Staff Meeting Bulletin
Hospitals of the » » »
University of Minnesota

Body Section
Roentgenography

olume XIII Friday, November 21, 1941 Number 8

STAFF MEETING BULLETIN
HOSPITALS OF THE . . .
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Volume XIII | Friday, November 21, 1941 | Number 8

INDEX

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William A. O'Brien, M.D.

I. LAST WEEK

Date: November 14, 1941

Place: Recreation Room
Powell Hall

Time: 12:15 to 1:30 P.M.

Program: "Cor Pulmonale"
Phillip Hallock
L. G. Rigler

Discussion
H. S. Diehl
C. J. Watson
Maurice B. Visscher
John L. McKelvey
Phillip Hallock
L. G. Rigler

Present: 135

Gertrude Gunn,
Record Librarian

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II. ANNOUNCEMENTS

1. DEPARTMENT OF ANATOMY

The Anatomy Seminar will meet on Saturday, Nov. 22, at 11:30 a.m., room 226, Institute of Anatomy. Dr. Earl J. Boehme will speak on "Repair of ventral hernia with autogenous living fascia (lata)."

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2. SEMINAR IN PATHOLOGY

12:30 p.m., Monday, Nov. 24, 1941, Room 104, Institute of Anatomy.
Substitutes for blood.
Dr. A. J. Kremen.
Visitors welcome.

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3. CONTINUATION COURSE FOR PUBLIC HEALTH NURSES

Will be given at the Center for Continuation Study, January 8, 9, and 10, 1942. Program will be arranged for County Nurses and those engaged in Sanitorium field work. Tuition $5.00. Because of the large number of advance registrations for rooms for another course which will be given at the same time only a limited number of nurses can be accommodated at the Center. Arrangements have been made to house many in Sanford Hall. The county nurses are the vanguard of the Public Health movement in communities without full time public health officers. With nurses in schools and colleges and nurses engaged in special activities, such as the Indian Service, they carry on the public health program in cooperation with the local medical profession and the local health agencies.

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4. THE AMERICAN BOARD OF DERMATOLOGY

Is pleased to announce that Henry E. Michelson, director of the Division of Dermatology, has been made a member of the examining board. This recognition of the high plane which dermatology occupies in our group should be a matter of great personal satisfaction to all.

Last week our group had the pleasure of entertaining Professor M. Oppenheim, of the University of Chicago, who gave a special clinic and addressed the local academy meeting.

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5. SPECIAL FOOTBALL MEETING

Yesterday was Thanksgiving in Minnesota, and in the ordinary course of events we would be looking at the football pictures today. One more game must be played before we may have this pleasure. Accordingly, the Athletic Department will sponsor a special showing of the highlights of the 1941 football season at the next meeting of the general staff of the University of Minnesota Hospitals on Friday, November 28th, same time, same place as the regular scientific meeting. There will be no bulletin next week. . . .

BODY SECTION ROENTGENOGRAPHY

Kenneth Olson

The principle of body section roentgenography was first described by Bocage in 1921 in his application for a French patent on the idea. He believed that sagittal or coronal sections of the body could be projected on an x-ray film by moving the roentgen tube and film during the time of the film exposure. He devised, by theoretical means, three methods for building a machine to accomplish the projection of body planes. The three methods were: first, the tube and film move in parallel planes; second, the tube and film move in circles, squares, crosses or spirals; third, the tube and film move in concentric arcs about an axis. In all three methods, the tube and film must move in opposite directions to one another during the entire exposure.

Jean Kieffer, of Connecticut, in 1929, built the first usable apparatus called the "x-ray focusing machine." However, the first article reporting the use of section roentgenography on patients was written by Vallebona of Italy in 1930. His method, called stratigraphy, was first used in the examination of the skull. The patient, seated in a rocker, was rotated about an axis with the film and tube remaining stationary. Vallebona's method was certainly not satisfactory from the patient's point of view and like the third method of Bocage, did not give a true plane in focus, since the plane in focus shifts in relation to the planes of the tube and film surface. Another procedure was described in 1931 by Ziedses Des Plantes of Belgium and was termed planigraphy; here the tube and film move in parallel planes in opposite directions while the body being examined remains stationary. Then in 1935, Grossman and Chaoul of Germany advocated the method of tomography in which the tube and film move in a pendulum motion while the film surface remains parallel to the plane of focus. In 1938 Moore of St. Louis working with Kieffer proposed the method of laminography which is similar to planigraphy, but allows greater variations in technique. Thus, nine years elapsed between the time of the building of the first machine for body section roentgenography by Kieffer and the first formal report of its use in this country; at that time this method of roentgen examination had been used by European investigators for eight years.

Twining, in 1937, devised a simple apparatus attachable to a standard x-ray table based on the tomograph principle of motion. This was a great step forward, since the cost of the apparatus was very reasonable compared to the price of the machines previously developed and, consequently, resulted in a more general use of this type of roentgenography. The construction was so simple that many "home-made" outfits were patterned after Twining's apparatus using both the tomograph and planigraph methods. However, at present, all the cheaper machines are restricted to motion of the tube and film in a straight line, which gives a fairly satisfactory roentgenogram but not as good a one as that produced by the multiple motions of the more expensive apparatuses. All the machines, except one, built for body section roentgenography have been adapted to horizontal tables. The one exception an apparatus called the "Intraskop", made in Germany, permits vertical motion only but is exceedingly complex and expensive. No apparatus has yet been devised which will permit sectional roentgenography in both horizontal and vertical directions.

