

nostic investigation. The injections were continued even after the patient had been dismissed, so as to prevent a rapid re-expansion of the organ and to conserve efficiently the local and general effects of the pneumo-thorax. Suppurations of the lung, being affections of chronic course in which medicinal treatment is almost ineffective and in which surgical treatment involves serious danger, a.p.t. may resolve the problem and for this reason should always be applied where possible.

The danger of a.p.t., however, must be borne in mind. In the writer's series at least four cases resulted in early death, probably due to a.p.t. Illustrated in case XXV.

Burnanand (196) and Morgan (48) also reported cases indicating such dangers. Observation of certain principles regarding the a.p.t. treatment and checking each step by Roentgenogram and Fluoroscopic examinations will greatly help to avoid the dangers. Accidental perforation of lung may sometimes occur.

Precise indications for the application of a.p.t. in the lung abscess, summarizing the opinions of the various authorities, may be outlined as follows:

- (1) Pleura totally or partially free from adhesions.
- (2) Lung compressible.
- (3) Sufficient outlet for evacuation.
- (4) Possibility of maintaining the required compression.
- (5) Absence of lesion in the other lung or other organs.
- (6) Sufficient normal lung tissue between abscess and visceral pleura.
- (7) First a.p.t. causes sufficient evacuation without delatious after effect to the patient.
- (8) The procedure must be done gradually, assisted by Roentgenographic observations.

McMichael (197) states that probably in no field of endeavor have X-ray been of more practically value than as an aid in diagnosis and treatment of pulmonary tuberculosis, and in the induction of a.p.t., indicating as they often do, possible danger and turning defeat into victory.

It may not be amiss to cite other advantages of Artificial Pneumo-thorax at the close of this section. The use of a.p.t. sometimes as a useful method of diagnosis in Roentgenology has been demonstrated in many occasions, such as in eliminating pleural annular shadows in order to differentiate from the true cavitations, or in disproving the presence of intrapleural liquid. The latter point was beautifully illustrated in our case XXXI, Fig. 200-203.

In our present series bad effects were observed in case XIV, XV. In case XVIII there followed marked subcutaneous emphysema; in case III compressive effect on the

vessels and other mediastinal structures may be seen—Figures 35, 36.* Also see page 178.

In cases IX, XXIV and XXXI beneficial effects from the artificial pneumo-thorax treatments were obtained.

Diagnostic pneumo-thorax is of considerable aid in establishing a positive diagnosis as to which lung is the more diseased, besides its being a beneficial method of treatment in certain cases.—Singer and Graham (235).

CHAPTER XIV.—ROENTGENOLOGIC DIFFERENTIAL DIAGNOSIS OF LUNG ABSCESS.

SECTION I.—GENERAL SURVEY.

The X-ray appearance of lung abscess of the Type I and II are characteristic, and the diagnosis is almost instantaneous; but as it has been shown in our case analysis, 65 percent of the series constituted class III and IV types of radiography, which were subjected to varieties of interpretations, and consequently, with Roentgen alone, it would have made the situation unnecessarily more confusing.

There are many intrathoracic conditions, which produce similar shadow on the X-ray plates, requiring a Roentgenologist's close study before giving final interpretations. Any intrathoracic condition which tends to increase the density is capable of casting a shadow, and the Roentgenologist is forced to diagnose the complex involved in many dimensions on a single flat plate, although stereoscopy is valuable supplement to the drawbacks.

Under such circumstances, it is certain that, besides various methods used in the procedure of Roentgenography as enumerated elsewhere, an adequate interpretation can only be obtained by intelligent correlation with best clinical knowledge and involving pathology in each case.

For the sake of precision, various intrathoracic conditions which have Roentgenologic interest, in reference to lung suppuration, are discussed in the following.

Gaarde (198) analysed one hundred and fifty eight cases with abnormal Roentgenologic findings in the mediastinum, according to which he met following occurrence of

* Miller and Lambert (237) state that it sometimes happens that the air introduced works around into the pleural space near the mediastinum and may actually cut off drainage already partially established, resulting in an exacerbation rather than a relief of symptoms, also necessary cough for evacuation may be hampered due to the immobilization of the thoracic wall. Therefore they feel that this procedure carries with it too great a risk to warrant its employment as a routine procedure in the treatment of lung abscess.

intrathoracic diseases which may come under Roentgenologists' observation in his daily routine, requiring Roentgenologic differentiation :

Aneurysm	67
Hodgkins Disease	30
Lymphosarcoma	26
Carcinoma	13
Tuberculous Lymphnodes... ..	4
Abscess :	
Mediastinal	2
Encapsulated empyema and lung abscess	4
Lymphatic Leukemia... ..	4
Syphilitic Mediastinitis	2
Secondary Sarcoma	2
Pott's Disease	2
Enlarged Thymus (adult)... ..	1
Benign Tumors (lipoma)... ..	1
Total	158

To the above quoted Gaarde's list, the following diseases which require Roentgenologic Differentiation from lung abscess may be added ;

- Lobar pneumonia, Broncho-pneumonia.
- Mediastinal Pleurisy with effusion.
- Tuberculous abscess.
- Bronchiectasis.
- Pneumokoniosis.
- Hydatid cysts.
- Dermoid cysts.
- So-called "annular shadows."

In summing up, Gaarde says that accurate differential diagnosis of diseases of the mediastinal region is most important as it is in some instances the means of effecting a cure or at least of prolonging life.

X-ray treatment of lymphoma and leukemia may add months or years to the patients' life, and treatment for syphilis, and surgery for inflammatory lesions may afford complete cure in such cases. The more important procedures which was followed routinely in making a differential diagnosis clinically, in these 158 cases in which X-ray examination indicated the presence of the mediastinal diseases are: (1) fluoroscopy for expansile pulsation; (2) careful search for enlarged lymphnodes elsewhere that a biopsy may give information with regard to the nature of the original tumor; (3) painstaking history, especially to elicit the possibility of inflammation or syphilis; (4) Wassermann test; (5) leukocyte and differential count to rule out leukemia and inflammatory conditions; (6) exploratory puncture, which should not be done as a routine, caution being exercised lest an aneurysm be punctured (puncture has a

definite place, however, and often leads to a diagnosis), and (7) careful physical examination for signs of intrathoracic pressure.

SECTION II.—PNEUMONIA.

(a) Lobar Pneumonia :

The Roentgen shadow of lobar pneumonia is more or less characteristic;—it is homogeneous owing to the nature of the exudate and its contour conforms with the shape of the individual lobe or lobes which are affected. Exact correspondence in the shape, however, between the pneumonic shadow and the lobe affected is not always obtainable, because of the fact that only a part of the lobe may be involved instead of whole lobe, especially in the upper lobe pneumonia in children, and that overlapping position of the uninvolved adjacent lobe may greatly modify the shadow of pneumonic lobe.

The shape of the pneumonic lobe may also be modified by the position of the tube (high or low focus), and by the position of the patient (anterio-posterior, postero-anterior or oblique or lateral).

In the early stage of lobar pneumonia the shadow is usually homogeneous and of moderate density so that the lung markings may be distinctly seen through it. In the stage of grey hepatization the shadow uniformly increases in its density, yet not so intense, so that the dome of the diaphragm and rib shadows are seen through.

Successive Roentgen examinations will demonstrate the absorption of the exudate, usually beginning at the periphery progressing toward the root. These characteristics of the shadow of lobar pneumonia will lead one to make correct diagnosis without difficulty; but when the resolution is very irregular, taking place at different places, forming a circular defects or pseudo-cavities, they may be mistaken for lung abscesses.

Often the resolution takes place very slowly at the root region, so that the shadow persists in this locality for number of weeks. Such a shadow may simulate the lung abscess shadow of Group III. In such an instance the history, clinical symptoms and the course of the disease have to be depended on for final diagnosis.

Lower lobe pneumonia with partial consolidation, or middle lobe pneumonia (although rare) may cast similar shadows like those of Group III lung abscess. In the former, however, the shadows are less dense, more homogeneous, and characteristics of the later development of the films will decide on the diagnosis.

(b) Broncho-Pneumonia :

Broncho-pneumonia casts hardly any demonstrable shadow so that physical signs of bronchiolitis and lobar pneumonia are more dependable, unless a large area is involved and the lesion is confluent.

In acute confluent broncho-pneumonia, accompanied by much indurating lung tissue, such as produced by inspiratory infection, the X-ray shadow can not be distinguishable from that of lung abscess of Group IV. In fact the former frequently terminates in cavity formation. Frequent X-ray examinations, co-operated by clinical and physical findings are necessary.

Recent epidemic influenza produced varieties of lung complications which produced manifold Roentgen pictures. Very often they simulated those of advanced tuberculosis or of third degree pneumo-koniosis. The frequent involvement of more than one lobe and the usual rapidity of clearing up of such lesions may serve as differential points from lung abscess. In time of difficulty, both clinical course and physical findings should assist the Roentgenologist.

SECTION III.—PULMONARY TUBERCULOSIS.

This is the most important disease which should be differentiated from lung abscess.

Hess (199) states that differential diagnosis of lung abscess from localized tuberculosis may be difficult. Infiltration in a lower lobe with no involvement of the apex, it is probably not tuberculous. Tuberculous cavities, as a rule, contain no fluid. They occur usually in upper lobe and are not common in the lower. The X-ray examination is an essential preliminary procedure in all cases of lung abscess.

In Diabetics, however, tuberculous lesions may be found in the lower lung field.

The characteristic parenchymal tuberculous lesions, as depicted on the Roentgenogram, may be, in the very early stage, miliary or submiliary spots. When they are numerous, they may appear as localized homogeneous granular area, although they are detected with difficulty. Unmistakable Roentgen picture, during the period of next evolution, is a group of submiliary spots usually located at apex or infra-clavicular region, often arranged in rows in the direction of usual lung markings constituting a peculiar mottling—to which the writer applied the term of "cirro-camulus clouds." At still advanced stage the spots become coalesced and form larger patches with more or less fibrous appearance in the periphery. For such characteristic shadow the writer applied the term of "tufted fibrous cloud." For example, Case XX, Fig. 151, 152.

Stivelman (200) pointed out that a typical lobar pneumonia is frequently confounded with pneumonic phthisis and unless the clinical course of the disease is carefully studied and other laboratory findings consulted, a differential diagnosis may be impossible. The same condition obtains in chronic interstitial pneumonia. Here the Roentgen evidence is in itself rarely sufficient to point to a definite diagnosis. Unilateral chronic pleuro-pulmonary tuberculosis, especially the types which follow pleural effusions, is indistinguishable, Roentgenologically from interstitial pneumonia

of non-specific origin. In such cases we must resort to the clinical history, and especially, careful sputum studies, for a differential diagnosis.

When the lesions become more advanced and especially the chronic age, when there is much fibro-productive reaction, the shadows become more fibrous more regularly arranged in parallel in the usual direction of the lung markings, to such appearance of the shadow the writer applied the term of "fibrous cirrus clouds." Case XXXII, Fig. 212-227.

Armand-Delille P.-F., and others (238) stress on the deviation of trachea as revealed on the Roentgenogram in chronic tbc.

Stivelman further states that a history of pulmonary complaint of long standing, especially cough, haemoptysis, frequent colds with elevation of temperature, when associated with bilateral disease and evidence of bronchitis and emphysema will speak in favor of pulmonary tuberculosis even though the sputum may give negative findings. A history of a recent pneumonic process or surgical intervention in the upper respiratory tract followed by profuse and foul expectoration, clubbed fingers and evidence of toxemia, will speak in favor of pulmonary abscess.

Tuberculous and non-tuberculous pulmonary cavitation. Almost pathognomonic of pulmonary tuberculosis is the Roentgen-ray finding of an area of rarefaction or cavitation anywhere but particularly in the upper lung field, especially if this area is surrounded by an appreciable wall and is situated in the midst of shadows signifying parenchymatous infiltration. It is almost pathetic to watch the keenest clinician miss fairly extensive cavitations which speak for themselves on the Roentgenogram. The failure to elicit these on physical examination is due either to the fact that the communication between the cavity and its draining bronchus is temporarily blocked by a plug of mucus or sputum, or the cavity may be entirely filled with fluid, conditions which preclude the generation of those physical signs by which cavities are recognized. Basal cavities and cavitation in the hilum region, and more especially pleural annular shadows, which are in reality a form of interlobar pneumo-thoraces are more often missed than elicited on physical exploration of the chest but almost invariably found in the Roentgenogram.

However, a diagnostic pitfall can be avoided when it is remembered that not all areas of rarefaction or cavitation are of tuberculous origin. Such areas of rarefaction near the hilum region or basal fields may be due to extensive bronchiectasis resulting from chronic bronchitis, interstitial pneumonia, and changes secondary to pleural disease. These dilated bronchi are engendered by increase in intrapulmonary tension incident to long continued and distressing cough on the one hand and traction on the outer wall of the bronchi by the contraction of fibrous tissue when pulmonary sclerosis is present on the other. Indeed, it has long been known that not all areas of rarefaction are due to ulceration of the pulmonary parenchyma. Areas of rarefaction in

the lung tissue may be due to abscess formation, and when accompanied by collateral inflammation they are in their early stages indistinguishable from tuberculous cavitation on Roentgen-ray examination alone. Malignant metastatic nodules, when their circulation is shut off may ulcerate and discharge their contents into the nearest bronchi and thus exquisitely simulate tuberculous cavitation."

Wessler and Jaches (46) in describing pulmonary tuberculous cavities classify them in three forms:

The first and perhaps the most common type is the annular cavity, which is found especially in early tuberculosis and represents probably an early stage in its evolution.—It appears to result from a slow breaking down of the more chronic proliferative type of infiltration, in which caseation is not extensive and is gradual in its development. It therefore lies in the lung field which is not densely infiltrated and may often only be recognized by a thin line of demarcation from the surrounding lung.

These cavities are practically always situated near, but not in, the apex of the lung. Their favorite site is in the infra-clavicular region near the axilla. The smallest annular cavities may be only a fraction of an inch in diameter; the largest may attain a size of two to three inches. This form of cavity is commonly not discovered by the physical examination. As it is not surrounded by consolidated lung, and as in many cases, it does not communicate with a bronchus, the characteristic physical signs of a cavity are either not produced in it or are not transmitted to the surface of the chest.

The second type of cavity lies in densely infiltrated lung in which it probably arises from a rapid breaking down of caseous tissue. It has a punched-out appearance, is air-containing and often shows a fluid level. It is surrounded by a dense, well defined wall which is composed both of fibrous tissue and the adjacent consolidated lung. Their shape will be determined by the character of their walls, which in turn will depend on the degree to which a fibrous capsule is formed about them. Thus the rapid necrosis which occurs in acute caseous pneumonia may give rise to an irregular excavation with no evidence of a limiting membrane.

The third type or fibrous-walled cavity represents the terminal stage of either type described, in which conservative influences limit its extension and attempt to encapsulate it. The indurative tendency of apical diseases here manifests in its most pronounced form and as a result we commonly find cavities of moderate size at an apex surrounded by a zone of connective tissue of varying depth and density. They are frequently adherent to the chest wall by a much thickened pleura, which often interposes an insurmountable obstacle to their collapse by artificial pneumo-thorax. Clinically, these cases are often characterized by remarkable chronicity. They are consistent with fair health and when, as is often the case, the cavities are completely lined by smooth connective tissue, the expectoration may be negligible and may not contain tubercular bacilli.

In all these types of cavities it may be stated that generally the surrounding induration and irregular mottled density is much less marked than that of suppurating cavity of pyogenic origin, and the former usually is accompanied by other characteristic tuberculous lesions which are stated in the beginning of this section.

"Arrested" tuberculous lung reinfection by other pyogenic organisms may take place resulting in non-tubercular abscess in which tbc. will fail to be demonstrated in the sputum for a long period. Case XXXII in which repeated laboratory examinations failed to demonstrate the acid-fast bacteria, but from the beginning characteristic tubercular shadows were observed on the films. Absence of tubercular bacilli, and even negative guinea pig inoculation do not eliminate tbc.

On the other hand, it happens too many times that patients with lung abscesses are sent to tuberculous sanatorium or they are attended at their homes by family physicians just to let them run their course. Four of such cases (Morgan, 48) were quoted before in the section of etiology.

One of Le Wald and Green's (202) cases spent six months in a tuberculosis sanatorium, and two of them were taken care of in the tuberculous service of the Department of Health of New York, these were later correctly diagnosed by X-ray.

X-ray if correctly interpreted is the most reliable means at our disposal in differentiating the pathological condition of the lung.

McKinnie (203) outlines necessary precautions in dealing with tuberculous empyema and says that tuberculous case never heals by operation, although his statement requires some modification in that there is a certain success in the surgical treatment of pulmonary tuberculosis. Lilienthal (204) reported some cases in which apicolysis, thoracoplasty, paravertebral thoracoplasty and even drainage and excision were applied.

Hedblom (205) says "Assuming a purulent effusion of the pleura, not definitely meta-pneumonic or post-influenzal, the greatest care should be used to exclude tuberculosis before instituting open drainage, since cases of empyema showing no tubercle bacilli almost universally heal promptly, while those having tubercle bacilli rarely do so."

In chronic suppurative disease of the lung, the mottling appearance of peripheral lung field is often mistaken for tuberculous lesions. This is due to chronic congestion or scattered broncho-pneumonia. The shadow appears more homogeneous and reticulated, lacking the characteristic of tuberculous lesions. (Case XVI).

Absence of tubercle bacilli in the sputum during prolonged laboratory examination does not always eliminate tuberculosis, such a case is well illustrated in our series, No. XXXII.

Pottenger (207) points out that tuberculosis, with cavity and tubercle bacilli in sputum, heals up thick walled cavity left, and its secretion expectorated in which tubercle bacilli seldom are seen.

Mix (128) states that temperature in tuberculosis is characteristic. In the morning and in the evening it is, low, even reaching subnormal point, rises to 100-101 degrees F between 1-4 P.M. A "see-saw" temperature of streptococcus infection, steady rise in pneumococcus and in typhoid. An example of temperature from a lung abscess case is shown as:

	6 A.M.	9	12	4 P.M.	6	9
First day	100	99	99.4	100.2	100.8	100.8
Second day... ..	99	99	99.6	99.4	99.6	100.6

It will be noticed that not only is there irregularity during the same day, but the oscillation of temperature curve is varied from day to day.

It is well to remember the dictum of Brown (206) that "abnormal physical signs at one apex should be considered as due to pulmonary tbc. until proved not to be, while those at the base should be looked upon as not tbc. until definitely proved so."

Reflex muscular changes, or trophic changes, physical signs in the chest, in differentiating this disease has been fully stated in quoting Pottenger (206) in the chapter of Physical Diagnosis.

SECTION III.—BRONCHIECTASIS.

Presents many similar clinical manifestations to the chronic tuberculosis or chronic lung abscess; the clinical differentiation of these three diseases has been discussed in the chapter of Physical Diagnosis.

The Roentgenogram of bronchiectasis is rather characteristic and typical in form and there is no difficulty in diagnosis unless it is complicated by other lesions. That bronchiectasis, however, rarely exists alone, but usually associated with some destruction of pulmonary tissue is emphasized by Lord (70).

Bronchiectasis has been described by Moore (208) as of infiltrative, cylindrical, and sacculated. The first type has a Roentgenologic resemblance of chronic bronchitis; the second produces a fan-shaped mottling with greatest density at the hilum and showing one or more small pseudocavitations; the third type shows larger multiple pseudocavitations, 1-3 cm. in diameter, surrounded by dense fibrous tissue. The second and third types are likely to be confounded with the abscess, but as the lesions are often bilateral and somewhat symmetric, they would hardly be confused. Those bronchiectatic lung abscesses resulting from lung abscesses are more frequently unilateral, and in the latter case there is more evidence of destructive lung tissue or productive fibrosis.

Armand-Delille and others (209) described the means of differentiating the condition by injecting Lipiodol into the bronchi. The authors used a specially devised curved troicar fitting in a canule, which is driven under local anaesthesia, into the intercrico-thyreoideal space. After the canule is inserted in the trachea 5 cc. of 1%

novocain injected, this being followed shortly after by lipiodol, of which 8-10 cc. suffices for a child of 7-14 years old. The authors reproduced in this article several X-ray pictures illustrating different types of bronchiectasis and also the appearance of a normal chest after a lipiodol injection. The similar method has recently been described by Coyon and Marty (210).*

Bronchial dilatation when it is associated with much thickened wall, is found on the plate as elongated cylindrical or fusiform shadows, illustrated in Case XVI, Fig. 121-127, or in cross section, as small circles, which, when numerous, appear quite honeycombed. Case XXXV, Fig. 246-248. In the absence of much thickening, they are not visualized, and in such a case, in presence of cough and large amount of expectoration, may easily be mistaken for tuberculosis of lung abscess. Injections of lipiodol or other radio-irradiant substance into the bronchi will facilitate diagnosis.

SECTION IV.—PLEURAL EFFUSION.

Pleural effusion, serous, sanguineous or purulent, commonly extending from the base upward, obliterating the costo-phrenic angle, most often unilateral, and showing a horizontal fluid level above or the curved line of Damoiseau, is familiar in its Roentgen-ray aspects, and not like to be confounded with pulmonary abscess. Carman

* Grady (236) described cases in reference to the use of Lipiodol in the diagnosis of pulmonary lesions with general review on the subject. According to this writer, although the number of his cases are not sufficient enough to warrant a detailed discussion, no immediate or late ill effects of importance has been observed, although the possibility of harmful effects could not be disregarded.

W. F. Manges, in discussing Grady's paper, says that insufflation with bismuth subcarbonate has more advantage than lipiodol, because, 1, lipiodol is very expensive, 2, it does not lend itself so well to bronchoscopic application as does the dry bismuth subcarbonate. Wm. H. Stewart, in discussion of the same paper, said that lipiodol by the gravity method was successful in outlining general bronchial tree, but he never felt confident of obtaining detail of the site of the lesion.

According to recent studies by Singer and Graham (235), in many cases the bronchiectatic areas show themselves as triangular shaped densities with the apex at about the hilum, extending toward diaphragm. The density of these shadows varies with the amount of contained secretion and the position presented to the X-ray screen or Roentgen plate. In these cases that have been operated upon, these triangular shadows have been found to represent atelectatic, bronchiectatic lower lobes, with the characteristic cyanotic appearance and indurated feeling on palpation; unaffected lobe or lobes had hypertrophied so much as to fill out the chest cavity and surrounded the collapsed lobe. In the Roentgen plate these collapsed lobes manifest themselves as dense shadows in the region of the cardio-diaphragmatic region. Some cases showed diffuse small shadows resembling broncho-pneumonic areas in the opposite lung, together with the dense shadows described above, and this condition was considered to be due to a "spill over" from the opposite side. Considerable work has been done on the diagnosis of bronchiectasis by the introduction of opaque powers, as bismuth subcarbonate and bismuth in oil, or instillation of lipiodol. Singer and Graham feel, however, that the use of foreign bodies in the lung is not always necessary to make a diagnosis, and it has other drawbacks, such as blocking smaller bronchi; this may become a foreign body and complicate an already serious condition, as they met some such cases in their series.

(210) states that change of the fluid level with changing position of the patient is distinctive. However, in certain cases, this change of fluid level cannot be demonstrated. The characteristic appearance of fluid in the pleural cavity depends largely on its quantity and on the presence or absence of adhesions. The appearance of a simple pleural effusion is that of a dense shadow extending upward from the diaphragm on the affected side and an irregular upper surface, usually concave, above. Hess (199) states that one of the earliest and most constant X-ray signs of free fluid in the pleural cavity, unaccompanied by pneumo-thorax, is the obliteration of the costophrenic angle. This sign is more marked in adults than in children. The great value of making serial or frequently repeated X-ray examinations to determine the progress of the case should be emphasized. In the early pre-effusion stage, sometimes much engorged pleural vessels can be seen on the Roentgenogram. Fig. 250-a, b. This is in a short time followed by characteristic progress of the shadow as indicated by Fig. 250-b. When no free air is present with the effusion, very slight change can be noted in the relative shape and position of the shadow on change of posture. If adhesions are present, the effusion may become encapsulated and the shadow then appears of more less spherical form. In these cases, as in lung abscess, the exact limits of the effusion can best be determined by lateral or oblique examinations or by stereoscopy. Much difficulty is encountered in chronic cases in which great pleural thickening had occurred accompanied by adhesions.

SECTION V.—SUPPURATIVE PLEURISY.

Difficulty may be experienced to differentiate purulent pleural exudate from simple serous type and in such a case, thoracentesis only gives decided answer. If the progress of the disease is observed Roentgenologically from its early period, it is usually possible to tell the nature of the exudate. Early stage of fibrino-purulent pleurisy is indicated on the Roentgenogram by a thickened band up along the costal wall detaching the lung surface from the costal wall. Such a picture may be soon followed by the appearance of homogeneous density in the lower lung field as the fluid begins to collect at the base. On account of the thickened pleura which is more usually the case with this type of exudate, the upper margin may be found hazy irregular and not clearly outlined as concave like that of serous effusion. In the presence of much thickened pleura, or if parenchymal lesion presents, usual characteristics of serous fluid may not be seen. The character of the shadow may sometimes be such that the diagnosis on X-ray plate alone may be difficult. In the interpretation of such a deceptive Roentgenogram the physical findings must be carefully correlated, although a consideration to the character of the density and the effect which may be produced by fluid pressure should clear out the mist. In case of doubt, establishing a.p.t. will instantly solve the question, as well illustrated by Case XXXI, Fig. 200-203, in which the first

film was interpreted by a Roentgenologist as "fluid in chest with retraction of heart and vessels." The points on the differentiation are discussed under the case.

SECTION VI.—INTERLOBAR EMPYEMA AND ENCYSTED EMPYEMA.

Abscess may simulate encysted empyema with bronchial fistula as to be indistinguishable. Especially in cases which followed influenzal infection, Lemon (122) noticed such difficulties. In cases of long standing, even after operative, it has been impossible to distinguish abscess from empyema with bronchial fistula or from bronchiectasis; only necropsy has shown the internist's and surgeon's errors. According to Hess (199) the X-ray appearance of interlobar empyema is characteristic, showing a dense, almost horizontal band crossing the lung field, in the neighborhood of the interlobar fissure, wider toward the periphery. Carman (211) states that interlobar empyema may give a single rounded shadow, well out in the lung field with clear lung tissue around it, and is not connected with hilar shadows. The most characteristic and striking X-ray appearance of either empyema or lung abscess occurs when free air has been introduced. There may be then seen a horizontal fluid level, changing its position with every change of posture, and in constant movement on the fluoroscopic screen with each respiration. This is especially well seen in the large purulent effusion with free air above it encountered in pyo-pneumo-thorax. Sinkler (211) gives good illustration of interlobar empyema.

The differentiation of lung abscess from encapsulated pleural effusion, or vice versa, is often difficult. The following illustrative case, presented by Wessler and Jaches (46) may be of interest: This was in a man who contracted pneumonia, presumably of the influenza type and developed a pulmonary abscess. Physical signs were those of lobar pneumonia of the right lower lobe in the stage of resolution. All of a sudden, without any marked aggravation of his symptoms the area of dullness at the right base became very flat and the breath sounds were much diminished. Above the region of flatness a dull tympanic note was heard, with distant cavernous breathing. Succussion and metallic tinkle were easily elicited. The question now arose whether this was a rapidly forming abscess cavity or a localized pyo-pneumo-thorax due to the perforation of an abscess. The distinction between these conditions is occasionally difficult, and it may be worth while to summarize the considerations pro and con as we weighted them at the time. In favor of lung abscess:—(1) The known existence of a lung abscess with the expectoration of large amounts of fetid sputum. (2) The physical signs which would correspond to those of a large cavity. In favor of a localized pyo-pneumo-thorax:—(1) The marked superficial dullness, which suggested a pleural effusion. (2) Demonstration of a shifting fluid level which was very distinct. (3) Improbability of the development of so large a cavity as was

indicated by the physical signs in a few days. (4) Fluoroscopic examination, which indicated a collection of fluid and air on the surface of the the lung, not in its depth. The X-ray plate showed the horizontal level of fluid, which was surrounded by a dense adhesion on all sides. This patient was operated on, and, as predicted, a walled-off collection, of foul-smelling pus was found and this was evacuated. A superficial perforated abscess of the lung was found. The patient rapidly improved and was discharged well some weeks later. Circular shadow of even density, such as represented in Fig. 226, may be mistaken for abscess. It is usually situated peripherally. Fig. 23, 24, 231, 232.

Le wald and Green (202) reported a case of lung abscess in which two fluid levels were noticed in a large cavity on the X-ray plate, and it was thought that such double fluid levels might possibly be formed by the difference of density in the same fluid, as evidenced by the layer formation of the sputum in the cup when it had stood a while. The writer, however, hesitates to agree with this view regarding the double fluid level formation in the same liquid, because such different levels in the sputum cup hardly produce appreciable difference of density in the X-ray radiability, more over, even if there would be any difference in the radiability of the fluid, with the thickness of the chest walls, especially with surrounding induration of the lung tissue, such difference would probably be quite difficult to differentiate. It is probable that two fluid levels may be produced by co-existence of cavity and encysted effusion, or by double cavities overlying each other. Simultaneous occurrence of encysted serous and purulent effusion has been noticed in a few instances by Wessler and Jaches— (Clinical Roentgenology of the Diseases of the Chest, page 252-253). Figs. 251, 252. Another possibility of producing double "fluid level" may be by fluid in the cavity and pleural adhesion.

Encysted purulent pleurisy may sometimes produce unique rounded shadow which makes it very difficult to differentiate from new growth, Hydatid cyst or lung abscess, especially in the latter case when there is reactive induration around such encincture. Carman (211) states that encysted empyema is likely to give a rounded or oval shadow of sharp outline, of medially situated and seldom multiple, or mottling. If gas bubbles are seen on top, then difficult to differentiate from abscess cavity.

Babonneix and others (213) recently showed such a case, which would have been mistaken more for Hydatid cyst without the assistance of laboratory investigations. Most unusual location for an effusion encapsulated within the general pleural cavity is perhaps in the medial portion of the chest near the mediastinum. As a primary effusion this is perhaps the rarest form. It is more often seen as a secondary collection which occurs occasionally after operation for the evacuation of an empyema. Frequently this portion of the chest is protected by adhesions, so that pus does not collect in it. If, however, during the course of the operation, these adhesions are severed, and this

portion of the cavity becomes infected, and effusion may form in this location which, owing to the adhesions, is not readily drained and may, therefore, give rise to urgent symptoms. These effusions are particularly difficult to recognize by means of physical examination because the altered physical conditions in the chest which result from the operative pneumo-thorax tend to obscure them. The discovery of this type of empyema is therefore, dependent on the Roentgen examination. It may cast highly localized, even circular shadows and may easily be mistaken for abscess at the root or new growth of this region. Wessler (213) has shown an excellent illustration of this type.

SECTION VII.—MEDIASTINAL PLEURISY.

This is not to be confounded with lung abscess if its clinical and ordinal Roentgenographic studies were carefully made. When the lesions of the mediastinum erodes through the trachea or bronchi, or secondary complication occurs in the lung, the diagnosis may not be easy.

A collection of fluid between the mediastinum and the lung is undoubtedly the rarest of all effusions. The collection of fluid in such an odd location depends on pre-existing of simultaneous fixation of the anterior margin of the lung to the thoracic wall or to pericardium and the posterior margin of the lung to the posterior wall or mediastinal structures, so that the communication with the general pleural cavity is interrupted.

The effusion may be, therefore, anterior, posterior, or in a medium plane, above or below the hilus, paravertebral, unilateral or bilateral. There may be several sacs on one or both sides of the median shadow, in the same plane or at different levels.

One localized on an internal horizontal plane, can not be diagnosed by clinical methods. An effusion in this situation lies in contact with the heart and is entirely enclosed by the overlying lung. For this reason physical signs are not well marked and even when present they are scarcely of a character to suggest a deep seated effusion. The Roentgenologic shadow may be simulated by Hodgkin's Disease, Hilum Tuberculosis, tubercular tracheo-bronchial lymphnodes, thymic enlargement, chronic mediastinitis or disease of pericardium or heart.

Pincherle (215) collected 30 cases among 2000 cases examined Roentgenologically for various diseases of the chest, and from the study of these cases, he concludes that mediastinal effusion does not pulsate either spontaneously or from transmitted movements, and its shadow may be superimposed on one or even both the margins of the heart, giving rise to a double contour of the shadow of the heart. By placing the patient in an oblique lateral position, the two shadows may be separated. The clinical signs of mediastinal pleurisy are not characteristic. Serous pleurisy can be differentiated from dry pleurisy only by exploratory puncture, and empyema from serous

effusion by the greater severity of the disease and the nature of the fluid obtained. It is hard to localize mediastinal pleurisy by percussion and it is only possible in cases located near the anterior or posterior wall of the thorax. Symptoms of compression are not very frequent. Differential diagnosis must be made from tuberculous gland, pericarditis, abscess, tumors of the mediastinum in general and tumors of the thymus, especially in infants, aneurysm of the aorta and diverticulum of the esophagus. The etiology is always tuberculous in the serous and dry forms, while the purulent forms may be due to other bacterias. The prognosis is good if there are no complications. Cure may be brought about by spontaneous absorption or surgical operation or by organization of the exudate and encapsulation.

Two cases illustrating posterior mediastinal pleurisy are given by Frederic Tice (216) with excellent Roentgenograms, and general discussion of the subject, also Barjou's "Radiodiagnosis of Pleuropulmonary Affections" is quoted.

SECTION VIII.—TRACHEO-BRONCHIAL LYMPH NODES.

It is now universally accepted that because of their anatomical and physiological relation to the lungs, the tracheo-bronchial glands and the cluster of glands in the hilum region are the first to be involved when large numbers of tubercular bacilli regardless of the portal of entry, reach the pulmonary tissue. These glands, reacting to the noxious invader undergo inflammatory, and later permanent structural changes which increase their size and make them less permeable to the Roentgen-ray, with the result that they cast a larger and denser shadow on the Roentgenogram than the normal lymph nodes. Clinicians will agree that known diagnostic method will so surely demonstrate the existence of the diseased nodes as the X-ray. On the other hand, these lymph nodes are frequently the despair of the Roentgenologist because tuberculosis is not the only etiological factor in the causation of this glandular enlargement.

The hilum lymph nodes increase in size and density in bronchitis and bronchiectasis, and often attain even a larger dimension during the after the exanthemata and more especially measles, whooping cough and diphtheria. Moreover, such glandular enlargement appears early in the course of pulmonary abscess and persists long after most non-specific pneumonic processes. Stivelman (200) pointed out that the Roentgen appearance of these glands does not point to any etiological relationship, and it is extremely hazardous to make, as it is often done, a diagnosis of tuberculous tracheo-bronchial adenopathy from the plate alone. In case XXVII, Fig. 182-188, there was no Roentgenological evidence of lung abscess but the shadow suggested enlarged tracheo-bronchial lymph-nodes. Abscess confined at hilar region may cause this enlargement. In such cases clinical study and laboratory investigations must be depended on.

SECTION IX.—PNEUMO-KONIOSIS.

Pneumo-koniosis of the advanced type shows patchy shadows of variable density and size situated in the subapical region. It is bilateral and fairly symmetric. In the more chronic cases the dense shadows may suggest consolidation. In this lesion the Roentgenologic characteristics are so different from abscess formation that the two diseases are not likely to be confounded. In the third stage it is characterised by massive fibrosis with generally scattered nodular fibrosis. The clinical study regarding etiology of granite cutter, coal miners and sputum examinations should distinguish this condition when Roentgenogram alone is not satisfactory. Advanced pneumo-koniosis is often associated with tuberculous infection.

Pancoast and Prendergrass (216) give excellent description of the subject with review of the literature and Roentgenographic illustrations of various stages. Cavitations, however, sometimes are associated with pneumo-koniosis according to Hoffman (217) in granite workers blocked lymphatics cut off nutrition and that any infection may cause a fibrous area to break down cavities was frequently observed in those workers.

SECTION X.—PULMONARY MALIGNANCY.

Malignant metastatic nodules, when their circulation is shut off, may ulcerate and discharge their contents into the nearest bronchi and thus exquisitely simulate tuberculous cavitation.

Stivelman states that the diagnosis of pulmonary malignancy has been much simplified as the result of the many recent reported studies. Indeed, the relative increase in the incidence of pulmonary neoplasm is in no small measure due to the fact that we are now on the look out for, and better able to discover these conditions ante-mortem. The Roentgen-ray is at times of inestimable value in the detection of some of these neoplasms, but it often fails us in the most complicated cases. It is a matter of common knowledge that early metastasis in the lung tissue can not in the majority of instances be discovered without the aid of the Roentgen-ray, and not infrequently metastatic nodules of much larger size escape detection on most careful physical explorations of the chest only to be easily elicited Roentgenologically. It is different in the case of primary pulmonary malignancy. Here the X-ray shadow which is usually dense and homogeneous, especially when situated in the upper lung field, may exquisitely simulate an old fibroid tuberculous process with pleural thickening, pulmonary abscess, and localized or interlobar effusion. Matters are further complicated when there is a pleural exudate secondary to the lung tumor. The Roentgen shadow in this case is indistinguishable from an ordinary effusion of extensive pleural thickening. The age of the patient may not help in the diagnosis

because both fibroid phthisis and pulmonary malignancy are found in patients of the same age group. The differential diagnosis will then rest on clinical history and not on the X-ray alone.

A history of the cough of more recent onset, in a patient past middle age, loss of weight, troublesome and persistent pain on the involved side of the chest, and particularly early dyspnea in the absence of cardio-renal disease, is suggestive and requires further investigation. If in addition to such a history, physical exploration of the chest discloses an absolute unilateral lesion with a flat note on percussion, feeble breath sounds or crackles and some evidence of glandular enlargement, especially when tubercle bacilli cannot be found in the sputum, a diagnosis of pulmonary malignancy may safely be made. When there is a co-existing effusion, a diagnosis can not be arrived at Roentgenologically unless some of the exudate is removed and replaced by air in accordance with the method recently described.

In order to make adequate interpretation of Roentgenogram in malignancy of the chest, a thorough understanding of its pathology is indispensable.

Kaufmann (218) describes three forms of primary cancer of the lung: (1) A tumor beginning in the first or second branch of a main bronchus, near the hilus. This may result in a circumscribed stenosing infiltration, or a large nodule surrounding the bronchus, or thick string like infiltrations extending out from the hilus along the lymph-vessels, or a carcinomatous lymphangitis develops, with the greater and lesser lymph channels filled clear out to the alveoli. (2) An infiltrating form in which sometimes an entire lobe is infiltrated with caseous, pneumonic, carcinomatous material. (3) A circumscribed tumor in the midst of a lobe, soft or hard, more or less round, and of varying extent. There may be nodular foci in its vicinity and eventually in the other lobes of both sides.

Krause (219) discussing all lung tumors, classifies them in three Roentgenologic groups: (1) Tumors which extend as an arch from the hilus shadow. Of this sort are the carcinomas, which originate in or around the main bronchus near the tracheal bifurcation. (2) Tumors which infiltrate a lobe. These show as large, dense shadows sharply set off from the clear lung. A sarcoma of the upper lobe, which Krause saw, exemplified this class. (3) Small tumors in the medial lung field. To these belong the connective-tissue tumors, such as fibromas, osteomas, chondrolipomas, and enchondromas.

Assmann (220) points out that the Roentgen-ray shadows of tumors are not only due to the tumor tissue itself, but also to numerous complicating factors, especially to neighboring infiltrative processes, atelectasis due to compression of a bronchus, connective tissue formation, and shrinking processes. Often there is gangrenous disintegration of tissue or abscess formation or pleural exudates which may completely change the original character of the Roentgen-ray picture.

Many complicating factors which would materially affect the Roentgen-ray picture become apparent on studying those reports made by Adler (221). Thus, in 75 cases the large vessels in the mediastinum were either invaded directly or compressed by the tumor mass. Bronchiectasis was recorded in no less than 28 cases; 19 cases were either probably or definitely associated with tuberculosis; a few showed tubercular cavities, and in three the miliary form of tuberculosis was noted. Atelectasis from bronchial obstruction or compression was mentioned in several cases; in a few instances pneumonia of various types were present.

In the series of Carman (210) consisting of 38 cases, two chief Roentgenologic types were noted, one in which the shadows are largely lobar and one in which they are principally hilar. The lobar shadow is often extensive and may or may not be accompanied by some smaller shadows of metastasis. A less common lobar type, the miliary, may appear as multiple small shadows in both lungs. Two varieties of the hilar type have been observed, one rounded and circumscribed, the other with an irregular border and shadowed extensions. The extensive, dense, lobar shadow attended by smaller shadows of metastasis is considered to be pathognomonic. All other varieties require careful interpretation in the light of the clinical facts.

Stereoscopic plates are essential to satisfactory examination of the chest. These may be made with the patients standing, sitting or prone; usually the standing position is preferred. Roentgenoscopy is an important supplement to Roentgenography, especially in those cases in which the mediastinum is invaded, in order to distinguish between cancer at the root of the lung and aneurysm or other mediastinal lesions. It is especially valuable in determining the presence or absence of pleural effusions. Fluoroscopy permits inspection of thoracic conditions at any desired angle of view, as well as their behavior during various phases of respiration. In this connection Adler's (221) remarks regarding the different effect of pulmonary and mediastinal tumors on the respiratory mobility of the lung are well worth remembering. He says "It has repeatedly been noted that in lung tumor the mobility of the lung is markedly diminished or entirely abolished. In cases of mediastinal tumor the respiratory motility of the lung remains unchanged or is increased, and Jacobson has found this valuable in distinguishing between the two types of tumor. The shadow of a carcinoma or sarcoma just starting from the hilus and gradually extending toward one of the pulmonary lobes is a very striking picture, and often suggests the tumor diagnosis when the observer, though other characteristic symptoms were present, would have been led astray. The interpretation is more difficult when the shadow extends over the upper lobe of either side, as this is the favorite localization of tuberculous processes. Sometimes the sharp linear delimitation at the base of the shadow makes for tumor rather than tuberculosis. It speaks for tumor also if the affection is confined to upper lobe. But where tuberculosis is associated with advancing carcinoma or sarcoma the

Roentgen-rays are of little value and if a differential diagnosis is possible, it must be attempted by other means." In doubtful cases re-examination at intervals will show the rate of growth of the lesion and assist in determining its probable character. In case XXIII it was especially hard to give diagnosis at first, without determining the regression of the abscess shadow (Fig. 167-175).

SECTION XI.—METASTATIC CANCER OF THE LUNG.

Metastatic cancer of the lung occurs in two principal forms, the gross nodular and miliary. Gross metastatic nodules are, commonly multiple, of various sizes, round, bilaterally distributed and sharply circumscribed. Miliary metastasis from extra-thoracic foci is usually bilateral, symmetrical, and unaccompanied by any large dense area in the lung which might be regarded as the primary source. Obviously, however, the original focus could be in the lung and so small as to escape detection. Absolute distinction between primary and metastatic cancer, when no extra-thoracic focus can be demonstrated, can be obtained only by exhaustive examination at necropsy. It is not possible to make a pathological distinction between the various forms of secondary tumors. In general it may be stated that very large tumors with sharply circular outlines are sarcomatous. Metastasis from testicular carcinoma may be very large, single circular and clearly defined. The reader is referred to the other paper by the writer, on the Testicular Carcinoma of the Lung.

Bramwell (222) published a very interesting case of metastatic lung abscess. His case is quoted as follows because of the clinical interest. "Case—Two abscesses in the lung; ulcer of the stomach; malignant deposit at the root of the right lung; hereditary webbing of the second and third toes of the left foot.

"I next wish to show you, gentlemen, the stomach and lungs from a case which presented great difficulty in diagnosis during life. The patient, a man, aged 43, was admitted to the infirmary on November 5, 1906. I first saw him on October 20, 1906. He came to me complaining of general weakness, pain in the lower part of the chest and gullet, loss of appetite and flatulence. He stated that three weeks previously he had had an attack of dry pleurisy; that since that attack, he had lost flesh and had been troubled with palpitation, sleeplessness and stomach symptoms. I was unable to detect any definite evidence of organic disease either in the stomach, lungs or heart. When admitted to the infirmary a fortnight later, he looked ill. He complained of pain over the region of the stomach, liver and lower part of the right chest. On one occasion he vomited a small quantity of "coffee-ground" material which looked like blood, but which did not give the characteristic blood reaction with guaiacum and ozonic ether. After his admission to hospital he developed a temperature and a good deal of cough and mucopurulent expectoration. He became very weak and anaemic.

Repeated examination of the sputum failed to detect any tubercle bacilli—we suspected either tubercular or malignant disease with secondary deposits in the lung.

Some weeks after admission, dullness developed over the lower part of the right lung. On making a diagnostic puncture, Dr. Brown drew off some pus. We then thought that we had to do with an empyema. Mr. Cotterill kindly operated upon the patient. There was no empyema, but a large abscess in the lower lobe of the left lung; two points of pus were evacuated; a drainage tube was inserted. For a few days, there was some slight improvement, but the patient then gradually got worse; he continued to spit up a good deal of purulent material; eventually he died with edema of the feet on March 5, 1907.

Post Mortem Findings.—On post mortem examination, a large abscess containing two pints of pus was found in the right lung; the abscess was mainly situated in the anterior aspect of the upper and lower lobes; the walls of the abscess were formed by gangrenous lung tissue; this abscess was quite distinct from the abscess in the posterior part of the lower lobe which had been opened and drained. It is very unusual to meet with two large abscesses in the lung, one in the lower and another in the upper lobe. The presence of the second abscess was not suspected in the operation. The stomach was dilated; at the pyloric end there was a large ulcer, which was obviously of old standing and perforated through the whole thickness of the stomach wall; the omentum underneath was nodular and hard, evidently the seat of a malignant growth. A large nodular mass of malignant growth was present at the root of the right lung; it was mainly situated under the arch of the aorta; it infiltrated the root of the lung, involved numerous lymphatic glands and obstructed some of the large bronchi. The pathological sequence of events seems to have been:—(1) a simple ulcer of the stomach, which had healed; (2) the development of cancer in the base of the ulcer; (3) a deposit of secondary cancer at the root of the right lung; (4) the formation of two large abscesses, the first in the lower, the second in the upper lobe of the right lung. The case is a very unusual one and presented great diagnostic difficulty during life. Multiple abscesses in the lung are usually pyemic in origin and of small size."

SECTION XII.—BRONCHIAL STENOSIS AND ITS EFFECT ON X-RAY.

Golden (223) studied the effect on X-ray plate of bronchial stenosis in carcinoma of the bronchus in several cases, and he concluded that as its physical effects are concerned, bronchial carcinoma may be considered as developing in two stages: (1) stage of invasion and (2) stage of broncho-stenosis which is characterised by bronchiectasis, infection, atelectasis, and pleural thickening, with or without fluid.

The hazy ill defined shadow about hilus during the stage of invasion may be replaced, as the effect of bronchostenosis begins to manifest themselves, by a dense homogeneous shadow, covering the area of one or more lobes, sometimes accompanied by displacement of the heart and trachea to the affected side. Such massive shadows are due to atelectasis of the corresponding lobes with associated bronchial and pleural changes and not to the tumor itself. Hence it is evident that they are not characteristic of bronchial carcinoma, but may be produced by any process which occlude a bronchus. Syphilitic stricture and pressure on a bronchus from an aneurysm or from tuberculous glands are other causes of broncho-stenosis. During the past three years, however, Golden had seven instances of broncho-stenosis due to pulmonary neoplasm, only two from syphilis and none from pressure of an aneurysm or tuberculous glands. His experience seems to indicate that neoplastic broncho-stenosis is distinctly more common. It is obvious that a correlation of clinical and laboratory information is necessary in order to reach a definite conclusion in these somewhat confusing cases. But when these shadows occupying the position of one or more lobes present themselves for consideration, if the possibility of broncho-stenosis due to neoplasm is mentioned, the diagnostic machine will at least be started on the right road.

SECTION XIII.—PULMONARY SYPHILIS.

In recent years, the subject of pulmonary syphilis has been widely discussed. The time has not yet arrived when the frequency of its occurrence can be correctly estimated. Suffice it to say that it is seen less often than some Roentgenological reports would indicate.

Stivelman (200) states that whether it is encountered in the form of diffuse fibrosis or Gumma of the lungs, a definite diagnosis can not be reached on the basis of a Roentgenologic examination alone. In the first instance the plate can not be distinguished from pulmonary sclerosis of non-specific origin and in the latter case it may exquisitely simulate malignant metastasis, localized pleural effusions, pulmonary abscess and at times patches of frank pulmonary tuberculosis. Here again it is the clinical course of the disease, the result of the physical, sputum and blood examinations that must determine the true nature of the affection.

Syphilis of the lung, because of its infrequency, will not often enter into the differential diagnosis, although a few fairly well-proved cases have been reported. Assmann (220) recounts a case in which a Roentgen-ray examination by Forsell showed enlargement of both hilus shadows, especially intense on the right, with a consolidation as large as a "goose egg" and branches radiating into the pulmonary tissue. At necropsy this consolidation was found to be made up of connective tissue, strands of which extended into the upper and middle lobes.

SECTION XIV.—ANEURYSM.

With its sharply delimited shadow extending from the mediastinum requires differentiation only from a clear cut encysted abscess. Expansile pulsation, as noted on the screen, would make the differentiation. In the occasional absence of this pulsation a history of syphilis or a positive Wassermann reaction may be decisive. Lung abscess rarely pulsates although Greenberg (224) met one such case.

SECTION XV.—HODGKIN'S DISEASE.

The Roentgen manifestations of this disease are manifold and they present some unique features which are of value in distinguishing it from malignant tumors and other diseases within the chest. Enlargement of external lymph-nodes are usually present in this disease. The disease manifests itself in one of two ways: (1) A bilateral and fairly symmetrical projection from the mediastinum, extending the entire length of the median shadow. Its borders may be undulated and either clear-cut or irregular. This picture is quite diagnostic and not to be confounded with other mediastinal diseases. (2) A unilateral projection from either hilum with a circumscribed or ragged margin. This type cannot be distinguished Roentgenologically from abscess starting in the hilar region with much indurated lung, or primary cancer. In such instances the clinical study aided by biopsy alone establishes the diagnosis.

SECTION XVI.—BENIGN TUMORS.

Benign tumors can be excluded with ease, besides they are rare, remain stationary for long periods or progress slowly and are likely to have well-defined margins. Jacobaeus and Key (225) have reported 6 cases of pulmonary tumor, all of which were benign save one, a fibroxanthosarcoma. All the Roentgenograms show a single, rounded, dense, clear-cut shadow. Four of the shadows projected from the mediastinum; two were in the left upper lobe. These writers dwell upon the diagnostic value of thoracoscopy and Roentgen-ray examinations before and after the induction of pneumothorax.

At least four cases of the writer's series of lung abscess, which had long standing subacute inflammatory process near the root, were often interpreted as fibroma by some Roentgenologists. Case XVI, Fig. 113-124; Case XXII, Fig. 161-166.

Benign tumors may produce chronic symptoms resembling that of chronic lung abscess.

SECTION XVII.—HYDATID CYSTS.

They are usually single, though sometimes multiple; they tend to occur in the right upper lobe, and when unruptured produce a circumscribed rounded opacity. Abscesses seldom show roundness of cysts. Heuser (226) states that cyst presents similar rounded shadow like sarcoma but it appears less dense than the latter. Glassman (227) presents typical Roentgen picture of Hydatid cyst of the lung.

SECTION XVIII.—DERMOID CYSTS.

They are single, arise in the mediastinum, and are less opaque than hydatid cysts. Barjon comments on the perfect roundness of cysts, as though they had been traced by a compass.

SECTION XIX.—STREPTOTHRICOSIS AND SPIROCHAETAL PULMONARY GANGRENE.

These may be accompanied by extensive cavitation, which on Roentgen-ray examination alone are indistinguishable from tuberculous cavitation. In all such instances a painstaking study of the clinical history, symptomatology reinforced by repeated physical exploration of the chest and particularly careful examination of the sputum will lead to a correct diagnosis while reliance on the Roentgen-ray alone may leave cause for regret.

SECTION XX.—ANNULAR SHADOWS.

By annular shadow it is meant here a ring formation on the Roentgenogram without definite characteristics of an abscess formation. There seem to be widely varied opinions among authorities regarding an annular shadow in thoracic Roentgenograms. Namely, from extremes that all annular shadows should be looked upon as cavitations, which has recently been questioned by various writers, and to a very limited opinion, but even in the latter no rulings have been ventured.

A certain number of such shadows, by a fortuitous arrangement, may simulate cavities. It is not uncommon, especially at the roots of the lungs, for the shadows of blood vessels and indurated lymph nodes, may happen to cast shadows resembling cavity walls. It needs only to be stated that tuberculous cavities and the hilum of the lung are very rare and that a careful scrutiny of these shadows will disclose their true nature.

