1. *Weight and Size Limitations.* It seems desirable that there shall be no single piece of the apparatus which cannot be conveniently carried by one man. Experience shows that a package weighing 43 pounds and having a thickness of 7 inches and a depth of 15 inches and a length of 14 inches can, when provided with a suitable handle, be conveniently carried for short distances (say a couple of hundred feet) and up and down stairs. With a given weight, an increase in thickness is always troublesome and, for going up and down stairs, length and depth also deserve serious consideration, as they determine whether the arm of the person carrying the package can or cannot be fully extended. It seems undesirable to have any single package appreciably exceed 45 pounds in weight.

As the outfit must be readily transportable in an automobile, it seems desirable to limit the length of the longest package to the width of the tonneau of a small car, that is, to about 36 inches.

2. *Capability of Standing Mechanical Abuse.* As a portable outfit is necessarily subjected to a great deal of mechanical vibration during use and transportation, it should be as rugged in construction as is possibly con-

[1] W. D. Coolidge and C. N. Moore, *General Electric Review,* Vol. 21, pp. 60–67 (1918).

sistent with the required light weight. Provision must, of course, be made in suitable carrying cases for any necessarily fragile parts.

3. *Water-proofness.* As the outfit must, obviously, often be taken out in the rain, it is desirable that every part shall either be rainproof or provided with some waterproof cover.

4. *Amount of Electrical Energy Available.* The operating electric current will, in general, be taken from a lighting circuit and the connection will be made to the nearest lamp-socket or base-board receptacle. This will usually mean a 110 volt circuit fused for either 6 or 10 amperes. The total amount of energy available will then be about 660 watts (the amount used in the electric flat-iron). For radiographic exposures of one second or less, about twice this amount of energy can be used without blowing 6 ampere fuses. Longer exposures with this larger amount of energy can, of course, be made by replacing the usual 6 or 10 ampere house fuses with some of larger capacity.

5. *High Efficiency Desirable.* As the amount of electrical energy available is so definitely limited, the questions of electrical and *x*-ray efficiency are clearly matters of prime importance.

6. *Best Voltage for X-Ray Tube.* As, with a given amount of energy supplied to the tube, the photographic action of the *x*-rays produced increases directly with the voltage, it is clearly desirable to use as high a voltage on the tube as is consistent with the production of satisfactory radiographs. This appears to be about 60,000 volts.

7. *Size of Focal Spot in X-Ray Tube.* For best definition in radiography, the size of the focal spot in the tube should always be as small as can be used with the amount of energy to be employed. As, for portable work, not more than 10 milliamperes at 60,000 volts is available, this will mean a focal spot diameter of about 1/8 inch (3 mm.).

8. *Rigid Tube-Support.* It will be possible to get, in portable work, the fine definition which comes from the use

of such a small focal spot. To realize on this possible gain, however, it will be necessary to take adequate precautions to guard against too much mechanical vibration of the tube. (An amplitude of vibration of as little as 1-16 inch would, for example, reduce the sharpness of definition from that obtainable with a 10 milliampere tube to that of a 30 milliampere tube. This calls then, for a very rigid tube-support.

9. *Low Tension Winding of Transformer or Coil should be Insulated from Ground.* This is made desirable by the fact that, in most cases, one side of the lighting circuit is already connected to the earth. If such a circuit was connected to a transformer primary, one of whose terminals was already connected to earth, it would cause a short-circuit on the line unless it happened that the grounded side of the line was connected to the grounded side of the transformer. The necessity of finding out, by suitable test, which side of the line is grounded is obviated if the transformer primary is itself not connected to earth.

10. *Sufficient Range of Electrical Control to Adapt Outfit to Operation on All Lighting Circuits.* The voltage of lighting circuits varies somewhat in different cities, and in different parts of the same city and is also different in a given place at different times. Furthermore, the voltage which must be supplied to the primary of a transformer or coil for a given secondary voltage is not independent of the load, but increases with it. It is desirable that one should always be able to supply to the tube terminals the same high tension voltage regardless of what the line voltage at that particular place happens to be at that particular time and regardless of the milliamperage which he chooses to use. For this reason, there should be a control apparatus, and its range should be adequate.

11. *Quietness of Both Mechanical and Electrical Operation.* This seems especially desirable in portable work; for those patients who cannot safely be taken to an *x*-ray laboratory are in general in poor condition to stand noises

caused either by the mechanism of an x-ray outfit or by high-tension discharges. This condition is further intensified by the fact that, owing to the small size of the average bedroom, the whole outfit is very close to the patient.

12. *Sufficient Mechanical Flexibility in the Tube-Holding Mechanism.* The tube-holding mechanism should have ample flexibility so that the tube can quickly and readily be brought to any desired position, in order that the patient may be disturbed as little as possible.

13. *Ship-Shape Condition of High Tension Circuit.* The condition and surroundings attending portable work are certain to be very varied. To safeguard both patient and operator from accidental electrical shock, it is, therefore, even more than usually desirable that all parts of the high tension circuit should be in as ship-shape a condition as possible.

14. *Current Limiting Device.* To further safeguard patient and operator from the high tension, some form of overload circuit-breaking device should be used in the low-tension circuit. In case a human body were accidentally interposed between the high tension conductors, the house fuses might eventually blow, but a good mechanical circuit-breaker would operate much more rapidly and hence give better protection.

The overload circuit-breaker also affords a good deal of electrical protection to the x-ray apparatus itself.

15. *X-Ray Protection.* In the past, portable work has often been done with entirely inadequate protection for the operator, and this appears to be one of the reasons why so little portable work has been done. It is clearly desirable to have as good x-ray protection in the home of the patient or in the hospital as in the x-ray laboratory.

16. *Stereoscopic Tube-Shift.* In many portable cases it will be difficult to move the patient so as to get the customary right angle projection. Provision, therefore, should be made for stereo-radiography.

17. *Connections for Low Tension Circuit.* The ter-

minals of the connecting cables should be so designed that the apparatus cannot be connected up wrong. The terminals should also be sufficiently rugged so that they can be stepped on without being injured.

18. *Precautions Necessary to Guard Against Tube Breakage.* Experience teaches that even in the x-ray laboratory many more tubes are broken in handling than in use. In portable work, the amount of handling which the tube will receive will be much greater than in laboratory work, and as a result, breakage will be greater unless careful consideration is given to the design of the tube, the tube-holder and the tube-carrying case.

DESCRIPTION OF AN EXPERIMENTAL PORTABLE OUTFIT

The experimental apparatus described below is the result of an attempt to comply with the requirements laid down in the preceding section.

1. *General Description.* The complete alternating current outfit, as it stands, ready to be taken out, is shown in Fig. 1, and again set up ready for use, in Fig. 2. In Fig. 2, the lamp socket which serves as the source of current is at the right and above the picture. A cable is seen leading from the lamp socket down to the instrument box on the chair. From the left side of the instrument or control box, another cable is seen leading to the transformer which stands on the base of the wooden tube stand. From the transformer, insulated conductors (a single one at the anode end and a double one at the cathode end) carry the high tension current to a new self-rectifying radiator type of x-ray tube. On the top of the instrument box the single control handle is seen at the front left-hand corner and the push-button x-ray switch at the front right-hand corner.

2. *The Tube.* The regular type of hot-cathode tube, together with the special lead-glass shield which goes with it, weighs about 7 pounds. Experiments with this combination showed that, because of its heavy weight, a relatively heavy and bulky tube-stand was required for a sufficiently

rigid support. For this reason, the development of the special small tube, shown in Fig. 3, was undertaken. This tube has an overall length of 14 inches. The bulb has an inside diameter of 2 inches and an outside diameter of 2½ inches. Except for the transparent window, the whole tube is made of glass having a very high lead content (55 percent by weight of element lead, equal in protective power to one-fourth its thickness of sheet lead). The bulb is ¼ inch thick and therefore offers the same x-ray protection as 1-16 inch of sheet lead.

This tube then requires no external x-ray shield and offers the same protection as does the regular 3¾ inch radiator tube when the latter is equipt with its special heavy shield.

It had been the original plan to use a small tube made of the ordinary thin-walled lime glass and to surround this with a close-fitting thick-walled lead-glass shield. The experiment was tried, however, of making the bulb of the x-ray tube of the thick-walled lead-glass intended for the shield, putting in a thin-walled lead-free window for the passage of the desired bundle of rays.

There was a great deal of difficulty encountered in making the first experiment. The lead-glass used was a quarter of an inch thick and was, for this reason, very hard for the glass blower to handle. Unless heated very slowly and uniformly, it cracked. It was, furthermore, because of its high lead content, unlike ordinary glass, in that as it was heated it suddenly became very soft instead of having a long temperature range thru which it was plastic. To make matters still worse, the available lead-free glass for windows had a considerably higher melting point. Such tubes were finally successfully produced, however. Upon operating them, it was found that, quite contrary to expectations, they were much better than tubes of the same size made of thin lime glass. They ran with less crackling noise than any of the many tubes with which they were compared. It at first seemed possible that this might be due to these first thick-walled tubes having, for some unknown reason, a better vacuum than the tubes with which they were compared. Later experiments, however, showed that the better result could not well be ascribed to this cause. It was also not due to the substition of lead-glass for lime-glass, for tubes made of thin-walled lead glass were no better than those made of the customary thin-walled lime glass. It was then due to the use of *thick-walled* glass, and this conclusion was experimentally confirmed by making some tubes from lime-glass bulbs having a quarter inch wall thickness. They behaved as well as the thick-walled lead-glass bulbs.

The effect of the bulb thickness on the quietness of operation of a tube is probably to be ascribed either to the leakage of electricity thru the glass or to the electrostatic condenser action of the negatively charged inner surface of the bulb and the slightly conducting outer surface. Further experiments will be undertaken to clear up this point.

The cathode of the new tube is the same as that of the regular 10 milliampere radiator tube. The anode is also the same except that it is shorter. The path which the heat has to travel from the focal spot to the radiator is 5½ inches in the new, and 8¼ inches in the earlier tube. For continuous operation, then, the capacity of the smaller tube should be somewhat greater than that of the larger one.

The window has essentially the same x-ray transparency as does the wall of the bulb in the earlier types of tube.

The new tube, complete with radiator, weighs 2 pounds, that is, less than one-third as much as the earlier type fitted with a shield giving the same amount of x-ray protection.

3. *The Transformer.* The transformer is shown completely assembled with cover in Fig, 1 and uncovered in Fig. 2. Inside views are shown in Figs. 4 and 5.

It is an oil insulated transformer and delivers 10 milliamperes at 60,000 volts (useful). Complete with woooden base and carrying cover, it weighs 43 pounds. It is especially designed with reference to the operation of a self-rectifying tube, or, in other words, to have for a given weight, a minimum inverse voltage.

When the development work on this transformer was started, the lightest oil-insulated transformer available for this service weighed, without any protecting cover or base, 72 pounds.

Of the various steps taken to reduce weight, the most effective consisted in so shaping the transformer case as to make it conform, as closely as possible, to the high tension coils. This very considerably reduced the required amount of oil.

With this reduction in the volume of the transformer, the safe bringing out of the low tension leads, in such a manner that they cannot get too close to the high tension parts of the system, becomes an important problem. This was solved in the following manner:

A U-shaped metal piece (25 in Fig. 6), was introduced into each end of the transformer case. The tongue, 26, of this U-shaped piece fits tightly in the space between the end of the core and the end wall of the transformer case and holds the U-shaped member in the position shown in Fig. 4, which is an elevation of the transformer (with cover removed). This is also shown in the plan view given in Fig. 5. The U-shaped pieces, together with the side walls of the case, thus form rectangular metal enclosures, completelly walled off from the other, or high-tension, compartment. The primary leads, 28, are brought up thru the right hand compartment, which they enter thru an opening, 27, in one of the lower corners. The other two low tension leads, 29, are connected to the inner ends of the two high tension coils and lead out thru the left-hand compartment to a milliammeter in the instrument box. The diagram of transformer connections is shown in Fig. 7, in which 28 is the low tension coil and 13, 13 are the two high tension coils.

Besides serving to keep the low tension leads away from the high tension part of the transformer, the U-shaped members, 25, serve two other important functions. Extending as they do from the core to the cover, they help to hold the core down. Placed in position, they electrostatically shield the high tension coils from the sharp edges of the case, 21, 22, 23 and 24, for the outer surface of the inner legs of these members lie flush with the surfaces 17 and 18 of the transformer case. They therefore reduce the danger of electrical breakdown at these points.

The low-tension coil is wound on a treated paper tube and is made integral with this by subsequent treatment with a special black varnish which is baked until it is hard. This tube slips tightly over the core. The high tension coils are likewise impregnated with black varnish and baked. As a result of this treatment, it becomes impossible for these coils to suffer from mechanical vibration. To keep them from moving laterally on the primary, the treated paper support-tubes on which they are wound, and with which they are made integral by the black-varnish treatment, are left long enough to completely fill the core window. Rotation of the secondaries is also prevented by the support tubes. They are so shaped at their outer ends that the core prevents their rotation.

Current for heating the cathode spiral is derived from a separate coil wound over one of the high tension secondaries.

As a safety spark gap, to protect the transformer from high voltage surges, a sphere gap, set to spark over at 90,000 volts, is used for the transformer terminals.

The sphere-gap has been used in preference to a point-gap for the following reasons:

(1) A sphere-gap is quicker in action than a point-gap and its use therefore imposes less electrical strain on the insulation of the transformer.

(2) It avoids the corona attendant on the use of pointed electrodes.

(3) It saves space (the electrodes of a point-gap would have to be about 9 inches apart, while the corresponding spacing of the 2 inch spheres is 3½ inches).

To prevent warping of the cover of the transformer, which would cause a change in the spacing of the terminals of the safety-gap, the cover is made of bakelite.

The removable cover, to which the carrying handle is attached, is made to extend below the bakelite cover, to shed rain. In use, it is clamped in place by four wing-nuts which screw on pivoted bolts attached to the upper corners of the transformer case.

The base of the transformer is made of wood, to better withstand mechanical abuse. It is made large (7 x 14 inches) for stability.

4. *The Control of Tube Voltage and Current.* Auto-transformer control is used. The auto-transformer, together with a special auto-transformer switch, is located in the instrument-box (see Fig. 8). By means of this combination, operated from the handle at the left side of the box, it is possible to always deliver a definite voltage, say 100 volts, to the transformer primary even though the line voltage may be as much as 15 percent above or below this value.

The voltmeter, shown at the left rear corner of the instrument box indicates the voltage delivered by the auto-transformer.

The milliammeter is connected in to the middle point of the secondary of the x-ray transformer.

Nothing further would be needed for the control of voltage and milliamperage, were it not for the fact that the cathodes in different tubes are not exactly alike and that the voltage of the filament heating circuit will not be exactly the same for all transformers. To take care of this complication, a little rheostat, diagramatically shown at 9 in Fig. 7, is built into the reel used on the cathode side. As this is in the high tension circuit, it is desirable for the safety of the operator, that it should be used as seldom as possible. For this reason and also to prevent the setting, once made, from being accidentally disturbed, a perforated metal cover is provided which is kept locked securely in place over the rheostat by means of a thumb screw. See Fig. 9, which shows one face of the cathode reel with rheostat uncovered.

The *x*-ray transformer is calibrated[1] by means of a suitable sphere-gap and kenotron. The calibration of a certain experimental transformer was, for example, as follows:

For 5 m. a. at 60,000 volts (effective), use 100 volts on the primary.

In using a tube for the first time on this transformer, the rheostat in the filament circuit would be adjusted until with a voltmeter reading of 100, the tube is carrying 5 milliamperes. The cover is then fastened over the rheostat and it should never be necessary to remove it as long as the same tube and transformer are used.

In subsequent work, and regardless of what the *line* voltage may be, the desired milliamperage is secured by merely setting the auto-transformer switch. With this method of operation, it will always be found that the primary voltage is near enough to the figure given in the calibration. (If the milliamperage is correct and there is an error of 5%, for example, in voltage, the error in exposure will amount to only 10%, an amount which in ordinary work will be negligible.)

This simple method of control is made possible by the fact that the electron emission from the hot-cathode changes so very rapidly with temperature and, hence, in this case, with the voltage applied to the primary of the *x*-ray transformer. This is illustrated by the following table which shows how the milliamperage changed, in an actual experiment, as the applied voltage was changed by means of the auto-transformer switch. The rheostat in the filament circuit was not touched during the experi-

[1] See *General Electric Review,* XXI, page 58 (1918).

ment. The third column gives the values of the high tension voltage (effective).

Portable Transformer No. 11

Primary Volts	Tube Current (Milliamperes)	Tube Voltage (Useful)
100	2.8	60000
102	5.0	61000
104	6.0	61500
107	7.4	62000
110	8.5	63000
111	9.5	64300
112	10.0	65000

An increase of 12 percent in primary voltage has here caused an increase of 260 percent in milliamperage and an increase of only 8.3 percent in secondary voltage.

5. *Circuit-Breaker.* This is shown in Fig. 10. It is placed inside of the instrument box and is connected in series with the main low voltage circuit. When tripped, it can be reset by means of the vertical rod which leads up thru the cover and is surmounted by a large button.

This circuit-breaker is a very important part of a portable or any other x-ray outfit. It reduces the danger to patient and operator from accidental electric shock. Furthermore, even with the best hot cathode tubes so far produced, it will occasionally happen that there is a high voltage surge which causes a flame discharge to take place across the safety gap on the transformer. This amounts to a practical short circuit on the line and, in the absence of a circuit-breaker, the current drawn from the lamp socket would suddenly jump from, say, 6 amperes to perhaps 50. As a result, some fuse or fuses in the garret or the basement, as the case may be, would burn out. The circuit-breaker, which operates at about 20 amperes will, with an overload, act quickly enough to save a 6 ampere fuse. Its use will save the operator much time which would otherwise be spent in locating house fuses.

6. *Switches.* The main circuit is closed by means of a push-button switch located in the right front corner of the instrument box and opened later by a motor-driven adjustable relay (time-switch) which is seen at the front of the instrument box. The push-button switch is a three leaved one, with a 6 ohm resistance between the middle and lowest leaves. Upon pressing it, the upper and middle leaves first make contact, thus closing the low tension circuit thru the resistance which is then short-circuited as the middle and lowest leaves come together. Unless the circuit is closed thru resistance, in this way, there will be a very high voltage surge whenever it happens that the circuit is closed at or near the peak of the voltage wave.

7. *The Tube-Stand.* Before taking up the development of the stand described below, a good deal of consideration was given to the method which has been most frequently used in the portable work of the past. This method consists in using an adjustable arm carrying the tube-holder at one end and attached at the other to the case of the coil or other high potential source. The method necessitates placing the coil on the edge of a chair or table. This gives a rather precarious support. Furthermore, the chair or table presumably has four legs. If the joints are good and strong, this is bad, as the support will then rock until a wedge is put under the leg which is off of the floor. If the table or chair is sufficiently weak in the joints it will, under the weight of the coil, stand on four legs, but such a weak piece of furniture does not give a good firm support either. Besides the question of the bearing on the floor, there is also the question of having the coil properly supported on the chair which may have a seat of almost any shape. Besides the above objections, the chair or table support is clumsy to move around.

The stand which was finally developed is made of wood. It is shown in Fig. 2 and again, disassembled, in Fig. 11. Wood was chosen rather than metal because of its being an electrical insulator and because it stands mechanical abuse better than a thin-walled metal structure of equal weight.

The triangular base has a 3-point support and is made as large as can be accommodated in the special suitcase designed to carry the photographic material and some of the detachable parts of the outfit.

The upright post has a metal casting attached to the bottom and this is securely clamped to the base by means of two machine-screws with wing-shaped heads. The considerations which determine the position of the upright on the base are the following:

(1) In position for use at the bedside, the wooden upright should come between the metal of the bed and the transformer terminals. This definitely places the upright essentially in the middle of the base.

(2) For maximum stability, the upright should be so located on the base as to bring the transformer, as it is in Fig. 2, over two of the base supports.

As there is no brace extending from the upright to the front point of the base, the latter can be pushed forward, under even the lowest bed, until the upright almost touches the side of the bed. In this way the overhang required of the extension arm is reduced to a minimum.

The upright is made of large section for torsional rigidity.

The extension arm is secured by two clamp-screws. It pivots about and can be slid thru the one in the upright. The second clamp-screw, with the short arm to which it is attached, makes it unnecessary to set the first clamp-screw up very tight and, furthermore, it sets a safe limit to the downward travel of the tube.

Motion of the tube about three different axes, at right angles to one another, is secured thru three clamp-screws. In addition to this, the tube may be easily rotated about its own length axis.

For the stereoscopic shift, a small clamp-screw which attaches the U-shaped tube-holder to the balance of the tube-holding mechanism is loosened and the tube may then be easily moved on the arc of a circle, of 24 inch radius, whose center is the center of the photographic plate when the latter is in position. To prevent possible movement of the whole stand, during the operation of making the tube-shift and changing plates, a little fiber cup, attached to the base, is brought, by rotation of the steel member which carries it, under the front caster.

As a mechanical safeguard for the tube and to render manipulation easier, a helical spring is used at the point where the tube-carrying mechanism is attached to the end of the extension arm. This spring counteracts the effect of gravity in tending to cause rotation about the clamp screw at this point. Without this spring, the tube-carrying mechanism can, when the thumb-screw in question is loosened, swing down, under the influence of gravity, so far that the tube strikes against either the extension arm or the upright post.

Heavily insulated cable is used for the high tension leads. This is to prevent corona with its attendant noise and odor. It also helps greatly, by its weight, in reducing tube-vibration, cutting it down to less than half of what it would otherwise be.

The use of large cable necessitates large special reels. To keep the high tension leads away from the bed and the patient, these reels are placed high upon the stand. They are supported at the ends of a wooden cross-arm and are widely spaced to allow much freedom of movement of the tube without having the leads come too close together. The cable used on the cathode side is a two conductor cable and two separate circuits have to be provided thru the reel on this side. One circuit leads thru the spring of the reel to the fixed axis and the other leads thru a metal brush, and a slip-ring shown in Fig. 2, on the inner face of the reel.

The cross-arm and tube-holder must be kept dry, as they have to support the full electrical potential of the high tension circuit. They are carried in the suitcase. For use in places where the humidity is very high, it may prove desirable to make them of bakelite.

The type of caster used for the base is very important. The casters must work nicely on polished floors and on thick rugs. Of many different types which have been tried, the "A. B. C. Ball" casters have proved to be by far the best. Equipt with these, the tube-stand may be readily moved by taking hold of it anywhere. With any other type of caster which has been tried, it would be necessary to use a larger base as, otherwise, the stand could be too easily overturned in attempting to push it about. Contrary to what might have been predicted, the easy mobility which these casters give, also greatly reduces the trouble from tube vibration. This may readily be seen by striking the side of the tube-holder with the hand. When this is done, it will be found that, with the other casters which have been tried, the upright post is given a torsional deflection and then continues to execute a series of torsional vibrations. While these may be of small angular magnitude, they produce a considerable linear movement of the tube at the end of its long support-arm. When the experiment is tried with "A. B. C." casters, the result is entirely different. The mobility of the system is then so great that, under the force of a sidewise blow, the whole stand moves, thus eliminating the torsional vibration of the upright post.

The greater mobility of the "A. B. C. Ball" caster appears to be due partly to the fact that it is a ball-bearing device, but mainly to the fact that it permits free movement in any direction without first having to be forced into a certain definite position with respect to this direction.

8. *Special Hospital Base for Tube-Stand.* For hospital work, a different base, mounted on three light and relatively large rubber-tired wheels, is used for the stand. A fourth wheel, smaller than the others, is mounted a short distance back of the main rear wheels. It is so placed that it is normally about a half inch above the floor. With the transformer in position, the center of gravity of the stand is only slightly in front of the axis of the main rear

wheels. By a slight downward pressure, exerted on the rear end of the extension arm, the front wheel may be lifted from the floor. The stand is then on two wheels and can readily be turned sharply to either side. The small rear wheel merely serves to keep the stand from being tipped over backwards. In this way the axes of all four wheels can be rigidly mounted instead of having to be pivoted and steered.

9. *A Special Alternative Tube-Holder.* A special tube-holder has been developed which must be tested out in competition with the simpler one shown in Fig. 11. It is made of bakelite and is shown in Fig. 12. The x-ray tube is flexibly mounted inside of the holder, by means of the two discs of sponge rubber seen in the figure on the side arms of the tube. It may be accurately centered in the holder and then fixed in place by a single clamp-nut, attached to a bakelite strip which is carried by a thin bakelite ring which surrounds the sponge rubber disc used on the cathode side-arm. The bakelite tube of the holder is rotatable in two brass rings.

The total weight of the holder is 1¼ pounds. The advantages which it offers are the following:

(1) It serves as a carrying case for the tube which can be put as it is, without special packing precautions, in the suit-case.
(2) It can be used for special work where it is desirable to intercept the light coming from the tube.
(3) It serves for the ready attachment of filters and diaphragms and, if desired, of a pointer for indicating the direction of the central beam of x rays.

The disadvantage, if it has one, is that it conceals the glass x-ray tube and may hence lead to more mechanical abuse than the latter would otherwise get.

As shown, it is not adapted to stereo-work, but it can readily be made so.

10. *Operation on Direct Current Circuits.* For direct current work, a converter (rotary) has to be used. This is shown in its carrying case in Fig. 13. Unless a starting box, or its equivalent, is employed, the starting of this rotary will blow 6 ampere fuses. To obviate the need of using a regular starting box, which is needlessly large and heavy, a two point switch and a single small resistance unit are employed. Upon turning this switch to the first point, the converter is connected to the line thru the resistance unit and on the second point the resistance is cut out.

The connections are so arranged that the use of the converter does not in any way affect the calibration of the balance of the electrical part of the outfit.

The converter weighs about 35 pounds.

The direct current taken from the line, for 60,000 volts (useful) at the tube, will be about 6 amperes for 5 milliamperes and 10 amperes for 10 milliamperes of high tension current.

11. *The Suit-Case.* This is divided up into compartments and, with its contents, will weigh about 40 pounds.

12. *Technique.* This will be the same as that of any other tube operating with the same current and voltage.

In this connection, attention should be called to the fact that the capabilities of such an outfit may be tremendously increased by the use of screens and especially so by the use of the Duplitized film and double screens. With this last combination, for example, with 10 milliamperes, chest radiographs may be made at a distance of 28 inches, in one-half second; mastoids at a distance of 20 inches, in two and one-half seconds; and frontal sinuses at a distance of 18½ inches in nine seconds.

With double screens having a speed factor of say 6, a 10 milliampere tube is made to do work which, for the same speed, would require without screens a 60 milliampere tube. The result is the vastly improved definition which goes with the 10 milliampere focal spot, which is less than half as large as that required for the 60 milliampere tube. Furthermore, the radiograph made with the double screens will, if the same voltage is employed in both cases, show markedly greater contrast.

In closing, the author wishes to acknowledge his indebtedness to the many members of the laboratory staff and to the many factory engineers who have contributed to the development work described in the paper.

It is also a pleasure to thank Mr. C. N. Moore for his helpful efforts in testing the outfit in the laboratory, in the home of the patient and in the hospital.

He also wishes to express his appreciation of the many courtesies received from Dr. Charles G. McMullen, whose sympathetic coöperation has been of the greatest assistance.

Research Laboratory
General Electric Co.
Schenectady, N. Y.

FIG. 1

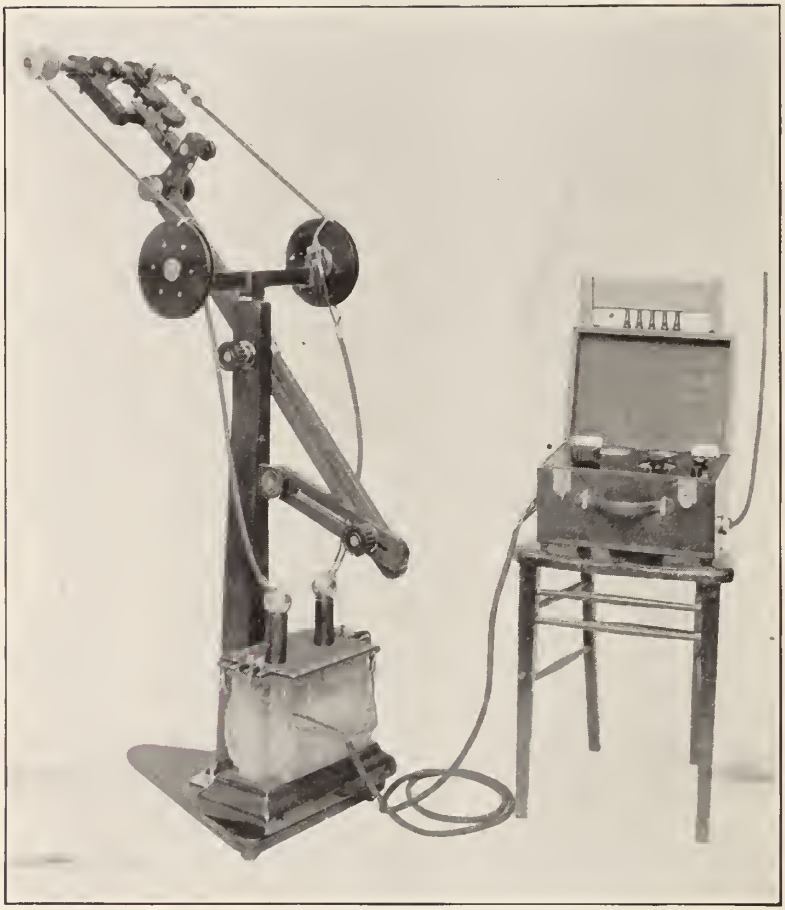


FIG. 2

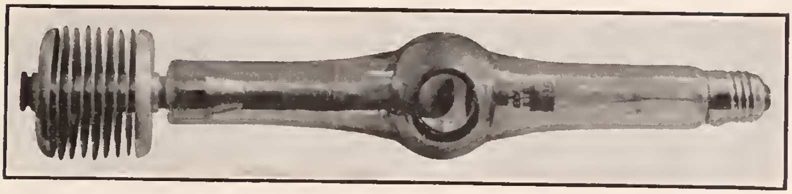


FIG. 3

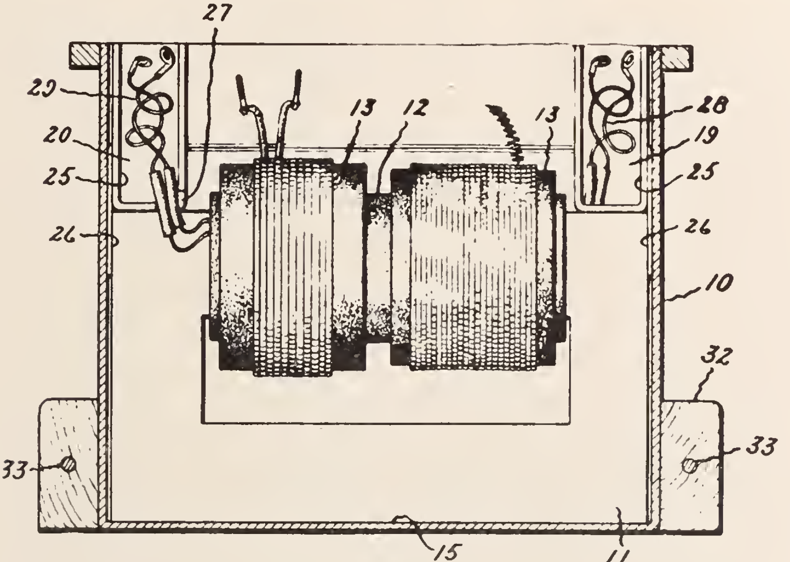


FIG. 4

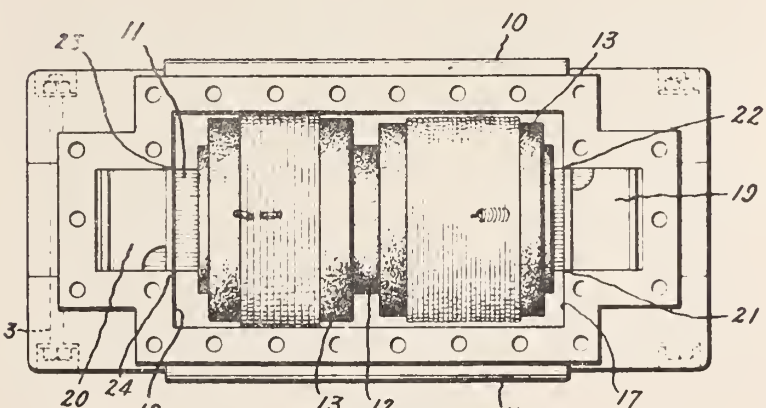


FIG. 5

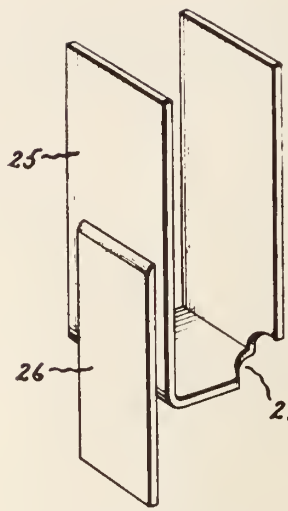


FIG. 6

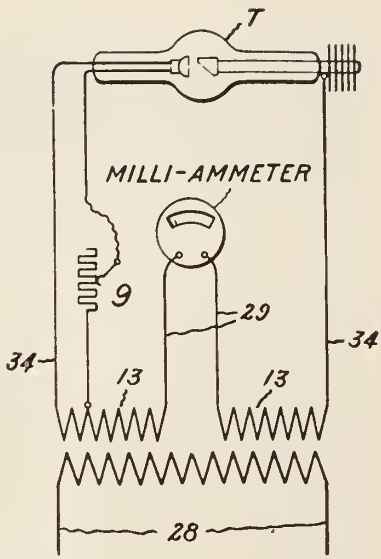


FIG. 7

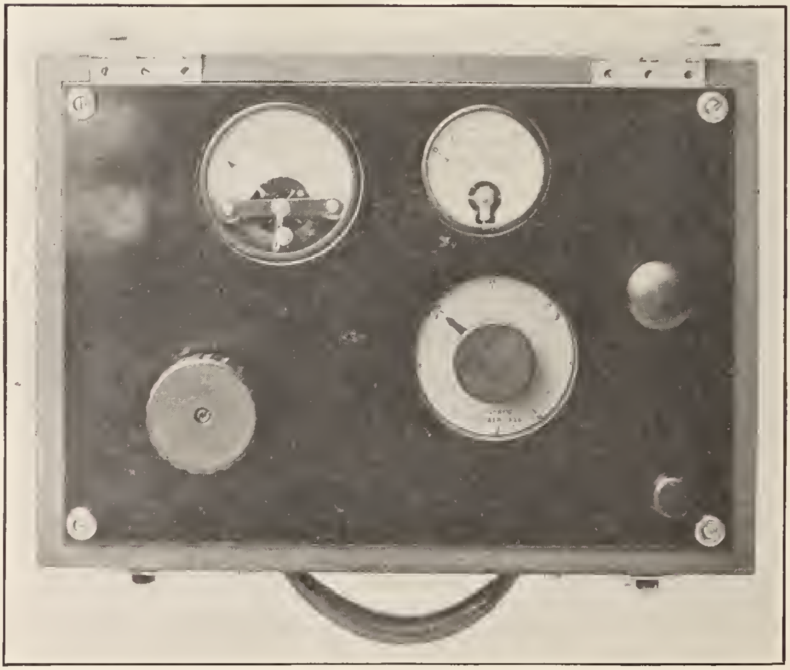


FIG 8

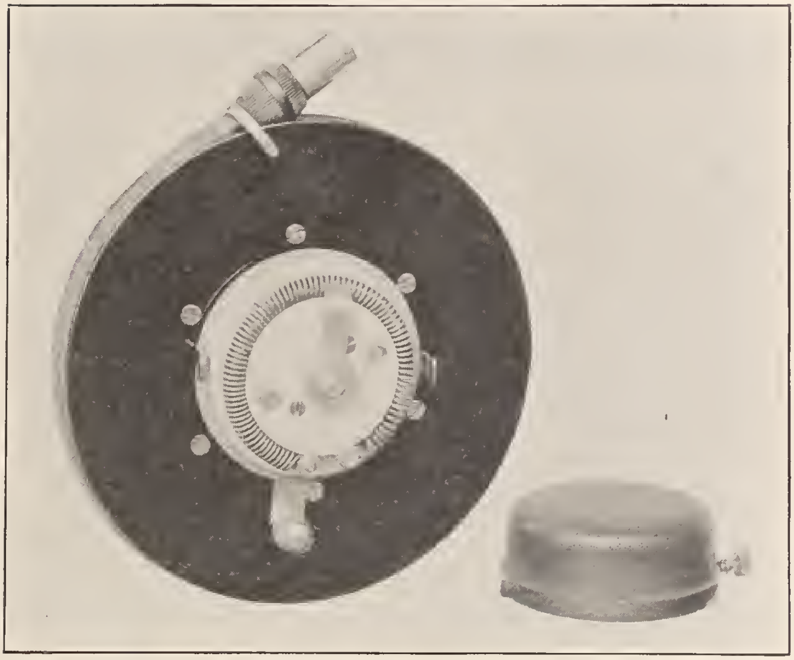


FIG. 9

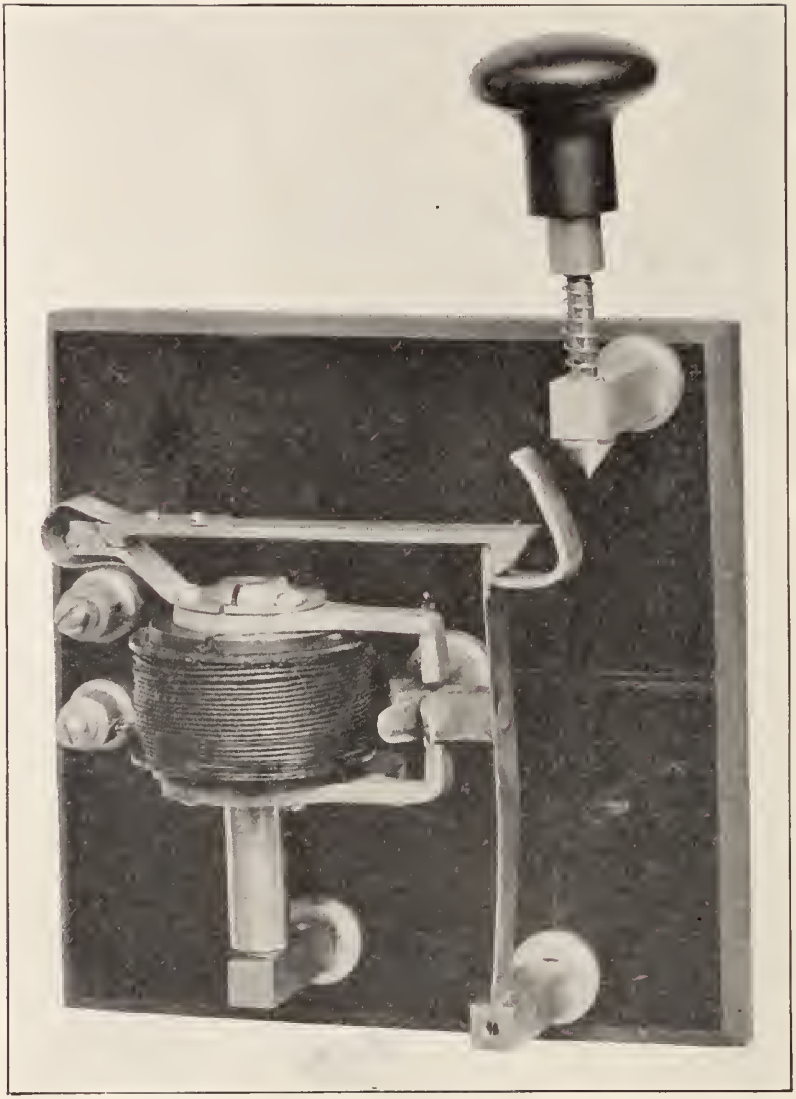


FIG. 10

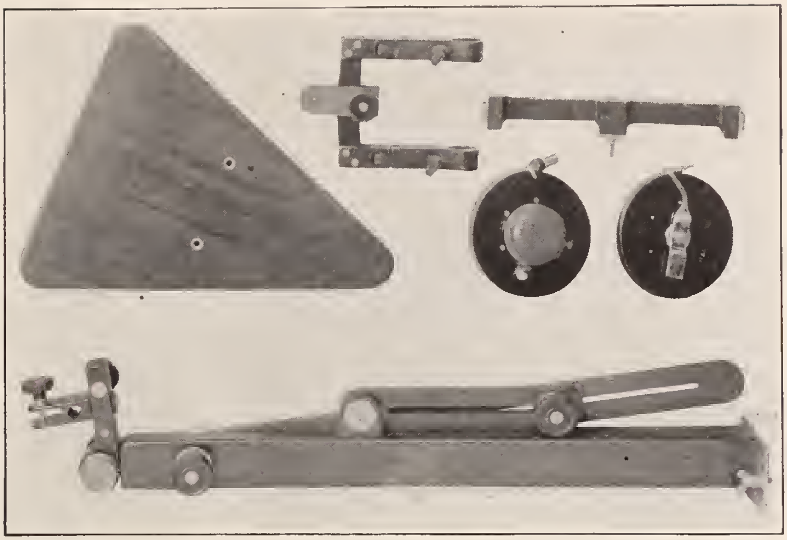


FIG. 11

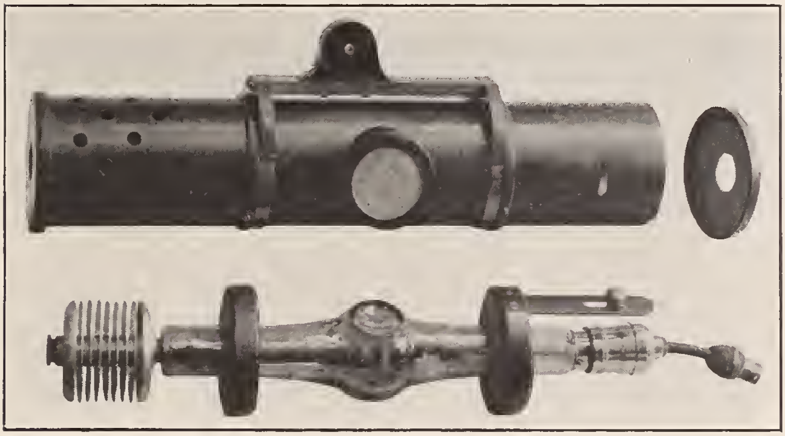
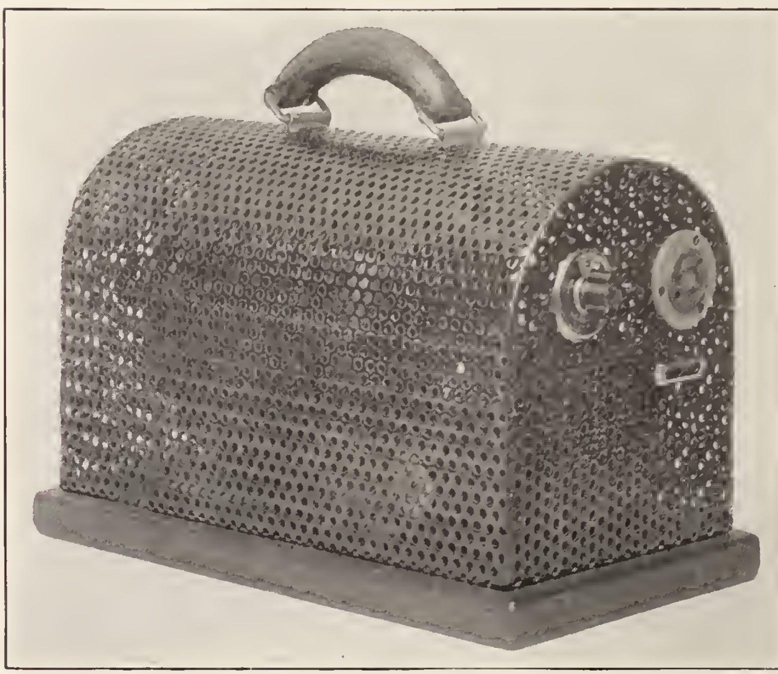


FIG 12



FIG, 13

THE VALUE OF THE ROENTGEN-RAY IN THE TREATMENT OF UTERINE FIBROIDS

Mary Elizabeth Hanks, M. D.
Chicago

In cases of uterine fibroids roentgenotherapy was almost as well established scientifically and technically ten years ago as now, yet there is a surprising ignorance on the subject even among physicians, who still regard it as a "new" treatment that is unproven, experimental and dangerous. This misconception persists even though the evidence that came from the hundreds of carefully recorded cases in Freiberg, Vienna, Paris, London, and other great clinical centers was abundantly corroborated by eminent men of our own country. Early doubts and fears did not materialize. On the contrary, clinical results have gone beyond our expectations. Important questions have been answered satisfactorily; the technique has been perfected until now there should be no doubt of the legitimate practicability of this therapeutic measure in properly selected cases.