The use of various terms, stratigraphy, laminography, planigraphy and tomography, to describe a method of projecting body planes on an x-ray film has led to confusion. Since all methods have the same basic principle and differ only in the paths of the motion of the tube and film, Andrews has suggested that the general term, "body section roentgenography", be used to include all types. The use of the individual terms should be reserved for describing the use of a particular method.

Body section roentgenography is the clear projection of a true plane in a body on an x-ray film by means of blurring, partially or completely, the shadows of objects above and below the plane in focus. The image on the film consists of two parts, a sharp image and a blurred image.

The sharp image represents the plane in focus in the body being examined; the blurred image represents the tissues and the objects above and below the plane in focus. The average thickness of the plane in focus usually varies from about 0.3 mm. to 5.0 mm. and is inversely proportional to the amplitude of motion of the tube and film; in other words, if the amplitude is doubled, the thickness of this clear section is halved. Blurring really amounts to a spreading out of unwanted shadows so that small or fine densities are thinned out so much they become obliterated and the larger shadows are reduced materially in density. The more the path of motion is extended the more the blurring is increased and if there is no motion, there is no blurring. The farther the structures are away from the plane in focus, and the nearer the tissues and objects lie at right angles to the path of motion of the tube and film, the more effectively are they blurred.

In order to obtain body section roentgenograms, continuous motion of the tube and film in opposite directions with proportional velocities must be maintained during the entire exposure. The propelling force for motion may be manual or motor driven. The path of travel of the tube and and film may be of any design or form, and only one plane in the body being examined will be sharply in focus. The focal plane is at the level of the axis of motion. These paths of motion are usually classified as follows:

1. Rectilinear, i.e. in a straight line
2. Circular
3. Spiral
4. Sine
5. Combinations of the first four paths.

The type of the path of motion determines the character of the blurring. The rectilinear motion results in linear streaks of blurring, whereas the spiral motion produces a uniform blurring with no artefacts and a minimal amount of distortion. The spiral motion has proved to be the best of all the types of motion. It gives better roentgenograms and can be used to better advantage in the thicker parts of the body because of better blurring. The exposure time is longer due to the necessarily greater distance of travel to complete the parabolic spiral. However, this factor is of no importance in the majority of cases. If very thick sections are desired, circular or rectilinear motions give the best results. For thin sections and short exposure time, the rectilinear motion is preferable. In both of these situations the spiral motion is inferior.

At the University of Minnesota Hospitals we are utilizing a simple apparatus which permits rectilinear motion alone. This was made at nominal cost under the direction of Professor Koepke of the Department of Mechanical Engineering. Similar apparatus is now available commercially at a modest cost. An elaborate machine based on the design of Kieffer which permits all types of motion is also available commercially but is vastly more expensive. For most purposes simple linear motion is sufficient.

Our equipment is based upon the planigraphic principle wherein the tube and films move in parallel planes in opposite directions. The ratio of the distance from the tube to the plane in focus to the distance from the same plane to the film remains constant during the course of the movement. Therefore, all points in the plane in focus will be projected on the same points on the film even though the tube and film are in motion. All points of other planes than the plane in focus are projected at different points on the film surface during the time of motion resulting in a blurring of all points above and below the clear plane in focus on the film. The apparatus is attachable to one of the radiographic tables and consists of a rod connecting the tube holder with the film carriage and passes through an axis. The only fixed point of the rod is at the axis or fulcrum. The upper end of the connecting rod passes through a sleeve attached to the tube holder and the lower end of the rod passes through a sleeve attached to the film carriage. The mechanism of the axis through which the connecting rod passes is attached to the table top and is built so that the level of the axis or fulcrum of the system can be raised or lowered to a desired level from the table top. The axis is the pivot point of the system and the level of its [illegible] determines the plane that will be

projected in focus on the film. It is necessary that the film surface be parallel to that plane in the body of the patient that is to be examined. As an illustration of practical application: if a patient has a chest lesion five centimeters from the posterior skin surface, the patient should be placed on the roentgen table on his back, then the axis should be set at five centimeters from the table top. The plane in the patient's body, five centimeters from his back, including the area of disease, will then be projected on the roentgenogram as the plane in focus. Then exposures of planes two centimeters apart above and below the five centimeter level are made in the same manner. The motion of our apparatus is instituted by grasping the tube holder and pushing against it so that the motion is uniform throughout the exposure. By means of the connecting rod and axis the tube moves in the direction of the force and the film moves in the opposite direction. The velocities of the tube and film are proportional during the time of the motion. The motion is of the rectilinear or unidirectional type and is in a straight line in the direction of the long axis of the table; no variation of the direction or form of motion can be made with our apparatus.

Technique

The standard film should be taken first and the suspected lesion checked as to location and its distance from the nearest anterior or posterior skin surface. In order to obtain the best result, the anterior or posterior skin surface nearest the lesion should be next to the film. When the patient is in proper position, serial films are taken through the entire thickness of the lesion or suspected area. The sections of the chest are usually taken about two centimeters apart, but this distance may be less or more as desired. As a general rule the sections may be thicker and spaced further apart where no dense structure or object overlies in close approximation to the desired area of projection. In regions where dense structures or objects are in close apposition as in the temporomandibular joint, base of the skull, and other portions of the bony skeleton, the sections are made thinner and taken closer together, often being only a few millimeters apart. The thickness of the sections projected on the film is determined by the extent of the amplitude of motion of the tube and film and may be varied for each case, as desired. One of the serious objections to the use of this method is the large number of roentgenograms which must be made but the more one becomes familiar with the method the less the number of films which will be necessary for each case. If a specific lesion or an anatomical part is desired, measurements may be made on the usual postero-anterior and lateral views. Such measurements will permit sufficiently exact localization of the desired plane so that the number of films may be kept down to two or three. In the case of the lung, for example, body roentgenograms of various bronchi may be made with only two films each, providing the depth of the particular bronchus is known. If, however, a cavity is being sought within a diffuse area of density in the parenchyma, it may be necessary to make six or eight films before the exact plane is delineated. Stereoscopy can be used with this method of roentgenography but does not aid enough diagnostically to compensate for doubling the large number of films necessary. The factors for obtaining a good film are similar to those used in ordinary roentgenography except that the length of exposure may be slightly greater.