A confusion between the CROSS SECTION OF A BRONCHUS and a cavity is possible only to the inexperienced. Fig. 123, 124, Fig. 142-144, Fig. 229, Fig. 210, 211. They are usually found near hilum. Of greater importance than these sources of error are the ANNULAR SHADOWS of PLEURAL ADHESIONS which may be circular outline and may closely simulate a cavity. Fig. 94, Fig. 180-181, Fig. 70-71, Fig. 82-83, Fig. 243-247. On the otherhand, thin walled cavity near hilum may be easily mistaken for pleural adhesions. Fig. 158 -a, -b, 159.

The distinction can not always be made and resort to stereoscopic or repeated X-ray examinations may be necessary in order to determine their true nature. Fig. 166 illustrates cavities although they may appear like cross cut dilated bronchi at hilum by looking at a single plate.

According to Anderson (228) pleural annular shadows are realities which must be distinguished from intrapulmonary cavity shadows. The lesion casting such shadows appears most often to be a subacute or chronic localized pleurisy, which often undergoes rapid changes in size. This may be accompanied by a puckering, dimpling or umbilication of the subjacent pulmonary tissue and the resulting pleural interstice may contain a small amount of fluid. If the fluid level within the shadow varies greatly from day to day, or if it disappears with postural drainage, the evidence favors true cavity. Pleural annular shadows develop without any demonstrable rarefaction of intrapulmonary density, usually in the upper and posterior parts of the chest or in the planes of the interlobar fissures. The inner border is practically sharply defined, while the outer one gradually shades off sometimes extending as a diffuse cloud over wide areas of the field or as a pleural cap enveloping the apex. Through the ring unbroken pulmonary markings can often be visualized distinctly. The shadow increases in size by a uniform widening of its internal circumference, practically never by a coalescence of small shadows. A feature of distinction is the frequent rapidity of its extension without a proportionate change in the pulmonary infiltration. The pleural shadow may spread itself over a wide field in several weeks or months, while the relatively small pulmonary densities show little change in the distribution. True cavities may become greatly contracted or obliterated by the shrinking of the enveloping fibrous tissue, a process which required 2-3 years or longer, of slow healing. Anderson believes the site of a healed cavity is always marked by the density of a fibrous tissue. However, I have noticed in many instances that these fibrous tissues have quickly disappeared.

Demonstration of a bronchial communication with the shadow is presumptive evidence of cavity.

Lung abscess is often associated with annular shadows caused by pleural adhesions or distended bronchi. Shadows due to pleural adhesions are distinguished by these characters described above, viz. hazy outline, variable day to day, homogeneous lung

markings within the ring, absence of mottling, in the surrounding area, and by introduction of a.p.t.

Those cases by thickened and dilated bronchi are shown as small circles with thickened outline, often multiple.

Dunham and Norton (229) stated from their Roentgen study in tubercular patients at Cincinnati sanatorium, that cavities are responsible in the vast majority of cases, for the annular shadows, and as a rule, these cavities are thin walled, which entails a very grave prognosis, the danger being out of proportion with clinical signs and symptoms (in tuberculous patient). The only uniformly satisfactory method of making the differentiation is by a.p.t. which happens to constitute the best of treatment for such cavities, being free from danger in case which the shadow should be due to an air containing pocket. Out of author's material, 67 cases, 24 were proved by a.p.t., 32 by prolonged X-ray observations and the remaining 11 by autopsy. Clinically, if a patient has expectoration (containing tbc. bacilli, an ulcerative focus almost always exists in the lung; the more copious the expectoration, the larger the cavity is likely to be, if the X-ray shows a single doubtful annular shadow without any other rarefaction and the patient has sputum with tbc. bacilli, that shadow probably represents true cavitation. In our present series, rounded shadows were apt to be mistaken for cavities, for instance, Case XXVI, Fig. 180, 181; Case XXXV, Fig. 245-248.

CONCLUSIONS.

1. The diagnosis of pulmonary abscess is not always easy; the physical signs are usually scant; localized dullness, diminished breath sounds, some changes in the vocal resonance and whispered voice are most important signs if accompanied by definite clinical symptoms.

2. Every case with chronic tuberculous symptoms should receive careful investigations, including Roentgenoscopic, serial-roentgenographic and, if necessary, bronchoscopic interpretations assisted by carefully taken history in order to establish true explanation for the symptoms.

3. Majority of lung abscess following operations in the upper air passages are caused by aspiratory infection, first taking place around the root region, and then invading deeper pulmonary tissue; the X-ray findings if serially taken are characteristic.

4. Lung abscess following operations in general, under general anaesthesia are more often due to aspiratory infections than it is thought; the Roentgenologic characteristics can be noted in this type.

5. In any cases in which respiratory tract symptoms follow operations, especially tonsillectomy, under general anaesthesia, a developing abscess should be suspected even though symptoms and signs, and X-ray examinations point to broncho-pneumonia; accordingly due precautions should be taken.

6. High percentage of lung abscesses in recent years following operations have been the result of neglect or mismanagement on the part of the nose and throat surgeons and dentists.

For prophylaxis it may be suggested that, (a) careful preparation of the patient before operation—cleansing of nose, throat and mouth, proper care for pyorrhea and sinusitis, etc.; (b) employing a local anaesthetic whenever possible; (c) keeping the head low during such operations; (d) taking care to prevent blood and mucus from accumulating in the throat and being aspirated; (e) use of suction apparatus by a trained medical anaesthetist; (f) use of moderate Trendelenburg's position with head low, and return of the patient to the bed on his left side with face down; (g) especially in operating on the antrum, frontal, sphenoidal and ethmoidal cells it is imperative to block off, by means of properly placed postnasal tampons, all possible avenues, so that pus, granulations or other debris may not escape into the lower air passages.

7. Roentgenologic appearance of lung abscess may be classified into four groups, viz. I. cavity with fluid level; II. circular homogeneous density without fluid level; III. localized triangular density around the root shadow; IV. large dense shadow occupying lower lung field.

Group IV cases are usually complicated by pleural diseases, or multiple abscesses, and the mortality is highest. Group III cases are most frequently found in aspiratory type; respond best to postural and bronchoscopic drain; mortality lowest; may proceed into any of the other groups.

8. Majority of X-ray findings in the early course of the disease were negative for, demonstrating actual cavitations, unless X-ray examinations be made repeatedly and in different positions.

9. Destructive lesions produced by aspiration take place primarily in the hilar region, and such lesions may advance peripherally or toward the base in the later course of the disease, so that cavitations may be spontaneously found in the peripheral region only. The popular idea that aspiratory lung abscesses are more often found in the right lower lobes can not be indorsed.

10. Decision as for the selection of the method of treatment must depend on the character and the location of the lesion as evidenced on the X-ray screen or Roentgen plate; and the efficacy of such a treatment should be checked up by serial Roentgenography and the clinical findings.

11. In general, it may be stated that, (a) thorough medical treatment, with early

postural rest and drainage should be first instituted assisted by bronchoscopic observations and drain, if possible; (b) when the above method fails, pneumo-thorax should be produced carefully, and surgery resorted for those patients who do not respond to the other methods; (c) the exploratory needle should not be employed; (d) when surgery is decided on, para-vertebral and local anaesthesia, if necessary, with gas and oxygen, should be used; in the majority of patients, a more deliberate, extensive and logical operation should be planned than resection of the chest wall over the abscess and cautery or blunt puncture of the abscess; (e) if the patient's condition is such that extensive operation would involve too much risk, resection, blunt puncture and exploration of the abscess with the finger should be the limit of surgery.

12. Lack in proper teamwork may lead to serious mistakes. The surgeon, physician, bronchoscopist and Roentgenologist should be intimately associated in making the diagnosis and in the care of these patients. The Roentgenologist must have more intimate concern with the clinical medicine, while the clinician as well ought to master in ordinal technic of the regional Roentgenology, and to gain sufficient knowledge to be able to correctly interpret films, and thus healthy development of clinical medicine can only be expected.

In the management of the cases too, there must be proper co-operation between surgeon, clinician, Roentgenologist and bronchoscopist. In this respect, G. C. Shattack's (230) impression on the chest surgery may be quoted as follows:

".....Chest surgery differs from the surgery on the other parts of the body in two important respects; (1) its field has been much enlarged during the war, (2) some of the questions which arise in connection with chest cases are of a kind with which the physician is more familiar than the surgeon. For example, it may be important in case to know whether the dyspnea is due to a large haemo-thorax, pneumo-thorax, pulmonary oedema or massive collapse of the lung; whether the circulatory disturbance can be relieved by aspiration or is due to shock or to haemorrhage; whether the temperature is probably caused by infection of the haemo-thorax or due to some other causes.Surgeon is constantly occupied in the operation room, while the physician has more time to study the case in the ward and to direct treatment in detail....."

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APPENDIX.

SUPPLEMENTARY CASE OF LUNG ABSCESS.

Since the completion of this manuscript, another case of lung abscess has come under the writer's observation. As this case involves certain etiologic, Roentgenologic and surgical interests, it is added here as a supplementary case. This case is, of course, not included in the general consideration of the series of one hundred cases.

Case:—P. S., mechanist, Greece, aged 26, single. Admitted to the Hospital on Jan. 19th, 1926 with the chief complain of profuse expectoration and fever of about ten days' duration.

His Past History:—Remembers having Measles, but no other childhood diseases. In August 1911 he has admitted to this hospital where he remained under observation for about a month. At this time he was supposed to have incipient pulmonary tuberculosis; his chief symptoms being pain around right scapula, cough and fever; the physical findings were then dullness over right apex, especially posteriorly with numerous moist rales; temperature 100-103 F. during the first four days, then 98-100

F.; the laboratory findings were: Von Pirquet positive, no tubercular bacilli demonstrated during repeated sputum examinations; W.B.C. 17,000 with poly. 85%.

After leaving the hospital the patient spent in the country for eight months during which time said to have had bronchitis. Had tonsillectomy in 1909, but no other operations. Had no pneumonia, pleurisy or influenza, although would get many "colds" during each winter for past 3 or 4 years. Two years ago had a "severe cold" with slight haemoptysis, at which time the X-ray said to have shown tbc. Digestive system: always good appetite, a.p.t. to eat too fast and too much, and stomach easily upsets. No venereal diseases.

Family History:—Father 62, mother aged 51, both alive and well; three brothers and three sisters, all well and none lost in the family. No chronic illness or tuberculosis in the family.

Present Illness: Patient contracted cold three weeks ago which came on suddenly, but with no severe symptoms such as chills or high fever or cough. He felt quite sick and went to bed where he remained for three days, then got up feeling much better, but not strong enough to return to work. He was up about home feeling quite well until 6 days later, when he was taken sick a second time with a "cold" and some gastro-intestinal disturbance. He had a severe cough, fever for a few days and pain in his right chest. The cough at first was not productive, but later became quite so. The sputum at first was bloody, later became more pussy without blood, which smelled badly.

Physical Examination:—General appearance: Well developed and nourished, lying quiet in bed, appearing neither acutely nor chronically ill. Head: hair, scalp, ear, nose, are negative; eyes negative except pale mucous membrane, eye balls slightly more prominent than normal. Mouth: pharynx slightly injected, tongue coated, teeth good. Neck and spine negative. Chest: fairly well developed, symmetrical, no deformities; expansion equal on both sides, but excursion is small; slight lagging of supra and infra-clavicular space.

Lungs:—Apices dull posteriorly, especially on the right side; the rest of the lung appears resonant. Numerous mucous rales over both apices posteriorly at angles of both scapulae and in interscapular regions, which do not clear up on coughing. Breath sounds do not seem to be materially altered, although somewhat diminished at right scapular region. Anteriorly over right apex are heard crepitant rales. Some crepitant and some coarse rales in right axilla which clear up by coughing.

Heart:—Apex felt at 5th i.c.s., 8 cm. from mid-sternal line; right border within normal limit. Heart rate regular, quality good, and no murmurs.

Abdomen:—Scaphoid type; fair amount of subcutaneous fat. In the wall of the abdomen in the mid line, just below the umbilicus is a rounded firm mass about 4 cm.

in diameter, which is not attached to the skin, but is attached to the fascia, feels like a fibrolipomata. Otherwise entirely negative.

Extremities:—No real clubbing of fingers, but nails have a peculiar shape.

Lymphatics:—Few small post-cervical and axillary nodes palpable.

COURSE.

Laboratory Findings:—Blood culture, 5 days negative plain broth—dex. broth,—two agar plates. Hglb. 100%, W.B.C. 14,250 with poly. 68%, S.M. 22%, L.M. 6%. Sputum: Streptococcus and diplococcus; repeatedly negative for tbc. Contained a few elastic fibre, odor not foul.

Patient was bringing up about 100 cc. purulent material every day. Postural treatment was instituted with the patient lying on his left side, but without improvement. Had septic type of fever ranging between 101-104 F.

The Roentgenologic findings were: A large cavity containing fluid level, near periphery and high up in the right axillary region, with fairly well localized induration. Later Roentgenography showed increasing shadow. For further description refer following pages.

Since the clinical as well as the Roentgenologic findings rather spoke in favor of operative interference, the patient was operated on Feb. 4th, 1926.

Operation:—Incision high in axilla, slightly curved. 2 inches of 4th and 5th ribs were removed. Needle obtained pus. Abscess opened through about 1/4 inch of necrotic looking tissue. Considerable thick pus was present and some rather solid granular material which was evidently inspissated pus, which was saved for later microscopic examination. On opening the cavity there was considerable coughing which made it necessary to give him a few drops of chloroform. Two large rubber tubes were introduced.

Note:—It was necessary to do practically the whole operations before opening the abscess, since the coughing of the patient made it impossible to do much after that. Large segments of ribs were not removed, although this would have been just as easy, for two reasons: 1. It would have opened up wide tissue planes for infection: 2. The reproduction of the ribs is always very irregular and hard, and makes them difficult to remove if an attempt is ever made to collapse the cavity.

Post-operative Course:—On the third day after the operation the patient's fever dropped to 100-101 F., and then on he made steady improvement; the cough greatly decreased, expectoration almost negligible. The patient was up about on the tenth day; discharged greatly improved at the end of 4th week after the operation.

Pathological Examination:—Specimen consists of a mass of necrotic whitish tissue. Microscopically, reveals a mass of tangled structure resembling mycelium with clear spore-like bodies, occasionally branched form appears. The exact nature of these masses cannot be determined accurately but they suggest some form of higher bacteria, possibly *Aspergillus Nodulans*.

ROENTGENOLOGIC FINDINGS.

Fig. 255. Jan. 20th, 1926, erect, A-P position.

Right Lung Field:—There is a dense shadow, roughly triangular in shape, occupying right upper axillary region. This shadow is composed of a rounded area of less density just below the mid portion of the clavicle, and of a highly dense homogeneous area of triangular shape, situating below the circular area with the apex pointing downward. The rounded rarefied area has more or less regular, well defined outline, $4\frac{1}{2}$ by $3\frac{1}{2}$ cm. in size, but containing no definite fluid level, suggesting a large empty cavity. It is surrounded above by a zone of homogeneous haziness which is limited from less hazy apical shadow. The lower margin of the triangular density curves downward along the lower border of the 3rd rib in front, and its apex is seen to reach the level of the lower border of the 7th dorsal rib, just inside of mid-clavicular line. There is some aerated lung tissue interposed between the abscess shadow and the mediastinal shadow, although this zone contains some increased linear markings. The right bronchus is visualized. The hilar shadow is somewhat accentuated, but it is well separated from the abscess shadow. The apex is slightly hazy, but homogeneous, not presenting the characteristics of tubercular infiltrations. The lower lung field is lighted up normally, and contains some engorged vessels.

Left Lung Field:—No pathology is noted in the left lung. Both costophrenic angles are clear. Heart: The right heart border is slightly bulging, measuring $4\frac{1}{2}$ cm. right of midsternal line, and the left border, $7\frac{1}{2}$ cm. left of midsternal line.

Fig. 256. Jan. 29th, 1926, erect. Right Lung Field: A large cavity with fluid level, high up in right axillary region and with triangular shaped density below. The outer border of the triangular shadow is seen to curve downward and inward along the lower border of the 3rd anterior rib shadow, and the apex is located at the level of the 8th dorsal rib, while the inner border is indefinite, appearing mottling, continuous with dense, mottling hilar shadow. The whole shadow has become more extensive than previous. The cavity has also increased in size and more definitely outlined, containing definite fluid level. There is increased homogeneous haziness at

the apex. The Left Lung Field is normally aerated but appears engorged; hilar shadow slightly accentuated. Both costophrenic angles are clear. The right lower lung field is normally aerated, but contains some engorged vessels.

Fig. 257. Lateral erect, Feb. 3rd, 1926. Nearly upper 1/2 of the lung field is occupied by ill-defined density. There is complete ebonization at its upper extremity, and shortly below this, there is flattened out triangular shadow, whose apex is located as low as the upper level of the 8th dorsal vertebra. Its lower margin is rather clearly defined; the upper border is straight (or the base of the triangle) and horizontal indicating fluid level, above which is seen a faint arch formation forming upper wall of the cavity, including below a rarefied area. The shadow extends as far back to the posterior thoracic wall, while anteriorly there is a zone of normally aerated lung tissue interposed between the abscess and the anterior thoracic wall, which measures about 3 cm. Costophrenic angle is clear.

Fig. 258. Erect, 2/13/26. Taken 9 days after the operation. The position of the patient is twisted due to the wound dressing.

Right Lung Field:—There is haziness in upper half of the lung field. Now only a faint shadow of the cavity remains high up in the axilla, measuring 1.2 cm. with very faint irregular outline. A slightly above and medial to this, there is also irregularly rounded rarefied area which may be a part of the cavity. From this picture and the findings in the previous films, the cavity now seems to be run across by numerous trabeculi, and partially compressed by re-spreading lung tissue. The surrounding induration has almost completely disappeared during such a short period. The hilar shadow is accentuated. The homogeneous haziness in the apex may be due to thickened pleura. There two large tube drains are inserted. The rest of the lung field appears normal.

Fig. 259. 2/13/26. Taken erect at the same time as the foregoing figure, but after the tube drains have been removed. This presents the same picture. The gaps where the pieces of ribs were removed at time of operation are shown. The most part of the density at right axillary region has cleared up. No pathology in the left lung field.

COMMENT.

From the history of the patient, very little could be found regarding to the etiology of this case, and it might be easily grouped under "idiopathic" class. There were suggestive history and physical findings for apical tuberculosis 15 years ago, but the evidences were not sufficient enough to warrant the diagnosis. If tuberculosis

had existed at that time, and this persisted with off and on activities, as suggested by those recurrent symptoms as repeated "cold," haemoptysis, etc., and the lesion had advanced to the formation of large cavity, as it did in this case, we certainly ought to find much more severe changes in the Roentgenogram, due to reactive fibrosis and calcification, and secondary retractions, while in this instance there was very little noticeable in the right apex, disregarding the changes due to the acute abscess formation.

There is another strong point which speaks in favor of this not being tuberculous nature—the fact that there was such quick and remarkable good result obtained by the surgical procedure. Tuberculous cavitation will not cure, so rapidly at most, by simple operation for evacuation of the cavity.

Roentgenologically, not only large part of the pathological shadow disappeared shortly after the operation, but no characteristic tuberculous shadows were seen. Finally, guinea pig inoculation of the cavity contents resulted also in negative.

It is of great interest that the microscopic examination of "inspissated" pus content of the cavity revealed a mass of *Aspergillus Nodulans*. Slow processed, localized infection of the lung caused by this fungi may be said to have invited secondary saprophytic infection resulting in the acute abscess formation in this case.

Brief survey of recent literature will show that varieties of organisms, including fungoid bodies, may infect the lung tissue and produce very similar symptoms like tuberculosis.

Armand Delille and others (1) reported in 1924 Mycotic pulmonary lesion in a patient suffering from dermatitis due to the same organism.

Bissell (2) observed, during the two years prior to the epidemic of 1918, a group of cases in which the symptoms and physical signs pointed to pulmonary tuberculosis, but in which the characteristic Roentgen signs of that disease were absent.

Hopkins (3) grouped those cases admitted to a sanatorium into three classes: (1) those frankly tuberculous, (2) tuberculous suspect, and (3) those frankly non-tuberculous. According to this writer, the percentage of non-tuberculous cases and tuberculous suspects admitted to any sanatorium is without question quite high. The two definite things about the non-tuberculous cases are the nature of the symptoms and the fact that, even after prolonged investigation, evidence sufficient to warrant a positive diagnosis is not obtained.

In the Tropical and Sub-tropical countries fungoid and spirochaetal pulmonary infections are frequently met with, such as reported by Greer (4) and Johns (5).

Wahl and Haden (6) reported some cases in 1924 of chronic pulmonary disease caused by a new fungoid organism, a group of *Trichophyton* family.

Gonzalo (7) discusses various agencies which may produce apical infiltrations other than tuberculosis.

This is another example in which the surgery was of great success. Such Roentgenologic findings—peripherally situated large abscess with localized induration and with no involvement of the rest lung—should sufficiently warrant proper surgical interference. Another point emphasized in this case is the fact that there was very little in the physical signs compared with the Roentgenologic findings. It will be of interest to compare this with Case XXXII.

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Case of Pulmonary Metastasis of Testicular Carcinoma. PLATE I—X.



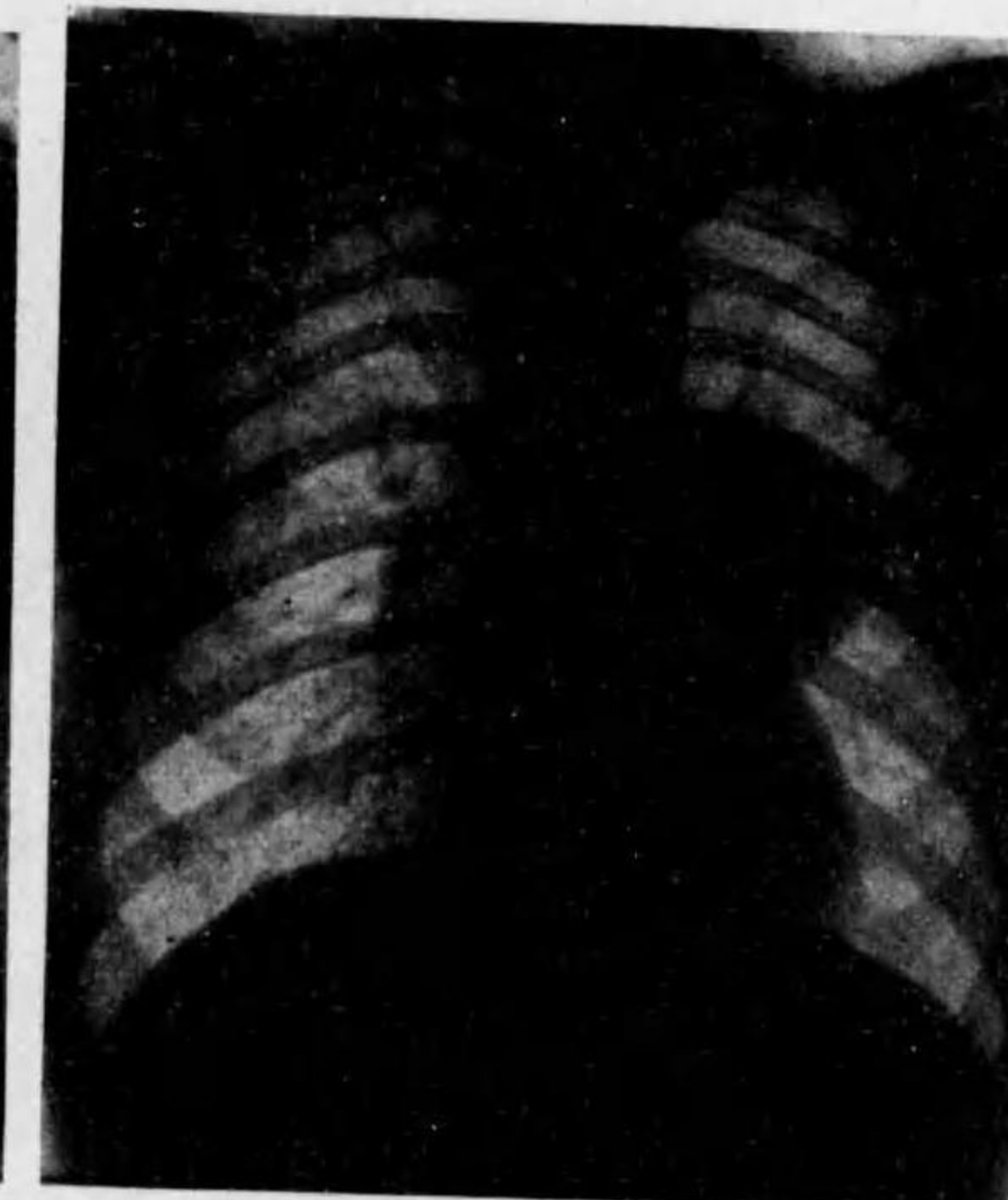
A CASE OF PULMONARY METASTASIS OF TESTICULAR CARCINOMA. Plate I, Oct. 20th, 1924 in erect position. Circumscribed circular shadow projecting out from the mediastinum in the left lung field, partially overlaid by heart shadow, of uniform density, not encapsulated. Lung markings are seen through the mass, situating behind the heart, and moves up and down with the respiration under the Fluoroscopic examination.



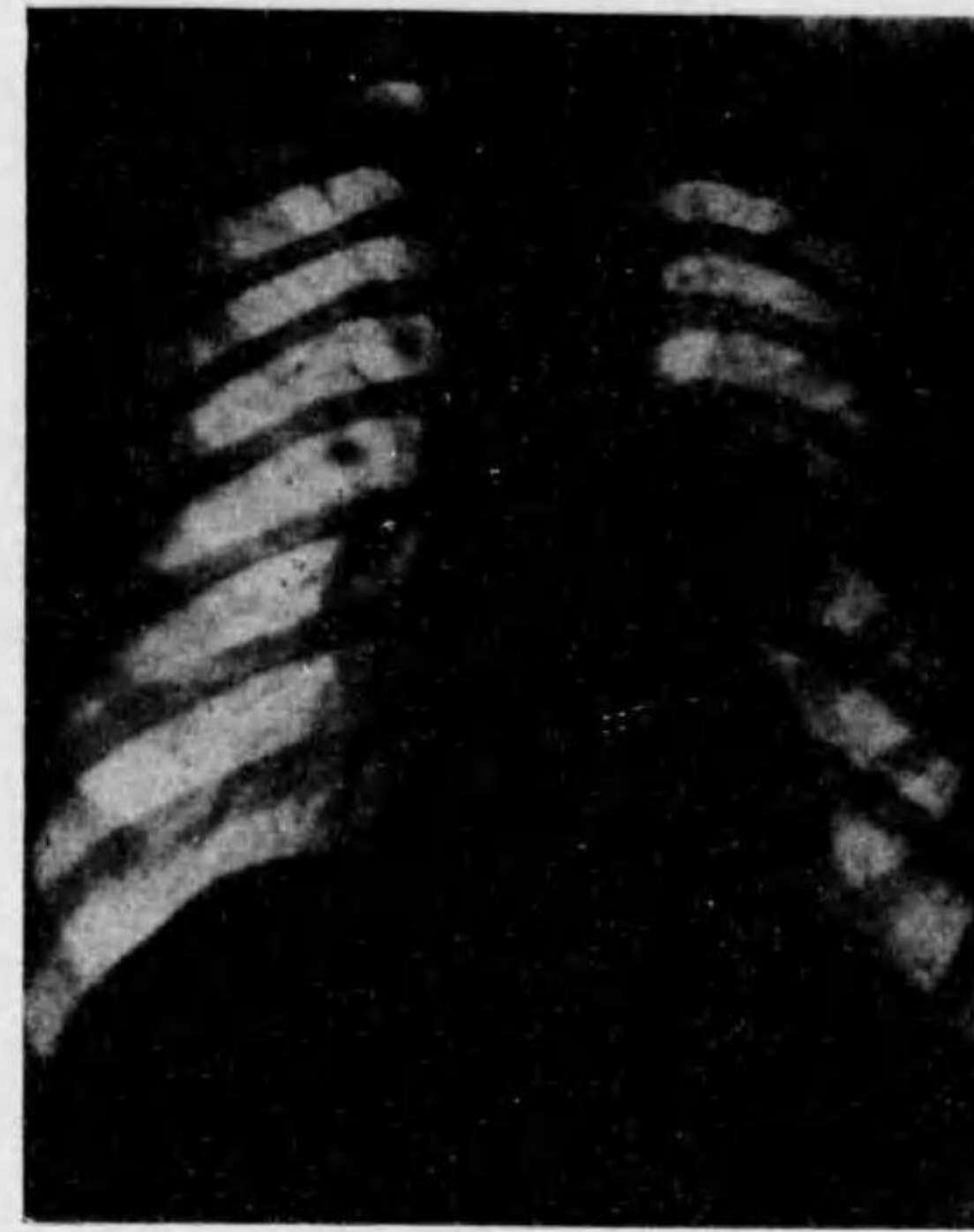
A CASE OF PULMONARY METASTASIS OF TESTICULAR CARCINOMA. Plate III, Taken on 10/23/24 for stereoscopic study. Similar shadow extending out from left hilum, suggesting new growth. It is of very slight uniform density and not surrounded by capsule. Suggests metastasis.



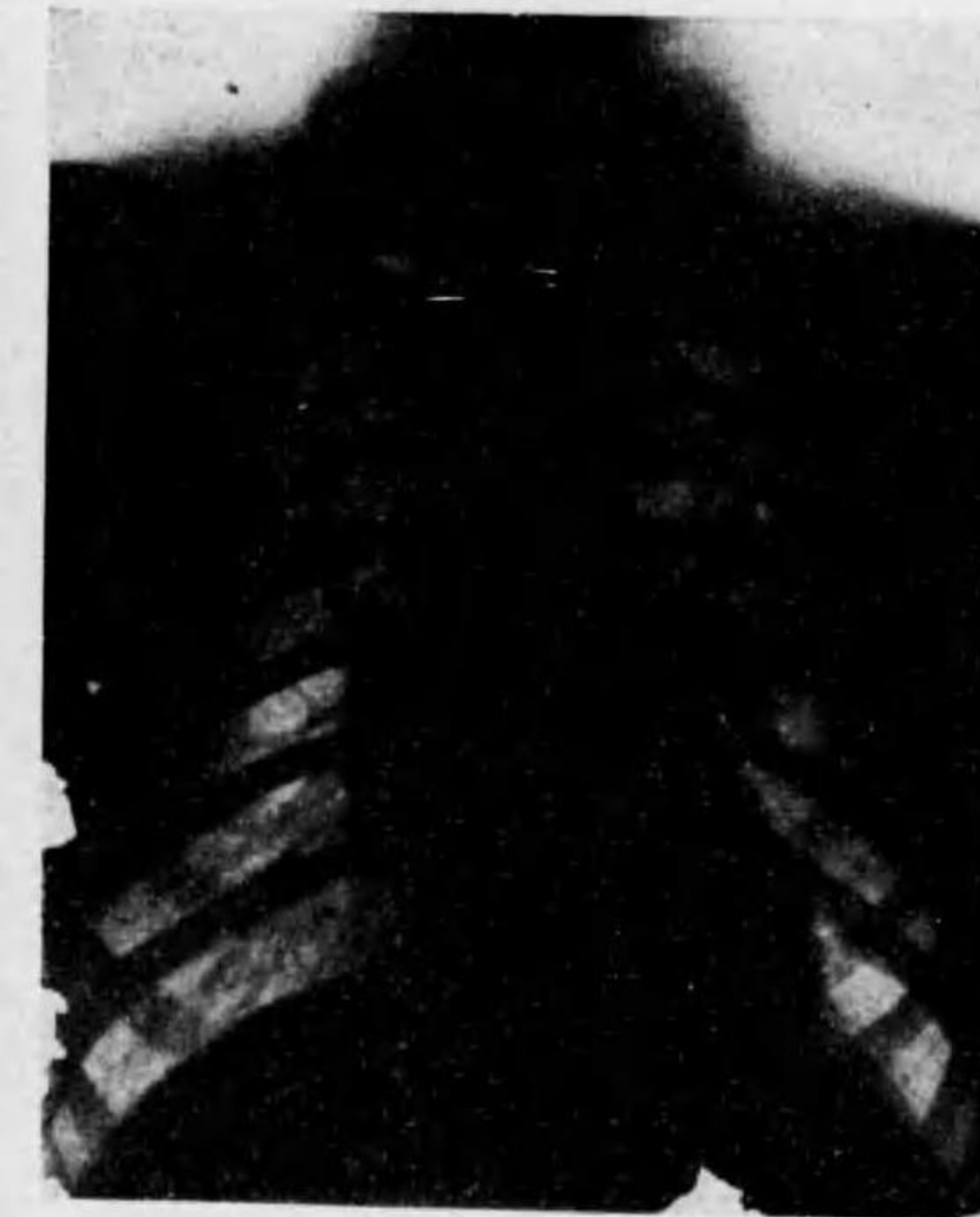
A CASE OF PULMONARY METASTASIS OF TESTICULAR CARCINOMA. Plate II, Taken on 10/22/24, in prone position at high inspiration. Shows the same tumor mass. Apices are lighted up normally.



A CASE OF PULMONARY METASTASIS OF TESTICULAR CARCINOMA. PLATE IV. Taken on 11/10/24. Projecting from the middle portion of the mediastinum on left is a dense irregularly oval shadow, the outline of which fairly smooth.



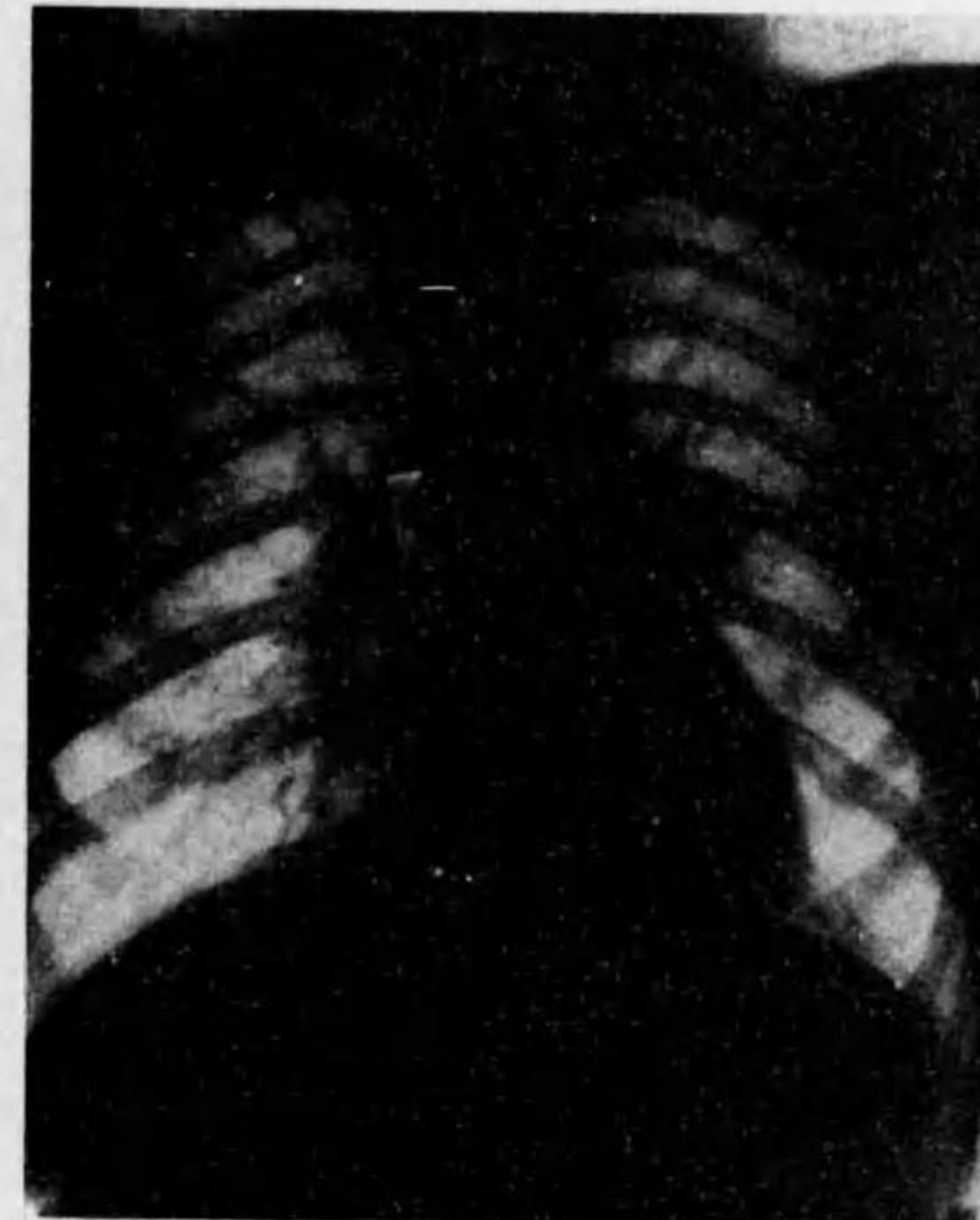
A CASE OF PULMONARY METASTASIS OF TESTICULAR CARCINOMA. Plate V. 12/ 23/ 24. The tumor mass is already seen much smaller than the previous observation. The outer margin is hazy; it now measures 9cm by 6 1/2 cm.



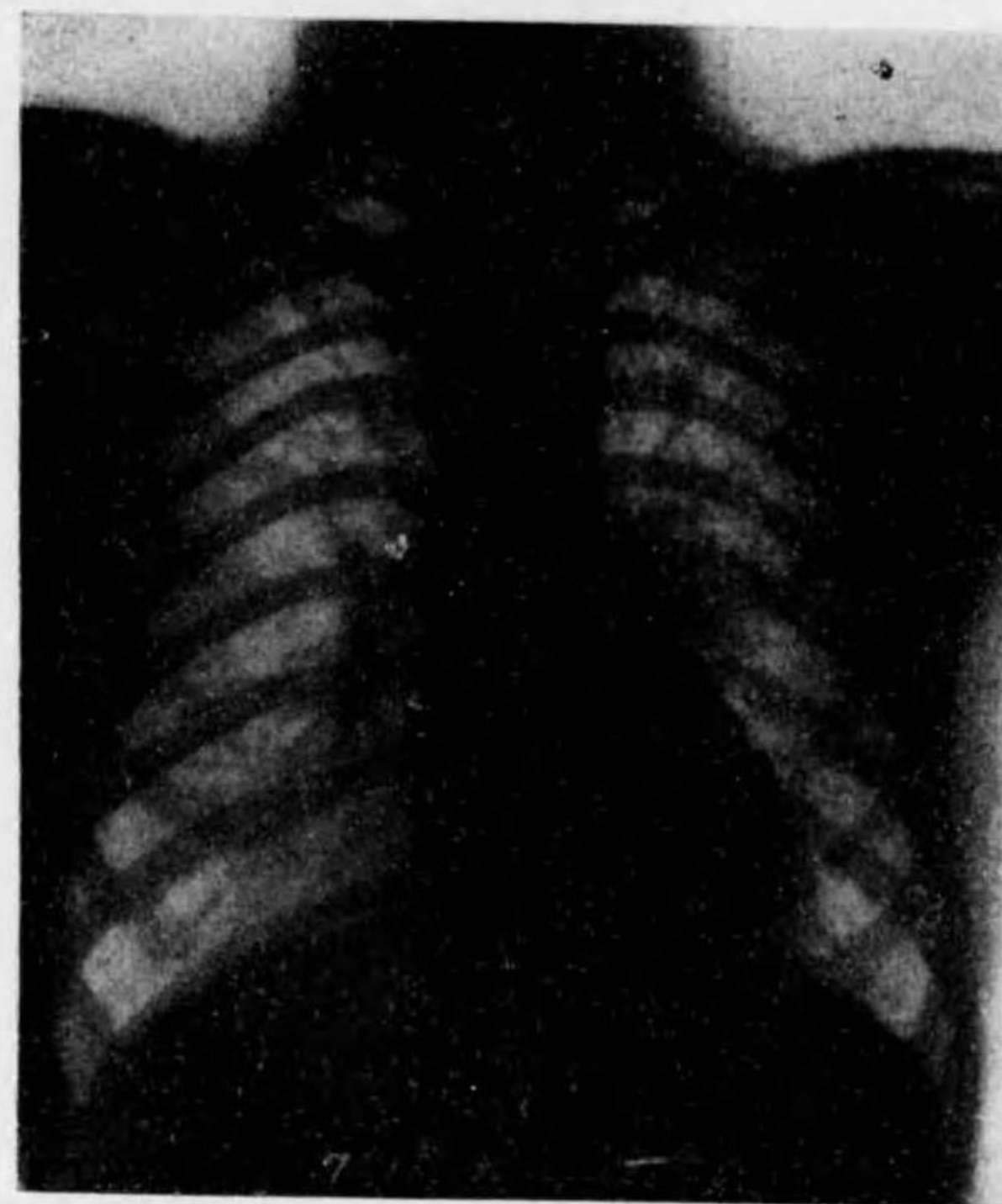
A CASE OF PULMONARY METASTASIS OF TESTICULAR CARCINOMA. Plate VII. 3/ 16/ 25. Similar findings on the right. The tumor mass on the left has almost gone, instead we notice fibrous, accentuated hilar shadow.



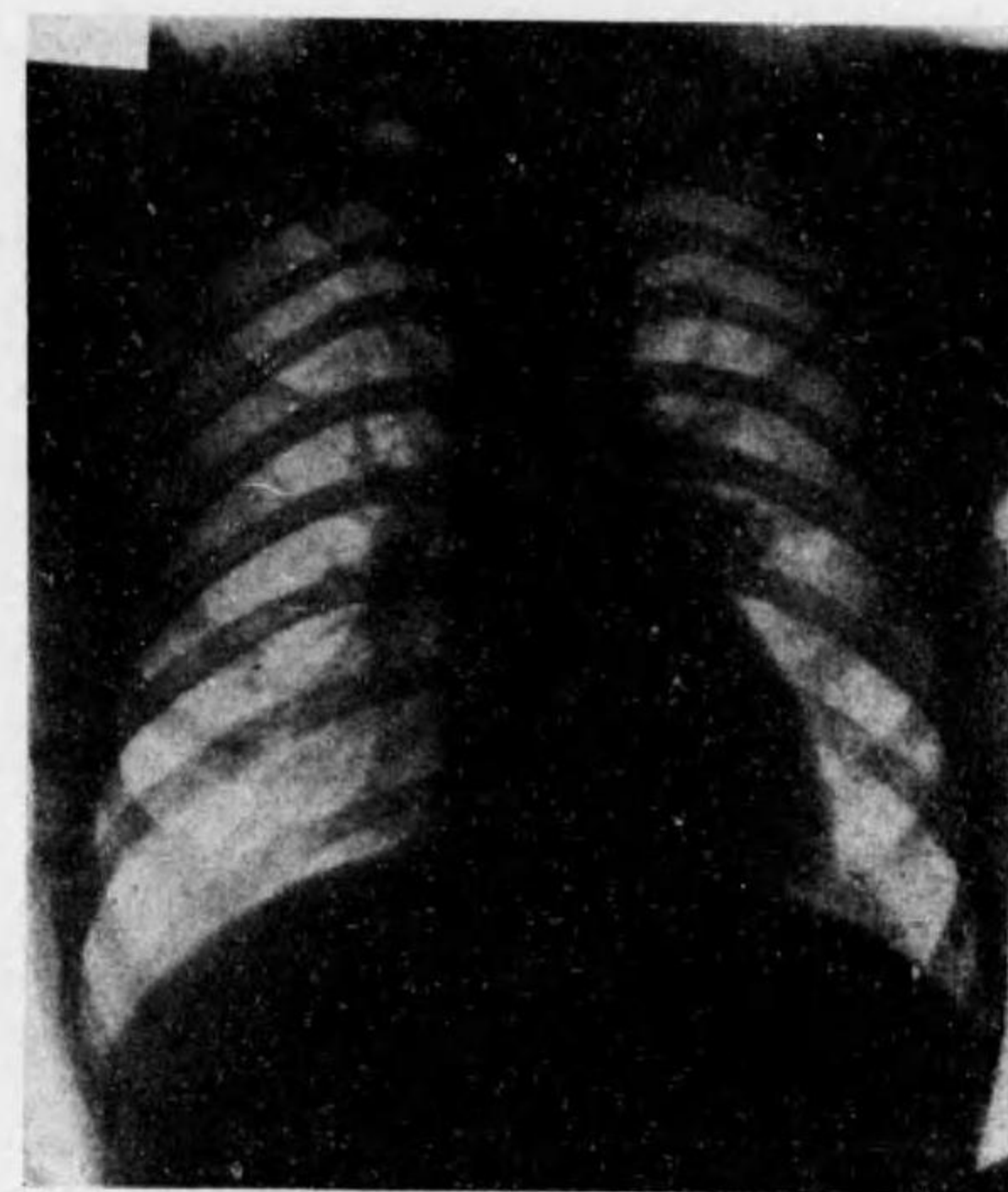
A CASE OF PULMONARY METASTASIS OF TESTICULAR CARCINOMA. Plate VI. 2/ 2/ 25. Only small shadow of moderate density, 3 cm by 3 1/2 cm in the left hilar region.



A CASE OF PULMONARY METASTASIS OF TESTICULAR CARCINOMA. Plate VIII. 5/ 15/ 25. Now no tumor visible in the left hilum which is not any more thickened than that of the right.



The same base. Plate IX, taken on Oct. 6, 1925. Presents the same picture as the previous one.



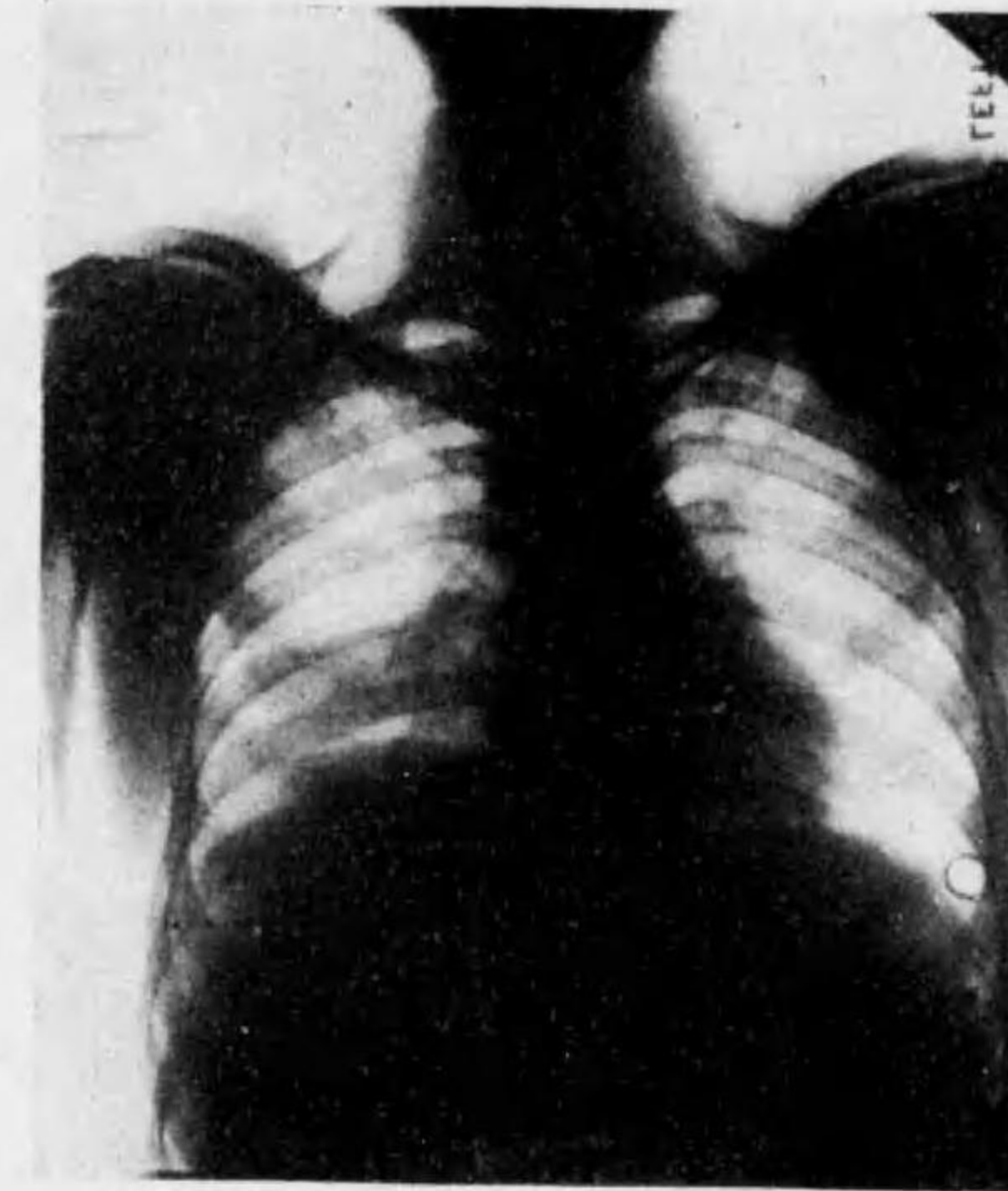
The same case. Plate X, taken on Feb. 25th, 1926. This also presents the same picture as the previous one. There is no sign of metastasis or spreading of the tumor. The patient is doing well and working regularly.

Case of Perforating Gastric Ulcer Causing Lung Suppuration.

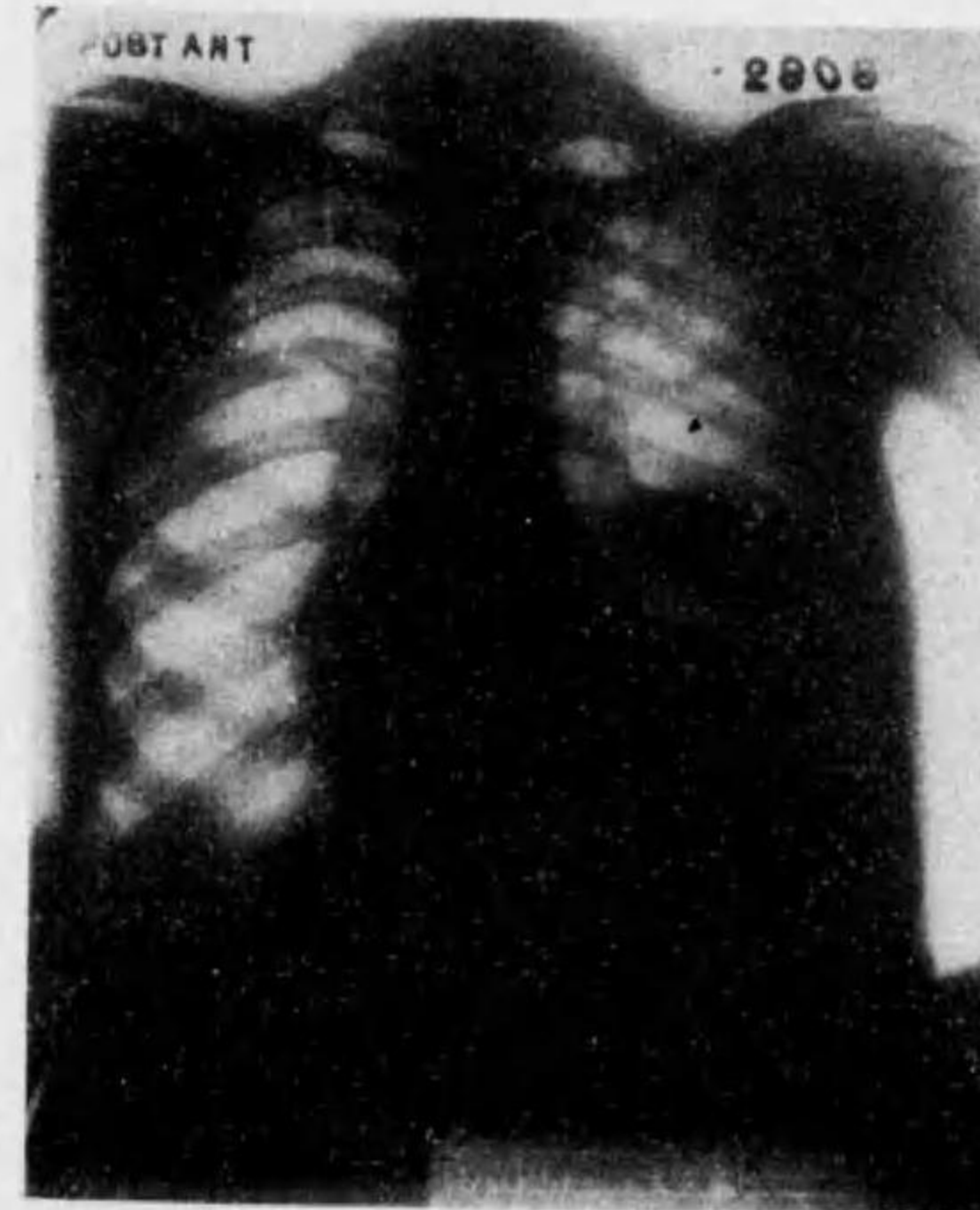
PLATE I—XVII.