It seems worth while to discover, if possible, the reasons for the slow acceptance of this phase of a remarkable science. Every layman knows of *x*-ray in diagnosis and talks glibly and intelligently on the subject, but he knows little or nothing of its therapeutic value. Why is not the whole story understood? There are probably several answers to this question.

First: The whole medical fraternity in its engrossed, eager study of fascinating diagnostic problems, has seemed to lose sight of the prime object of all medical science, the cure of disease. Roentgenologists, with few exceptions, have given their entire time to the diagnostic branch of the science. Others do therapeutic work in a perfunctory fashion, because they cannot afford to turn aside the revenue. One man frankly said to me that he hated the treatment of fibroids, but it was a good "pot boiler." Others have intimated as much.

It is true that deep roentgenotherapy requires exceeding great care as to technique, and there is more danger both to patient and operator from the high tension current when applied over an extended time. Then, too, the fluoroscopic examination, the mechanical and chemical steps in the making of plates, and the correct interpretation of the lights and shadows, differ so widely from the whole subject of therapeutics that the necessary readjustment of the mental processes produces almost a revulsion.

Because therapeutic work is a secondary matter, few papers are read and the subject finds little place in the deliberations of scientific bodies. Nobody talks about the fibroid question, for instance. So, hundreds of women continue to form the same procession to the operating table, just as ten years ago. It is a safe contention that the reason lies with us, who have neglected to develop our technique, to study the follow up of our cases, to perfect and fortify our records and to meet objections with incontrovertible facts.

Apropos of objections, one of the favorite headlines against *x*-ray treatment is "Burns." *X*-ray dermatitis is not only a distressing accident for the patient, but it is disastrous to the good repute of *x*-ray. The number of cases, always greatly exaggerated, makes a weighty argument.

Very early in my *x*-ray career my enthusiasm for deep ray work was nearly wrecked by a large third degree dermatitis which I saw in a certain hospital. It impressed me so deeply and put such a fear into my heart that it was finally evident that I must down this wraith. I began by following each case that came to my knowledge to its origin. To date, a total of seven has convinced me that at least the seven were preventable, and my practices and devices for safety reflect the lessons that came from the seven. Briefly, the cases (none of them my own) are given below.

First: A young interne with more daring than wit went beyond orders and trebled the time with the result of the third degree burn above described.

Second: This was an occasion when treatment areas overlapped. One can almost insure against this accident by surrounding the treatment area with lead, closely fitting the skin.

Third: A filter slipped out, unnoticed, during the treatment. The filters should be fastened in.

Fourth: An operator forgot to insert the filter. Don't forget. There are instances when forgetting borders on criminality.

Fifth: A tumor that was not a fibroid was "obstinate." Fifteen series were given in rapid succession with the Coolidge tube and massive doses and still the tumor grew. If a tumor shows no improvement after the second cycle, it is not a fibroid or is a seriously complicated one which belongs to the surgeon.

Sixth: The time-clock was set and left alone in full charge of the treatment while the operator attended to other patients. It did not alarm. The patient carried away a big third degree dermatitis. Automatic time-clocks should not be trusted with a patient's safety and with a man's reputation. Two timers are good to check each other, but you should watch them both.

Seventh: An osteopath came down to Chicago from Northern Michigan, bought an *x*-ray equipment and learned all about it in two weeks. Soon after a patient came from the North for a skin graft.

In these seven cases there were no "idiosyncrasies" nor "peculiar susceptibilities." They were all preventable and were clearly the result of bravado, ignorance or carelessness.

Another very successful argument against *x*-ray is that there is danger of a fibroid "degenerating into cancer."

It is impossible to repudiate too emphatically the repeated inference that an incipient, unrecognized cancer under *x*-ray goes on to a fatal issue, while the same cancer, operated, would be forever disposed of. When we remember that 87½% sarcomatous growths recur after surgical treatment, the cancer argument loses weight. Theoretically a fibroid may become sarcomatous (both being connective tissue) but actually it is a very rare occurrence. According to the pathological records of the Presbyterian Hospital, New York, sarcoma of the uterus occurs twice in three hundred and fifty cases of fibroid tumor.[1] This amounts to a little over one-half of one per cent instead of five and ten per cent, quoted from statistics.

As to a fibroid degenerating into a carcinoma, that is as impossible as it is for an orange to degenerate into a potato. Fibroids are not made of the kind of cells that can become carcinomatous, but a fibroid may, very rarely coëxist with carcinoma, as it may with a housemaid's knee.

Because the uterus is by far the most common site for both fibroids and cancer it would be strange if they did not occur occasionally in the same uterus. For twenty years I have been in practice in Chicago and a large per cent of my work has been gynecologic. I have never seen a case of sarcoma in the pelvis and I have seen possibly two cases of coëxistent fibroid and carcinoma. In one the diagnosis was positively established, in the other the diagnosis was made macroscopically through the abdominal incision, and the case was not operated. She recovered, however, and has been earning her own living so long that I doubt the diagnosis. Many physicians and surgeons to whom I have talked or written seem to have had an experience corresponding to my own, until now I am convinced that it is not fibroids but statistics that have "undergone degeneration".

Pfahler makes the following statement appropos of *x*-ray and malignant complications: "There is no case on record of subsequent malignant degeneration following *x*-ray therapy." In the Freiberg clinic where about four hundred cases were treated with x-ray and radium, there is no case on record that subsequently developed malignancy.[2] In the Copenhagen clinics Nordentoft was "unable to find on record any instance of malignant degeneration in relics of fibroids that had retrogressed under x-ray treatment."[3]

The charge that x-ray causes adhesions and complicates operation is not supported by facts. X-ray breaks up adhesions, as has been proven many times. Fraenkel was "impressed with the way in which parametritic adhesions binding down the uterus were found loosened up after a course of Roentgen ray exposures" for some gynecologic affection. He says, "This action of the Roentgen ray on them is a welcome addition to our armamentarium."[4]

Legitimate questions are often asked, for instance, "What happens to the tissues under x-ray?". Our accurate knowledge has come from a variety of sources. Briefly stated, we have the following:

First: The tumor cells and especially the nuclei show hypertrophy. The chromatin coagulates, is diffused and may be displaced into the protoplasm. Later vacuoles occur and the nuclei are obliterated. Finally nothing is left of the cell but detritus which is carried away by the leucocytes. Young connective tissue gradually takes its place. Not infrequently the tumor cell changes its characteristic properties and with it is "a diminished clinical malignancy."[5]

Second: X-ray produces an oedema of the endothelial lining of the capillaries which causes an endarteritis obliterans with a resulting anemia of the tumor resembling that of the normal menopause.[6] Howard Kelly says, "It has been well established both from roentgen ray and radium that an obliterative endo-arteritis occurs almost invariably in the field radiated. We have noticed this in a number of cases in which we have operated after extensive radiation."[7]

Third: X-ray inhibits ovarian stimulation by its effects first on the ripe and ripening Graafian follicles, then the primordial follicles, then the interstitial tissue. The effect of the ray upon menstruation depends upon the number of follicles that are destroyed. If all of them, amenorrhoea will persist; if only the ripe or ripening follicles, menstruation will be resumed when the primordial follicles develop.[8]

Fourth: The internal secretion is not interfered with at all, or not until later. This belief is upheld by several recognized authorities.[9] In the cases I have observed the absence of obesity and the minimized disturbances of the menopause have led me to a full endorsement of these findings.

In short, as will be seen by the above summary, *x*-ray produces in the tumor, ovaries and blood vessels similar conditions which prevail in a normal menopause. (It is always safe to imitate Nature.)

It is quite possible to reduce a fibroid tumor without exposing the ovaries, and it is not necessary to produce the menopause.[10] One of my most satisfactory cases requested that the ovaries be not included in the path of the rays. With some misgivings her wish was granted, but to this day we can see no reason for regrets. Dr. Pfahler reports a deliberate attempt to dissipate a fibroid without influencing the ovaries. This was done with the definite object of preserving fecundity of the patient, who was extremely anxious for a child. In collaboration with Dr. McGlinn, a surgeon-gynecologist, who exactly located tumor and ovaries, the experiment was carried out with such precision and success that the woman conceived and delivered a normal child soon afterward. Fraenkel reports that after *x*-ray he has repeatedly observed amenorrhoea for a few months, then pregnancy and a perfect child.[11]

In view of these reliable reports, it seems logical, in cases of young women, to attempt the relief of the tumor without including the ovaries, in order to preserve fecundity if possible. Radical operations during the childbearing period, in women who desire children, are surely not justified without first making an attempt to reduce the tumor as Dr. Pfahler describes.

In the matter of technique I have followed the lead of those who employ the modern methods, among whom there is a surprising agreement on all essential points, which indicates a good degree of satisfaction.

The Coolidge, tube with the broad focal point, backing up a parallel spark gap of nine inches has been employed. The dose has been five milliamperes from three and one-half to four and one-half minutes at a skin distance of seven inches with filters of five millimeters of aluminum and sole leather. We have followed the cross fire method through ports-of-entry from one and one-half to three inches in diameter. The patient has received from three to seven series, each series representing from twelve to thirty exposures and requiring from three to six consecutive days. The patient is then sent away for from two to four weeks.

To safeguard the comfort of the patient and to eliminate as much as possible the secondary rays, the entire body is protected by a complete covering of sheets of lead-rubber. These are supported by a frame which lifts the weight well away from the head and chest, giving a wide air space. Abundant fresh air is kept in brisk circulation by an electric fan that, when desired, may send a gentle breeze across the patient's face.

We have had no nausea to combat and no illness of the nature often described. That ideal state may be attributed to short seances, the studied perfection of ventilation and also to extreme care to avoid the inclusion of the stomach and intestines within the path of the ray. Dr. Jones, of Battle Creek, is probably right in his contention that *x*-ray causes an arrest of digestion with resulting nausea, vomiting and diarrhoea by inhibiting the secretion of the glands along the digestive tract. If the patient is suffering in this way, the heavy, characteristic air of the *x*-ray laboratory adds greatly to her distress.

The new patient is started with a small dose, perhaps three and one-half minutes, which is increased one-quarter of a minute each series until her full dose is reached. The first object of that is skin safety; the second is to usher in the menopause gradually. If I could cure a fibroid with one series I would not. That would be too much like a radical surgical operation, which not only precipitates the climacteric, but pushes a woman clear through it in one hour. The result is many distressing symptoms that are in some cases fatal to a woman's health. Nature's way is a slow way. The gradual tissue changes incident to the menopause gives time for a perfect readjustment without the shock of the sudden transition which always sacrifices the patient to speed.

One warning is given to my patients and that is that *x*-ray may at first aggravate the hemorrhage. This lesson came to me early. One of my first and most difficult cases was a very poor surgical risk who had an enormous tumor. There was a very profuse flow with each menstrual epoch which usually continued for two weeks. She was alarmingly anemic. After her third series she had such a serions hemorrhage that she was entirely disheartened. It was decided to discontinue treatments. That was two years ago. She has had no period since and the tumor is much reduced and is steadily receding, but should have a few more treatments later.

The material for this report is based upon my first thirty consecutive cases, most of whom have been under my observation almost continuously from the day of diagnosis until now. Not one has failed to respond to the treatment and some of the most difficult went beyond our expectations and are now remarkably improved. For review, the cases are classified as follows:

Fifteen (50%) are recovered so that no tumor is demonstrable.

In four, the tumors are almost imperceptible and are improving so rapidly that they will soon come into the above class.

Five who had large tumors are "symptomatically cured." The tumor in each case is so reduced that the patient is not conscious of it. Amenorrhoea is established and the health restored to normal, yet comparatively small tumors can be found. Older operators say of cases of this class that they will finally disappear though it may take two or three years.

Two, referred cases, who had large tumors growing to the umbilicus, show great improvement as to the size of the tumor. Amenorrhoea is established, general health steadily improving, and these may later belong to the "symptomatically cured" class, but time must complete the story.

The four cases remaining were bad surgical risks and were referred to me in the hope of relief.

Case I. This patient was referred to me after catheterization had been necessary for several months, owing to pressure on bladder and urethra. She was deformed from an old spinal lesion (probably Potts' disease) which shortened the torso considerably. The tumor was large and not only impigned upon the bladder, but by upward pressure embarrassed respiration and added to the labors of a badly damaged heart. The anemia and the inroads upon her general health would have incapacitated her, but for a determined optimism which should put her into a class by herself. Of course, she was not a surgical case.

The first series of *x*-ray treatments relieved the obstruction to the bladder, the second cured it. Finally the tumor was reduced to the level of the pubic bone when I last saw her. The relief from the reduction of the tumor was marked and the patient often expressed great satisfaction. A year later, however, the heart gradually gave out and she died.

Case II. This patient had the largest fibroid I have ever seen. Her physician considered her a bad surgical risk, both because of the enormous tumor and because of its inroads upon her general health. The tumor filled the entire abdomen like a full term pregnancy, and was very dense and immovable. The prognosis was not good, but the task was undertaken with the hope of reclaiming her for surgery at least. Six series reduced the tumor about two-thirds. The heart, the anemia and general health are much improved, but the tumor has become stationary and she reports one normal period. The case now seems like an excellent surgical one, but her physician is inclined to more treatments and we shall probably give her two series more.

Case III. This tumor, about the size of a large grape fruit, was complicated by a mass of organized exudate and old inflammatory tissue which dated back ten years to an almost fatal abscess, including, as the doctors thought, tube, ovary and appendix. The woman when brought to me was seriously anemic because of the old sepsis and prolonged flowing. The history shows that at one time bleeding was continuous for one year. The heart was damaged by the infection and was very weak. Fainting spells were not infrequent. It is clear that radical surgery at this time was contraindicated. We gave her seven series I then sent her to her home in the country for four months. When she returned last November she had hemoglobin 85 instead of 53, was much stronger (staying at the hotel instead of the hospital) and the heart was doing good work. Anenorrhea was established and the fibroid almost gone. The chronic inflammatory mass was still there, but smaller, less resistant. Adhesions, which had been everywhere and very dense, were not overcome but were more elastic as the mass and tumor were freely movable without pain. The relief in this case has been all or more than we could expect and she is beginning to realize the health she longed for.

Case IV. In this case a very large intramural grew a little above the umbilicus, extending wide out on either side and filled the pelvis almost to the pelvic floor. The hemorrhages had been prolonged and severe, the anemia bordered on the pernicious type, and the patient refused operation. Indeed she was in no condition for it. Under treatment the tumor receded as intramurals do, but amenorrhoea was not established until after the fifth series. The general health and anemia were much improved after that, and the patient is grateful and optimistic. However, I believe this case is complicated by a submucous growth which may yet require surgery, and the tumor lies much too low.*

This accounts for my thirty cases.

Accurate diagnosis is essential to the selection of proper cases. One cannot always depend upon the opinion of the physician referring the patient. He has not in mind the requirements of the *x*-ray case. It would be humiliating to face a failure resulting from wrong diagnosis with this inadequate defense: "I did not examine the case." The best diagnostician may make a mistake, but if we remember that a fibroid improves after the second cycle we shall not go far from wrong.

Prognostic accuracy adds to the patient's satisfaction. Limited results, if prognosticated at the beginning, satisfy the patient.

The intramural type of fibroid is the most favorable for *x*-ray treatment. It is fortunate, therefore, that all fibroids are primarily intramural[12] and that about seventy per cent are still intramural when discovered.[13] The large dense tumor is slower and less apt to recover entirely, though they continue to recede long after treatments are ended.

The subserous type is one that is usually "clinically cured." The tumors reduce in size and are quiescent and the results are very satisfactory. The *submucous* type is better operated.

Contraindications for treatment and indications for surgery are (1) symptoms of necrosis, (2) cystic or calcareous degeneration, (3) cases complicated by pyosalpinx or other suppurative conditions, (4) large proliferating, or papillo-

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*Since writing the above, word from her physician says, "Tumor the size of a baseball."

matous or dermoid cysts, (5) pedunculated tumors, (6) a suspicion of malignant complications leaves no doubt as to surgery.

Cases complicated by simple follicular cysts of the ovary I am not now refusing, though the prognosis, as to the ovary, is conservative. It has been a matter of surprise, however, that the *x*-ray does so much good in these conditions.

Certain cases are especially entitled to the benefits of *x*-ray. I refer to those in which operation involves too great a risk, as when the case is complicated with (1) severe anemia, (2) organic heart lesion, (3) diabetes or nephritis, (4) tuberculosis or bronchitis, (5) severe cases of goitre or of varicose veins. Also there are the cases of menorrhagia with no demonstrable pathology and those with a prolonged distressing menopause, respond remarkably to the influence of *x*-ray.

In conclusion: It is difficult to understand why in the face of all evidence the doctrine, that all fibroids should be operated as soon as dignosed, is tenaciously held, even though the mortality rate of the highly competent surgeon is not less than one per cent, while actually in all cases in the hands of all surgeons it is nearer five. This is a far greater mortality than results from the few cases complicated by incipient cancer that escaped detection and were treated by *x*-ray.

The advantages of *x*-ray over surgery are: No mortality rate; no accident with anaesthetics; no ventral hernia; no pneumonia nor bronchitis; no phlebitis; no thrombosis nor embolism; no hospital expense with loss of time and earnings; no nerve shock with long period of recuperation.

On the other hand the *x*-ray patient observes with great satisfaction a constantly increasing strength and exuberance of spirits while living her life or earning her living. It has been a great satisfaction to me to observe the promptness and ease in which my women have assumed the normal compared with the unaided or the operated case. The nervous symptoms are reduced to a minimum, the flushes of heat are not so tormenting and the readjustment resembles that of the ideally normal case.

After five years of study and observation and two and a half years of personal experience, I fully appreciate Dr. Pfahler's sentiments when he said, "The treatment of fibroids with x-ray is 100% satisfaction."

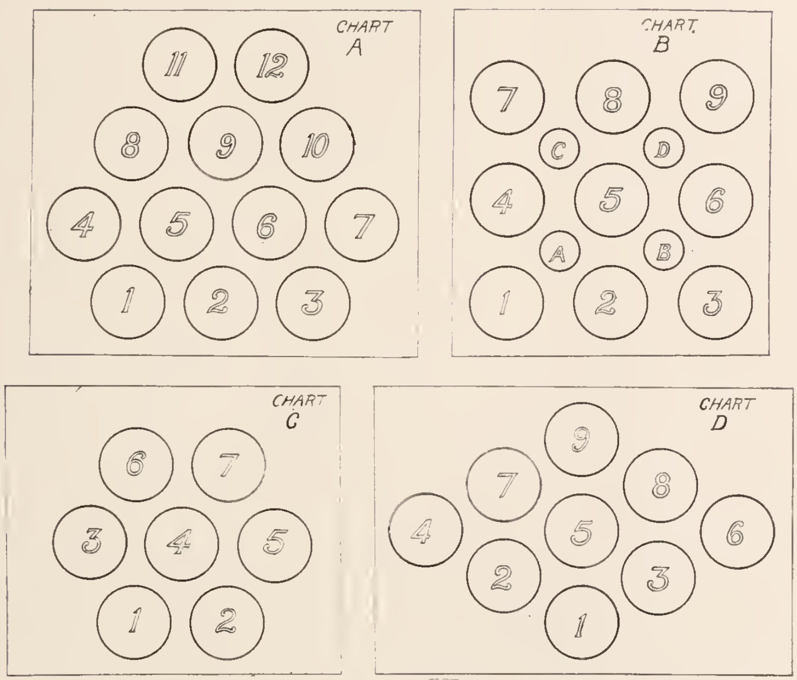
NAME Mrs. James E. Anyperson Age 46 ADDRESS 2789 Anywhere Tel. 176 North

History.
Patient in perfect health until five years ago. Menses became painful profuse and prolonged. General loss of health with anemia myocarditis with pulse rate of 100 or over. Finally anaemia + general weakness so incr. that surgery was urged and refused.
Exam reveals ultra-mural fibroid, filling the pelvis and extending to within one-half inch of umbilicus. Tumor dense and adherent.

DATE 1917	AREA	MILLI-AMPERES	SPARK GAP	TIME	SKIN DIS-TANCE	FILTERS	SIZE OF OPEN-ING	TUBE	ESTI-MATED DOSE
3/15	ant 123 A.	5	9	3¾	7	5 Al.+SL.	2½	C.	
3/16	ant 4567 A	"	"	"	"	"	"	"	
3/17	ant 8910 A	"	"	"	"	"	"	"	
3/18	ant Post 1112-12C	"	"	"	"	"	"	"	
3/19	ant 34567C	"	"	"	"	"	"	"	
4/7	ant 1234 A	5	9	4	7	5al-SL	2½	C.	
4/8	ant 5678 A	"	"	"	"	"	"	"	
4/9	ant Post 9-123A	"	"	"	"	"	"	"	
4/10	Post 4567A	"	"	"	"	"	"	"	
5/8	ant 1234A	5	9	4¼	"	"	"	"	
5/9	56789A	"	"	"	"	"	"	"	
5/10	Post 1234 C	"	"	"	"	"	"	"	
5/11	567 C	"	"	"	"	"	"	"	
6/6	ant 1234B	5	9	4½	"	"	"	"	
6/7	56AB-B	"	"	"	"	"	"	"	
6/8	Post 1234C	"	"	"	"	"	"	"	
6/9	567C	"	"	"	"	"	"	"	
7/3	ant 1234A	"	"	4½	"	"	"	"	
7/4	567 A	"	"	"	"	"	"	"	
7/5	Post 1234A	"	"	"	"	"	"	"	
7/6	567A	"	"	"	"	"	"	"	
8/15	1234A	"	"	4½	"	"	"	"	
8/16	5678A	"	"	"	"	"	"	"	
8/17	1234B	"	"	"	"	"	"	"	
8/19	56AB-B	"	"	"	"	"	"	"	

COMMENTS
Blood count
Haem 60.
R.B.C. 4125000
W.B.C. 7500
No deformed cells—Color index 1
First Series 19 exposures
After 18 days rest patient returned. Tumor slightly smaller. Patient has been more comfortable and stronger.
2nd Series 16 expos.
After three weeks away patient reports that period due one week ago (Apr. 30) did not appear.
Tumor much smaller. Patient looks + feels improved in every way. Haem. 75.
3rd Series 15 exposures
4th Series 14 "
Patient has an occasional "hot flash," but is happy and improving in all ways. Tumor steadily receding.
When returned for 6th series Tumor on level of pubic bone, freely movable. Amenorrhoea established. Blood exam: Haem. 90 RBC. 5400000 WBC 6000.

The record cards, for the immediate recording of salient points, are convenient for quick reference.



The charts are to insure accuracy of record. They vary in arrangement according to size and shape of tumor. The size of area exposed may vary in size as indicated in record card.

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[9] Nemenoff, Petrograd, Translated Am. Jour. Roent., 1916; Bordier, Paris, Jour. A. M. A., 1911; Pfahler, Jour. A. M. A., 1916.
[10] Grier, Am. Jour. Roent., 1916; Kelly and Burnam, Jour. A. M. A., 1914.
[11] Fraenkel, Am. Jour. Obstet., 1917.
[12] Dudley, Chicago.
[13] Crossen, St. Louis.

700 Marshall Field Building

MALIGNANCY OF LUNG

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The subject of the diagnosis and treatment of malignancy of the chest will be summarized in this paper by a synopsis of the most important clinical diagnostic signs and therapeutic results obtained from a personal observation of ten cases of malignancy of the chest during the past two years. This material embraces only primary malignancies of the chest, and secondary metastiases in other organs will not be included. With regard to the diagnosis, we merely wish to summarize the important early diagnostic evidence indicative of malignancy of the chest, as represented by this series of cases. These points will be demonstrated by the following roentgenographic illustrations, consisting of (1) roentgenograms of primary malignancy of the lung; (2) roentgenograms of primary malignancy of the pleura; (3) roentgenograms of secondary malignancy of the pleura and pericardium, extending from the lung or mediastinum; (4) roentgenograms illustrating other thoracic conditions frequently mistaken or confused with malignancy; and (5) roentgenograms illustrating the effect of treatment of malignancy. The roentgenographic diagnostic evidence for malignancy demonstrated by this series, is as follows:

(1) The majority of malignancies occur primarily in the mediastinum and invade the upper lobes of the lungs, more frequently the right than the left.

(2) The shadow of malignancy of the lung itself, not involving the pleura, is a very dense, even, diffuse shadow, free from mottling.

(3) This even, diffuse shadow does not limit itself to any anatomical markings of the lung, such as the lobes,

interlobar spaces, lymphatic tracts, bronchi, etc., as it does in other lung diseases.

(4) Its progressive growth and infiltrative character, as shown by a series of roentgenograms, furnishes very positive diagnostic information.

(5) Malignancies of the pleura, either primary or secondary, evidence themselves, in the great majority of cases, both clinically and roentgenologically, *as simple pleural effusions,* for which they are frequently mistaken.

(6) The *rapid recurrence* of effusion, either pleural or pericardial, after paracentesis, should make one suspect a malignancy.

(7) Cytodiagnosis, such as hemorrhagic fluid, character of cells in the fluid, etc., is of little value as a differential point, similar findings occasionally occur in other pleural effusions of non-malignant nature.

(8) Extreme dyspnea should always make one think, not only of malignancy of the chest, but also of malignancy of the pericardium. This dyspnea is usually attributed to mediastinal pressure from direct growth, whereas the four post-mortems that we have had on these cases demonstrated that in each one it was undoubtedly due to a pericarditis with effusion, caused by malignant pericarditis. In two cases in which repeated paracenteses had been done on the pericardium, this dyspnea was relieved temporarily. It recurred, however, very quickly, on account of the very rapid recurrence of effusion so characteristic of malignancy of the pericardium or pleura.

(9) Endothelioma of the pleura or other malignant tumor of the pleura is best demonstrated by paracentesis, followed by injection of air, as preparation for the roentgenogram. If there are any nodular masses along the pleura, they then will be shown very distinctly on the plate. Other evidence, such as temperature, leucocyte count, Wassermann examination, sputum examination, and cytodiagnosis, is helpful in differentiation.

With regard to the treatment of maligancies, our method is as follows: This was given by Dr. M. B. Titterington at St. John's Hospital. It consists of giving fractional massive doses daily, over long periods of time. The dose employed was a 25 milliampere minute, with a 9-inch spark-gap, 10 inches distant with 5 mm. filter. This treatment consists in exposing two areas daily, for five minutes, the complete circle of the body being made in six days.

MALIGNANCY OF LUNG

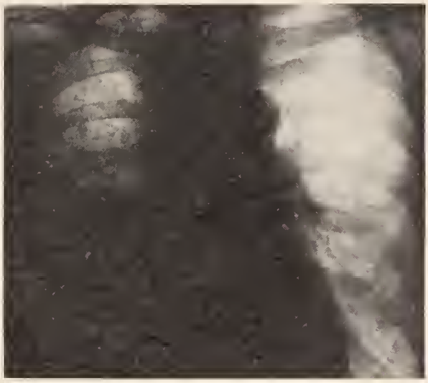
(Slides)

No. 1. Malignancy of left upper lobe, metastasis in right upper and middle lobes. Note the even, diffuse density involving the entire right upper lobe, not confined to the anatomical markings of the lung. No evidence of pericardial effusion. The metastasis in the right lung consists of small, mottled areas, not so confluent as primary tumor.

No. 2 (Maguire). Malignancy of right upper lobe of lung. Note the even diffuse density of the mass, not limited to the anatomical markings of the lung or pleura. Slight fusing of the left hilus shadows. No evidence of pleural or pericardial effusion, or malignancy of these tissues.

No. 3 (Crashaw). Malignancy of right upper portion of chest. Note the even, diffuse, extremely dense shadow, not limited to the anatomical markings. Absence of effusion in pleura or pericardium, denoting absence of malignancy of these tissues.

No. 4a (Bruner). Beginning malignancy of right lung. Note the tongue-shaped shadow along the fissure, extremely dense, with mottling in both lobes, above and below this area, mistaken for tuberculosis by noted specialists of Saranac and Ashville. The mediastinal shadow is wide, but no evidence of malignancy of the pleura or pericardium, as shown by the negative shadows for effusion.



4b. Six months later. Note the increase in size of the very dense shadow along the interlobar fissure, with more extensive infiltration in the lower right lobe. Pleura and pericardium yet free from evidence of malignancy, as noted by the absence of shadow of effusion.

4c. Six months after previous one. Note the increase in size of the dense shadow at the interlobular fissure, with more marked density of the infiltrated mass in the right lower lobe. Mottling of the lung above the interlobar fissure. Evidence of effusion in the right lower chest and pericardium indicative of carcinomatous extension to the pleura and pericardium.

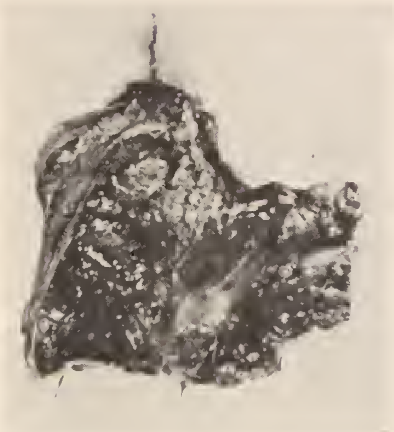
4d. Note the increased density of the entire right side, with metastasis around the upper right hilus. Marked density of the entire right side, which is probably due to fluid. Enlargement of the pericardial shadow is due to effusion of the pericardium.

No. 5a (Musick). Endothelioma of pleura. Note the diffuse shadow which is produced by effusion, filling the entire left side of the chest. Very slight displacement of the heart to the right. Only vague hilus shadows in the right side. This shadow corresponding to pleural effusion is characteristic of malignancy of the pleura. Its differentiation from ordinary pleurisy is made by the rapid recurrence of fluid after paracentesis.

5b. Same case, showing effusion in the lower left half of the chest, with definite shadow in the upper axillary angle, protruding into the thoracic cavity, characteristic of endothelioma of the pleura. Note the absence of shadows in the lung itself. (Immediately following paracentesis and injection of air into pleura.)

5c. One month later. Note the increase in size of the shadow in the upper axillary region, and continuation of absence of lung shadows.

5d. Ten days later. Note the increase in size and density of the epithelioma in the left upper axillary region, and the even level of the effusion shadow in the lower left chest.



5e. Specimen taken from pleura and lung of above case. Pleura was removed from the chest wall, and this specimen shows its interior. Note the multiple malignant mass covering the entire surface, and also external surface of the pericardium. Pericardia interna and lung absolutely free from lesions, epithelioma limited to visceral surface of the pleura.

5f. Specimen of same, showing tumor mass, which was about size of half orange, projecting from pleura directly into cavity. Multiple metastases covering visceral pleura and pericardium.

No. 6 (Mills). Sarcoma of lung, pericardium, and pleura. Note the shadow, made up to large extent of effusion in the right chest and pericardium. Malignancy of the lung is obliterated by the density of this shadow of effusion. Diagnosis: Early suspect diagnosis made by rapid recurrence of effusion in the pleura and secondary involvement of the pericardium. Autopsy revealed sarcoma of the mediastinum, lung, pleura, and pericardium, with effusion.

No. 7. Carcinoma of right chest, mediastinum, and pericardium. Note the similarity to the previous case, which was sarcoma. Roentgenogram merely shows effusion in the right side of the chest and pericardium. Suspect diagnosis could be made by rapid recurrence of this effusion after paracentesis.

DIFFERENTIAL SLIDES
(Other conditions to be differentiated from malignancy.)

No. 8 (Susman). Empyema of mediastinum. Note the vertical shadow on the right, extending into the right thoracic cavity, continuous from diaphragm to apex, extending above the clavicle shadow. Broadening of the mediastinum. Shadow limited to anatomical markings of the pleura, which has been displaced to the right. This same shadow occurs turning patient slightly on the bias, throwing the vessels to the right and the heart to the left. This can be differentiated by noting the position of the clavicle and ribs on each side of the chest.

No. 9 (Grant). Empyema of mediastinum. Note the similarity to the previous slide (No. 8). Displacement of the mediastinum over to the right side, the vertical shadow going from the diaphragm to the apex, above level of clavicle. Note the changed position in the chest, the patient being turned slightly to the right side, which is brought out by the angle of clavicle and sternum.

No. 10. Pericarditis with effusion. Diagnosis of partition in the pericardium, limiting the effusion to the right half of the pericardium. Note the enlargement of the pericardial shadow, uniform throughout, shadows limited to the enlarged pericardium. No extension into peribronchial lung shadow or above level of clavicle. This case had a very distant apex beat and cardiac impulse in the fifth and sixth interspaces, to the left of the nipple line, which is usually obliterated in pericarditis with effusion. For that reason, the diagnosis of malignancy was considered. This case, however, recovered entirely, proving pericarditis with effusion. Note the density of the left lower portion of the shadow.

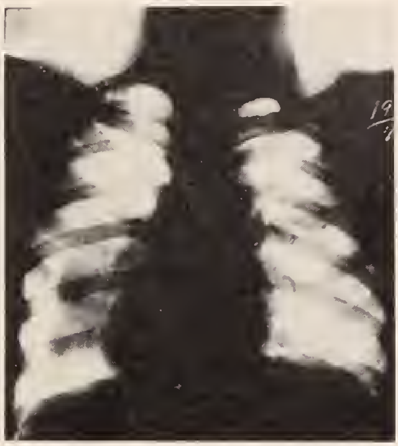
No. 11. Pneumonia in right upper lobe. Note the limitation of the shadow to the anatomical marking of the lung, and also its decreased density as compared with malignancy.

No. 12. Simple pleurisy with effusion of right lower thorax. Note the same dense shadow that occurs with malignant effusion. Differentiation cannot be made with the x-ray alone. The clinical course of rapid recurrence of malignant effusion, as compared with simple effusian is most frequently the differential point. Cytodiagnosis is also of some help, although there are frequently simple and tuberculous pleurisies that are hemorrhagic in nature.

No. 13. Gumma of lung. Note the extension of the gumma directly from the mediastinum into the middle third of the chest; its decreased density and increased mottling, as compared with malignancy. The clinical course, Wassermann examination, etc., are important aids in differentiation.

No. 14a. Pneumothorax of left chest. Note the collapsed lung opposite the heart shadow, which might be mistaken for malignancy. Remainder of left chest, free from lung markings, however, is proof of its being a pneumothorax.

14b. Ten days later. Note the increased expansion of the lung, and pneumothorax, of left phrenic angle.



14c. Ten days after previous one. Note the additional expansion of the collapsed lung, with the small tip going down to left diaphragm, probably due to an adhesion. In this case the lung returned entirely to normal.

No. 15. Tuberculosis of apices. Diffuse infiltration and mottling of both apices, extending down into and scattered through both lobes. Note the difference in density and confluency of these shadows, as compared with malignancy, and also their distribution. They are rarely unilateral, with smooth, dense edges.

TREATMENT

(Roentgenograms illustrating effect of x-ray treatment upon malignancy.)

No. 16a. Malignancy of mediastinum and right upper portion of thorax. Note the even, diffuse density of the mass, extending from the mediastinum out to the right side of the chest. No evidence of pleural or pericardial involvement, as noted by the negative shadows for fluid in these endothoracic cavities.

16b. Six weeks after treatment (consisting of x-ray and Coley's fluid). Note the beginning decrease in density of the tumor mass.

16c. One month later. Note the additional decrease in density of the tumor mass and the beginning contraction of the right upper chest.

16d. Ten weeks after previous picture. Note the further decrease in density of the tumor mass and the beginning contraction of the right upper chest. Also the beginning displacement of the trachea toward the right, and the upward displacement of the right diaphragm.

16e. Three months later. Note the return of opacity to the right upper lobe, the marked retraction of the right chest, with displacement of the heart to the right and upward displacement of the diaphragm. Also additional displacement of the trachea. During this time the patient progressively improved, and the swelling of the face and neck, due to obstruction of the superior vena cava, disappeared entirely. The patient has now been under observation for sixteen months, during which time she has made steady and progressive improvement.

University Club Bldg.

CERTAIN FEATURES OF TECHNIQUE IN ROENTGEN THERAPY

ARTHUR W. ERSKINE, M. D.
Cedar Rapids, Iowa

The ease and accuracy with which a definite dose of radium can be administered make a strong appeal to the average roentgeno-therapeutist, accustomed as he is to the degree of vigilance required to maintain even moderate exactness of dosage. The duplication of results of radium treatment day after day is made possible by the fact that radium throws off a constant, unchanging beam of light, and that the distance is always the same, as near to the part to be treated as the thickness of the filter will permit. When the same amount is always used, there are only two variable factors in radium treatment, the filter and the time. In roentgen therapy there are at least five important variable factors entering into the determination of the dose, and adding to the difficulties of its estimation. Some of us believe that it is possible to standardize some of these factors to such an extent as to approximate the accuracy of radium dosage. Suppose, for a few moments we examine the desirability and practicabiliy of such a standardization.

The prime essential in roentgen therapy is a constant line current. This is especially the case when a step down transformer instead of a storage battery is used to excite the Coolidge filament circuit. Variations in the line current affect the amount of output of rays in direct ratio, while variations in the filament current not only change the quantity but also the quality of the rays produced.

Assuming, then, that the line current is constant, and taking for granted the possession of a transformer capable of delivering a secondary current of at least 100,000 volts to a Coolidge tube, we find three factors which admit of a certain degree of standardization. The first of these, and the one on which there is the least difference of opinion, is the amount of current to be sent through the tube. Five milliamperes seems to be the most generally adopted amount of current but whatever the figure chosen, it should always be kept the same, and in order to save time it should be the highest the tube will stand without undue overheating when operated continuously. This is our first fixed factor.

The anode skin distance is the most important factor to be considered because the dose varies inversely as the square of the distance. It is hard to realize how rapidly the dose varies with only slight changes in the anode skin distance. For instance, changing the distance from seven to six inches increases the dose in the ratio of thirty-six to forty-nine, or a little more than thirty-six per cent. Roentgenologists, in describing a technique, sometimes speak of the anode skin distance as "about eight inches." "About eight," may mean anything from $7\frac{1}{2}$ to $8\frac{1}{2}$, quite a difference when we see that the squares of these two numbers are $56\frac{1}{4}$ and $72\frac{1}{4}$ respectively. No one would tolerate such a wide range of error in a mechanical measuring device such as a timer.