Value of Body Section Roentgenography

In hospital practice, the diagnostically difficult, the unusual and atypical lesions are not rare. It is common to search for a more detailed information about the type and character of a lesion in order to aid in its diagnosis or treatment.

Body section roentgenography is a method of giving information supplementary to that obtained by the various commonly used roentgenographic procedures. It is thus a special means for aiding in the interpretation, localization and uncovering of lesions. It has proved to be a

valuable method of roentgenography in a great majority of the cases in which it has been tried. However, like all other diagnostic methods in the practice of medicine, it also results in some failures due either to the character of the film produced or to the interpretation by the roentgenologist. A selection of cases and locations in the body for which this method can be used to advantage should be known in order to derive the greatest benefit from its use. A hard and fast rule cannot be made as to when or where it would be of value since there may be so many variable factors in the patient and in the character of the lesion but, with increasing experience with the method, one becomes more adept at recognizing its indications. An attempt will be made to demonstrate the value it has been to our department and to other roentgenologists as reported in the literature.

The greatest value of body section roentgenography is in its use in the respiratory system, especially the lungs. Inability to obtain in a roentgenogram all the information desired about a lesion in the lung may be attributed to various factors. The foremost difficulty is due to the fact that the lung area on the standard film has two-thirds of its surface covered by ribs. In addition, other bony structures such as the spine, sternum, scapulae and clavicles and certain soft tissues, such as the thymus, of greater density than the lungs, may, by superimposition, give misleading shadows, alter the appearance of even dense lesions, or mask lesions of slight density in the lung. Also, in the lung itself, there are numerous vessels and bronchi which may, by their position, have two or more branches crossing one another, and result in misleading shadows. These may resemble disease areas similar to early tuberculosis lesions or cavities. The shadows of overlapping normal structures are eliminated by body section roentgenography, since the tissues above and below the plane in focus are completely or partially eliminated. Thus, the ribs, spine and other normal structures do not interfere and show only when they are within the plane of focus. The anatomical relationships of pulmonary arteries and veins with their branches can be demonstrated and may be of great help in studying disease areas that cause their displacement. The trachea, main bronchi and branches are delineated clearly, as well as their relationship to vessels, while pseudo-lesions simulating cavities or consolidations can be recognized. The superimposition of structures normally present is not the only difficulty encountered, since areas of disease, such as consolidation, atelectasis, fibrosis, calcifications, thickened pleura and pleural effusion may, by their position or nature, cover other lesions or prevent the visualization of their cause on a standard film. Lesions in the anterior portion of the lung may prevent a posterior area of disease from being discernable on the ordinary flat roentgenogram. Overexposed and stereoscopic films are of great help in overcoming many of the difficulties of shadows from normal and disease tissues, but factors may occur wherein not all of the information desired is attained. It is in these cases that body section roentgenography may be of great value in furnishing additional information as to the extent and character of an area of disease.

As might be expected body section roentgenography has been utilized most frequently in the study of pulmonary tuberculosis. The multiple types and stages of tuberculous lesions may present difficult problems of interpretation; since they usually originate in the posterior portion of the lung and extend anteriorly, the older dorsal lesion may be hidden by the lesion in the anterior lung. By studying sections of the lung at succeeding levels, one can determine the exact nature of the lesions more accurately. The question of whether or not a cavity is present is often difficult to determine by standard roentgenograms. Cavities may be simulated by local areas of emphysema caused by fibroid or fibrocaseous lesions and by bronchial dilatations resulting from the contraction of peribronchial fibrosis. Cavities that have presented roentgen diagnostic problems because of their character and location can now usually be delineated by section roentgenography. The types of

cavities that have been the most difficult to demonstrate are the thin walled cavity surrounded by normal or mottled lung fields. Likewise areas of softening or caseation surrounded by dense consolidations or fibrosis are difficult to distinguish by other roentgenographic methods. As to location, the cavities at the apices are usually more difficult to discern or to differentiate from localized pneumothorax or emphysematous bullae than in other parts of the lung by the usual standard, stereoscopic, or overexposed types of roentgenogram but can, as a rule, be brought out very well by section films. The demonstration by section roentgenograms of a circumscribed area of rarefaction communicating with a bronchus is excellent evidence of cavitation being present. A diagnosis of cavitation may be made without demonstrating the communicating bronchus for the bronchus may not be at the level of the sections taken and therefore will not be shown on the roentgenograms. The value of this type of roentgenography in demonstrating the presence of a cavity in the apex is illustrated by the following case report.

Case Reports

Case 1. A 76 year old man came to this hospital because of urinary frequency and dysuria. During the admission examination, he stated that he had tuberculosis about 46 years ago but had been well since that time. On routine fluoroscopic examination in the Out-Patient clinic we found densities in both upper lobes and a film of the chest accordingly was ordered to delineate more exactly the nature of these shadows. Physical findings of the chest were negative except for evidences of a moderate emphysema. The conventional film of the chest revealed old fibrotic calcified tuberculosis in both apices with some signs to suggest the possibility of cavities but these were not definite enough to make such a diagnosis. For this reason body section films of both apices were ordered. The planigrams revealed a large cavity in the left apex, with some calcification and thickening of the wall around the cavity. Below and behind the large cavity, there were a number of smaller cavities. The right side showed several small cavities, but they were not as clearly outlined. However, if more detail had been desired, further sections could have been made to delineate the cavities in the right upper lobe of the lung more adequately.