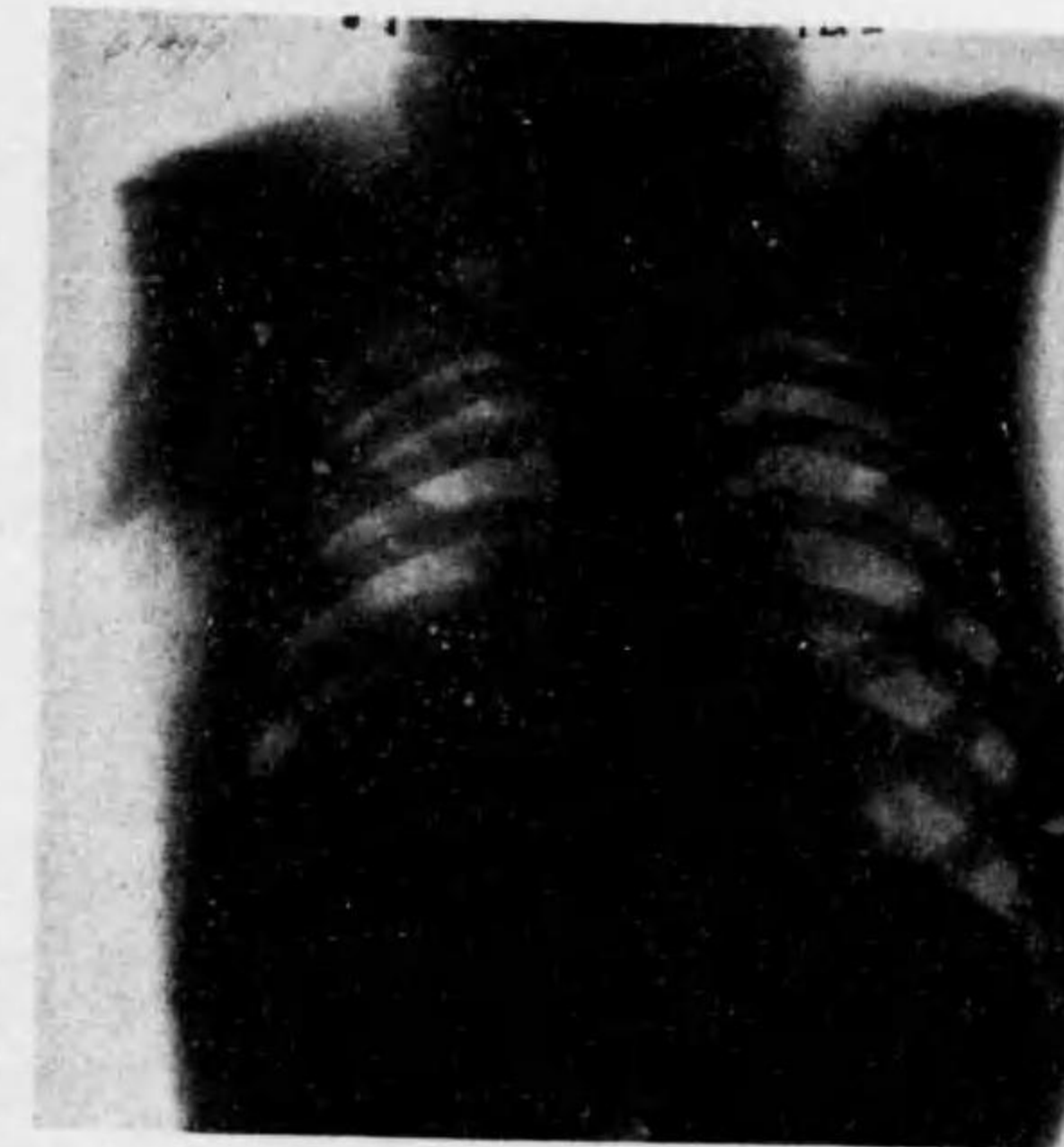
A CASE OF PERFORATING GASTRIC ULCER CAUSING LUNG SUPPURATION. Plate I, May 11, 1923, in erect antero-posterior position. Homogeneous density in right lower region with upper convex margin. For detailed explanation see the text.



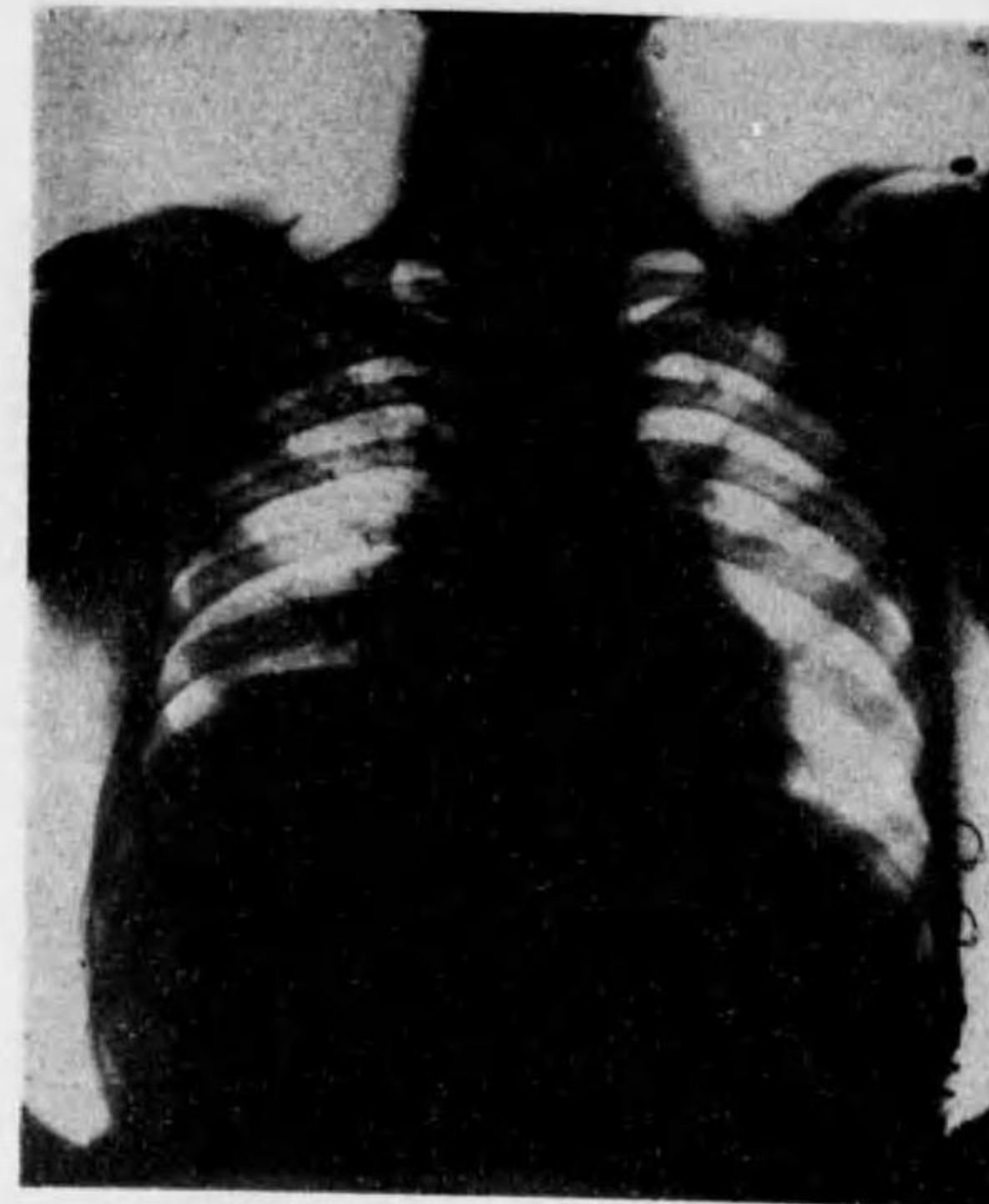
A CASE OF PERFORATING GASTRIC ULCER CAUSING LUNG SUPPURATION. Plate III, May 16th, 1923. By exploratory thoracentesis pus was obtained in 4th intercostal space on nipple line. See the text.



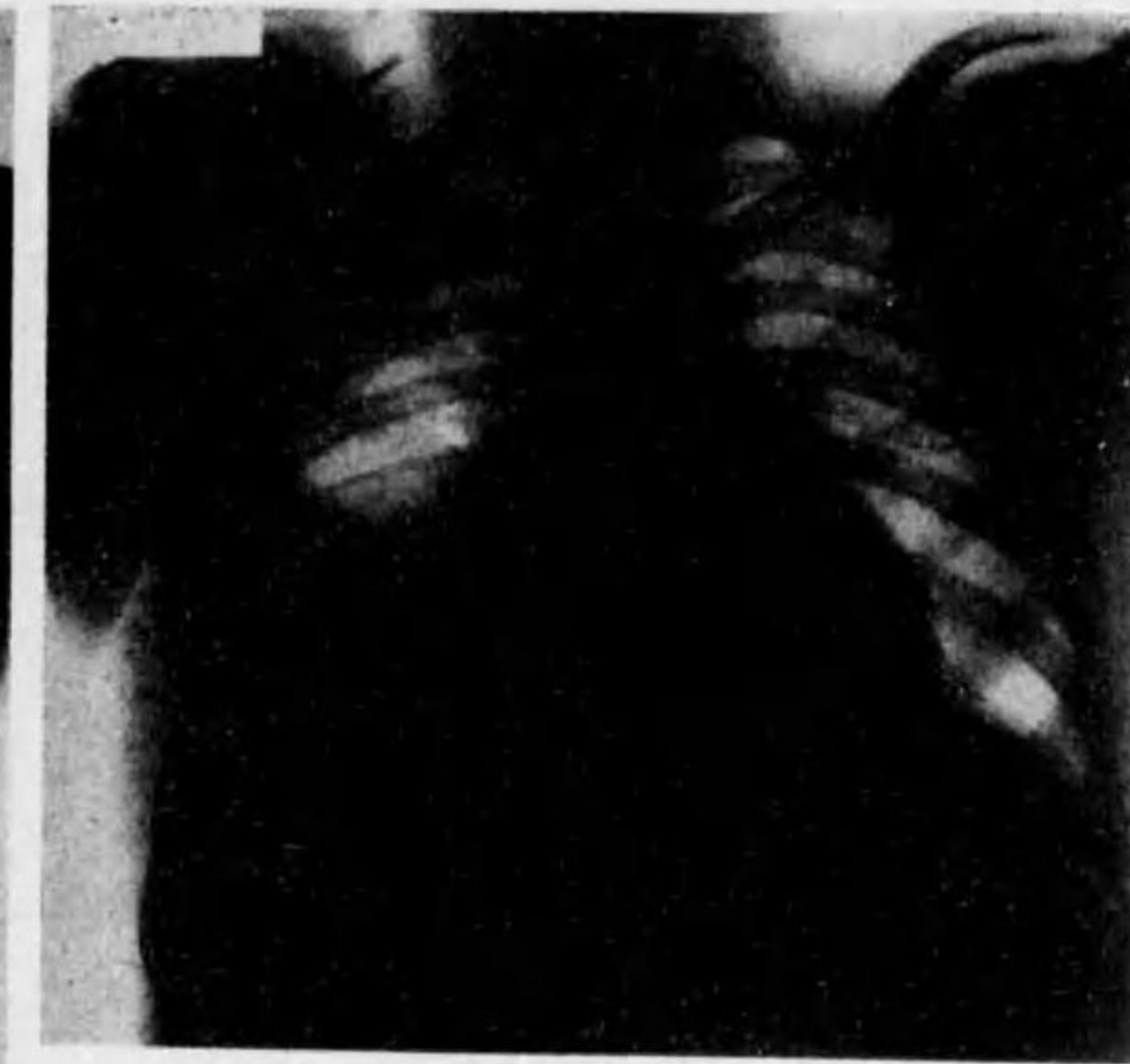
A CASE OF PERFORATING GASTRIC ULCER CAUSING LUNG SUPPURATION. Plate II, May 11, 1923, in erect. Postero-anterior position. Notice the concentration of the basal shadow. See the text.



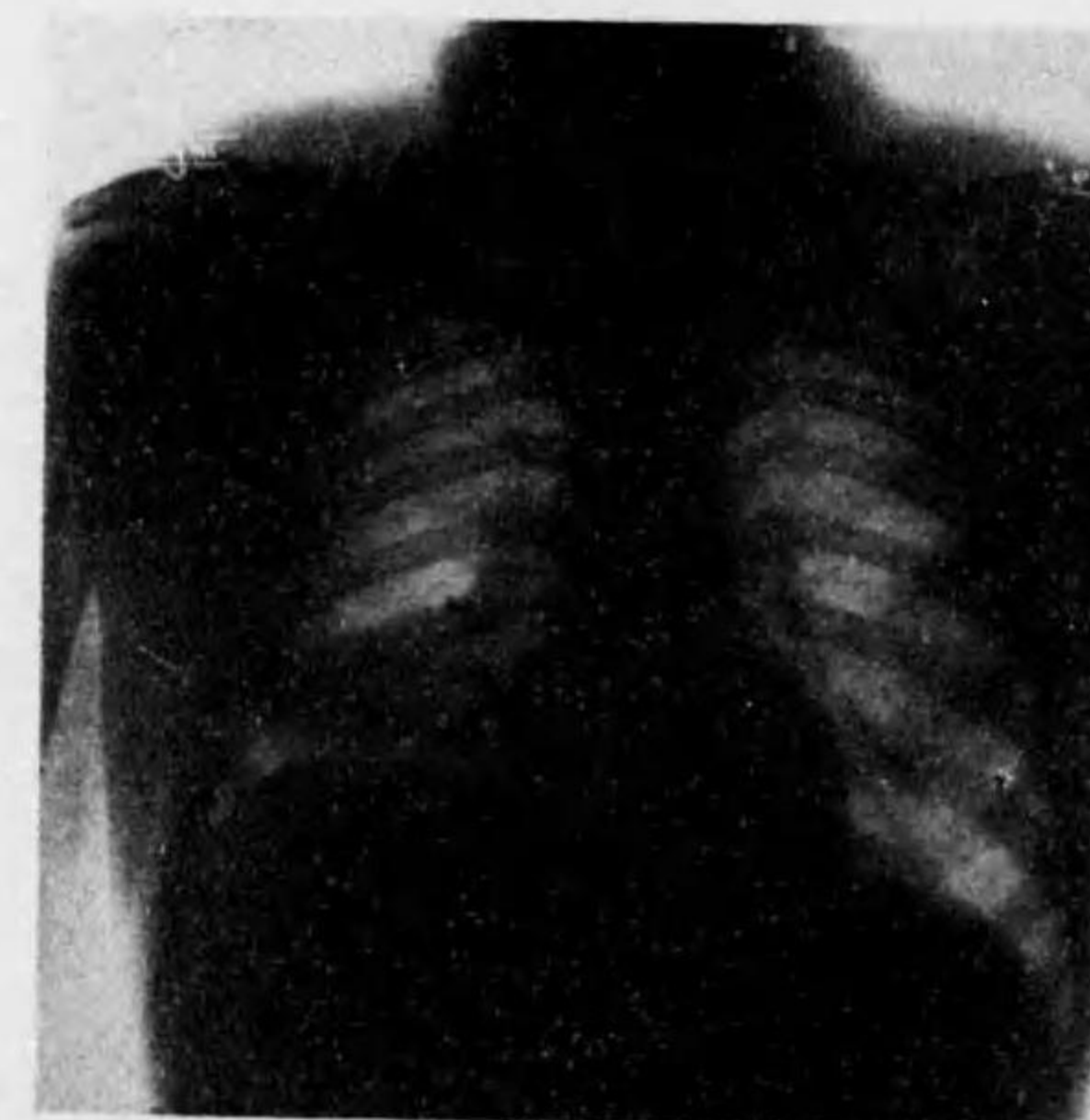
A CASE OF PERFORATING GASTRIC ULCER CAUSING LUNG SUPPURATION. Plate IV, 6/12/23. See the text.



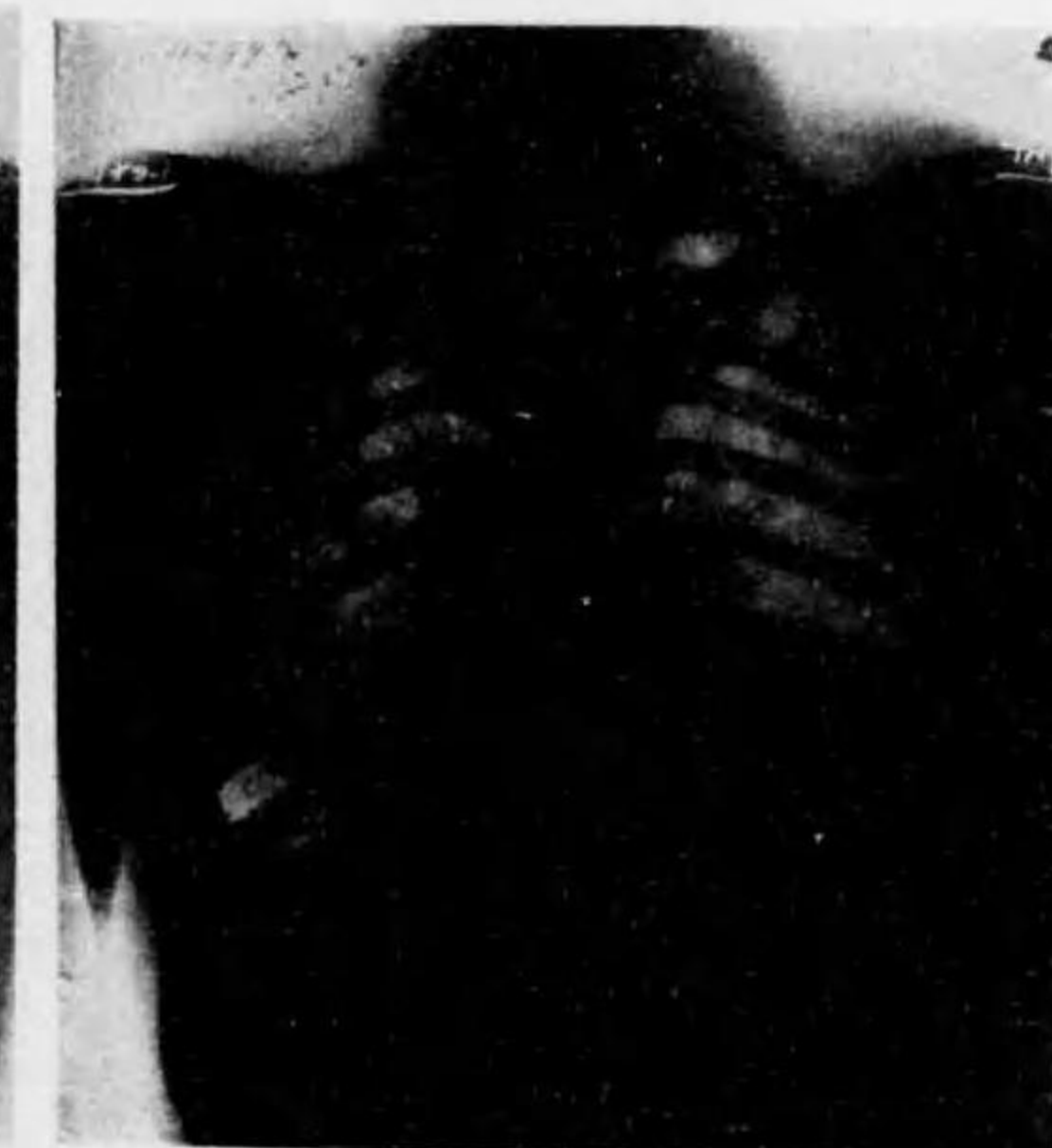
A CASE OF PERFORATING GASTRIC
ULCER CAUSING LUNG SUPPURATION.
Plate V. 7/ 25/ 23.



A CASE OF PERFORATING GASTRIC
ULCER CAUSING LUNG SUPPURATION.
Plate VII. 10/ 22/ 23. For interpretaton see
the Text.



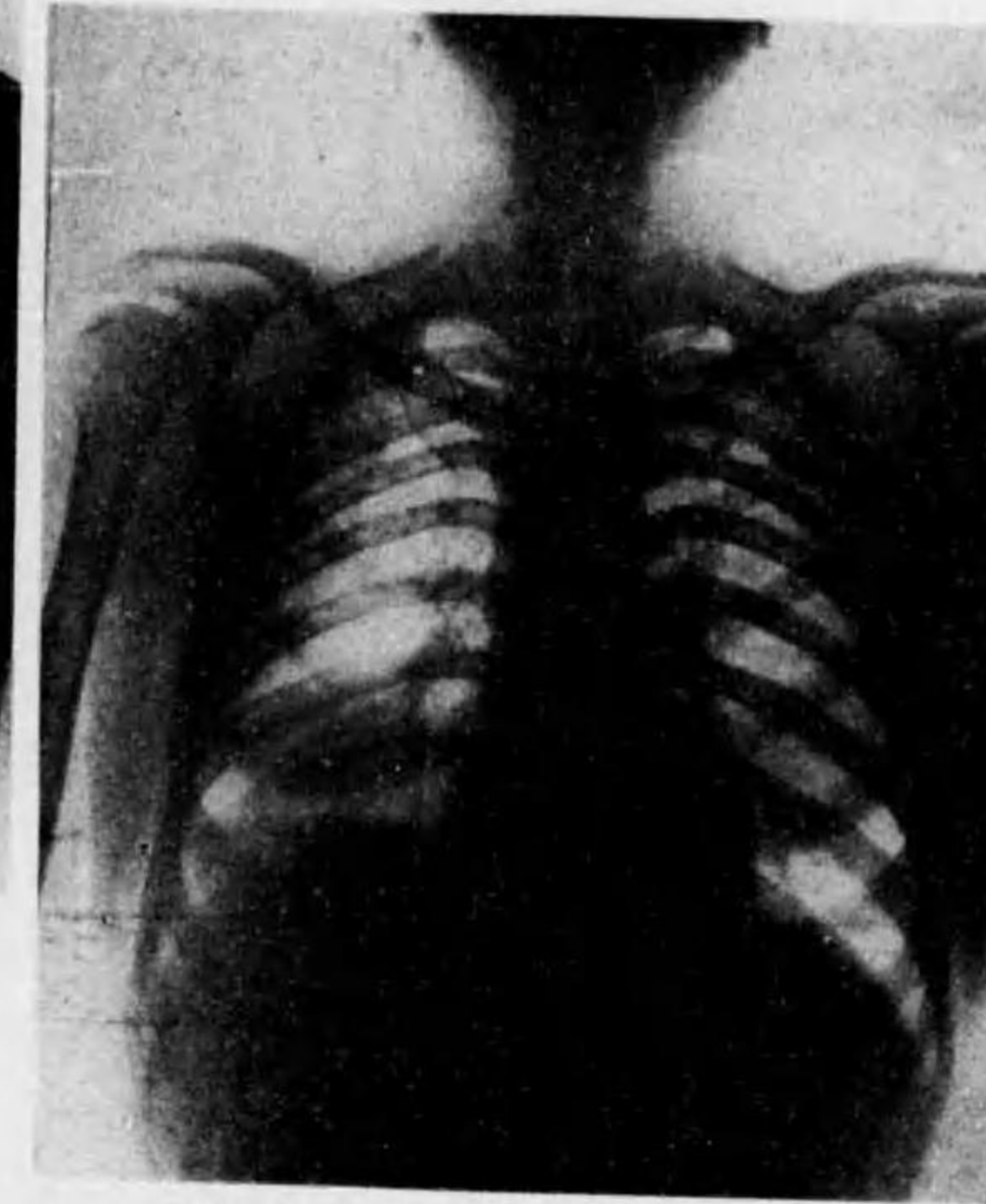
A CASE OF PERFORATING GASTRIC
ULCER CAUSING LUNG SUPPURATION.
Plate VI. 10/ 17/ 23. See the text for interpre-
tation.



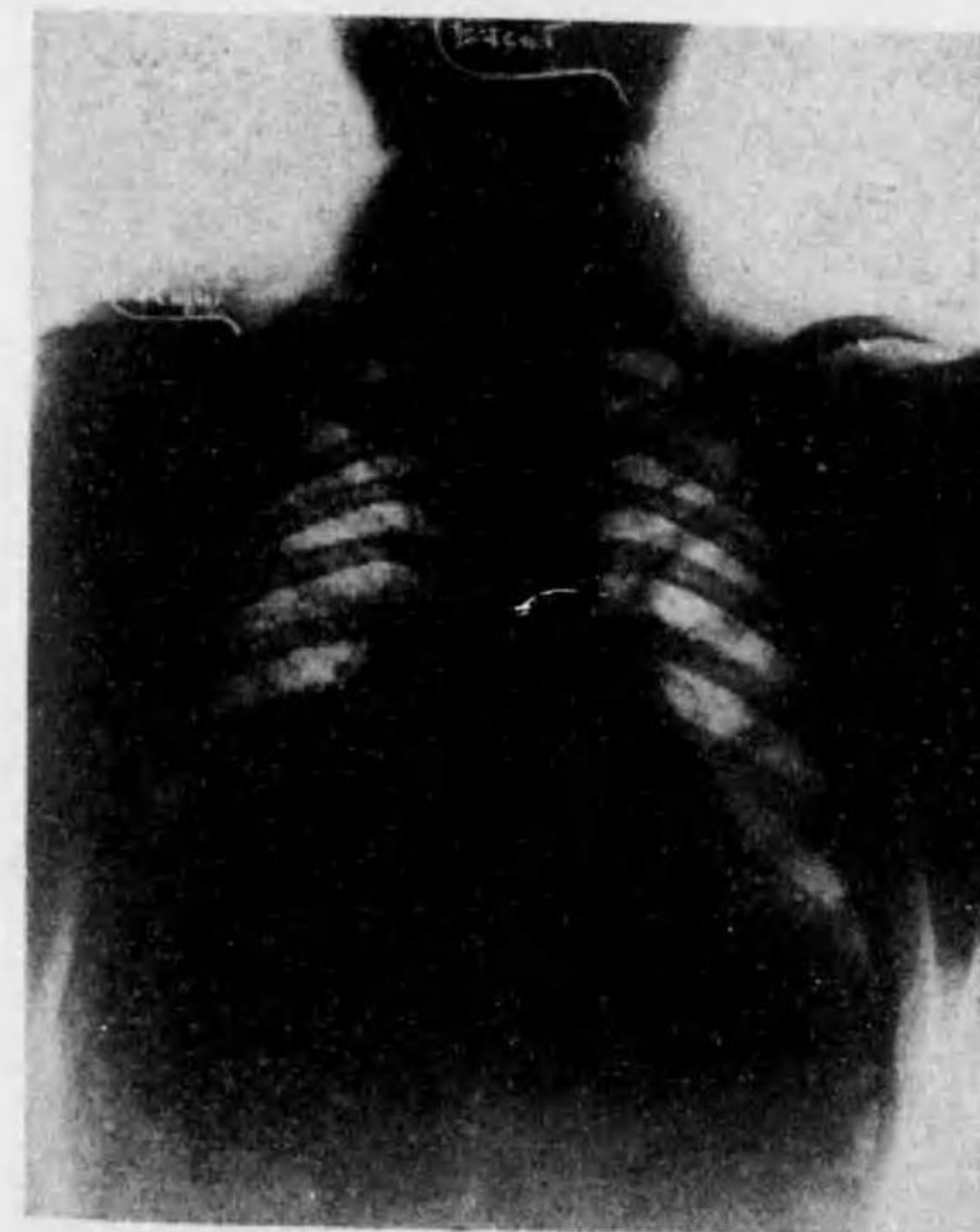
A CASE OF PERFORATING GASTRIC
ULCER CAUSING SUPPURATION. Plate
VIII. 11/2/23. The figure is reversed so that
lesion is seen on the right hand side. For
explanation see the text.



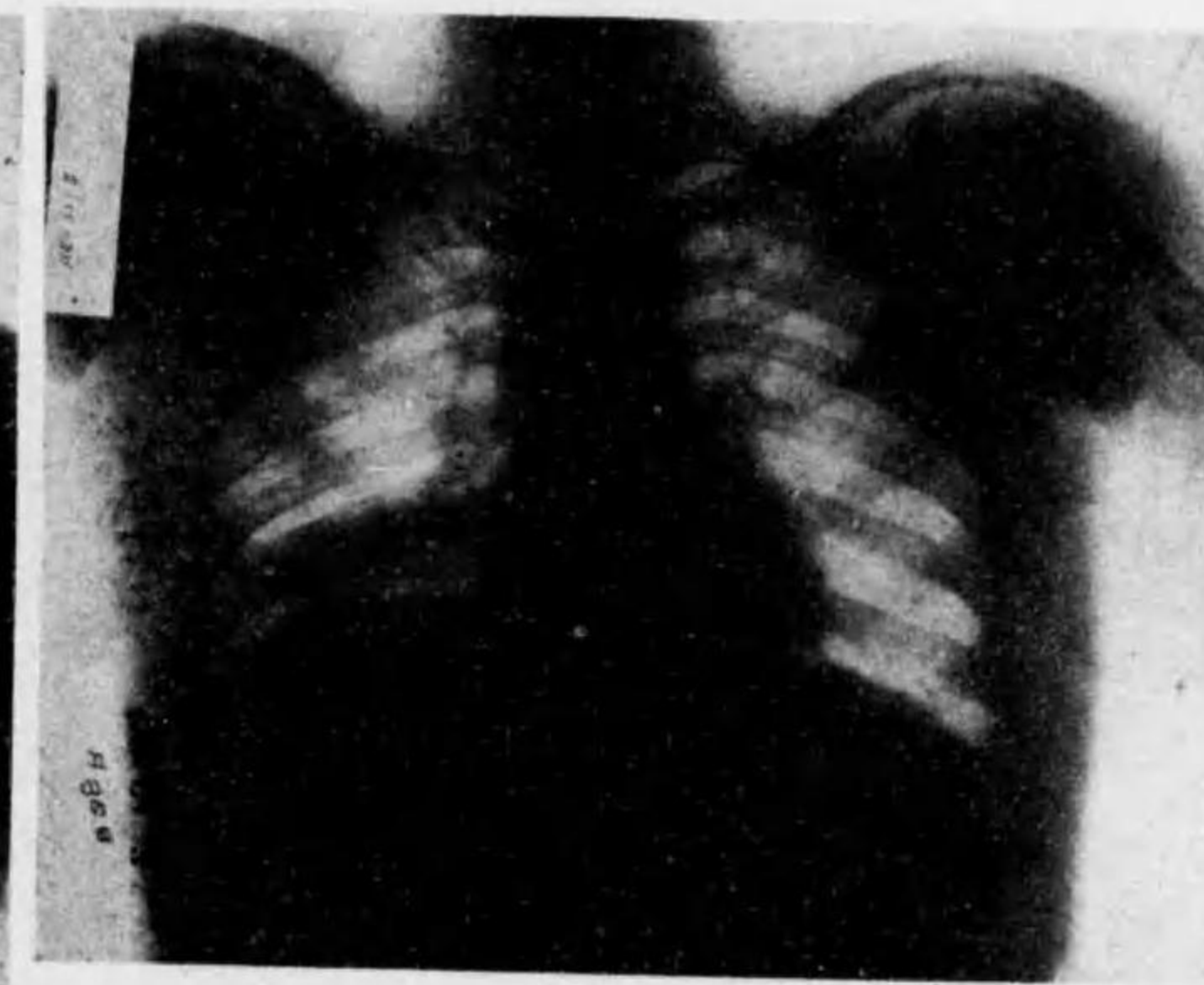
A CASE OF PERFORATING GASTRIC
ULCER CAUSING LUNG SUPPURATION.
Plate IX, 11/ 19/ 23. See the Text for interpre-
tations.



A CASE OF PERFORATING GASTRIC
ULCER CAUSING LUNG SUPPURATION.
Plate XI, 1/ 22/ 24. Explained in the text.

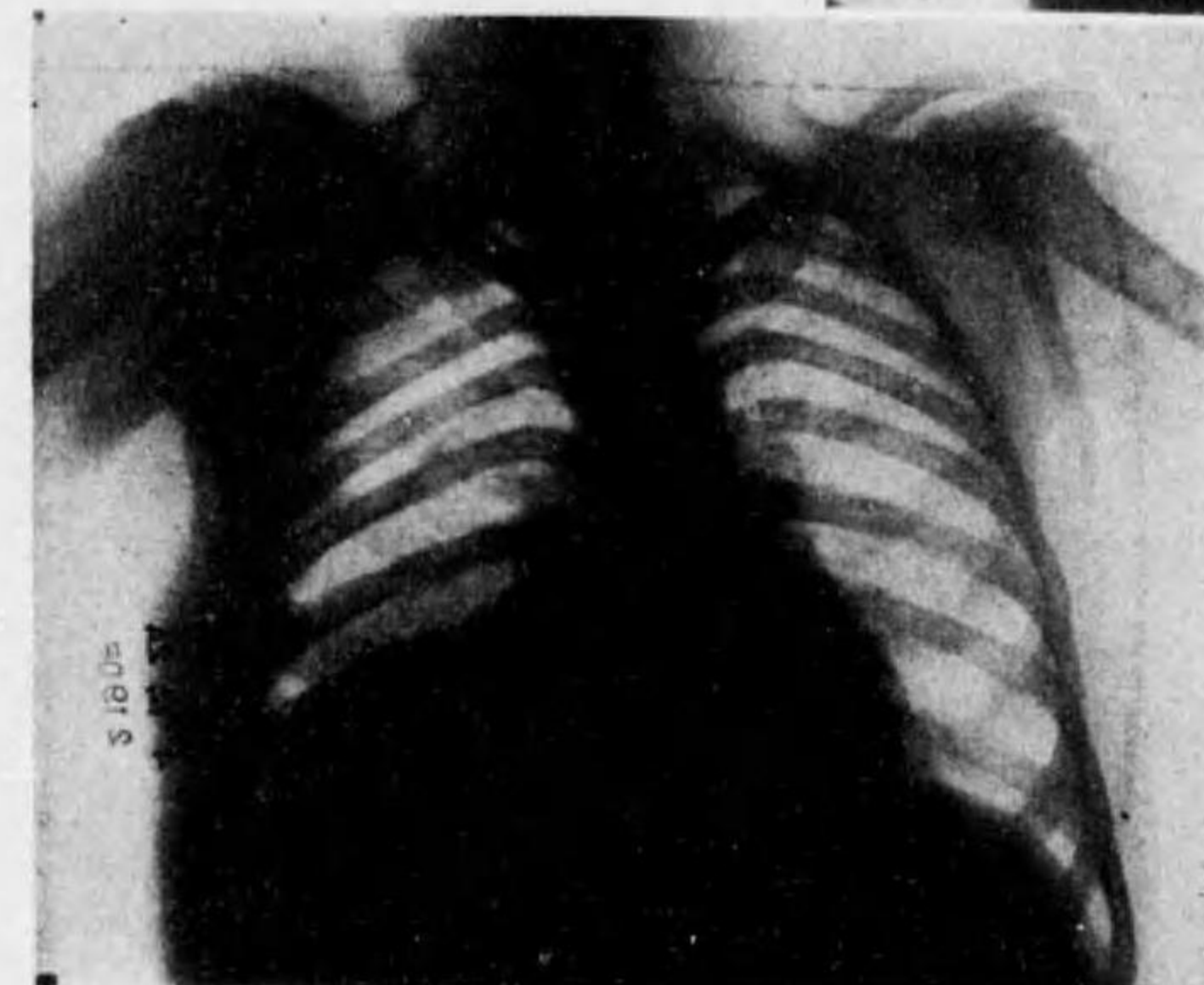
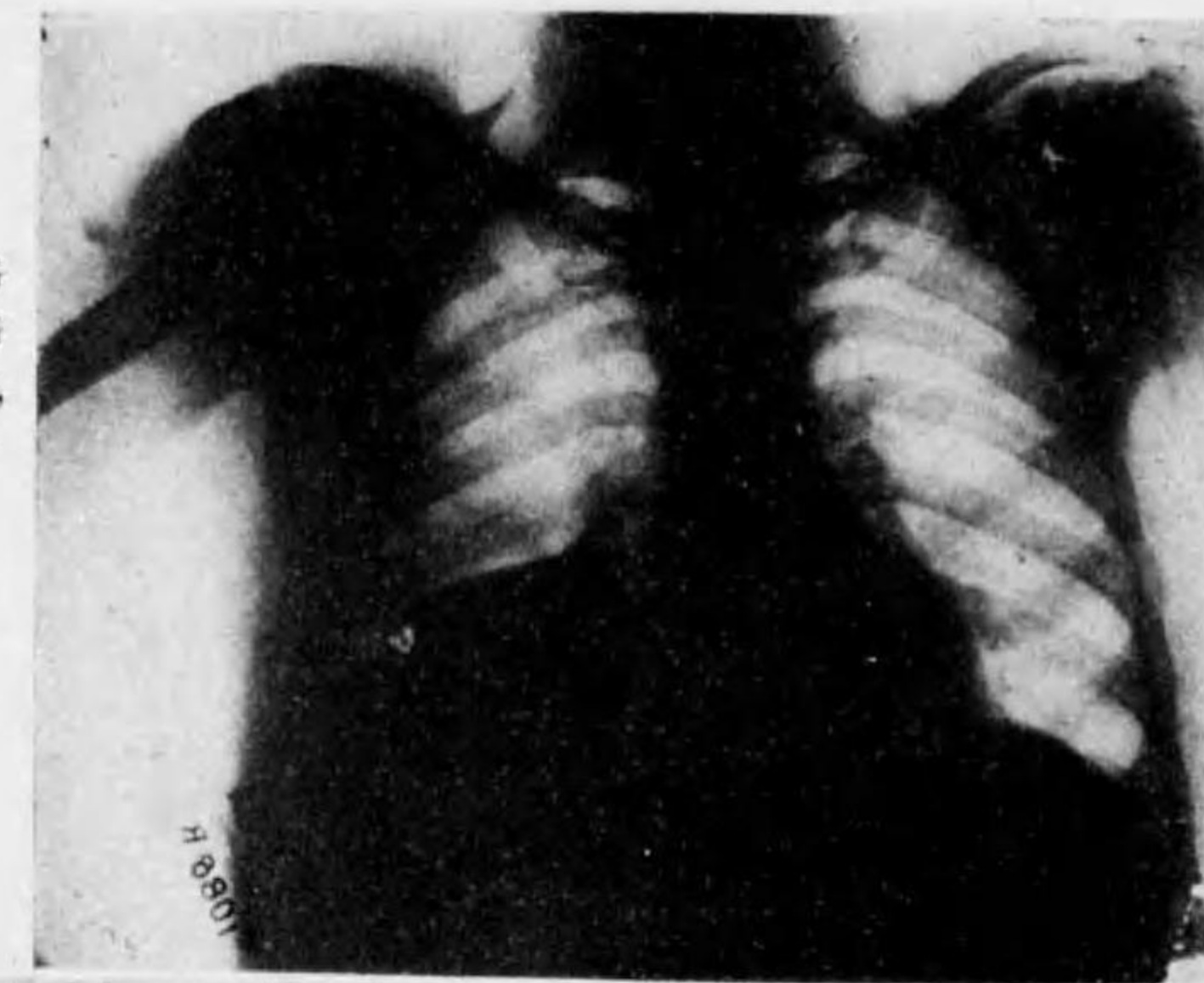


A CASE OF PERFORATING GASTRIC
ULCER CAUSING LUNG SUPPURATION.
Plate X, 12/ 8/ 23. Interpretations in the Text.

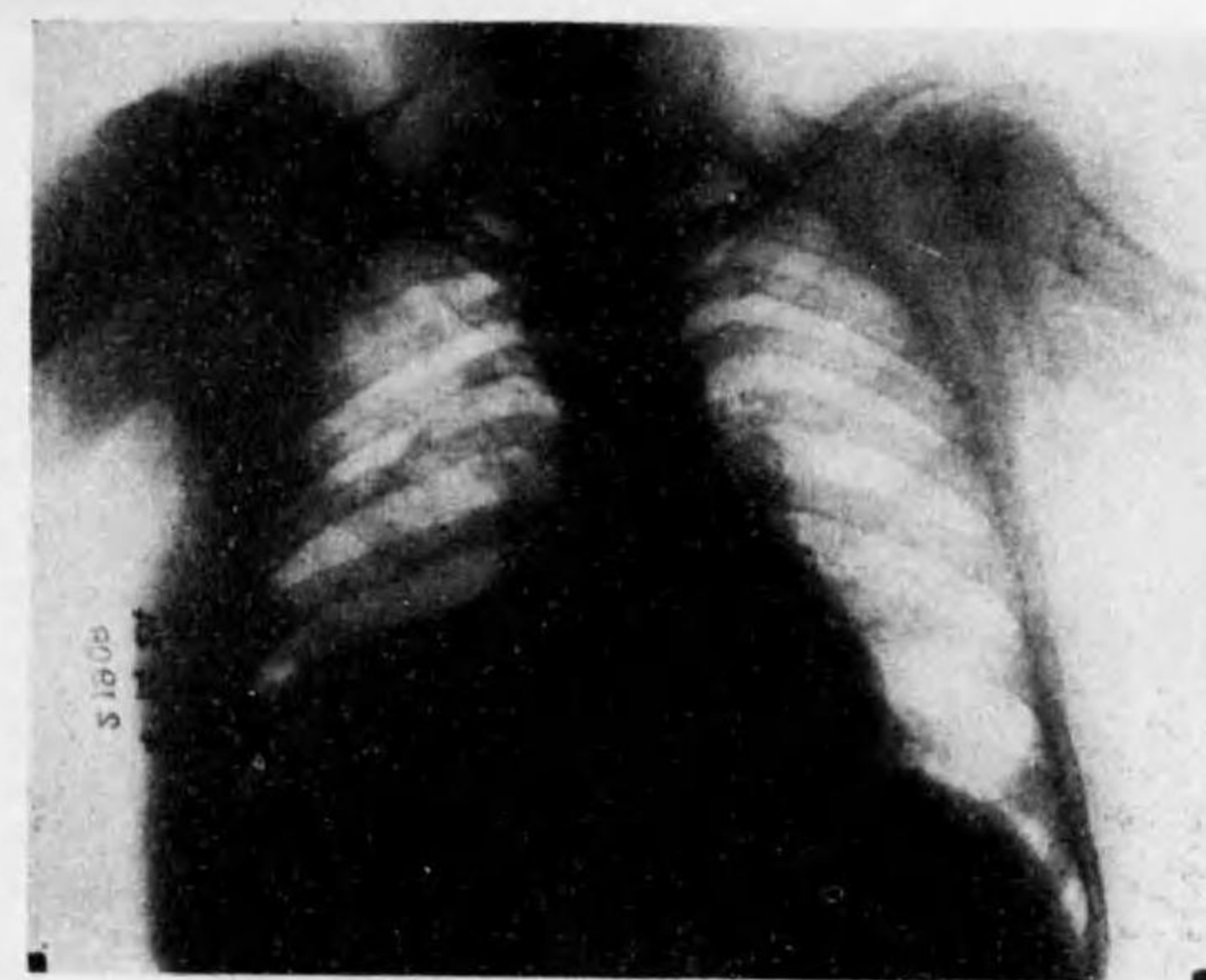


A CASE OF PERFORATING GASTRIC ULCER
CAUSING LUNG SUPPURATION. Plate XII, 2/ 15/
24. Notice the diminished density at base, but appears
reticulated. See the text for interpretation.

A CASE OF PERFORATING GASTRIC ULCER CAUSING LUNG SUPPURATION. Plate XIII, 2/ 25/ 24. Notice the re-appearance of the infiltrating area at the base.



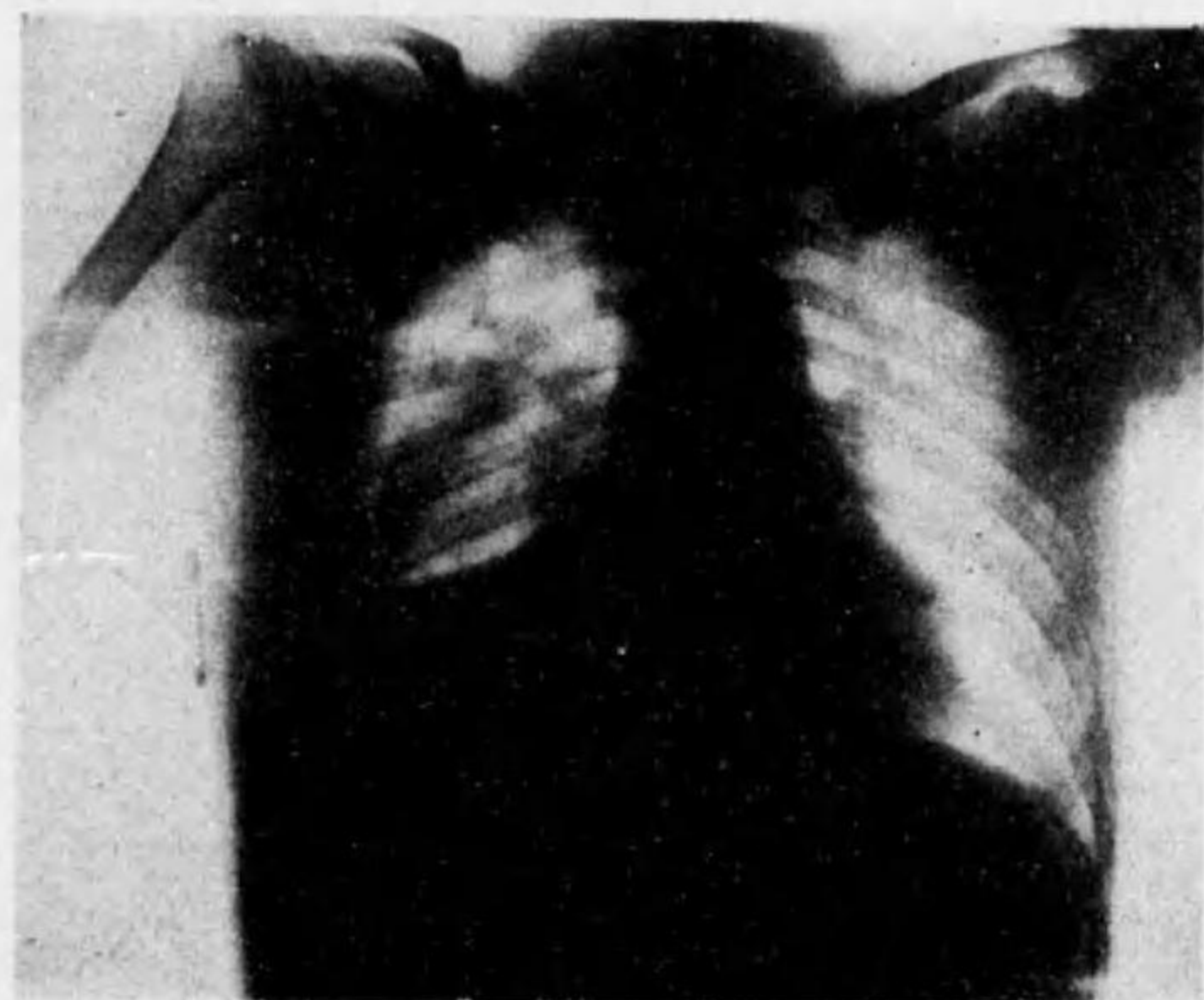
A CASE OF PERFORATING GASTRIC ULCER CAUSING LUNG SUPPURATION. Plate XIV, 3/ 24/ 21. Similar shadow as before, explained in the text.



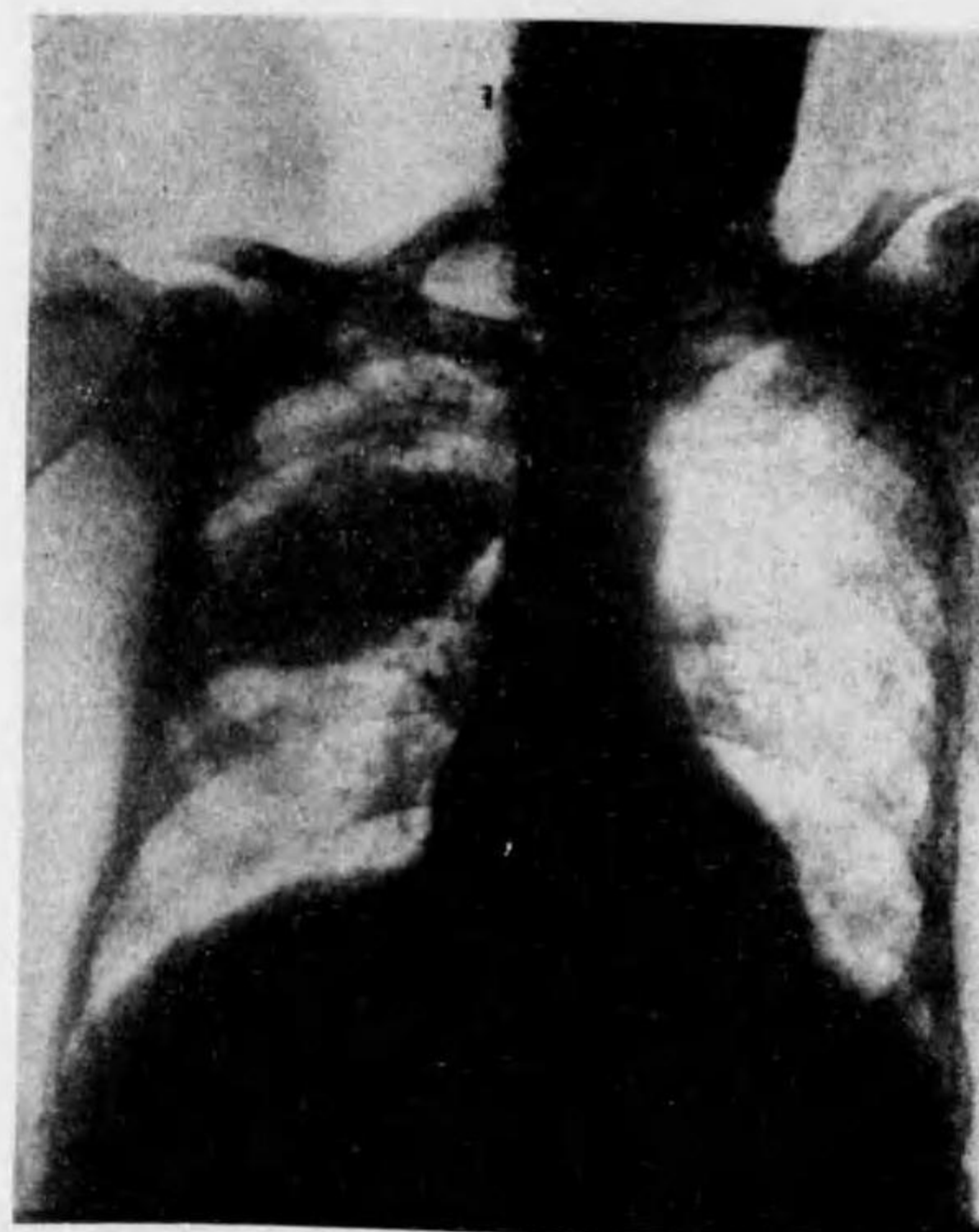
A CASE OF PERFORATING GASTRIC ULCER CAUSING LUNG SUPPURATION. Plate XV, 4/ 14/ 24. Showing partial pneumothorax (artificial), upper lobe compressible; adhesions at base; the lesion not interfered. See the text.



A CASE OF PERFORATING GASTRIC ULCER CAUSING LUNG SUPPURATION. Plate XVI, 5/ 6/ 24. Gastric picture indicating defective cap shadow and a faulse niche in great curvature.



A CASE OF PERFORATING GASTRIC ULCER CAUSING LUNG SUPPURATION. Plate XVII, 5/ 20/ 24. Taken after the operation, showing increased density at right base and moderate thickened pleura due to exudate Exploratory thoracotomy revealed no pathology.



Case I, Fig. 1. Pt., man aged 23, five weeks ago had emergency operation for obstructive hernia. Notice "fish-tail" density.