In this connection it may be said that it is not desirable to have the tube close to the skin when giving deep treatments. To illustrate: In treating a tumor three inches beneath the skin, with an anode skin distance of six inches, the tumor receives 36-81, or considerably less than half of the skin dose. If the anode skin distance be increased to ten inches, the tumor receives 100-169, or almost two-thirds of the skin dose. It is evident then, that as the anode skin distance is increased, the difference between the amounts of radiation received by the skin and the deeper parts is lessened. Since the dose of roentgen ray is limited only by the tolerance of the skin, it is an advantage to use as great an anode skin distance as the capacity of the apparatus, or more properly, the tube will permit. In my own work I use a fixed distance of nine inches for all work, although I should prefer ten or even twelve inches. Whatever the distance adopted, it should be the greatest at which a full dose can be given in a reasonable time, without excessive strain on the tube, and it should always be the same. The distance must not vary even a quarter of an inch. This is our second fixed factor.

The third factor which will admit of a certain degree of standardization, is voltage, more commonly expressed as the parallel spark gap backed up by the tube, under given conditions. The spark gap indicates, in a rough way, the penetrative power of the rays produced. I believe it is a rather common erroneous conception that a tube backing up a short spark gap, produces only soft rays, and one backing up a long spak gap, produces almost entirely hard rays. The facts are that with a short spark gap only soft rays are produced, with a medium spark gap more soft rays and some medium rays, while by using a long spark gap we get many more soft rays, more medium rays, and some hard rays. In other words, by using a long spark gap we obtain a beam of light with the widest possible range of penetrative power, especially rich in soft and medium rays, and adaptable by means of filters to every therapeutic requirement. The only objection to the use of a single, fixed, maximum spark gap for all work is that in giving unfiltered or slightly filtered treatments for superficial lesions, the highly penetrative rays may do harm to the underlying deeper structures. Such a possibility is eliminated by the relatively small number of hard rays, the lessened time, the greater distance, and the filtering effect of the skin and subcutaneous tissues. Suppose, then, that we take as our third fixed factor, the voltage necessary for the deepest and heaviest treatments.

Just what the maximum voltage, or spark gap, should be is a question open to argument. In my work I use an arbitrary reading on an uncorrected kilovolt meter of 88,000, which gives a direct spark gap reading 8½ inches in the winter time in a steam heated room. The kilovolt meter is used because of the fifteen to twenty per cent variation in the direct spark gap reading due to differences in humidity and barometric changes.

With a constant line current and the three factors, miliamperage, distance and voltage fixed in the manner outlined, we have at our command a steady, unchanging beam of light, whose qualities can be known, and with which we can duplicate results, day after day, and week after week.

It does not follow that results can be duplicated with the same settings on a different apparatus, some of the reasons being: differences in line currents (even though constant), differences in the length of the arc in the rectifying discs, losses by leakage, different lengths of overhead wires, errors in meters, and, possibly, differences in the efficiency of tubes.

When the same apparatus is always used, however, and the rheostat button is known which will deliver the required current at the required voltage, it is only necessary to set the rheostat on that button and adjust the filament control until the correct number is registered by the milliameter. After the settings are once known, if the milliameter should get out of order, the reading can be taken from the kilovolt meter or the ammeter in the filament circuit; if all three meters are temporarily out of order, the spark gap can be set at the desired distance and the current be kept just spitting across the terminals.

To work out the dosage in time with three or four different filters requires about three months experiment. The various mechanical devices for measuring dosage are apt to be disappointing and perhaps dangerous. The personal equation involved and the multiplicity of factors that can affect their final results, are possible elements of error which permit much more exact results to be secured by relying entirely on electrical measurements and arithmetic.

The only factors which need be varied are time and filter and by the exercise of good judgment in their manipulation the quality of rays best suited to the needs of the patient can be selected from the beam and administered to him in as definite a dose as any drug.

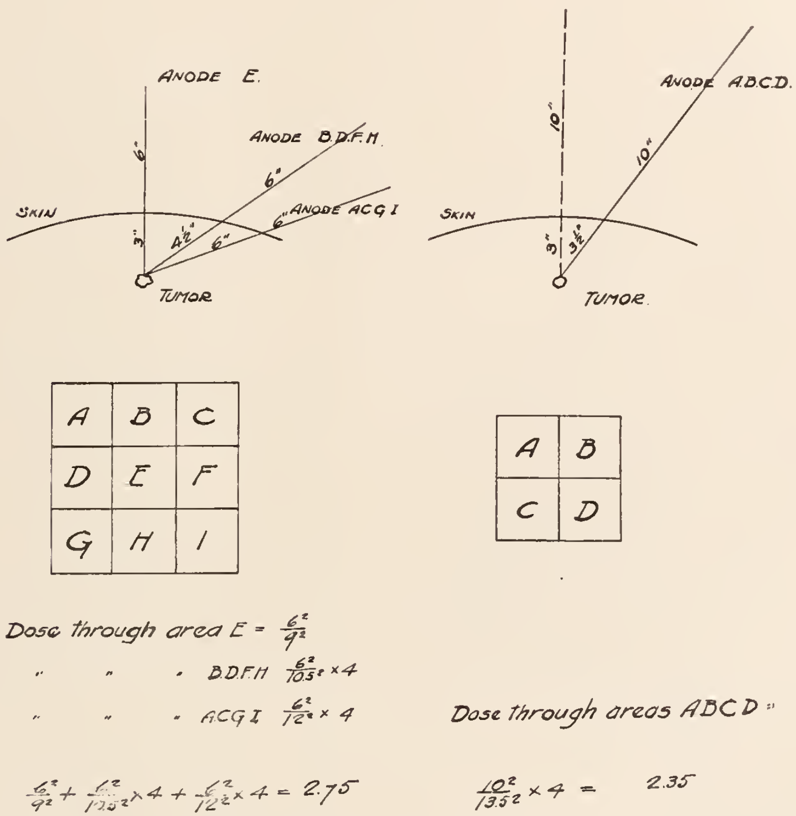


FIG. I. Diagram showing the relative efficiency of short and long anode skin distances in deep therapy.

325–30 HIGLEY BUILDING

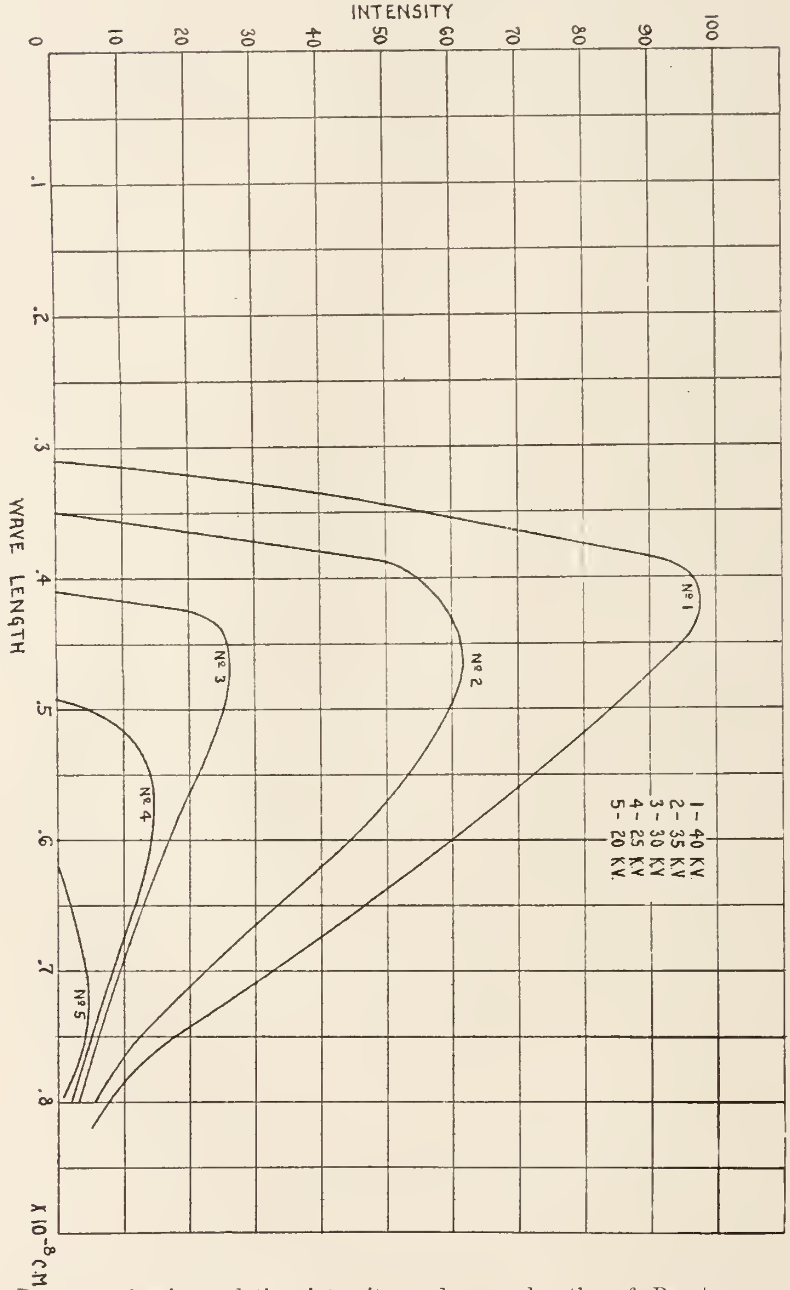


Diagram showing relative intensity and wave lengths of Roentgen rays produced with various voltages. Courtesy of Mr. Montford Morrison.

THE VALUE OF NEGATIVE ROENTGEN FINDINGS OF THE STOMACH

Wm. L. Ross, M. D.
Omaha, Nebraska

Roentgen ray findings in the stomach are of equal interest to the internist and the surgeon. C. Graham, of Rochester, says that the roentgen ray is the greatest modern boon to gastric diagnosis. And this is true in two ways:

First, when the roentgen ray reveals clearly a definite pathology and thus makes and seals a diagnosis for us.

Second, when it reveals to us a normal stomach and duodenum, and sets us searching elsewhere for our trouble. It is to this second phase of radiographic work, to the negative findings or absence of pathological changes as revealed by the roentgen ray, that I shall confine my remarks.

After a well written case record and physical and chemical examination are completed in a case of upper abdimonal pain or distress, and leave a positive diagnosis still shouded with a degree of doubt,—it is then that we look to the roentgen ray to clear up the diagnosis for us. As compared with the present day, these border-line cases were rarely met with formerly, presumably, because formerly, after the case record, physical and chemical examinations of the stomach failed to establish a positive diagnosis in upper abdominal complaints, the next, and only remaining procedure was to open the abdomen. This carried a certain amount of risk to life, and was accompanied with pain, and great inconvenience to the patient, all of which caused our patient to delay or postpone as long as possible submitting to such a method of final diagnosis, all too frequently causing us to lose sight of him altogether, without ever having arrived at a satisfactory conclusion concerning his trouble. This class of patients are, however, easily persuaded now, to undergo the roentgen examination, which establishes a definite pathology within the stomach, or gives the stomach a clean bill of health and causes us to search further for pathology elsewhere in the upper abdomen.

The roentgen findings are now relied upon for diagnostic purposes to such an extent, that W. J. Mayo advises that every person, in whom there is a suspicion of cancer of the stomach, should be promptly subjected to examination by the roentgen ray. He further states that the early diagnosis of cancer of the stomach depends upon the roentgen examination.

When expert surgeons, like W. J. Mayo, place such emphasis for diagnosis upon the roentgen ray, what a world of anxiety rolls off a patient's mind when the *x*-ray plate records a smooth outline of the stomach with no filling defects, and we can assure him, with a negative finding of such real diagnostic value before us, that his trouble must be elsewhere.

It is in the border-line cases of upper abdominal lesions or complaints, that resort is, then, made to the roentgen ray for negative or positive findings in establishing a positive diagnosis, while the diagnosis of suspected malignancy of the stomach is easily confirmed or negatived by roentgen ray examinations. In border-line cases, when symptoms mix; in differentiating between gastric and duodenal ulcers; between chronic gall bladder trouble with adhesions; duct obstructions, duct infections, perforations, contractions and perhaps even pancreatitis, our roentgen examination is invaluable. Practically all chronic conditions of the type just referred to, cause chronic gastric disturbance, which, to the patient, may be, and most frequently is, his chief complaint. It is in such cases, in which symptoms mix to such extent that a clear cut syndrome of gastric ulcer, duodenal ulcer, cholelithiasis, cholecystitis with adhesions, or appendicitis, cannot be obtained, and our diagnosis is left clouded, that negative roentgen ray findings of the stomach are of great value, and help to confirm the somewhat vague clinical indications, and our own suspicion of extra-gastric pathology, which in a reflex way has produced the stomach symptoms of which our patent complains.

It is not the essayist's intention to burden you with enumerating symptomatology or statistics concerning diseases of the upper abdomen, with all of which you are familiar. I wish, rather, to point these remarks by reading you the histories of two cases in point, and showing with a few slides what the findings were in each.

Case No. 1

Mrs. B., age 57, white, married. First seen May 3, 1919, when she consulted me for stomach trouble; her chief complaint being, as she stated it, sickness of the stomach and vomiting, and pain in the right side just under the rib line, extending around to the back and upward toward the shoulder blade. Her illness dated back 14 years; following a runaway in October, 1905, in which she was thrown out and dragged on the ground. Her right side was hurt at the time, and a severe cutting pain and tenderness followed. The pain was aggravated by a deep breath. For about ten days she was confined to her bed. Right after the runaway, she suffered with sickness of the stomach, and vomited frequently for about two weeks. The vomited material consisted of either a watery foam or a yellowish green substance. After getting out of bed, she found that she could not straighten up when standing, because of a severe pain in the right side.

About two weeks after the runaway injury, the patient fell in such a manner that her neck and shoulders were held firm and her abdomen forced forward. This bending of the trunk backward, from the waistline up, caused severe pain in the right side. After this accident, however, she found that she could stand straight without pain in the right side. She could breathe freely, a thing she had not been able to do before the second accident. She had been troubled with vomiting, and some pain in the right side, more or less ever since her accident fourteen years ago. For the past six years, the attacks have come on every three for four weeks. They are likely to be brought on by getting over tired, or catching cold. The pain usually comes on suddenly within a minute, and precedes the vomiting. The pain and vomiting often continue night and day for 24 to 48 hours, and if severe pain has ushered in the attack, the vomiting is severe and recurs every few minutes to an hour. No food is vomited, but a watery, foamlike material. Sometimes bile is vomited. When the vomiting stops, the pain, less severe, continues for two or three days. If the attack was severe and continued a long time, the pain would continue proportionately. She has more or less soreness in the right side all of the time. Preceding an attack, she nearly always has a hunger pain. But eating does not prevent an attack. Sweet and greasy foods particularly disagree with her. Pork will cause pain in the stomach, and pie crust disagrees with the stomach. Night attacks usually come on about three to four hours after eating. She belches a great deal, or passes wind by the bowels. The gas belched has no taste or odor. Attacks occur oftener in the winter. Often she has an attack of vomiting just before breakfast. The substance vomited is not sour unless candy has been eaten. As a rule, after vomiting, she can eat breakfast.

Three weeks ago, she had a severe attack of pain and vomiting. She vomited a sour substance at first, about 11 P. M. She continued to vomit every one or two hours for one day and two nights, and during this time she could not eat anything, nor did she drink water. She was constipated.

Sitting up straight and leaning back eases the soreness in the right side some. When lying on her right side, she has to lie with her right arm up, and her right leg stretched out to ease the pain. Any flexion of the body to the right side increases the pain and soreness, and if continued long, will cause vomiting. No other position will influence the pain and soreness. Often heart burn and regurgitation of food precedes the attack. If she becomes constipated, she is more likely to have an attack.

This history, which I have quoted largely in the patient's own words, is somewhat vague, in that we must doubt whether there was any actual cause and effect relationship between the two accidents, both of which appear to have made a deep impression on the patient's mind, and the trouble from which she was suffering when seen by me. Such a history, too, leaves us thinking of possible chronic gastric ulcer, chronic duodenal ulcer, and gall bladder trouble (possibly gall stones), without definitely directing our attention to any one of these conditions to the exclusion of the others. The patient's personal history is otherwise completely negative.

The family history is negative, except that her mother, an invalid practically all of her life, died of tuberculosis at the age of 58; and that her older sister and a brother both have stomach trouble.

On physical examination, the head was negative. The chest was negative. The abdomen was flat and flaccid. There was marked tenderness to pressure over the stomach region, and over the appendix region. Pressure over the gall bladder region caused pain to radiate to the right side, and up toward the shoulder blade. Pressure over the appendix caused pain which radiated up toward the gall bladder. Pressure over the lumbar ganglia caused pain. There was no pain on pressure over the larger part of the liver or over the spleen. The uterus was retroflexed and greatly atrophied.

Gastric analysis was not made. Uurinalysis showed a normal 24 hour output, acid in reaction, with a specific gravity of 1016, and no albumin or sugar.

This leaves us still somewhat in doubt as to our diagnosis. Cholecystitis with adhesions, and possibly cholelithiasis, we can surely say, but what shall we say about the stomach, concerning which the patient makes her greatest complaint? Has she a chronic indolent gastric ulcer, or a duodenal ulcer of the same type, or both? Or should we even suspect carcinoma? Neither her history, her symptoms, nor her physical findings seem to completely justify us in saying which, if any, she is suffering from.

Here is a typical case in which our roentgen ray examination of the gastro-intestinal tract should be of great help. Therefore, such an examination was recommended and undertaken within a few days. The results were illuminating. A series of 12 plates showed a stomach high in the abdomen, the pyloric end drawn and held markedly to the right; of smooth contour, with no filling defects; normal muscular tone, and one of the few perfect duodenal caps I have seen. Our roentgen ray examination has thus ruled out all of the stomach pathology which we previously felt ground for suspecting, and leaves us with a final diagnosis of cholecystitis with adhesions, and chronic appendicitis.

Case No. 2

Mr. H., age 31, white, married, consulted me March 3, 1919, his chief complaint being pain in the stomach. His history was as follows:

Pain in his stomach, severe, and of a heavy and dull, rather than sharp nature, commenced suddenly about six weeks ago. The attack, he stated, was like that of acute indigestion. Previous to this attack, he had not suffered with stomach trouble for ten years. Since the onset of the present attack he has suffered daily. The pain in the stomach sometimes extends around the right side to the back and upwards under the shoulder blade. The taking of liquids does not as a rule cause distress. The taking of solid food increases the pain. The stomach pains continuously and severely for about one hour after eating, and then lets up some, but does not stop altogether. He belches a great deal. The gas belched tastes of the food eaten. He is hungry all of the time.

About ten weeks ago, that is, about four weeks previous to the onset of his stomach trouble, he slipped on the ice, fell, and hurt his left side. He felt as though something was torn loose in his left side above his lower ribs, and immediately following the accident he was confined to his bed for about two weeks, with a sharp pain between his hip bone and his lower ribs on the left side. During the first week, this sharp, severe pain was practically continuous. After about one week's time, the sharp pain subsided somewhat, but a deep seated pain has been felt continuously ever since, and he has been confined to the house and for the greater part to his bed, up to the present time.

About two weeks before consulting me, that is, about eight weeks after his accident, the patient noticed a small lump about the size, he stated, of a hen's egg, in his abdomen to the left of the mid-line, and midway between the symphysis pubis and the crest of the ilium. This lump, he stated, had rapidly grown from that time until he consulted me, and was slightly tender to pressure. For the past month he had been constipated, and had had to resort to enemas to get a bowel movement. He had rapidly lost flesh and strength. His previous medical history was as follows:

As a child, negative. As an adult, about ten years ago, he had some stomach trouble which lasted six months, with complete recovery. Seven years ago, he had his appendix removed. June 1, 1918, he had his left testicle removed for sarcoma. September 2, 1918, he had consulted me with the following complaint:

Tenderness to pressure over a small area just below the inner half of Pouparts ligament, with a sharp pain in the left groin when attempting moderately heavy lifting. The patient had been referred to me from the Mayo clinic for treatment, with the following findings and recommendations:

"Mr. H. came to the clinic complaining of general lumbar pain, a dull inconstant ache, but never acute. He has had no hematuria, chills, night sweats or fever. His urinalysis was negative. Combined functional test on the kidneys in two hours and fifteen minutes showed a return of 55%. The blood Wassermann was negative. X-ray of the kidneys, ureters, and bladder was negative.

"Physical examination showed an absence of the left testicle. The left vesicle was very tender and slightly nodular; the right was normal. Inasmuch as the nature of the attacks was not a definite one, and the possibility of sarcoma was to be considered, we suggested that the patient take radium treatments. We treated him on August 9th, and suggested that he report to you as per our letter presented by him.

"While we were unable to demonstrate anything definitely pathological in this case, we do believe that several *x*-ray treatments should be given to offset the possibility of a metastasis in the retro-peritoneal gland, which is not an infrequent complication of sarcoma, provided, of course, this condition *was* sarcoma."

The patient was accordingly given *x*-ray treatment and remained under observation until he met with the accident, which interrupted his treatment, and brought him to me for the gastric trouble which I have just described. When I next saw him, on March 3rd, of this year, complaining of his stomach trouble and the lump in his side, he was very fearful that the lump was a recurrence of his sarcoma, in which fear his local doctor had joined. A small lump, which he could feel in his stomach at this time, was attributed to the same cause.

On physical examination, head and chest were negative. In the abdomen, a hard mass was felt, roughly oval in shape, beginning just above and to the right of the umbilicus, and extending transversely one and one-half to two inches to the left of the mid-line. Below this mass was another larger and firmer oval mass lying perpendicularly, about 6 by 3½ inches in size, and extending from just above the umbilical line downward, and lying just to the left of the median line. The mass was smooth on the anterior surface and outer margin, the inner margin presenting rather a sharp edge with a marked notch about the middle. The mass was movable, and could be displaced upwards to about the iliac crest, the displacement being accompanied by some pain. The descending colon, filled with gas, was felt over-riding the mass. The patient stated that this mass when first noticed, was about one-half the size of a hen's egg, and that it varied in size somewhat from time to time. The accuracy of these two statements, I greatly doubt.

Here, then, we have a man complaining of severe stomach disturbance and pain in the left side of his abdomen, presenting two masses in his abdomen; who has had sarcoma of the left testicle, and who has been assured by his local doctor that these masses are a recurrence of his sarcoma.

To consider the stomach first: our first impression was a malignancy of the stomach, with obstruction producing his stomach symptoms and the mass in the stomach region. We thought that the other mass might possibly be a malignant growth, but more probably was a spleen displaced as the result of trauma.

A gastro-intestinal roentgen ray examination was, of course, indicated, the presumption from history and physical findings being that it would reveal malignancy of the stomach. The findings, however, were merely those of a large dilated stomach, smooth in outline, with no filling defects, but with marked obstruction and retention. The duodenal cap was irregular.

Here, then, our supposed malignancy of the stomach proved to be non-existent—a negative finding and a very valuable one, in that it forced us to look elsewhere for the cause of our gastric symptoms.

The final diagnosis was obstruction followed by dilatation of the stomach, and retention, due to an extra-gastric cause —a traumatic displacement of the spleen with a consequent downward pull on the gastro-splenic omentum, causing a kinking of the first part of the duodenum; as was subsequently proven by replacement of the spleen with relief of the gastric symptoms.

These two cases illustrate the value of negative x-ray findings in examinations of the stomach. There are many such cases in which, without negative x-ray findings, intrinsic pathology of the stomach cannot be ruled out, the diagnosis is clouded with legitimate doubt, and we cannot institute a definite plan of treatment.

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A PLEA FOR CLOSER CO-OPERATION BETWEEN THE ROENTGENOLOGIST AND THE GENERAL SURGEON

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Mr. President and Members of the Western Roentgen Society: The title of this paper does not entirely convey to the author the correct idea, for he believes the Roentgenologist is indispensable to the surgeon and should be a part of his working team, and is as essential in many instances as a specially trained and skilled anthetist, chemical laboratory expert or surgical assistant is necessary to enable him to procure for the patient the best and most satisfactory post-operative results. The word coöperation should be association or affiliation.

I wish to speak frankly and try to express clearly my opinion of the close relation of the *x*-ray laboratory and its management to the general surgeon so he can give his patient the maximum benefit of the services rendered with the minimum expenditure of the patient's energy.

First and paramount it is necessary to obtain a detailed history as well as the past and present symptoms of the patient and correctly interpret the relation of these to the physical findings procured by the usual methods of examination. These old and time honored truths must not be cast aside for newer works, no matter how beneficial an aid the new science may prove itself to be, for the *x*-ray like other laboratory reports are of the greatest value when they corroborate the physical findings and are an aid to account for symptoms by revealing pathology not sufficiently advanced to be detected by the old methods.

Careful roentgenoscopic examinations and good roentgenograms will reveal to the keen observer early pathological lesions and many abnormalities that otherwise would be undisclosed by the usual procedure of examination. Pathological lesions will be discovered, their location and the structures involved would lead one, if found with our present day methods of physical examination, to believe that pathognomic symptoms should long since have been produced; but the patient during the taking of a most careful history has suggested nothing that would lead one to suspect the existence of such lesion. In such cases it is only the most skilled and experienced technicians that are able to render invaluable service to the surgeon After the discoveries are made the questions then to be considered are:

1st—The probable duration of the existence of such lesions, whether congenital abnormalities or acquired conditions.
2nd—The liability of symptoms arising or damage being done if the conditions are not corrected.
3rd—Should these conditions be corrected by surgical interference?
4th—The age and condition of the patient to withstand a surgical procedure that such correction would require.
5th—The amount of good to be accomplished by attempting surgical relief, whether permanent, to prolong life or only to relieve suffering.

I am a firm believer that there should be a definite scientific reason for subjecting a patient to an operation. I would not have you think for a moment that I believe every patient must be a sufferer before surgery is to be advised, but I would like to be understood as believing that present suffering should be relieved and anticipated future suffering avoided by the performing of an operation. If it is our conscientious belief after due and careful consideration that present non-symptomatic lesion accidentally discovered will in the near or remote future cause impairment of health or happiness, shorten one's life or usefulness, and there is reason to believe that such lesion can be corrected by surgery; then I say operate while the patient is in as good a physical condition as possible, the sooner the better. It is in such cases the roentgenologist and surgeon, acting in unison, must be alert and correct in the interpretation of the roentgenoscopic or roentgenographic findings and be cognizant of the price the patient must pay for undue haste or delay.

I believe the roentgenologist should be a physican and a good one at that. He surely must be an anatomist and be conversant with the normal relations of structures, as well as the symptoms apparent abnormal findings should produce. He should be a thinker and each case is to be studied as an individual one and not as one belonging to a certain group or class of similar cases. He should not be an alarmist, nor should he be over cautious. Above all not only should he be a manipulator of an *x*-ray outfit, but must be able to render a just and correct diagnosis of what his machine reveals to him without being influenced by the surgeon's opinion. After noting his findings and opinions, the surgeon and roentgenologist than have a further duty to perform, and that is the unbiased opinions of both must be blended into a single idea which must be based upon findings, symptoms and results to be obtained if surgical work is to be done.

If the work requires plates, they should be of a proper size and so developed that the structures to be observed stand out clear and distinct so there can be no mistake as to the minutest pathology. One should remember that a picture of a foggy day leaves much to the imagination and the enemy may be upon us before we are aware of his presence, or he may be retreating and getting out of range and, to our surprise, when the fog rises and a clear picture is brought to view, there has been a great waste of ammunition and delay in advancing.

The mangers of *x*-ray laboratories that take plates develop the same, charge for work in accordance with the size of the plate and difficulty of handling them, irrespective of what they reveal, all the time impressing upon their victims that, the larger the plates the more they are getting for their money. The unwieldly, developed plates are then turned over to the patients as their property. Immediately they go forth with their cherished false idol to their physician or surgeon or to many physicians and surgeons, thereby getting many unintelligent and incorrect opinions of incompetent and unscrupulous judges, until they believe in or trust no one. They stagger under the load of different opinions, lose faith in all physicians and turn to Christian Science for relief and then for the first time they get a unison of opinion from all they consult. Christian Science and similar cults can exist only in direct proportion to our shortcomings.

Such laboratories, if they exist, are I believe a menace to the public at large and are surely a handicap to the advancement of scientific roentgenology.

The ideal location for an x-ray laboratory is in a hospital, readily accessible and working in unison with the other laboratories. However, the great percentage of our population is in the rural districts and they should by no means be deprived of the convenience and benefit of such x-ray work as can be done conscientiously and scientifically by their local physician. I have many times seen much better work done in laboratories in small villages than I have seen turned out by elegantly furnished laboratories in our large cities and medical centers.

In special lines of surgery, for instance the head and spine,—I mention these for it is the line of surgery in which I am especially interested—flat plates are valueless or of little value. The stereo-roentgenograms concentrated on definite areas are of the greatest value. To secure the knowledge required in head work at least three sets of stereo-roentgenograms of the lateral view, one for each of the fossa, should be taken. For the spine one should be taken for every two or at most three vertebrae if we are seeking for minute defects.

Lastly, the roentgenologist should be a business man, as should all professional men. He and his family must live and so must the surgeon that is associated with him. His fees must be in reach of the masses or like other professional necessities the cities and states will operate at the tax payers' expense free laboratories for the deserving poor and these laboratories will be the same menace to the public and our profession as our free dispensaries are at present. The deserving charity will be crowded out by the parasites, who need all their money to keep up appearances, but are professionally the dead beats able to pay, imposters. The last class of patients should be handled by the closest coöperation of all professional men, irrespective of their specialty.

I believe in good pay for high grade services. A sufferer is, I believe, entitled to the benefits of advanced science whether he be rich or poor, but the professional man should no more be expected to render his services gratis than the butcher or baker or any business man should be expected to give his stock of goods to the poor without remuneration.

Finally, let me make a plea for closer coöperation, not only of the roentgenologist and surgeon, but of the roentgenologist and all in our profession. A coöperation not only for our science and our financial betterment, but for the benefit of humanity by the earlier recognition of the beginning ravages of disease than has been our privilege heretofore and a united effort to discover ways and means to arrest the progress of such disease before irreparable damage has been done. Only by such coöperation can roentgenology, which is at present only in its infancy, be rapidly developed into its possibilities.

25 E. Washington St.

PATHOLOGICAL TRAINING FOR THE ROENTGENOLOGIST

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It is probable that most specialists in medicine, particularly if they have been teaching their particular subject, are convinced fully that any other field than their own may be neglected with more or less inpunity. To one who has taught pathology, particularly in its correlation with clinical medicine, the feeling is almost irresistible that of all subjects demanding immediate acquaintance it come near to being preëminent. This, of course, after having accepted the premise that anatomy and physiology are the basic elements of the entire superstructure.

Without a knowledge of the abnormal changes it is impossible to understand fully the symptomatology of any disease, and consequently to properly treat the conditions that are present. There is probably no method of diagnosis at the present time that depends so absolutely upon the existing physical conditions as does that of roentgenology. Yet how many of the men who now are doing roentgenology, (all doing that work are not roentgenologists) have any underlying foundation of pathology? Very few, yet the interpretation of the lights and shadows depends on a proper understanding of the anatomical changes that have and are taking place.

For some years there has been a tendency for non-medical men to take upon themselves the responsibility of making roentgenograms. There could be no objection to this provided that they stopped after the plates had been developed and made no comments other than what relate to matters of technique. Unfortunately, this is not always the case. There are entirely too many instances in which the further step of interpreting the plates has been taken. That this is successful in certain kinds of work, must be admitted, but that should not mean that the layman is qualified in all varieties of work. It would seem that if high grade diagnostic skill is to be expected, there should be certain qualifications demanded of the roentgenologist. It goes without question that he should be a graduate from a good medical school. But more than that should be required. As already said, roentgenology depends for its results upon the ability of tissues, of varying quality and quantity, to interfere with the passage of the rays. Consequently a knowledge of the normal histology and anatomical structure of the organs and tissues is a prerequisite. The next step is the acquisition of a familiarity with the abnormal changes of those tissues and structures. This means more than the smattering that is picked up during the medical course. If the early days of the men prominent in medicine are studied it will be found that many an hour was spent by them either in laboratory or postmortem room. It was by so doing that they built the foundation on which their future careers were developed. It should be also in roentgenology as in other specialties, the best specialist is he who has practiced general medicine sufficiently to fully appreciate the far-reaching influence upon the body of some local condition. If he is to be anything more than a technician he must know more and be able at least to understand what the changes are that take place in disease.

The roentgen plate gives the results obtained by the passage of certain manifestations of energy through materials of varying density. It is, of course, absolutely essential that the technique be good, otherwise the plates will not be satisfactory. If the rays are too hard they will penetrate too readily and the fine shades of contrast will be lost in the same way that under the microscope objects cannot be seen if too much light is used. As a general thing the soft ray with its lessened ability to pentrate will be the one to show best the variations in density that are so necessary. But who is able best to determine just how hard or soft a ray should be used? It would be the man who had a mental picture of the abnormal conditions present in the area to be examined, and he, necessarily, would be the one who had had the medical training. It is he who should pass judgment as to the technique to be followed, even if he himself does not carry out the actual work.

In order to get the best results in all respects there are certain conditions that should be fulfilled but seldom are. One of the greatest mistakes that is made by the medical profession at large is the lack of coöperation that exists between them and the laboratory man, the roentgenologist being essentially of the laboratory. To send a patient for roentgenograms of the chest, for instance, without giving a detailed result of the clinical findings is on the same plane as sending a piece of tissue to the pathologist and expecting him to make a diagnosis and outline the treatment, without having any information concerning the case. If the patient is to be properly benefited there must be to a greater or less degree an actual consultation. There is probably no field of roentgenology in which a thorough knowledge of pathological changes is so necessary as in the proper interpretation of chest plates. So many times the practitioner, not knowing much about the subject himself, insists that the roentgenologist do all the work, not only of getting the plates made, but of interpreting them and even suggesting treatment. To overcome this requires, of course, that the internist be familiar with diseased conditions, which, unfortunately, is frequently not the case. In lung cases the more common point to be determined is first the presence or absence of tuberculosis. How can a man who has never seen a lung, even in the laboratory, to say nothing of in the individual, appreciate the wonderful complexity of the structure? He cannot visualize the general appearance, but what is more, he has little of any understanding of the finer histology of the tissues forming the organ. He, therefore, can have no true realization of the changes that take place in disease. To the non-medical man a discussion of the appearance of the pleura under varying conditions can mean but little or nothing. Yet to the physician who has been at the autopsy table the matter of pleural thickening and adhesions is one of the greatest importance. His experience has taught him to realize what an effect the pleural changes must have on the adjacent structures, and on the clinical symptoms. He will have seen numerous cases where, although large amounts of fluid were present, they were so delimited by pleural adhesions that changes in position of the patient had no effect on the location of the exudate. Some pleuras may be so thickened and dense as to be almost cartilaginous, others may be equally thick, but made up of fibrin and exudate with but little density. The changes in the lung itself are many and varied, and if they are overlain by an extremely dense pleura the resulting plate will be very different from one in which no pleural involvement was present. Although it is advocated by some roentgenologists, as well as by some physicians, that the roentgenological examination should be made without the advantage of any clinical history, such a procedure is indeed a bad one. As said already the urgent necessity is for more coöperation, not for less. It is as great a mistake for the roentgenologist to be willing to make the final diagnosis as it is for the physician to allow such an important matter to pass from his own hands. Although in the laboratories, clinical and roentgenological, there are certain diagnoses resting on demonstrable facts, yet many of the findings should be considered as nothing more than links in the chain.

There is still another point that is a common stumbling block to the roentgenologist, and if he is one who has not had a medical training, he should be very chary in making any dogmatic assertions. The clinician will very frequently bring the utmost pressure in trying to force an opinion as to whether the condition is acute or chronic, active or passive. The more both parties to the discussion know about anatomy, physiology and pathology the more likely are the final opinions to be correct. Possibly this argument comes up most frequently in regard to tuberculosis of the lungs, and to abnormal conditions about the roots of the teeth. To one who is versed in pathology and who has made many autopsies, the varied changes that take place in such lungs form a familiar, though varied picture. To the untrained man, the roentgenograph is nothing more than a matter of lights and shadows, or more correctly stating it, a question of varying densties. He has no ability to visualize the actual appearance of that tissue. On the other hand the trained individual can recall the appearance of many diseased lungs, he can remember the peculiarities of distribution and of density, the condition of the overlying pleura and a hundred other things. He realizes the difficulty that frequently arises in determining whether a lesion is acute or chronic, even when the lung itself is actually before him. It is not always easy to decide as to which set of lesions is probably primary, which secondary, and so on. Naturally, it is very much more difficult to come to any definite conclusions when all the data must be obtained from the finished plate. One's judgment must be influenced very largely by the clinical condition of the patient. A thorough physical examination, including that of the blood, urine, etc., should be required, and with all the findings before one there can be given opinions as to what is taking place. To do otherwise, to make a diagnosis on insufficient evidence means trouble for the patient and everybody concerned.

It might seem an almost impossible error, yet the opening of the dental foramen in the lower jaw has not infrequently been mistaken for a rarified area due to a root abscess. At other times no roots have been shown on the dental film, yet on extraction the roots have been very evident.

Such mistakes will become less and less common just in proportion to the roentgenologist understanding what the changes are that can take place in infections of the bony structures. It is just another indication of the fact that we are dealing with shadowgraphs resulting from variations in the structure of the tissues, and these variations can, in the vast majority of instances, be appreciated only by the man who has had proper and sufficient training.

In order that the best work should be done, best from the point of view of both patient and physician, it would seem that the essential requirement for a roentgenologist should be a medical training, with special reference to anatomy, physiology, and pathology. A good technique can be obtained in a comparatively short time, but the proper interpretation of the plates requires much more knowledge and should not be relegated to one who from the very nature of his training cannot know what the changes are that have occurred. It would seem that it will be little more than a matter of time when the separate states will demand that the responsible individual in a roentgenological laboratory be a graduate of medicine. Until that time comes roentgenology will not occupy the dignified position that is its due.

TO THE MEMBERS OF THE WESTERN ROENTGEN SOCIETY

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In this age of mechanics, the accredited roentenologist has to rub elbows with untrained laymen, in fact, even being compelled to bid for and share work with anyone who has nothing more to offer the public than the mere possession of an ordinary *x*-ray machine. This highly disconcerting situation is the condition as it exists today on the Pacific Coast, and it is more than likely of equal prevalence in your part of the United States.

To find a remedy for this evil is the present project of the west coast roentgenologists, and in order to acquaint you with the matter as it appeals to us, the writer requests the privilege of presenting a few personal thoughts on this topic, and will give verbatim a short article which he has just delivered to the medical profession on the coast.

This subject is now being thrashed out in the California state, county, and local medical societies with the hope that a solution will be reached, whereby medical roentgenologists will be protected and tendered the same professional courtesies that are enjoyed by all specialists. The writer has for many years keenly resented the attitude which many shortsighted medical men assume toward roentgenology, and he trusts that this splendid body of men that make up the Western Roentgen Society will do their part in correcting the evil.

The paper follows:

THE LAY RADIOGRAPHER

Some months ago, one of America's leading Eastern dailies wrathfully alluded to California as the boob state of America. It occurs to the undersigned that the originator of this now more or less famous sentence must have derived his inspiration from a knowledge of the laws which govern the practice of medicine and surgery in the state of California.

Apropos of this, whether the laws are at fault or that their precepts are either incompletely executed or else grossly ignored, does not alter the fact that in so far as these laws relate to roentgenology, the situation is highly unsatisfactory. It appears that medical men, irrespective of the fact that they may have both academic and medical degrees, are penalized by being required to pass an examination or pay a reciprocity fee, together with license and tax fees before they may legally engage upon their chosen work of roentgenology. On the other hand, it seems that any number of laymen, of whatever status or caliber, can, upon the purchase of an *x*-ray machine, enter into direct and active competition with the qualified medical practitioner, not only unmolested by the authorities, but actually encouraged by a certain number of medical and dental practitioners, many of whom are members of the regularly organized state and county scientific societies. It is incomprehensible that a medical specialty so inseparably bound up with every individual branch of medicine and surgery is permitted to pass into hands totally unfit by lack of scientific education and training, and exploited as a commercial entity. It is equally preposterous that medical men will patronize and consult with laymen engaged in such work, men whose knowledge of the fundamental associated sciences is obviously limited. It is also regrettable that a certain part of the profession has been instrumental in fostering the development of lay radiographers by patronage and in individual cases encouraging a system of fee splitting.

More and more is our attention directed to the fact that in no other medical specialty is a general knowledge of medicine and surgery more desirable than in roentgenology. If this is granted, then for no other reason should a roentgenologist be a highly trained medical man.

Aside from the commercial and economic aspect of this problem, it must not be forgotten that modern electrical generators and improved Coolidge tubes have increased in direct ratio both the usefulness and dangers associated with this work, thus making it all the more necessary to elevate rather than lower the status of those concerned in the diagnostic and therapeutic use of the roentgen ray.

The great war, now happily terminated, has immeasurably broadened the scope of roentgenology. Medical officers of the army and navy have had brought to their immediate attention new and manifold uses of the roentgen rays, as amply demonstrated in every medical military unit. Their interest, as well as enthusiasm, has been aroused. These men, returning to civilian practice, will require modern roentgenologic assistance as never before. This will mean increased demands upon the rapidly growing roentgenologic colony, and will, no doubt, create a goodly number of new mechanical radiographers, manipulators, and picture takers, many of these made expert by a recent acquisition of an electrical plant or by any other equally short cut to knowledge. To complicate matters, the exigencies of warfare necessitated the training of individuals as roentgenologic manipulators, owing to the limited number of available medical men for this purpose. A certain proportion of such trained laymen will no doubt branch out as medical *x*-ray specialists.