Longstanding chronic tuberculosis with its multiplicity of types of lesions of different ages may have cavities overshadowed by calcified, fibrous or possibly exudative lesions, but if section films are made, the needed information can be obtained. Areas of atelectasis, thickened pleura and fluid may obscure the visualization of cavities in stereoscopic and heavily exposed films, but may be no obstacle for body section roentgenography. This is also true in determining the effect of thoracoplasty and pneumothorax on the patency of a cavity in regard to whether the collapse of the cavity is complete. We have been using section roentgenography for this purpose with increasing frequency and have been able to demonstrate more clearly the presence or absence of uncollapsed cavities than was possible heretofore. Thus, body section films are of great value for proving or excluding the existence of cavities and, also, produce valuable information in regard to the location, size, number, presence of trabeculation and character of the walls of the cavities. Consequently, the differential diagnosis of tuberculosis, abscess, carcinoma, and cysts is better accomplished. Then, too, the presence or absence of bronchial communication, with a cavity, in spite of the overlying density of the atelectatic lobe involved, can be shown clearly as in the following case report:

Case 2. A 40 year old woman came to this hospital with a history of known tuberculosis for 20 years with intermittent sanatorium care. The sputum had been positive for tubercle bacilli at various times and was so at the time of admission to the Out-Patient Department. The first chest roentgenogram revealed a calcified fibrotic tuberculosis of the apex and subclavicular region in the right lung. On the left side there was a uniform density of the upper lung field.

representing a collapse of this portion of the lung. No further detail of the nature of the lesion could be made out. The trachea, heart and mediastinum were displaced to the left. Body section roentgenograms were then made of the left upper lung, which revealed marked distortion of the trachea and main bronchi. The left upper lobe bronchus was displaced upward by collapse of the upper lobe. One large and two smaller cavities, as well as a communication of the bronchus with a cavity, were clearly demonstrated.

Body section roentgenography delineates the bronchi well, and any narrowing, dilatation, or obstruction can usually be seen. Bronchiectasis may be recognized by this method directly, without the use of contrast media, by showing the dilated and sacculated bronchi. Section roentgenography may permit demonstration of the location and cause of the obstruction of a bronchus, and may frequently show the obstructing agent, whether due to inflammatory stricture, foreign body, broncholith or benign or malignant tumors. It has been very useful in the diagnosis of carcinoma and benign tumors, since it will often reveal the location, extent and may even outline a benign adenoma. When an operation is contemplated, an attempt to show the obstructing agent by this method in place of iodized oil should be done, because, if successful, the interference of the oil at operation can be eliminated. An example of the demonstration of an adenoma obstructing a bronchus is noted by the following case:

Case 3. A 29 year old woman was sent to the University Hospitals with a history of an unproductive cough for ten weeks, which was thought to be due to pneumonia by her local doctor. One week before admission here, she had coughed up some old, dark blood. The first roentgen examination of the chest showed the heart and mediastinum shifted to the left with an elevation of the left diaphragm. There was an increased density of the left lower lobe. The findings suggested an atelectasis of the left lower lobe due to a stenosis of the left lower bronchus with the cause undetermined. Bronchograms made before the patient came here were reviewed and showed a constriction of the left main bronchus with bronchiectasis beyond the obstruction in the left lower lobe. Body section films were then taken, which demonstrated a rounded, well demarcated, clear cut mass in the left main bronchus arising from its inferior surface near the orifice of the lower lobe bronchus, and extending into the lumen partially obstructing the bronchus. The shadow was such as to suggest the characteristic appearance of a benign tumor. The whole left lower lobe bronchus showed marked stenosis due to the edema and the inflammatory process in the left lower lobe. The tumor was removed through a bronchoscope, and the base cauterized. The tumor proved to be a benign adenoma on microscopic examination. Body section films of the left main bronchus, seven months later, showed a normal bronchus with no evidence of recurrence. The atelectasis and bronchiectasis of the left lower lobe were still present but had diminished markedly.

Carcinoma of the bronchus causes an irregular filling defect in the portion of the bronchus involved with tumor. This results in lack of aeration of the lung supplied by the bronchus due to obstruction of the passage of air through the bronchus. Therefore the conventional roentgenogram of the chest shows a uniform density of the affected lung obscuring the visualization of the obstructing tumor. Iodized oil examination usually can demonstrate the area of obstruction in the bronchus if the carcinoma is in the larger bronchi and not confined to the periphery of the lung or in the smaller bronchi. Body section roentgenography can often demonstrate the tumor occluding the bronchus and may show the malignant character of the infiltration of the bronchus by the finding of extension into the surrounding tissues. The following case report is an instance where a routine chest film revealed an area of atelectasis of a right upper lobe and then both the planigraphic and the lipiodol examination revealed the obstruction in the first portion of the upper lobe bronchus