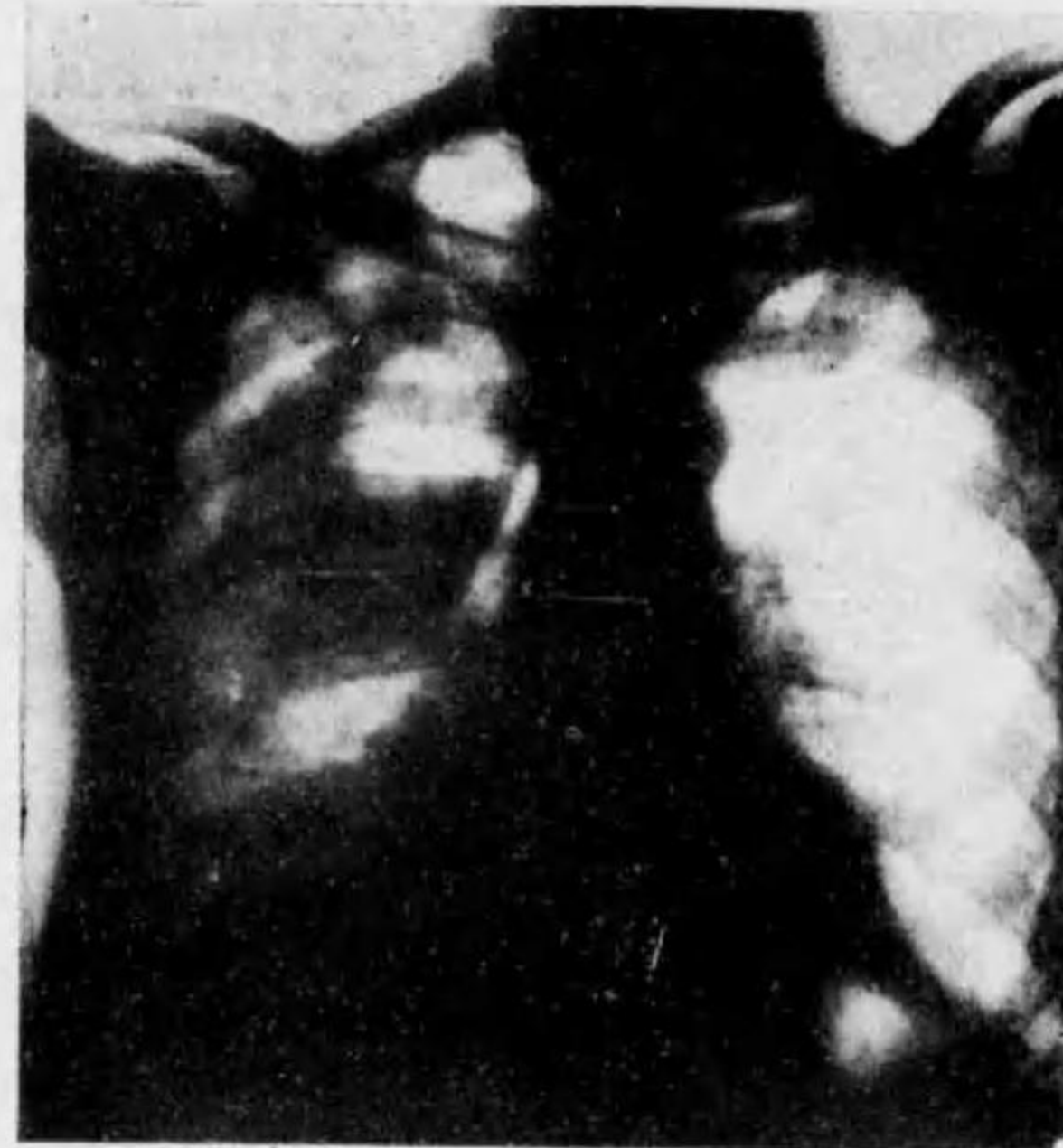
Case I, Fig. 5, taken erect, 9/30/21, after another treatment with A. P. T.



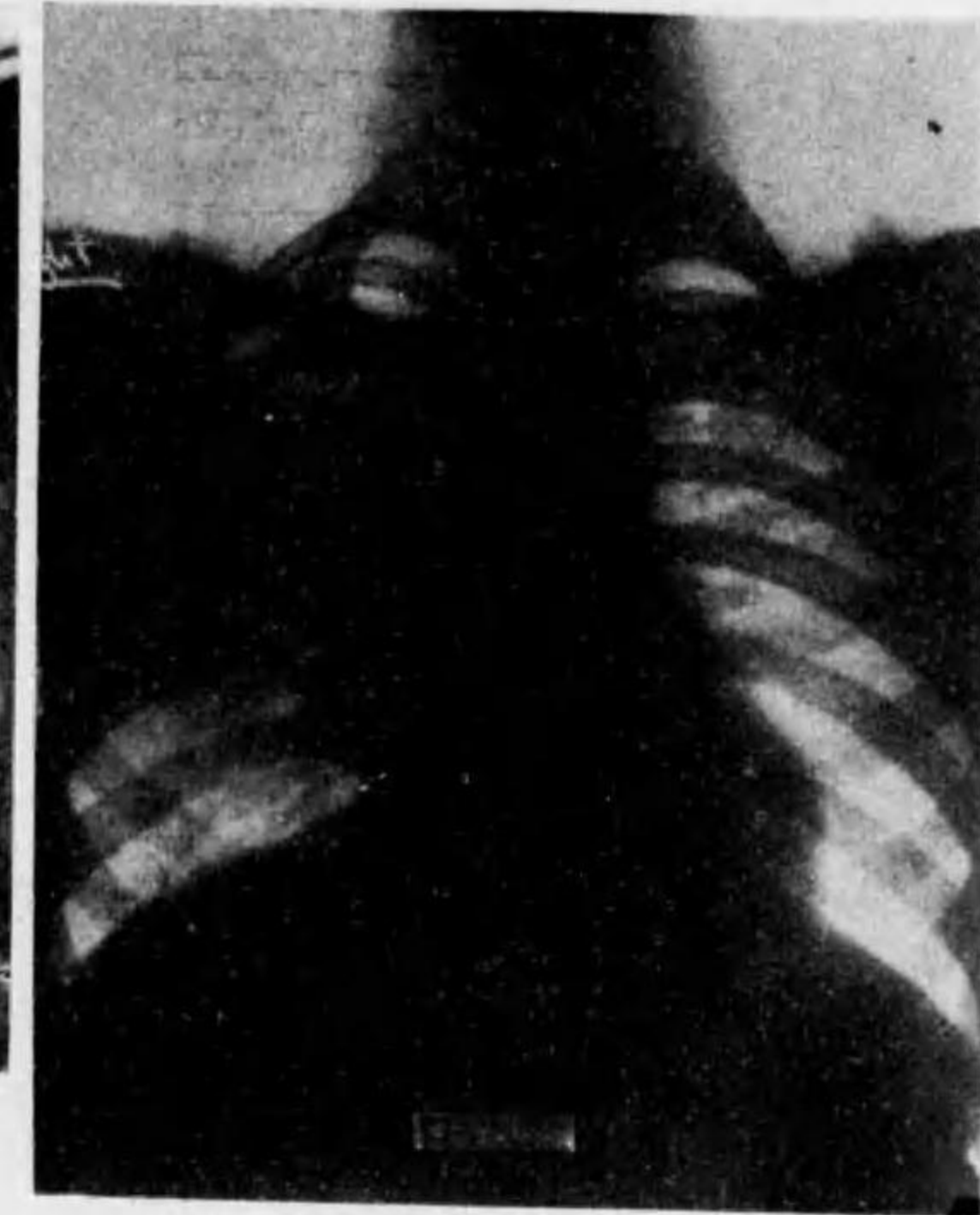
Case I, Fig. 3, taken erect a week after the previous film.



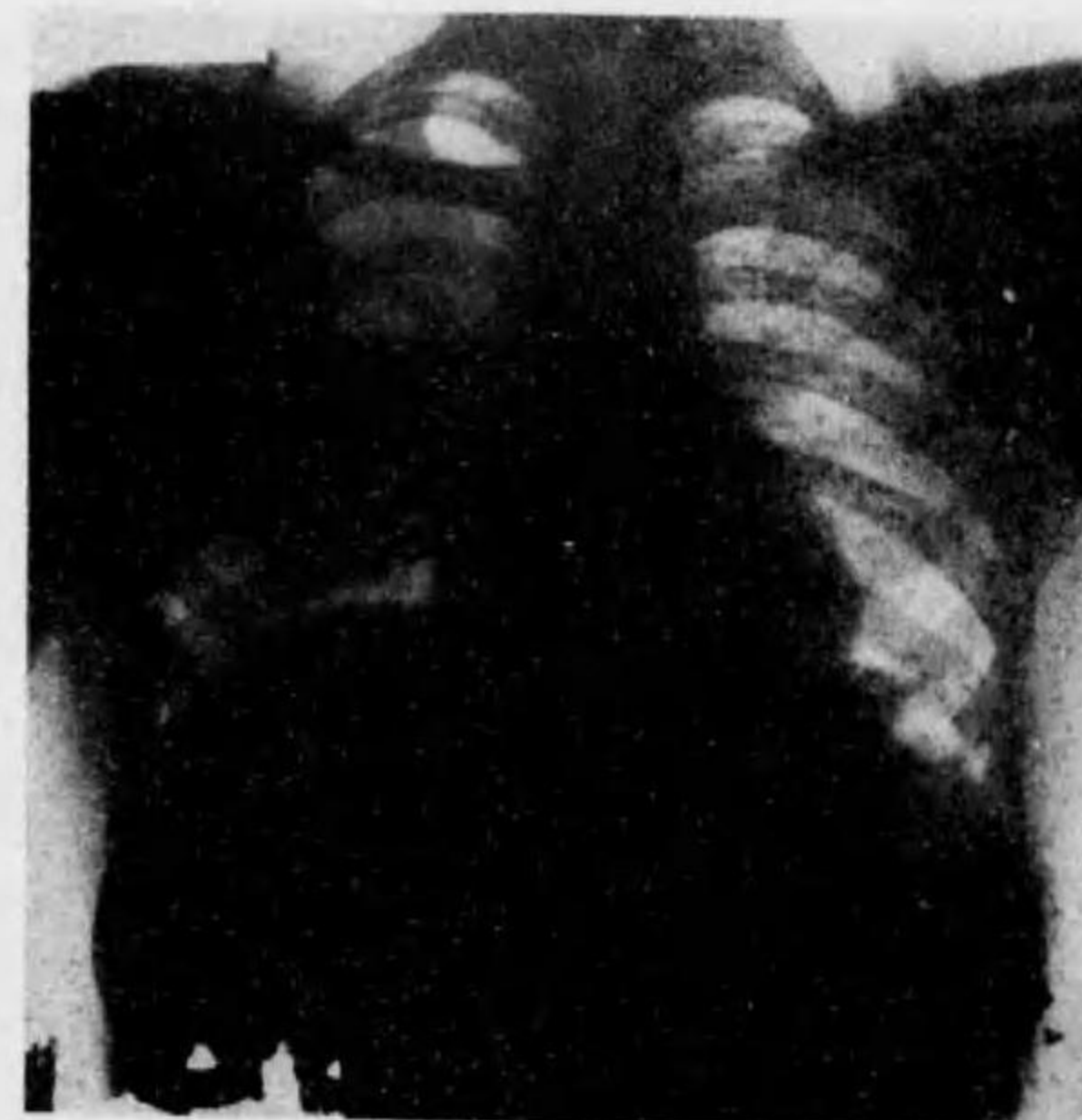
Case I, Fig. 7, taken erect, on Oct. 24, 21. explained in Fig. 8.



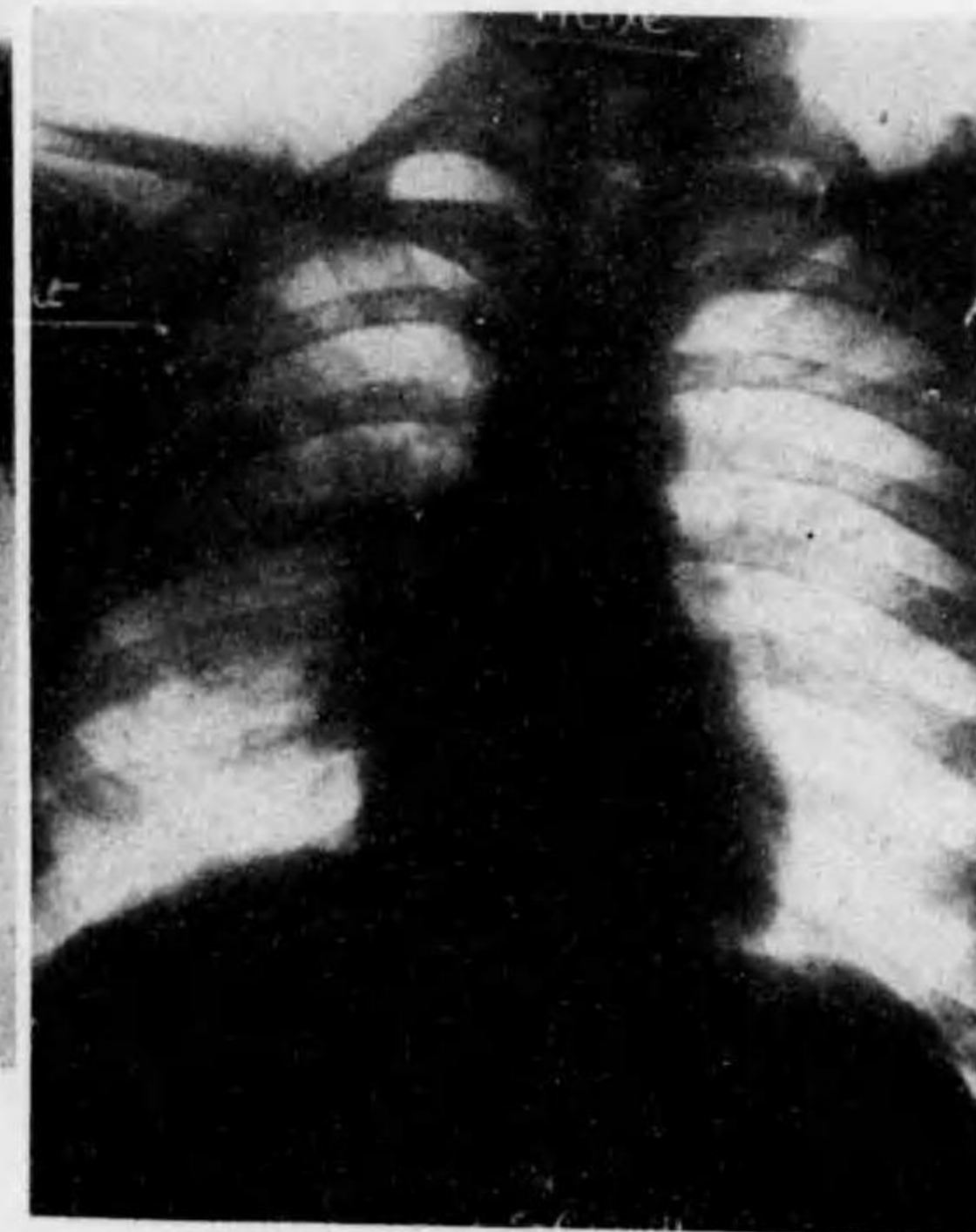
Case I, Fig. 8-b. Taken Nov. 15th '22 or about a year after the last film. Notice the remarkable improvement. Signs of cavity disappeared; lung has re-expanded. Roots shadows accentuated, lung markings increased, diaphragm flattened out indicating some adhesions.



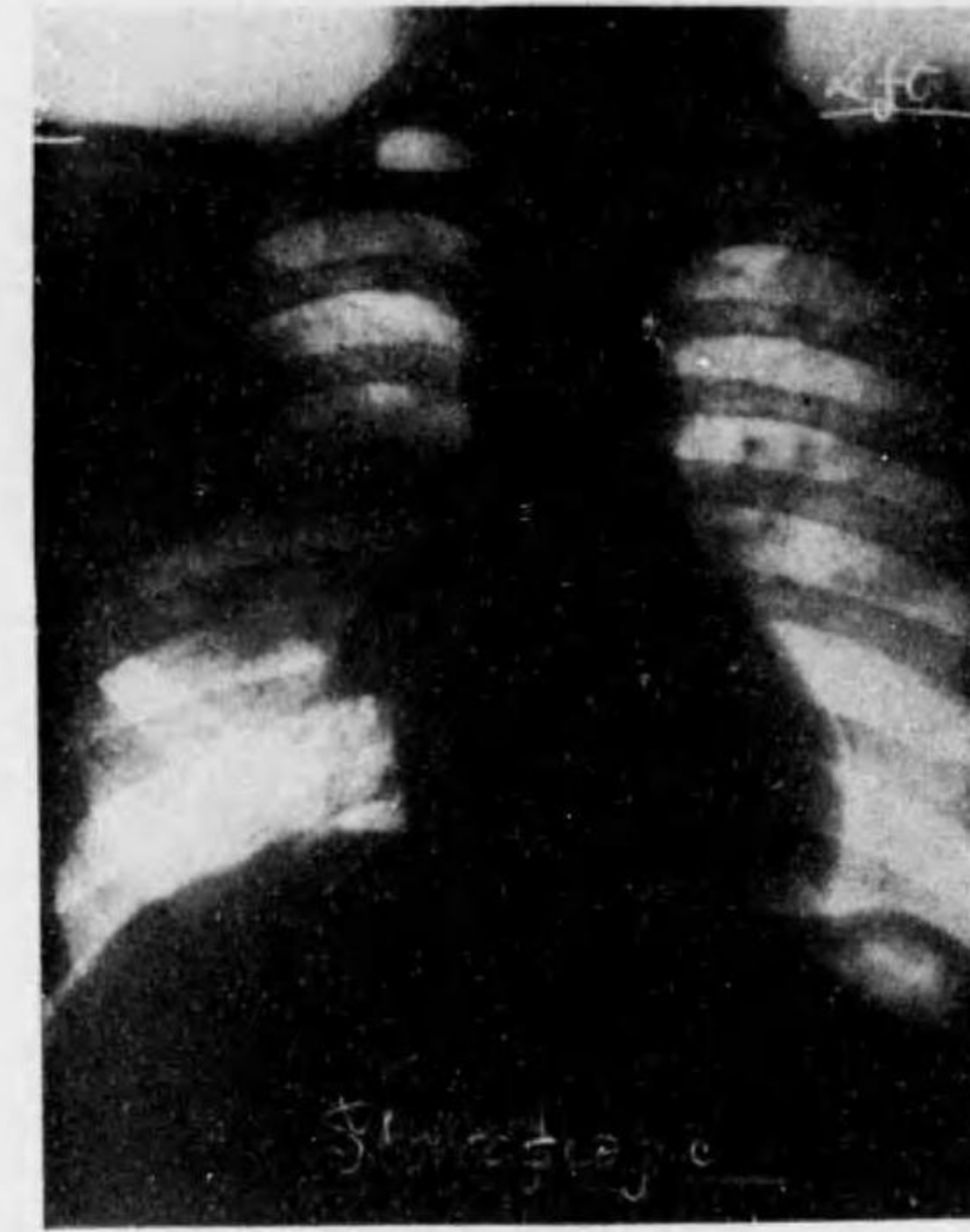
Case II, Fig. 11. Taken three days later in prone position. Group of small honey-combed density suggestive of abscess formation.



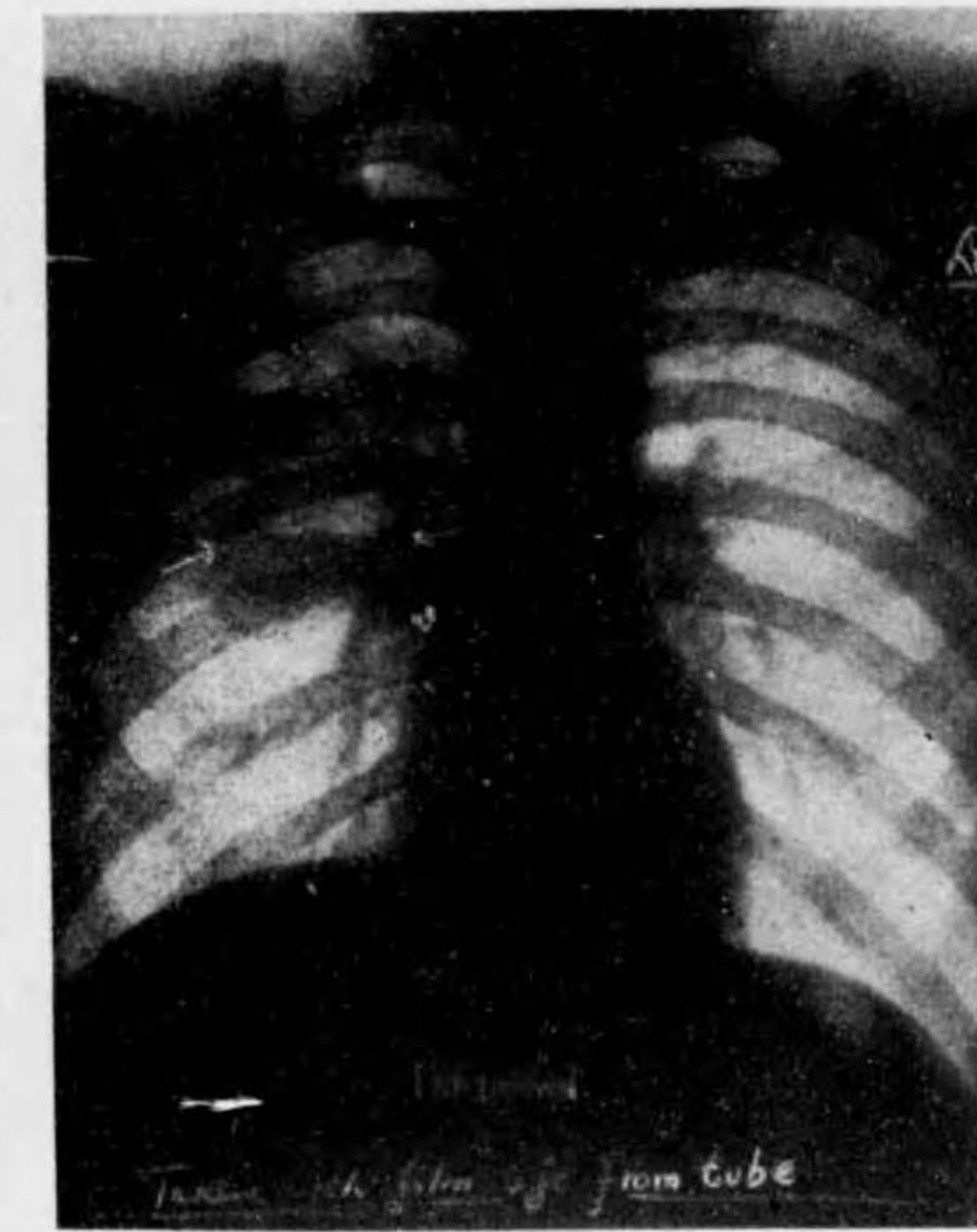
Case II, Fig. 9. Man, 30. About 17 days ago had ether anaesthesia for stretching sciatica.



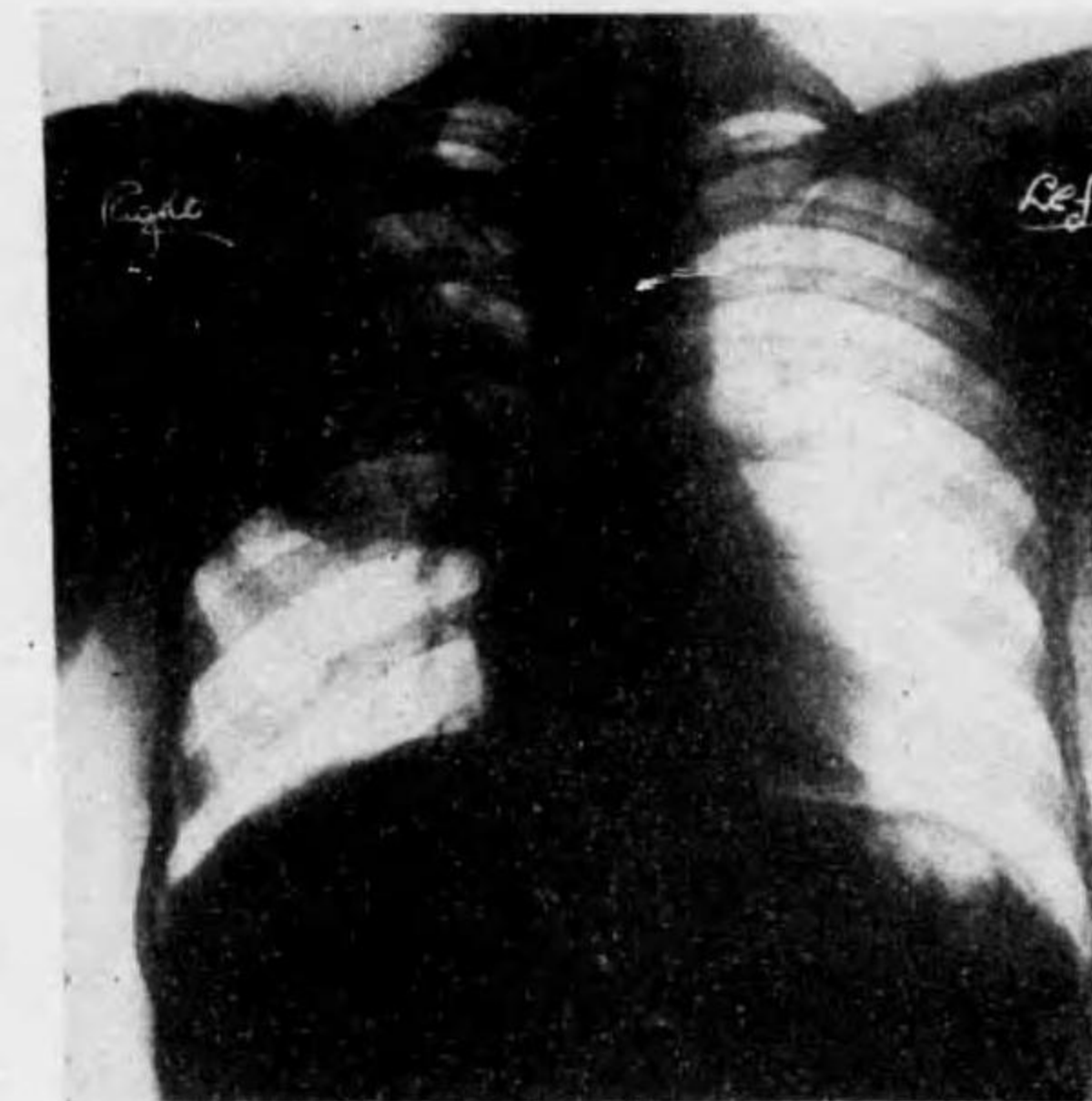
Case II, Fig. 13, taken still a week later, in prone position.



Case II, Fig. 15, taken prone, 9/26/24.



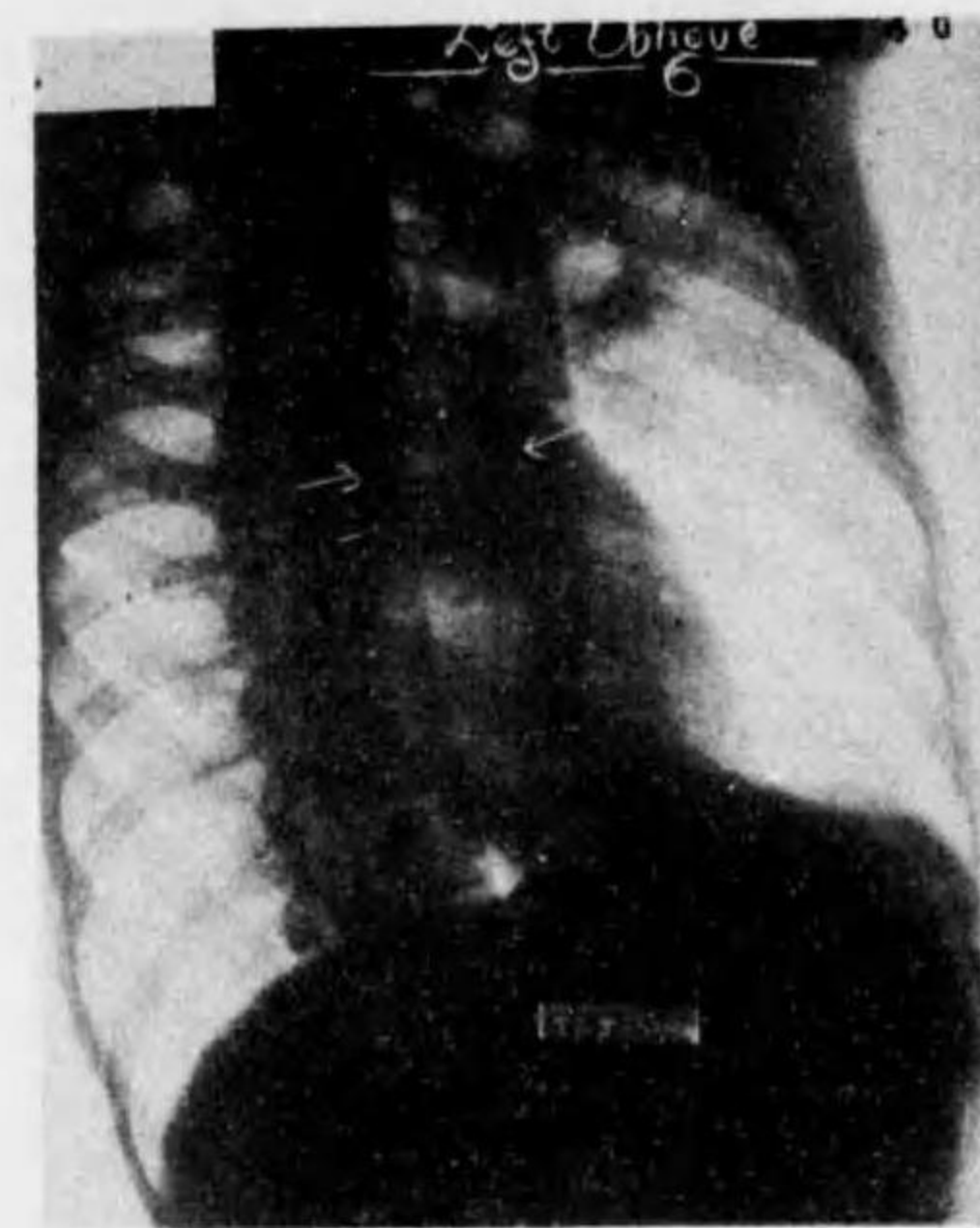
Case II, Fig. 19, taken on the same day in erect antero-posterior position. Shows irregular triangular shaped cavity with fluid level.



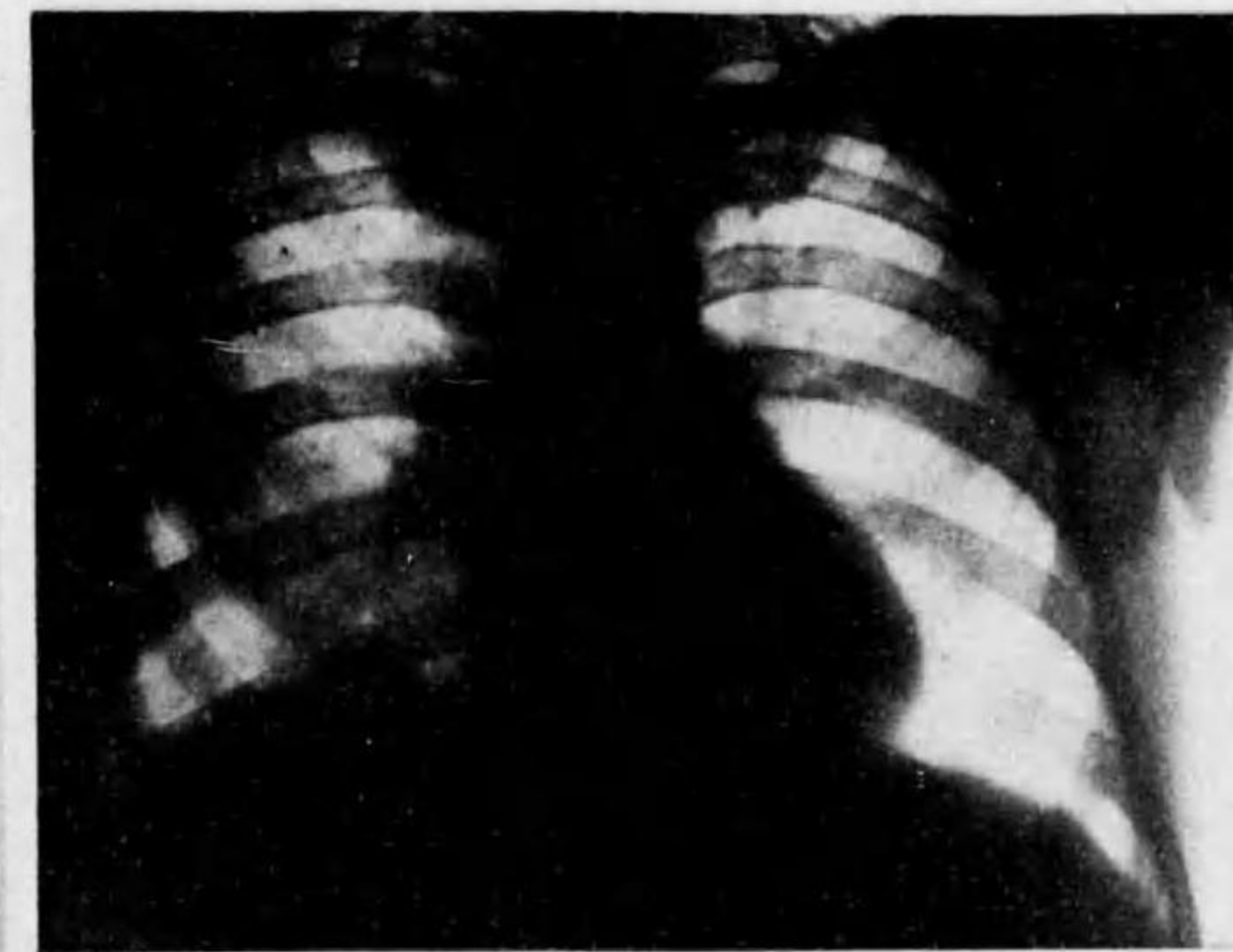
Case II, Fig. 17, 2nd, 1924, in prone position. Showing "geographic mottling" and no definite cavity.



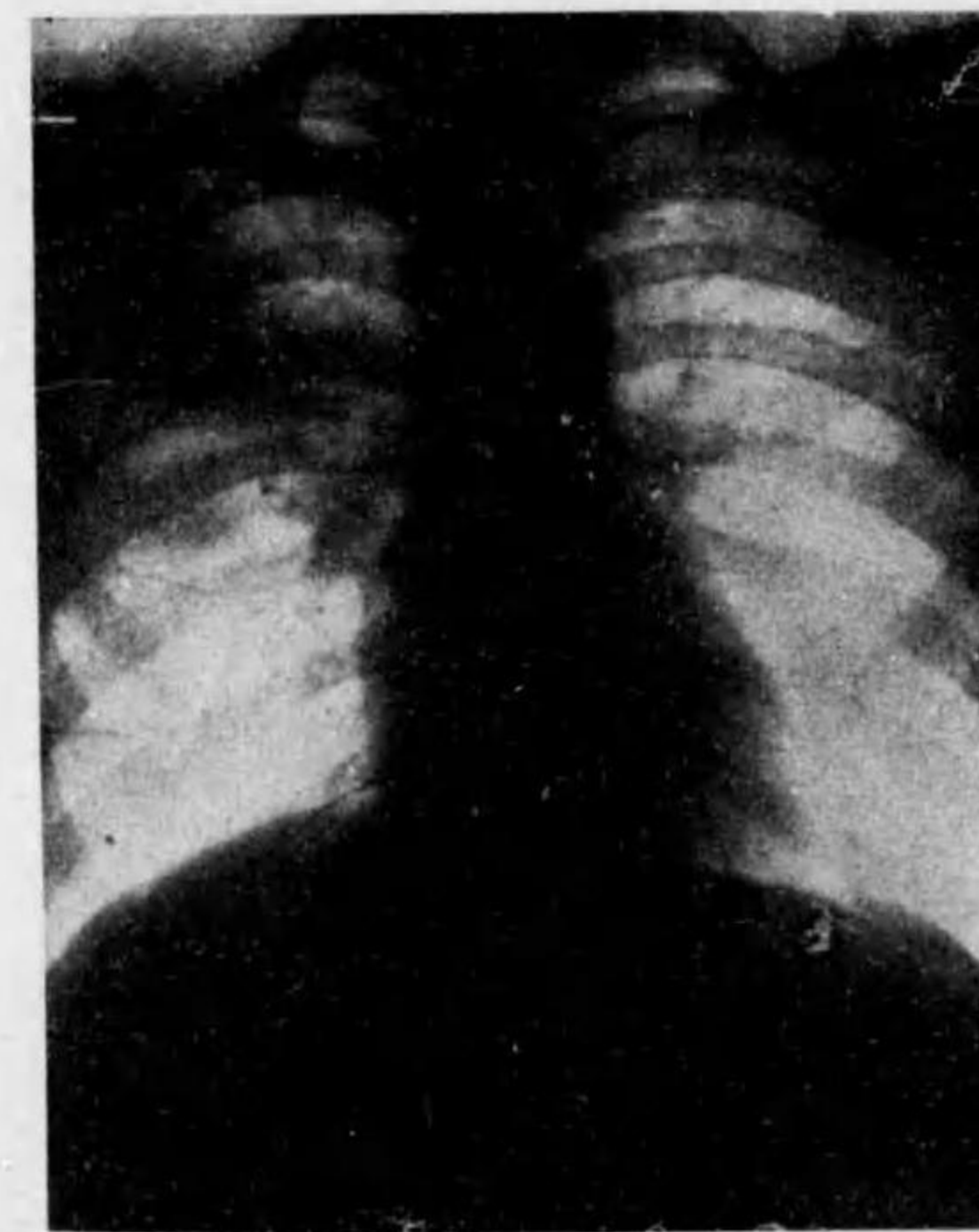
Case II, Fig. 21, taken at the same time, but in lateral erect position. Nothing new is shown here, because the lesion is overshadowed by mediastinum.



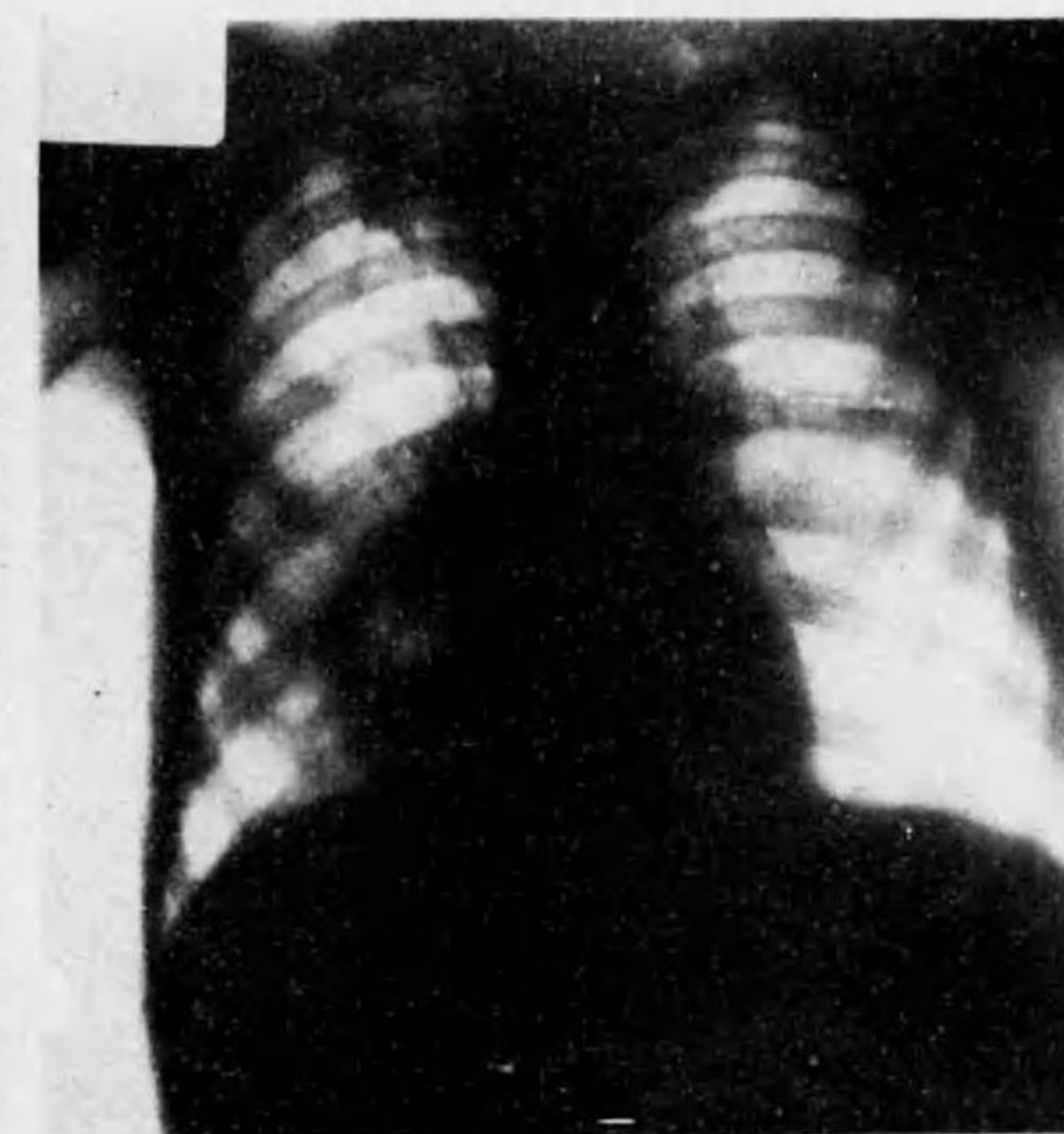
Case II, Fig. 22, taken at the same time, but in rt. oblique erect position. Notice triangular cavity shadow with fluid level near the spine. Details shown in Fig. The circular shadow observed in axillary region in previous picture not seen here.



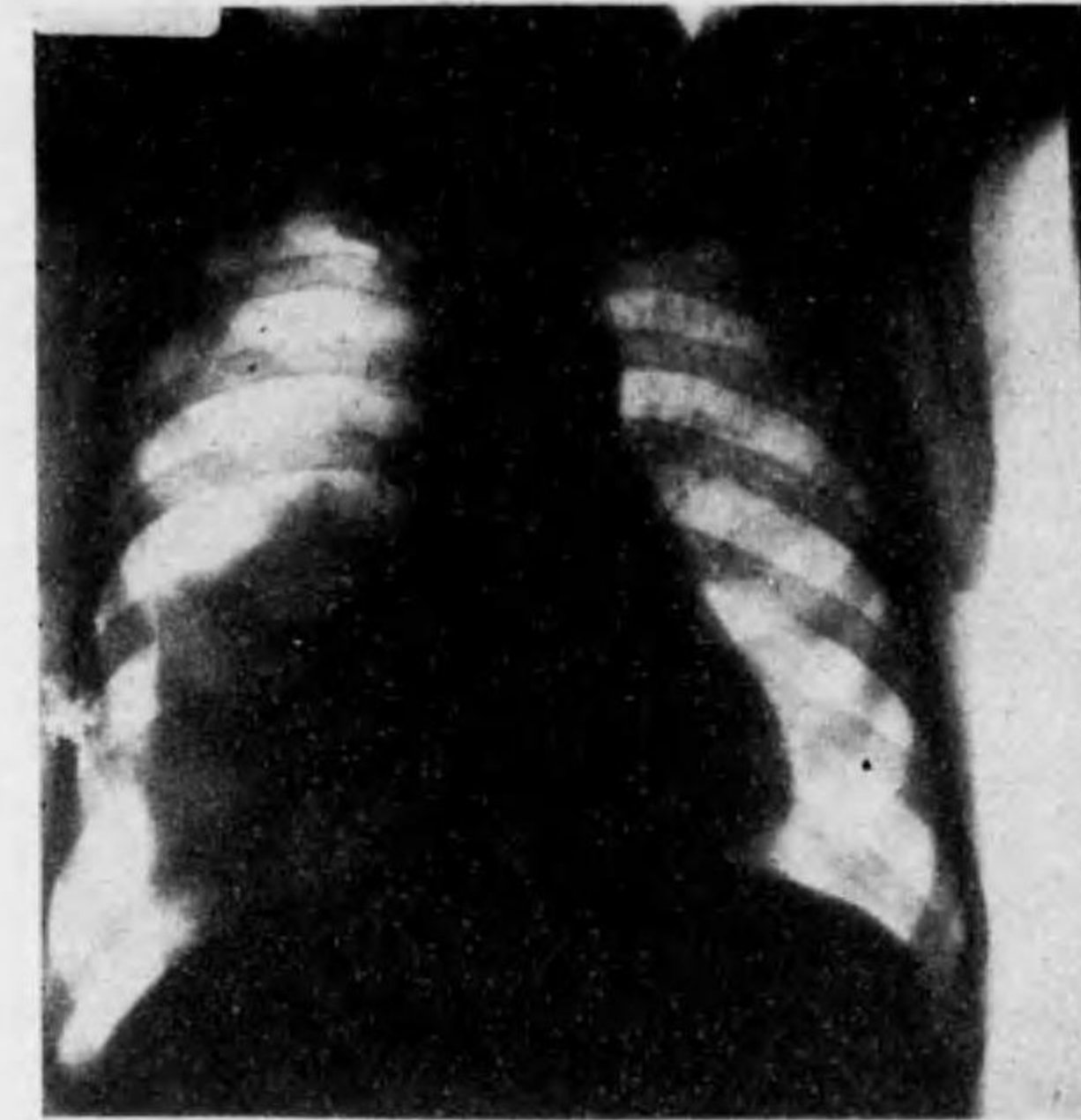
Case III, Fig. 25. Taken in prone pos. 5/11/21. Stone mason, aged 45. 10 days ago was operated on for gastric carcinoma. Moderately thickened area below rt. hilum; hazy shadow in the periphery suggestive post-operative condensation; the "rainy" appearance is due to Pt.'s moving.



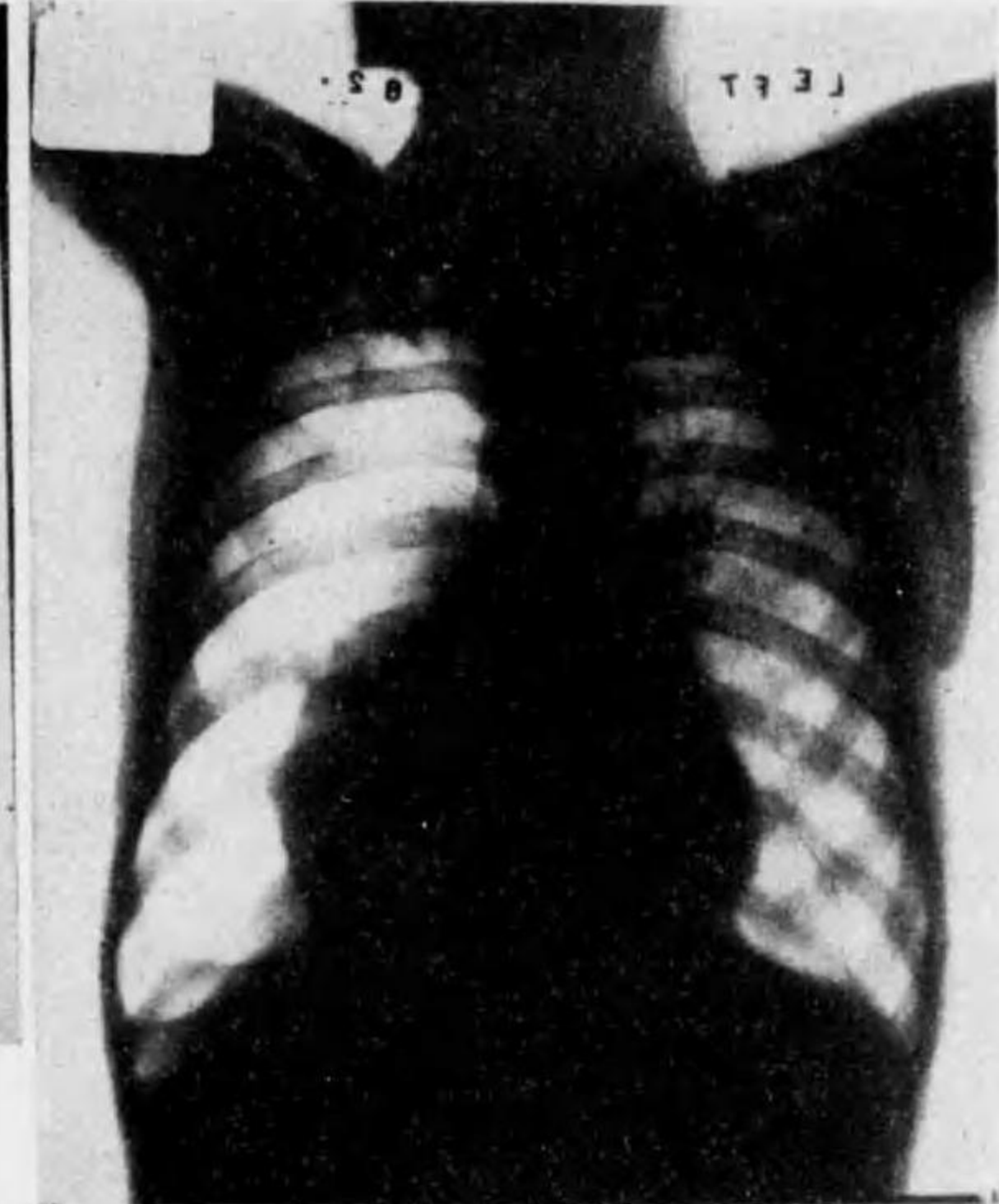
Case II, Fig. 23. Taken stereoscopically in prone position two weeks after the last. Notice clear cut oval shadow of even density at axilla, in the position where a ring-like shadow was observed in Fig. 19.



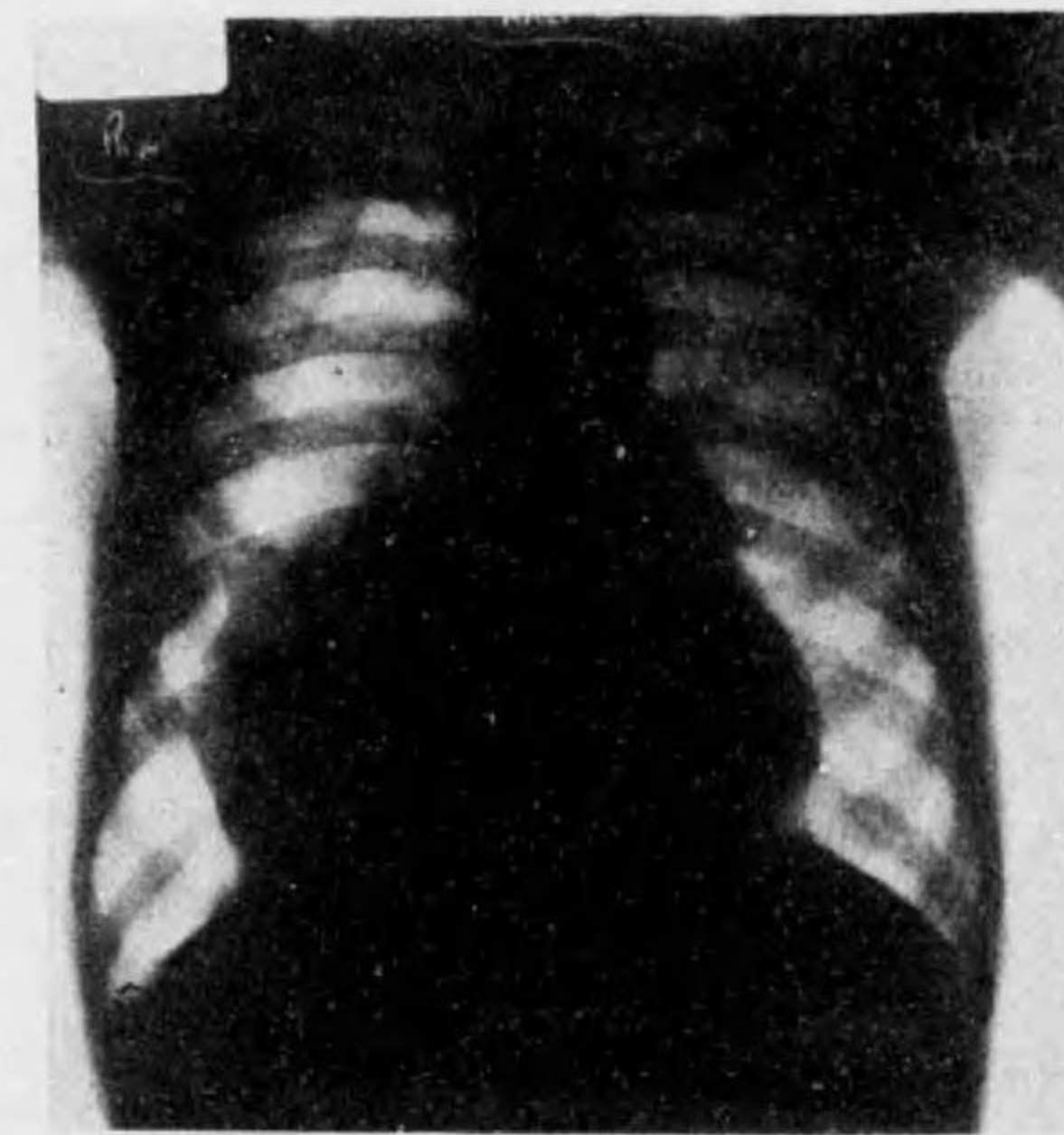
Case III, Fig. 27. Taken erect 10 days after previous film. A large cavity with fluid level at lower end of rt. hilum now making its appearance. See Fig. 28.