You are all more or less familiar with the conditions as outlined by these remarks, and the correction of some of these evils lies largely in your own hands. If your roentgenologic colleague does not merit your support, and you feel inclined to patronize a layman, it is suggested that he not be supported in the same manner as your other specialty consultants. Place him where he should legally stand, and view his work in the light of a technician or laboratory assistant. This would have a tendency to discourage many technicians, now posing as doctors, and who in the eyes of the laity seem fully as well qualified as the medical roentgenologist. A striking analogy of this situation is had in the case of Ophthalmology vs. Optometry. You surely would not refer a patient with an eye lesion to an optician for diagnosis, yet this is precisely what occurs when such a patient is referred to a radiographer for a diagnosis.

The basic remedy, however, lies clearly in legislation that will sharply distinguish between the roentgenologist and the lay radiographer. If the latter is to exist as an independent institution, then by all means impose upon him the same penalties to which the medical man is subjected. Let him obtain a license from the state board of medical examiners, in the regular way, and don't attempt to change the present medical practice act, or create any new boards. Compel the board of medical examiners to recognize as they should that roentgenology is *de facto* the practice of medicine. Then will the roentgenologist, perhaps for the first time, feel that he has reached his well earned place beside his professional confreres, and may he never again be alluded to under the onus of that hateful phrase the "*x*-ray man."

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THE *X*-RAY FROM THE SURGEON'S STANDPOINT

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Everybody, no doubt, has a certain amount of academic interest in roentgenology, but to the practical surgeon the main interest centers in the proper interpretation of the plates after the technical act of producing them is over.

After the announcement of the discovery of the roentgen ray, and we had sufficiently recovered from the shock, all were agreed that this would be a godsend to bone surgery, but no one was so farseeing as to believe it would ever be of any especial assistance to us in any other department of our work. Had anyone told us then how much we would rely on the *x*-ray in the year 1919 as an aid in diagnosis in almost every branch of our art, he would have been set down as having more imagination than practical sense.

But here we are, and the field of accomplishment is so large and wonderful that one scarcely knows where to begin to catalogue it. Whether the suspected lesion be bony, abdominal, thoracic, or intra-cranial, we are more or less dependent on the *x*-ray as an aid in diagnosis. Let us put an emphasis on that word "Aid," for when one overlooks his ordinary clinical methods and comes to trust in the *x*-ray alone, he is headed towards destruction. If one would avoid serious mistakes he must carefully correlate the case history, the symptomatology, the physical findings, all the other laboratory findings, and the *x*-ray readings. With these qualifications I am ready to take off my hat to roentgenology as one of the greatest helps we have in establishing accurate diagnosis.

Even in fractures and other bone lesions a blind following of plate readings may lead to ludicrous if not more serious mistakes. A roentgenogram taken through a single plane may be absolutely misleading. As is now generally known a single roentgenogram may show a fracture when none exists or may indicate no fracture when the bone is broken squarely off and overlapping. It is my opinion that in bone lesions generally there should be no arbitrary limit to the number of plates taken, but there should be enough of them and taken at a sufficient number of angles to make the exact condition of the lesion perfectly plain, so that every element of error is eliminated.

The next great field in which the surgeon is interested and in which he relies on the *x*-ray for assistance is in the gastro-intestinal tract. The opaque meal and the opaque enema are of inestimable value in helping to reach an exact diagnosis. In some cases the facts elicited in this manner seem almost uncanny. As an illustration, a patient's gastric symptoms may be so definite and so insistent that it is hard to escape the conclusion that a gross stomach lesion exists. And yet a careful and intelligent use of the screen may show the stomach normal, the symptoms being dependent on a spasm of the pylorus, caused by a mild appendicitis or cholecystitis or other intra-abdominal inflammation or irritation. Here is one of the places where the *x*-ray reaches its highest point of efficiency and where we rely on the roentgenologist to make no mistakes. Before I depended on the *x*-ray for assistance I know I have operated for a supposed gastric lesion when none existed except the pyloric spasm and that the true lesion was unsuspected.

When we have to deal with a real lesion of the stomach or pylorus the *x*-ray is valuable in two classes of cases. In the first we may be able to ascertain by the older methods that disease is present. We may be able to determine to a relative certainty the location of the lesion. We may study the case never so thoroughly, but be unable to determine positively whether the lesion is malignant or benign. Altho it has its limitations in many of these conditions the *x*-ray gives us a precision in reaching a conclusion which adds greatly to our understanding of the case and gives us a confidence in what to advise the patient that is of the utmost value.

I do not believe the *x*-ray will always correctly decide between cancer and an ulcer, but with the combined experience of all you men engaged in this work, and practice in interpretation of the roentgenograms, the percentage of error is becoming very small. Accurate *x*-ray readings in this class of cases is now proving of great practical value at the operating table. As you all know, after the abdomen has been opened and the stomach lesion is under inspection and touch, it is not always possible to make a certain diagnosis of cancer or a benign ulcer. The best of surgeons make mistakes. A very radical and dangerous operation is sometimes done under the belief that cancer exists, and after its removal the pathologist pronounces it benign. On the other hand, conclusion may be reached that one is dealing with an indurating ulcer, a gastro-enterostomy is done and the supposed ulcer is not removed. The future history of that case may prove that it is malignant, but the error is too late to be remedied. The calamitous nature of such a mistake is accenuated when we stop to realize that the malignant case that is interpreted as benign and not removed is the early cancer, the one most favorable for successful surgical removal.

Already the roentgenogram is rendering material help to the surgeon in coming to this momentous decision at the operating table. The *x*-ray plate may indicate so definitely malignancy or benignacy that it may be of material assistance in deciding whether to make a radical removal or not. I wish to admonish men engaged in *x*-ray work to redouble their study of these cases. Not only should all plates be thoroughly studied, but the roentgenologist should go to the operating room, see and study the case for himself during the operation, and also follow the specimen to the pathologist in order to see the case as a whole and to correct his error in reading the plates with the hope that he may come nearer and nearer to a correct differentiation between cancer and ulcer.

It is not necessary to lay stress on the assistance we sometimes get in coming to a definite conclusion about constrictions, kinds, etc., along the intestinal tract. A spastic or dilated segment of gut is often vividly shown on the plate. Diverticulæ are not only discovered but definitely located.

Incidentally I may say the *x*-ray has helped to explode some bugaboos with reference to the normal position of the viscera. Formerly our views of what position the several viscera occupied were as fixed as if our knowledge had been gained by the study of a frozen cadaver. If a viscus was out of its "normal" position it gave rise to a feeling that it ought to be restored and fastened in its proper place because it certainly could not functionate when away from its normal environment. The more the *x*-ray plates are studied the more it is realized that a viscus will carry on its work in almost any location if it is healthy. The V-shaped transverse colon is found so often in healthy subjects that we do not itch to hang it up even if the point of the V extends to the pelvis. Although the stomach may seem to be in happier surroundings in the upper part of the abdomen, we now know that even when it rests down on the uterus it may perform all its functions perfectly and painlessly. Many cases of general visceroptosis exist for years within the abdomen of a healthy individual. If a patient with visceroptosis comes to us with symptoms that might be interpreted as due to toxemia from the intestinal tract, careful and intelligent use of the *x*-ray will give us almost perfect knowledge of the degree of stasis and aid materially in deciding whether the visceroptosis is responsible for the symptoms complained of.

The diagnosis of stone in the urinary tract is so accurate that it has largely superceded all other methods It shows the size, location, shape and number of the stones to such a nicety that it has made a previously very difficult field of surgery easy and simple. But here, too, there are sources of error. Substances in the intestinal tract as well as calcified glands may be mistaken for stone. It is, therefore, necessary to hitch up our clinical findings with the radiologist in order to avoid mistakes.

One chance of error I want to point out, for it is very easy to happen. I was called to a town outside of Omaha to operate for a stone in the kidney. The patient was in a private hospital and it was absolutely certain that the stone was there, for it was pointed out to me on the x-ray plate. As nearly as it could be figured the stone was in the pelvis of the kidney. The plate was a week old and only two days before there had been a violent attack of nephritic colic. I went after it with the same confidence an artillery man shoots at an enemy he cannot see when he is directed by a man up in a balloon. The kidney was exposed, examined, the pelvis was palpated, no stone was felt. It was decided that it must be in the kidney substance instead of in the pelvis. The kidney was carefully palpated from pole to pole between my fingers. No resistance was felt that seemed at all significant of stone. The kidney was needled. No stone was discovered. Bearing in mind that sometimes a small stone might be missed by these methods the kidney was split by an incision along its convex border. No stones could be found. Next the ureter was followed down as far as I could reach when I was forced to desist because the patient's condition was growing critical. It was decided that the x-ray had played us a trick and Prof. Roentgen was anathematized. A day or two later the patient had another severe attack of nephritic colic. He stated that the sharpest pain seemed lower down than before. When able he came to Omaha. Another x-ray showed a stone exactly the same size and shape as in the previous plate, but low down in the ureter. It was removed and the patient relieved. In the attack two days before the operation, and after the plate had been taken, the stone had migrated several inches down the ureter.

Since then I never allow any great length of time to elapse between making of the plate and the operation, and if severe colic occurs after the plate is made, I insist on another plate before operating to insure against any change in position of the stone. This rule only applies to comparatively small stones.

The *x*-ray as an aid in diagnosis has come to stay. It figures largely in the everyday work of the surgeon. As we have no right to neglect any clinical test or laboratory finding in seeking for a correct diagnosis, we have no right to withhold the use of the *x*-ray if there is any probability of its being of the least assistance. No man in our profession has a right any longer to rely entirely on himself. No one can be a master in all the things required in the study of many of our obscure cases. The surgeon needs the internist's aid, often he needs the pathologist, the chemist, the ophthalmologist, and the roentgenologist most often of all.

Coöperation is in the air. The doctor who does not coöperate with his fellow is bound to be narrow, inefficient, to make needless mistakes. The shortsighted policy of each medical man working by himself and imagining that he is superior to his fellow and trying to convince his patients that his competitor is a fool or a knave or both in one, is happily past. This old time status when the family doctor devoted his energies to looking wise and holding himself in magnificent isolation is slowly giving way to a feeling of fraternity and the real efficiency which comes from intelligent teamwork.

Bee Building

Case Reports

LUNG NEOPLASM

L. A. Marty, M. D.
Kansas City, Mo.

The patient was a male, age 66, married—three children, healthy. Occupation—merchant broker. No serious past illnesses. Present complaint—coughing, shortness of breath, expectoration of mucous.

History: Patient has had shortness of breath for fifteen months, aggravated by slight exertion, or sometimes without cause. He is very weak, sleeps well, but coughs considerable. Has occasional night sweats. Lost thirty-five pounds during first four months of illness; has had no loss of weight since. His appetite is fair, he has no gastric disturbance. No headache, no aches or pain at all. No oedema of ankles, or abdomen. Expectoration of mucus is most at night. No urinary disturbance. A doctor in St. Louis told him he had laryngitis and gave him inhalation, from which the patient imagines he secured too much medication, with lung irritation since. Had asthma (so called) a year ago; went south for it without effect. Says he had six sputum examinations which were negative, also *x*-ray examination of chest which was negative. He almost died of "asthma" when south in April, 1917. No relatives have died of tuberculosis.

Blood examination shows: Hemoglobin 60%, white blood cells 12,000, red blood cells 3,600,000. Urine shows traces of albumen.

The pulse is regular, 100; temperature 99.5.

An *x*-ray report which the patient brought with him reads as follows:

"X-ray plates of the chest show non-tuberculous mottling in lung. An unusual infection of right mediastinal glands (one as large as a hen egg at right hilus). There is sufficient mechanical impingement to account for respiratory trouble."

This examination by the roentgenologist had been made three weeks previous to our examination. The examination at this time shows a very distinct shadow over an area in the right lower chest. This spot is close to the diaphragm and is too far removed from the hilus to be a hilus gland. It is large and rather well defined at this time.

Some thirty days, following this examination, the patient was taken to the Mayo clinic at Rochester Minn., for examination and treatment, this being sixteen months following the first complaint that the patient had made in regard to his health. Upon his return from the Mayo clinic, I wrote to Dr. H., who had charge of him while there, and asked him what had been done. His letter of reply contains the following:

"In reply beg to say that the operation I performed was primarily for the purpose of excluding the presence of pus. To this end I secured adhesions between the parietal and visceral pleuræ, and then aspirated repeatedly with a fair sized aspirating needle. On the last attempt I secured a plug in the needle, which I submitted to the pathologist for examination. He said that the tissue contained cells suggestive of neoplasm, but the specimen was necrotic, and he was therefore unwilling to commit himself as to the nature of the tumor. I regretted this very much at the time, and also now that I cannot give you a definite report."

Some two months after my first examination of the patient, he came under my care for roentgenization. I had at this time the plate made by the first roentgenologist, our plate made at our first examination, and then a plate which I made at this time. These three plates showed the very rapid growth which was taking place in the tumor of the right lower lung. My next plate was made on July

11th, following the massive treatment which I had given him on June 20th. The plate made at this time shows a very appreciable diminution in the size of the growth. I then gave another massive treatment over eight large areas; all areas being directed to the tumor. I made an examination of the patient again three weeks later. The tumor does not show much diminution in size, since the last examination, but when this plate is compared with the one made six weeks before, the difference can be very plainly seen. At this time another massive treatment was given.

During the first treatment which was given him, he had a very hard coughing spell and began bringing up large quantities of this mucus; which he has continued to bring up ever since. The history, given above, states that he had expectorated some mucus. This was just a little thin mucus, such as is many times coughed up from the bronchi, but this that he began to expectorate during the first treatment was a very thick, ropy, yellowish white mucus, and in great quantities. Microscipoc examination of this expectoration showed no bacteria whatever, but only large nucleated cells.

Although at the Mayo clinic they were very careful to secured adhesions between the lung and the pleura, it seems that those adhesions have been broken up, for in examinnig his chest with the stethoscope, it is very easy to hear the collapsed lung, which has never filled out, flap against the side of the chest during each inspiration.

The man during this time was very much emaciated, very weak, and it was hard for him to lie on the table long enought to receive his treatment. He could not get the proper rest at night.

Three weeks later, another massive treatment was given, and that was the last I saw of him. He lived for three or four weeks following this, when his death was reported to me. No post-mortem was obtained.

A positive diagnosis in this case was never made, but from my study of the sputum and everything else in connection with the case, I am lead to believe that this was a carcinoma of the lung. At any rate, there is no question but that it was a malignancy of some kind. As we never found trouble anywhere else in the body, we take it that this was primarily in the lung.

As a fitting summary to the subject of chest neoplasms, I can best quote directly from Ewing's new book, "Neoplastic Diseases," as follows:

"Primary tumors of the lungs have long attracted much clinical and pathological interest. Bayle, in 1810, vaguely describes pulmonary cancer, and Stokes, 1842, recognized several varieties of the disease. Ebermann as early as 1857 collected 72 cases, one occuring before the age of nine years. Jacoud appears first to have sharply distinguished the disease from phthisis. Behier pointed out the prominence of pressure symptoms and the frequent invasion of supraclavicular nodes. Bennett's Lumleain Lectures in 1872 dealt fully with the clinical aspects, from an analysis of 39 cases. Kokitansky recognized several gross varieties of the pulmonary lesions, but the earliest microscopical studies were those of Langhans, Marchiafava, and Malassez, 1871 to 1876.

"The more detailed interest and knowledge date chiefly from the later studies of Wolf, 1895, and Passler, 1896. Since that time the literature has grown to very considerable proportions, so that Adler in 1911, was able to tabulate 374 cases of carcinoma and 90 of sarcoma. Since 1912 Scott and Forman find reports of 120 new cases.

"Etiology. Primary malignant tumors of the lung form about 1 per cent. of all cancers. Among 16,578 cancer autopsies from various continental sources 168 pulmonary cancers were recorded (compiled from Karrenstein and Adler). Kaufman places the proportions much higher, at 1.83 per cent. It is evident that increased attention has greatly augmented the list of observed cases. Knierim (1909) reported that at Leipsic, during nine years, 66 cases of bronchial carcinoma, seven asanthomas, and two alveolar tumors had been observed.

"Males are much more frequently affected than females, 71.9 per cent to 24.8 per cent. Alder gives the following analysis of age incidence:

10–20 years	6
20–30 years	10
30–40 years	30
40–50 years	78
50–60 years	113
60–70 years	94
70–80 years	23
80–90 years	2
	356

"Horn observes an adenocarcinoma in a girl of 18 years. A congenital multiple appears to have been encountered by McAldowie in an infant of five and one-half months, while Nuscheler reported a case in a girl of seven years, and Werner describes a small cell carcinoma in a female of 19 years. Sarcoma occurs at somewhat earlier ages, chiefly between thirty and forty years, and six cases have been reported in the first decade. The right lung is more frequently affected than the left Of 106 cases Perrutz located 35 per cent on the left side, 54 per cent on the right, while 10 per cent were bilateral.

"The chief etiological factor is tuberculosis. Of Wolf's 31 cases 13 were associated with tuberculosis. Squamous-cell carcinoma developing in the wall of a tuberculous cavity is described by Schwalbe, Friedlander and Perrone. Wolf found tuberculosis lesions throughout diffuse carcinoma, or surrounding tumor-masses. In the old scleroses, atelectases, and reparative lesion of tuberculosis may be found many alterations of bronchial and pulmonary epithelium, marked by considerable cellular overgrowth. Oertel points out that the association may be accidental, at other times the two processes exist in symbiosis, while rarely tuberculosis appears to inhibit the carcinoma. Several cases in which there was active miliary tuberculosis with carcinoma suggest that the malignant process may light up latent tuberculous foci (Wolf)."

PLATE NO. 1
This plate was made fourteen months after the beginning of the illness and shows the rather ill-defined border of the tumor as it appeared at that time.

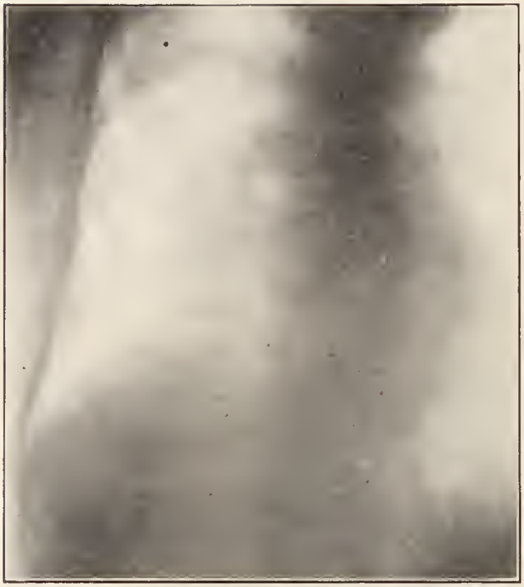

PLATE No.2

This plate was made fifteen months after the beginning of the illness. There is increase in size of the tumor mass and the border is becoming more distinctly marked out.

PLATE No. 3

This plate was made seventeen months after the beginning of the disease. We now see a very large mass and a well circumscribed border.

PLATE NO. 4

This plate was made eighteen months following the beginning of the disease. The effect of the roentgenization is very apparent as the tumor is much smaller and more sharply defined.

Plate No. 5

This plate was made practically nineteen months following the beginning of the disease. There is not much diminution in size since the plate No. 4 was made three weeks previously; but when compared to the plates made at an earlier stage of the disease—plate No. 3, you will see that there has been much improvement from the treatment.

Rialto Building

MULTIPLE SARCOMATOSIS SECONDARY TO SMALL ROUND CELL SARCOMA OF THE BUTTOCK

A. F. Tyler, M. D., B. Sc.
Omaha, Nebraska

M. C. R. Colored. Age 35. Male. Occupation: Cook. Referred by Dr. J. W. Duncan.

Patient came to St. Joseph's Hospital on January 11, 1918, from Creighton Medical College, complaining of a lump the size of an egg in the right gluteus maximus muscle. This was very painful. This lump began as a small pimple on December 18th. It did not pain much at the onset, but the patient had an acute attack of appendicitis, and probably pain was not noticed, but from December 18th, it began to enlarge. On January 11th he saw a doctor at Creighton Medical College and was referred to St. Joseph's Hospital. After dressing it here two or three days, a piece was taken out and examined microscopically, and was pronounced granuloma. This seemed to help for a while and the wound healed. After the first two weeks in the hospital, the patient thinks it had reached its maximum growth and remained that size until excised January 25, 1918, by Dr. Duncan.

Wasserman test: Negative.

One nodule enlarged and broke down after the second week here. This also relieved it. The patient says this was caused by sitting down on a button on his underwear.

On February 7th, a second piece was excised by Dr. McMartin and sent to pathologist J. S. Foote, and the growth was this time diagnosed a small cell sarcoma.

The inguinal glands were involved on both sides and were hard and matted together. Complete excision was necessary. The growth looked much like a very large keloid, nodular, and was partially broken down and was the size of the flat of the hand and about one and one-half inches deep in all but one place where it extended deeply into to buttock about one-half inch from the anus at the edge of the muscle. The patient came from the operating room in good condition but suffered severe pain so he could not sleep. Recovery from the operation was uneventful.

This patient was referred for roentgen therapy while at St. Joseph's Hospital immediately after operation. While being treated, the lumps began to appear in the skin, but would disappear after a single treatment. In a few days others would appear. The patient finally drifted from observation until September 1, 1918, when we found him covered with thousands of small nodules in the skin. These were especially abundant on the thighs and arms, abdomen and back. Two large palpable masses in the lower half of the abdomen were thought to be enlarged iliac glands. Fluoroscopic examination revealed several metastases in both lungs.

The patient continued to weaken, more metastases appeared in the skin, those in the abdomen and chest increased in size till death ensued from asthenia October 14, 1918. Post-mortem examination was denied.

City National Bank Building

UNNECESSARY ROENTGENOSCOPY NOT REQUIRED

Reprinted from *The Journal* of the A. M. A., Volume 72, No. 25, p. 1865.
(United States Fidelity & Guaranty Co. *et al.* *v.* Wickline (Neb.), 170 N. W. R. 193)

The Supreme Court of Nebraska holds that a claimant for compensation under the employers' liability act pursuant to Section 3675 of the Revised Statutes of Nebraska of 1913, cannot be denied a recovery because of a refusal to submit to a roentgen-ray examination or to have a roentgenogram taken of the person, where the uncontradicted evidence shows that neither was necessary. Section 3675 provides that, after an employee has given notice of an injury he shall, if so requested by the employer of the insurance company carrying such risk, submit himself to an examination by a physician or surgeon furnished and paid for by the employer or the insurance company, and refusal of the employee to submit to such examination shall deprive him of the right to compensation during the continuance of such refusal. The court says that under the statute the request for an examination must be reasonable, and it did not appear to have been in this case. The testimony before the court showed affirmatively that neither a roentgen-ray examination nor a roentgenogram was necessary. No physician nor other person testified that either was necessary, nor did it appear that a request was made to the court to require the employee to submit to either.

In the present advanced state of the science of roentgen-ray examinations and the taking of roentgenograms of the person, there appears to be no reason why such examination or roentgenogram should not be permitted by a claimant for compensation under the employers' liability act, on request by the employer or insurer, unless the request is shown to be unreasonable.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

Of THE JOURNAL OF ROENTGENOLOGY, published quarterly at Iowa City, Iowa, for April 1, 1919.

State of Iowa

County of Johnson

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Bundy Allen, M. D., who, having been duly sworn according to law, deposes and says that he is the Editor of THE JOURNAL OF ROENTGENOLOGY and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations.

That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher: Western Roentgen Society, Iowa City, Iowa.

Editor, Managing Editor, Business Manager: Bundy Allen, M. D., Iowa City, Iowa.

That the owners are: Western Roentgen Society, Inc., Chicago, Ill.

That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

BUNDY ALLEN

Sworn to and subscribed before me this 4th day of April, 1919.

(Seal) ANNA F. GORDON

Form 3526.—Ed. 1916 (My commission expires July 4, 1921.)

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PNEUMO PERITONEUM

The introduction of gas or air into the peritoneal cavity, as a diagnostic or therapeutic procedure, opens a field for research work of almost unlimited possibilities.

To date no untoward result has been reported by the original investigators in this field. It is true that criticism has been directed against both the operators and the method; but no destructive criticism has altered the fundamental fact that a new and valuable branch of roentgenology promises to be popularized. Criticism has come from some to whom the procedure promises to be of the greatest benefit, *i. e.,* the internists.

Unhappy results must surely accumulate as literature develops on this subject, but in the final analysis the indication for its use will be the essential and most difficult problem, rather than the technique or the differential findings.

To properly estimate the widening scope of roentgenology a conception of the visceral changes discernible in the process of pneumo peritoneum is essential. In the absence of specific reports of complications following its use, it is well for us, in the interest of conservatism, to weigh carefully the possibilities of harm and to urge a careful preliminary survey of all the anticipated pathology or anomalies to be excepted in a given case. To do this presumes collaboration with the referring physician or with a consultant of unquestioned ability and conservatism who shall confirm the inference that valuable diagnostic data may be obtained in the case at hand. Thus, indications for its use must come first from an intimate knowledge of what viscera are possible of visualization when contrasted with gas injected.

Contemplation of the procedure must be preceded by a tentative diagnosis of pathology that logically gives gross discernible morphological findings. A history must be carefully taken with the view of discovering a subacute or acute pyogenic peritonitis, recent abortions, erosions of intestinal mucosa, profound advancing anemia, advanced diabetes, etc.

Laboratory findings, such as differential blood count, Widal, and urine examinations, are extremely essential in selected cases. Thus the problem is not only medical but one requiring the highest type of medical skill, which in itself nullifies the fear that the science of roentgenology may suffer from decadence or regress into a mechanical vocation.

The field of internal medicine is so encroached upon by the roentgenologist today that the lines are inseparable. Hence the fear that the commercial laboratory may in any way supplant the medical man, is largely dispelled and with each advance come greater responsibility and a stimulus to achieve in behalf of humanity and in this accomplishment attain an essential and conceded efficiency.

It is not unlikely that by our work we may modify universally surgical technique in our discovery of the untoward post-operative belly changes. In no work is the individual factor more manifest than in the interpretation of tissues under the screen, and by virtue of this one fact it behooves the early workers in this field to interpret with caution and make it possible for the surgeon to minimize and shorten his operative procedure with a minimum of visceral disturbances and consequent surgical sequellæ.

O. H. McC., President.

PNEUMOPERITONEUM IN X-RAY DIAGNOSIS*

B. H. Orndoff, A. M., M. D.
Chicago, Ill.

In this article, it is my purpose to discuss briefly the technique used more than one hundred times in producing Pneumoperitoneum.

The illustrations present some particular phase of technique or pathology, whose detection is greatly facilitated by the addition of this method to other diagnostic methods.

Pneumoperitoneum indicates that the peritoneal cavity has been distended with a medium of a gaseous character. In our early cases air was used, later oxygen and nitrogen have been used. Oxygen seems preferable.

TECHNIQUE

The apparatus used in producing pneumoperitoneum consists of a tank of gas (oxygen), a water bottle indicator, a pressure gauge, needle, cotton filter, rubber tubing, glass connections, etc., as shown in illustration.

The *x*-ray apparatus in ordinary use has been made to suffice, but this work would be greatly facilitated by equipment designed especially to meet the particular requirements. In order to secure a lateral view with the patient lying face upward, an ordinary hospital chart may be used as a table in front of an upright fluoroscopic screen apparatus. Other fluoroscopic observations are made with the horizontal fluoroscope and with the patient in various positions over the horizontal and before the upright fluoroscopic screen apparatus. The position of the patient is essential as it is necessary to have the gas in contact with the part, organ or surface of the organ desired for observation or radiography.

*Read before the Kalamazoo Academy of Medicine, Kalamazoo, Michigan.

The needle used may be an ordinary intraspinal needle of not less than eight centimeters in length and with hose connection at its base, as shown in illustration No. 319. The site on the abdomen through which the puncture is to be made should be selected with a view of avoiding pathology in the abdominal wall or in some viscus directly beneath. This may be accomplished by observation and palpation, that is, selecting an area of skin with a healthy appearance and avoiding any object of increased resistance to palpation in the peritoneal cavity. There is practically no danger of damage to normal air filled loops of jejunum when introducing a needle of the character described.

The antiseptic preparation of the site has consisted of covering a small area with a solution of equal parts of lysol and glycerine. A small wooden applicator is used to make firm pressure against the skin which is covered by the lysol and this serves to produce a pressure anaesthesia, which is usually sufficient to be quite satisfactory. A needle is thrust through the skin at the site where the pressure was made after it has been thoroughly covered again with the antiseptic solution. It is obvious that by this procedure a small quantity of the antiseptic solution is carried along with the needle in its course through the abdominal wall.

The oxygen used in this work has been supplied from the regular hospital size or 130 gallon oxygen tank.

The water bottle indicator is constructed from an ordinary deep narrow bottle, a double perforated cork and two glass tubes. The inflowing oxygen is conducted by the glass tube about one inch beneath the surface of the water. The outflowing tube passes just through the cork in order to avoid collecting the water thrown up by the oxygen from the inflowing tube. It is obvious that the flow of oxygen will be indicated by the rapidity of the bubbles passing up through the water.

The pressure gauge is an ordinary blood pressure apparatus graduated to millimeters of mercury and preferably with a large dial.

The cotton filter consists of glass tubing filled with absorbent cotton. The cotton filter and rubber tubing connecting with the needle are sterilized in an ordinary formaldehyde sterilizer. The needle is sterilized by boiling.

The apparatus should be assembled in the manner shown in the illustration and a flow of gas turned on which will show a pressure of twenty to forty millimeters of mercury on the gauge. At this time the rapidity of flow of oxygen in the water bottle indicator is carefully noted. It is also well to note that a slight obstruction to the exit of gas from the needle produces an immediate change of pressure as indicated in the gauge. No gas is permitted to flow through the needle while inserting it. Allow considerable gas to flow through the tube after the apparatus is assembled in order to remove all of the formaldehyde from the cotton filter and rubber tubing before inserting.

The needle is inserted by grasping the skin with one hand and with a firm hold on the base of the needle in the other hand, direct it almost parallel with the surface of the skin. After passing through the skin, the base of the needle is elevated until it reaches a position perpendicular to the surface. The hand now grasps a firm hold of the tissues of the abdominal wall in order to elevate it as far as possible from the abdominal viscera while the needle is carefully inserted through the remainder of the abdominal wall. The muscles offer very little resistance. The fascia offers considerable resistance. The peritoneum usually offers considerable resistance. When the needle has reached the peritoneal cavity the oxygen tank is opened, permitting a flow of gas approximately the same as showed twenty to forty on the gauge before inserting the needle. If the gauge shows a constantly increasing pressure, it is obvious the needle is obstructed. If the needle is in the peritoneal cavity, it is laying against some viscus and if a slight retraction of the needle releases the pressure, one may be sure that gas is flowing into the cavity. If slight retraction does not release the pressure, it may mean the needle has not yet entered the peritoneal cavity.

Observations made laterally with the patient lying face upward should occur at frequent intervals during the administration of the gas and the amount introduced should be sufficient to elevate the abdominal wall from five to fifteen centimeters above the general level of the abdominal viscera in this position. This requires as a rule from 1.5 to 4.0 liters but actual measurement is neither necessary nor practical.

When sufficient gas has been introduced, the needle is withdrawn, the wooden applicator with the lysol solution is applied to the puncture wound, after which the excess of the solution is removed, and no other application or dressing is necessary.

Observations are carried out while the patient is lying before the upright screen. The position of the patient is changed slowly, while a study of the viscera and abdominal densities are being conducted.

Certain positions will be found to bring into view the pathology desirable to record and such positions can usually be duplicated successfully on the radiographic table. In some instances, however, it is desirable to use duplitized films and intensifying screens, and where a particular position of a viscus or abnormal density is found, to utilize the same rays and position for the radiogram.

SUMMARY

1. The procedure of producing pneumoperitoneum is not difficult, and while a few important points in technique are essential, they require no special training other than the usual medical training of a physician.

2. The size, position, mobility, relative density, variations in density, contour, contents and cavities of the abdominal viscera can be visualized and studied in a manner which opens to physicians entirely new possibilities.

3. New findings are encountered which seem to invite the conclusion that the basis for possible new clinical disease entities have been established and old clinical entities relegated to obsolete classifications.

4. Peritoneal adhesions between abdominal viscera and the anterior abdominal wall are demonstrated without difficulty. The importance of the functional pathology originating from this source will be studied carefully by the workers in this branch of medicine.

5. Fixation of the gastrocolic omentum to the anterior abdominal wall in seven cases have all shown as a cardinal symptom — vomiting, which is temporarily relieved by producing a pneumoperitoneum. The symptom returns as the oxygen is absorbed.

6. Perihepatitis, perispleenitis and pericolitis with peritoneal adhesions offer new phases for the study of functional pathology of these organs.

7. After pneumoperitoneum has been produced valuable aid in diagnosis is offered by filling the colon, stomach, duodenum, small intestines, bladder, kidney, pelvis, and appendix with oxygen. Variation in the diameter of the walls, changes in relative densities and the presence of neoplasms are detected before they have reached large proportions, and, consequently, diagnosis and prognosis is rendered more rational and reliable than has heretofore been possible.

8. Postoperative peritoneal adhesions to the anterior abdominal wall may be prevented by keeping the peritoneal cavity distented with oxygen for three to five days, or until the peritoneum is healed.

In concluding this paper, I wish to express my sincere thanks for the helpful coöperation received from Dr. C. C. Rogers and Drs. Walter, Stewart, and other members of the Staff of the Frances Willard Hospital.

1925 Marshall Field Annex.

No. 319. Apparatus shown consists of oxygen tank, water bottle indicator, pressure gauge, cotton filter, rubber tubing and ordinary spinal puncture needle.

No. 3160. ILLUSTRATION IS A LATERAL VIEW. PATIENT LYING FACE UPWARD

Abdomen fully distented. Anterior superior spine of the illeum is distinguished appearing above the level of the intestines and the tip of the liver which shows just distal to the costal arch.

Note the distance between the parietal and visceral peritoneum and the absence of peritoneal adhesions.

No. 3222. ILLUSTRATION IS THE SAME LATERAL VIEW. PATIENT LYING FACE UPWARD

Spine of the illeum can be observed same as preceding illustration.

Peritoneal adhesions can be clearly observed binding loops of certain intestines to the parietal peritoneum of the anterior abdominal wall.

No. 3278. ILLUSTRATION IS AN ANTERO-POSTERIOR VIEW. PATIENT LYING RIGHT SIDE UPWARD

The margin of the liver and kidney, gas filled loops of intestines, ileum bones, a pocket of gas in the true pelvic and the margin of the uterus can be observed.

No pathological findings.

No. 3263. ILLUSTRATION IS AN ANTERO-POSTERIOR VIEW. PATIENT LYING LEFT SIDE UPWARD

The margins of the spleen and kidney, the transverse and descending colon are observed.

The dense line extending from the splenic flexure of the colon and the spleen to the lateral abdominal wall is abnormal.

This finding in our experience so far is always associated with left hypochondrial distress and pain.

No. 3161. ILLUSTRATION IS AN ANTERO-POSTERIOR VIEW. PATIENT LYING FACE DOWNWARD

Note shadow of diaphragm, both sides, small liver, spleen (number plate indicates left side) shadows of both kidneys.

No. 3113. ILLUSTRATION IS AN ANTERO-POSTERIOR VIEW. PATIENT STANDING

The liver and spleen are observed to have descended from the dome of the diaphragm on both sides, downward and to the median line. They over-lap almost the entire kidney shadows. Peritoneal adhesions are observed between the liver and parietal peritoneum at the region of the sixth rib and interspace. Adhesions are noted between the spleen and splenic flexure of the colon.

The spleen shows considerable enlargement.

The final report of the examination in this case shows a positive Wasserman reaction which probably accounts for the enlarged spleen.

No. 3168. ILLUSTRATION IS A LATERAL VIEW, PATIENT LYING FACE UPWARD

Note the extensive peritoneal adhesions in the gall-bladder region.

Also note long fibrous bands extending from the region of the appendix to the parietal wall beneath the site of an operative scar of fiften years' duration.

No. 3157. ILLUSTRATION IS A LATERAL VIEW. PATIENT LYING FACE UPWARD

Note very extensive dense peritoneal adhesions compromising the margin of the liver and portions of the transverse and ascending colon, together with the gastrocolic omentum. The anterior attachments are beneath the site of a long operative abdominal scar.

No. 3190. ILLUSTRATION SHOWS CASE WITH NEEDLE INSERTED

Adhesions binding instestines to anterior abdominal wall beneath side of operative scar.

The intestines involved could not be determined by fluoroscopic examination or by observation of the radiographs.

Next illustration shows further information in this case.

No. 3193. ILLUSTRATION SHOWS THE RESULT OF DILATATION OF THE COLON WITH OXYGEN OF CASE ILLUSTRATED IN No. 3190

In the screen observation it was clearly determined that the adhesions were principally the transverse colon and probably the gastrocolic omentum.

No. 3192. ILLUSTRATION SHOWS ANTERO-POSTERIOR VIEW OF SAME CASE, HORIZONTAL POSITION, FACING UPWARD

The colon can be outlined by the presence of large quantities of gas, which was passed in through a rectal tube. The irregular density extending from the level of the second lumbar vertebra to the right (indicated by the number plate) is the point where the adhesions hold the intestines as appears in the lateral horizontal view No. 3190.

No. 3298. ILLUSTRATION IS A LATERAL VIEW, PATIENT LYING FACE UPWARD

The patient same as indicated in Nos. 3192, 3193 and 3190.

The patent was operated upon. Adhesions were surgically treated. Abdomen was filled with oxygen immediately following operation. No further oxygen was introduced until end of third day, when observations showed the findings this radiogram indicates.

The adhesions appear more numerous than preceding the operation. The case illustrates the necessity of introducing oxygen daily, if necessary to prevent contact with the peritoneum of the anterior wall for a period of at least four days.

No. 3226. ILLUSTRATION IS AN ANTERO-POSTERIOR VIEW. PATIENT LYING LEFT SIDE UPWARD

The densities extending from the region of the spleen and splenic flexure of colon to the parietal wall indicate peritoneal adhesions.

History shows cardinal symptoms include left hypochrondrial distress and pain.

No. 3252. ILLUSTRATION IS AN ANTERO-POSTERIOR VIEW. PATIENT LYING LEFT SIDE UPWARD

The densities produced by the spleen, kidneys, descending colon, psoas muscles, etc., can be observed. The contents of colon present a remarkable picture of small bodies whose densities with dark margins and lighter centers are quite typical of gall stones.

History shows injection of large quantities of olive oil which may explain the appearance of the colonic contents.

Long, loose fibrous peritoneal adhesions are noted in the region of the spleen, splenic flexure of colon, etc.

History shows cardinal symptoms include left hypochondrial distress and pain.

No. 3265. ILLUSTRATION IS AN OBLIQUE ANTERO-POSTERIOR VIEW. PATIENT LYING FACE DOWNWARD

There is much evidence of peritoneal adhesions involving the spleen, splenic flexure, pariteal wall, peritoneum, ascending colon, gall bladder region, liver, etc.

The pockets of gas are found more or less localized and it was with difficulty that a position could be secured which would permit the gall bladder to be surrounded with air while the radiogram was made.

No. 3160. ILLUSTRATION IS AN ANTERO-POSTERIOR, SLIGHTLY OBLIQUE VIEW. PATIENT LYING FACE DOWNWARD

It will be observed that the gas is present in pockets at different areas due to the fixation of viscera as the result of peritoneal adhesions. These adhesions can be distinctly identified in this radiogram, along the ascending colon, between the liver and colon, between the liver and parietal wall near the distal margin, etc.

The gall bladder which appears with almost liver density, extending from the distal surface of the liver, is also involved in peritoneal adhesions.

This case gives a history of gall bladder drainage and later resection. Is at present suffering from severe digestive phenomenon.

No. 3176. ILLUSTRATION IS AN ANTERO-POSTERIOR VIEW. PATIENT LYING FACE UPWARD, BUT HIPS ELEVATED, i. e. THE TRENDELENBERG POSITION

Rays are directed at right angle to the long axis of patient. A pneumoperitoneum has been produced, as well as a pneumocystoma or air distended bladder.

The bladder wall can be observed to be of uniform diameter and uniform density throughout the portion shown in this position.

The illustration shows the catheterizing cystoscope inserted through which the oxygen was introduced.

No. 3177. ILLUSTRATION IS AN ANTERO-POSTERIOR VIEW. PATIENT LYING FACE UPWARD

Hips elevated to permit oxygen in the peritoneal cavity to displace all organs possible in the true pelvis.

The pneumocystia places the bladder wall in position to be shown with detail.

The rays in this illustration were directed obliquely downward and distalward to eliminate the confusion of the shadows of the coccyx and to show the posterior wall of the bladder approaching the region of the trigone.

It is obvious that a very small neosplasm or hypertrophic cystitis could be positively detected in this manner.

No. 3119. ILLUSTRATION IS AN ANTERO-POSTERIOR VIEW. PATIENT LYING FACE DOWNWARD

Note the shadows of the diaphragm on both sides, liver, spleen, right kidney and absence of kidney on left side.

Peritoneal adhesions fix the liver and diaphragm for a short distance.

Case also possesses six lumbar vertebra.

No. 3225. ILLUSTRATION IS AN ANTERO-POSTERIOR VIEW. PATIENT LYING FACE DOWNWARD

Note the small protruding density on the surface of the right kidney. History suggests perinephritic infection.

No. 3290. ILLUSTRATION IS AN ANTERO-POSTERIOR VIEW. PATIENT LYING FACE DOWNWARD

Note diaphragm, liver and spleen which is overlaid by large amount of gas in stomach.

Left kidney is large and occupies a proximal position. Right kidney is very small and occupies a very low position.

Catheterization showed the right kidney eliminated urine below the left in proportion of one to four.