Case 4. A fifty-two year old woman gave a history of having an attack of "flu" about 9 months ago and again 2 months ago. After the last attack she had lost about ten pounds in weight. A persistent cough with raising of considerable amounts of sputum had been present since the attacks two months previously. Physical examination of the chest was negative. The conventional roentgenogram of the chest revealed a density in the right upper area involving the anterior and axillary portions of the upper lobe of the right lung. The density extended out from the right upper hilum along the lower portion of the upper lobe with some protrusion downwards suggesting the possibility of a tumor being present in the lung. Bronchogram showed a definite defect in the right main bronchus near the orifice of the upper lobe bronchus characteristic of a tumor. The planigrams demonstrated a rounded, well demarcated tumor defect extending into the right main bronchus at the level of the upper lobe bronchus. This tumor was found to be 8 cm. from the posterior chest wall. The mass caused a defect and narrowing of the right main bronchus and protruded well into the lumen up to about 1 cm. from the carina. The tumor mass obstructed two branches of the upper lobe bronchus. The diagnosis of bronchogenic carcinoma of the right main and upper lobe bronchus was confirmed by microscopic examination of the tissue removed at the second bronchoscopic examination. The tissue removed at the time of the first bronchoscopic examination was diagnosed as chronic inflammation. The gross impression of the bronchoscopist at the first examination was adenoma of the right main bronchus at the level of the right upper lobe bronchus. The tumor was smooth in outline and was not ulcerated. Its location corresponded exactly with that described by roentgen examination.

The two cases above described indicate that tumors of the bronchi may be so well demonstrated by planigraphy that their exact distance from the carina can be calculated. This is of great importance as it may be crucial in the determination of the operability of the lesion.

Body section roentgenography of the larynx, first reported by Leborge in 1936, is beneficial in showing the normal and abnormal anatomical details of the laryngeal structures. The films show the relationships of the true and false cords, ventricular cavity, subglottic region and pyriform sinuses, as well as the position of the cords with and without phonation and swallowing. If any disease or tumor has advanced enough to show a deviation from the normal position, size, or shape, it may be demonstrated by this method. Extrinsic pressure, paralysis of the cords, laryngocele, benign or malignant tumors, or infections such as tuberculosis, may often be differentiated. In determining the extent of a particular lesion, especially in the subglottic region, the endoscopic examination allows good visualization of the upper portion of the tumor but not of the lower portion. This type of roentgenography is the most satisfactory means other than laryngoscopy of examining the normal as well as the abnormal larynx. Extension of the tumor to surrounding adjacent structures can be better shown by this method than be endoscopic examination. Planigrams of the larynx also are beneficial to the laryngoscopist since it reveals the location, size, extent and stenotic effect of the tumor on the larynx and trachea. The endoscopic examination will be more easily done if the character of the passage way has been well demonstrated by roentgen examination. Stenosis of the larynx and trachea in diphtheria and high tracheotomy can be well shown and also the progress under treatment can be demonstrated by this method. Body section films are useful in demonstrating foreign bodies which do not have enough density to be shown by the conventional roentgenogram such as glass, bone, etc. Planigraphy is not only of value in the preliminary studies of a lesion but also for later comparative studies as follow-up examinations after treatment. The following case history illustrates its use in carcinoma of the larynx.

Case 5. A patient with a history of a noticeable change in his voice for five years had a biopsy of one of his vocal cords two years before coming to this hospital. The tissue had been sent to

Dr. E. T. Bell who made the diagnosis of squamous cell carcinoma. Laryngeal mirror examination revealed carcinoma of the left vocal cord with fixation of the cord. There was infiltration of the arytenoid and extension below the left cord. There was questionable extension across the anterior commissures. Planigraphic films revealed a carcinoma involving the left vocal cord with extension downwards in the left subglottic region. There was some irregularity and thickening of the right vocal cord representing possible carcinoma involvement. At operation, it was found that the carcinoma involved the left vocal cord and had extended into the left subglottic region. There was roughening and thickening of the anterior commissure and the anterior half of the right vocal cord.

While it is possible to demonstrate tumors such as polyps projecting into the lumen of the larynx or trachea by ordinary lateral roentgenograms, it is exceedingly difficult to determine to which side of the trachea they are attached.

By the anteroposterior view, with the ordinary roentgen method, it is impossible to demonstrate tumors because their densities are not great enough to be separated from the surrounding tissues and overlying spine. However, with the planigraphic method the tumors can be shown in the frontal projection. The following case illustrates the localization of a benign papilloma of the trachea and of the left vocal cord.

Case 6. A male 52 years of age gave a history of having hoarseness for 8 months which had become progressively worse. The conventional lateral roentgenogram revealed a benign tumor arising from the posterior wall of the trachea at about the level of the seventh cervical vertebra. A weakness with posterior bulging of the posterior wall of the trachea just above the tumor was present representing a hernia of the trachea. The anteroposterior orthodox roentgenogram did not reveal the tumor so that localization as to whether the tumor was on the left or right side could not be determined. Likewise the vocal cords were not clearly shown. Planigrams in the anteroposterior position were made at four levels through the larynx and trachea and demonstrated a benign tumor of the left vocal cord with edema of the right cord. Also, as the sections included the upper trachea the benign tumor of the trachea at the level of the seventh cervical vertebra was shown to be present on the left side of the posterior wall and extending into the lumen of the trachea. The tracheal rings could be clearly made out and showed destruction. The tumor was well circumscribed and did not appear to invade the soft tissues about the trachea. A diagnosis of a benign tumor of the trachea and the left vocal cord was the correct interpretation. Microscopic examination of the biopsied material was done and a diagnosis of benign papilloma was made.

Body section films are especially useful in demonstrating bone lesions or fractures located in the upper cervical, upper thoracic or sacral regions of the spine, as well as the sternum, temperomandibular joint, and, sometimes, the petrous portion of the temporal bone. These enumerated regions have many bones overlapping them which tend to prevent obtaining a clear view of the desired portion. This is illustrated in the following case history:

Case 7. A 17 year old girl sustained an injury when struck by a truck 2 months before being sent to this hospital; she had come in for treatment of fractures of the radius and ulna which had united in poor position. Immediately after the injury, a fracture or dislocation in the cervical vertebra was thought to be present because of pain and grating on attempted movement of the neck. Reduction of the cervical spine injury was done under ether anesthesia. The neck was treated by traction for one week and then maintained in a cast. X-ray examination with the ordinary cervical spine films showed no evidence of fracture of the cervical spine. Then planigrams of the upper cervical spine revealed a definite transverse fracture through the base of the odontoid process of the second cervical vertebra. There was some absorption of

the ends of the fragments with no evidence of callus formation. There was no evidence of dislocation at this time.