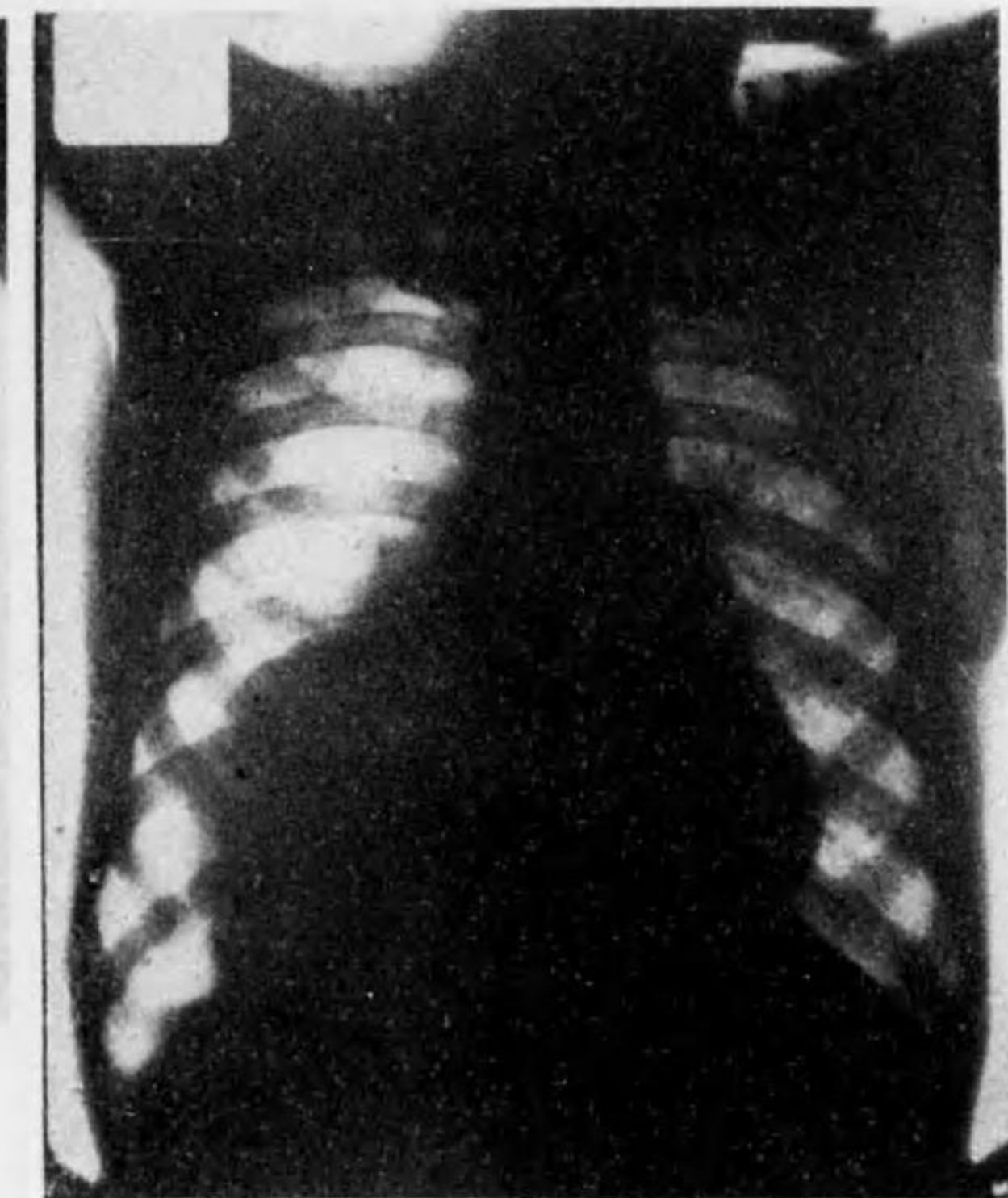
Case III, Fig. 29. Taken erect 6/ 1/ 21, after treated by A. P. T. Notice the remarkably compressed cavity. There is slight induration around the cavity; heart is displaced to the left.



Case III, Fig. 32, 6/ 4/ 21. Erect. Most part of the upper lobe is compressed to a small rounded, faint shadow.



Case III, Fig. 31. 6/ 3/ 21. Erect, result of more A. P. T. Cavity is now reduced to only a fissure.



Case III, Fig. 34. Erect, 6/ 5/ 21. After more "air". No longer cavity seen; left lower lobe more aerated; left lung markings increased; heart and mediastinum displaced to the left.

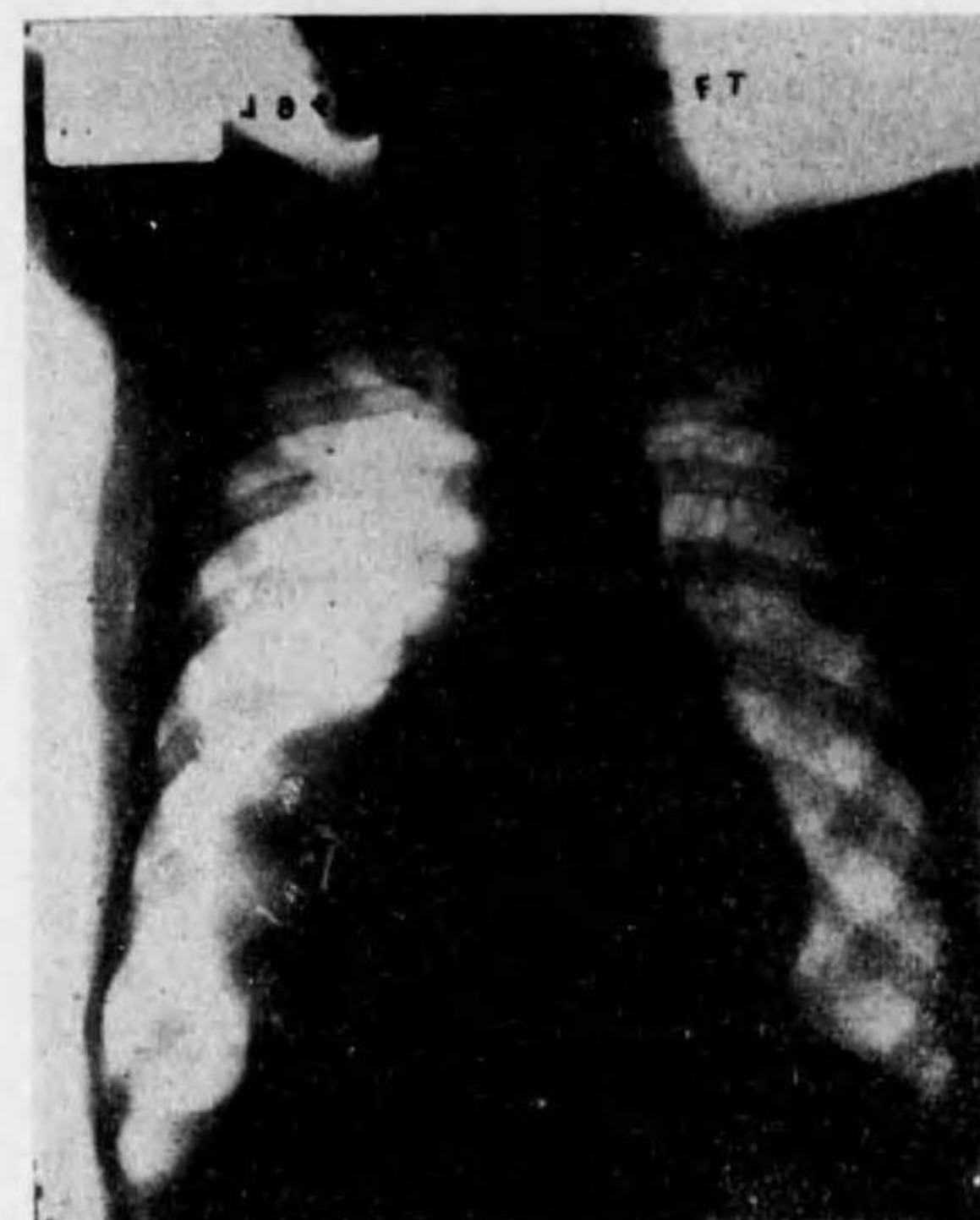
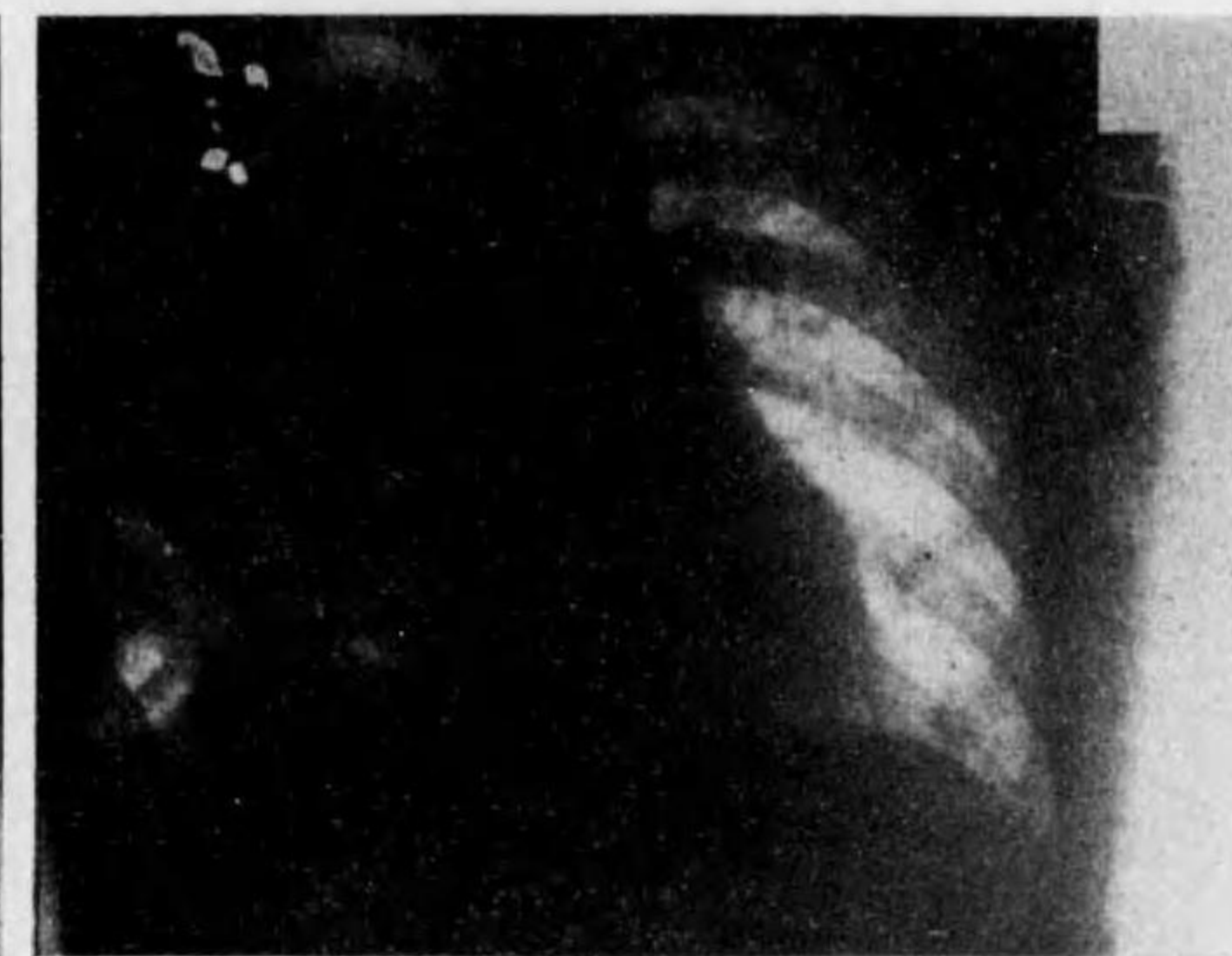
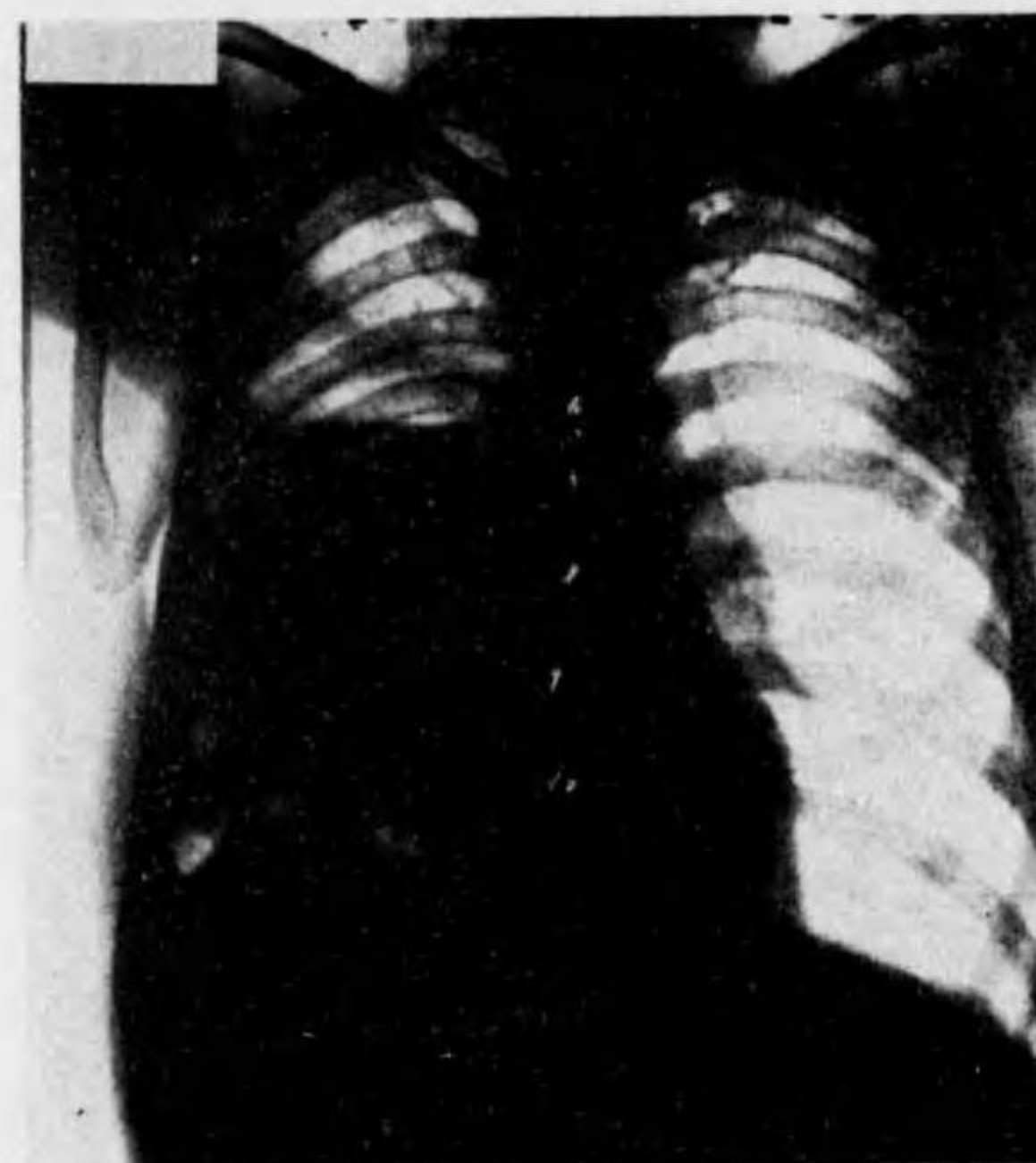


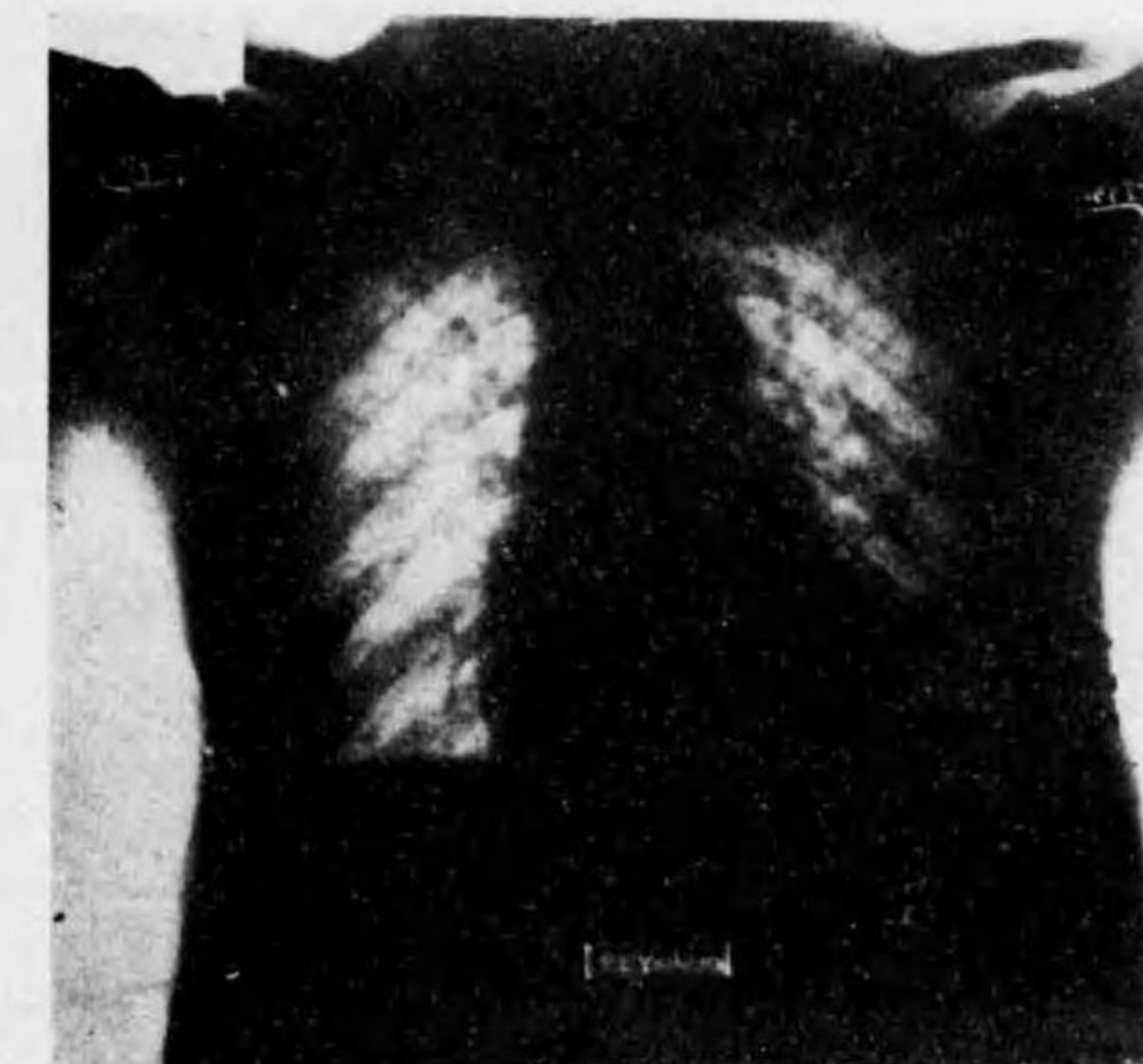
Fig. 35, Case III, Still later. A few days later the pt. died suddenly.



Case IV, Fig. 39, 12/ 25/ 21, lateral prone pos. Shadows less dense, but more fibrous. Two central rarefied areas, but no fluid content. More pneumothorax.



Case IV, Fig. 37, Dec. 19th, 21. Man 46, began as "pneumonia" 5 weeks ago. Rt. lung: diffuse density in lower half; faint arch formation above the upper margin indicating cavity; markedly infiltrating area below.



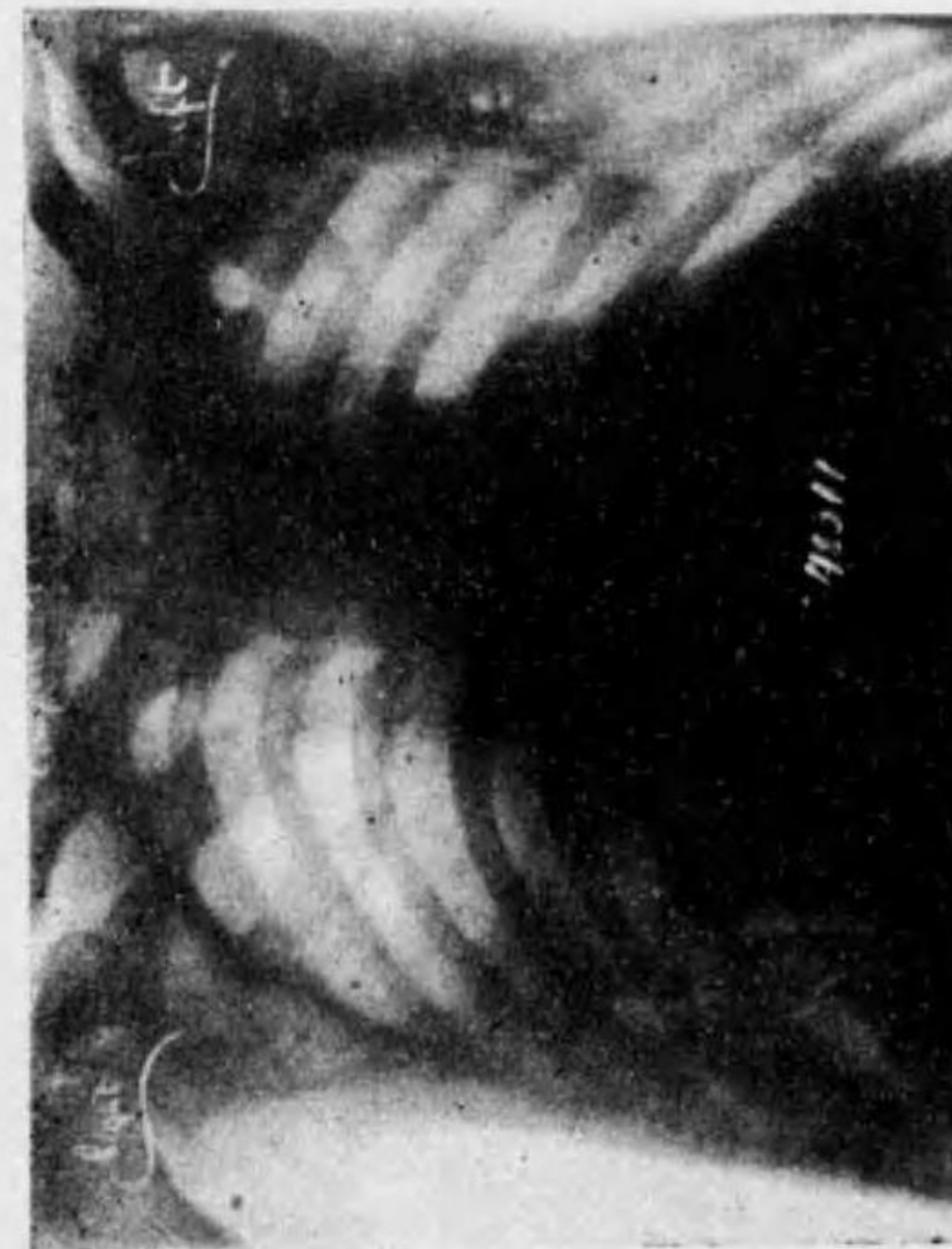
Case V, Fig. 41, prone, 1/ 5/ 23. Artist, aged 51, diabetic. Began as "severe cold" 5 days ago. Left lung: hazy apex; high diaphragm; bulging out of left hilum suggest mediastinal emphysema.



Case VI, Fig. 44, 2/ 14/ 21, spine pos. 31, gas bacillus infection following nearly drowning and fractured tibia. This was taken two weeks after the accident.



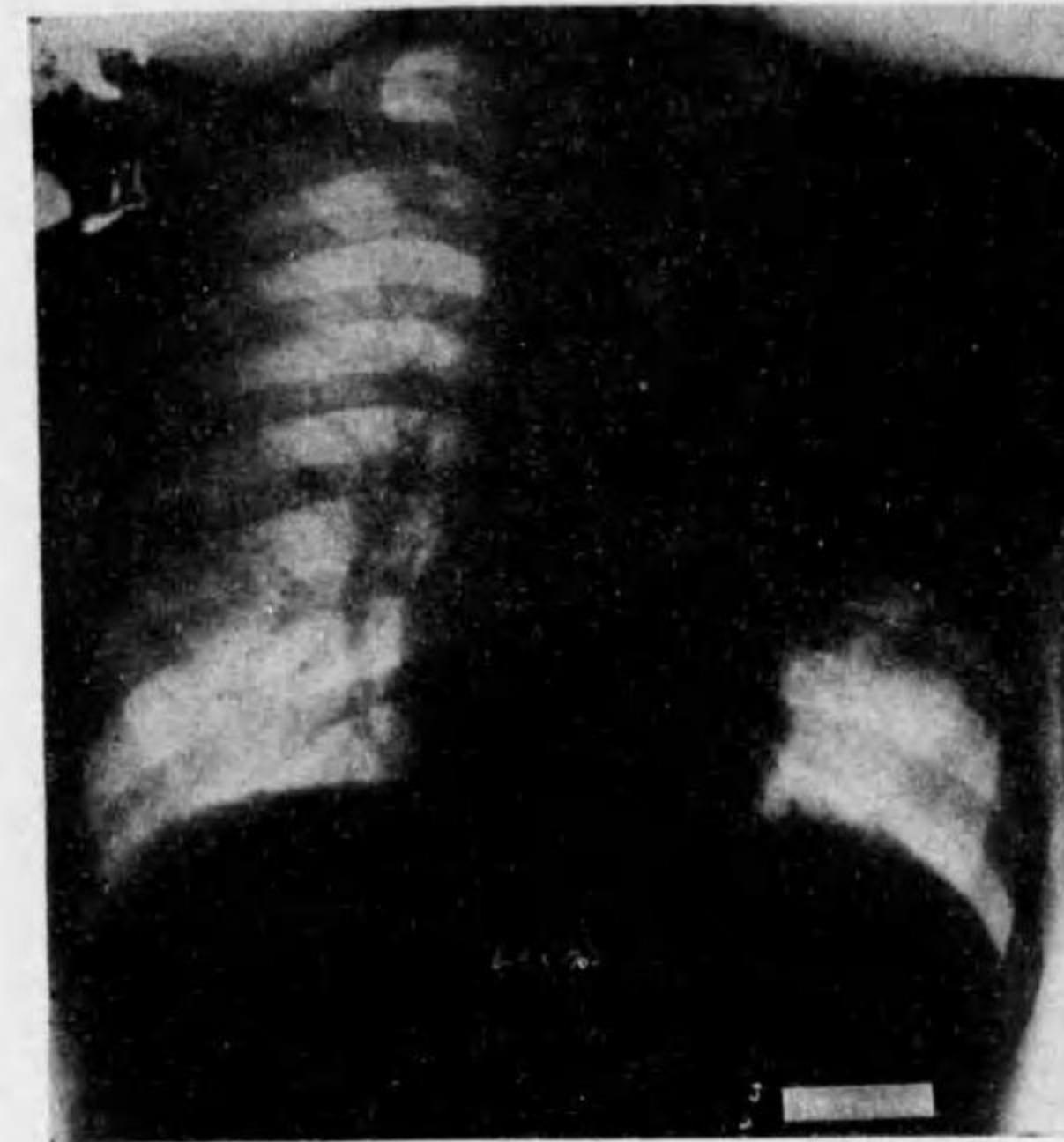
Case VI, Fig. 46, Taken 9 days after previous, in spine pos. Increased pneumonic shadow, rounded cavity at base with fluid level and dense, infiltrated area below.



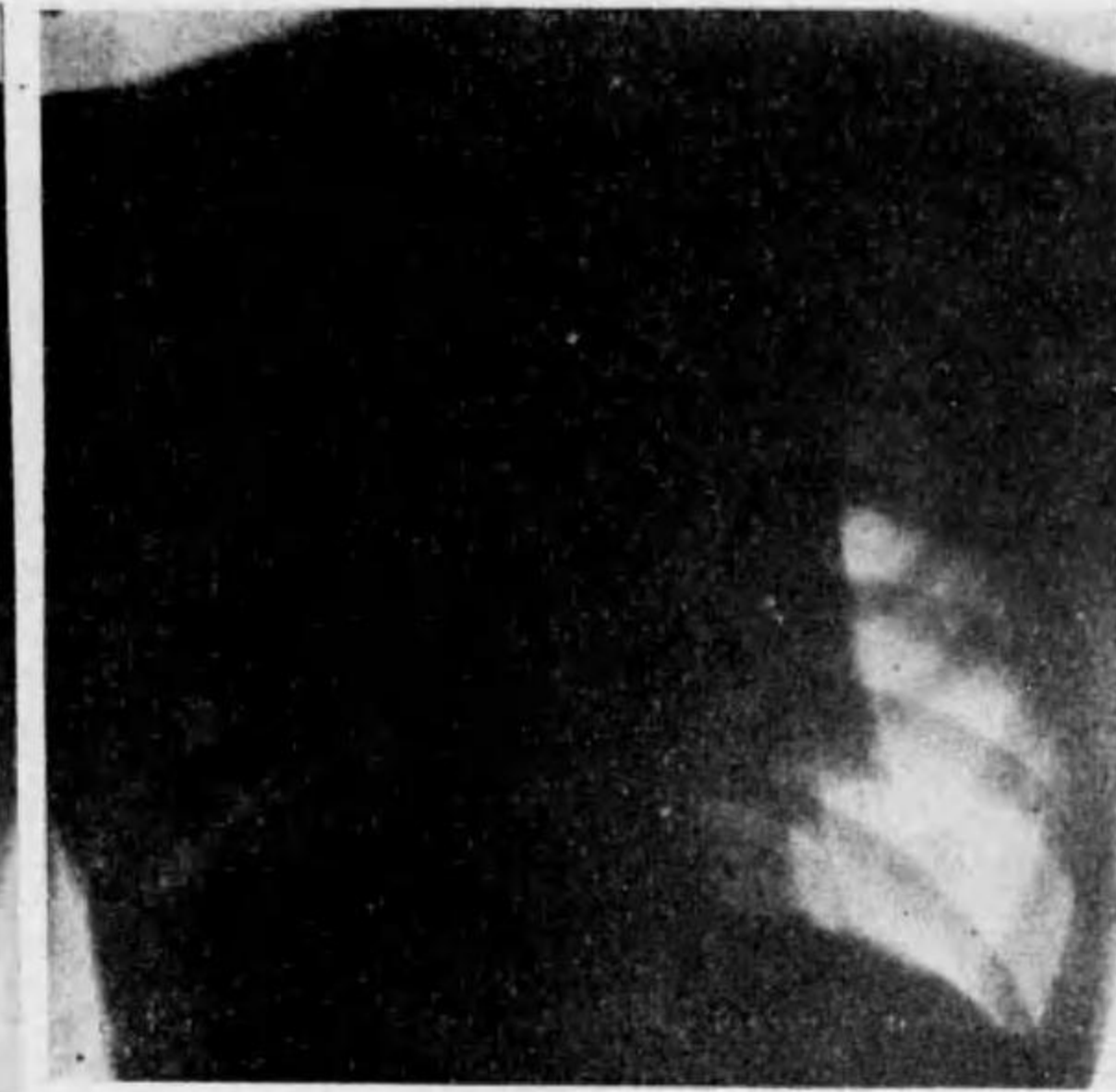
Case VI, Fig. 48, and 49 taken simultaneously six days later. Fig. 48 taken at full inspiration. Post Mortem showed a large cavity at in rt. lower lobe; many small cavities in mid and lower lobes and isolated pneumonitis in upper lobe.



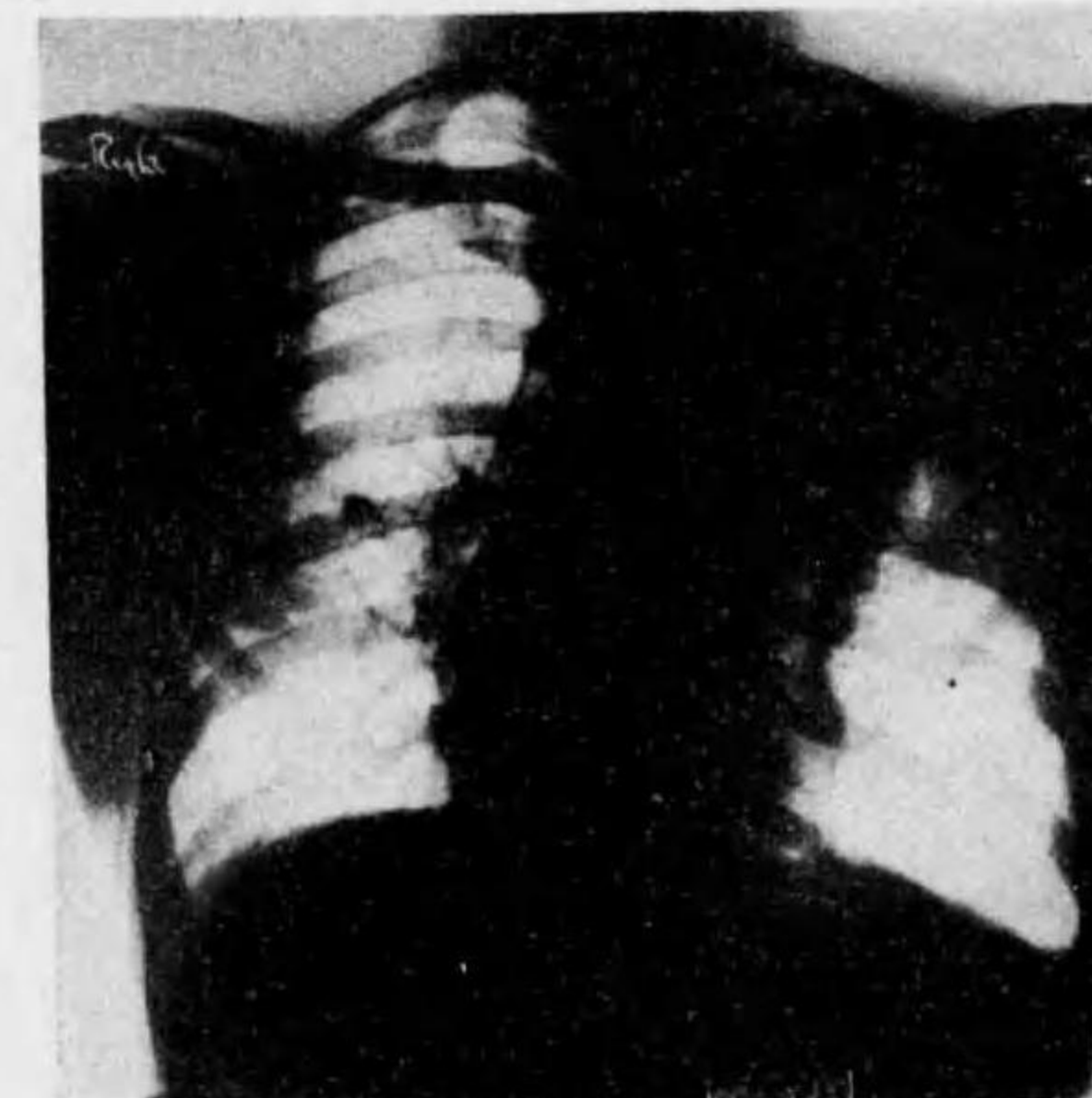
Case VI, 49, Same as Fig. 48, but taken in full expiration. No change in the height of the diaphragm. Cavity shadow more distinct.



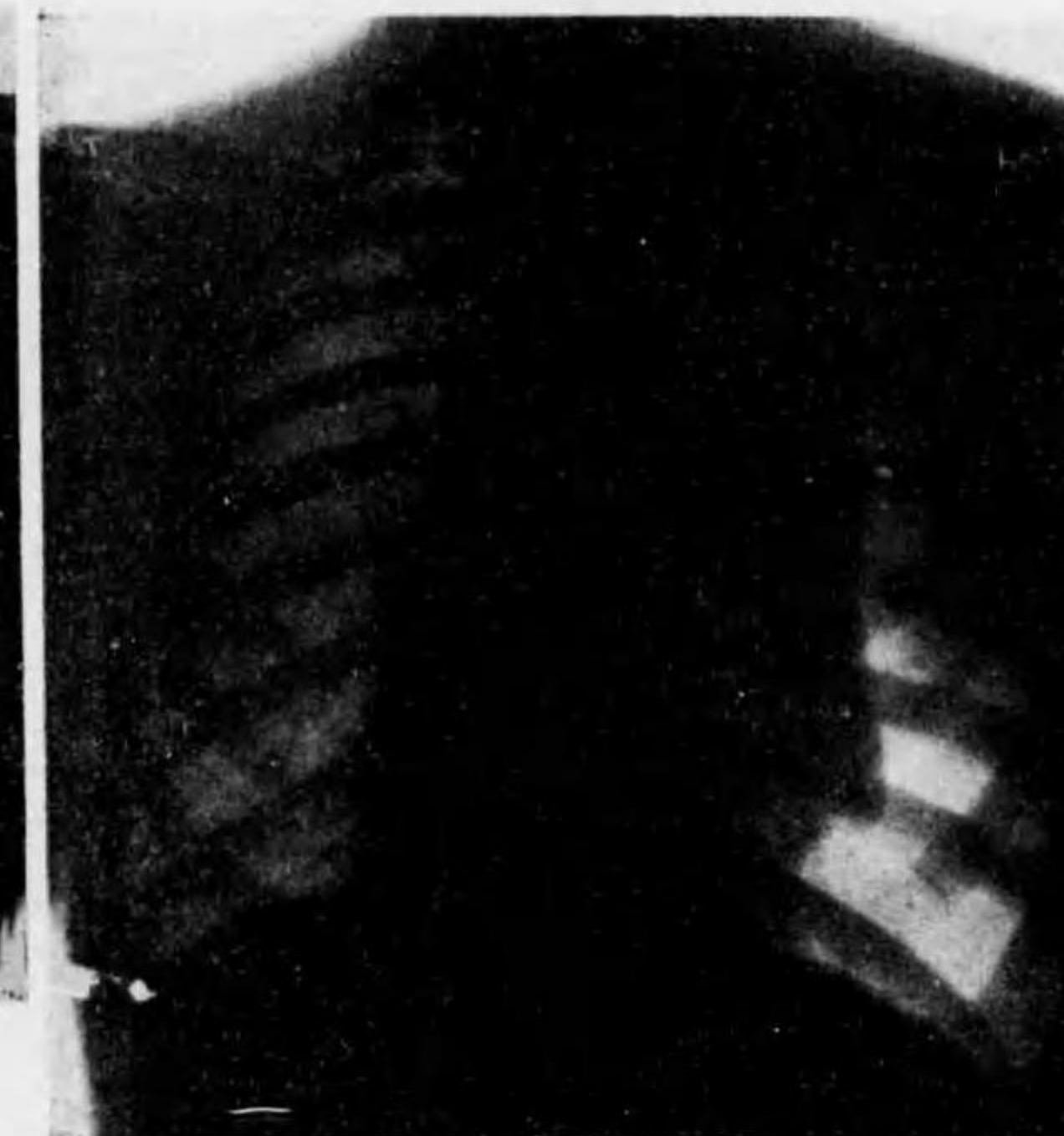
Case VII, Fig. 51 9/22/23. Italian aged 26; sixteen months ago, had tonsillectomy, ten days later, this was followed by expectorating and cough. Until recent he was treated as having tuberculosis.
Density in upper left 2/3. Two suspicious areas of cavitation.



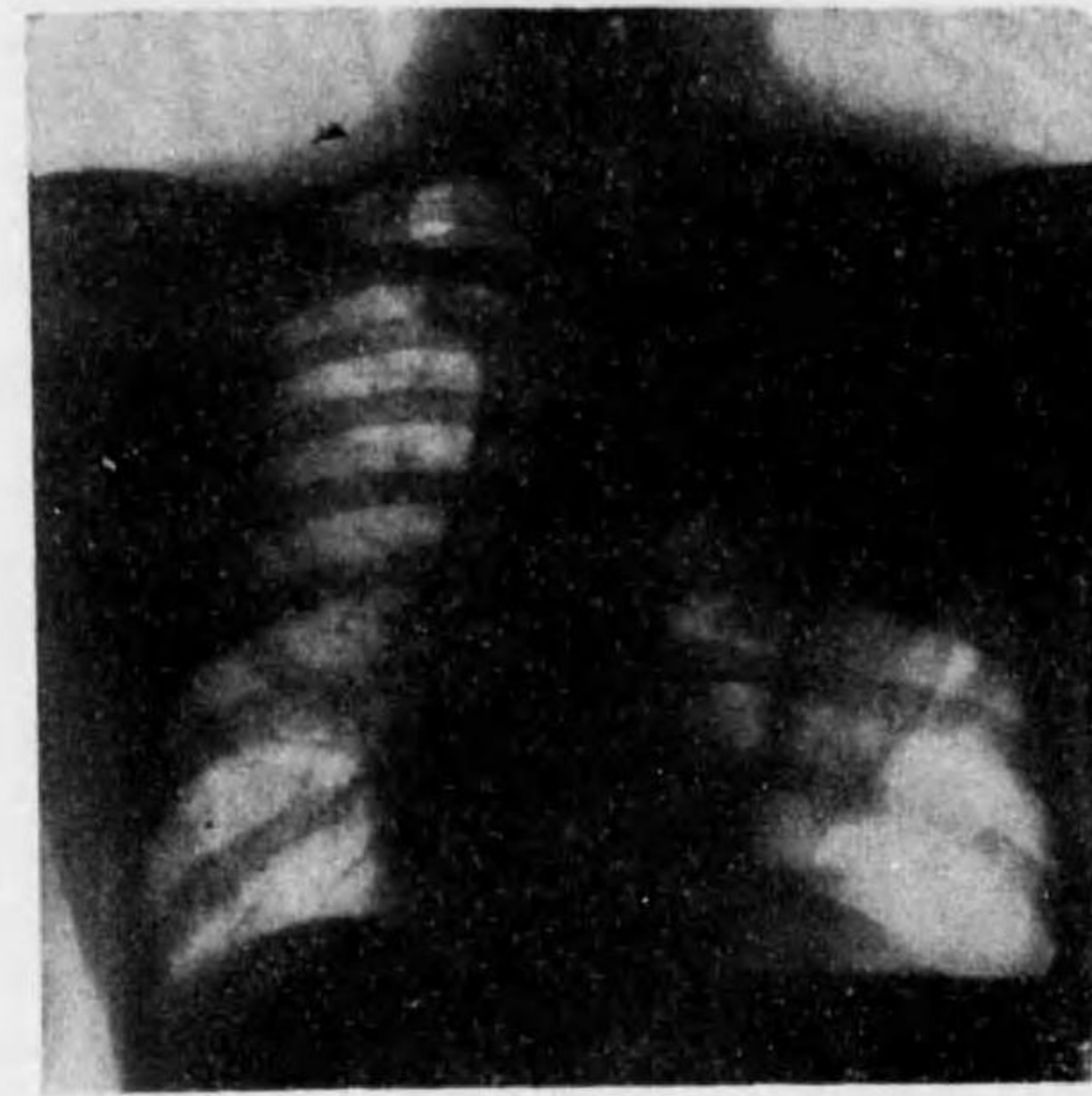
Case VII, Fig. 56, taken 7 days later. Shadows now less dense and less mottling. At base notice the effect of A. P. T., "curling paper" & "Banian tree" adhesions.



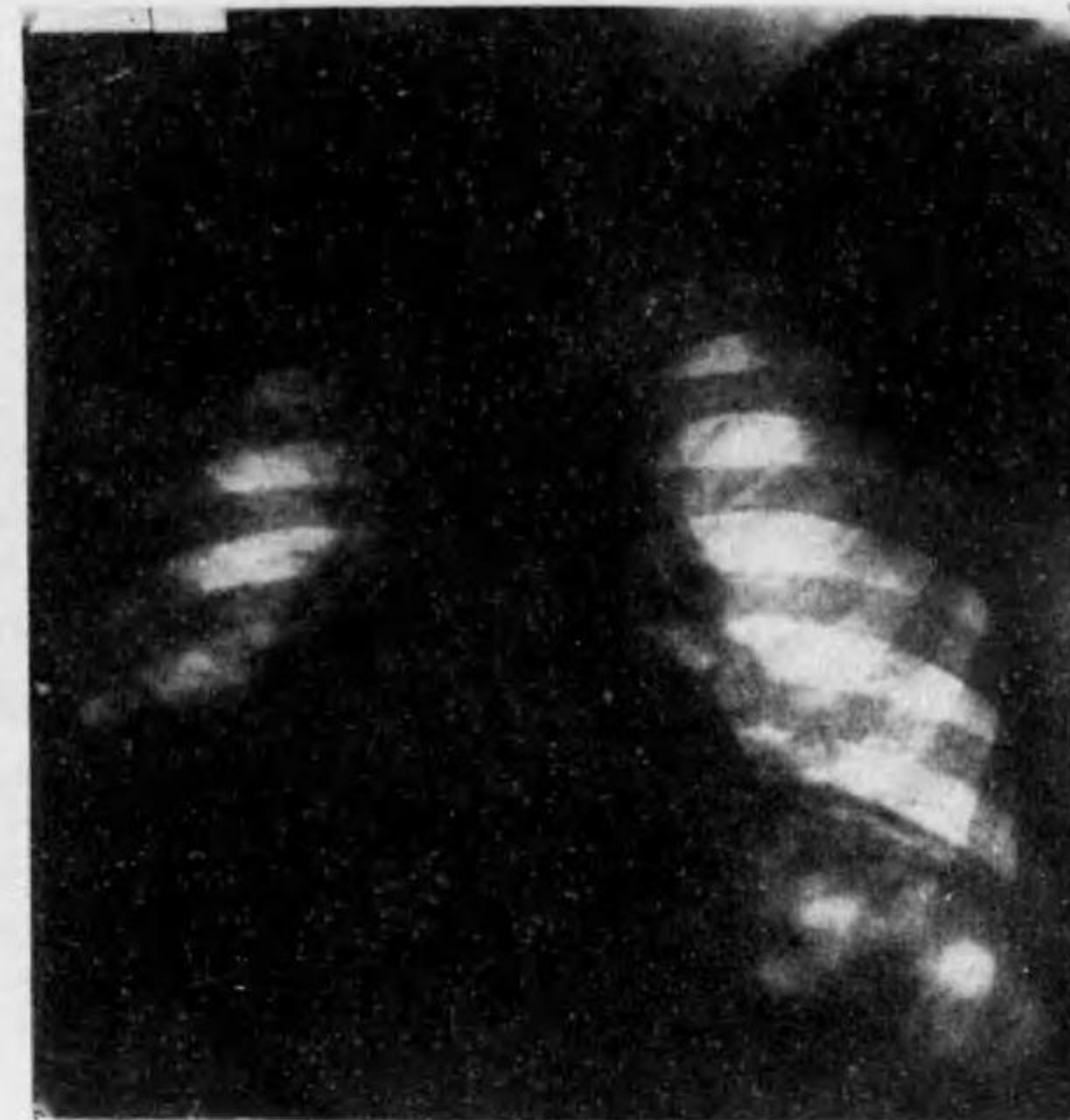
Case VII, Fig. 54. Taken erect, two weeks after figure 51. Shows effect, of A. P. T. Mediastinal structures displace to the rt., upper left now less dense. Cavity shadow is distinctly visible; there are numerous adhesions at base.



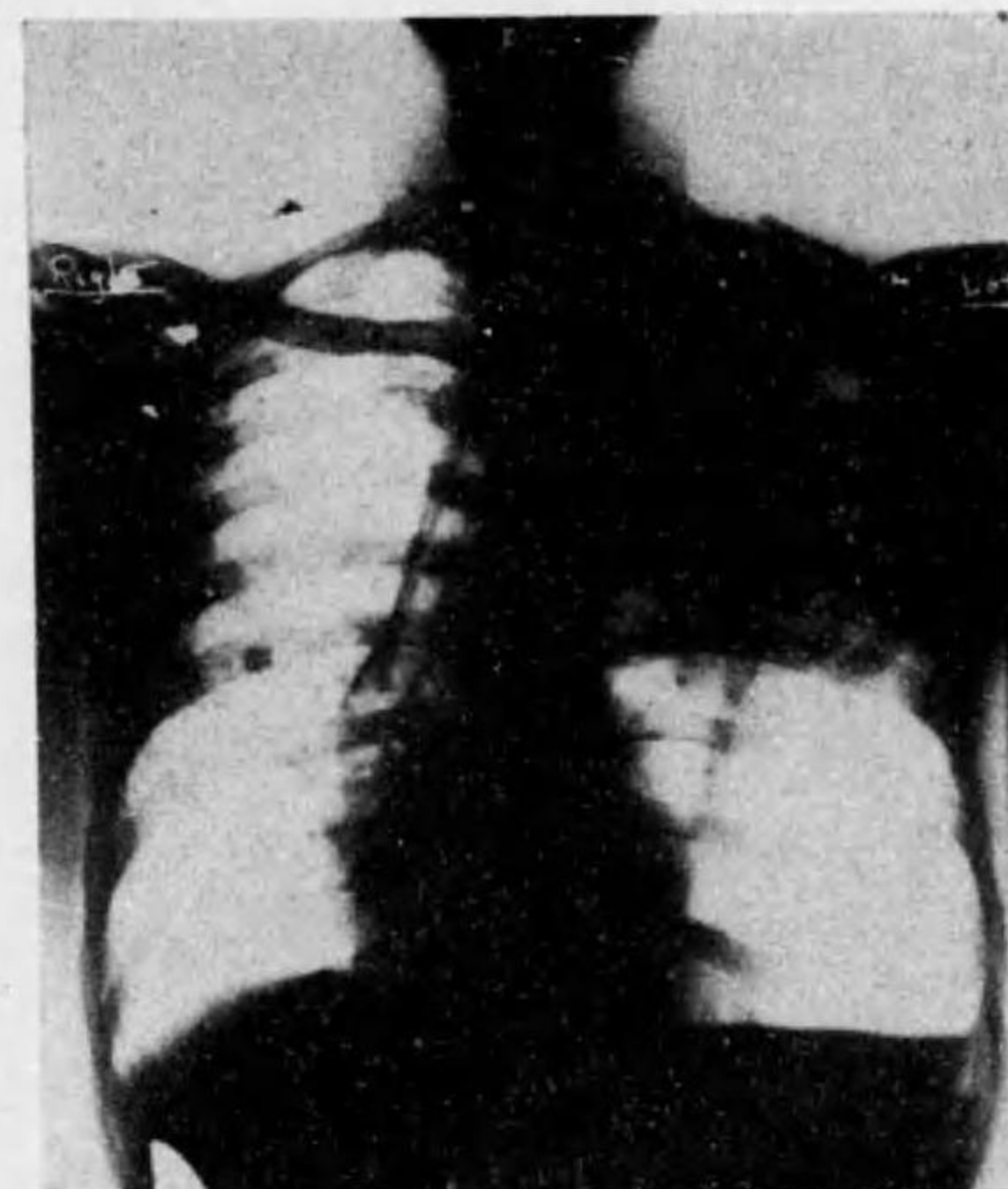
Case VII, Fig. 59, 11/1/23. Showing much compressed left lung, displaced mediastinum. Cavity now barely seen; probable adhesion at left root or pleural shadow.