No. 3209. ILLUSTRATION IS AN ANTERO-POSTERIOR VIEW.
PATIENT LYING FACE DOWNWARD

Note the outline of liver, super-imposing somewhat the shadow of the right kidney.

The spleen (number plate side) seems rather enlarged, but no outline of the kidney can be observed.

The triangular density at the site of the upper pole suggests an enlarged adrenal.

No. 3197. ILLUSTRATION IS A LATERAL VIEW. PATIENT LYING FACE UPWARD

Three large bands of peritoneal adhesions are observed to extend from the region of the mesentary and the parietal walls. The most dense band shows large accumulation of metastatic tissue masses along its course.

Distributed generally over the surface of the parietal peritoneum are innumerable similar sized metastatic tissue masses. The dense mass at the base of the bands of adhesion, appearing with more or less even contour, shows in the screen and radiograph as a collection of bodies of varying densities and malignant manifestations.

Certain of the bodies contained in this mass show cystic degeneration of the centers.

About nine liters of amber colored fluid was removed as the pneumoperitoneum was produced.

History taken from patient indicates pathologist's report from a previous operation showed malignancy of the pancreas.

No. 3296. ILLUSTRATION IS A LATERAL VIEW. PATIENT LYING FACE UPWARD

Case is one suffering from myeloid leukemia.

The arched mass of intense density with regular contour is the surface of the greatly enlarged spleen. Just proximal to the splenic notch, denoted by the depression in the arched outline, there are small bands of peritoneal adhesions between the surface of the spleen and parietal peritoneum.

No. 3186. ILLUSTRATION IS AN ANTERO-POSTERIOR VIEW. PATIENT LYING FACE DOWNWARD

Hips elevated to permit intraperitoneal gas to accumulate in the true pelvis.

Note the shadow of the uterus which is probably pregnant about eight weeks.

ROENTGENOLOGY FROM THE STANDPOINT OF THE INTERNIST *

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Your program committee, by arranging a symposium on "standpoints", has sensed the fact that the Roentgenologist's place in the medical body social is as yet anomalous. The roentgenologist is in the position of a manufacturer who has one product to sell but who has not as yet determined to whom or through what channels he shall permanently market this product. Under present conditions, he is compelled to sell in the open market to a widely diversified clientele. He must convince his various customers that they are getting exactly what they want, no matter how ill adapted the goods may be to their uses. It unfortunately stands to reason that the "stuff" he sells to a poorly trained, general practitioner must be made to appear different from what he sells to a well trained specialist; to the former he sells ready-made diagnoses, to the latter, raw material of a finer quality. Furthermore, one must not lose sight of the fact that the roentgenologist has been trained as a physician and that the lure to sell directly to the patient (usually sub-rosa) becomes at times pretty strong. Roentgenological production is not yet standardized and as a purchaser of roentgenological wares, I desire to discuss what goods I, as an internist, think I want and why I think I want them. It is only by a discussion of our various needs that the function of the x-ray man will gradually be determined to the betterment of medical and surgical practice. To present my standpoint as an internist will neces-

*Abstract of a paper given before the Omaha Roentgen Society, Omaha, April 5, 1919, in a symposium on Roentgenology, considered from the standpoints of the various specialties.

sitate a discussion of: 1, certain fundamental principles; 2, the phrase "*x*-ray diagnosis"; 3, the value of the *x*-ray method in medical diagnosis, its limitations and its method of application, and, 4, of the roentgenologist himself.

1

FUNDAMENTAL PRINCIPLES

The roentgen ray reveals variations in densities only. Its disclosures depend on pathological processes which cause disturbances in the position or size of normal densities, or the production of abnormal densities. Therefore, the roentgen method has to do only with changes in morphology, with states, with the *results* of processes. Only where the ray reveals motion, as in screen examinations of the heart and lungs and in examination of the gastro-intestinal tract by the aid of opaque meals, does it approach the physiological. Therefore the defects of the roentgen method must be those inherent in any morphological method, for the modern conception regards disease as dynamic and is rapidly shifting from the morphological to the physiological aspect. In medical diagnosis as in pathology, morphology has today relatively little to offer in the way of future progress, because it is in the study of function that the future of medicine lies. However, present medical diagnosis depends much upon morphology and for that reason the *x*-ray today is a most valuable diagnostic aid. In spite of the remarkable advances of the last decade the *x*-ray is destined to remain a coarse method when compared with the biologic and physio-chemical methods of the future, yet today it is a powerful means in the hands of the diagnostician for revealing changes which could only be suspected unless his training had involved years of rigorous clinical observation checked by autopsies. Its use also helps the prospective clinician to shortcut the preparation formerly necessary to arrive at an optimum degree of proficiency. The roentgen ray, as a labor saving device, both in study and in practice, should be emphasized.

2

"*x*-RAY DIAGNOSIS"—AN UNHAPPY TERM

There is a widespread misuse of the word diagnosis when methods alone are meant. The word diagnosis, when applied to methods, should be restricted to those conditions in which an absolute diagnosis can be made by that method alone, as by the *x*-ray in fractures. It is just as incorrect to speak of roentgen diagnoses of the lung, as it is of laboratory and serological diagnoses of syphilis of the nervous system. Roentgen ray, laboratory, and serological *findings* are terms in keeping with the facts. Findings and diagnosis are not synonymous. The finding of an enlarged sella turcia, or an abnormal shadow in the lung, is a tremendously important fact, but it does not necessarily reveal the morbid physiology at work and it tells us nothing of the correlated processes elsewhere in the body. An unfortunate result of roentgenological work is to make the observer focus on one organ or a set of organs and forget that he is often contemplating but a minor part of the deranged mechanism. In this respect, roentgenology's tendency may be said to be dissociative. Medicine is advancing today because it is becoming better coördinated and more comprehensive. Our thinking strives to take in the whole, to acquire depth, to become stereoscopic, as it were. One gets a cubist's picture of the functions and diseases of the gastro-intestinal tract if one studies merely barium shadows. The internist must ever hold in mind *that the Roentgen ray reveals the results of processes but not how such processes come into being.*

3

THE VALUE OF THE *x*-RAY METHOD IN MEDICAL DIAGNOSIS, ITS LIMITATIONS, AND ITS METHOD OF APPLICATION

The diagnostician's "batting average" will vary in direct ratio to the number and efficiency of the methods he employs in the study of his cases. The man who diagnoses cases "over the foot of the bed" will often pull off a spectacular "stunt", but the man who adds to his foot-of-the-bed impressions, information gained from anamnesis, physical examination and special methods, will make a larger number of "hits". It has always seemed to me unfortunate that there were not a diagnostician's official score keeper who could get out the "batting averages" at the end of the season. Then the clinician who disregarded the *x*-ray, as well as the pathological *x*-ray enthusiast, would be shown up at the end of the season, incidentally to the advantage of society.

The greatest fallacy in the Roentgen method seems to me to arise from the failure of clinical men to use it as part of a routine in the manner in which they make urinalyses. It is a misfortune that in too many instances the roentgen ray is used merely when it is expected to be a positive factor in arriving at a diagnosis. The value of *negative x*-ray findings seems to be much neglected in the estimation given of this method. When a patient complaining of weakness, of rapid heart action, and of loss of weight without goitre, shows a malady positive Von Pirquet and slight febrile manifestations, it is obviously of value to know that there are no abnormal shadows in the lung. The differential diagnosis of latent pulmonary tuberculosis from myocarditis, endocarditis, Graves' disease, latent syphilis and neurasthenia, demands a resort to all diagnostic methods of proven worth. It is just in this most difficult class of cases that disturbances in lung and mediastinal densities are often of crucial importance in determining the conditions at work and it is the experience gained by the routine use of the Roentgen method that stands one in stead when the problems grow difficult. Furthermore, the routine use of the method occasionally treats one to gratifying surprises. A young lady consulted me several years ago with the classical syndrome of mucous colitis. She had previously been examined and treated by several excellent men. Of genito-urinary symptoms there were none. A microscopic and chemical examination of the urine revealed nothing but a few cylindroids. The roentgen ray disclosed an unsuspected stone the size of a bean lying in the right ureter at the brim of the pelvis. Removal of this stone accomplished a complete cure of the mucous colitis.

A method often falls into ill repute because unreasonable demands are made upon that method. The medical mind longs for pathognomonic symptoms, "short cuts" and "rules of thumb", so that every new method is pounced upon in the hope that it will provide diagnoses-while-you-wait without the use of brains. In estimating the position that the *x*-ray takes in my own work, I cannot say that it gives me decisive information in more than one case out of twenty, exclusive of examination of teeth. However, I should feel myself seriously handicapped were I forced to dispense with the method for, by its confirmative or negative evidence, it adds much to one's diagnostic sense of security. When one, from the history and from the usual clinical findings, excludes an ulcer of the stomach in a neurotic patient who is sure she has an ulcer, the negative testimony of the *x*-ray adds to one's peace of mind. I should estimate that the routine use of the roentgen ray would add five to ten per cent to a good diagnostician's efficiency.

The tendency of physicians to make only an occasional use of the roentgen ray, *e. g.*, when they expect to find something, places an unwarranted strain upon the roentgenologist's conscience. The expression of disappointment on the face of the expectant clinician when given negative findings is hard to bear, for, if the roentgenologist doesn't find what he is expected to find, he runs a grave risk of losing the physician's business. His sub-conscious mind tends to work toward self-preservation at the expense of truth, a not altogether negligible factor in sifting Roentgen ray evidence.

4

THE ROENTGENOLOGIST

I am convinced that x-ray examinations are best made by men who devote their entire time to this work and that these men would best be associated with clinicians, surgeons, and pathologists, so that they may have an opportunity to estimate the end results of their labors and thus be kept modest. A clinician who himself uses a method as complicated and imposing as the x-ray method tends to become a victim of the technique. It is easy for him to get himself into the absurd position of a man, who, facing a barn at a distance of a few feet, thinks he is getting a comprehensive view of the landscape. The roentgenologist must restrict himself to the acquisition of clinical data and his interpretation in internal medicine should not, as a rule, get beyond the point of diagnostic suggestions. Early in my experience with the method the positive statement of the roentgenologist, as to conditions present, repeatedly got the better of correct clinical judgment based on other methods. On the other hand the value of the roentgenologist's interpretations is not to be passed over lightly. *One of the chief advantages of the roentgenologist to the profession is a "viewpoint", a diagnostic asset not to be despised.*

The psychology of roentgenology would make an interesting study. The dim lights and strange glares in a black darkness, the whir of machinery, the assemblage of unusual objects all tend to arouse the dormant sense of the supernatural. Physicians are all likely to trade too much on this asset. The patient, through ignorance, is prone to accept the x-ray verdict as final and we medical men, through indolence, are too prone to assume that our obligations are discharged when an x-ray examination has been made. The internist should strive not to over-play this psychological card, but to convince the patient that the x-ray method is of value and that the physician who is intrusted with the study of his case fails in his duty unless all methods of proven value are used.

CONCLUSIONS

In conclusion, I wish, from the internist's standpoint, to emphasize the following points:

1. The Roentgen method is an extremely valuable method, but its greatest value lies in its use in conjunction with other methods.
2. The use of this method should be so facilitated and the cost of it so distributed that its use can approximate the routine in diagnostic investigations.
3. The more nearly the actual roentgenological work can be restricted to professionals the greater will its value become.
4. It should be kept constantly in mind that we are dealing merely with a method, and that the *x*-ray method does not, as a rule, make diagnoses, but gives findings.

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ROENTGENOGRAPHY OF THE CHEST*

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In reading a paper upon the subject of chest roentgenography I do so with full realization of the importance of the subject at the present time. The so-called Flu epidemic has left us with an unusual number of chest problems requiring aid from every source possible for diagnosis. The acute Flu is seen hanging over in a more chronic form, quiescent tubercular conditions lighting up and other manifestations of the various mixed infections.

In a previous paper, given before the Western Roentgen Society, I have described reasons, based upon pathological findings of various pathologists, for using rapid screen work in chest roentgenography; the involuntary movements obscuring the fine detail necessary for early diagnosis. I suggested some natural advantages, as differences in density and disadvantages, as the shape of the chest and resulting overlapping of structures. The results of such technique are gratifying, but it is not the *sine qua non* of chest roentgenography.

The results in the roentgen ray diagnosis of early chest lesions are based directly upon technique. Opinions as to its value vary as the individual technique and study vary. Major Davis, in reporting the study of one thousand chests in Camp Devens, says, "Success in demonstrating the tuberculous lesion depends on the care in technique, and in the keenness of the interpreter." We must have uniformity of roentgenograms or else the case requiring the greatest detail has the poorest plates. The clinician will

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*Read before the Omaha Roentgen Society, April, 1919.

often judge us by our failures in the cases where he needs us the most.

The tube used is of the greatest importance. It is needless to say that it must be a fine focus with no appreciable secondary radiation. The size of the focal spot will determine, besides the energy used, the distance at which we must work and the resulting detail. Doctor Orndoff has shown that a penumbra of one-fiftieth of an inch is discernible to the eye. Therefore, if we wish detail, we must measure the focal distance of our tube and photograph the focal spot. It is the lens of our camera.

The patient is our next consideration. Each one is an individual with peculiarities of breathing, nervousness, dyspnoea and contour of the chest. To obtain uniformity of results in a technique where there is no latitude, every chest must be measured for the focal depth and the anterior-posterior diameter. Measurements by the eye have not sufficient accuracy. It is quite evident that a heavy breasted woman will have a greater focal depth than a thin-chested boy, although the actual depth of the lung itself can be the same. The anterior-posterior diameter is valuable in computing the energy necessary to produce the proper chemical action on the film. My associate, Doctor Bouslog, has observed that allowance must be made for each additional half inch in this diameter. The fluoroscope will determine the position of the patient.

Double screens with films and the best of dark room technique are necessary. An exposure of one-quarter second or less is now practical. The developer should be one of contrast as much latitude as possible.

In considering the diagnosis, I shall limit myself to a discussion of the early pulmonary lesions. Here a clear understanding of the anatomy and pathology of the lung is necessary. Of a great many men, two workers have probably gone further than any others to crystallize this information — Doctors Miller and Dunham. The primary unit of the lung is the secondary lobule. This in man is surrounded by a connective tissue membrane or septa, and is composed of many primary lobules. Each primary lobule is formed by the ductulus alveolaris, its sub-divisions and air cells, the lymphatics, blood vessels, and capillaries and nerves. There are no lymphatics beyond the ductulus alveolaris, in other words, none around the air cells. But the lymphatics do surround the primary and secondary lobules and there are lymphoid masses at the bifurcation of the ductulus alveolaris. Near the periphery, these lymphatics drain into the pleural space while the deeper ones drain along the bronchi, arteries and veins into the mediastinal glands. There are lymphatic nodes at the bifurcation of all the bronchi.

Clinically, pulmonary tuberculosis, as well as other pulmonary infections, takes on various forms and no one description will fit the pathology of them all. According to Dr. Dunham, "The tuberculous lesions start in the lymphatics within the lung and are are spread first through the lymphatics, later by breaking into the bronchus, and later still by penetrating the veins." The tubercular lesion does not start in the capillary or bronchus, or air passages, but "the bacillus is removed from the ductulus alveolaris, as is carbon, to the lymphoid tissue centers before the germ has caused a pathological lesion in the air passages." He also describes a fan-like structure "due to masses of tubercules" in the lymphoid tissues of the secondary lobules. The lymphatics and lymphoid masses thus assume the greatest importance, and it is to them and the connective tissue septa that we should look for our earliest changes. Congestion of the air cells is a still later phenomenon, but the only reliable one of activity. It is to the roentgenologist what the sub-crepitant rule is to the internist. Lymphoid and septal changes may be old or very early.

Jordan examined children and found his early changes in the mediastinal glands. Others also think it starts in the hilus and spreads outward into the lung by continuity and contiguity. Others classify tuberculosis according to the lobes and location, etc. In practical work, we should search, not only the parenchyma but also the course of the bronchi and the mediastinum. We must also remember that other things will produce changes in the lymphatic structure and cause connective tissues to increase and air cell congestion besides infection. Among these are the chemical and dust irritations, and leukaemias, tumors, and disturbances of the circulatory system. A differential study, however, can usually be made with a great deal of accuracy.

In conclusion, may I again call attention to the development of technique? We should endeavor to show as much normal anatomy as possible and then study the pathological variations. The clinical history, physical examination, and other laboratory findings will, when properly correlated with the roentgen findings, usually give a true diagnosis. Such coöperation sharpens the observation of the internist and roentgenologist and works to the advantage of the patient.

BONE REGENERATION

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The growth of bone and its regeneration has been of interest to men for centuries. During recent years, however, it has come into the "limelight" as one of the most popular fields of experimental enterprise.

Hunter, in his bone work in England years ago, was impressed by the adaptability of that tissue to the demands made upon it for function and strength. He observed the deposition of new bone where needed and the absorption of bone cells when their function has ceased; as for instance the disappearance of the socket after extraction of the teeth. He stated that every living particle in the human body retains something of that quality which we call consciousness.

In studying the histological structure of bone we find that all bone tissue is covered by periosteum, a limiting and protecting membrane in whose deeper layers we find bone forming cells. Normally they are found there only in scarce numbers, but those can rapidly increase when irration of bone by injury is produced. Osteoblasts are also found in bone tissue itself and a fragment of bone without periosteum transplanted into the living body to perform the function of bone will retain its vitality and reproduce. If transplanted into a living body, not of physiological use, it will be absorbed.

Injury to the bone with loss of its continuity is usually followed by union if conditions are favorable. Fibrous tissue fills in the gaps, paving the way for osteoblasts. More or less of an external callus is formed, depending upon the immobilization of the part as well as the degree of separation of the periosteum from the underlying bone.

Opportunity to study the structure of bone, its physiological and pathological changes by the roentgen rays is one of the great advantages we have at the present time. The quality of bone and its power to regenerate is markedly affected by the physical condition of the individual. Pyogenic infection will destroy bone, but regeneration after suppuration has ceased and necrotic material has been removed, is usually rapid.

PLATE 1 shows the spontaneous regeneration of the entire diaphysis of the tibia, which had become necrosed through the action of pyogenic bacteria. This plate was taken five years after removal of infectious material. It has the appearance of normal bone. The periosteum presents a somewhat roughened appearance and the medullary canal is slightly irregular in outline. The muscular development and the solidity of the bone indicate a good functional result.

PLATE 2. In Tuberculosis we find lusterless bone with marked variation of its density, and later on absorption of bone tissue. Regeneration may take place when bone grafts are properly applied and the physical condition of the patient is improving.

PLATE 3. In Syphilis we find changes in the periosteum, irregular bone outgrowth a disturbance of the normal texture and later rapid absorption of bone tissue. Normal regeneration and re-establishment of function does not occur.

Autoplastic bone transplantation has been used in non-infected fractures where it was impossible to replace and retain fragments in such apposition as was necessary for good anatomical and function results. In fractures of the surgical neck of the humerus the transplants have become absorbed within a year, the compact bone of the graft which fitted into the cancellous portion of the recipient bone had changed into a cancellous bone. The rapidity with which a transplant is absorbed depends upon its size, its blood supply and the age of the individual.

PLATE 4. A transplant taken from a fractured fibula to repair a fracture of the tibia. Two months after operation we see that the grafted bone has become continuous with the recipient bone, the line of separation has disappeared. The shadow of the transplant is much more dense than that of the native bone. In this plate, as in plates of other bone grafts, we notice as area of less density of recipient bone surrounding the graft. The fractured ends of the tibia have united with the formation of a small callus. A small strip of periosteum was left in the defect of the fibula which shows a beginning of regeneration of bone.

PLATE 5. Eleven months after operation the meduallary canal of the tibia has forced its way through the transplant. An even, gradual, decreased density in shadow of the transplant is apparent with a tendency to assume the texture of the native bone. The defect of the fibula has been regenerated by compact bone with a beginning formation of medullary canal.

PLATE 6. The medullary canal of the fibula is somewhat distorted, but continuous. This plate was taken recently.

PLATE 7. We have an ununited fracture of the hip. The head of the femur being a sequestrum, had become soft and degenerated. The fractured end of the shaft was covered with scar tissue. This case came under the observation of Dr. Charles Davison after two years standing. He removed the necrotic bone and the scar tissue and transplanted the upper one-third of the fibula into the femur in such a way as to produce a new neck and head fitting into the acetabulum and re-establishing relationship and function of that bone as nearly as possible.

PLATE 8. One year after operation the head of the fibula with its periosteum is fitted into the acetabulum. The rest of the bone graft was stripped of its periosteal covering and manipulated into the upper part of the shaft of the femur. A small portion of the lower end of the transplant is seen to project beyond the shaft of the femur.

PLATE 9. Two years after operation we find that the new head of the femur has become hypertrophied in order to conform to the demands for function and strength. That part of the transplant within the shaft of the femur has firmly united with that bone and the lower end which has previously projected serving no function has become absorbed. Anatomical and physiological result is good.

This case is an excellent example of the vast possibilities in bone surgery and the great field for research to the roentgenologist.

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THE TREATMENT OF METASTATIC CARCINOMA OF THE SPINE BY DEEP ROENTGENTHERAPY

With the Report of Four Cases, and Remarks on Pre-Operative Treatment of Carcinoma*

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The object of this paper is to prove that deep roentgentherapy will bring about a healing process in deep-seated carcinoma. Every one will acknowledge that metastatic carcinoma of the spine is not a superficial disease. It is not the object of this paper to recommend roentgentherapy in the treatment of such advanced carcinoma. It is my belief that when metastatic carcinoma of the spine has developed, we are dealing with the beginning or with a part of a general carcinomatosis, and not with a localized area of disease. It is also my belief that when one has general carcinomatosis to deal with, in which there is local manifestation giving rise to most of the symptoms, one can influence this local disease but we cannot expect to get the patient really and perfectly well by any means that we known today. The life of the patient can be prolonged and made more comfortable but later some area of the body, which has escaped treatment or has been unsuccessfully treated, will make itself manifest.

The second object of this paper is to encourage the use of the roentgen-rays in the early treatment of carcinoma, by proving that a favorable and curative effect can be produced upon carcinomatous tissue, even in an advanced stage, and if this fact is proved there should be no other proof needed to establish this form of treatment as a method of choice in the early treatment of carcinoma. By

*Reprint from September, 1919, issue of *Surgery, Gynecology and Obstetrics.*

this I do not mean that we should replace surgery or that we should replace any other method that has been proved efficacious in the removal of the disease, but I do most earnestly wish to discourage the practice of waiting for the use of the roentgen-rays until general carcinomatosis has taken place, or until metastasis has taken place, or until there is an extensive recurrence following operation. All of the cases of metastatic carcinoma of the spine, which I am about to report, had primary carcinoma of the breast.

Ante-operative treatment. It is my opinion that the ideal method of treatment of carcinoma of the breast or carcinoma elsewhere, in the light of our present knowledge, consists of a thorough course of x-ray treatment preceding the operation, in which the disease is treated from every angle, and in which the lymphatic areas draining the breast are included in this ante-operative treatment. Within a few days, or as soon as it can be practically arranged after this preliminary course of x-ray treatment, I believe that a complete operation should be performed. Then following this operation, at the end of four weeks from the time the first course of x-ray treatment was given, a second or postoperative course of treatment should be given and these courses of treatment should be repeated at intervals of a month or more. Three to eight such courses or series of cross-firing will suffice; a general average is about five. In this way I believe the best possible results and the greatest number of cures of carcinoma can be obtained. Whenever it has been possible during the past two years or more I have carried out this plan of treatment.

This ante-operative treatment is based not only upon clinical observation but upon experimental work. Colwell and Russ[1] and Nogier, Jaubert de Beaujeu and Contamin[2] have shown the direct effect of the x-rays upon the cells of an adencarcinoma of a mouse. The tumor upon removal

[1]London: G. Bell & Sons, Ltd., 1915.

[2]Compt. rend. Acad. d. sc., 1909, Dec. 29.

from the animal was minced and then exposed to x-rays after which it was inoculated into normal mice to see whether it would grow. A typical example showing how the subsequent growth is interfered with is shown by one of their experiments in which fifteen mice were inoculated with the tumor tissue which had been exposed to the x-rays and in which 50 per cent of the rays were absorbed by the tumor tissue. Of these fifteen mice inoculated by this tumor tissue, there were no positive results and there were fifteen negatives. Of the control fourteen were positive and one negative. From these observations the author concludes that the rays hinder the subsequent growth of tumors when inoculated. With less absorption of rays there were more successful inoculations. In addition to the decrease in the number of successful inoculations there was a reduction in the rate of growth of the tumor even when inoculation was successful. Marie, Clunet, and Raulot-Lapointe,[3] in a study upon the heredity of the characters imposed upon tumors when they are exposed to the x-rays, selected a sarcoma of the mouse, a rapidly-growing tumor of a high degree of malignancy, with extremely stable histological features. A mouse bearing the tumor was exposed to a strong dose (30 H) of unfiltered x-rays, and five days later the animal was killed and portions of the tumor grafted into a number of mice; when this irradiated graft had grown to a suitable size, one was selected and submitted to the same dose of x-rays and five days later portions of it were again grafted into a number of mice. In this way the irradiated tumor was kept growing for twenty months and the new characters imposed upon it by the x-ray were thoroughly established. These new characters were found to consist mainly of (1) a reduction in the percentage of successful grafts, (2) a reduction in the malignancy of the tumor, (3) a slower rate of growth and certain histological features of which the following were the most important: (a) the presence of the "giant" cells,

[3] Bull. de l'Ass. franc. p l'etude du cancer, vol. iv, 4.

some cells being as much as four or five times their original diameter, (b) atypical mitoses, (c) basophile "giant" cells having multiple nuclei. This shows a gradual reduction in the malignancy of the cells and their power to reproduce themselves, even under most favorable circumstances and even with the most malignant type of cells. This is additional experimental evidence in favor of both ante-operative treatment and postoperative treatment.

Colwell and Russ also refer to the excellent researches made by Clunet and Raulot-Lapointe, which researches are reported in detail in Clunet's *Tumeurs Malignes* (1910). In these researches the author has adopted the following procedure: He treated the malignant condition with the *x*-rays and at various stages of the treatment obtained portions of the growth for histological study. As a result of observations of this nature upon nineteen cases of squamous cell carcinoma of malpighian type in the human subject, they state that before the ultimate disappearance of the growth, the cells pass through at least five successive phases which are characterized as follows: (1) the latent phase; (2) development of moustrous characters; (3) keratinization; (4) disintegration and phagocytosis; (5) formation of the connective-tissue scar.

1. *The latent phase* varies from six to fifteen days and during this time no cytological changes are to be seen. Its duration is rather shorter for carcinoma of the spino-cellular type than for the basocellular type.

2. *The development of monstrous characters* is marked by: (a) an enlargement of all parts of the cells, which may be increased in diameter as much as two or three times; (b) an increased number of atypical mitoses; (c) the appearance of enlarged nuclei, markedly chromophile; and (d) the appearance within the cells of forms having a pseudoparasitic character.

3. *Keratinization* may be either disseminated, total or atypical. When disseminated, each cell undergoes keratinization independently of its neighbor, in contrast to those effects appearing to influence all cells alike. When atypical keratinization is observed, the protoplasm becomes granular, at first orangeophile and finally eosinophile; these granules gradually fuse together into one mass of keratin, and altogether they are probably similar in their chemical constitution to eleiden. They do not give the same color reactions as this substance.

4. *Disintegration and phagocytosis.* The disintegration of the degenerating cells appears to be caused mainly by the polynuclear cells and the fibroblasts of the stroma, which are in an active condition. Macrophages and plasma cells appear at a later stage and accumulate around the vessels, remaining in the vicinity long after the disappearance of the malignant cells.

5. *Formation of connective-tissue scar.* As by a general rule this is not brought about by the formation of fibrous masses, but the tissues assume the structure of healthy skin, except for the absence of hair and of glands; the elastic fibers are also less numerous and more attenuated than they are normally. No neoplastic masses are to be found in these supple scars, which appear to be quite healthy. On the other hand, at a depth below the skin, cells may be found which have been acted upon by the x-rays but are not yet destroyed. Such cells remain in a latent condition and if the treatment is not continued they give rise to recurrences.

REPORT OF CASES

I shall make a report upon four cases of metastatic carcinoma of the spine, in all of which there was undoubted destructive disease due to the carcinoma and in which I have been able to demonstrate by roentgenograms not only the disease but the healing and healed process. Symptomatically the patients have shown either marked improvement or complete recovery.

CASE 1. Mrs. B., age 32, came to me September 19, 1913. She had been operated upon August 20, 1910, by John B. Deaver for carcinoma of the right breast (confirmed by pathological examination). The patient said that she had had in all four operations, for three successive recurrences. September 19, at the beginning of my treatment, the entire operative area on the right side was studded with nodules which were firmly adherent. These extended to the axilla, and in the right axilla there were masses from one-half to three-quarters of an inch in diameter firmly binding the tissues. There were large nodules in the supraclavicular region on the right side. The left breast contained a mass of tumor tissue with retraction of the nipple, with metastasis in the left axilla and in the left supraclavicular region. There were two small nodules in the left side of the scalp. About three inches of the left second rib and a small area in the third rib on the left side was destroyed and about an inch and a half of the right tenth rib, together with disease of the eighth, ninth, and tenth dorsal vertebra, the fifth lumbar and the upper part of the sacrum. There were also distinct deposits in the lungs.

Ordinarily such an extensive distribution of disease would preclude even the thought of accomplishing any good results, but this patient had an unusual amount of determination to get well. Therefore, I decided to see what could be accomplished. All parts of the body, not including the extremities received treatment, and as much cross-firing was used as was possible. She received an enormous amount of treatment during a period of approximately eighteen months, and during this time 237 doses averaging about 15 x, or amounting to about 3,555 x, in all. As the result of this treatment she gained 17 pounds in weight, she gradually became able to look after her household duties and to do all her housework. All of the nodules on the right side of the chest disappeared as well as those in the right axilla and the right supraclavicular region. The mass in the left breast had shriveled, and while there remained considerable retraction of the nipple, the area felt like fibrous tissue and was freely movable. The metastasis in the left axilla and supraclavicular region had disappeared. The disease in the second rib had entirely healed. The disease in the vertebra showed evidence of healing. The disease in the third rib and the tenth rib healed, and there was an increase in lime deposit which was evidence of healing in the fifth lumbar and in the sacrum. At the end of two and a half years she was free from symptoms excepting dyspnœa. During the succeeding six months she began to fail the dyspnœa became more marked, and an examniation of her chest on September 12, 1916, showed an extensive fibrous process throughout both lungs with retraction of the diaphragm upward, a general contraction of the lung area, and an examination of the extremities showed extensive metastatic carcinoma in all of the long bones. She died November 7, 1916.

This patient, therefore, was suffering undoubtedly from an extensive metastatic carcinoma at the time of her first visit. Over the areas treated by the roentgen-rays the disease healed. The patient regained a reasonable amount of health, was able to assume her household duties, and remained free from most of her symptoms during a period of at least two years. She probably had her life prolonged for a period of at least two years, during which time she lived in reasonable comfort. It illustrates, however, the statements made in the introduction to my paper that these cases are examples of a general carcinomatosis, and that ultimately we may expect the patient to die of carcinoma, even though there is a period of reasonable comfort and freedom from symptoms. It proves quite clearly the healing process of the roentgen-rays. It is interesting to note that the disease of the bones in the area treated showed no progression. It is also worthy of note that despite the fact that this patient received an enormous dosage over a period of 18 months covering the entire body and all the viscera, during which time the blood-making organs must have received much treatment, the patient continued to improve and the disease disappeared.

It seems to me to be a strong argument against the fact that we must depend upon a lymphocytosis for the healing of carcinoma or that prolonged *x*-ray exposure will reduce the lymphocyte and thus interfere with healing. It is likely that the discrepancy between Murphy's experimental work and this work upon the human subject is due to the fact that with small animals the entire body is exposed to the rays at once, while in clinical work we only expose a small portion of the body on any one day.

Case 2. Mrs. P., age 34, was referred to me by L. H. S. DeWitt on November 5, 1915. On July 18, 1914, she had been operated upon for carcinoma of the right breast, by Lyman, of Grand Rapids, Michigan. Six months later the patient noticed recurrent nodules in the scar. On year after the first operation on the right breast Dr. DeWitt removed recurrent and metastatic nodules from the operative field, and also removed the left breast on account of carcinoma. At the time of my examination, November 5, 1915, she had two nodules in the right supraclavicular region, size three-fourths inches, disease in the upper mediastinum, disease of the head of the left humerus and in the head of the right humerus, disease in the left eighth rib, disease in the fifth dorsal vertebra, disease in the right glenoid cavity and the upper sacrum. She also had pains radiating down and along the right thigh, and tenderness over each of these points. At the end of a month there was some distinct improvement, her general health had improved, the metastatic nodules had definitely decreased in size, and there was some evidence of distinct healing process in the diseased areas of bone. This patient improved during the first three months; then conditions became rather stationary for two months more, and then the disease showed distinct evidence of progression and treatment was discontinued.

She died August 4, 1916, or approximately nine months after beginning treatment.

Case 3. Mrs. M., age 52, was referred to me by Dr. VanLennop, April 8, 1916. She had had her right breast amputated by Charles Noble in 1905, or 11 years previously and had no local symptoms or evidence of recurrence during these 11 years. In fact she had no evidence of metastasis anywhere until about three months before coming to me, she fell down stairs and injured the back of her neck. This was followed by a neuritis, pains in the head, and a distinct swelling on the back of the neck. My examination showed almost complete destruction of the entire cervical vertebra, so that the patient's head seemed to be supported on a mass of soft tissue. The entire cervical vertebra were found decalcified and disorganized. There was also evidence of disease in the upper portion of the chest, and disease in the fourth, fifth and eighth dorsal vertebræ. She had received in all 165 doses during the first year. Since then she has received no treatment. At the end of six months, the vertebra which had been almost totally destroyed, had almost totally recalcified or healed. The patient was able to go about her usual affairs, was able to travel from place to place on rather long journeys, and was having a reasonable amount of comfort in life. During the fall of 1917, or about eighteen months after beginning treatment, I found her upon the boardwalk at Atlantic City, with a pulse of 120. In every other respect she seemed to be in a comfortable condition and free from symptoms. I ordered her placed in bed under the care of her family physician, and she has been under his care ever since. I received a telephone report from her son on September 3, 1918, at which time her heart condition had very much improved and none of the other symptoms referable to the spine had recurred.

This patient, therefore, showed a most pronounced healing of the diseased areas in the spine. This has been persistent, and so far as the carcinoma is concerned has been successful over a period of almost three years. It is entirely likely that sooner or later the disease will make itself manifest, and the patient will take the usual course as a result of general carcinomatosis.

Case 4. Mrs. S. P., age 43, referred to me by C. C. McCormick, March 27, 1918. This patient had been operated upon in August, 1917, by Deaver, for carcinoma of the left breast, and received no postoperative x-ray treatment. In fact, none of these patients which I am reporting received any postoperative or ante-operative x-ray treatment. I do not mean by this that if she had received ante-operative or postoperative treatment she would have avoided the complications of metastatic disease that developed, for I believe that in most of these cases, if not all, the metastasis has taken place before the operation. In this case the operation took place in August, and in December McCormick wrote me telling me that she was having excruciating pain in the spine and extending down the legs and that she was bedfast. At that time the weather was bad, and I wrote to him that she undoubtedly had metastatic carcinoma of the spine, and since the patient was bedfast it was not right to take her away from home simply to die. I heard nothing further until March, when McCormick sent her down to the Medico-Chirurgical Hospital for examination and treatment. This was against my advice and better judgment, for I must confess that I do not like to treat these patients in which the disease has become extensive, even though occasionally one gets well or gets freedom from symptoms, for ultimately they die of the disease.

At my examination I found no evidence of local recurrence over the operative field, but I found disease with total destruction of the second lumbar vertebra, together with disease of the ninth dorsal vertebra. The disease of the second lumbar vertebra gave the usual angular deformity which is found when the body of the vertebra is destroyed. At the time of my examination and at the time of beginning treatment, she had been bedfast for fifteen weeks.

Under *x*-ray treatment, and with the assistance of a brace to give her spine support for her body, she was able to get out of bed. Gradually there was a recalcification of all of the diseased vertebra, and at present she can go about without any brace, though I have not given permission to do this. She can bend her spine in all directions; she has the appearance of perfect health; she has gained 30 pounds in weight and is able to do her washing and ironing and general housework, and so far as symptoms act as a guide to us she has recovered completely.

She was demonstrated before the Philadelphia County Medical Society about a month ago, at which time I was able to show the healing process in the vertebra, and the free movement of the spine in all directions. Up until the middle of December this patient has received in all five courses of treatment, each course representing or requiring from 27 to 30 doses, making a total of 175 doses during a period of less than nine months. She is asked to return at the end of three months for inspection and observation. (Patient has returned April, 1919, and is still free from symptoms and is doing all of her housework.) She returned for examination exactly one year (March 17, 1919) after she had been sent on a stretcher. At this time she was free from all symptoms and the diseased vertebræ seemed to be healed (Fig. 1 and 2). She has been doing all her housework including her washing and ironing.

I treated this patient probably more extensively than the others, for I covered the entire spine and the entire body, not including the extremities. I have not included the extremities in the treatment of these cases recorded, for I fear that there would be too much destructive effect upon the blood. This may be a mistake on my part, and we may find later that it is advisable to cover the entire body from the head to the extremities, for surely there has been no serious effect upon the blood in the cases that I have just reported. There has been nothing to suggest destructiveness to the blood. In these cases the patients only had a few blood examinations made, but there was nothing appearing in the blood except a moderate grade of anæmia. If there were much destructive effect upon the blood, the general health of these patients could not possibly improve as they have done.

TECHNIQUE

In the treatment of these cases, one must not only keep in mind the localized disease discoverable by the *x*-rays or by roentgenograms, but we must treat the case as one of a general carcinomatosis, and I think the next patient that I shall treat I will include the extremities and try to make the treatment a general one. In the four cases just treated, however, the exposures were confined to the body, not including the extremities, and the whole body was divided up into about thirty areas, crossfiring chiefly upon the spine, but of course reaching all other parts of the body as well. I used for each exposure, or for each dose, 8 minutes with 5 milliamperes, a 9-inch parallel spark gap, 5 millimeters of current at a distance of 8 inches, and the rays were filtered through 6 millimeters of glass or alumnium.

CONCLUSIONS

As a result of the studies made in these four cases and the treatment given, I believe that the following conclusions are justified:

1. The roentgen-rays when applied properly and in sufficient quantity upon deep-seated cancer tissue may be ex-

pected to destroy the cancer cell, and this cancer cell is replaced by healthy scar tissue, or fibrous tissue. When the disease is located in the soft tissues it is replaced by fibrous tissues, and when located in bone it heals by bone sclerosis.

2. As a result of this healing process, the patient is given the prolongation of life, and is made more comfortable.

3. One cannot expect the patient to make a complete, permanent recovery, for ultimately the disease is apt to show metastasis particularly in the areas not treated.

4. It is entirely likely that these metastatic carcinomata of the spine without other evidence of metastatic involvement have an unusual amount of natural resistance, and that this increased resistance on the part of the patient helps us greatly in the healing process. It seems to me likely that many of the patients, or most of the patients, die of visceral involvement, before there is time enough for symptomatic disease to develop in the spine, and so it is only in the more resistant cases that there is time enough for spinal metastasis.

5. With the clinical and microscopic proof of the destructive action on malignant tissue followed by a healing process, and with the experimental proof of a decrease in the malignancy of cancer tissue which has been exposed to the x-rays and a decrease in its capability of inoculation, we can recommend most strongly the use of deep roentgentherapy both as ante-operative treatment to be followed immediately by operation and then postoperative treatment, given after the proper interval, which should be four weeks after the ante-operative treatment.

Fig. 1. Case 4, showing complete destruction of the second lumbar vertebra, due to metastatic carcinoma. Examination made six months after the primary operation upon the breast. Patient had been bedfast three months.

Fig. 2. Case 4, showing second lumbar vertebra healed and recalcified. The patient is free from symptoms, has gained 30 pounds in weight and does all her general housework, including washing and ironing.

DESCRIPTION OF AN APPARATUS FOR THE COLLECTION, PURIFICATION AND TUBING OF RADIUM EMANATION FROM A RADIUM SOLUTION*

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The use of radium on a very large scale for therapeutic treatments involves danger of loss, and this factor has been an important one in causing those hospitals and clinics with a gram or more of radium in use, to utilize radium emanation instead of using applicators containing radium.

Radium emanation was discovered in 1900 by Dorn, the name emanation having been suggested several years previously by Rutherford, for the analogous radioactive gas which was emitted from thorium compounds. Radium emanation is a radio-active gas, and decays with a half period of 3.85 days: that is, in 3.85 days half of any amount of radium emanation will have decayed or transmuted, and in another 3.85 days, half of the remaining emanation will decay and so on, so that by the end of 30 days, practically all of the emanation is gone. (See table II showing rate of decay of radium emanation.)

Due to the fact that radium and radium emanaation both are the source of the same decay products, namely Radium A, Radium B and Radium C, and that the beta and gamma rays utilized therapeutically result from the decay of the products Radium B and Radium C, it follows that either radium or the radium emanation may be employed. Radium, being a very slow decaying radio-element with a half decay period of 1700 years, maintains practically constant amounts of Radium B and Radium C, resulting in a con-

*William Duane, Ph. D. Methods of Preparing and Using Radioactive Substances in the Treatment of Malignant Disease, and of Estimating Suitable Dosages. Boston Medical and Surgical Journal, CLXXVII, 787–799, Dec. 6, 1917. Reprinted in *Radium*, X, 93–112, March, 1918.

stant radio-activity, the emanation however, because of its rapid decay, has a constantly decreasing radio-activity.