This is a case of fracture of the odontoid process which was not visible in the ordinary cervical spine film due to the overlying bony portions of the jaw, face and occipital portion of the skull. However, as in other portions of the body where overlying structures and tissues obscure detail of a particular portion, the planigrams showed the desired object free of the shadows of the unwanted objects. Therefore a more accurate interpretation as to the presence or absence of a fracture or dislocation of the spine can be made and may demonstrate the presence of callus formation more definitely. It has proved to be beneficial in localizing and showing the extent of lesions in the vertebrae as to whether confined to the body, laminae or pedicles. This method may show destructive changes in a vertebra and may sometimes demonstrate whether the responsible process is primary in the vertebra or in the surrounding tissues when this cannot be done by the ordinary roentgen examinations. Neuromas of the spinal nerves cause erosion of the associated vertebra and can usually be demonstrated better by section films than by other methods. The standard anteroposterior view of the spine shows the rather dense vertebral bodies superimposed upon by their pedicles, laminae and the spinous processes making it difficult or sometimes impossible to detect small or even moderate sized lesions in the center of the vertebral body. Lateral views may not detect lesions in the center of the vertebral bodies. This appears to be due to the width of the vertebral body and to the fact that the contrast of density between the area of disease and the normal bone is not sufficient. The planigram projects thin sections without the added difficulty of superimposed shadows and at the same time increases the local contrast and therefore can demonstrate lesions in the spine not shown by the conventional films. A definite destructive lesion in the sacrum was clearly demonstrated in the following case:

Case 8. A 27 year old male gave a history of having pain in the left hip and lower back which was accentuated by coughing and lifting. Barium enema examination revealed a normal colon, but some abnormal process was noted in the sacrum and lumbosacral spine films were ordered. The spine films were interpreted as showing a questionable area due to incomplete fusion of the lamina of the upper sacral segments. Then body section films of this area were made and clearly demonstrated that there was a large destructive process in the upper sacrum, characteristic of a malignant tumor such as chordoma or sarcoma. Biopsy was done and on microscopic examination, it was found to be a sarcoma.

In the spine, because the body, pedicles, laminae, and spinous processes are superimposed on one another in the anteroposterior spine film, it is difficult to tell the location and extent of destructive lesions in this region. However, the routine lateral and anteroposterior views are of help in determining the extent and location but if more information is desired as to the origin, character and extent of the lesion, body section films help one in arriving at a more definite conclusion. The following case history illustrates the more detailed information that can be obtained by body section roentgenography of the spine.

Case 9. A 17 year old girl first came here in November 1938 because of stiffness of the neck which later extended to include the thoracic spine. She had developed some pain in the back of her chest the first part of November. X-ray examination at that time was negative. She returned January 16, 1941 because of weakness, paraesthesia and numbness of both feet which had been present for 2 months. The clinical diagnosis was spinal cord tumor. X-ray examination showed a destructive, sclerosing process involving the pedicles and lamina of the third thoracic vertebra. There was also a possible mass to the right of the spine at the level of the fourth thoracic vertebra. Planigraphic films showed the sclerosing

tumor mass with destruction of the pedicles and lamina more clearly than the ordinary spine films and revealed changes in the posterior portion of the body of the vertebra. The mass was shown extending around the body of the fourth thoracic vertebra and to the right side. There was also shown involvement of the spinous process of the fourth thoracic vertebra which did not show on the plain film. The diagnosis was a destructive, sclerosing process involving the lamina and pedicles of the third and to a lesser extent of the fourth thoracic vertebrae. At operation, the destructive process involving the laminae of the vertebrae was found and thought to be a primary tumor of the vertebrae. The dura was normal. The tumor and the laminae of the second, third, fourth and fifth thoracic vertebrae were removed. The microscopic diagnosis of the tissue removed was osteogenic sarcoma of low malignancy.

There are a number of locations where body section roentgenography has been of limited value, as in the genito-urinary tract where it has been used with intravenous urography in young children who normally have a great deal of gas in their bowels. Gas is normally present in the small intestine up to three years of age. Consequently, this gas prevents clear visualization of the urinary tract. By this method we have recently shown a tumor, probably a neuroblastoma, displacing a kidney which because of the large amount of gas in the bowel would have been difficult to recognize by the standard pyelogram. Lesions within the kidney itself causing hydronephrosis or defects in the calyces and renal pelvis require good visualization of all portions to determine the nature of the disease process but a large amount of gas in the bowel may obscure or produce densities simulating lesions within the kidneys. These same factors apply to the ureters. Therefore, when gas obscures the urinary tract and cannot be eliminated, planigraphic films are of great value. In the abdomen, body section roentgenography has been confined to demonstrate aneurysms and calcifications of the adrenal glands. It is necessary that calcification be present in an aneurysm of the abdominal aorta to be demonstrated by this method because the contrast between the aorta and other structures in the abdomen is not sufficient. On the other hand, saccular and dissecting aneurysms of the thoracic aorta have been demonstrated with or without calcification by Moore and Scott of St. Louis. In their cases the patients were in the late thirties or older when the density of the aorta is sufficient to delineate it from the other structures. The correct diagnosis of dissecting thoracic aneurysm before death is difficult and rare because of the difficulty in showing this lesion by ordinary roentgen methods but this newer method of roentgenography helps in solving this problem within the thorax.