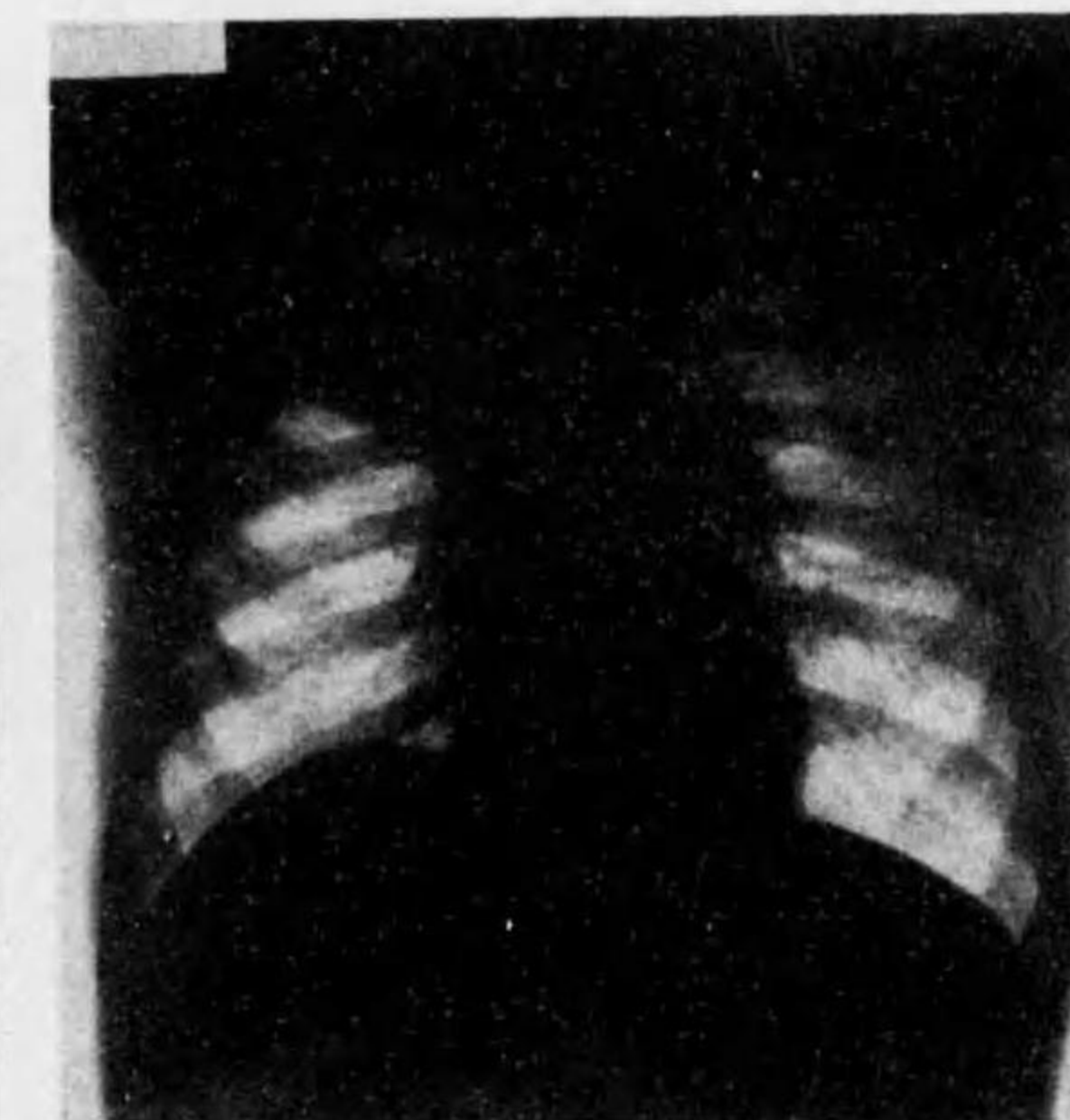
Case VII, Fig. 62-a & b, stereoscopic films. These were taken erect on Dec. 6th, 1923. The left lung now partially aerated, cavity still seen with its irregular ragged walls. Fluid at base and displaced mediastinal structures.



Case VIII, Fig. 64, taken erect, 9/27/21. Italian laborer, aged 36, operated on for perforating gastric ulcer on Sept. 4th. About a month later, a sudden rise in temp., cough and bloody expectoration. This shows mottling density at rt. cardiophrenic angle, haziness periphery and cloudy area just above rt. root.



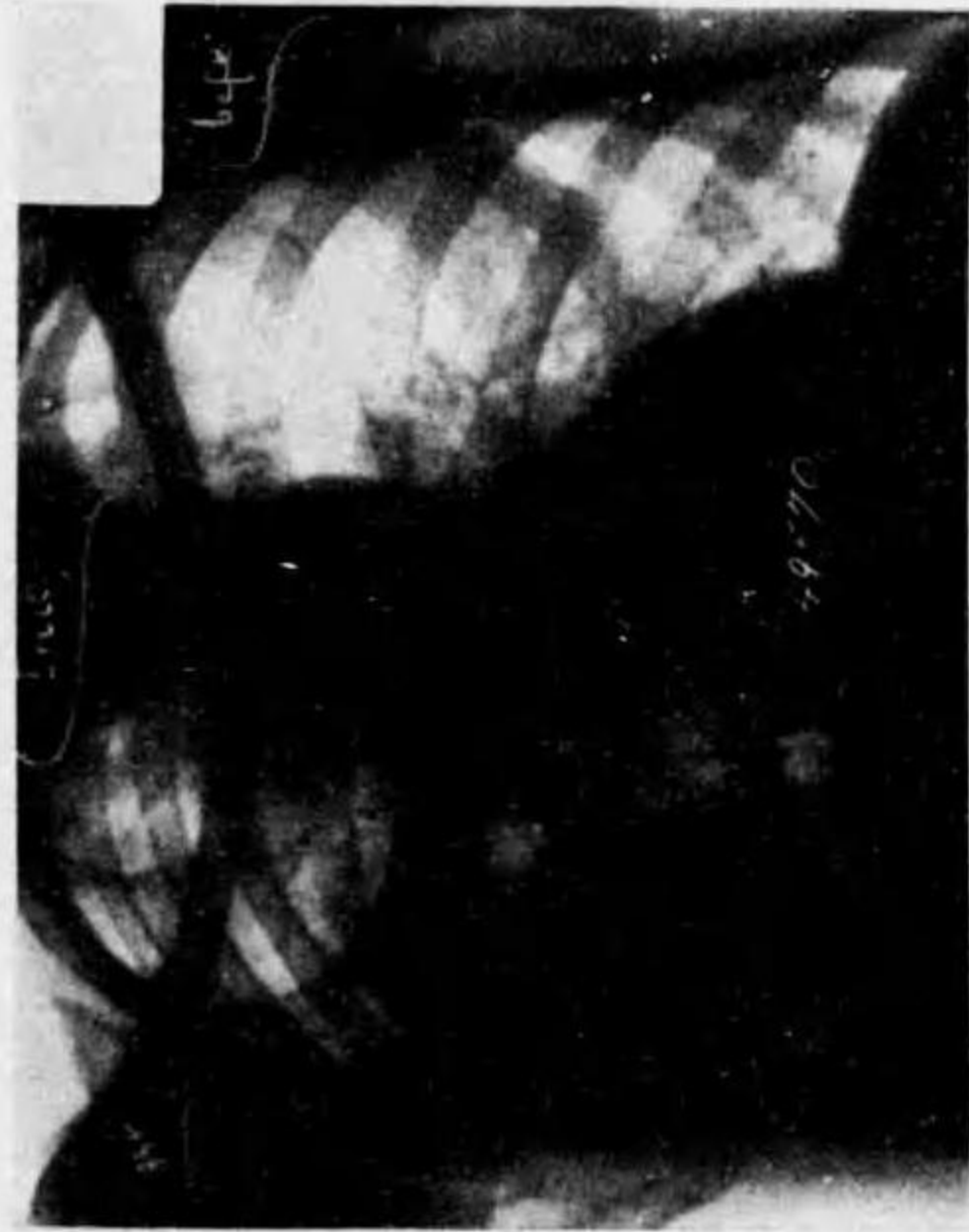
Case VII, Fig. 62-b



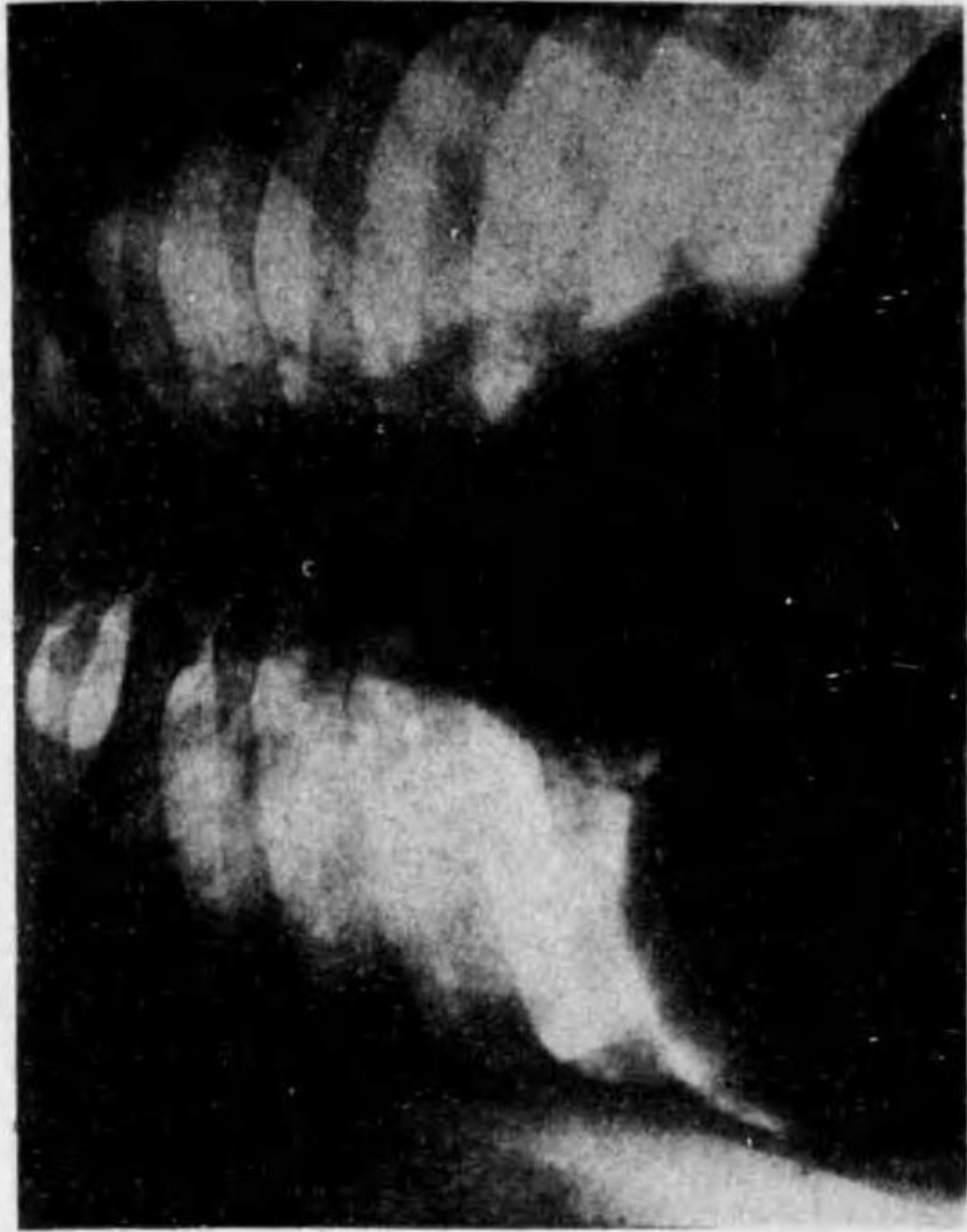
Case VIII, Fig. 68, erect, 10/29/21, indicating clear circular cavity with fluid level; triangular density below.



Case IX, Fig. 72, taken the next day in erect pos., and after medical pneumothorax. Air in pleural cavity.



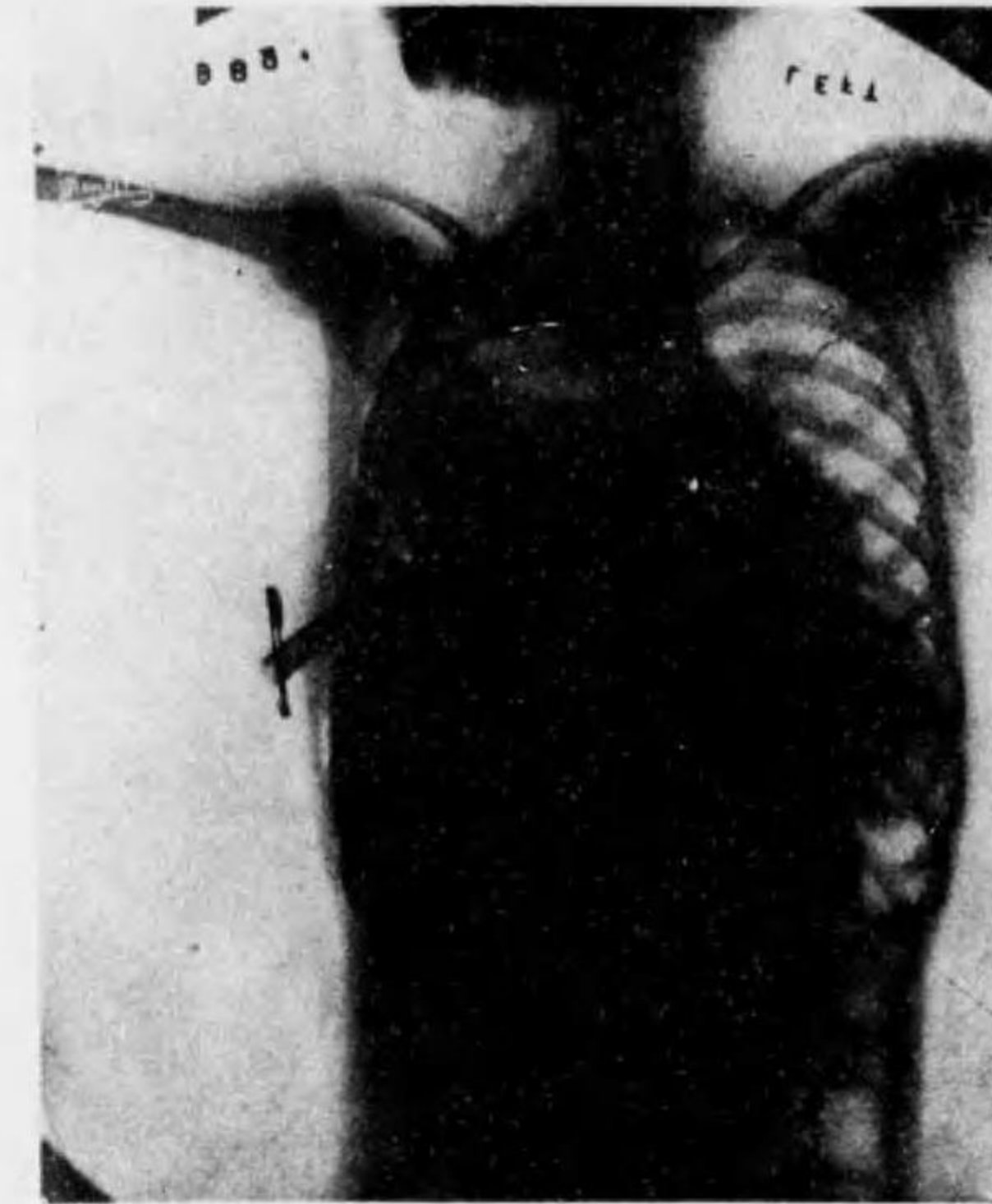
Case IX, Fig. 74, Taken in erect pos. 10 days later. There is a faint cavity shadow with irregular outline A short below this a small rounded shadow which may be another cavitation.



Case VIII, Fig. 66. Prone, 10/ 5/ 21. Widening mediastinal shadow to the rt, high rt. diaphragm and at subclavicular region a small mottling shadow suggestive of broncho-pneumonic area



Case IX, Fig. 70, May 10, '21, in erect position. Leather goods handler, aged 42, six weeks ago began with sudden chill and fever, and sputum in large quantities. Notice "geographic mottling" in upper 2/3 of rt. lung.



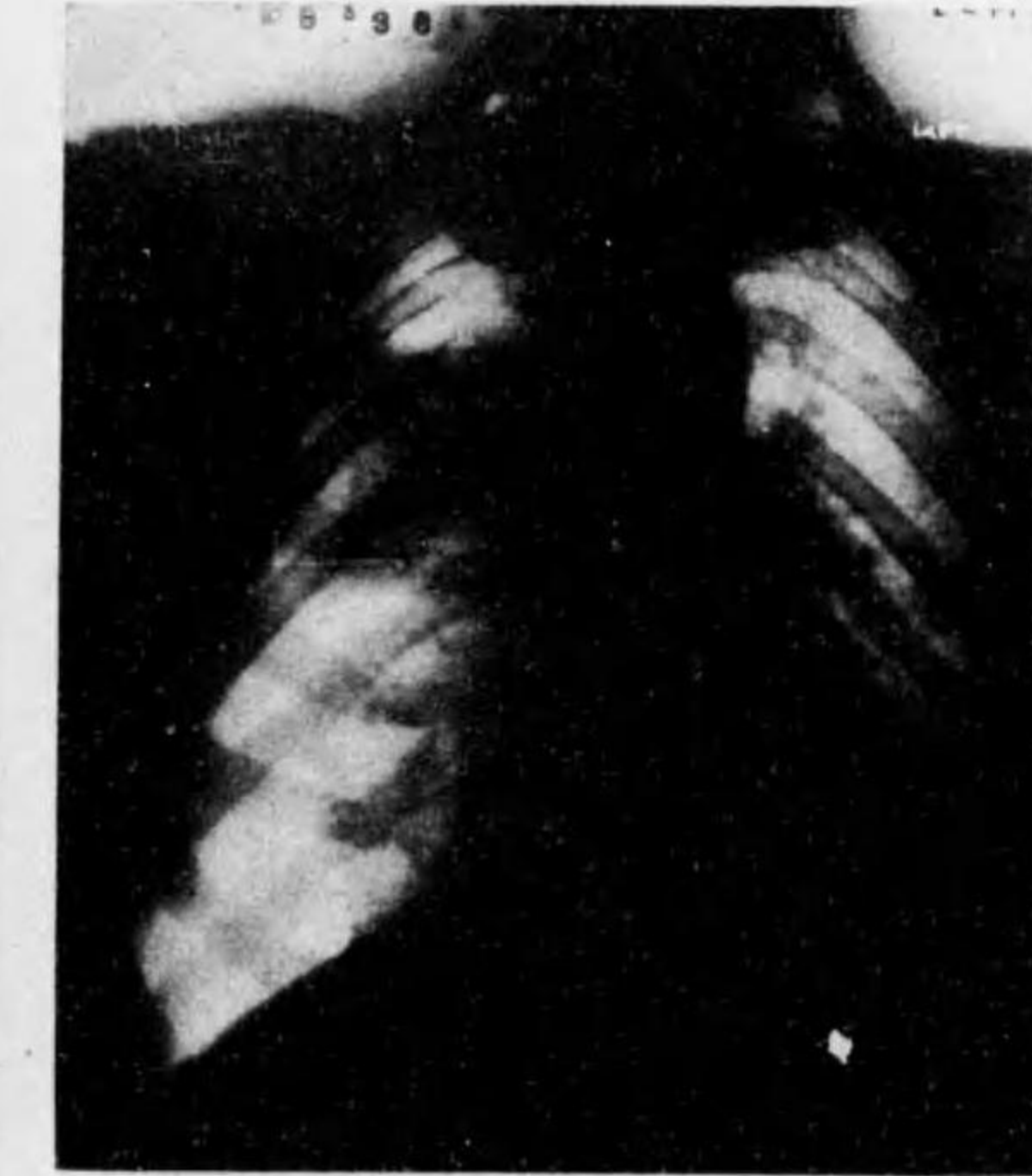
Case X, Fig. 76, 12/ 1/ 22, after thoracotomy. Girl aged 9, six weeks ago began with sudden chill and fever, sputum in large quantities. General density in upper rt. with irregular elongated rarefied area indicating a cavity. Also fistulous tracks may be traced above the clavicle and also to the bronchus.



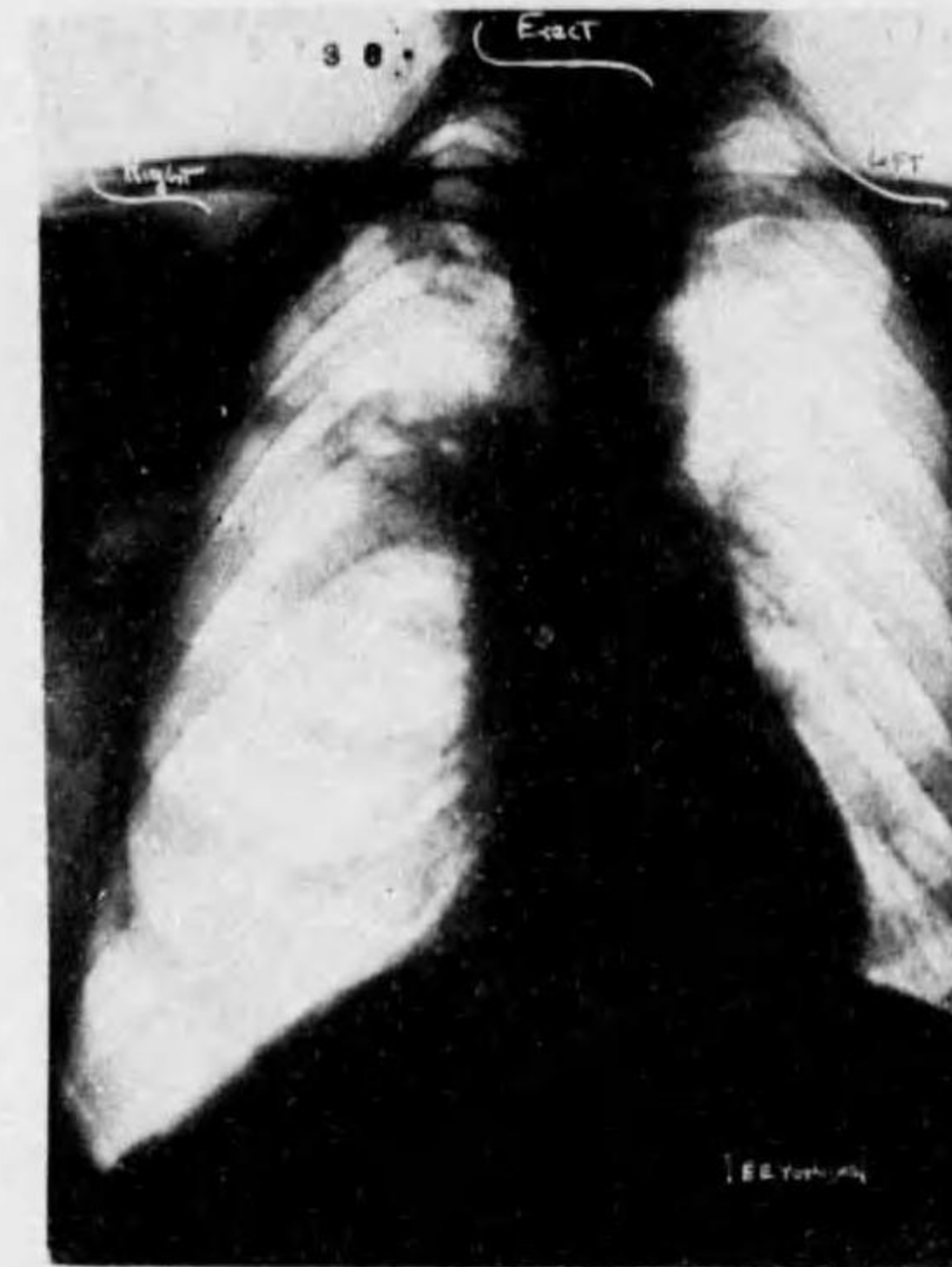
Case XI, Fig. 80, 11/ 20/ 22, erect position.



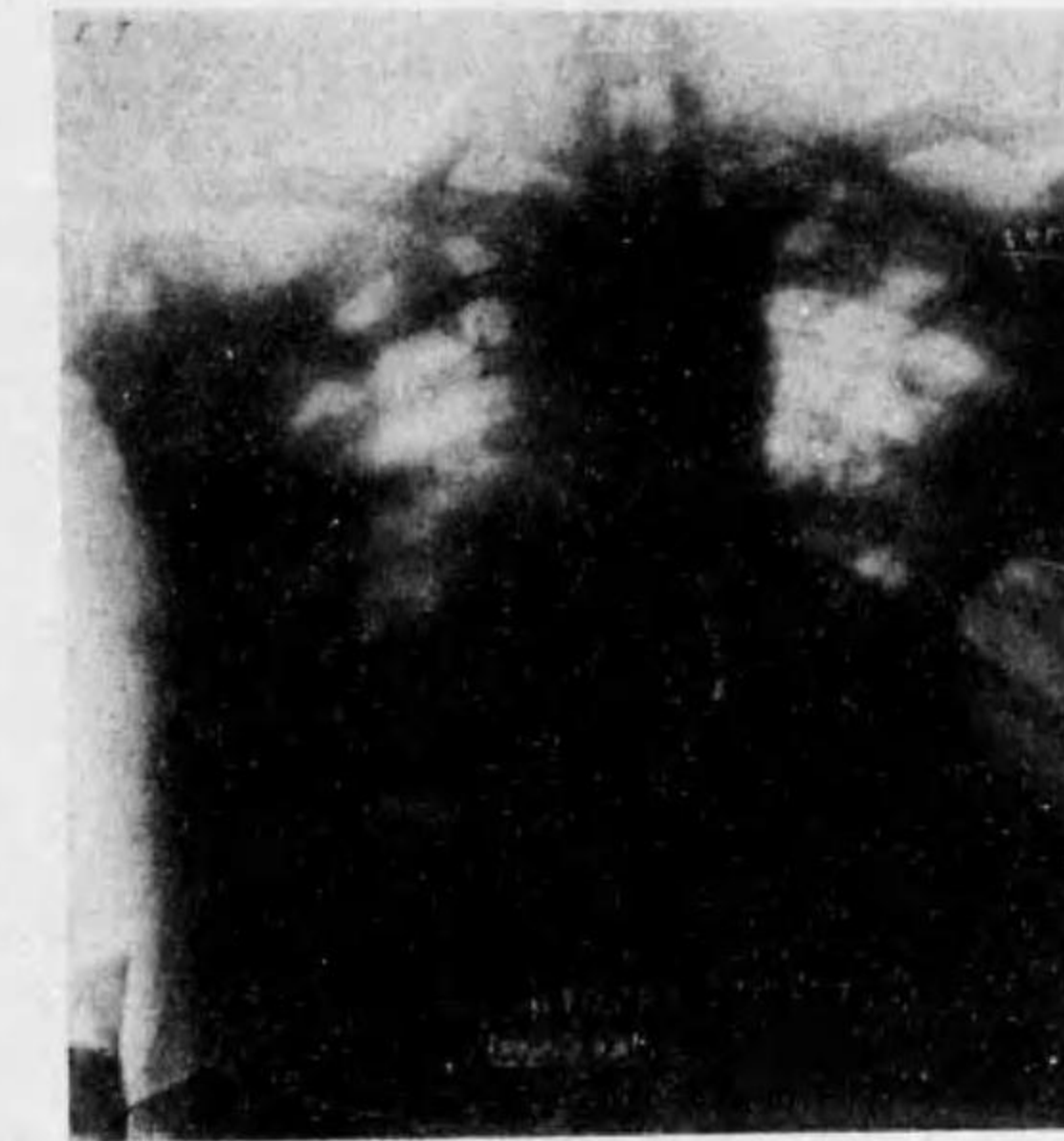
Case XI, Fig. 78., man 39, 4 months ago had operation on the eye under general anaesthesia; 10 days later pain in chest, fever and expectoration followed.



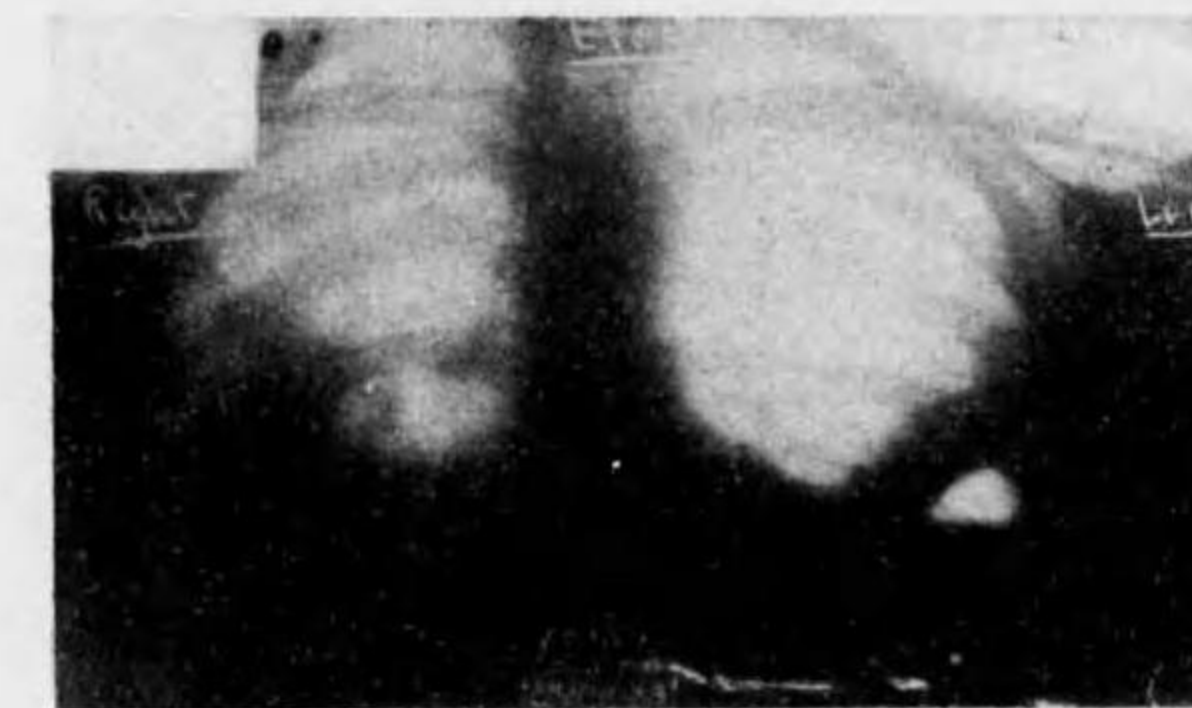
Case XI, Fig. 82-a, Taken two days still later.



Case XI, Fig. 82-b.



Case XII, Fig. 88, Two days later.



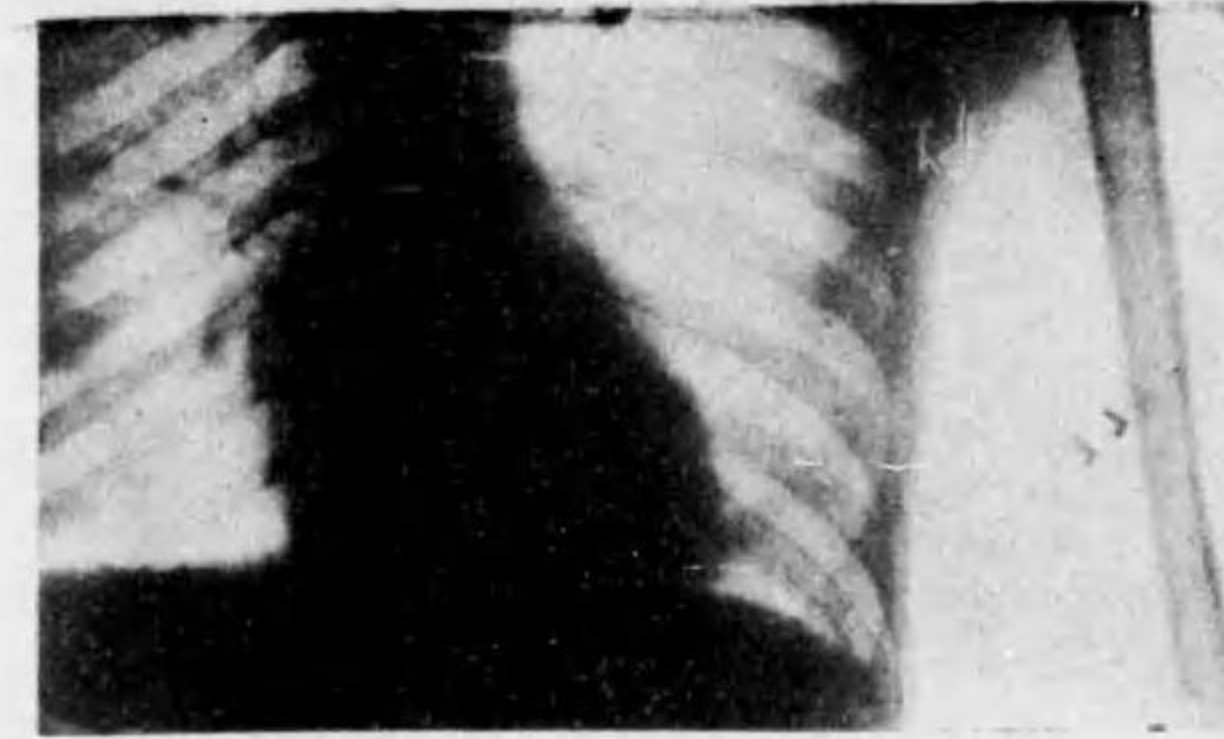
Case XII, Fig. 84, taken erect, 5/29/24. Man of 39, about three weeks ago began with sudden severe pain in the left chest with chills and fever. Explained in Fig. 85.



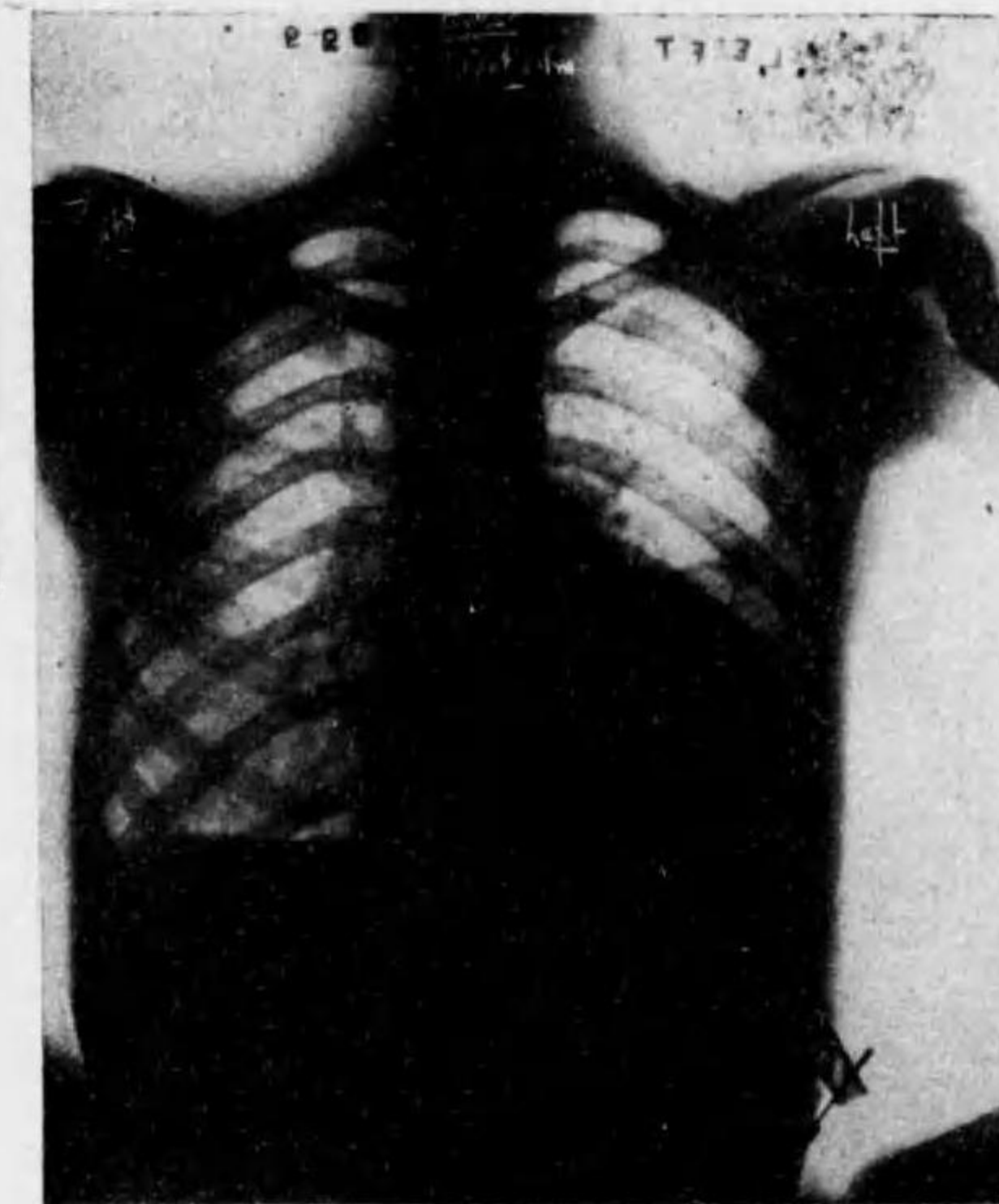
Case XII, Fig. 86, two days after, erect position, explained in Fig. 87.



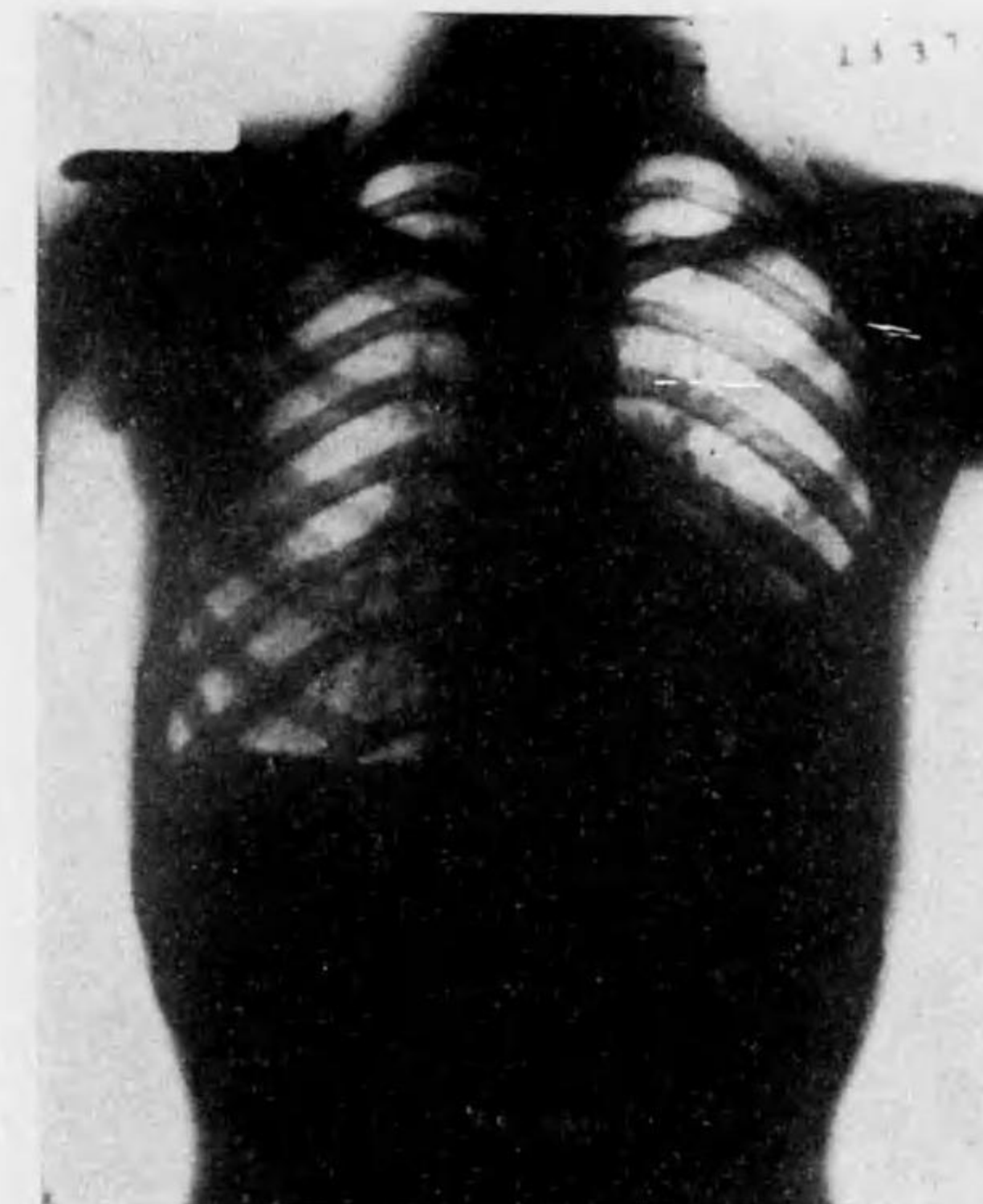
Case XII, Fig. 90, 6/7/24, or 5 days after the last film.



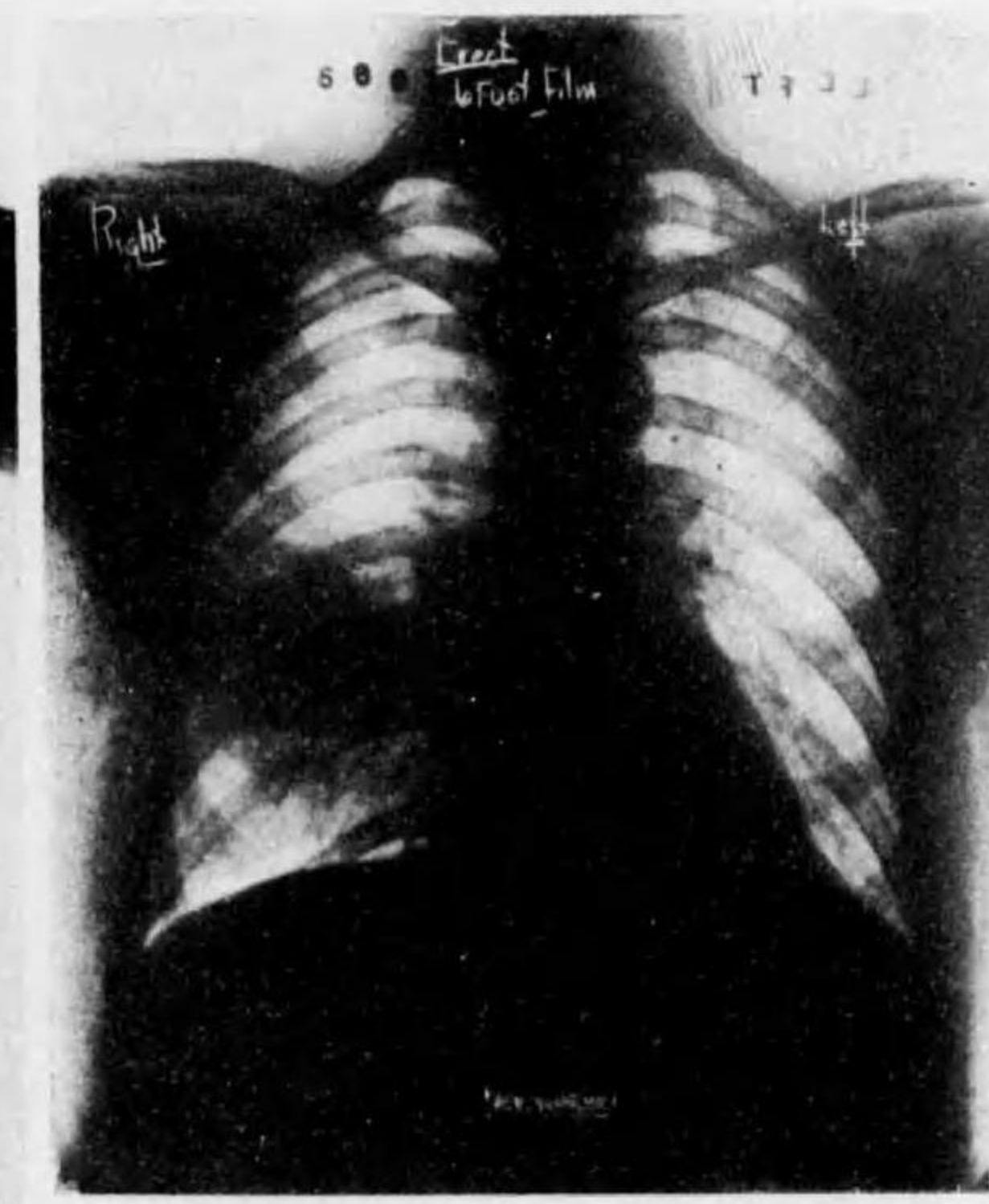
Case XIII, Fig. 92, 6/ 7/ 22. Taken erect. Girl of 17, over a year ago had pneumonia which was complicated by suppurative pleurisy; discharge persisted from the sinus on the chest wall until the present time. Thoracotomy revealed markedly thickened pleura, quite adherent lung to the pleura on the left lower region. An abscess cavity was located well toward posterior surface of the lower lobe, between thickened pleura and indurated lung.



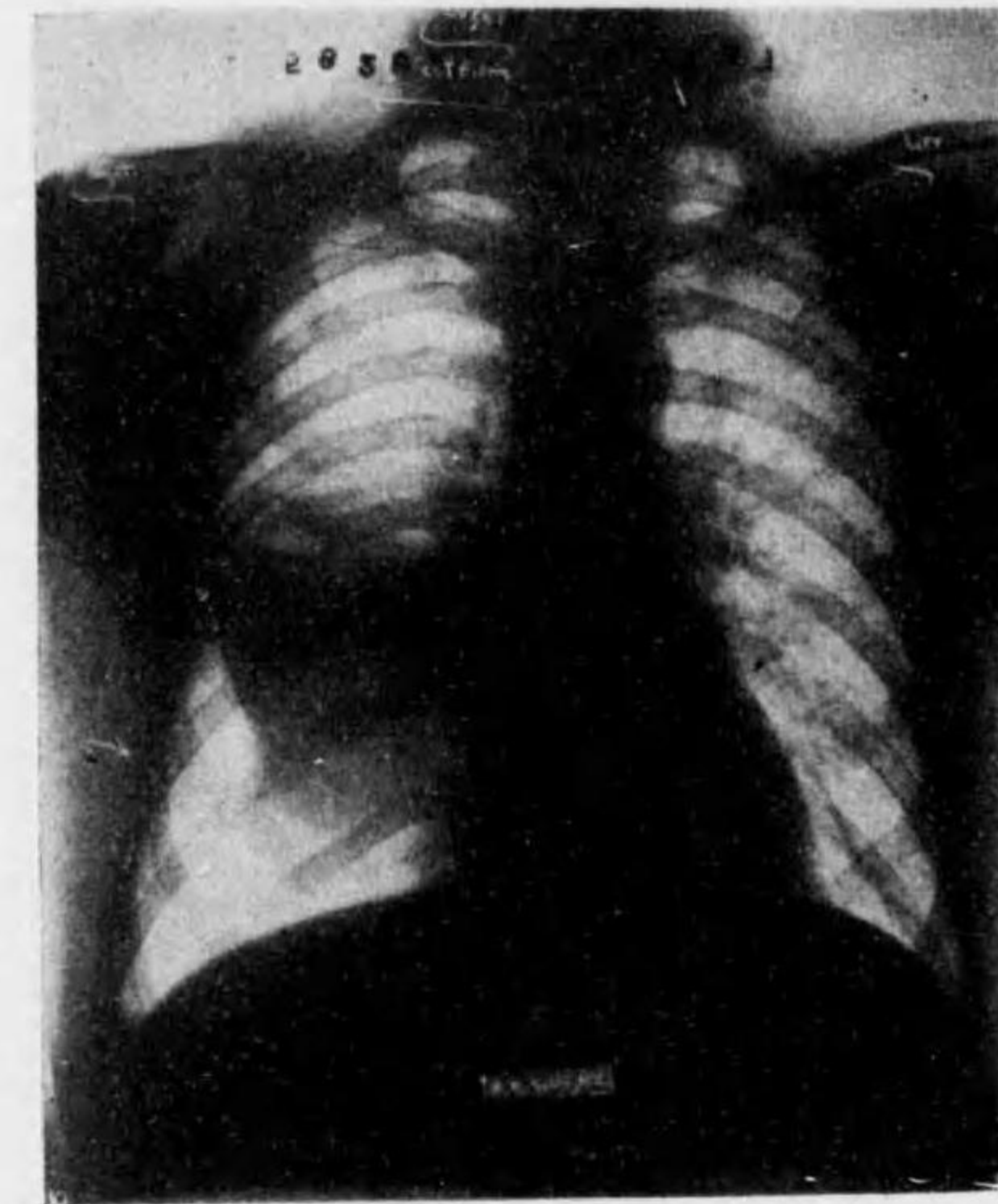
Case XIII, Fig. 94, Taken erect, 7/ 6/ 22. One month after the operation.



Case XIII, Fig. 96, Taken erect, two months after the operation.



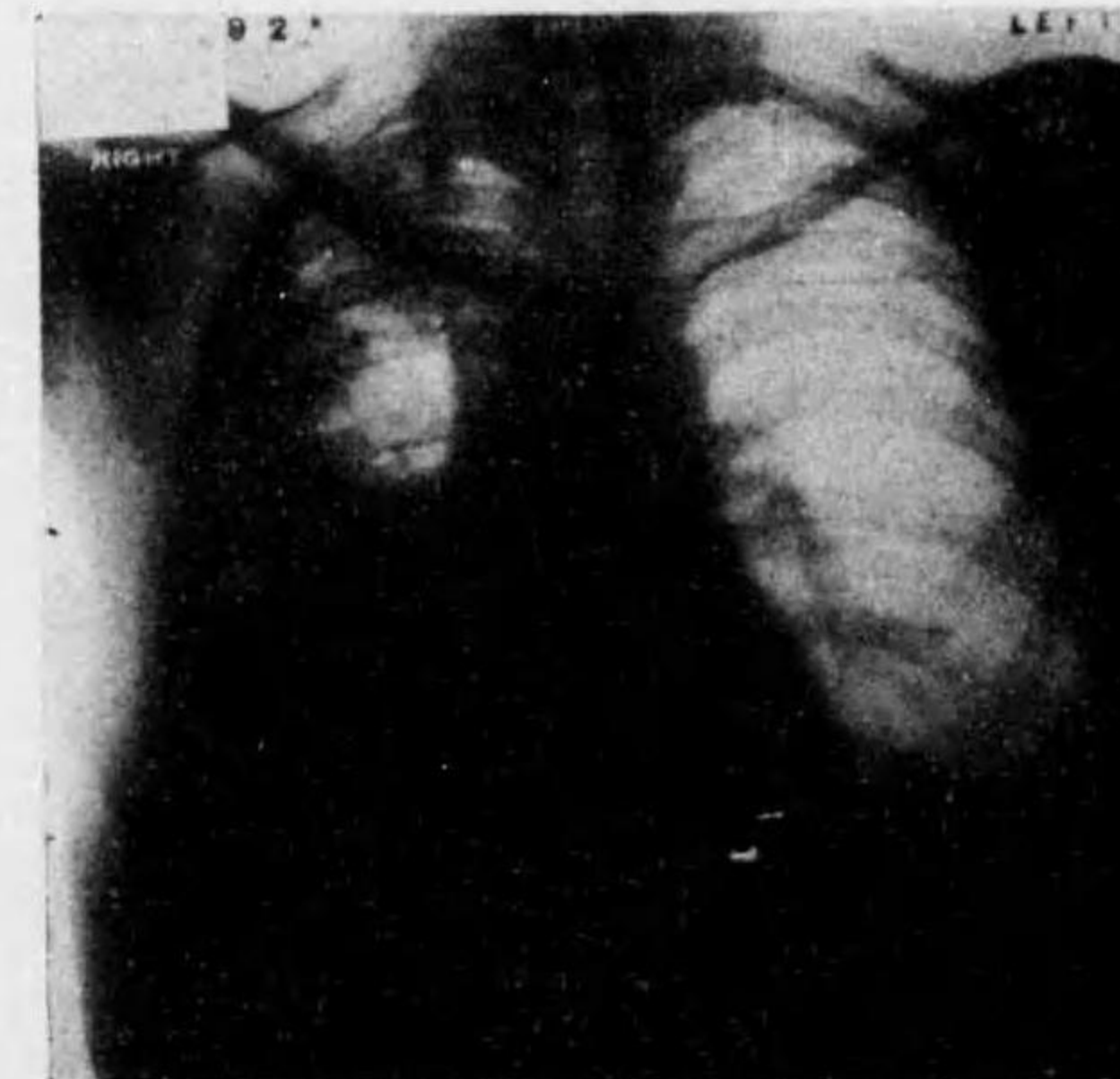
Case XIV, Fig. 98, July 11 th, erect. Man 36, six weeks ago began with sudden pain in right chest, two weeks later this was followed by cough and expectoration in great quantities.