The quantity of emanation in equilibrium with one gram of radium (element) has been named the "curie" in honor of Professor and Madame Curie. A curie of emanation has therefore the same beta and gamma ray activity as a gram of radium in equilibrium with its decay products, Ra Em, Ra A, Ra B and Ra C. A curie of emanation has a volume under normal conditions of temperature and pressure (0°C and 760 mm. barometric pressure) of 0.63 cubic millimeters, and weighs 6.2 micrograms (0.0000062 gram). Corresponding to micro- and milligram of radium (mcgm. and mgm.) we have the terms micro- and millicuries (mcc. and mc.).

Radium emanation may be condensed by the use of liquid air, and by proper manipulation can by this means be secured in pure form.

Radium emanation has been collected, purified and used in applicators in place of the actual radium salt at the London Radium Institute since its inception in 1912. Stevenson of Dublin seems to be the first one (Brit. Med. Jour., July 4, 1914) who used the emanation in needles buried in a growth.

At present radium emanation is being utilized in all the hospitals and clinics where more than a gram of radium is being employed. In addition to the London Radium Institute there may be mentioned the Manchester (Eng.) and District Radium Institute; the Harvard Cancer Commission (Huntington Hospital, Boston); the Memorial Hospital, New York; the Howard A. Kelly Hospital, Baltimore; the Mayo Clinic, Rochester, Minn.; and the Radium Institute, Chicago.

There has been recently installed in the Radium Research Laboratory of the Standard Chemical Company of Pittsburgh, by Dr. G. Failla, physicist of the Radium Department at the Memorial Hospital, New York, an apparatus for the collection, purification and tubing of radinm emanation obtained from a solution of a radium salt. See Fig. 1. This apparatus represents the latest type and is based on the Debierne-Duane apparatus, which differs from the earlier apparatus in that the liquid air is replaced by chemical means of purifying the radium emanation. In the apparatus installed at Pittsburgh, Dr. Failla has embodied all of the improvements which his experience at the Memorial Hospital has suggested, and the apparatus differs only in these details from the apparatus in daily use at that Hospital in the collection of the emanation derived from over three grams of radium.

It is obvious that this apparatus is quite fragile, and the operations in purifying, tubing and measuring the radium emanation are complicated, requiring the attention of a skilled operator, who best should be a thoroughly trained physicist.

In practice it is to be recommended that the glass parts be installed in duplicate, the additional parts being mounted on the opposite side of the steel frame. This avoids undesirable delays in securing the emanation in the event of accidental breakage or when it becomes necessary to replace the tubes in which the chemical purification of the emanation takes place. By reference to digramatic Fig. II, showing the apparatus, the method of securing the emanation may be briefly outlined.

The radium as chloride is dissolved in a small volume of very dilute hydrochloric acid which prevents precipitation of the radium, the solution being placed in vessel 1. This vessel is usually placed in a suitable safe to guard against any possibility of loss of the radium. A suitable outlet tube leads from vessel 1 to connect with the rest of the apparatus. When the apparatus is in working order, accumulated emanation is collected, etc., as follows: With the vacuum pump running and the stop cocks 22 and 8 set to give a vacuum in the line A, cock 6 is opened, allowing the mercury to pass from vessel 4 to 7, the mercury level being maintained just above 5, by closing 6. This permits the

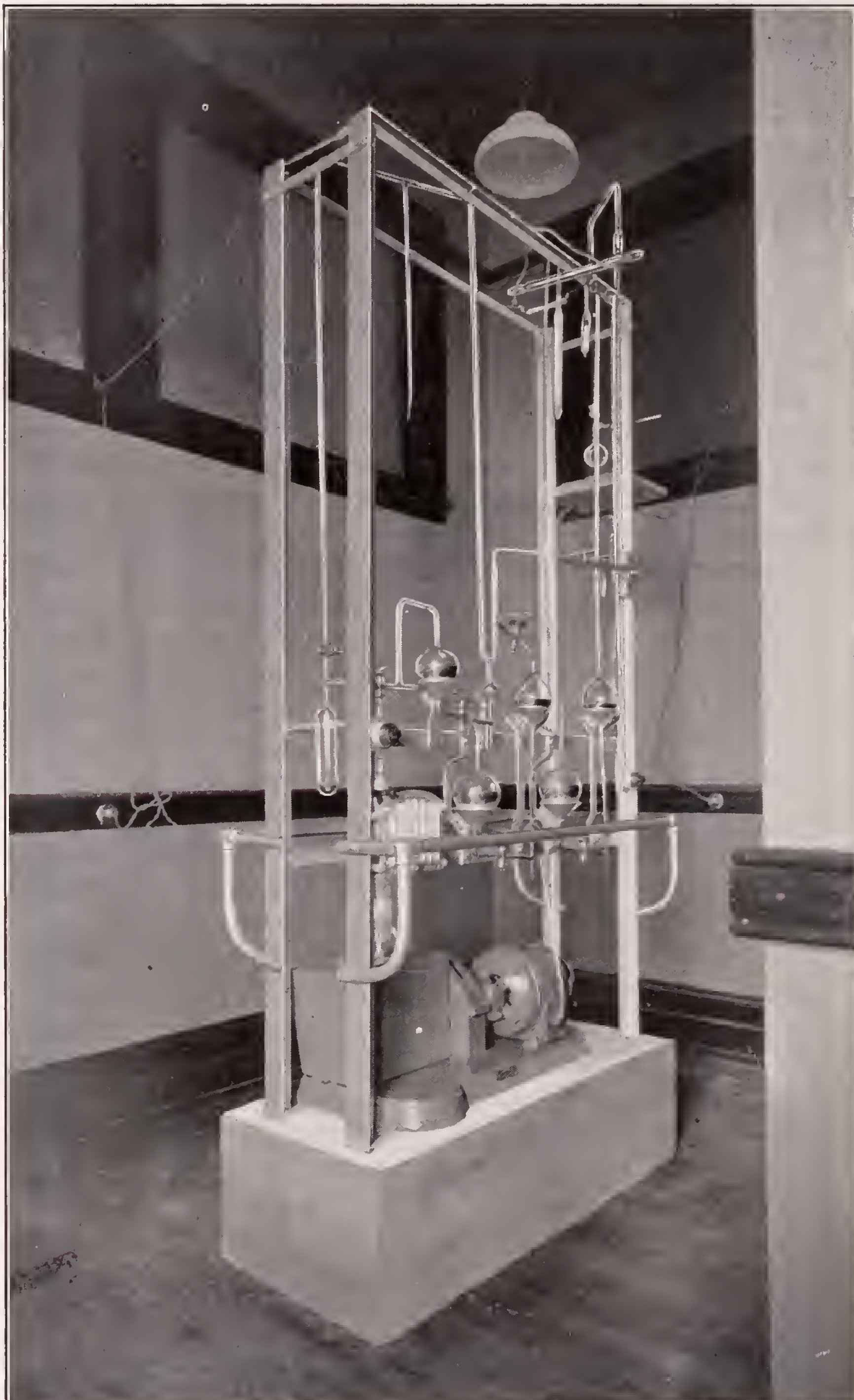


FIGURE I

accumulated emanation, water, vapor, hydrogen, oxygen, etc., which come from the radium solution to largely diffuse into vessel 4. By turning stop cock 22 air is admitted through the drying tube 23 to the line A communicating with vessel 7, and on opening cock 6, air pressure raises the mercury into vessel 4, forcing the emanation over into vessels 9, 10 and 11 when the sodium hydroxide, the heated copper-copper oxide spiral and phosphorus pentoxide absorb carbon dioxide, hydrogen, moisture, etc. Vacuum is again established in line A, stop cock 8 and 6 having been closed, and on opening cock 14, mercury flows from vessel 12 into 15. This permits the purified enamation to diffuse into vessel 12. Air is again admitted to line A and the mercury level in the U shaped 17 is raised above the base of the U by opening cock 20, which is then closed again. Cock 14 is then opened and the mercury passes from vessel 15 into vessel 12, compressing the emanation in the tube at cock 16. This cock is then opened momentarily to allow the emanation to pass through. The whole operation is repeated until all emanation has been forced past cock 16. By again opening cock 20, the mercury from vessel 21 forces the purified emanation up into the left branch of 17 and thence out into the capillary tube 18. As the difference in level of the mercury in 21 and in 18 is only a few centimeters, the emanation is under reduced pressure, and upon heating the capillary tube with a fine flame, the glass softens, falls together and the tiny emanation tube can be drawn off without loss of emanation. The next day the same procedure is repeated to secure the emanation, which has meanwhile accumulated. The capillary tube containing the radium emanation under reduced pressure can be divided into the desired number of smaller tubes by the careful use of a tiny flame.

When just prepared, the emanation tubes have little beta or gamma ray activity. As the decay products Ra A, Ra B and Ra C are formed, the beta and gamma ray activity increases, until a maximum is reached about three and a

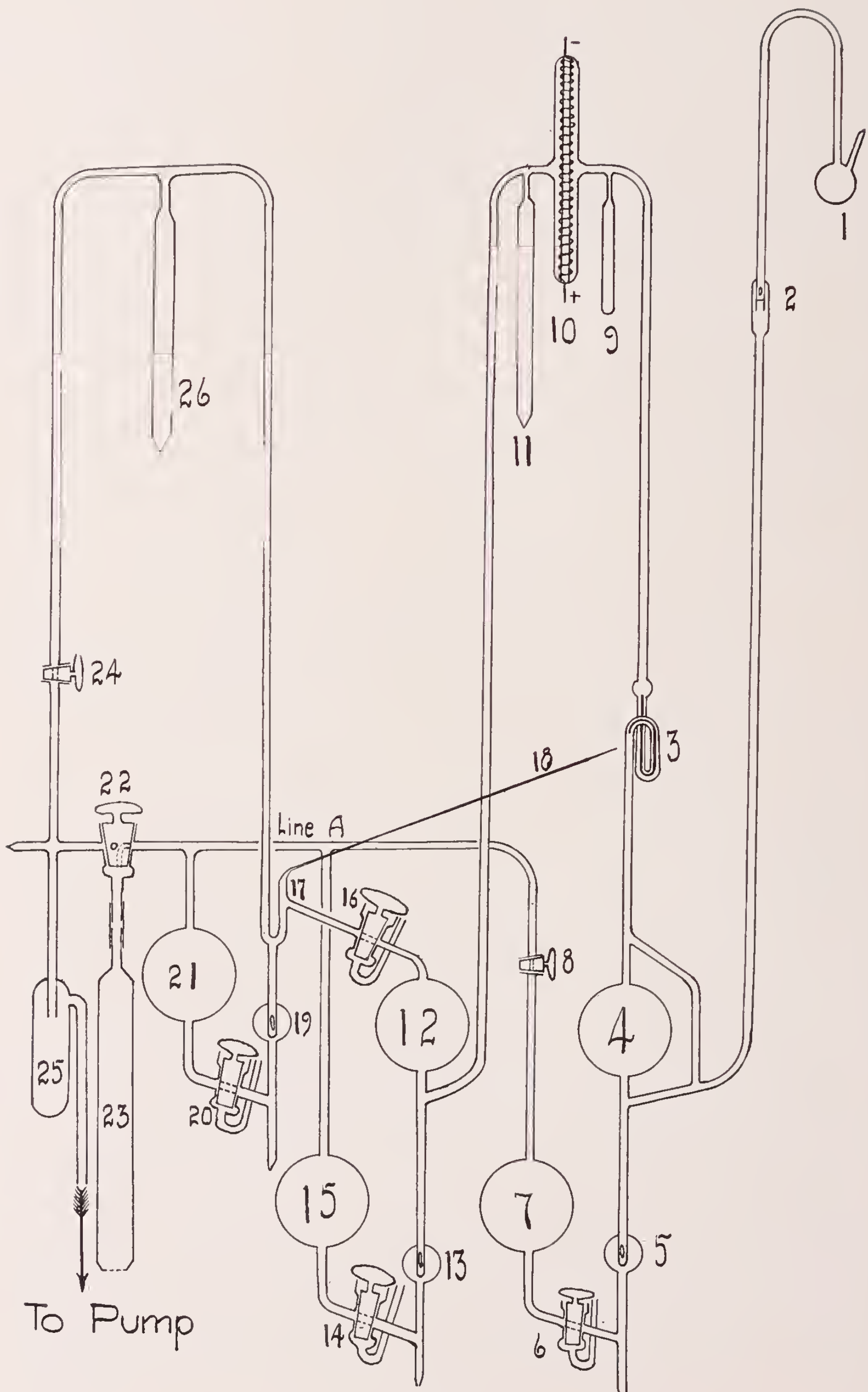

1
2
10
9
11
26
24
3
18
22
Line A
17
16
8
21
19
12
4
25
23
20
15
7
13
5
14
6
To Pump

FIGURE II

half hours after the emanation has been placed in the tube. See table I. After this beta-gamma ray activity decreases at practically the same rate at which the emanation is decaying, half of any activity being lost in 3.85 days.

Where it is desired to use the active deposit for application of the rays or for injection of a radioactive solution, the emanation is passed into a special glass vessel which is sealed on to the apparatus at 17. For an applicator the lead or metal plate which is to be activated is so exposed in the vessel as to permit the active deposit to form on the desired surface. When a solution is to be prepared, finely powdered salt is placed in the vessel. Emanation is admitted to the vessel for three to four hours to permit the maximum of active deposit forming. The emanation is then removed from the vessel by suitable manipulation, and the glass vessel is removed. The solution of active deposit is prepared by dissolving the salt in pure water. The activity of the active deposit may be determined by suitable gamma ray treatments.

TABLE I

INITIAL INCREASE IN BETA-GAMMA RAY ACTIVITY IN A RADIUM EMANATION PREPARATION DUE TO THE ACCUMULATION OF THE ACTIVE DEPOSIT OF RADIUM A, B, AND C

Time	Activity (maximum equals 1.000)
0	0.0000
10 min.	039
20 min.	119
30 min.	218
40 min.	321
50 min.	420
1 hour	511
1 hour 10 min.	593
1 hour 20 min.	663
1 hour 30 min.	723
1 hour 40 min.	774

1 hour 50 min.	817
2 hours	852
2 hours 10 min.	881
2 hours 20 min.	904
2 hours 30 min.	923
2 hours 40 min.	939
2 hours 50 min.	960
3 hours	970
3 hours 30 min. approx.	1.

The decay and accumulation curves for radium emanation are similar but reversed. So while radium emanation decays to the extent of 50% in 3.85 days, in the same time a radium preparation initially free from emanation will accumulate 50% of the equilibrium amount of emanation. Table II gives the data regarding the decay of radium emanation and its rate of production in a radium preparation initially free from emanation. (After Kolowart.)

From table II it is evident therefore that in 24 hours, there accumulates 16.4% of the equilibrium amount of emanation. So for example in a solution containing 1000 milligrams of radium there accumulates each 24 hours 164 millicuries (0.164 curie) of emanation. With a suitable apparatus, such as has been described, this emanation can be withdrawn in tubes and used. The next day a similar amount of emanation may be secured and so on indefinitely. The emanation preparations continually lose in activity and by the end of a month 99.5% of the activity has been lost. It follows therefore that after the collection of emanation has been going on for a month there will be thirty-one lots of emanation of varying age, the oldest preparation being reduced to less than 0.5% of its initial activity. (See table I, column 2, for basis of calculations.) Table III shows the activity of the theoretical amounts of emanation separated from the gram of radium on thirty-one successive days. The total activity of these tubes, 991.8 millicuries, represent the same activity practically as the gram of radium which produced the emanation. In practice an efficiency of 85 to 90% of the theoretical yield can confidently be expected when a properly designed apparatus is employed.

TABLE III

ACTIVITY OF RADIUM EMANATION PREPARATIONS ACCUMULATING IN THIRTY-ONE DAYS FROM ONE GRAM OF RADIUM (ELEMENT) IN SOLUTION

Age of Emanation Preparation in Days	Gamma Ray Activity Milli-curies
0	164.
1	137.
2	114.4
3	95.5
4	79.8
5	66.7
6	55.7
7	46.5
8	38.9
9	32.5
10	27.1
11	22.6
12	18.9
13	15.8
14	13.2
15	11.0
16	9.2
17	7.7
18	6.4
19	5.4
20	4.5
21	3.7
22	3.1
23	2.6
24	2.2
25	1.8
26	1.5

27	1.3
28	1.1
29	0.9
30	0.7
	Total . 991.8

The scope of this paper does not contemplate a detailed discussion of the methods of application of the emanation tubes in therapeutic treatments. For these details the reader is referred to the excellent work by Doctors Janeway, Barringer and Failla, of the Memorial Hospital of New York, on Radium Therapy in Cancer, and the article by Doctor Duane, previously mentioned.

TABLE II

DECAY AND GROWTH OF RADIUM EMANATION

A=fraction of emanation remaining after time t.

B=fraction of equilibrium amount of emanation formed in t days in a radium preparation initially free from emanation.

Time Days	Hours	A	B	Time Days	Hours	A	B
	0	1.00000	0.00000		14	90032	09968
	1	0.99253	0.00747		15	89360	10640
	2	98511	01489		16	88692	11308
	3	97775	02225		17	88029	11971
	4	97045	02955		18	87372	12628
	5	96319	03681		19	86719	13281
	6	95600	04400		20	86071	13929
	7	94885	05115		21	85428	14572
	8	94176	05824		22	84789	15211
	9	93473	06527		23	84156	15844
	10	92774	07226	1	0	83527	16473
	11	92081	07919	1	1	82903	17097
	12	91393	08607	1	2	82283	17717
	13	90710	09290	1	3	81669	18331

Time Days	Hours	A	B	Time Days	Hours	A	B
1	4	81058	18942	2	1	69246	30754
1	5	80453	19547	2	2	68729	31271
1	6	79852	20148	2	3	68215	31785
1	7	79255	20745	2	4	67706	32594
1	8	78663	21337	3	15	52074	47926
1	9	78075	21925	3	18	50916	49084
1	10	77492	22508	3	21	49783	50217
1	11	76913	23087	4	0	48675	51325
1	12	76338	23662	4	3	47592	52048
1	13	75768	24232	4	6	46533	53467
1	14	75201	24799	4	9	45498	54502
1	15	74639	25361	4	12	44486	55514
1	16	74082	25918	4	15	43496	56504
1	17	73528	26472	4	18	42528	57472
1	18	72979	27021	4	21	41582	58418
1	19	72434	27566	5	0	40657	59343
1	20	71892	28108	5	4	39455	60545
1	21	71355	28645	5	8	38289	61711
1	22	70822	29178	5	12	37158	62842
1	23	70293	29707	6	16	36059	63941
2	0	69768	30232	5	20	34994	65006
2	6	66698	33302	6	0	33960	66040
2	8	65705	34295	6	4	32956	67044
2	10	64726	35274	6	8	31982	68018
2	12	63763	36237	6	12	31037	68963
2	14	62813	37187	6	16	30119	69881
2	16	61878	38122	6	20	29229	70771
2	18	60957	39043	7	0	28365	71635
2	20	60050	39950	7	4	27527	72473
2	22	59156	40844	7	8	26714	73286
3	0	58275	41725	7	12	25924	74076
3	3	56978	43022	7	16	25158	74842
3	6	55711	44289	7	20	24414	75586
3	9	54471	45529	8	0	23693	76307
3	12	53259	46741	8	4	22993	77007

Time Days	Hours	A	B	Time Days	Hours	A	B
8	8	22313	77687	16	0	05613	94387
8	12	21654	78346	16	8	05287	94713
8	16	21014	78986	16	16	04979	95021
8	20	20393	79607	17	0	04689	95311
9	0	19790	80210	17	8	04416	95584
9	4	19205	80795	17	16	04159	95841
9	8	18637	81363	18	0	03916	96084
9	12	18087	81913	18	12	03579	96421
9	18	17291	82709	19	0	03271	96729
10	0	16530	83470	19	12	02990	97010
10	6	15803	84197	20	0	02732	97268
10	12	15107	84893	20	12	02497	97503
10	18	14442	85558	21	0	02282	97718
11	0	13807	86193	21	12	02086	97914
11	6	13199	86801	22	0	01906	98094
11	12	12619	87381	22	12	01742	98258
11	18	12063	87937	23	0	01592	98408
12	0	11533	88467	23	12	01455	98545
12	6	11025	88975	24	0	01330	98670
12	12	10540	89460	24	12	01216	98784
12	18	10076	89924	25	0	01111	98889
13	0	09633	90367	25	12	01015	98985
13	8	09072	90928	26	0	00928	99072
13	16	08543	91457	27	0	00775	99225
14	0	08046	91954	28	0	00647	99353
14	8	07577	92423	29	0	00541	99459
14	16	07136	92864	30	0	00452	99548
15	0	06721	93279	40	0	00074	99926
15	8	06329	93671	50	0	00012	99988
15	16	05961	94039				

USE OF THE HAND STEREOSCOPE IN VIEWING TRANSPARENCIES REDUCED FROM X-RAY STEREOSCOPIC NEGATIVES

E. B. Kneer, Sc. D., M. D.
Kansas City

The ordinary hand stereoscope may be utilized to excellent advantage to view by transmitted light transparencies reduced from a pair of stereoscopic *x*-ray plates. These transparencies are much more satisfactory than the opaque prints ordinarily employed and made to be viewed by reflected light. They are very convenient as exhibits before medical gatherings and to juries in court trials, as they may be passed about and viewed by window or lamp light.

To make these stereo-transparencies any reducing camera, such as is used in making lantern slide reductions, may be employed. However, a special mounting of the lens must be provided. It must be placed in its carrier or support with its center about one and one-fourth inches to one side of the center of the support. A focus of the image a corresponding distance to one side of the sensitized plate will be effected. Then, by simply turning the lens carrier over, end for end, the image of the second negative will be focused a symmetrical distance from the center toward the other end of the sensitized plate. The exposures are to be made alternately, the sensitive plate being protected by returning the plate holder shutter to place between exposures and while the *x*-ray negatives are being exchanged in the kit, and while the lens is being inverted. Thus a double "lantern slide" reduction is made of the stereo pair of *x*-ray negatives. This double slide should have its fields matted off and backed by clear glass, as is done in the case of ordinary lantern slide mounts. Three and one-fourth by seven inch plates, coated with the rapid lantern slide emulsion, are used. An ordinary 5 x 7 plate holder is modified to hold them, or a 3¼ x 7 kit may be inserted.

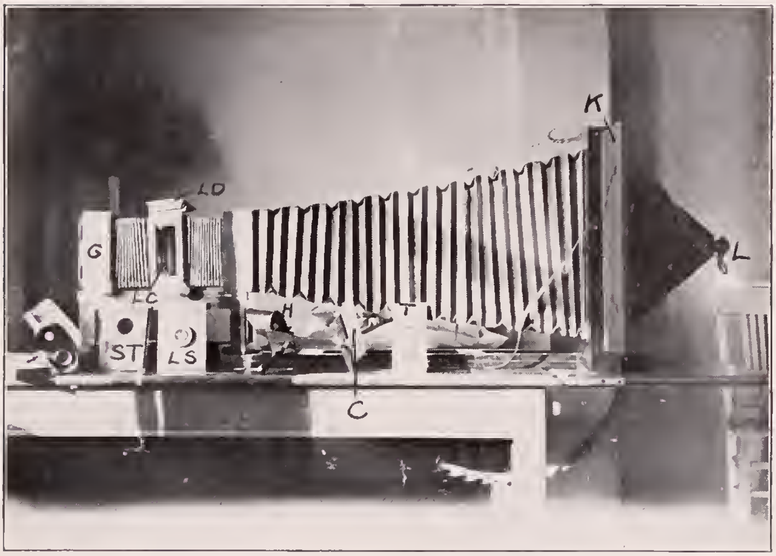
Stereo plates thus prepared and placed before a piece of frosted celluloid (to diffuse the light) in the hand stereoscope and viewed by transmitted light as transparencies give brilliant stereoscopic results as clear as, and sometimes clearer, than the original negatives viewed by the large stereoscope.

The illustration herewith and its description will make the procedure clear.

If a reducing camera is not at hand, like results may be obtained by placing the *x*-ray negatives in a window with the surrounding light shaded off and then photographing them to the proper dimensions with an ordinary camera. For this purpose the camera should be mounted firmly on a swivel board on a table facing the window, and for each exposure of the individuals of the stereo pair the camera should be swung the proper angle to place the images at symmetrical positions to each side of the center of the transparency plates.

Procedure for making the plates for the hand stereoscope: Place one of the stereo negatives in the kit (k); place the lens in its carrier (st) in the lens cell (lc); snap on the light at (L) and focus the image to proper size on the ground glass (g); place the plate holder containing the 3¼ x 7 plate in position behind (g); snap out the light at (L); remove plate holder shutter and expose by snapping on the light at (L) for the proper time, two to ten seconds, depending on the density of the stereo negative and the intensity of the light used (at least a 100-watt nitrogen mazda); snap off the light; replace plate holder shutter; invert the lens in the lens cell; replace the first stereo negative by the second in the kit (k), and repeat the above procedure for the second exposure. Develop as an ordinary lantern slide and mount as described.

Research Hospital



REDUCING CAMERA FOR MAKING LANTERN SLIDES AND STEREO-TRANSPARENCIES

L, electric light control; k, set of kits for plates to be reduced; lc, lens cell; ld, removable lid for lens cell; ls, lens carrier with lens mounted in center for lantern slide reductions; st, lens carrier with aperture to one side of center to receive lens when used for making stereo-transparencies; h, hand stereoscope with frosted celluloid backing at c to diffuse the light over the transparency; t, a stereo-transparency ready for the hand stereoscope.

A ROENTGEN SECTION OF THE SOUTHERN MEDICAL SOCIETY FORMED

One of the pleasing indications of a general desire for extension of roentgen organization is the success of the roentgenologists in the South, in obtaining a section in the Southern Medical Association. From a membership list of nearly 6000, Dr. Robert H. Lafferty of Charlotte, North Carolina, attempted to compile a list of men engaged in this branch of medicine. Resorting to the various medical directories, it was found that many of the most widely known and competent men in this specialty were not listed as such, hence considerable delay was occasioned by the correspondence necessary to obtain an approximate list.

In spite of the aid given by Dr. Seale Harris, secretary of the Southern Medical Association, at whose instigation Dr. Lafferty was chosen for this work, many of the notices of the meeting were received too late for the men to avail themselves of the invitation, thus curtailing the attendance.

No provision was made in the official program for an announcement of the meeting, the only publicity being an announcement from the chair in the several sections. The temporary roentgen organization was called to order by Dr. Lafferty, who explained the object of the meeting with a brief resume of difficulties encountered.

Dr. Samuels of New Orleans, discussed the advantages of such a movement and referred to the probable formation of an American Radiogological Association. Dr. McCandless of Kansas City, requested information relative to the procedure customary in forming a separate section in the Southern Association, in response to which Dr. Gray of Richmond, Virginia, gave a brief resume of the requirements, making farther reference to the remarks of Dr. Samuels in regard to the use of the term Radiological.

Dr. Gray expressed a preference for the term Roentgen and discussed the present organization plans of the American Roentgen Society. The chairman introduced Dr. McCandless of Kansas City, and asked that he discuss organization problems as President of the Western Roentgen Society, following which upon motion, a committee was appointed by the chair to make formal application to the Council at the meeting on Wedesday.

Dr. Gray and Dr. Leon J. Menville of New Orleans, were chosen to act with the chairman in in the preparation of a formal application. On motion the meeting was adjourned.

Through the courtesy of Dr. Seale Harris, Dr. McCandless was appointed to fill the vacancy (occasioned by the absence of Dr. George Dock, of Missouri) on the Southern Medical Association council which met the following day.

Favorable action by the council was had on the section and the nomination of Dr. Gray of Richmond, to serve as second vice-president of the Southern Medical Association, argues strongly for the prominence of roentgenology in the South the coming year.

Although the appointment of a temporary secretary has not been confirmed at the time the JOURNAL goes to press, the activity of Dr. Lafferty is ample to assure a successful meeting of the newly formed section which will meet at Louisville, Kentucky, the first Tuesday following presidential election in 1920.

THE JOURNAL OF ROENTGENOLOGY

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O. H. McCandless.

President 1919

EDITORIAL

The Journal of Roentgenology established early in 1918 will close its existence with this issue. Two short years constitute the period of its usefulness and two volumes its substance. The Journal was conceived and materialized entirely within the hands of the members of the Society. The group of members constituting the editors, editorial staff and the officers of the Society during the period of its existence labored diligently with complete concerted effort in its behalf. The termination of their efforts in connection with this Journal leaves not only pleasant memories of strenuous effort in a new field of endeavor, but has undoubtedly sealed ties of friendship which cannot be broken.

The appearance of the Journal may be thought of as an adventure in the field of scientific journalism. The principal requisite existing in those more directly responsible for it was red blood and ambition and it was hoped that this might counterbalance in a measure for lack of experience.

The officers of the Society, however, realized the extra burden of duty when conditions necessitated their endeavor to marshall into effect all of the forces of the organization for the prosecution of the one great common cause. The Journal proved its full share of usefulness at this time. It seems almost providential that the birth of the Journal should have been delayed until this most acceptable period.

The Journal marks an epoch in the development of this branch of the medical science in the West. It has been intended that the Journal should offer the greatest possible opportunity for the development of the younger men of the Society. The older men of the Society and the editorial staff have served to furnish the substantial foundation which secured the success that has been attained. The editors have given freely of their time and energy. They are fully aware of many errata having appeared, some of which stand uncorrected and in certain instances have been burdensome to the members concerned. In almost every instance, however, the fair-minded coöperative disposition, an attribute characterizing men of the West, has served favorably in behalf of the editors and their efforts.

The organization took pride in the fact that its officers worked without financial reimbursement. A full democratic spirit prevailed with freedom from politics and prejudices throughout the organization.

The demand for a Journal of this character by Western men is stronger to-day than ever before. The passing of the Journal of Roentgenology is but a natural step in the progress of the science. The precedent of a quarterly discontinuing with the development of a monthly issue is not infrequent in scientific journalism. Were it not for the inspiration afforded by the fact that the demand which made possible the quarterly journal will react in the formation of a larger and more desirable publication, there would indeed be sorrow in the editorial camp.

The Journal of Roentgenology has served its purposes and its editors wish to express their most sincere appreciation for the united support of the organization in their efforts in this great field of adventure.

The Portland Roentgen Club, of Portland, Oregon, was organized and held their first meeting January 14, 1920, in the office of Dr. Jos. Sternberg, Journal Building, at eight o'clock. Dr. Roy N. Payne read a paper, "Abdominal Tuberculosis"; the discussion was by Dr. Dorwin Palmer.

PRESIDENT'S ADDRESS

Mr. Chairman, Members of the Western Roentgen Society, Guests: I wish to read a brief president's address. As a foreword I wish to state that what I have to say is to a very large extent expressions of my own personal opinions and are not intended to commit the organization to any definite policy. It is my hope that they may be considered as suggestions and that they may provoke some general discussion among those interested in the welfare of this organization which will react favorably when these problems are presented before the executive sessions.

Essentially the function of the Western Roentgen Society is the dissemination of knowledge. To this end we gather twice a year to our market of scientific exchange. The eagerness with which the newer crumbs of knowledge are devoured stimulates us to individual effort and a part of the reward to our eminent contributors comes from the blessedness of giving.

Who can determine the amplification of a thought expressed to a thinking body of men and women? To him who is trained, yet lacking in experience, must appeal strongly the pervading spirit of democracy to which our organization is committed. Who knows what a harvest of achievement we may reap from the seeds of thought planted in the minds of those whose reputations are yet unborn and whose entity is yet submerged in the mass?

It is for you, and to you, that our efforts should be expended, and for you that our best minds should strive, that the horizon of our field may broaden as we ascend. Pursuant to this, our guest and our visitor should be accorded the place of vantage, that he may depart with a sense of hospitality extended and become that most precious of all acquisitions, a friend.

Who knows but he may return to us with ripened thoughts conceived in our meeting place and return with interesting discoveries that will mean a renaissance in our branch of science It seems just that we restrain expressions or acts that would imply a desire to limit the number of workers in our field. We should welcome the advent of co-workers and the utilization of different forms of radiant energy in the specialties in medicine, for it is to these men indulging in these specialties that we must look for the diversified use of radiant energy.

The work of Professor Milliken and others in analyses, by radiation, may make the analytical department of our laboratories the most important, both in efficiency and revenue.

The efficiency of our organization is in a great measure dependent upon the character and extent of our programs. Gatherings that will reach the isolated workers will often be at the expense and inconvenience of the men in the populous centers, and to the service of the sectional meetings has been invoked. The mailing lists of the workers in each section, presented to each new councilor by his predecessor, should increase year by year.

The original plan of the Kansas City Roentgen Club seems to commend itself to your notice. At an informal gathering the chairman of the meeting may be chosen alphabetically. Such a presiding officer *pro tem* may be required to furnish a meeting place and program. Similar requirements being exacted of the members alphabetically in a "round table" organization. A secretary chosen by ballot semi-annually may constitute the only other official. Such topics as fees and parliamentary procedure should be prohibited. Qualifications for members and members-elect should be adhered to. Visitors should be the guests of the Club.

Many of you are aware that the retiring president has opposed a membership of the Western Society beyond the limits of the Central Western states. The policy of extension, however, has prevailed and we now have an institution, national in scope, which is chartered under a name that is sectional. In view of this phenomenal growth and development, it is well that we ponder and accept soberly the responsibilities attending our success and growth. It has been suggested that a name be chosen commensurate with the scope and activity of the association. If such procedure is carried out, do we wish to append to us the name of any great scientist? Are we devotees to a science of Roentgen, or Curie, or Crookes, or are we devotees to the science of radiant energy? If in choosing such a name though, we be ourselves wholly satisfied, have we the right to perpetuate such a name in the literature and fasten it upon a professional posterity of workers in radiant energy whose ranks ramify into every conceivable branch of the medical science, and who must arbitrarily use it? Usage and acceptance by the American Medical Association has made it arbitrary. If the justice of our protest lies only in the fact that the science of *x*-ray is today the science of Coolidge, Snook, and Edison rather than that of Roentgen, our appeal would be warranted. Therefore the glossary of the future may read "Roentgen obsolete", signifying *x*-ray, formerly pertaining to the science of radiology. Is there no name comprehensive of the fundamental energy utilized by us; a name signifying the science of radiant energy or the science of the electron? It is hoped that in the selection of a name we may act without prejudice or sentiment in considering the appropriateness, dignity, and scientific fitness.

There are those who will be loath to discard a name that has become dear to us. It is like giving a daughter in marriage. She is the creature of our life's energy and devotion, yet she must go forth under a new name if she is to honorably accomplish, create, and fructify, and in going forth she must bear with her the blessing and benediction of those who fostered her in her youth.

In the event a suitable name receives selection by majority, it is hoped that we may get behind that name and make it stand for a definite principle consistent with progress. In our efforts to accomplish this let no spirit of rivalry make us blind to the achievements of that pioneer organization whose moving spirits have been so closely bound together in the past and whose scientific efforts have given us an organization structure builded without precursor, whose fundamental principles must guide us in future scientific endeavor.

Let our constitutional architects well consider the needs of the South where organization possibilities promise so much.

We must not treat lightly the returned military trained roentgenologist. He has assimilated in the abstract a wealth of facts that have cost the lives of a score or more of early investigators and covered an accumulation period of twenty years of expense and research. Let us not minimize his efficiency because it took us years to learn what he has acquired by a few months of intensive work. He is to become our leader and our peer.

To you, Military Man, we extend a welcome and an appreciation of your sacrifice; a welcome that is keener because of our familiarity with the fact that you shared the war's hazard equally with your medical brother, but in addition assumed the known and definite risk of the disasters attending constant exposure to the ray.

In the selection of program contributions and in the selection of officers, you will determine whether you want the young man who is coming into the world of science or the old man who is going out.

In your By-Laws you may provide for an honorary age legislation.

Extreme caution should pervade all efforts at medical retirement.

The scope of Radiology today is ever widening, among ailments possessing a multitude of etiological factors. The advent of pneumoperitoneum, the opaque meal, and pulmonary aids in diagnosis, place our specialty on a plane where no commercial laboratory may be competitive. The age of diagnosis is an epoch in the world's history and we may be justly proud of the part the *x-ray* is performing to this end. Making a diagnosis in the commonest ailments involves a consideration of diagnostic factors comprehended only by a broad medical training. Legislation therefore, is necessary to make diagnosis constitute the practice of medicine under our state laws. The report of a technician to one other than a qualified physician, should constitute a violation of the medical practice act and in behalf of the public the mail order laboratory and almanac symptom blank should be subject to control of State Boards of Health.

The healthy and unprecedented growth of the Western Roentgen Society has vindicated the accusation that it was superfluous. For the mistakes of the executive department we ask the indulgence of a loyal membership. The year's work has been arduous for our editor. Efforts to lessen his loyalty to our Society have been made. Journals have been late; it is to him in his double capacity that complaint has come. He has smiled and worked without recompense, except the reward that comes from a service well done. As the circulation and membership increases, provision for something more tangible will be made.

Doctor Trostler has made the apparatus exhibit an increasing success from year to year, and with the manufacturers we join in an expression of appreciation. Among the counsellors, it is a pleasure to thank Doctor Wasson for his initiative in the Western district.

No words will express adequately my appreciation of the inspiration that I have derived from my association with my predecessor, Dr. B. H. Orndoff. Few of you realize what he has meant to us in times of uncertainty. His unerring honesty, his fidelity to a principle, his untiring energy and righteousness at all times leaves us a debt that we may never repay. My personal love and regard is shared by those who know him best.

In closing I wish to impress upon you the need for support of your Radiological Society and your support and encouragement to the new officers of this earnest body of workers whose future knows no limitations, and who now constitute the largest single body of *x*-ray workers in the world.

There are several of the men that I believe should have special mention for their activity, among them Doctor Soiland, who has so efficiently acted in the capacity of counsellor for us, and has done much along the Pacific Coast in behalf of this organization, and I believe the credit should be given him for the work that he has done. Doctor McCullough has brought men from Pittsburgh with him, and a very loyal bunch. Doctor Williams has worked on the Executive Committee in behalf of the membership. I believe it would be tiresome to you for me to go over the total list of counsellors and commend them for their efforts. No provision has been made for recognizing the men who have come to us from the Pacific coast—I was not aware of the tremendous efforts that they have made, and no provision for commending these men individually for their efforts in behalf of this organization. We welcome their delegate, Dr. Loyd Bryan of San Francisco, and to their organization I wish to express a most heartfelt gratitude.

Members and guests, I thank you.

FLUOROSCOPIC STUDY OF THE LARGE BOWEL BY THE OPAQUE ENEMA: ANALYSIS OF EIGHT HUNDRED EXAMINATIONS

By Dr. L. J. Carter
Brandon, Canada

The eight hundred opaque enemas, the findings of which are analyzed in this series, are not to be regarded as complete examinations in themselves. They merely form one part of a general complete examination of patients in the Clinic of Doctors Bigelow, Sharpe, Carter, and Peirce, covering a period of about eighteen months. Diagnostic significance is attached to the findings only in so far as they connect themselves up with the complaints of the patients, and in the absence of adequate explanatory pathology demonstrable elsewhere.

Prior to about a year ago our routine *x*-ray examination of patients calling for gastro-intestinal study consisted in the giving of an opaque meal, with subsequent observations at five hours, eight hours, twenty-four hours, and daily thereafter until the colons were emptied. Only when this examination showed evidence of colon abnormality, was the routine supplemented by an opaque enema. However, it was gradually borne in upon us that more information was obtainable from the opaque enema than from the continued daily observation of the meal subsequent to the third day. Consequently we adopted a new technic which consisted in the giving of a laxative after the observation on the morning of the third day — usually castor oil — and the routine administration of an opaque enema the following morning. Only rarely did this laxative fail to empty all parts of the colon, in which case it was supplemented by a low enema. We do not believe that this laxative, given twenty-four hours prior to the opaque enema, can upset the normal equilibrium of the colon, and give rise to abnormal enema findings. It is much more practicable and agreeable to the

FIGURE 1

patient than a succession of three enemas, as advocated by some authorities. This new technic expedites the examination of the colon-delay patient by several days, and gives us more information. The opaque enema used consists of a suspension of barium sulphate in warm buttermilk.

That the information obtained from fluoroscopy of the filling colon is much greater than that obtained from radiography of the filled colon is well illustrated in Figures one and two. In Figure one, the radiograph fails to show a very marked constriction of the caecum. This constriction so effectually cut the caecum in two, and the outlet was so abnormally placed toward the inner side, that the roentgenologist thought for a moment he was observing an incompetent ileocaecal valve. In Figure two, after evacuation, the radiograph shows the constriction.

Infection of the appendix is diagnosed by the pain produced over the filling area by pressure at the site of the appendix. This pain is readily distinguished from that caused by manipulation of the terminal ileum area, while observations will show the presence or absence of constricting caecal bands. No great significance is attached to the visualization of the barium filled appendix. In the first place, only a small percentage of appendices were observed filled; and, in the second place, it is generally conceded that a filled appendix is not pathological unless it is definitely kinked, constricted, or bulbous, or remains filled after the caecum has been emptied of its barium.

Some authorities hold that a normal colon should be capable of complete evacuation after the opaque enema. This is not our experience. Many evacuated the pelvic colon only, a smaller number as far as the splenic flexure, and none were seen completely emptied. In one examination, the colon distal to the splenic flexure was seen empty, but was observed to refill from the transverse colon.

Reëxamination after evacuation should invariably be made especially in one class of colons, viz., where there is abnormal placement of some part. Figures three and four illustrate this well. In Figure three the high sigmoid seems to be adherent to the transverse colon, in fact, they could not be separated by manipulation. Figure four, after evacuation, shows the sigmoid loop separated from the transverse colon by three or four inches. This kind of observation has

Figure 2

been frequently repeated, and drives home the fact that juxtaposition of colons does not mean adhesions. Abnormal placements should be reëxamined after evacuation when the filling pressure has been removed, and apparent adhesions will be confirmed or disproved.