Body section roentgenography in combination with ventriculography and encephalography is of value for better visualization of the third and fourth ventricles and their adjacent regions. These areas despite many variations of the technique with pneumography still remain the most difficult to visualize and to interpret of any portion of the ventricular system. The overlying bony structures such as the pneumatized mastoid portion of the temporal bone in the lateral projection and the paranasal sinuses and bones of the base of the skull in the postero-anterior projection prevent clear visualization of the air filled aqueduct of Sylvius and the fourth ventricle. These bony portions of the skull can either simulate or prevent visualization of the fourth ventricle. Also, this region of the ventricular system is a roentgen problem because of the difficulty in replacing the fluid with air and of the small size of the aqueduct of Sylvius and fourth ventricle. The body section roentgenographic method is used to eliminate the confusing shadows since it allows projection of a plane clearly on the film while blurring the unwanted shadows of the denser and rarefied objects above and below the clear plane. This method has been successful in demonstrating the aqueduct of Sylvius and the fourth ventricle more satisfactorily than by the conventional films. The difficulty of seeing the lower portion of the ventricular system when filled with air can be

largely eliminated by the planigraphic examination but this is not the only difficulty of visualizing this region because often the aqueduct of Sylvius and the fourth ventricle will not fill with air. In these latter cases the planigraphic method will not be of any help but it does have advantages in visualizing the air filled ventricles more accurately when necessary.

Examination of the nasal sinuses by body section roentgenography has been of value especially in the study of the sphenoid and ethmoid sinuses. It has been used for differentiating the sphenoid and ethmoid sinuses. In the postero-anterior view these sinuses overlap each other and it is difficult to localize an infection especially of the posterior ethmoids from the sphenoid sinuses. Also, because of the overlapping shadows, infections of the sinuses especially the posterior ethmoids and sphenoids, may not be seen on the ordinary film, but body section roentgenograms may reveal the infected sinus. It has been reported by Sherwood Moore that in cases of retrobulbar neuritis where infection of the sinuses by the conventional roentgenograms could not be demonstrated, he was able to do so by the planigraphic method. The use of body section roentgenography has not been of any value in the gastro-intestinal tract, gallbladder, liver or spleen because of the lack of contrast between them and other abdominal structures.

Conclusions:

Body section roentgenography is a method of projecting a plane (which is in focus in the body) clearly on a roentgen film while blurring on the film all objects above and below this plane in the body. This is accomplished by any type of motion of the tube and film but the body being examined must be stationary. The plane being projected is parallel to the film surface and is at the same distance from the table top as the axis of the system of motion. The thickness of the section depends on the amplitude of motion of the tube and film. The disadvantages of the method are the cost of the apparatus and films, and also the amount of time required to complete the examination. The number of films necessary can be materially reduced as one becomes more familiar with the method.

Body section roentgenography may be best accomplished by the more complex and expensive machines which allow all types of motions. They give the maximum positive information with the least amount of artefacts caused by the motion of the tube and film. Also, the more complex machines allow visualization on the film of areas difficult or impossible by the simpler machines such as the thoracic and lumbosacral spine. The more complex machines permit a choice of the type of motion desired which will depend on the type of case to be studied and the location of the zone to be delineated. The simpler inexpensive apparatus is attachable and removable as desired and is used with the standard roentgen table and equipment. This latter type can be used in most instances where there is a need for this type of roentgenography and although it does not produce as good a film as the more complex machines it can be used successfully in most instances.

Body section roentgenography is a new method for aiding the radiologist in obtaining additional information regarding lesions which are difficult to interpret, whether due to the lesion itself or its location. The detail of the film is not as clear as the conventional films and the general contrast is less, but the local contrast is better. Therefore, shadows can be differentiated by this method which are not possible by the conventional roentgenogram. The attribute of better delineation and more accurate localization of a lesion has proved of distinct value. This method of roentgenography is more widely used and of greatest value in the respiratory system, especially in the chest, and the axial skeleton. It has distinct advantages in other regions, as has been noted. This method will be used more frequently as its merits are better appreciated and understood. It has been of value to our department in many of the locations and lesions noted and its use is increasing. This method of roentgenography, though used for a relatively short period of time, has proved to be an

excellent adjunct to other methods of roentgenography. Its scope of usefulness in the various organs and locations in the body is steadily increasing and by no means have all of its possibilities been explored. There will be further improvement in the design of the apparatus and in technique which will result in the projection of planes at any angle and in greater clarity on the roentgenogram and consequently permit a wider application.

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IV. GOSSIP

Alfred M. Freedman, University of Minnesota, tied with John R. Urst, III of Columbia, for first place in the bio-chemistry examinations of the National Board of Medical Examiners held in June, 1941.

Radium searchers, J. W. Buchta and Hervey H. Barber, of the departments of physics and chemistry respectively, were on the loose again over the week-end again looking for radium in Ashland, Wisconsin. As usual they found it. This time in a pile of ashes. It had been thrown out by a careless nurse who had been entrusted with the job of looking after it by a Sister who had not misplaced it in 17 yrs. of custodial responsibility. Their method of search is through the use of an electroscope which indicates when they are getting warm and finally leads them to the spot. The radium was worth over $1,000. At Sioux Falls, South Dakota, a few years ago they searched in vain for radium which had been lost by a local hospital until someone remembered that the hospital sold garbage to a pig farm. The electroscope indicated the presence of radium on the pig farm but it would not stay put as it was in a pig which was constantly moving around. Only one pig was involved, and after being converted into potential pork chops and what not the radium was removed from its innards. This fascinating story of radium was reinacted in the "March of Time" of that year.