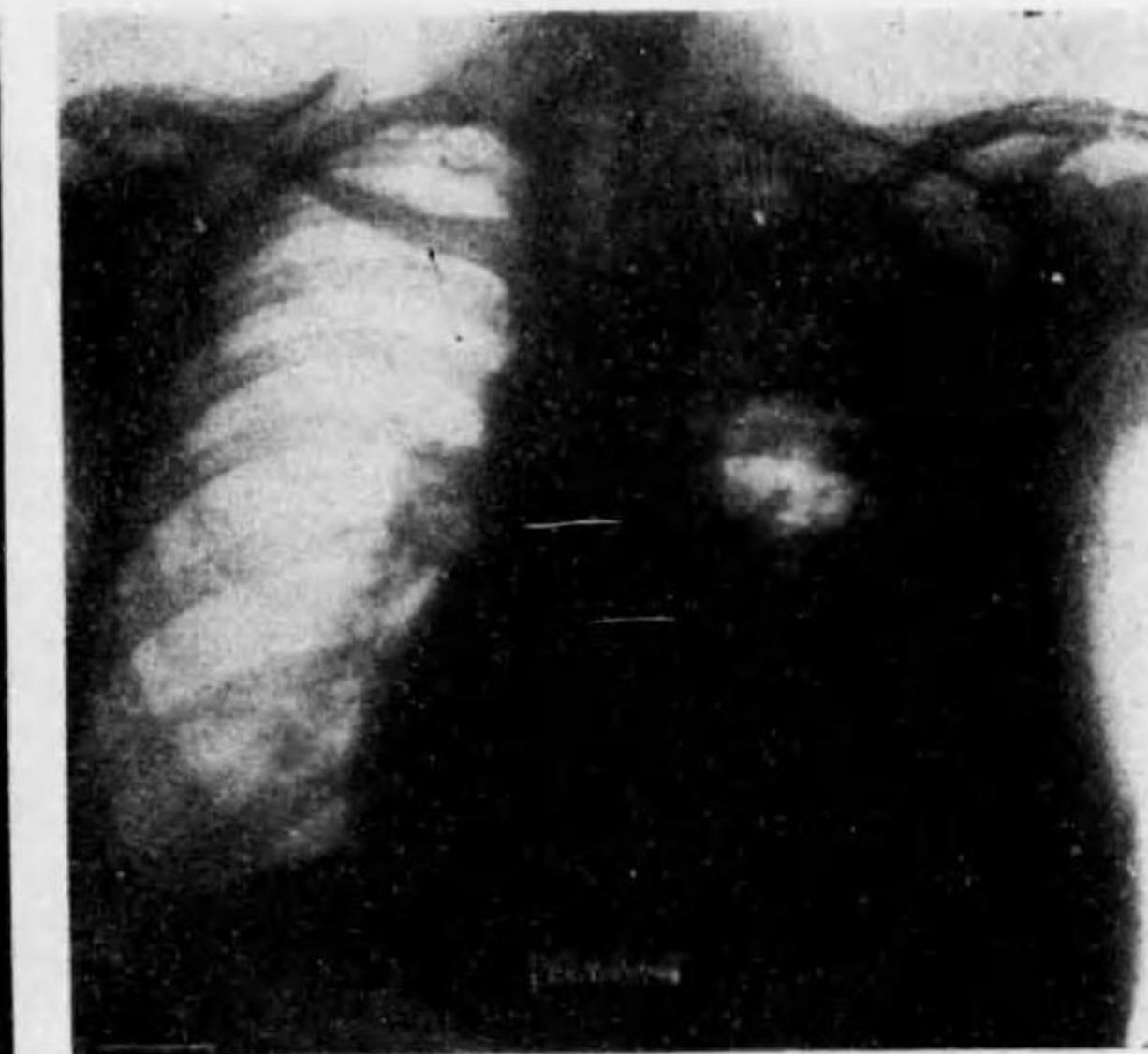
Case XIV, Fig. 100, Taken three days after the previous one, notice the increasing shadows. Shortly later pt. died of disseminating broncho-pneumonia spreading to the left side.



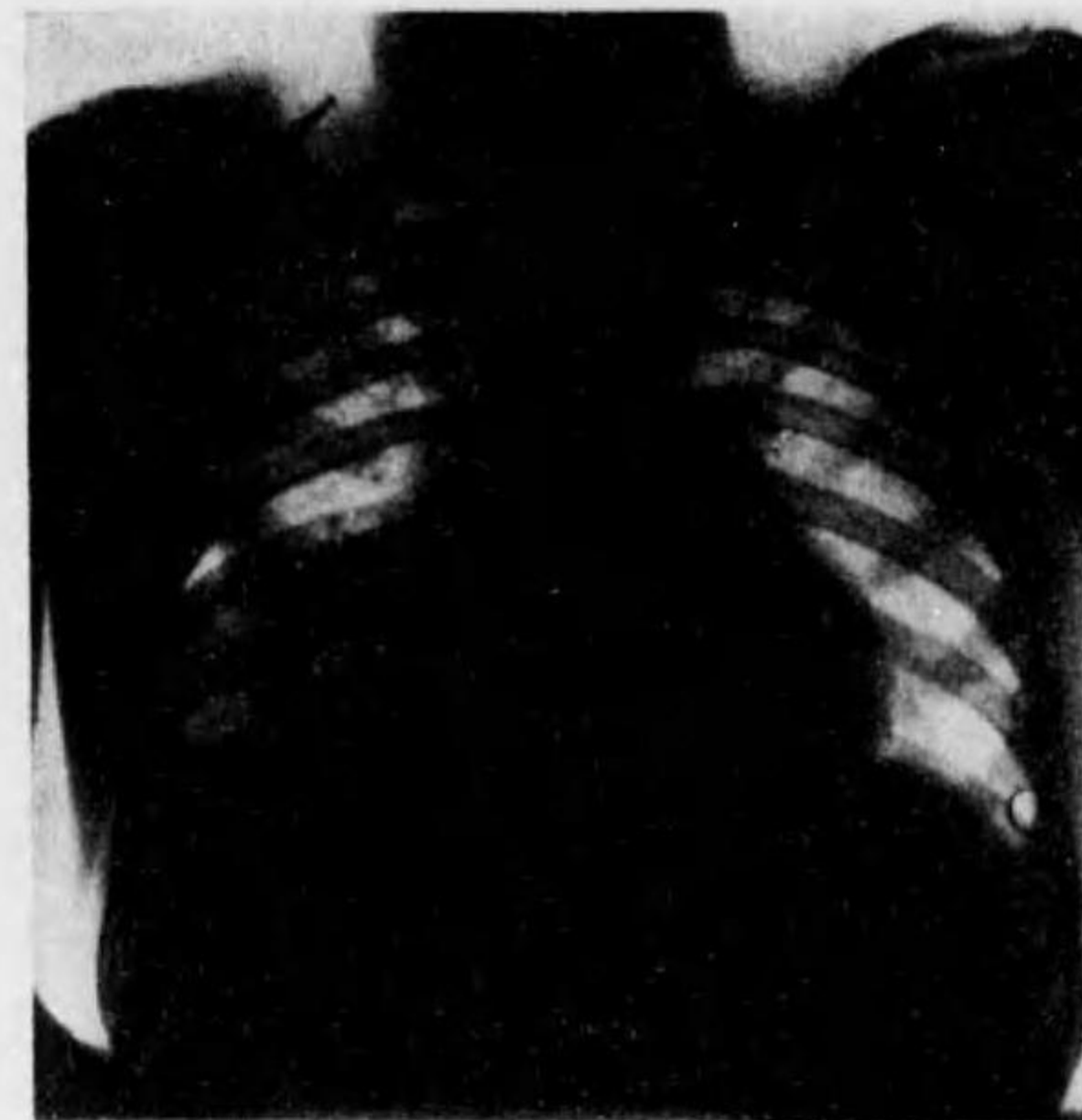
Case XV, Fig. 108, 2/ 16/ 23. Thickened interlobar pleura, a suspicious area just above the fluid.



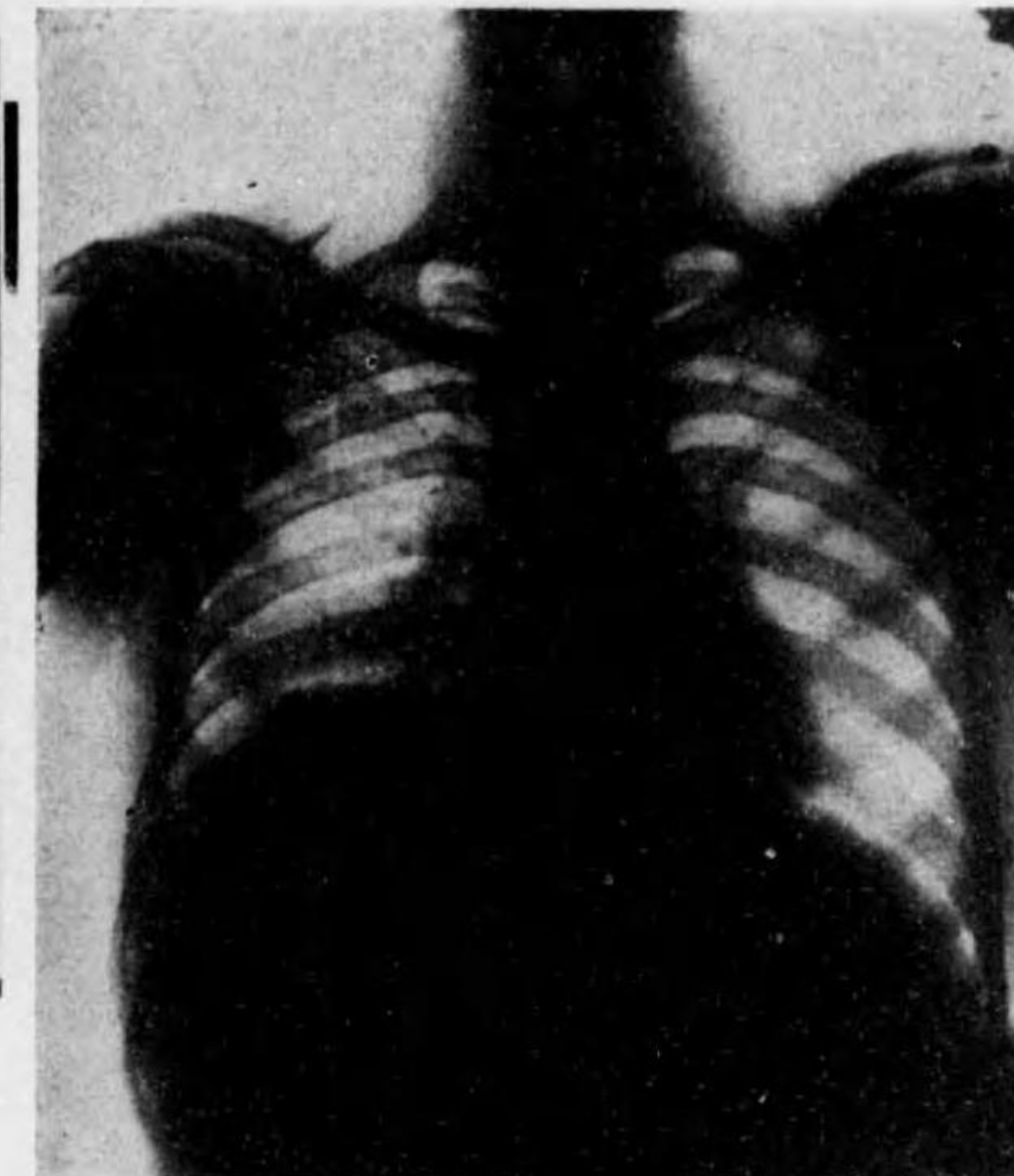
Case XV, Fig. 105, 1/ 10/ 23. Woman, 28, pregnant 5th months. Five days ago began as a 'cold', cough and expectoration soon followed.



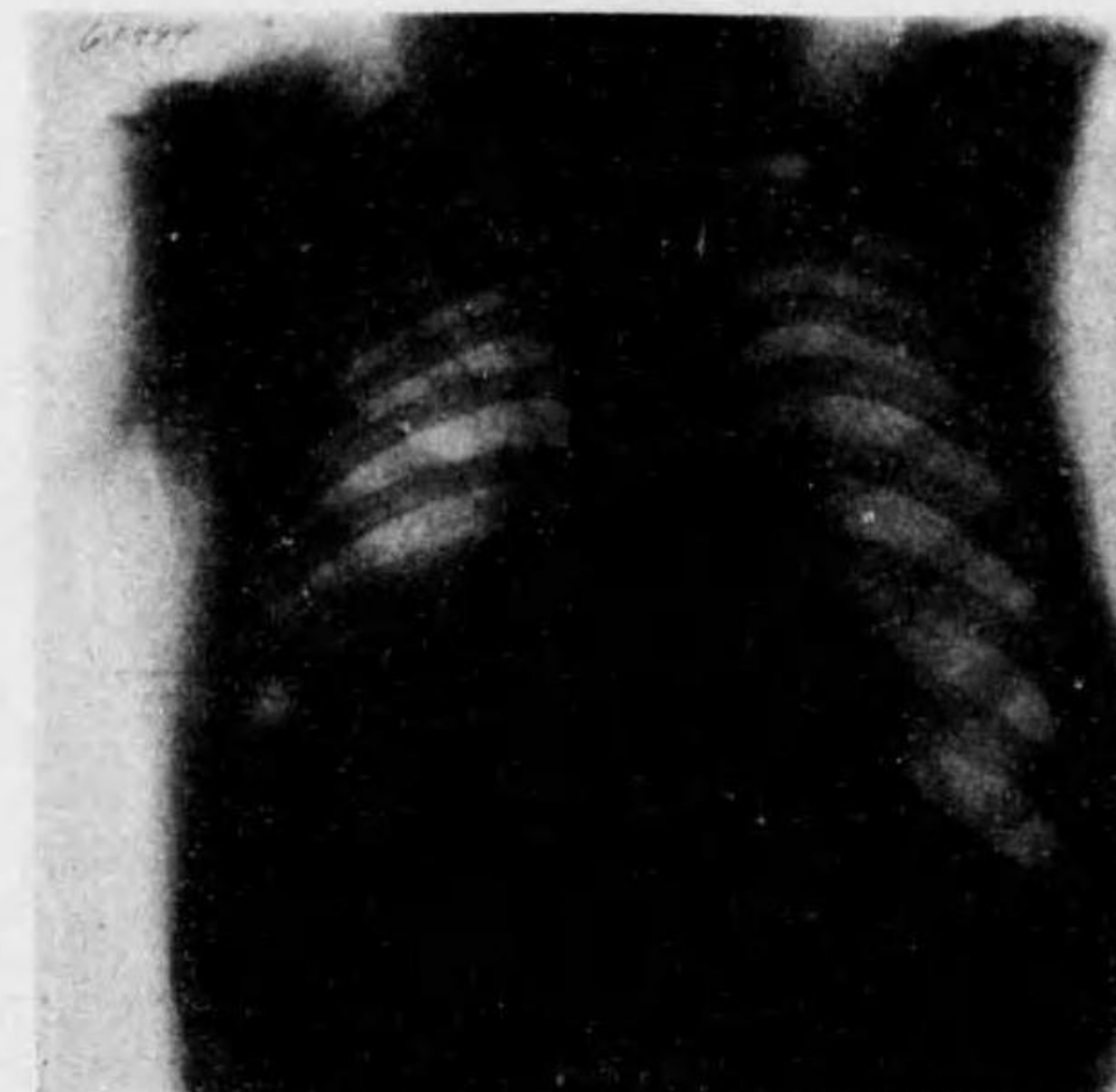
Case XV, Fig. 109, 2/ 17/ 23. Similar picture, a suspicious area above the fluid and to the right proved to be a cavity at operation.



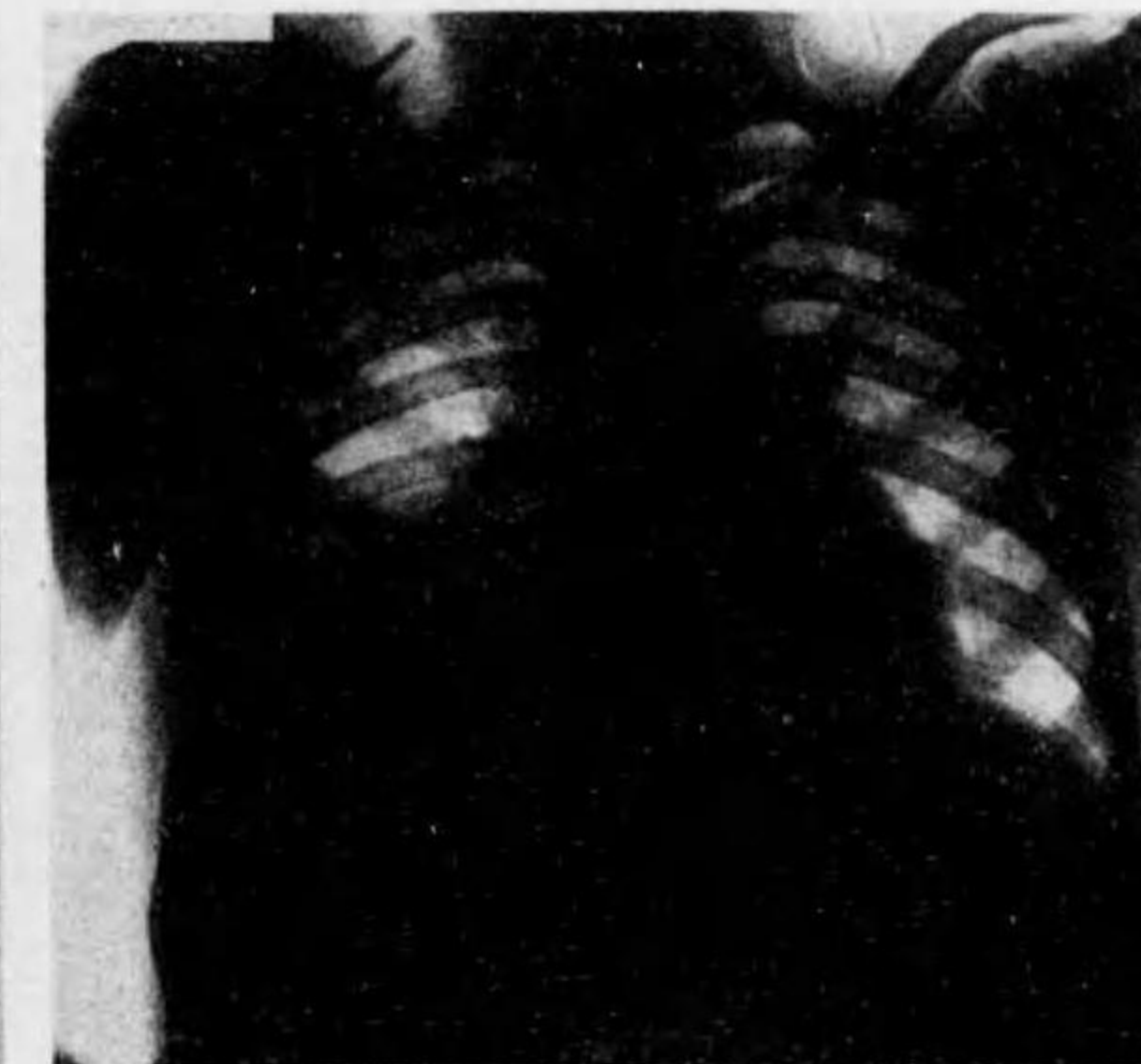
Case XVI, Fig. 113, erect, antero-posterior, taken 5 days later. Shows same picture, but more mottled.



Case XVI, Fig. 117, June 25th, '23. Same haziness at rt. base. Thickened root and mottling in upper lung field suggestive of congestion

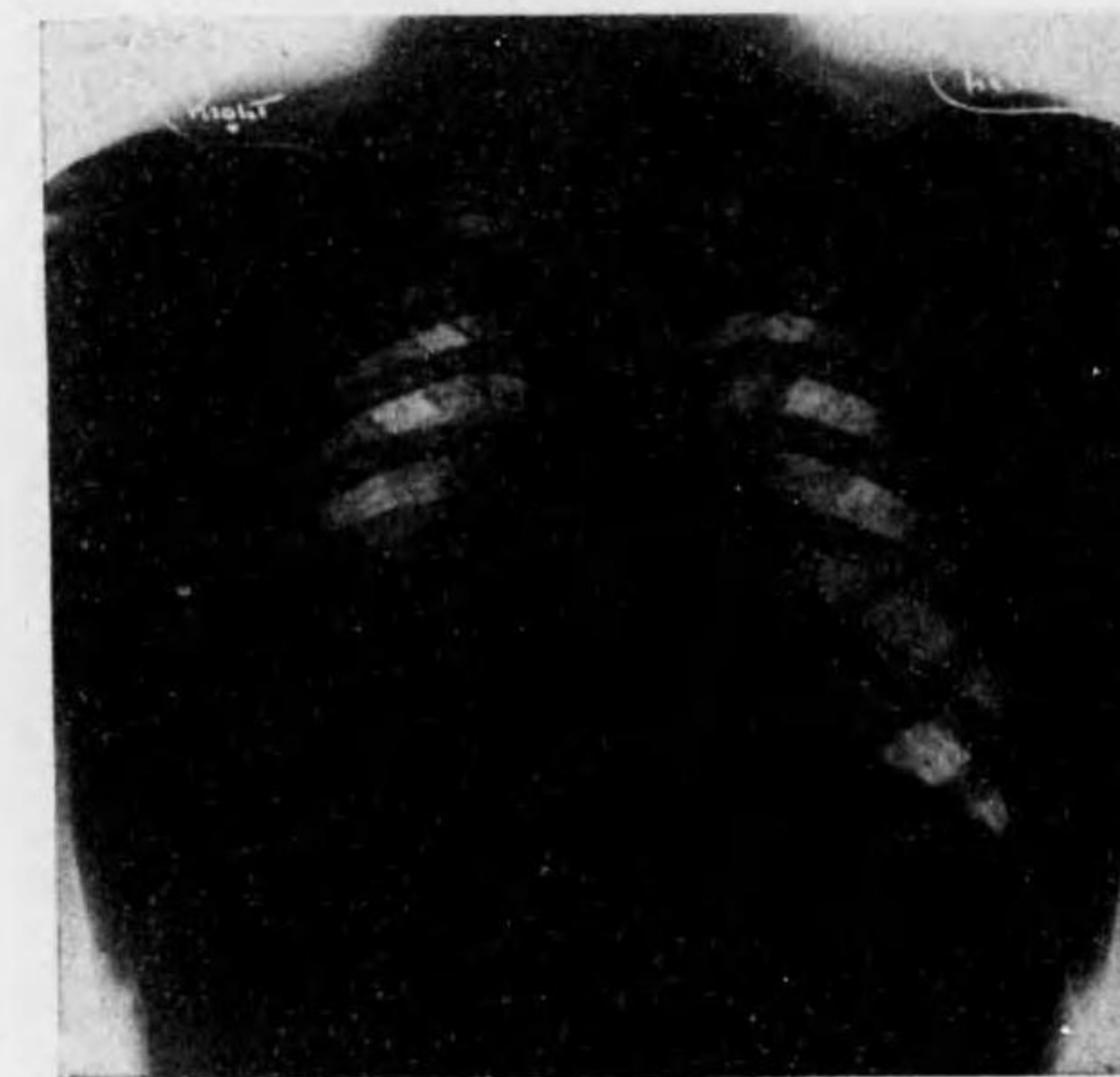
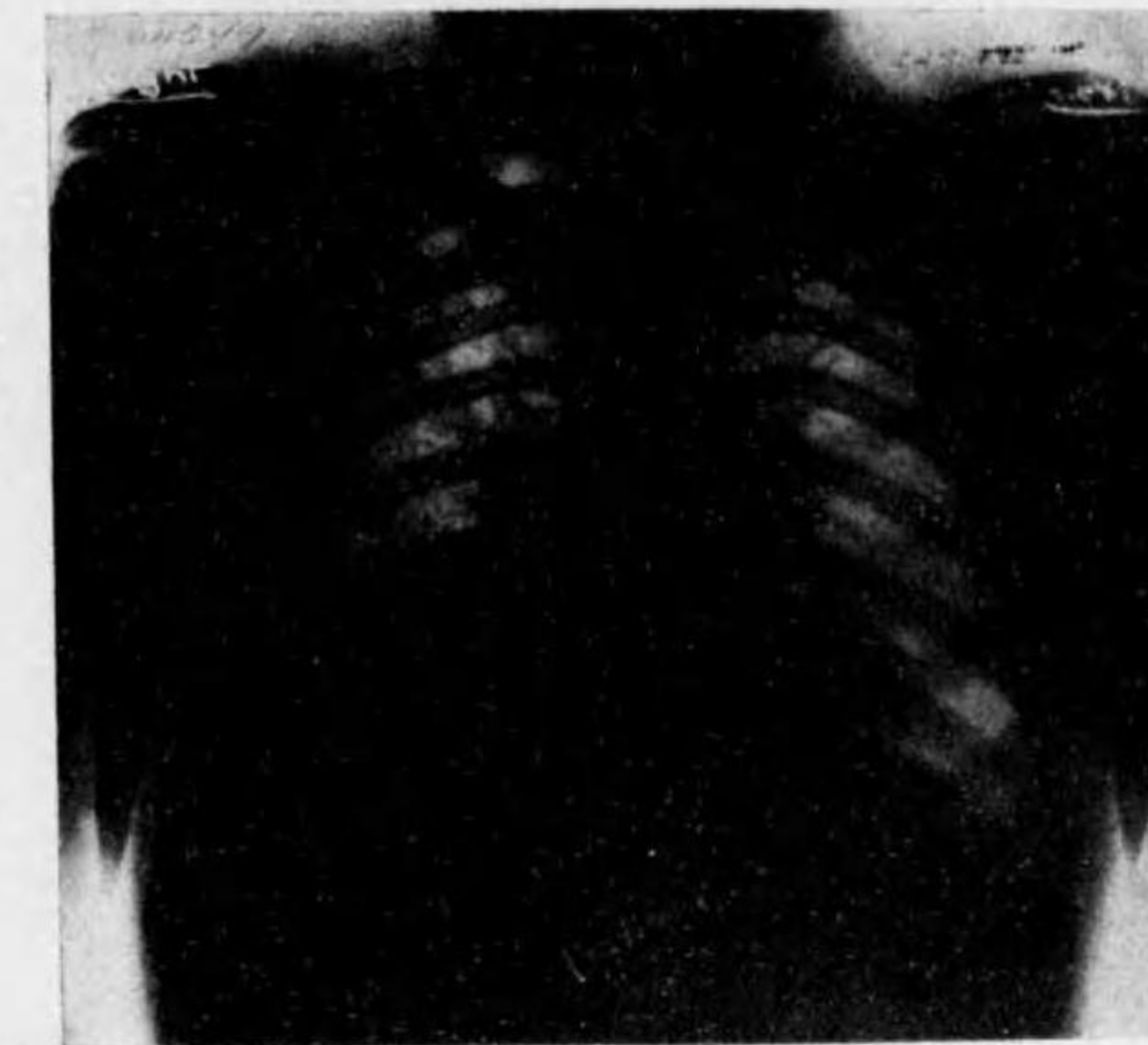


Case XVI, Fig. 115, June 12, '23. Hazy shadow at base whose upper border is less distinct; thickened bronchi.



Case XVI, Fig. 121, Oct. 22, '23. Rt. diaphragm higher than before; lower bronchus at base, appearing somewhat fibrous.

Case XVI, Fig. 123, Nov. '2, '23. More increased density at rt. base. There is honeycomb appearance within the density. Descending bronchi much thickened and dilated.



Case XVI, Fig. 125, Nov. 19, '23 Basal shadow now appears more fibrous. A few calcified nodes at root, upper lung field appears reticulated; descending bronchus presents saccular dilatation.

Case XVI, Fig. 130, Feb. 20, '24. There is again distinct increase in the basal shadow suggesting repeated infiltration.

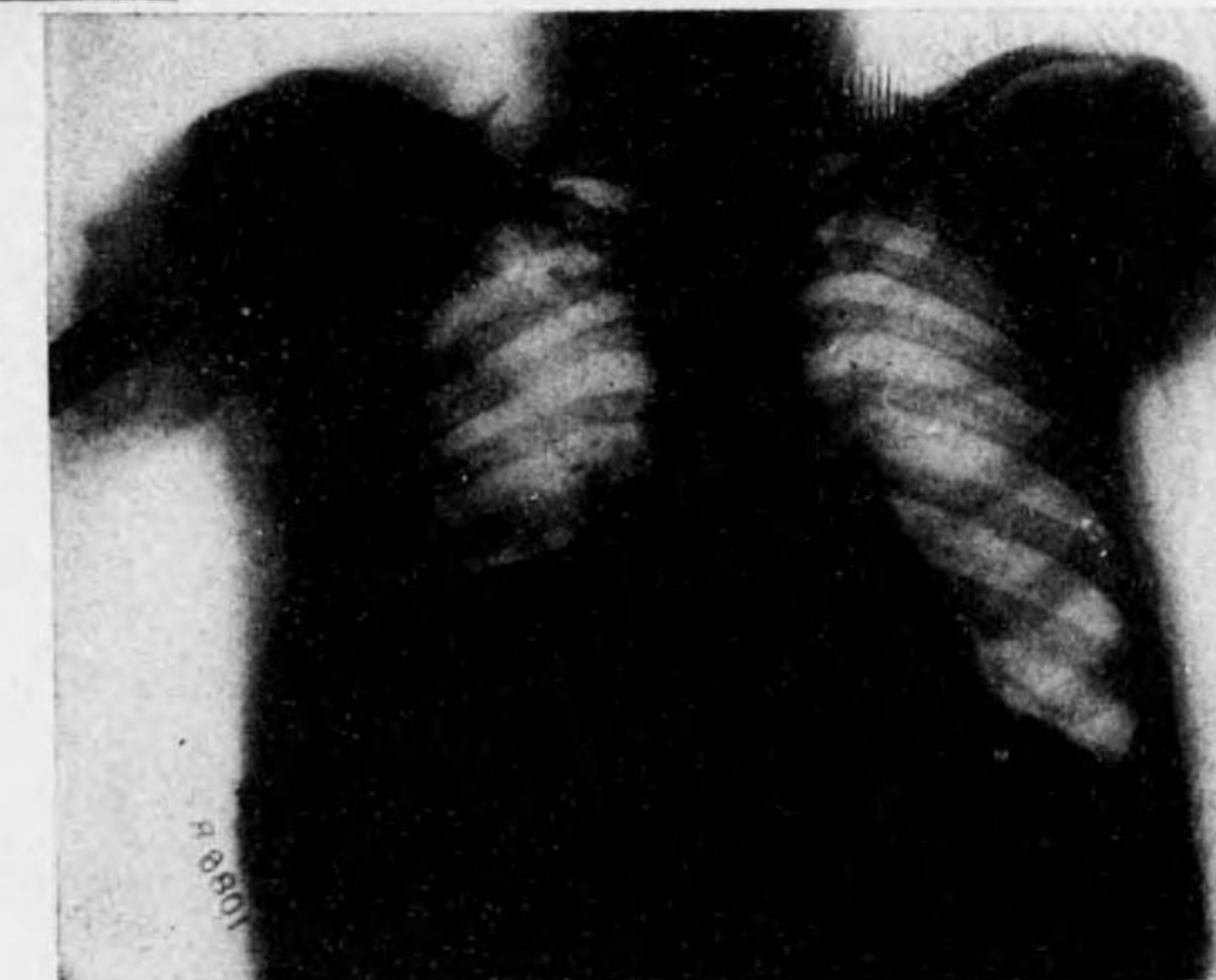




Fig. 133, Case XVII, boy of 8; 9 days ago operated on tonsils. X-ray taken on 9/13/24 in prone position.



Fig. 137-a, case XVII, taken 8 days after the previous film. Mottling density at root; lower and periphery increased homogeneous haziness suggesting thickened pleura (fibrino-purulent) Diaphragm is somewhat flattened out; also suggests small amount of fluid in costophrenic angle. Lung markings generally increased, some lordosis to the right.

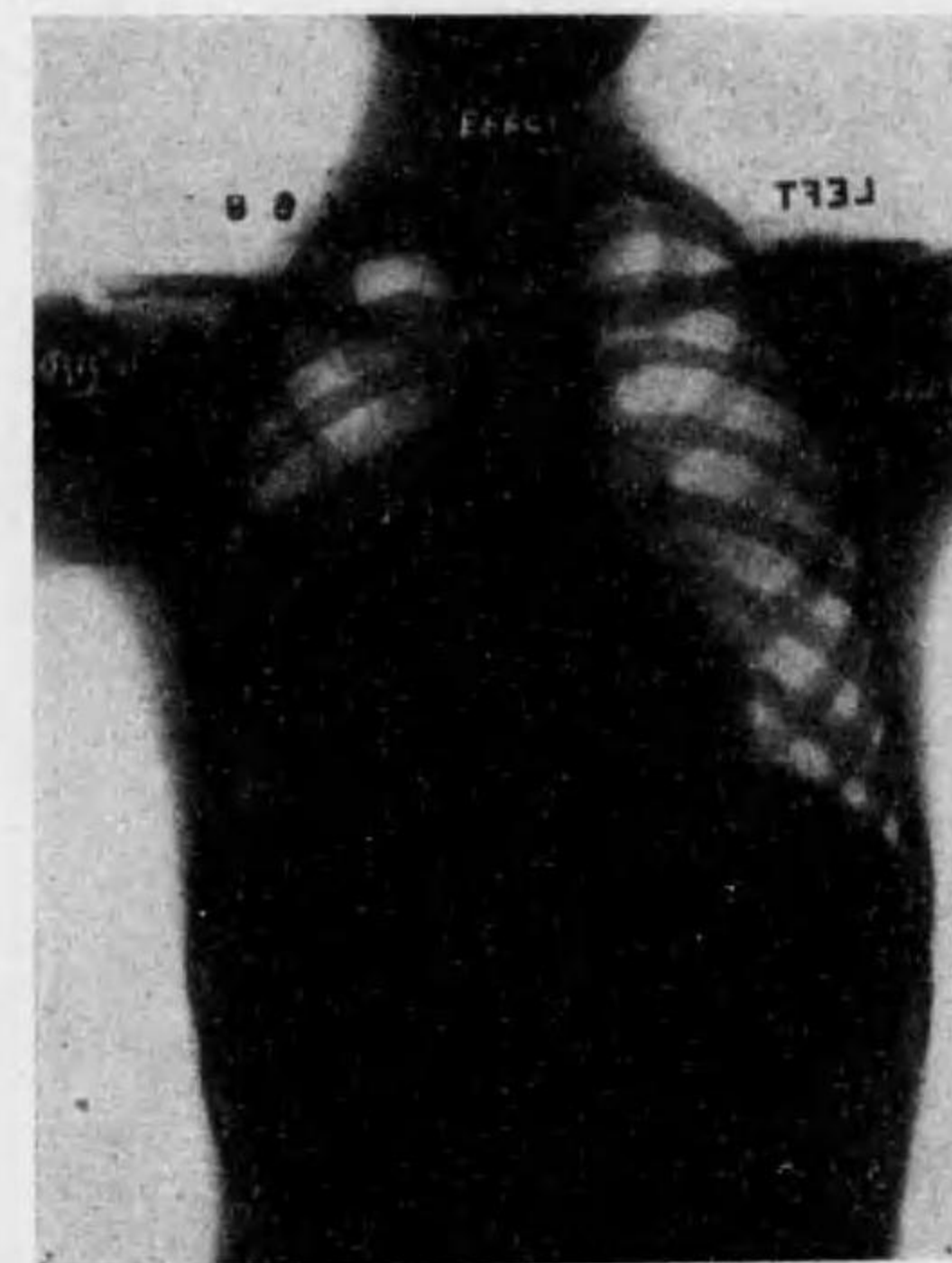


Fig. 135, Case XVII, five days after, taken in low focus than last film, hence the root shadow is now situating more low. The suspicious cavity shadow is now obscured by heart shadow. Oblique position might have helped in this case.

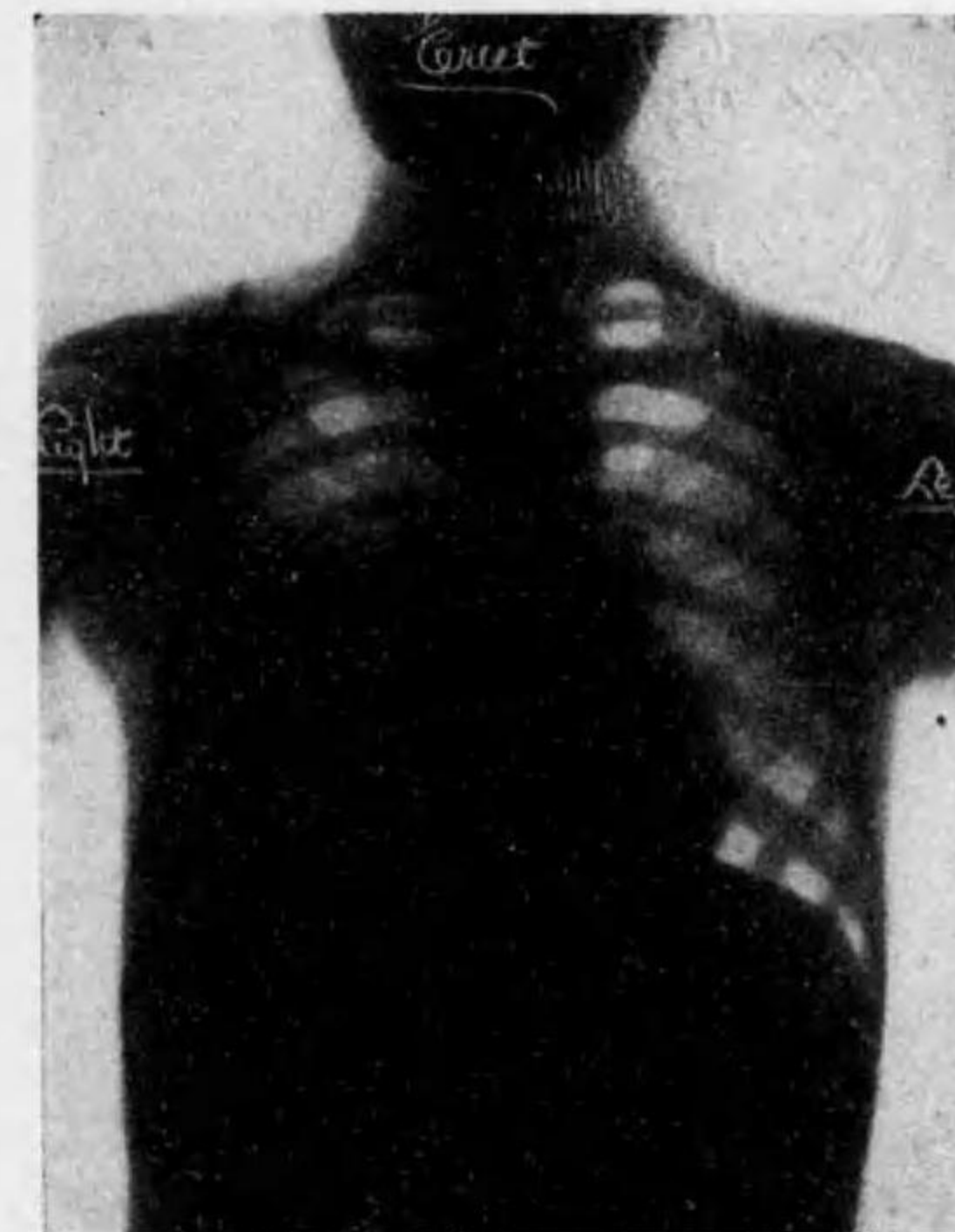


Fig. 138, Case XVII, taken 11 days after the last in erect pose; still quite mottling density at root; in outer field there is increased homogeneous haziness suggesting more thickened pleura. Lung markings are still visible, and accentuated. Interlobar pleurisy, fluid at base.

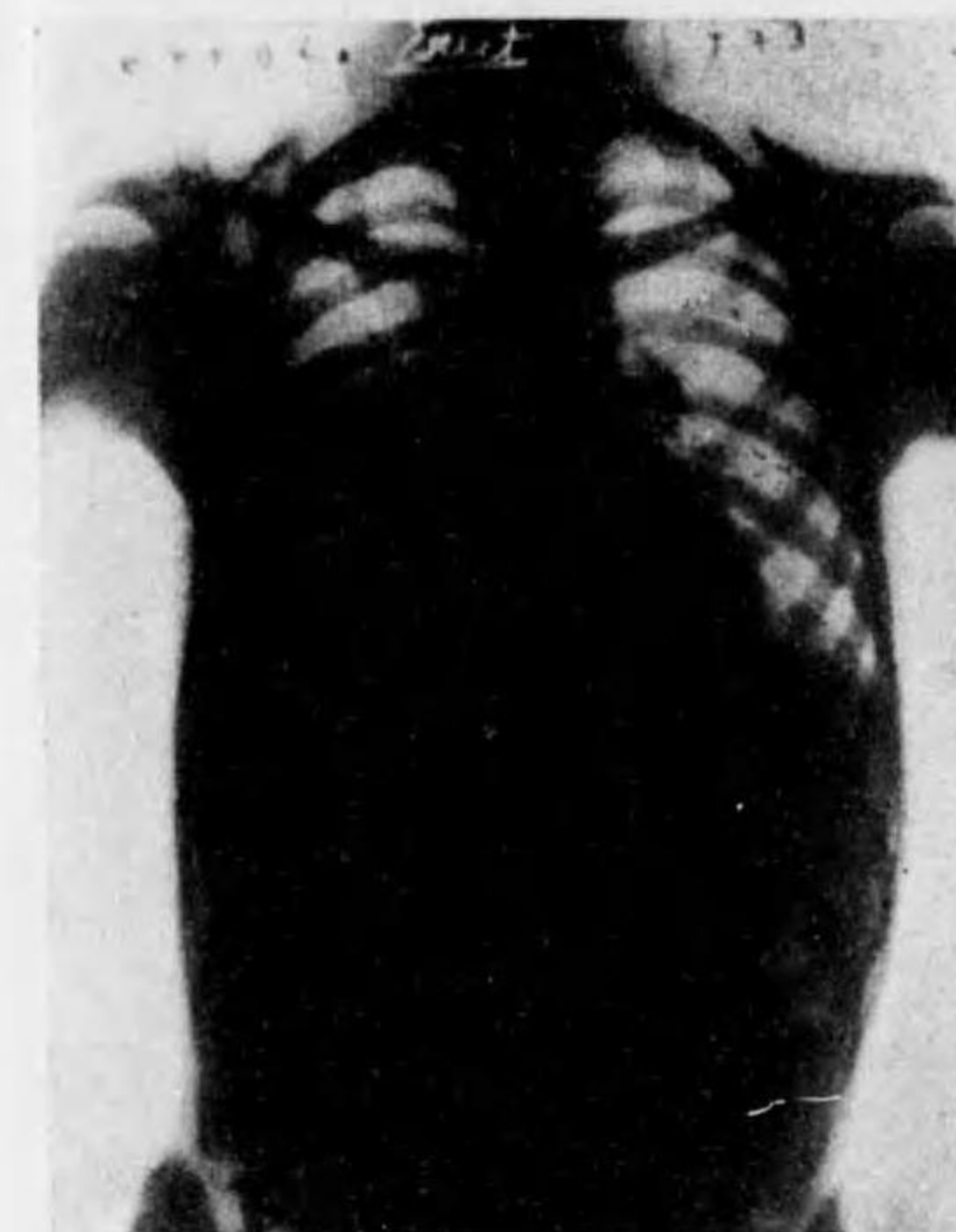
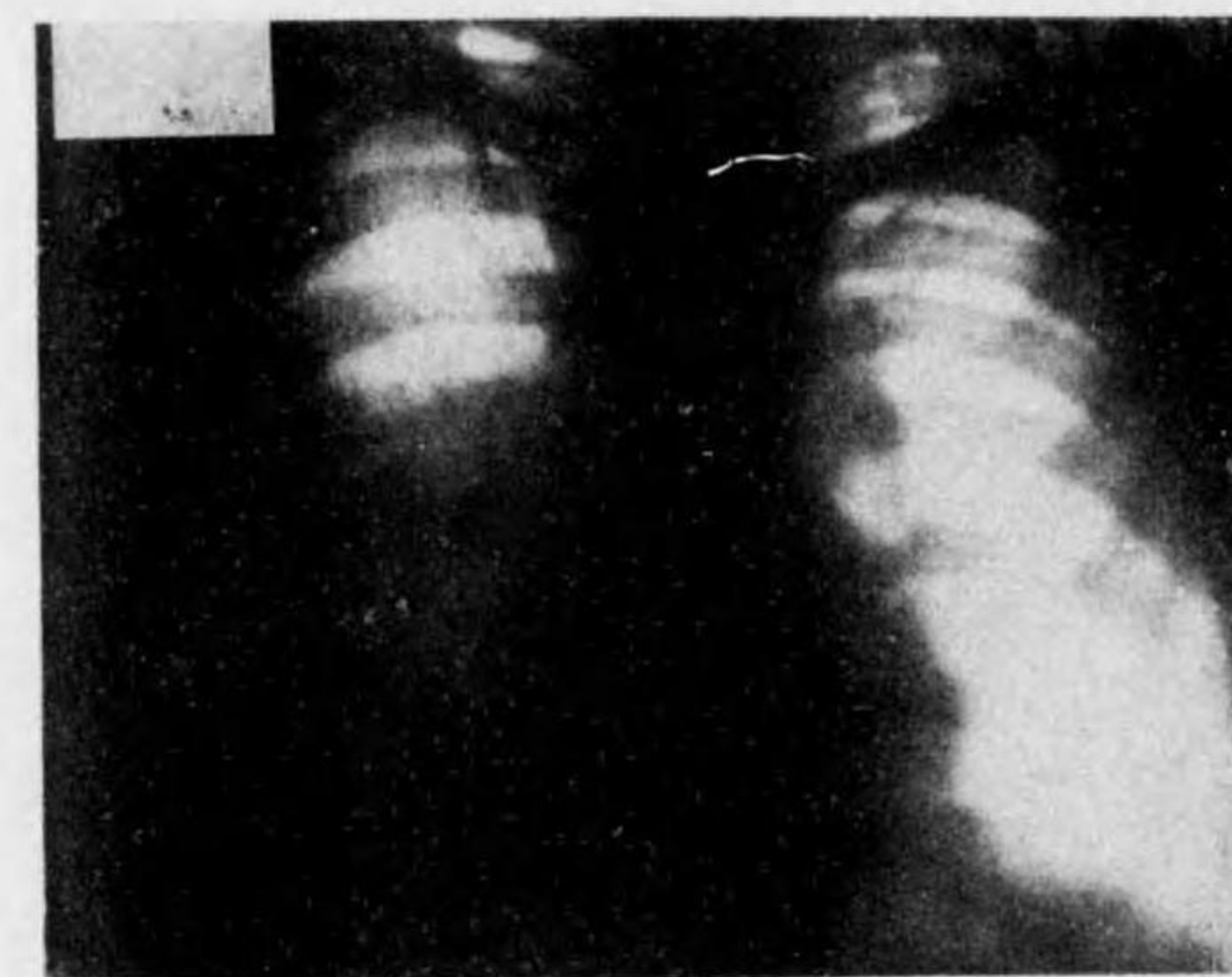


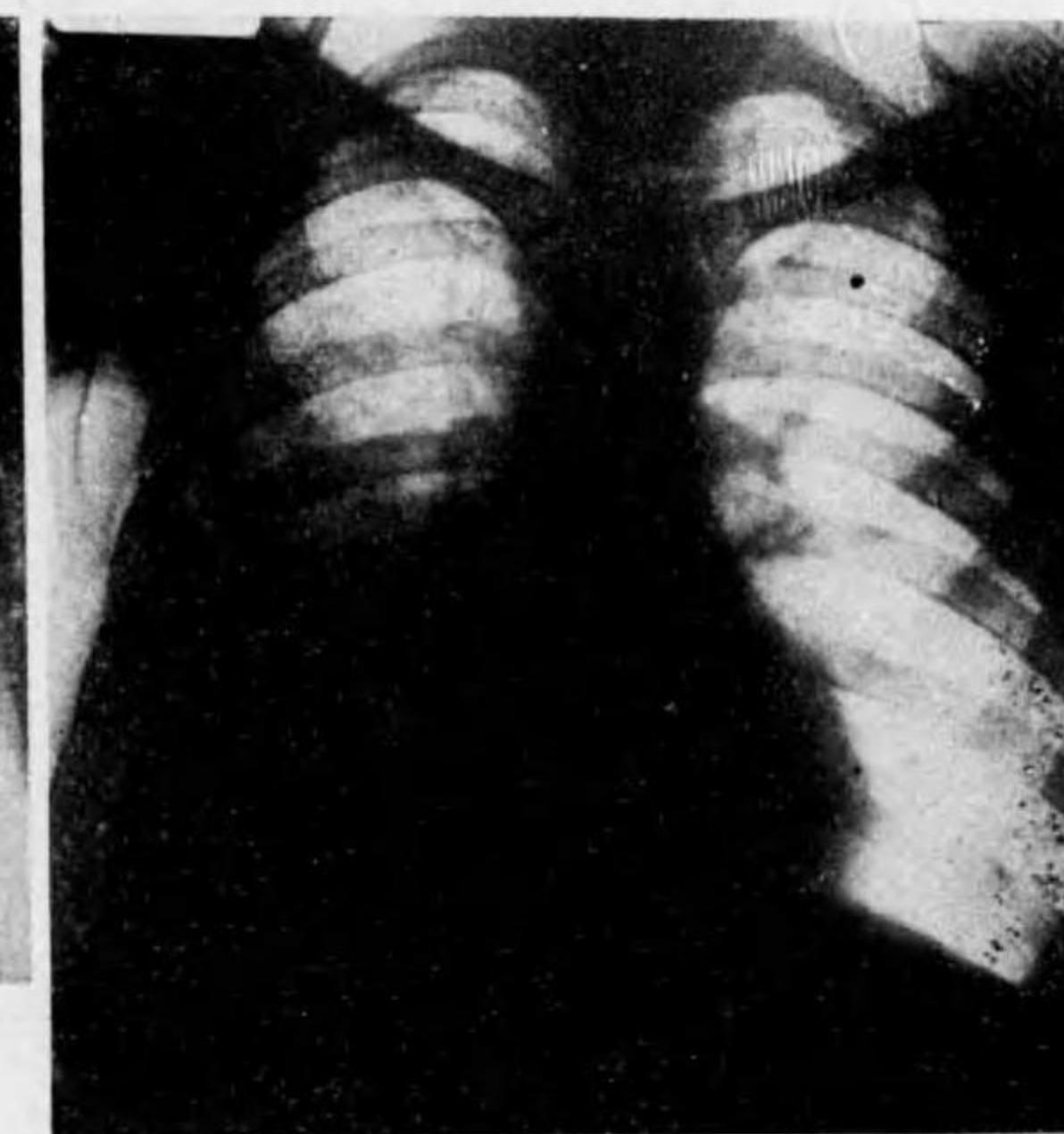
Fig. 139, Case XVII., 10/ 23/ 24, erect. taken right after thoracotomy for drain, notice tube in situ.



Case XVIII, Fig. 140, 11/3/ 21. Prone. Man, 39. Three days ago was operated on for gastric ulcer.