Antiperistalsis of colon contents has not been observed.

FIGURE 3

Mass movements have been observed, but comparatively infrequently.

Six patients were unable to take the enema because of relaxation of the sphincter consequent upon perineal laceration. This can usually be overcome by elevation of the

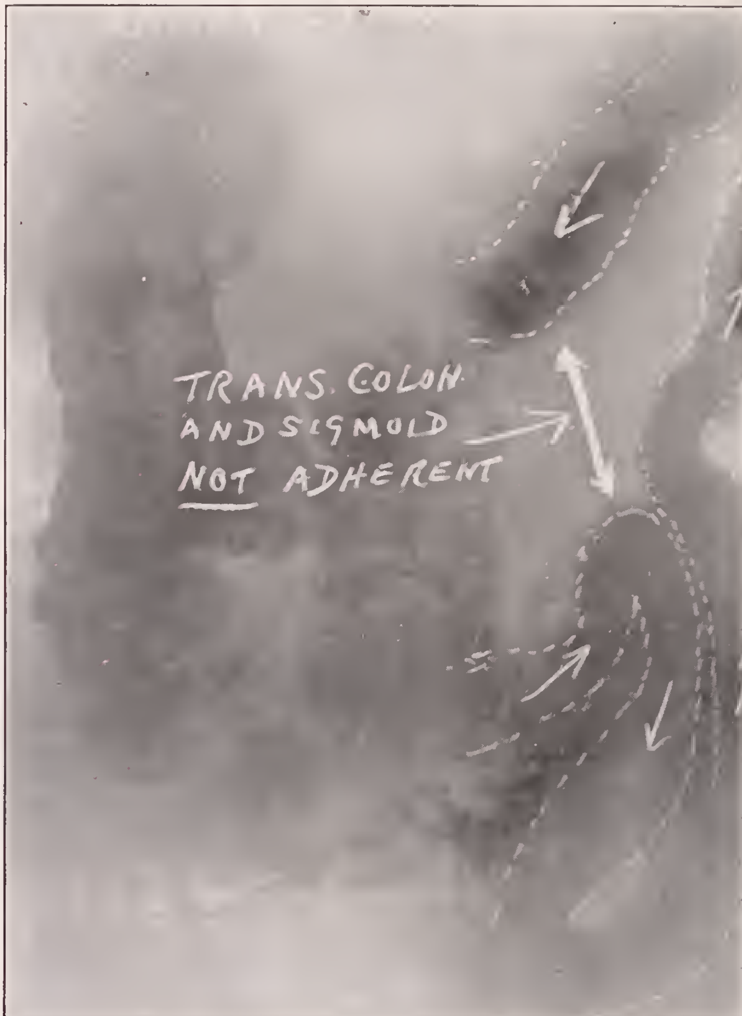

FIGURE 4

foot of the table. Six patients were unable to accept the enema in its entirety because of obstruction in some part of the colon. Most of these obstructions were malignant.

Pain was complained of during the giving of the enema by only thirteen patients.

Before proceeding to a detailed analysis of the findings obtained in these eight hundred enemas, a general definition of terms may prevent misunderstanding. (See Table one.)

A pelvic colon that does not rise out of the true pelvis during the filling process is regarded as "fixed", while one that rises above the umbilicus is regarded as being "abnormally placed", provided it does not descend when the tension of filling has been removed. An iliac-pelvic colon junction that does not descend into the pelvis is considered "abnormally placed". A splenic flexure that appears at or below the left costal margin is "prolapsed". A transverse colon that lies in the true pelvis, with the patient in the recumbent position, and which cannot be lifted out of the true pelvis by manipulation is certainly "abnormally placed". An hepatic flexure that descends much from the free margin of the liver is "prolapsed". A caecum that descends into the true pelvis and cannot be lifted out by manipulation is "abnormally placed" and "fixed". By "constricting bands" is meant an almost complete shutting off of the lumen of the bowel over a narrow area, with marked delay in the passage of the enema, and persistence of the narrowing after the enema has passed. "Constricting bands" are distinguished from "fixation". A banded colon is not necessarily a fixed one. Numerous constricting bands have been observed, for example, at the lower end of the caecum, while the caecum as a whole was seen to be fairly mobile. "Delay" refers to a more moderate retarding of the rate of passage of the opaque enema, without definite evidence of constriction. "Spasticity" means smallness of calibre of the colon, or a deepening and unusual tension of the haustral markings.

With these preliminary explanations, we shall proceed with the analysis: Out of eight hundred examinations, six hundred seventy, or eighty-four per cent, showed one or more abnormalities. Only sixteen per cent were normal colons.

Table I

Analysis of 670 Cases Examined After Administering Oqaque Enemas

	Caecum	Junction Caecum and Ascending Colon	Ascending Colon	Hepatic Flexure	Transverse Colon	Splenic Flexure	Descending Colon	Sigmoid	Rectum	All Colons	Totals
1. Constricting Bands	*169										
	†16										
	185	52	33		29	2	5	43			349
2. Delay in Filling (but not definitely banded)	58		14	14	26	39	6	92	6	5	260
3. Abnormal Placement (with Fixation)	‡2										
	§14										
	‖3			††27				§§47			
	**4			**2	††43	††18	5	***9			
	††46			—	**8	‡‡14		†††10			
	—			29	—	—		—			
	69				51	32		66		‡‡‡1	253
4. Fixation	109		4		14			§§§56			183
5. Spasticity	6		2		14		27	30	3	48	130
6. Tenderness on Pressure...	*92		2		2			3		3	102
7. Atonic Dilatation	32		9		4		4	10	1	26	89
8. Redundancy				2	16	3	2	9		13	45
Totals..................	551	52	64	45	156	76	49	309	13	96	1411

*Butt
†Mid
‡Inverted caecum
§Butt up and in
‖Butt up and out
**High
††Low
‡‡Extra loop
§§High central
***High Left
†††High Right
‡‡‡All to left of abdomen
§§§Does not rise out of pelvis

Table One is an analysis of these six hundred seventy abnormal colons. The horizonal columns classify the abnormalities (in the order of their frequency) into Con-

FIGURE 5

stricting Bands, Delays in Filling (without definite banding), Abnormal Placement, Fixation, Spasticity, Atonic Dilatation, Redundancy, Tenderness on Pressure. The vertical columns give a sub-classification, showing the numbers of these various abnormalities in the various portions of the colon. It will be noted that there are one thousand

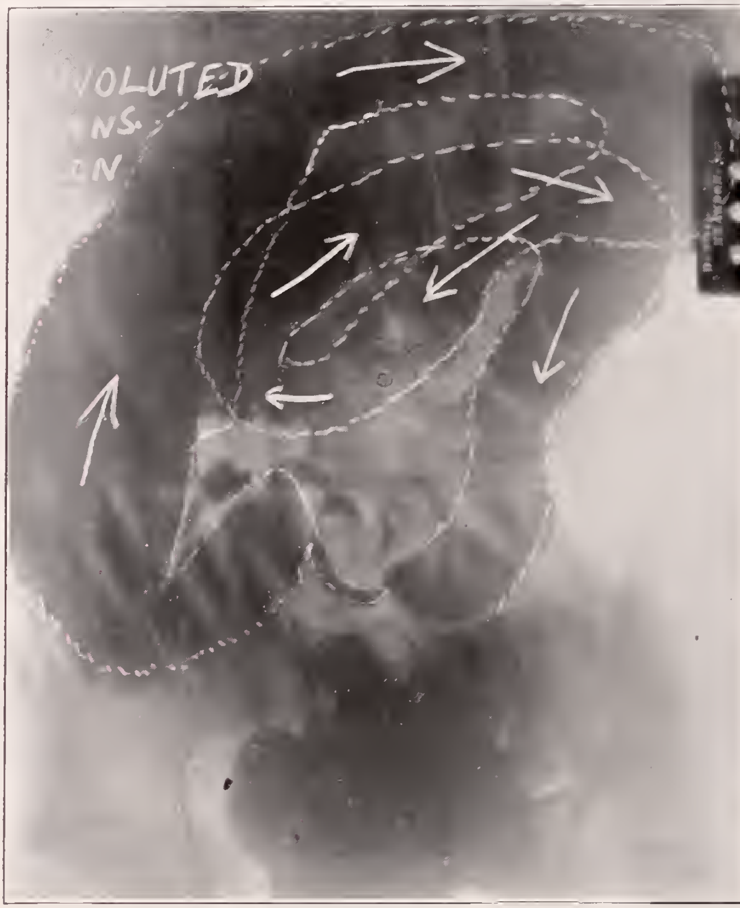

FIGURE 6

four hundred eleven abnormalities in the six hundred seventy colons, an average of over two abnormalities per colon.

The most frequent abnormality is "Constricting Bands" which occurs three hundred forty-nine times, and of which two hundred seventy are in the caecum and ascending colon. That is, fifty per cent of abnormal colons are banded, while forty per cent are banded in the region of the caecum and ascending colon.

Looking down the vertical columns it will be noted that

FIGURE 8

the caecum is the greatest offender, with the sigmoid coming next. The caecum is par excellence the seat of tenderness on pressure. The proximal colon — caecum and ascending colon — has forty-seven per cent of the total abnormalities; the mid-colon — transverse and flexures — has twenty per cent; the distal colon — descending colon, sig-

FIGURE 11

moid, and rectum — has twenty-six per cent; while all the colon is involved in seven per cent. A few reproductions of radiographs illustrate some of the abnormalities.

Figure five shows a large redundant colon.

Figure six represents a redundant convoluted malplaced transverse colon, which crosses to the region of the splenic flexure then returns in a loop to the caecum and back again to the splenic flexure.

FIGURE 12

Figure eight shows a fixed kinked appendix and a band at the junction of the iliac and pelvic colons.

Figure eleven shows a right-sided sigmoid. It emerges from the right side of the pelvis, ascends to near the right costal margin, descends again to the brim of the pelvis, and then takes its usual course. The transverse colon, crossing this redundant loop, obscures the picture and renders the diagnosis from the plate impossible if the course of the sigmoid had not been observed during the fluoroscopic examination.

Figure twelve is another one which would be difficult to interpret from the radiograph alone. The pencilled diagram represents the way the observer saw the colon fill. The sigmoid takes the normal position of the caecum and ascending colon, while the caecum lies centrally from the sigmoid.

RELATION OF COLON ABNORMALITIES TO AGE AND SEX

In this series of six hundred seventy abnormal colons, forty-two per cent were males and fifty-eight per cent females. The analysis of the one hundred thirty normal colons showed forty per cent males and sixty per cent females. So that the sex proportion is related directly to the total number of cases examined. Colon pathology has no sex preference.

But when we come to study the incidence of colon trouble at the various age periods we find a marked contrast between male and female. Table Two shows this graphically.

Table II

Age	Male	Female
Under 10	1 per cent	1 per cent
10 to 20	4 per cent	11 per cent
20 to 30	22 per cent	29 per cent
30 to 40	22 per cent	22 per cent
40 to 50	20 per cent	20 per cent
50 to 60	17 per cent	12 per cent
Over 60	14 per cent	5 per cent

In this Table the figures under heading, male and female, show what percentage of the colon troubles of each of the two sexes occurred at the various age periods. It is seen that the male has correspondingly less colon troubles from ten to thirty years than the female; the two remain equal from thirty to fifty years; while the female has less trouble from fifty years upward. The colon troubles of the male arise slowly during the second decade, remain at a constant maximum during the third, fourth and fifth decades, then recede but slowly as old age approaches. On the other hand, the colon troubles of the female rise quickly in the second decade, reach their maximum in the third decade, drop perceptibly during the fourth decade, remain constant during the fourth and fifth decades, and then recede quickly as old age approaches. This interesting variation between the sexes in youth is probably accounted for by the more active life of the young male, and the disturbances connected with the onset of menstruation in the female. The variations in old age are possibly due in part to the sudden change from active to sedentary habits on the part of men at about the age of sixty, while the habits of women remain more fixed.

RELATION OF ABNORMAL COLON FINDINGS TO SYMPTOMATOLOGY

Table III

Complaint	No.	Percentage	Incompetent Ileo-caecal Valve
Pain Abdomen	436	20% of all complaints	
Stomach Symptoms	432	20% of all complaints	
Auto-Intoxication			
viz: Weak and Tired......	220	33% of all patients	36
Headache	182	27% of all patients	27
Backache	117	17% of all patients	16
Constipation	115	17% of all patients	
Indigestion	105	16% of all patients	15
Rheumatism	116	17% of all patients	
Nervous	99	15% of all patients	14
Loss Weight	68	10% of all patients	
Eructations	77	11% of all patients	
Nausea or Vomiting..	74	11% of all patients	
Anorexia	55	8% of all patients	
Vertigo	50	8% of all patients	
Total............	1278	57% of all complaints	

The greatest number of complaints were of pain in the abdomen, four hundred thirty-six, or twenty per cent of all complaints. Of this total one hundred nineteen were of pain in the epigastrium, one hundred ten of pain in the right iliac region, one hundred ninety-two were in the upper abdomen, one hundred ninety-six in the lower abdomen, and forty-eight general.

Next in order of frequency came complaints referable to the stomach, four hundred thirty-two, or twenty per cent of all complaints. These consisted of pain, indigestion, eructations, anorexia, nausea and vomiting. Of this total only fifty-eight complaints could be based on definite stomach pathology, such as gastric or duodenal ulcer, gastric cancer, etc. That is, eighty-five per cent of stomach symptoms was referable to pathology outside of the stomach, and was susceptible of explanation by colon abnormalities. We feel that this is a very important point upon which the clinician should fix his attention.

The next symptoms which attract attention by virtue of their frequency are those which go to make up the general syndrome of auto-intoxication, viz., headache, backache, weakness and tiredness, rheumatism, loss of weight, vertigo, constipation, indigestion, erucations, anorexia, nasuea and vomiting. Table Three gives details for each of these complaints.

Summarized, out of a total of two thousand two hundred twenty-eight complaints recorded, one thousand two hundred seventy-eight, or fifty-seven per cent, could be placed in that general group which make up the picture of auto-intoxication — surely a very striking confirmation of the theory that colon pathology is a potent factor in the production of auto-intoxication.

INCOMPETENCY OF THE ILEO-CAECAL VALVE

Incompetency of Ileo-caecal Valve was noted in one hundred forty-four cases, twenty-two per cent of all abnormal colons. In eighteen cases it was unassociated with any other colon abnormality. It was associated with sixty-nine constricting bands, of which sixty-one were in the caecum; with thirty-five delays; with fifty-one fixations; with twenty-two abnormal placements, with twenty-nine spasticities; with twenty-one atonic dilatations; and with thirty-two tendernesses, all of which latter were in caecum. Altogether, incompetent ileo-caecal valves were associated with one hundred twenty-eight caecal abnormalities, and with ninety-nine abnormalities in the transverse, descending, and sigmoid. On the other hand, abnormalities of transverse, descending and sigmoid colons were not accompanied by incompetency of the ileo-caecal valve in three hundred twenty cases. So that this series does not seem to bear out the claim of many leading authorities that ileo-caecal incompetency is nearly always an end result of disturbances in the descending colon, sigmoid, and rectum. On the other hand, this series seems to suggest the close association between incompetent ileo-caecal valves and the abnormalities of the caecum.

Another interesting problem is the casual relation between incompeteucy of the ileo-caecal valve and the symptoms which make up the general syndrome of auto-intoxication. In this series of one hundred forty-four incompetencies, as shown in Table Three, thirty-six per cent complained of being weak and tired, twenty-seven per cent of headache, fifteen per cent of indigestion; sixteen per cent of lumbosacral backache, fourteen per cent of nerve disturbances. Compare these percentages with similar percentages for the total of six hundred seventy abnormal colons, and we see that they run practically the same. So that we conclude that incompetency of the ileo-caecal valve has no greater causal relation to auto-intoxication than have colon abnormalities generally.

ASSOCIATION OF ABNORMALITIES OF SIGMOID AND RECTUM WITH RETROVERSION OF UTERUS AND PELVIC INFLAMMATORY CONDITIONS

Retroversion of the uterus occurred sixty-one times in this series. It was associated with fixation of the distal colon in twenty-eight cases, while in thirty-three cases there was no sigmoid or rectal abnormality. Pelvic inflammatory conditions occurred twenty-six times, and were associated with sigmoid and descending colon abnormalities in nineteen cases, and unassociated in seven cases.

CONSTIPATION

TABLE IV

Abnormality	% of Patients	Abnormality	% of Patients
Bands	50	Incomp. I. C. Valve....	20
Delay	50	Fixation	19
Abnormal Placement..	40	Spasticity	16
		Atonicity	12
		Redundancy	7

Closely related to the problem of auto-intoxication is that of constipation. What are the colon abnormalities most assocated with the complaint, Constipation? Fifty per cent of all patients complaining of constipation had constricting bands in the colon (of which forty per cent were in the caecum), fifty per cent showed delay in filling at some part without definite constriction, forty per cent had abnormal placement, nineteen per cent were fixed, sixteen per cent spastic, twelve per cent atonic, and seven per cent redundant, while twenty per cent had incompetent ileocaecal valves. The marked associations of constipation with abnormalities in the colon are with constricting bands, delay without definite bands (probably due to pericolic membranes of a less highly organized character), and abnormal position. The lesser associations are with fixation (in normal position), spasticity, atonicity, and redundancy. Would it be out of place to suggest that the old classification of constipation into atonic and spastic no longer covers the field as looked at from the x-ray standpoint? Attention should also be called to the evidently small rôle which atonicity and redundancy of the colon play in constipation.

RELATION OF COLON ABNORMALITIES TO GASTRO-HYPERACIDITY

We found that eight per cent of colon abnormalities were associated with peptic ulcer, and twelve per cent with gall bladder infection. In the cases associated with peptic ulcer the average amount of free HCl found in the fifty-minute stomach test meal was forty one. In those associated with gall bladder infection it was thirty-one. In the eighty per cent of colon abnormalities not associated with demonstrable pathology in the gall bladder or gastric regions, the free HCl averaged twenty-five—practically normal. We are forced to the conclusion that colon pathology has no causal relation to gastric hyperacidity.

RELATION OF ILEUM EMPTYING TIME OF THE BARIUM MEAL TO VARIOUS COLON ABNORMALITIES SHOWN BY THE BARIUM ENEMA — FIVE HUNDRED OBSERVATIONS

TABLE V

Abnormality	Per cent Meal left in Ileum in 8 Hours	Per cent of Ileums Empty in 8 Hours
Spastic	30	35
Banded	35	35
Fixation	37	28
Abnormal Placement	39	26
Atonic Redundancy	40	24

After a barium meal is given, an eight-hour observation is made to determine what amount of the meal has left the ileum, as well as to determine mobility, tenderness, in the ileo-caecal area. In this series of colon abnormalities there remained on an average of thirty-two per cent of the meal in the ileum at the end of eight hours, while in twenty-nine per cent of the cases the ileum had completely emptied. A rather unexpected finding was that the patients with spastic and banded colons had the smallest amount of barium remaining in the ileum at the end of eight hours (thirty per cent and thirty-five per cent), and had the largest per cent of ileums completely empty (thirty-five per cent each) in eight hours. While, at the other end of the scale, the abnormally placed, the atonic, and the redundant colons had the largest amount of barium remaining in the ileum at the end of eight hours (thirty-nine per cent and forty per cent), and had the smallest per cent of ileums completely empty (twenty-six per cent and twenty-four per cent). Fixation occupied the intermediate position (thirty-seven per cent in ileum at the end of eight hours, and twenty-eight per cent of ileums empty in eight hours). The conclusion suggests itself that spasticity and banding may reflexly induce more vigorous peristalsis in the ileum and thus contribute to quicker emptying time, while the abnormally placed, the atonic, and the redundant colons, by virtue of their sluggishness, may dam back the oncoming barium from the ileum.

ASSOCIATION OF GALL BLADDER INFECTIONS AND PEPTIC ULCERS WITH CHRONIC APPENDICES AND CAECAL BANDS

In ten per cent of the cases these ileo-caecal abnormalities were associated with gall bladder infections, in six per cent with peptic ulcers, and in two per cent with both. That is, out of a total of five hundred fifty-one ileo-caecal abnormalities, only eighteen per cent were associated in any way with demonstrable gall bladder infections or peptic ulcer — a finding which does not seem to corroborate the view that pathology in these three tissues is very closely inter-related.

ASSOCIATION OF COLON ABNORMALITIES WITH BACTERIAL CULTURES FROM THE URINE

In a paper* read before the Canadian Medical Association in 1917, and appearing in *The Journal*, Vol. VII, p. 810, the writer called attention to the close relationship between intestinal stasis and bacteriuria. Out of a total of one hundred fifty-three cases of intestinal stasis reported, forty-four per cent gave positive urine cultures, fourteen per cent being staphylococci and thirty per cent colon bacilli.

***Canadian Medical Association Journal*, Volume VII, page 810.

In the present series, in three hundred fifty-four colon abnormalities of all kinds urine cultures were made, with a positive finding in eighty-nine cases (twenty-five per cent), sixteen per cent being staphlococci and nine per cent being colon bacilli. An analysis of these eighty-nine cases in which positive cultures were obtained showed that constricting bands, delays, and abnormal placements totalled sixty per cent of all the abnormalities, the fewer cultures being obtained in atonicity, spasticity, fixation, and redundancy. Now, we showed above that constipation was associated largely with these same abnormalities in which a positive urine culture was most frequently found, hence the findings in the former series seem to be confirmed by the close relationship between colon stasis and bacteriuria in the present series.

ASSOCIATION OF COLON ABNORMALITIES WITH LOCAL AND FOCAL INFECTIONS

The close association of the various focal infections with colon pathology is suggested by the frequency of their occurrence in this series. In the six hundred seventy abnormal cases, infected tonsils were found in one hundred thirteen, infected antra of highmore in ninety, infected teeth in forty-two, infected frontal sinuses in fourteen, infected ethmoids in fourteen, atrophic rhinitis in four, chronic otitis media in six. Altogether, foci of infection were demonstrated in two hundred eighty-three cases, or forty-two per cent of the patients with abnormal colons.

Local infections which might be considered the result of intoxication were associated as follows:

Chronic endo, or myo, or pericarditis, eighteen times; sclerosis of arch of aorta, thirty-three times; osteo arthritis, thirteen times; hyperthyroidism, six times. A striking feature of the thirty-three cases showing sclerosis of the arch of the aorta is that not one of these gave a positive Wasserman reaction.

RESULT OF WASSERMAN TEST

Of these six hundred seventy abnormalities, the Wasserman test was done in one hundred seventy-five, of which only eleven were positive, showing the rarity of association between syphilis and colon pathology.

FIGURE 13

BLOOD FINDINGS

The average leucocyte count in six hundred examinations of patients with abnormal colons was ten thousand, a moderate leucocytosis, such as might be expected in a chronic infective process. Only seventeen cases (or two per cent) were associated with anemia.

TUBERCULIN REACTION

Our routine practice is to give a tuberculin reaction test in all cases where the symptomatology and clinical and

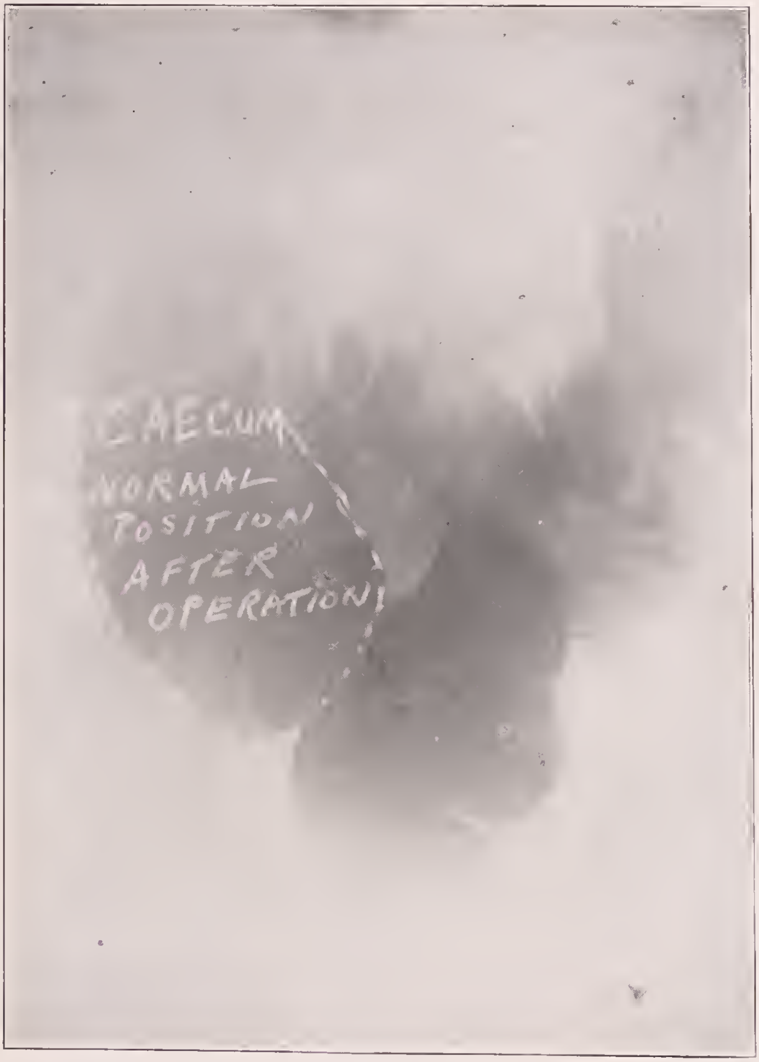

FIGURE 14

laboratory findings point to a chronic low grade type of disease. Such a clinical picture, for instance, as symptoms of weakness, tiredness, anorexia, loss of weight, and asthenia, coupled with low leucocyte count and relative lymphocytosis, would call for such a test. The one exception we make is where the clinical picture points to the lungs. This

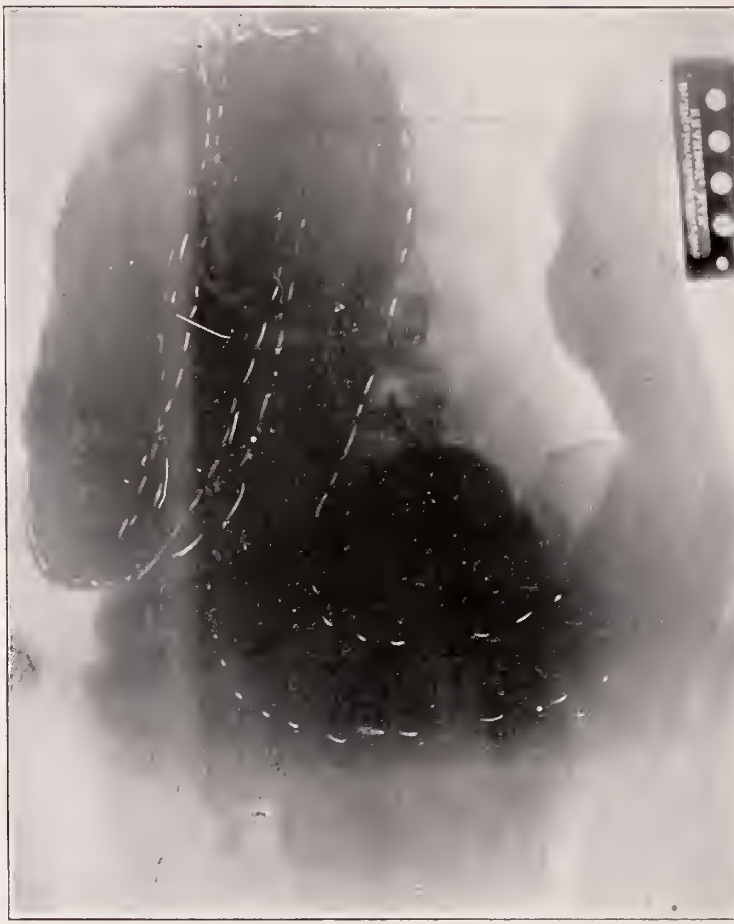

FIGURE 15

test is never given until thorough examination reveals physical findings in the lungs negative, for lung tuberculosis does not tolerate well any form of tuberculin. The test we use is the subcutaneous one, the test being given usually only once, and the dosage being from three to fifteen milligrams of old tuberculin. The reaction response is either clearly negative or definitely positive. The positive reac-

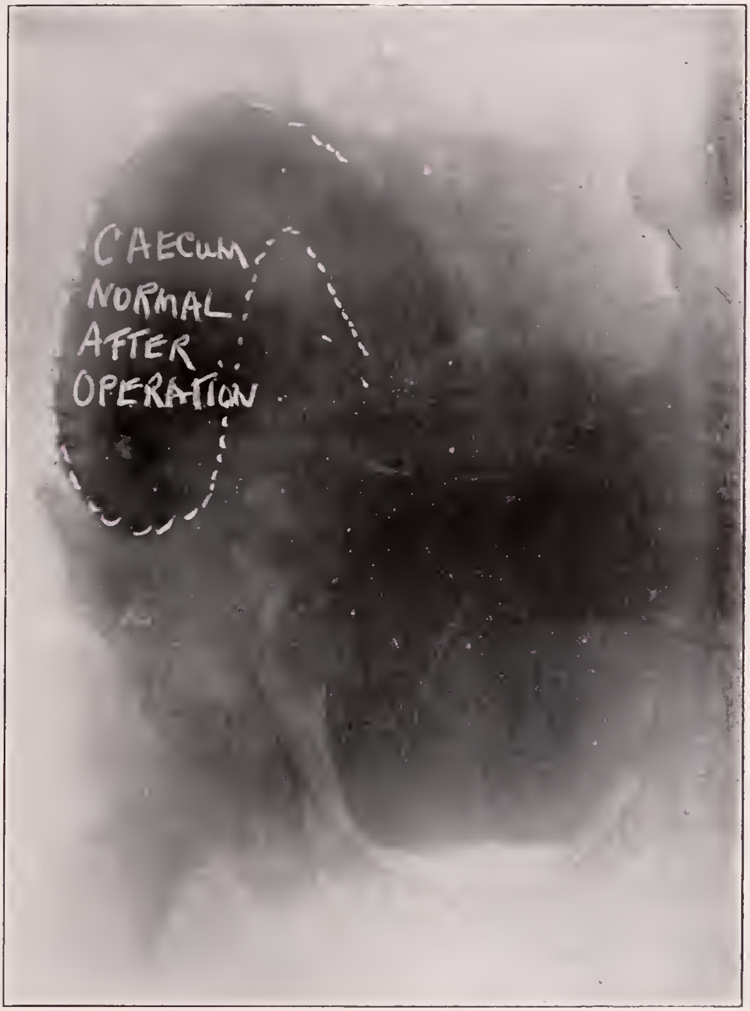

FIGURE 16

tion consists of rise of temperature, chills, general malaise, and pain usually localized to the point of infection. We have used this test in over five thousand cases, and have found it perfectly harmless. The discomfort to the patient is infinitely more than compensated for by the definite information obtained regarding the disease process, and by

FIGURE 17

the possible early diagnosis of an obscure tuberculosis with the greatly increased probability of permanent cure. In this series three hundred two tests were given with a positive result in fifty-seven cases, and a negative result in two hundred forty-five cases. That is, nineteen per cent of colon abnormalities were associated with positive evidence of tuberculosis, with no other demonstrable focus except the pathological colon itself, or possibly an underlying tuberculous mesenteric adenitis.

A few radiograph reproductions show rectifying changes made upon abnormal colons by operation.

Figure thirteen represents an inverted caecum. The roentgenologist diagnosed a caecum inverted with the butt adherent firmly in the region of the free border of the liver. At operation the appendix was found buried in adhesions on the inferior surface of the liver, and fixing the caecum in that location. Severing of adhesions released the caecum.

Figure fourteen shows the caecum, after operation, restored to its normal position, and quite atonic and dilated.

Figures fifteen and sixteen show the same condition of the caecum of another patient and the operative result.

Figures seventeen and eighteen illustrated the results obtained by operation on a large atonic, redundant colon. Caecosigmoidostomy was done in this case. Before operation the whole colon was dilated and fully as large as the caecum and ascending colon represented here. Following the operation Figure seventeen, taken about one year afterward, represents reduction in calibre of transverse colon and descending colon by fully one-third. Figure eighteen, taken about two years after operation, shows caecum and ascending colon also approaching normal size.

X-RAY DIAGNOSIS CONFIRMED BY OPERATION

The only absolutely certain test of the correctness of the roentgenologist's diagnosis in abdominal conditions is the finding of the surgeon. Of the six hundred seventy abnormal colons of this series, one hundred four have come to operation. These operations were done for the most part to release the colon from constricting bands, and to remove chronically infected appendices. In a lesser number of cases abnormal placements were corrected. In these one hundred four operated colons the x-ray diagnosis was

FIGURE 18

correct in exactly one hundred per cent. We have yet to have the abdomen opened and the surgeon search in vain for pathology which the *x*-ray proclaimed. There is no more certain fact in the field of roentgenology than the correctness of the findings in the fluoroscopic study of the large bowel, provided the observations are made with care and interpreted with judgment.

Doctor Donaldson: I am not prepared to discuss the paper. It is exhaustive, and at my laboratory we don't go as far as the Doctor goes in this follow-up.

I would suggest that the principal thing outside of the abnormalities in the sigmoid and rectum is that we use the enemas when we suspect spastic colons or when we are looking for possible caecal adhesions. The fluoroscope, of course, will bring that out when plates fail.

Then we also find the abnormalities in caecums and we consider a flattened caecum an abnormal caecum, at least as indicative of chronic inflammatory condition in that region.

For the enema, we use barium and a mucilage of acastra and we also use it warm, not hot and not cold, and we have very little trouble with patients being unable to retain the barium mixture.

AN ANOMALOUS TRANSDUODENAL BAND

By M. J. Hubeny, M. D.

Consulting Roentgenologist to Henrotin Memorial Hospital, Chicago Polyclinic Hospital and Post-Graduate School, Grant Hospital, and Chicago Municipal Tuberculcsis Sanitarium

The purpose of this paper is to call attention to the presence of an anomalous peritoneal band extending from the under surface of the liver or tip of the gall bladder and passing downward and to the left, crossing the duodenum usually at the junction of the first and second portions of the latter, then blending with the superior layer of the transverse meso-colon.

The continued development of abdominal surgery has led to an increased appreciation of the importance of the normal activities and pathological conditions of the peritoneum. The demonstration of the bacterial origin of peritoneal lesions and subsequent investigations as to the causation of such bacterial invasions, have placed our knowledge of the more acute forms of peritoneal disease upon a firm basis.

A far more difficult problem is the determination of the cause or causes of peritoneal adhesions and bands for which it is impossible to ascertain a definite antecedent acute inflammatory lesion. Virchow, in 1858, was the first to describe these structures in more detail, but at that time no basis for a correct opinion concerning their causation was forthcoming. Further observations of early cases gave considerable information relative to post-operative and post-inflammatory adhesions, with efforts to ascertain their cause and prevention. Later a desire to understand the symptoms and diagnosis of abdominal adhesions as apart from other lesions crystallized into definite clinical entities. Eventually the work of Jonnescu, Treves, Lane, and Jackson called the attention of surgeons to the existence of various bands, folds, and membranes in relation to portions of the gastro-intestinal tract and to their possible importance.

Considerable confusion exists concerning all these conditions, many theories having been advanced as to their causation. The frank post-inflammatory cases need not be disputed, but, where no evidences of inflammation are present, argumentation is justifiable. Different theories are advanced as causative factors, each of them having plausible conclusions.

Lane, Fagge, and others have attempted to explain peritoneal bands as crystalization of lines of force and the result of stress upon normal structures causing them to be altered.

In contradistinction to these views there are some who explain practically all these new or malformations of the peritoneum as the results of inflammation, either pre- or post-natal (Keith, Ballyantine and Veszprenit).

Another theory is the attempt to explain many of these formations on the basis of failure of rotation or descent of the gut or an anomalous growth of the peritoneum and mesentery in the presence of normal rotation.

Unfortuntely these bands with their associated symptoms are so often localized at or near that portion of the gut where we are most likely to have lesions of an inflammatory nature even though there is no remaining proof of such an inflammation.

Harris, through whose kindness and coöperation it has been my good fortune to verify most of the cases cited, has concluded that the band in question is non-inflammatory, being distinctly of embryological origin.

The uses of the *x*-ray have revealed numerous anomalies, the relative freqnency of their occurrence becoming more apparent. A few illustrations such as bilateral spatulous ribs, vertebral inserts, situs inversus, lack of colonic descent or patent ductus botalli makes it impressively evident that many anomalies of much less import can exist without recognition.

It is for this reason that the writer desires to call attention to the roentgenological aspects substantiating the clinical findings as exhaustively presented by Dr. M. L. Harris, before the Chicago Surgical Society, in the year 1914.

Homans has since reported eleven cases in great detail; his observations radiologically and clinically confirming and clarifying the findings previously given.

The clinical history usually elicited the fact that the complaint was one of long standing. The average age was forty years, the youngest being twenty-five years, the oldest fifty-five years; both sexes equally affected.

Symptoms were referable to the right upper quadrant, adding another explicable reason for symptoms in that area. Among these were sour stomach, epigastric discomfort, fulness and gas eructations; dull ache in epigastrium, especially to the right with knife-like exacerbations; no radiation of pain generally. Some of the cases had intermittent symptoms, although most cases complained constantly. In some respects the symptoms resemble those of appendicitis. Food relief was present in some. Gastric analysis was of no value. Vomiting was erratic, no hemastemesis present. Two cases had jaundice.

The possibility of confusion with appendicitis is illustrated by an instance in which a patient with vague gastro-intestinal symptoms was examined for possible gastric or duodenal ulcer in which a radiological finding pointed towards a transduodenal band; the hepato-duodenal ligament was short with an associated high fixation of the caput; the latter being somewhat elongated and exhibiting peristalsis similar to that found in the stomach.

Because of this an anomalous caput was suspected, not pathological, however, and the opaque meal followed through the gastro-intestinal tract, when an eventual determination of appendiceal involvement was made; removal of same gave complete relief of symptoms. This case exemplifies Pfahler's dictum of always advising a complete examination of the gastro-intestinal tract.

Radiologically the findings are variable. Some of the more recent cases and younger patients showed presence of hyper-peristalsis, although the youngest patient had a six-hour gastric residue, which was found in only two cases. Two had duodenal defects, which were due to agglutination of the adjoining portions of the first and second portions of the duodenum.

The significant observation is an elongated or dilated caput fairly well defined and quite regular in outline, with a moderate degree of fixation at the junction of the first and second portions of the duodenum.

CONCLUSIONS

1. Symptomatically; cholecystitis; duodenal or gastric ulcers or chronic appendicitis may be simulated.
2. Symptoms are usually of long duration.
3. An elongated or enlarged caput is significant.
4. An elongated or enlarged caput without symptoms should be considered negative.
5. Symptoms without an elongated caput should be considered negative.
6. Symptoms plus elongated or distented caput, fairly well defined and regular in outline is quite diagnostic.

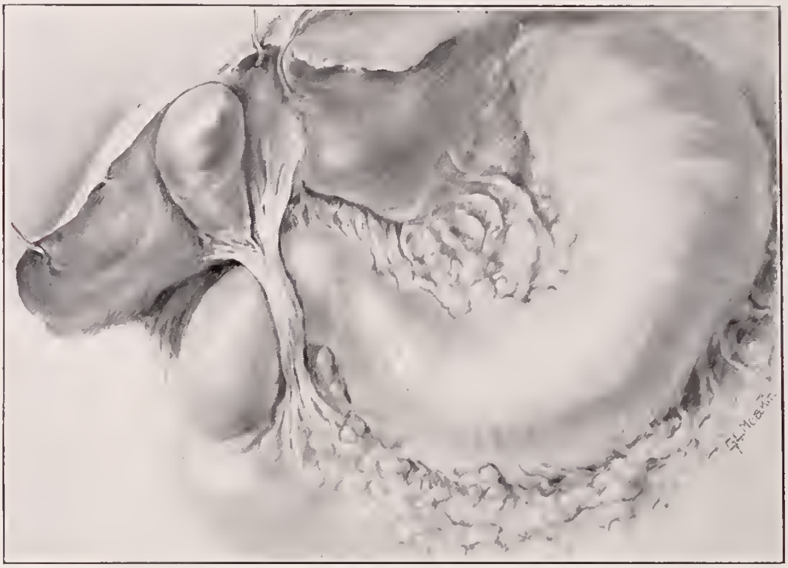

Plate No. 1. Modification of Original Sketch. Made by Dr. M. L. Harris, showing peritoneal band passing over the duodenum.

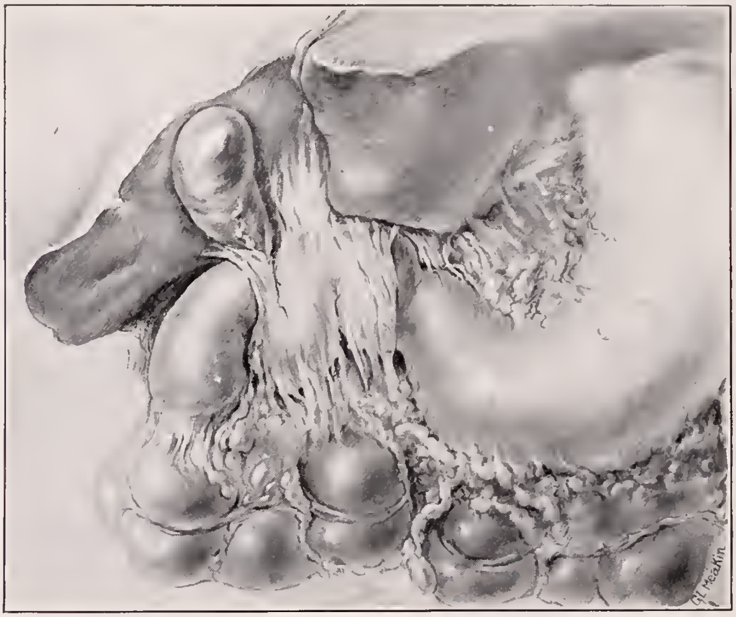

Plate No. 2. Modification of Original Sketch. Made by Dr. M. L. Harris, showing peritoneal band passing over the duodenum, with a reduplication of the latter.