Neurosurgeon Willaim T. Peyton, went hunting as usual this fall. As companions he selected some of the hearty junior members of our staff. Each morning they were routed from their beds at an untimely hour by the vigorous one. The morning of our story they refused to get up. The mighty hunter prepared his breakfast and went out into the night leaving the prostrate forms of his junior

associates in their various beds. Hours later when the hour indicated that it was a reasonable time to get up the juniors sallied forth to meet the new day. A short distance from the shack they heard noises indicating distress. All the time that they had slept on the mighty hunter had been walking in circles lost in a fog.

The bulletin of the Minnesota Medical Foundation now declares its purpose in the new title "Trends in Medical Practice and Research". Volume III, Number 1 is just off the press. It contains a series of surgical trends, feature articles, editorials, story of the Foundation, news of the medical school, book reviews, a list of the undergraduate medical students, and a calendar of future events. It will be published at regular intervals this year, and hopes to make for itself a place among the medical publications of this area. One may receive "Trends" in any one of the following ways: Foundation member, $1,000.or more; life members from $100. to $1,000. total assessment, annual members who pay annual dues of $10. (after payment for 12 consecutive years, you become a life member), student members, who pay annual dues of $1. and may continue in this status until 5 years after they receive their M. D. degree. There is now a special offer to non-members of $1. charge for the next three issues of "Trends". The editors hope that through "Trends" the medical profession will find an easy method of learning of our activities. Applications for membership may be sent to the office at 132 Medical Sciences building, University of Minnesota, Minneapolis.

The faculty voted approval of the change in the junio-senior medical curriculum. These years will be divided into fifths (a new use for the measure). In addition the classes will be divided into five sections. In general, the change involves a redistribution of less didactic teaching throughout both years and more clerk-ship time throughout both years. It would appear that there will now be time for electives and reading assignments. There will be combination junior-senior clinics and other changes now approved in modern medical educational practices. The question of examinations is being studied at the present time.

The Minnesota Museum of Natural History is open to the public each week day from 8:30 - 5:00 and Sunday afternoons from 2:00 - 5:00. A lecture illustrated with motion pictures is given each Sunday afternoon at 3:30 P. M. from October through April in the Museum auditorium. The Sunday afternoon lectures are largely attended by children and their parents. Last Sunday we saw pictures of anthropoids. When the animals put all sorts of things on their heads the scientific speculations as to the reasons were obscured by enthusiastic responses from the children The second movie was taken on a farm near Cold Springs. The farmer catches all sorts of young animals and feeds them thereby making pets of them. When they grow up they stay on the farm and whenever he appears crows light on his head, smaller animals attempt to run up his pants legs and others jump all over his person. In addition to the Sunday afternoons there are evening lectures. The next will be given Wednesday, December 10 by D. H. Janssen on "Haunts for the Hunted". It is a kodachrome film of the waterfowl life in the national refuges.

At the Medical Faculty Dinner held in the Coffman Memorial Union ballroom the other evening, Dr. Theodore C. Blegen, the new dean of the graduate school, made his first appearance before a medical faculty meeting. The directorship of our graduate activities at Minnesota seems to run to historians. Perhaps there is nothing better than history to keep one orientated in education. Dr. Blegen is well acquainted with our historical background and much of our early medical history is well known to him. He delighted all by his manner of presenting his subject and by his excellent insight into our

problems. One of his harrowing tales goes back to 1861 and has to do with a newspaper account of a foolish young woman who wore too light a headpiece on a cold day. She was coming home in an open sleigh wearing a new fashionable,and very slight bonnet. She complained once of the cold but did not wish to stop. When she reached home she was dead. Dead it says of a frozen brain.

The fifty-first annual meeting of the Western Surgical Association will be held at the St. Paul Hotel, St. Paul, December 5-6 under the presidency of Dr. Albert H. Montgomery, Chicago. The speakers will include, among others, William T. Peyton and Lyle A. French of our staff. Virgil S. Counsellor and Daniel A. McKinnon, Jr. of the Mayo Foundation.

U.S. Leads of Medicine according to Elsie McCormick:

Today the crown for pre-eminence in healing belongs to the United States.

Thirty years ago the standards of admission to our medical schools were lower than in any civilized country; our hospitals, on the whole, were far below Viennese standards of efficiency; our medical research was laughed at in every laboratory of central Europe.

Today American medical research occupies thousands of devoted workers and saves lives all over the world.

Of 410 medical discoveries made from 1928 to 1938 and listed by the National Geographic society, 17 can be credited to Germany and Austria, 35 to the British empire, 22 to other countries, and 336 to the United States!

The U.S.A. has become the medical center for all mankind.

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Harry A. Wilmer is finishing his internship as a patient at Glen Lake Sanatorium, Oak Terrace, Minnesota. He does not feel that his time has been entirely wasted for in his spare moments he has been occupied in writing a book for public information. It is entitled "Huber, the Tuber" and it follows the hectic career of a tubercle baccillus in "lungland." Although the text is only 100 pages there are 58 pages of the author's own drawings. The introduction is by J. A. Myers. Dr. Wilmer's many friends will be looking forward to the publication of this interesting book. It is good to know that he has been able to occupy his time so well.

Dean Harold S. Diehl met with the Procurement and Assignment Service Committee in Washington, D.C. on November 6. He is newly appointed to this group which is one of the remarkable committees of our time (no full-time Federalists). It has the jurisdiction over all medical matters in relation to national defense. The University of Minnesota is honored by the appointment of Dr. Diehl to this important group.

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