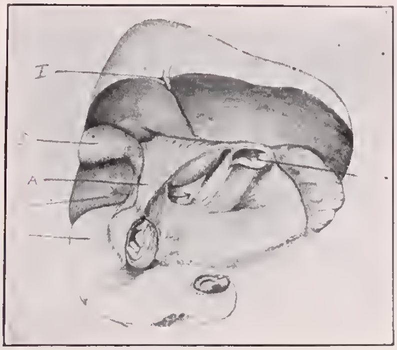

PLATE No. 3

PLATE No. 3. Hepatoduodenal Ligament (from Huntington's "Anatomy of the Peritoneum and Abdomen").
A, Hepato-duodenal Ligament;
B, Duodenum;
C. Cardia;
D, Gall Bladder;
I, Round Ligament;
F, Arrow Passing through the Foramen of Winslow.

PLATE No. 4

PLATE No. 5

PLATE No. 4. Normal Cap of Fish-hook Type of Stomach.
PLATE No. 5. Distorted Cap Due to Peri-Cholecystitic Adhesions.

Plate No. 6

Plate No. 6. Arrow heads show an anomalous duodenum, with distinct peristaltic waves similar to those seen in stomach. This was suspected as being due to, or associated with, a transduodenal band. A completion of the examination determined appendiceal involvement. Relief of symptoms followed appendectomy. No transduodenal bands were present.

PLATE No. 7

PLATE No. 7. Arrow heads show elongated cap. Transduodenal band found.

PLATE No. 8

PLATE No. 8. Arrow heads No. 1 show elongated cap. Arrows No. 2 show co-existing Haudeck's niche.

PLATE NO. 9

PLATE NO. 9. Elongated cap. Transduodenal band present.

PLATE No. 10

PLATE No. 10. Mate to No. 9. Six hours post cibum.

Plate No. 11

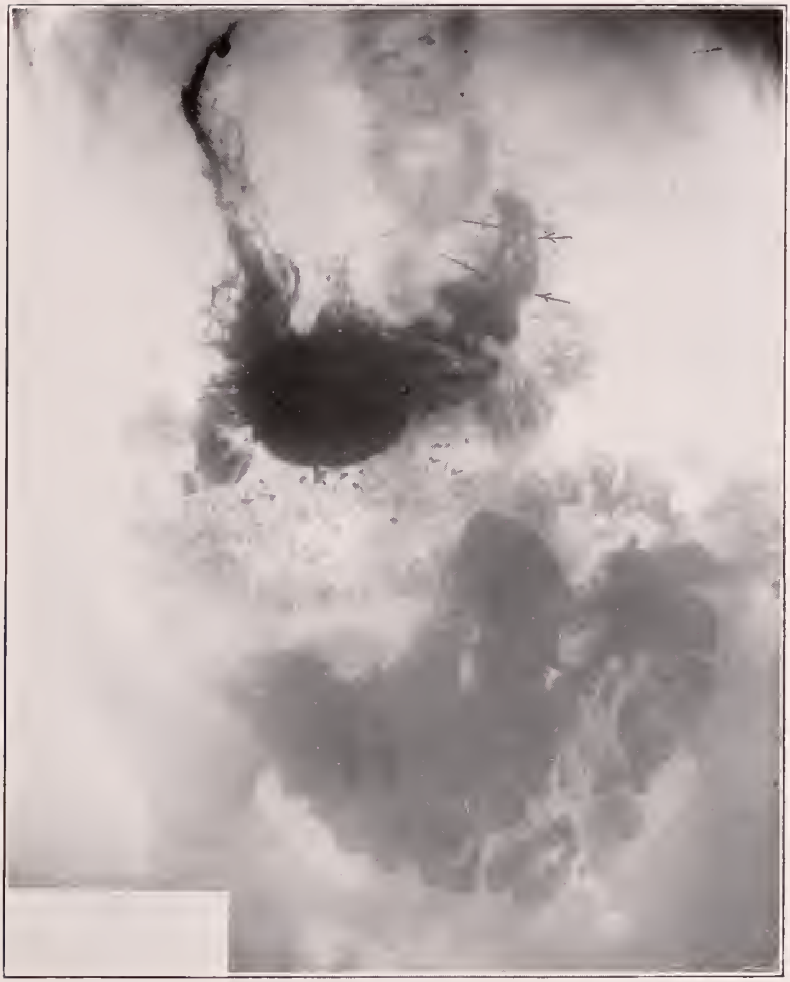

Plate No. 12

Plate No. 12. Mate to No. 11. Four hours post cibum.

PLATE NO. 13

PLATE NO. 13. Elongated cap. Six hours post cibum.

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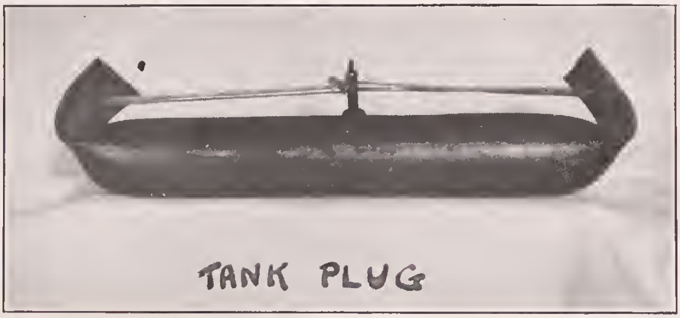
25 EAST WASHINGTON ST.

DEVELOPING TANK STOPPER

I. S. Trostler, M. D.
Chicago, Ill.

A very satisfactory and highly efficient plug or stopper for the top of developing tank may be made of a piece of rubber inner tube. This should be the size of the cross diameter of the tank, and about six or eight inches longer than the long diameter of the top of the tank.

Have a small (bicycle) valve fitted into the middle of this



tube and the ends sealed and carefully vulcanized so that the two ends of the airspace so made will be square and about ⅛ inch longer than the long diameter of the tank opening.

Inflate this short balloon with a small pump until snugly full and the stopper is complete.

If this plug is forced down into inside of tank to the level of the fluid an almost airtight seal is made. By its use I am always able to use the developer so preserved until the chemicals are exhausted. The solution does not oxidize and become dark colored as before using this stopper.

I have passed a loop of twine through the ends of the vulcanized parts of the plug so as to hold these ends at or nearly at a right angle with the hollow part of the tube (see accompanying photo).

615 Garfield Ave.

Case Reports

SEVERE COMPOUND COMMINUTED FRACTURE OF HUMERUS

J. Frederick Harvey, B. Sc., M. D.
Formerly Captain R. A. M. C. (Eng.)
Chicago

Private A. was wounded April 11, 1917, at Arras, France, by a shell which struck his right arm, producing a severe compound comminuted fracture of the humerus.

April 27, 1917. On this date, the patient was admitted to a Base Hospital in England. The wounds had been excised and drained. The arm and forearm were edematous, very inflamed, and a large quantity of pus draining from the wounds.

May 4th. Fig. I. The right arm was radiographed. The *x-ray* shows about eighteen or twenty detached and partially loosened fragments of bone which are irregularly distributed in the tissues of the middle third of the arm. A distance of three and one-half inches intervened between the proximal and distal portion of the shaft of the humerus which was not fractured. This intervening space was filled in by the loosened fragments of bone as shown by the *x*-ray. Many particles of metal can be observed distributed in the traumatised tissues. Extension was maintained by a modified Thomas splint for fractures of the humerus. Carrel Dakin irrigation was carried out.

Fig. II. August 2nd, 1917. The *x*-ray at this date shows considerable bone formation between the fragments of bone extending to and including the proximal and distal fractured ends of the humerus. The small rubber drainage tubes are shown in position.

Fig. III. August 31st, 1917. At this period there is still further evidence of osseous union between the several fragments of bone and the shaft of the humerus.

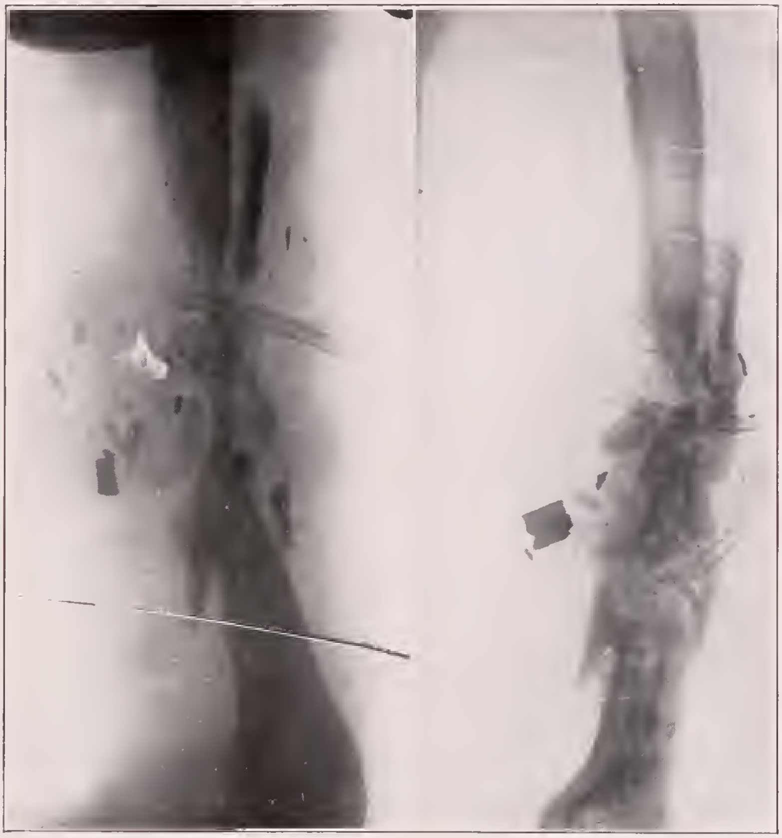


Fig. I Fig. II

Fig. IV. December 7th, 1917. The x-ray at this time shows a fair amount of callous and strong union of the fragments to each other and to the shaft of the humerus. The large foreign body has been removed but no attempt was made to remove the minute particles of metal. There is evidence of the formation of several small sequestrae.

Fig. V. March 4th, 1918. The x-ray at this date shows firm union of the fracture and the formation of sequestrae which are clearly defined. These sequestrae were removed a few days later.

Fig. VI. July 17th, 1918. The x-ray shows a very strong union of the comminuted bone with very little excessive callous formation. Note the general alignment is good and

Fig. III

Fig. IV

the excellent condition of the elbow joint. There is evidence of a small particle of dead bone. This sequestrum was removed a few days later, the very slight degree of discharge which existed at that time ceased and the wound healed rapidly.

It is evident that infection existed throughout the entire course of treatment of this case and the repair, as shown by the several illustrations, of an extensive compound comminuted fracture after fifteen months of treatment is re-

Fig. V

Fig. VI

ported to show that sepsis does not prevent bone formation. In many cases a slight degree of bone infection apparently stimulates osteoblastic activity.

ROENTGEN TREATMENT OF SARCOMA

WALTER A. SMITH, M. D.
Keokuk, Iowa

Foreword — The following contribution to today's program appears under the caption, "Roentgen Treatment of Sarcoma",* which is more or less misleading, as our own experience in this line of work is limited to a single case, which is still under treatment, a report of which, it appeared to us, might be of interest.

The purpose of reporting this case is twofold:

First. To impress on you the importance of being suspicious of sarcoma in all cases in the very young, giving a history of pain, swelling, and limited function, without injury, especially in the extremities, and to urge upon you the use of the *x*-ray in the diagnosis of these cases, before prescribing for a sprain, strain, tuberculosis, rheumatism, etc.

Second. To bring out suggestions through discussion by those who may have experience with this condition.

Dr. Bundy Allen, of Iowa City, reports a case very similar to ours, in the JOURNAL OF ROENTGENOLOGY for August, 1918. I will mention here one difference, which the prints plainly show: that the upper portion of the humerus was, in our case, entirely destroyed, save the articular surface of the head; while in Doctor Allen's case the distorted outline of the bone still shows.

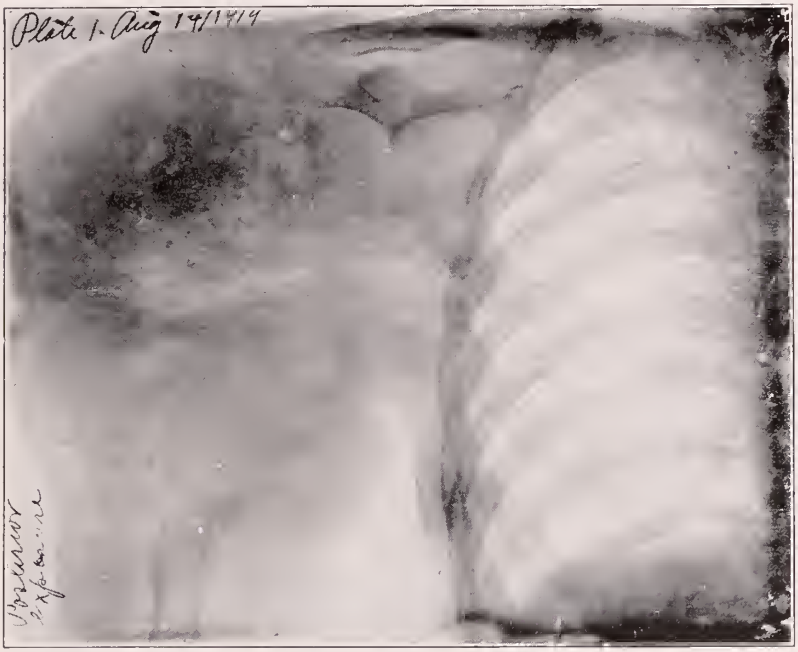
Patient—A boy of twelve; referred by Dr. H. A. Gray for examination and treatment, August 14, 1919.

There was a history of pain in the right shoulder, beginning in December, 1918, attributed to kind of work he had been doing (husking corn). As it did not improve after a

*Read before Lee County Medical Society at Ft. Madison, December 4, 1919.

month, a physician was consulted, who also took the condition to be nothing serious, and treated locally by counter-irritation, hyperemia, etc.

The pain was never severe, but was constant. In February, 1919, the arm near the shoulder began to enlarge and



continued to do so until the roentgen treatments were started, at which time the acromio-axillary circumference was $16\frac{1}{4}$ inches. (Plate one.)

The patient weighed $72\frac{1}{2}$ pounds; color, ashy; expression pinched.

Treatment was started at once, and continued at semi-weekly intervals until recently, using the intensive crossfire method. Up to this date (December 4) the patient has received in twenty-one treatments 1020 milliampere minutes.

At the time of the ninth treatment (September 14, 1919) the circumference at the same point as first taken was 12 inches (Second plate) and still remains at that. At this time, we suggested that the patient return to Doctor Gray for surgical treatment, but this was refused. The other arm measures 10½ inches. There is shortening of two inches and no true articulation with the scapula, and while there is apparently a false joint between the proximal and

distal involucræ, there is no motion at this point (Plate three) and there is a strong probability of later ossification, and the function is almost normal, the patient doing all kinds of work on the farm, even chopping without any noticeable inconvenience. Now weighs ninety pounds, looks vigorous and healthy. In addition to the roentgen treatment the patient received one cc. of sodium cacodylate at each call for the first six weeks.

The local application of the rays to the arm have practically been stopped; but we are still giving about 40 milliampere minutes at intervals of fourteen days, to lungs, liver, and cranium, with a view to preventing recurrence,

if possible. We will add that any surgical treatment is refused by the parents. We will be pleased to report further on this case, at a time when we can know the outcome.

We invite any suggestion or criticism, as to the handling of the case, for both will be of help.

MASONIC TEMPLE.

Abstracts

Drs. J. H. Means and J. C. Aub, Boston. The Basal Metabolism in Exophthalmic Goiter. *Archives Internal Medicine*, December 15, 1919.

"Using the basal metabolism as an index of toxicity in exophthalmic goiter, we have found that:

1. In the majority of cases, the results after two or three years are equally good with roentgen ray treatment or with surgery.

2. After surgery the metabolism shows a rapid preliminary fall, a secondary rise followed by a final fall; and that with roentgen treatment there is a gradual and progressive fall.

3. In securing the same end results with surgery or with the roentgen ray, a lesser rest factor is necessary with the roentgen ray. With the roentgen ray there is practically no mortality. With surgery there is a definite mortality.

4. Patients treated surgically do better, and the risk of operation is less, if they have previously had irradiation of the thymus and thyroid.

5. The risk of operation is greater and the need for preoperative roentgen treatment is greater in cases with a very high metabolism and moderate tachycardia than in those with an extreme tachycardia and moderate metabolism elevation.

6. The safest program for the treatment of exophthalmic goiter, as a whole, is the routine irradiation of thyroid and thymus glands in all cases, with surgery held in reserve for patients who then do not get well.

7. Surgery is contraindicated with patients whose metabolism is rising in spite of complete rest in bed, and also with patients of the type with moderate tachycardia and great metabolic increase, except when they have previously had thyroid and thymus glands treated by the roentgen ray.

8. Finally, we believe that in the management of exophthalmic goiter, periodic determination of the basal metabolism should be quite as much a routine as in the examination of the urine for sugar in diabetes mellitus. Further, that in borderline cases the basal metabolism furnishes very valuable aid in differential diagnosis."

This report is based on 345 metabolism estimations, 130 patients, Massachusetts General Hospital. Roentgenologists doing the work: Dr. G. W. Holmes, Dr. A. S. Merrill. Surgeon: Dr. C. O. Porter.

Medicine most used in medical treatment is hydrobromide of quinine, with rest.

Rest was also employed in the surgical treatment, and in some of the roentgenized cases.

Roentgen Ray Therapy and Surgery Compared

In the third year after treatment was established the end results were the same. In roentgen ray the improvement was gradual but progressive; with the surgical group there was a sudden marked improvement and a subsequent relapse. The factor of rest was distinctly greater in the surgical group than in the roentgen ray group, yet no more ultimate benefit was apparently secured. Moreover, when the roentgen ray treatment was begun the roentgen ray group had more of an increase in metabolism: 65 per cent, and surgery but 46 per cent. All the surgical cases were resting; only a few of the roentgen cases rested. The roentgen ray group were composed of the more severe type.

The chance of cure in exophthalmic goiter is as good with roentgen ray treatment as with surgery in groups of equal toxicity. That being true, the former method is preferable, the danger of fatal outcome being less. Of the nine known deaths, five were surgical, three due to unknown causes, and one after roentgen ray treatment. Average duration of cases in roentgen ray group, 5½ years. Average duration of cases in surgical group, 3¼ years.

George W. Holmes and Adelbert S. Merrill. The Treatment of Thyrotoxicosis by Roentgen Ray. *Journal of the*

American Medical Association, November 29, 1919, p. 1693 or 73.

In 1905 roentgen treatment of thyrotoxicosis was first recommended. In 1916 Pfahler was able to collect 76 papers on the subject.

During the past five years 262 cases have been treated by roentgen ray in the Massachusetts General Hospital. These may be arranged in four groups:

1. Those clinically well as result of treatment, 34.
2. Those definitely improved, but still showing evidence of etiology, 68.
3. Those who did not change nor become worse, 14.
4. Those with complete data at hand, and after sufficient time had elapsed to form an opinion of the final results, 36.

Not included because of insufficient data, 133.

Method: Coolidge tube, interrupterless machine, distance gap, 8 inches, 4 mm. al. 1 mm. leather, D—8 in. 3 areas, 2-3 erythema dose.

Thymus area as well as thyroid area.

Three treatments 3 weeks apart in a series; 2 or 3 series with 3-month intervals between, according to relief afforded.

Observation period—1½ years.

Dangers:

1. Hypothyroidism.
2. Telangiectasis and atrophy.
3. Toxemia.

Diagnosis of Type of Goiter:

Colloidal or simple.

Cystic.

Toxic goiter.

Only the toxic should be treated.

Comparison of Guy's Hospital, London, where no treatment was used in:

87 cases
61 cured
21 decidedly improved
5 unimproved

Stanton quotes 60 to 70 per cent of spontaneous cures after five or six years. This shows that the percentage of cures must be high or relief quick for any method to be of benefit.

Selection of Patient

Careful diagnosis means success or failure.

After two or three treatments, patients improve.

After one year, size diminishes.

Exophthalmos never entirely disappears.

Rest is a valuable adjunct.

In six months patient may resume occupation.

Relief from symptoms is not as quick as following surgery, but the mortality rate is less.

Adhesions do not occur to interfere with any surgery that may follow.

Summary

1. It is possible to decrease the activity of the thyroid and probably destroy the gland.

2. Roentgen ray relieves symptoms and shortens course of disease.

3. The study of basal metabolism is of great importance before and after and as a check on diagnosis.

4. Roentgen ray, accompanied by rest, should be tried in all cases of thyrotoxicosis, to destroy at least the thymus before resorting to surgery.

E. A. Park and R. D. McClure. Results of Thymus Extirpation in Dog. Review of Experimental Literature on Thymus Extirpation. *American Journal, Diseases of Children,* November 19, 1919, p. 317. See editorial on "Thymus Function," commenting on above, in *Journal of the American Medical Association*, November 29, 1919, p. 1700.

Extracts are the same as from other cellular organs.

The literature on experimental extirpation is vague. Park and McClure (Johns Hopkins University) are convinced that thymus function is absolutely unessential to life. They find that extirpation produces

1. No detectable alteration in the hair, teeth, contour of the body, muscular development, strength, activity or intelligence of the experimental animal.

2. No alteration in internal secretions. Growth and development are not influenced.

Hoskins contends that no proof has been furnished to place thymus with the glands of internal secretions.

3. The thymus is absolutely unessential to life.

4. Changes heretofore attributed to extirpation are due to confinement of animals.

5. They have failed to affirm claims of any experiments showing that the gland functionates.

W. F. Braasch and F. A. Olson. Radiographic Diagnosis in Renal Tuberculosis. *Collected Papers, Mayo Clinic.* 1918, Vol. X, p. 269.

Rule to make complete roentgen examination in all cases of suspected tuberculosis of kidney.

One out of five patients has positive roentgen data of definite diagnostic value indicated as follows:

1. When bladder or ureter prevents cystoscopy.

2. When cystoscopic findings are not typical of renal tuberculosis.

3. When clinical findings are not suggestive of renal tuberculosis or any involvement of urinary tract, as in closed tuberculosis pyonephrosis.

4. In presence of bilateral renal tuberculosis, when the typical shadows frequently render cystoscopy or further examination unnecessary.

The roentgenographic shadows are caused by the deposit of calcium, differentiated from stone by

1. Variableness in density.

2. Less density than stone.

3. Irregular and indefinite outline. Often may not be differentiated.

Seventy-five per cent of the tuberculosis shadows may be recognized. Size of shadow does not indicate extent of tuberculosis lesion. Most striking shadows occur in cases of complete caseation. May be differentiated by—

1. Renal stone. Actual difficulty of renal stone is rare;

if present is phosphatic. Stone in opposite kidney is also rare; only two cases known.

2. Extra renal shadows. Gall stones. Mesentery and glandular areas.

3. Ureteral shadows: Generally low. Caseation of kidney may be also present. Ureteral and periureteral shadows must be differentiated. Those outside usually give no corroborating evidence of tuberculosis. Otherwise are characteristic in themselves.

4. Calcareous deposits in prostate secondary to tuberculosis in kidney. Clinical findings will differentiate.

Renal outline: Interpretation not of much value. Errors great.

Bilateral involvement: If found in both kidneys, further cystoscopic and clinical investigation unnecessary. It may be bilateral, yet one may be unilateral so far as the roentgen ray goes.

Pyelography

This also aids in differentiating tuberculous kidney. In tuberculosis the typical findings are:

1. Irregular, inflamed ureter. Dilatation of pelvis.
2. Areas of cortical necrosis.
3. Stricture in ureter.

Conclusions

1. Value of roentgen ray in renal tuberculosis not fully appreciated.
2. Routine roentgen examination in every case advisable.
3. Shadows are seen in 20% of patients with renal tuberculosis.
4. Positive evidence may be obtained when all else fails.
5. The shadows resulting are characteristic.
6. Caseated areas in ureter and prostate may be outlined.
7. Pyelography is occasionally valuable in (a) identification of renal infections of doubtful nature; and (b) identification of doubtful shadows in renal area.
8. Cystograms may aid.

E. H. Weld. The Use of Sodium Bromide in Radiography. *Collected Papers, Mayo Clinic*, 1918, Vol. X, p. 963.

Well Known Opaque Media

1. Bismuth.
2. Colloidal silver salts (collargol, argyrol, electroargol, cargentos).
3. Silver iodide.
4. Thorium nitrite.

All these, according to Braasch, cause irritation, and even abscesses when used experimentally.

Thorium nitrite 15% caused the least. Until recently this was considered the best.

Ideal

Non-toxic, non-irritating, easily soluble in urine, and reasonable in cost.

Bromide: Smears over ureters, minor calices, and saccules of an inflamed bladder better than thorium.

Relative cost: Sodium bromide, 75 cents per pound; Thorium, $2.50 per pound.

Animal experiment: Macroscopically or microscopically it did not show any irritation. In 12 to 25 per cent no injurious effects were seen.

Sodium Bromide

1. Strength, 25 per cent.
2. Bland—does not damage kidney.
3. Outlines pelvis and ureter better than any other.
4. Less irritating to pelvic and vesical mucosa.
5. Easily prepared. Sterilized by boiling.

G. B. New. Value of Radium in Treatment of Neoplasms of Nose, Throat and Mouth. *Mayo Clinics,* 1918, Vol. X, p. 805.

Use heat and radium in cancer.

Cancer of the jaw and cheek are the most malignant, exceeded only by melano epithelioma. Syphilis, leucoplakia and irritations are the causes.

57 cases cancer in 1917 at the Mayo clinic.
32 cases inoperable.
4 cases had gland involvement and were operated.
21 cases had no gland involvement: treated by cautery and radium.

Treatment

Slow heat—soldering irons.
Water-cooled speculum.
Be watchful of hemorrhage.
In two weeks sloughs occur.
Radium is then introduced.

Results

21 patients treated.
20 traced.
14 free in 6 to 18 months; no local recurrence.
2 had recurrence of glands in neck. Operated.
12 cases showed no local or metastatic recurrence.
No operative mortality.

Radium has a distinctive place in treatment; applied on disc or tube. Placed over tumors or in them. Antra, may be opened. Used in all cases treated first by surgery, and in inoperable cases.

211 cases in 1917-1918: Nose 16, nasopharynx 14, antrum 15, pharynx 10, larynx 41, jaws and cheek 55, palate 7, tongue 24, upper lip 27, lower lip (angiomas) 2.

Lymphosarcomas yield first to treatment.

Epitheliomas of tonsils are very hard to check.

Squamous-celled epitheliomas of the larynx are fatal.

Lip or epithelioma of lip should not be treated by radium; danger of metastoses in neck is 50 per cent.

Results: Encouraging. Years of relief; no mortality. Number cured may be small, as it is too soon to have definite results. Number given months or years of relief is large.

R. D. Carmen. Radiologic Aspects of Hour-glass Stomach. *Mayo Clinic*, 1918, Vol. X, p. 44.

Hour-glass stomach is not a disease entity, but the roentgen knowledge accumulated makes it a most interesting subject for study. The varieties admitted the following classification:

A. Congenital.

B. Acquired.

1. Organic: constriction due to structural changes in or about the stomach. Causes: Ulcer, scar of healed ulcer, perigastric adhesions, cancer, syphilis, corrosive chemicals, resection, gastrostomy, enterostomy, congenital(?).

2. Spasmodic (or functional) cramp of gastric muscle without structural change.

(a) Intrinsic: cramp directly produced by lesion in the stomach causes the same conditions as those of organic hour-glass.

(b) Extrinsic: Cramp indirectly produced by those outside the stomach—duodenal ulcer, gall bladder, disease of appendix, neuroses, tabes, lead intoxication, morphine, nicotine.

(c) Pseudo hour-glass, simulating the hour-glass without either spasm or structural change in the stomach. Causes—contraction of abdominal muscles, pressure of stomach against spine, tumors outside the stomach, atonic stomach, gas and fecal matter in bowel.

The possibility of congenital hour-glass stomach is admitted, but the writer questions most cases.

The roentgenograms show much deeper constrictions than are seen at operation, due to the fact that the organic narrowing is exaggerated by spasm.

The causes of spasmodic hour-glass are not seen by the surgeon at operation because they are relaxed by narcosis. Therefore, if the hour-glass is the only roentgen sign present, the first thing to do is to exclude extrinsic causes.

Belladonna or atropin does not differentiate between organic and intrinsic types of hour-glass stomach.

Belladonna or atropin, to a physiologic degree, will differentiate between the intrinsic and extrinsic types of spasmodic hour-glass stomach.

The main causes of hour-glass stomach occur about as follows, with gastric ulcer accounting for the greater number:

1. Gastric ulcer.
2. Syphilis.
3. Gastric cancer.
4. Tuberculosis.
5. Following operation on stomach.
6. Corrosive chemicals.
7. Perigastric inflammatory processes.

Physical signs have been compiled by Moynihan. The number shows the possibilities of certain phenomena arising.

The syphilitic ulcer is thought by Dewis to be characteristic. It presents a long, narrow isthmus from which the walls rise abruptly, dumb-bell like. Le Wald also comments on the similarity. But the roentgenologist's first thought that the cause is syphilis arises from the clinical facts and not the roentgen findings. The roentgen interpretation must be confirmed by the history and clinical evidence of lues.

Spastic contraction is associated less frequently with gastric cancer than with gastric ulcer.

Spasmodic hour-glass contraction, associated with conditions outside the stomach, is the most difficult piece of differential diagnosis. Belladonna to the physiological degree will differentiate all of the extrinsic forms except that of duodenal ulcer. These may occur concomitantly. In every case of suspected hour-glass stomach, duodenal ulcer must be excluded.

Cancer gives little trouble. Close inspection will show the irregular edges, and the general picture will leave little doubt.

The use of belladonna, 20 drops at a dose, repeated until there is dryness of the throat and pupillary dilatation, is sufficient. Atropin may be used. Conflicting opinions have not changed the use nor confidence in the use of belladonna or atropin.

J. Delpratt Harris. The Treatment of Uterine Fibroids. *The British Medical Journal*, September 20, 1919, p. 376.

The roentgen treatment of uterine fibroids, especially if bleeding is on a firm basis, is recommended. For intramural fibroids it is the method of choice; for intrauterine fibroids the effect is less marked. In subperitoneal fibroids it is least effective. He uses, with some latitude, the method of Prof. Bordier of Lyons. In this method the treatment is by cycles, first one ovary, then the other, followed by a treatment over the uterus itself. This is repeated three times, making nine in each series. Three to six series, twenty-one days apart, are employed. He cites eighteen cases he has treated with uniformly good results and no known recurrence. The cases have been followed for three or four years.

Dr. Harris prefers this method to that advocated by Guos in the Freiburg Clinic—that is, massive doses through many portals of entry.

G. B. Eusterman, M. D. Syphilis of the Stomach. *Medical Clinics of North America*, 1919, Vol. III, 3, p. 669.

A careful, detailed case history and elaborate discussion of the subject makes up most of the paper. The criteria for roentgen diagnosis are:

1. Positive Wassermann reactions.
2. Evidence of syphilis elsewhere in the body.
3. Demonstration of a lesion in the stomach by *x*-ray.
4. Improvement following therapeusis.

The roentgen findings presented simulate gastric cancer. Obstruction at the pylorus, filling defect, and food residue in six hours were present in roentgen examination.

This case was followed sixteen months and the anatomical restitution observed roentgenologically. The presence of the above factors made the decision possible. Besides, the patient had an acid gastric juice which never occurs at this age in cancer.

Niches, incisura, and accessory pockets are absent or less marked, due to the pathological infiltration which gives shallow depth and a lack of circumscription.

R. D. Carmen. A Review of Roentgenology of Syphilis. *Mayo Clinics*, 1918, Vol. X, p. 616.

Syphilis of the Bones

Syphilis is essentially an inflammation of the periosteum alone, or of the periosteum and the bone itself.

Difference between syphilis and tuberculosis—tuberculosis originates in the epiphysis. In tuberculosis periosteal thickening is absent. In syphilis it is double plus. Tuberculosis destroys the bone. Syphilis causes bone incision. Swelling is due to soft parts in tuberculosis, to bone enlargement in syphilis. Sinuses are common in tuberculosis, in syphilis rare.

Syphilis periostitis or Gummatous Periostitis

1. Irregular contour of periosteum.
2. Moth-eaten if periosteum destroyed.
3. Sclerosis of bone accompaniment.
4. Anterior surface of tibia shows saw-like protrusion (scabbard shape).

Hereditary Syphilis

1. If any bones are affected, the tibia will be.
2. Typical—lobar-shaped tibia.

Syphilis of Joint

1. Most characteristic point:
   (a) Thickening of periosteum.
   (b) Outline not blurred but distinct.
   (c) Osteitis or sclerosis.
   (d) Sharply cut, distinct areas of necrosis.
2. Clean-cut joints:
   (a) Early signs not characteristic.
   (b) Proliferating and destructive processes side by side.
   (c) Fluid—subluxations—pathological frac.—debris.

Charcot Joint

1. Atrophy of articular cartilages.
2. Irregular destruction of bone.
3. Irregular hyperplasia of bone.
4. Detached bone masses and detritus.
5. Translucent areas.

Conclusions

1. With rare exceptions, tabetic osteoarthropathies may be diagnosed by roentgen ray alone.
2. Only by rays can detailed knowledge of joints be determined.
3. Roentgen rays show tabetic joint lesions when clinical signs are negative.
4. Joints of tabetics should be examined by x-ray.
5. All joint lesions should be rayed.

Syphilis of Aorta

Better use roentgen ray for control of diagnosis by clinical methods.

All of the aorta is visible except root and lesser curve.

Signs: Diffuse dilatation; certain part bulges; greater width; greater density; aneurysms make up one-fifth of the cases.

Syphilis of Lungs

Correlation with clinical and laboratory findings gives great aid.

1. Extensive distortion due to infiltration and contraction.
2. Not ill in proportion to findings.
3. Infrequent six-hour residue. Obscure cases should be treated for syphilis.
4. Diminished size.
5. Filling defect on greater curvature.

F. E. Diemer and J. H. Cramer. Roentgenological Determination of Pulmonary Tuberculosis. *American Journal of Medical Science*, 1919, Vol. 68, p. 871.

This is a roentgen study based upon 600 cases examined by the roentgen ray, 300 checked by clinical and physical findings, and a small percentage by laboratory findings. The work was done at Camp Lewis, Washington.

The Coolidge tube will not make a diagnostic chest: the gas tube is necessary.

Calcified areas in the lower quadrants mean primary tubercles.

Calcified areas in the upper quadrants mean quiescent, inactive, or chronic active tuberculosis.

Activity is described thus:

"Dense areas, undoubtedly lime salts, that are not discrete and where borders are not clear-cut, but blend gradually with the surrounding tissue, particularly if the center presents a delicate mottling (suggesting that connective tissue remains intact), indicate that the process is active and that the caseation area has not become completely calcified."

Many pathological conditions involve the lower quadrants, but few the upper.

Conclusions as to advantages of roentgen study:

1. Definite determination of tuberculosis is possible in all stages by roentgen study.
2. The stage of cavitation is easily determined.
3. There are distinct pathognomonic indications of pulmonary tuberculosis.
4. Exact involvement is more readily determined by roentgen study.

The value of roentgen study varies in different stages and forms of the disease. A minute description is given of the following:

1. The incipient stage, with the definite but hazy peribronchial infiltration. Determination is as early as by clinical methods. Often the cortical involvement and pathways to hilus and lower quadrants can be seen. In the cortical type the clinical symptoms are exaggerated. In broncho-pneumonic tuberculosis the reverse is true.
2. Chronic tuberculosis—roentgen study is of greater value. Indications are almost pathognomonic.

3. Caseation begins late and is difficult to determine.

4. Cavities—acute ones present; almost no distinct wall or capsule. Irregular in shape. The subacute and chronic types become more regular and present a capsule in density equal to the development. The earlier ones are less dense; the older, even calcified. Drainage sinuses are sharply defined. Healed ones are very sharply outlined and distinct. Empty sematous cavities are not sharply outlined, but follow the bronchioles in form and shape. Cavities may arise from them.

5. Peribronchial type of tuberculosis—parenchyma is not involved. Determination depends on the fuzzy outline of the bronchii and a delicate mottled appearance.

6. Massive hilus tuberculosis: Its existence can only be guessed, and the clinician is just as well off.

7. Disseminated type: In this there is nothing definite unless healing has taken place. Then it is widely distributed, and only calcification or late healing makes it visible.

8. Two varieties at once. An acute parenchymous may be grafted upon a chronic fibrous process.

The Pathognomonic Indications

These are more noticeable to the uninitiated.

1. Calcified deposits in the upper quadrants: not necessarily active.

2. Cavities—which usually mean activity.

Tuberculous cavities or abscesses are upper-quadrant in location. If watched for a few days, a fluid level and air space fills.

A non-tuberculous cavity tends to heal if adequate drainage is established. It is seldom empty.

A tuberculous cavity does not tend to heal, and is usually empty.

Other tuberculous findings, less distinct, are:

1. Fibrosis.
2. Retroaction of the trachea and mediastinal viscera.
3. Lack of illumination of upper quadrants.
4. Less radiobility, giving uniform or delicately mottled areas.

5. Dropped heart, with something in the upper chest.
6. Lagging diaphragm.

Roentgen study is indispensable in artificial pneumothorax.

H. C. Bumpus, M. D. Radium Therapy in Cancer of the Prostate. *Medical Clinics of North America*, 1919, Vol. III-3, p. 707.

The author uses four needles of a combined strength of 50 mg. of radium. These are inserted through the perineum, two on each side of the midline, and allowed to remain in the gland twelve hours. Local anesthesia is employed, to obtain which special attention must be paid to the pudic nerve. An opium and belladonna suppository is placed in the rectum, and in twelve hours a dosage of 600 mg. hours are administered. After local irritation has subsided the prostate is treated through the rectum by a special device which holds the radium in position and screens the beta rays. The patient can move around in bed. If possible the prostatic urethra is also treated. The gland receives, all told, about 1,000 mg. hours.

16 cases treated in the clinic in 1916.
12 have been traced.
3 are living.
1 died in the first year.
3 died in the second year.
4 died in the third year.
1 died in the fourth year.

Average life expectancy, 26 months.

Average dosage in two series of treatments, 1000 each.

1,000 mg. hours were given over a period of one month, 100 being the greatest dosage at one time.

In 8 of the 16 cases the glands were examined subsequently.

In all but two, the gland had decreased in size.

Five noticed complete absence of rectal pain.

Five of the 16 voided urine more freely, and 7 reported marked improvement.

In 4 there was a rapid decline.

A much larger series has been treated since, but time is a necessary factor. The more recent cases are not ready for report.

These sixteen cases were treated by rectal application. The new method promises still better results.

Conclusions

1. Radium relieves the pain.
2. Radium reduces the size and delays growth.
3. Radium prolongs life in many cases, and cures a few.

E. W. Weld. Renal Absorption with Particular Reference to Pyelographic Mediums. *Medical Clinics of North America,* 1919, Vol. III-3, p. 713.

This is a study undertaken to determine, first, the effect of different substances used in pyelography on the kidney tissue, and second, the gradual development of a hydronephrosis as demonstrated by means of the *x*-ray.

Conclusions

1. It is not feasible to note gradual development of hydronephrosis by *x*-ray. The media are soon absorbed.

2. There does not seem to be any difference in the effect on the kidney tissue of retention of the soluble solutions used as pyelographic mediums—sodium bromide, potassium, and sodium iodid, or thorium nitrate.

3. Sodium bromide and sodium iodid are seemingly nontoxic when injected into a vein.

4. Thorium nitrate 15 per cent solution, as now put on the market, varies in toxicity. Some solutions tested have been very toxic.

5. Potassium iodide solutions are very toxic when injected into a vein.

6. The effect on the kidney tissue of a pyelographic medium retained in the kidney pelvis is most noted in the first hour after injection. Later the results are the same as would occur from the gradual development of a hydronephrosis from a ligated ureter. This is not true when silver salts or other invaluable mediums are used.

7. The soluble media, as sodium bromide, potassium and sodium iodide, and thorium nitrate, are not retained in the kidney pelvis more than one and one-half hours when the ureter is ligated, but are absorbed rapidly, apparently from the medullary portion of the kidney.

8. Hydronephrotic kidneys absorb from their sacs in inverse proportion to the size of the sac or the amount of kidney destruction. The kidney tissue first to be destroyed is the medullary portion.

9. Substances in the blood stream or the intestinal tract enter the pelvis of a kidney with a ligated ureter in inverse proportion to the size of the hydronephrosis that has developed.

10. Absorption takes place mainly through the medullary portion of the kidney. This is a rapid process.

11. Absorption from the kidney pelvis indicates that the kidney may be a focus of infection that should always be considered.

12. Unabsorbable mediums produce destruction of the kidney tissue and should therefore not be used.

13. There is danger of injecting media into the blood stream if too great a pressure is exerted. For this reason, non-toxic sterile mediums should be used.

14. Sodium bromide seems to be the most practical pyelographic medium thus far produced.

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