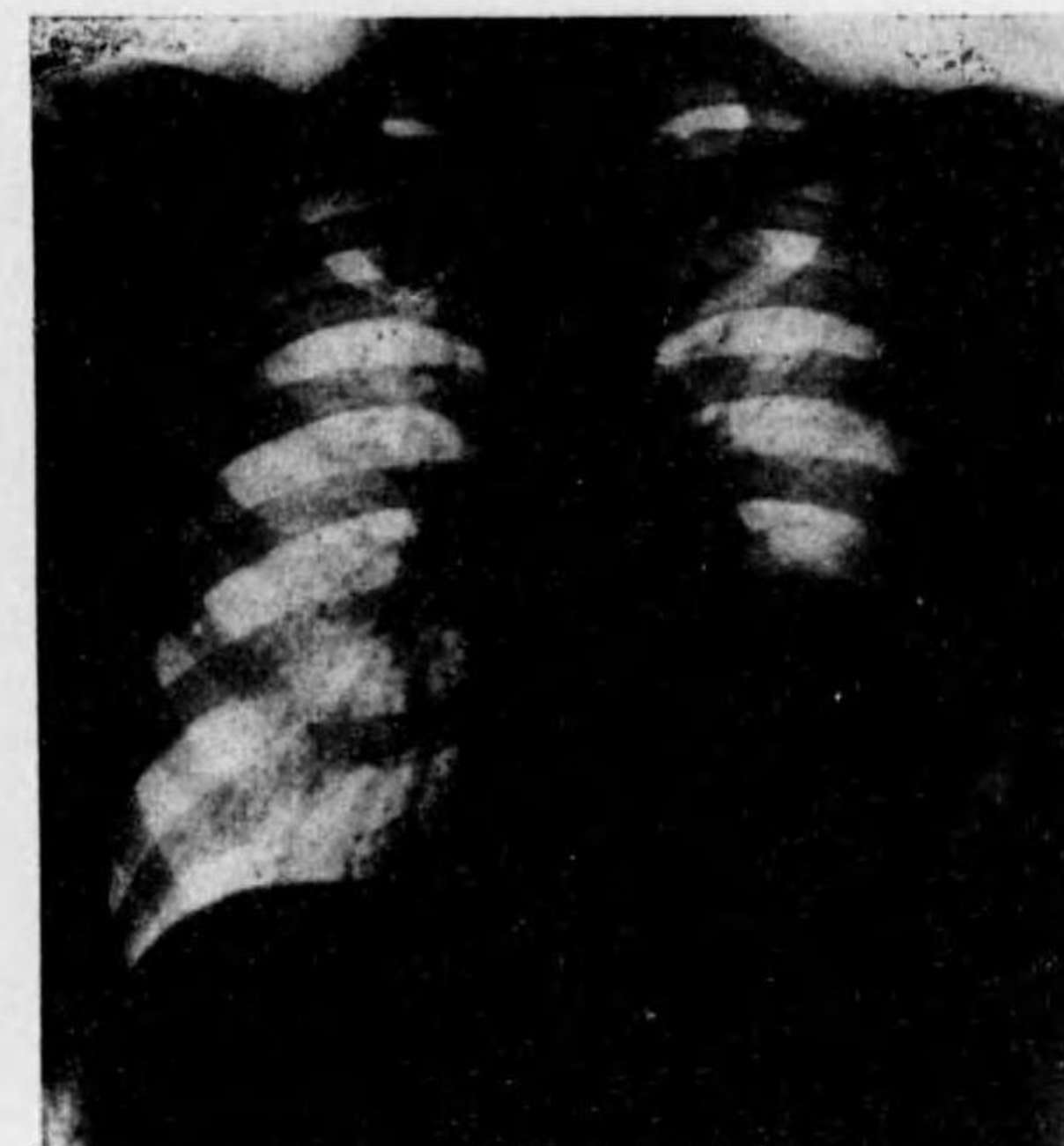
Case XVIII, Fig. 142, 11/ 9/ 21 or nearly a week later. Prone. Similar shadow, but more increased; both apices clear.



Case XVII, Fig. 143, Nearly three weeks later.



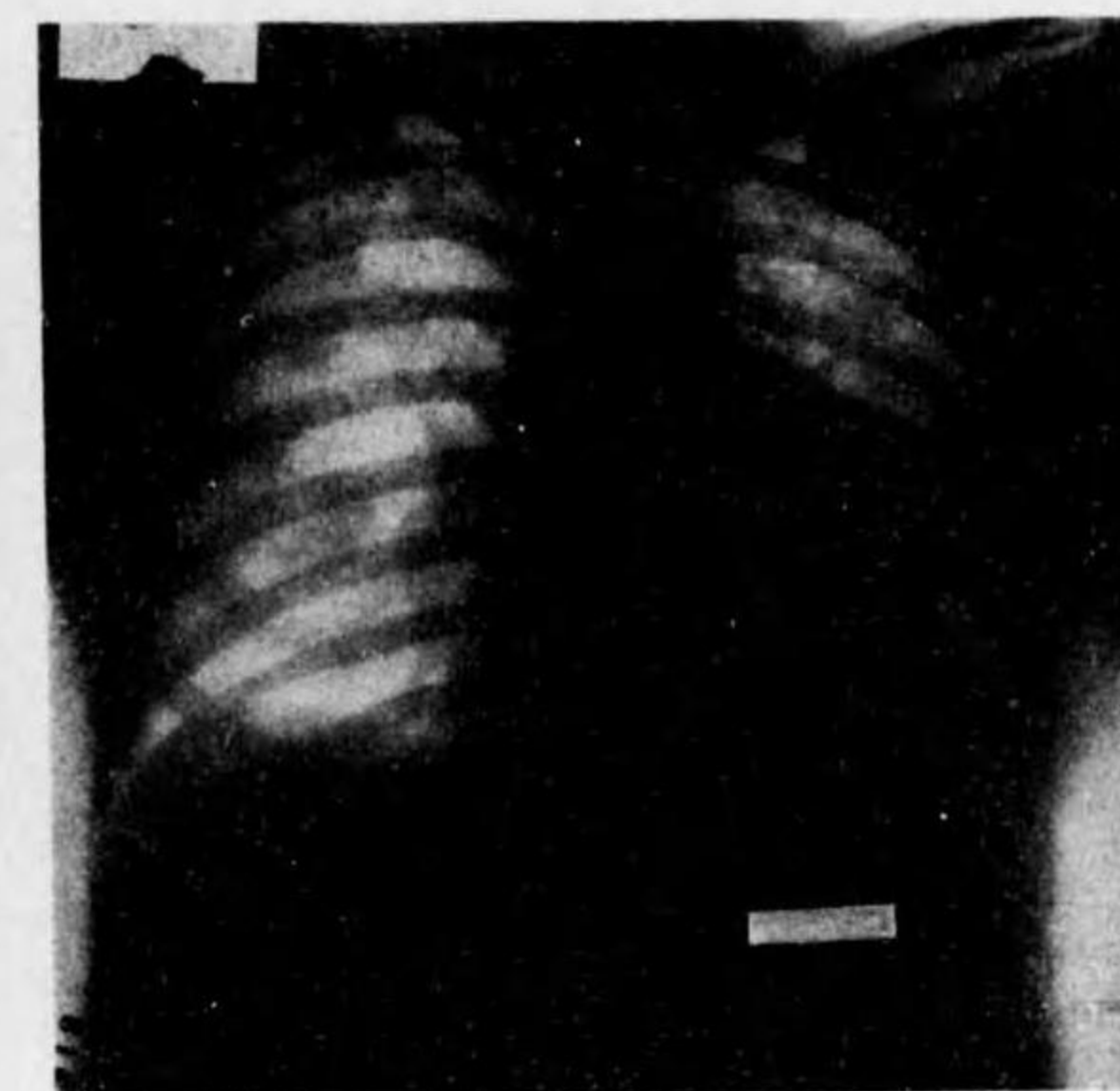
Case XVIII, Fig. 145, Three days after the last, in erect position.



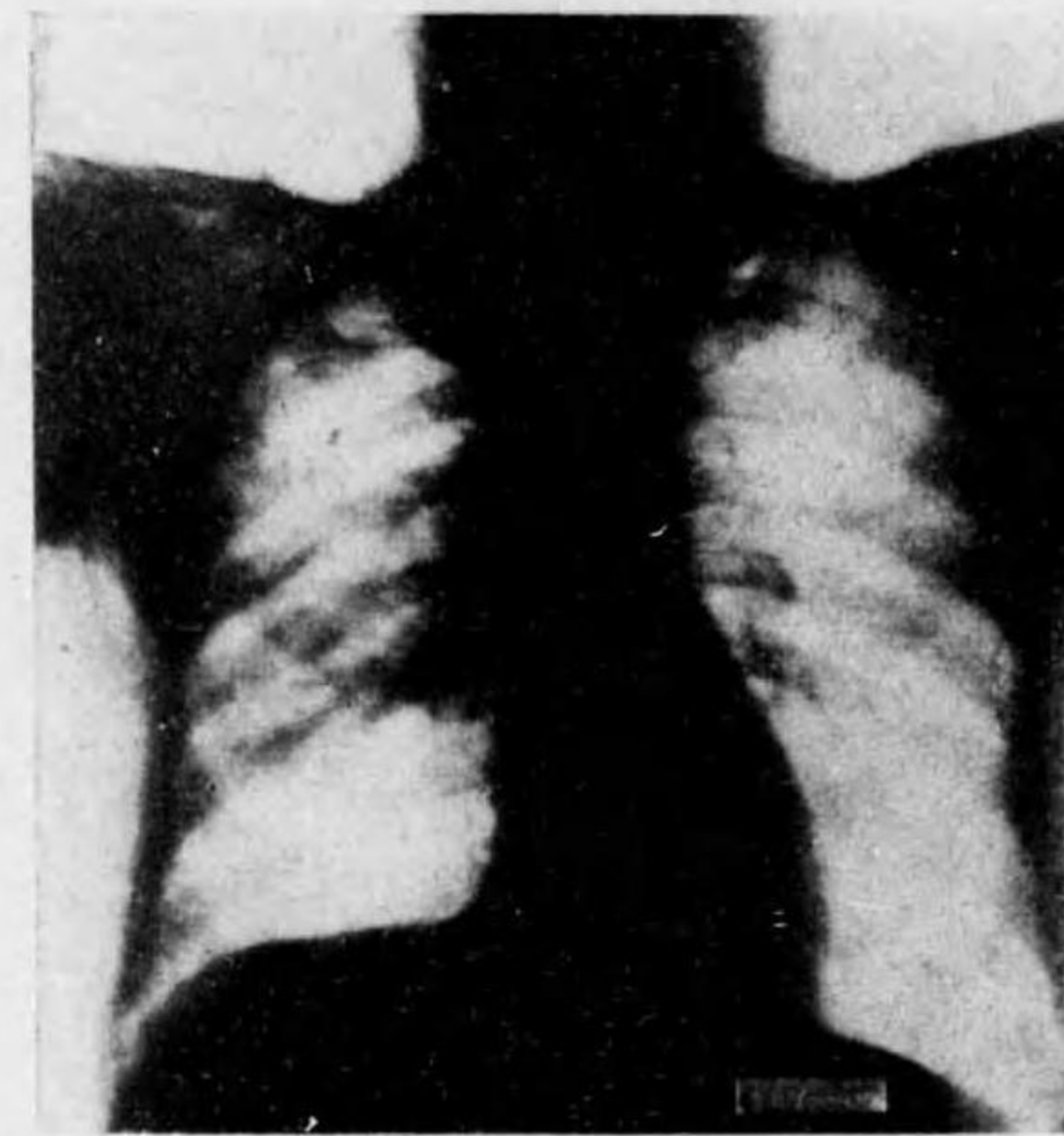
Case XIX, Fig. 147, 12/ 22/ 21. erect. I t. man 36, 11 months ago began as pleurisy.



Case XIX, Fig. 149, nearly a week later.



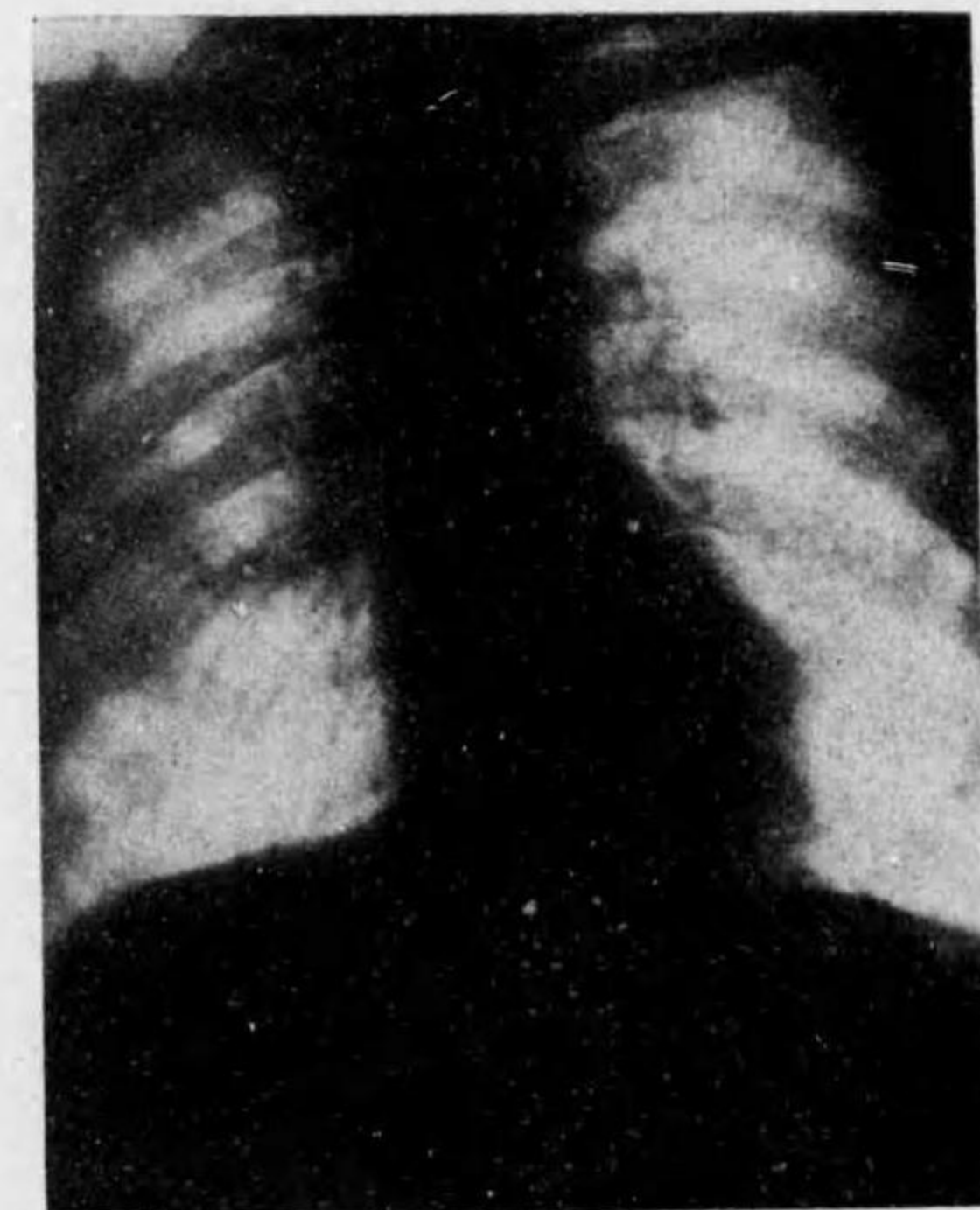
Case XX, Fig. 151: 4/10/23. Woman of 60. Six weeks ago began as pneumonia followed by pleurisy and empyema P. M. showed a large cavity at left lower lobe.



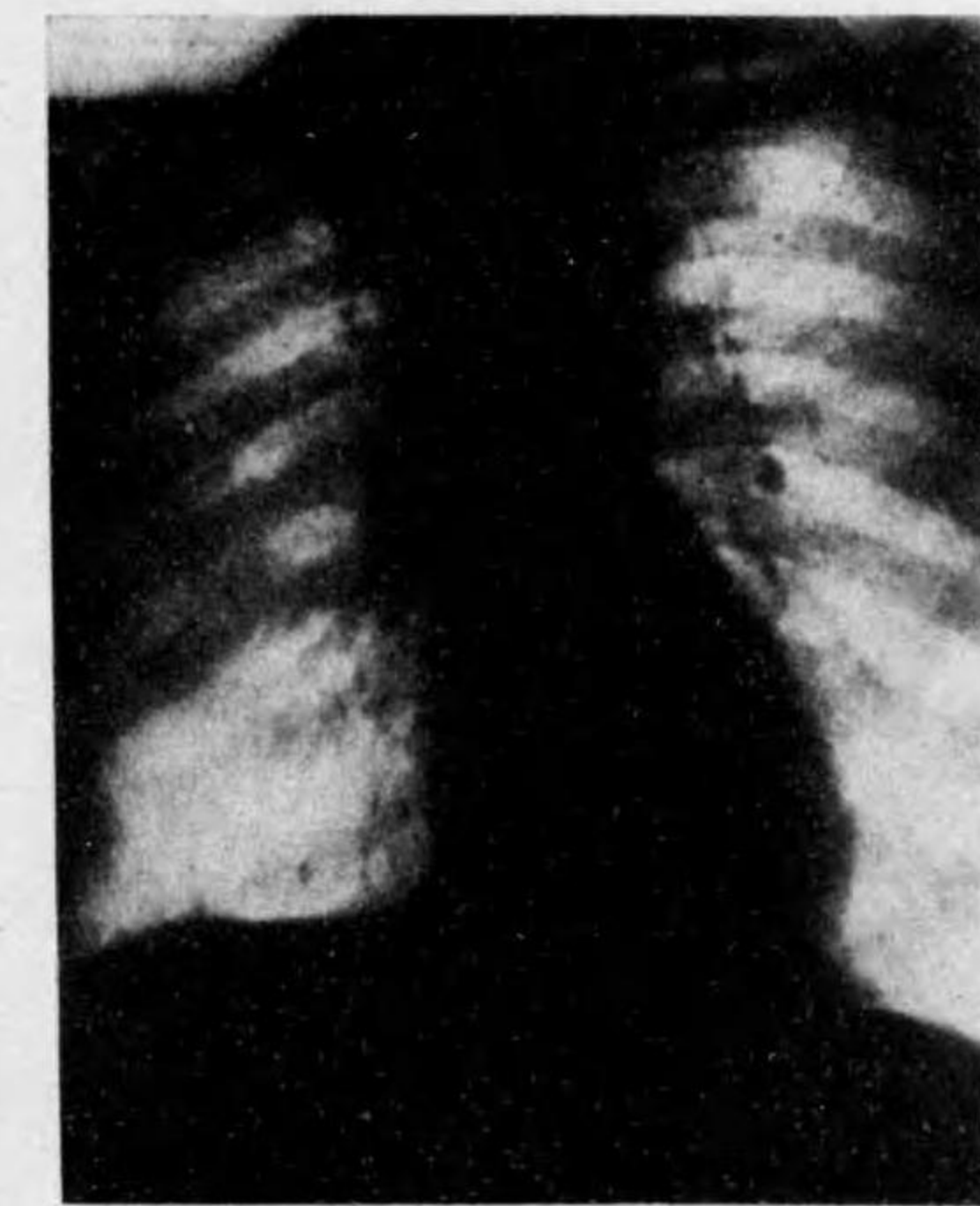
Case XXI, Fig. 153: 11/12/24. Man of 56, seven months ago began with choking on food. Marked density localized at rt. root region.



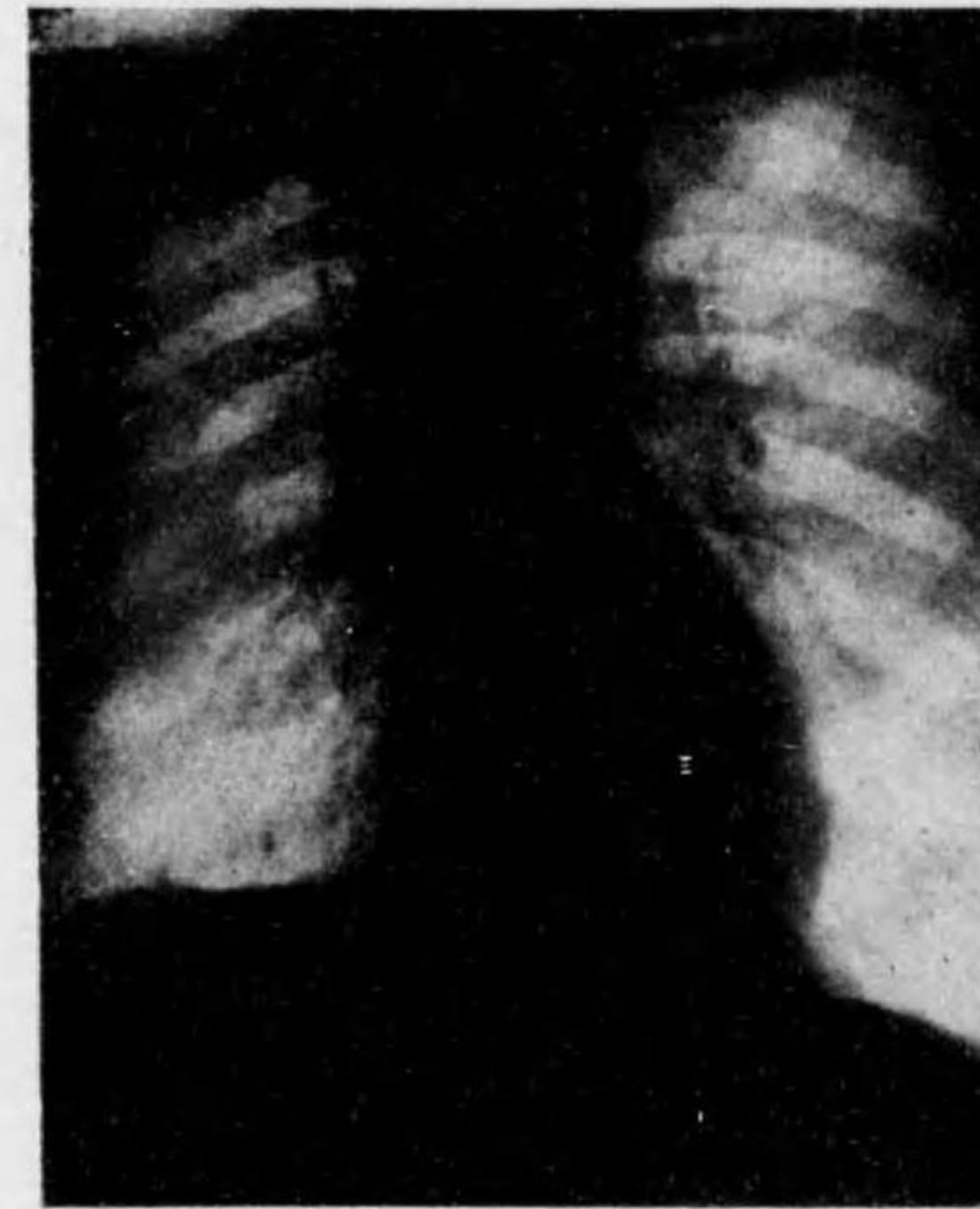
Case XXI, Fig. 157: Taken ten days after, or 11/23/24, in erect position.



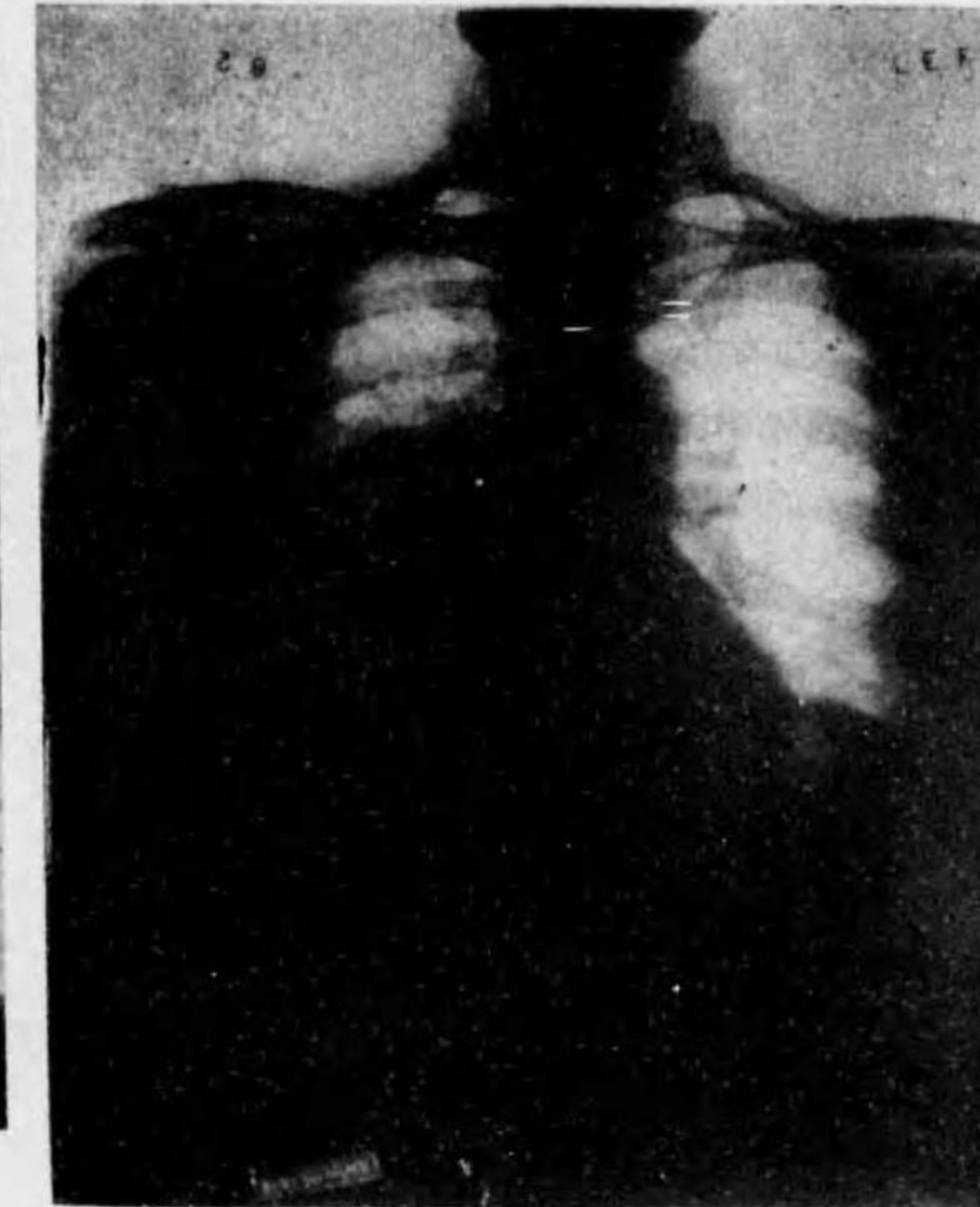
Case XXI, Fig. 154: 11/13/24. Taken in prone position for stereoscopic study.



Case XXI, Fig. 158, taken erect, less than two weeks after the last.



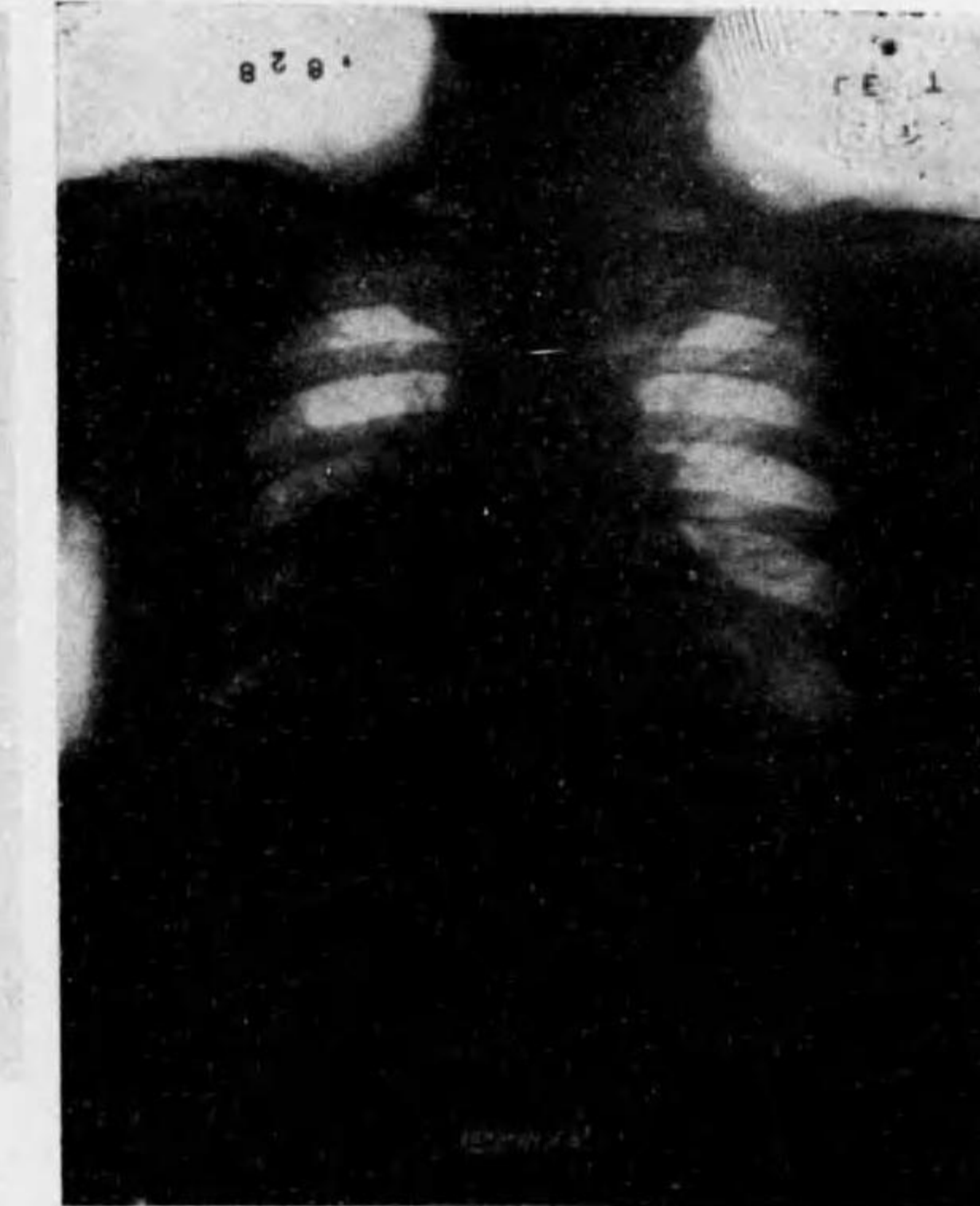
Case XXI, Fig. 158-b stereoscopic.
12/5/24.



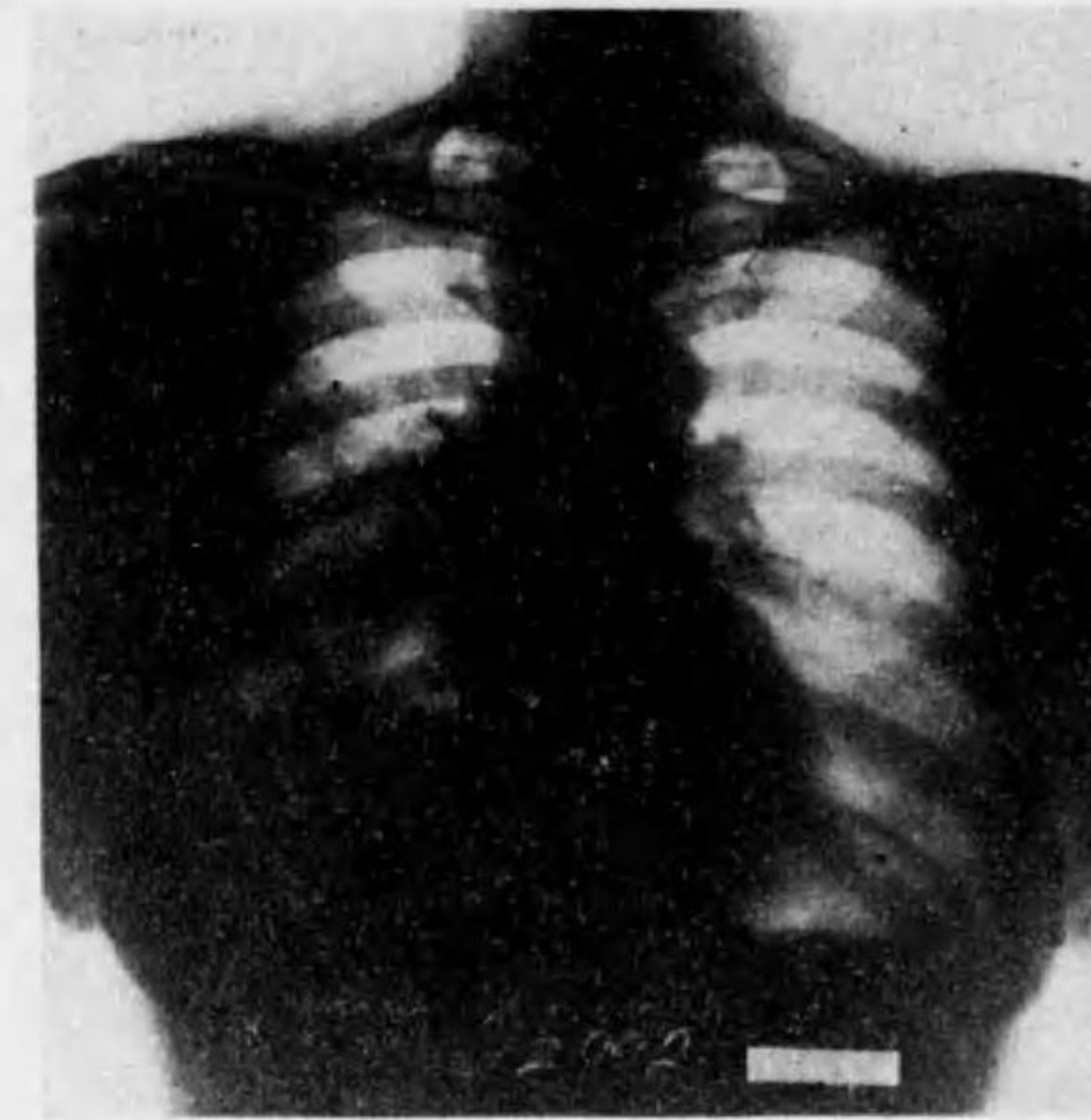
Case XXII, Fig. 161, 7/12/23, erect.
Woman aged 57. About 5 months ago began
as "severe cold". Irregular mottling at
rt. root, and diffuse haziness in lower 2/3.



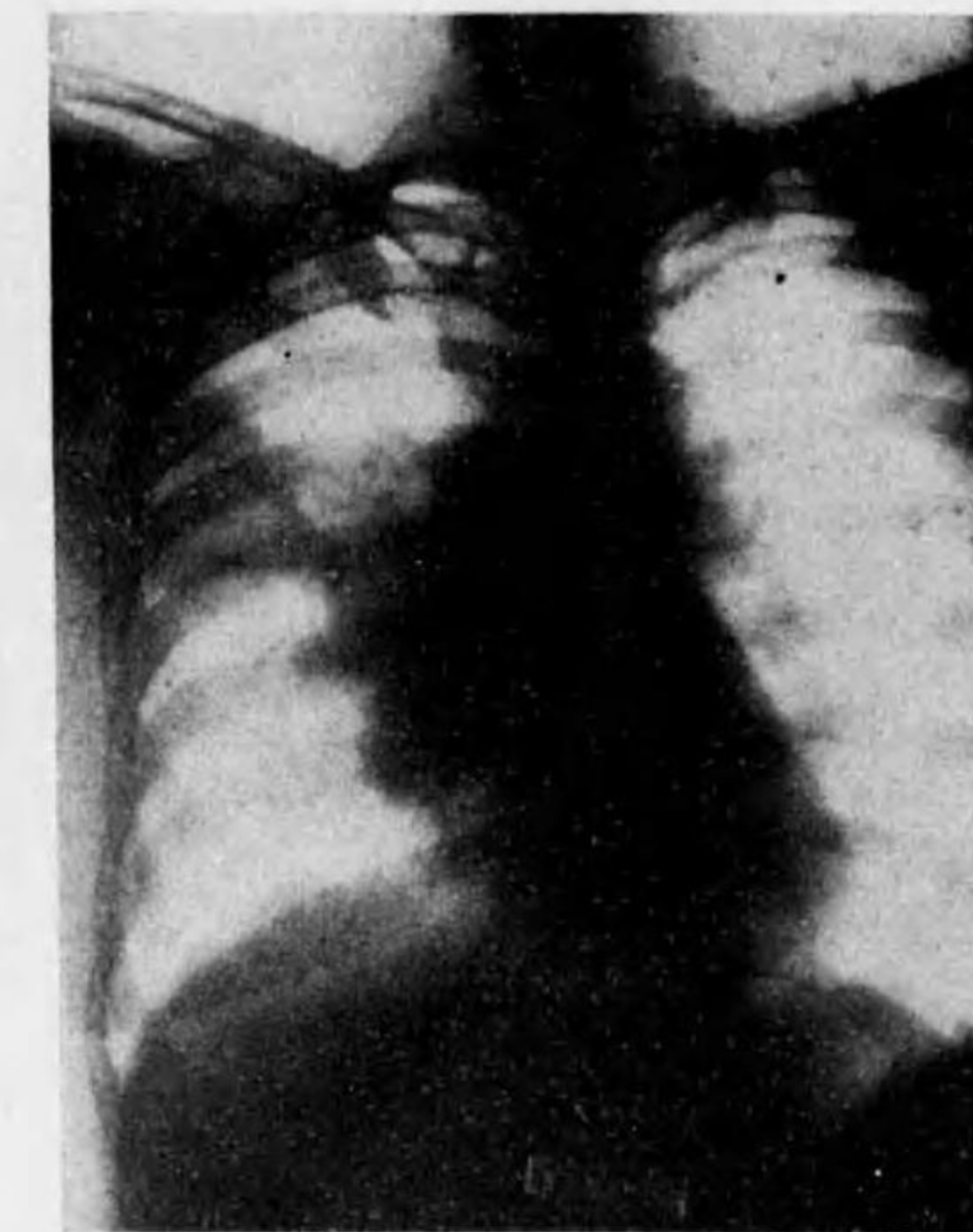
Case XXI, Fig. 160: 12/5/24. Lateral
view. Near root, there is elongated small
dense shadow which may indicate collec-
tion of pus in dilated bronchus, or
foreign body. Bronchoscopy is indicated.



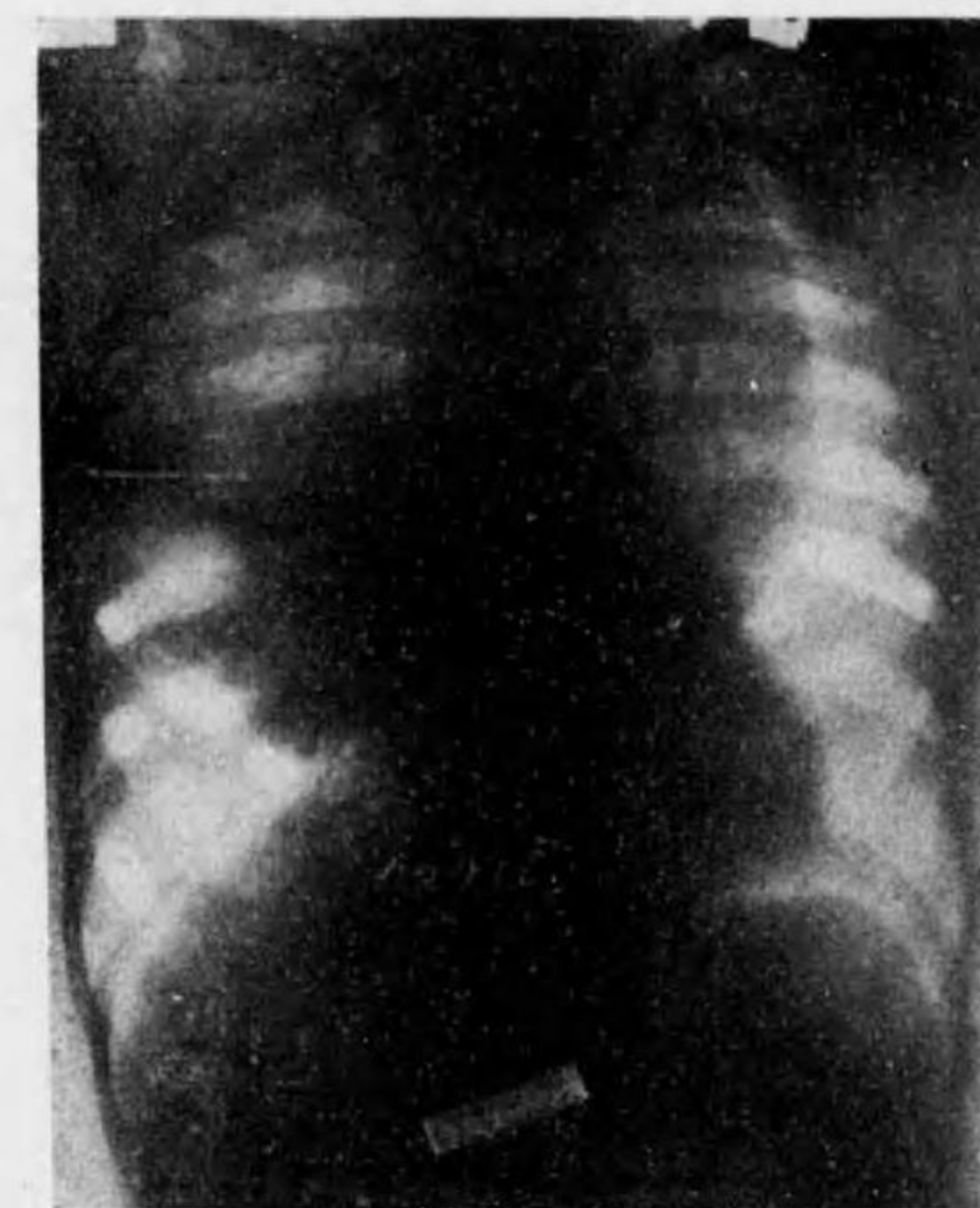
Case XXII, Fig. 163, taken three weeks
later in erect position. More localized mottl-
ing in region of mid lobe; surrounding
pneumonitis has decreased. See Fig. 164.



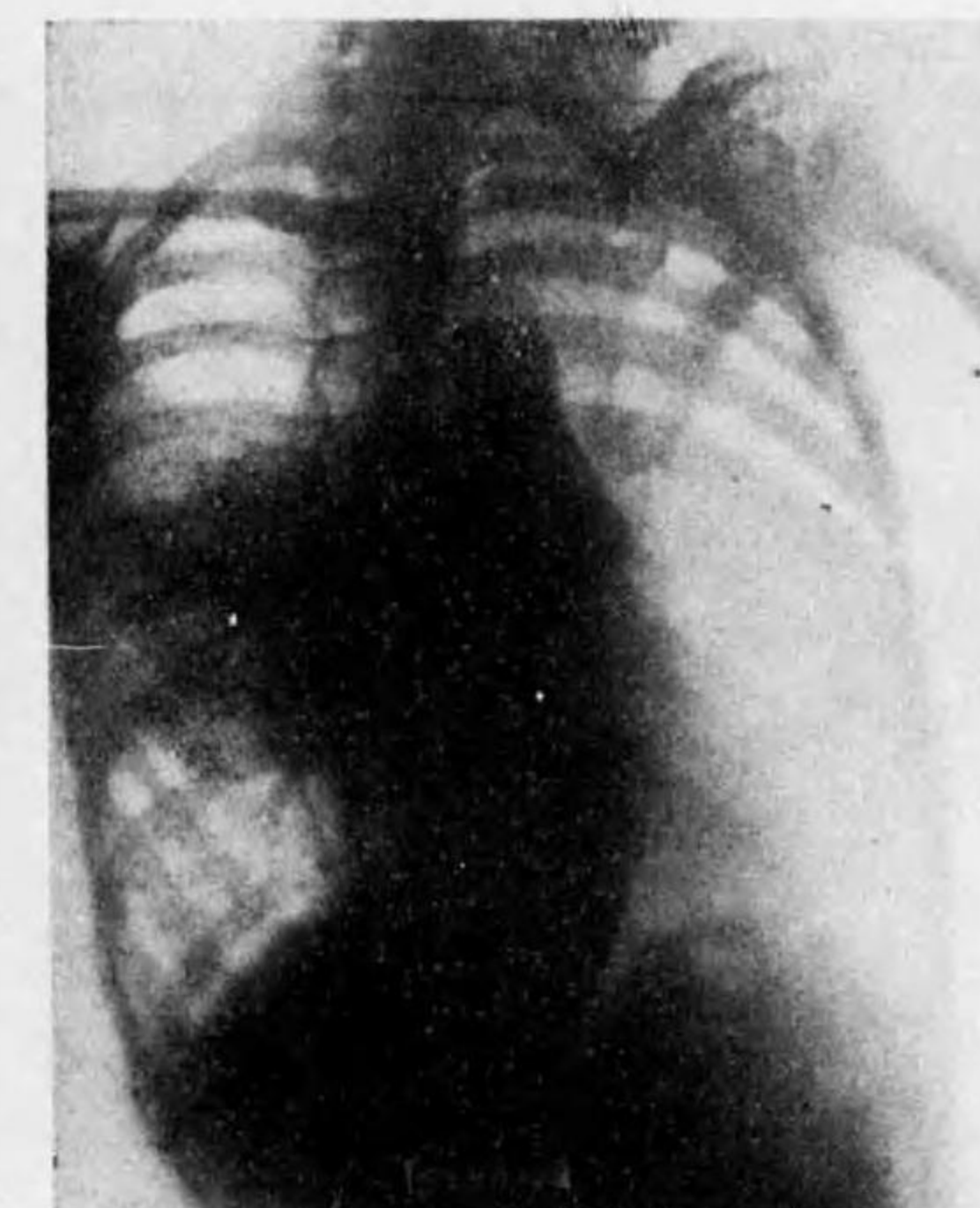
Case XXII, Fig. 165, ten days later, in erect pos. There are two rounded empty cavities surrounded by dense, fibrous shadow; New growth now eliminated



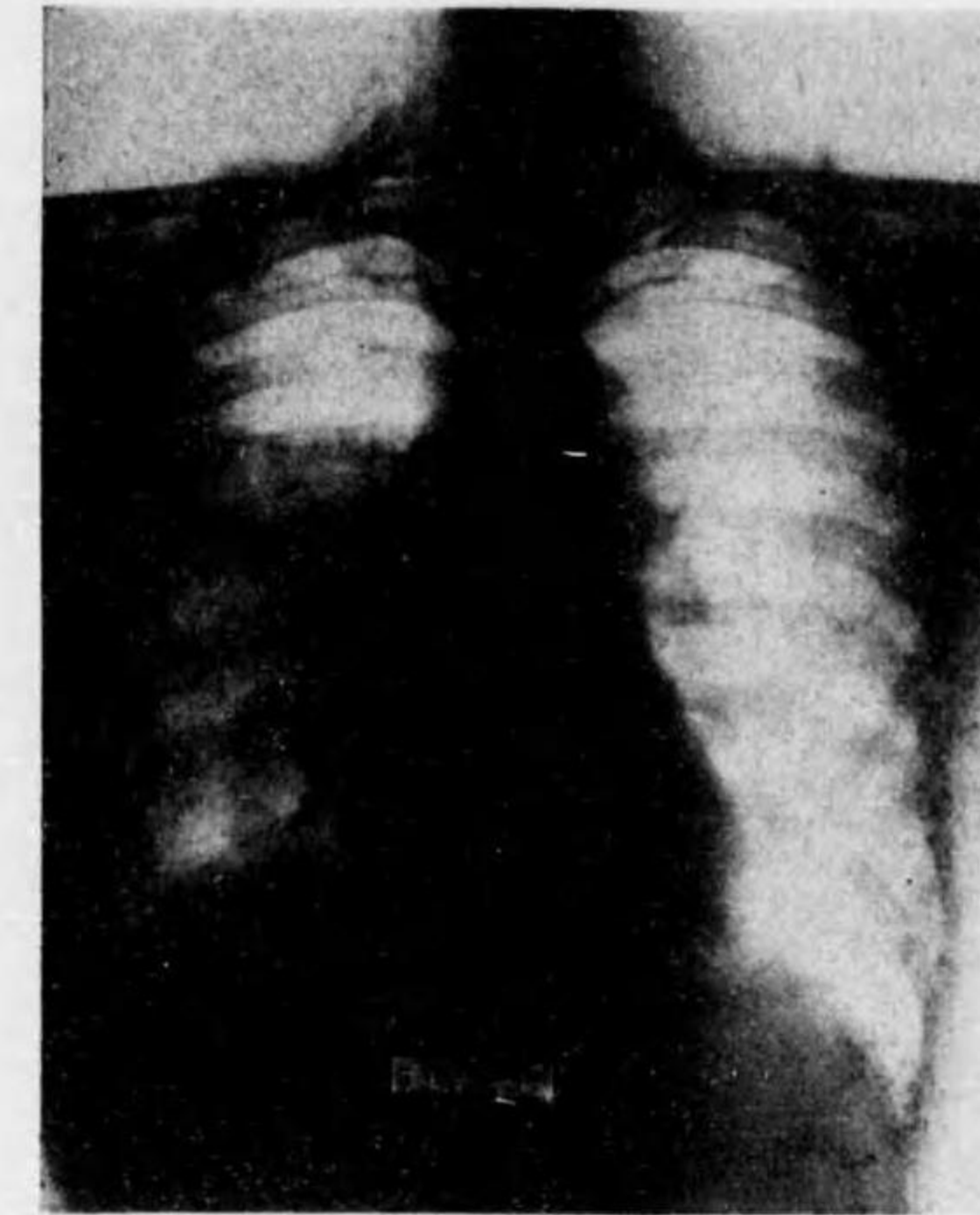
Case XXIII, Fig. 170 2/10/25. Rt. oblique position No cavity can be seen.



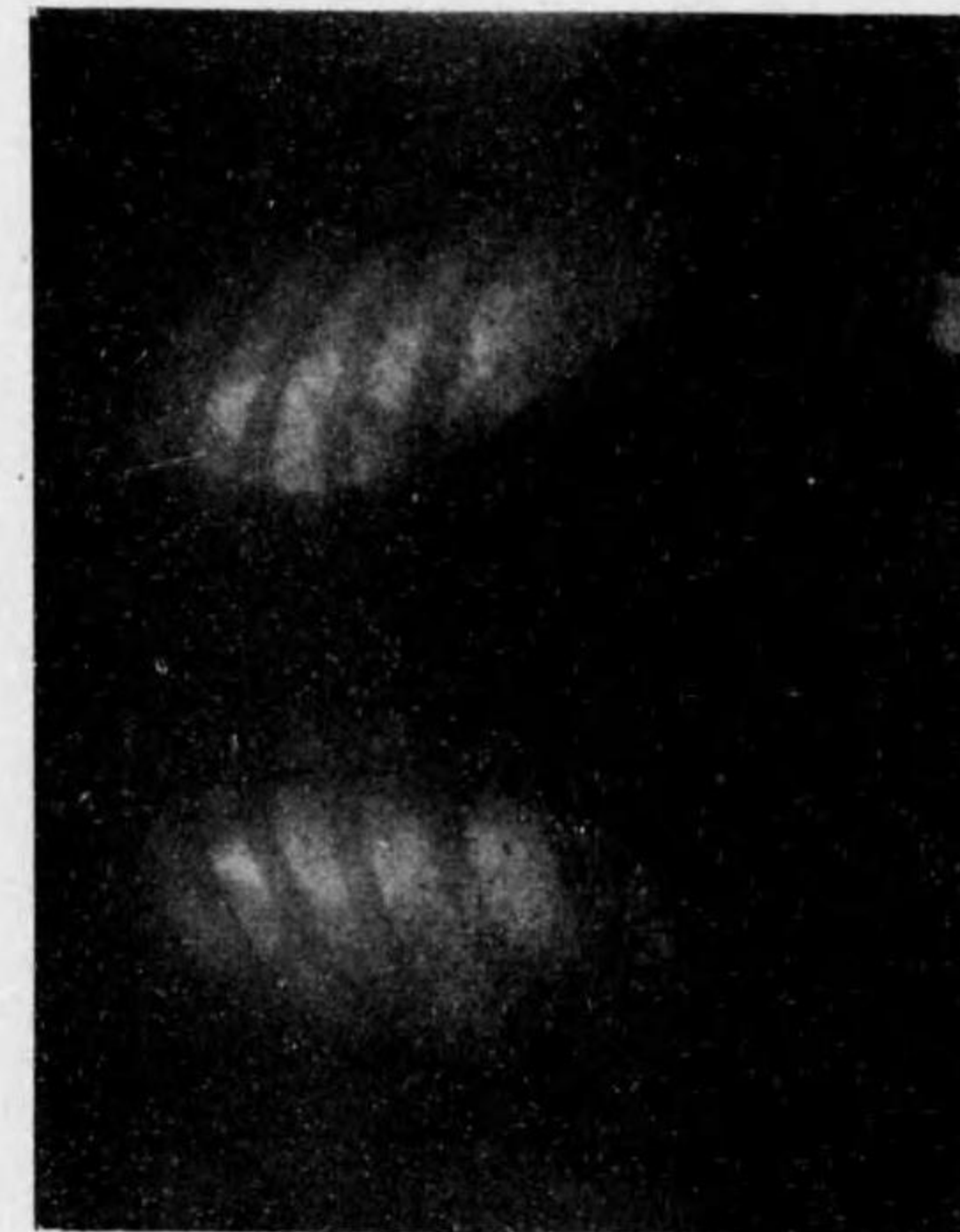
Case XXIII, Fig. 168. Taken erect, 2/10/25. Woman aged 40; Rt. sided mastectomy for mammary carcinoma several years ago. About a month ago swallowed candy. Shadow now smaller than previous one.



Case XXIII, Fig. 172: 2/10/25. Taken antero-posterior, with pt. lying on her left side.



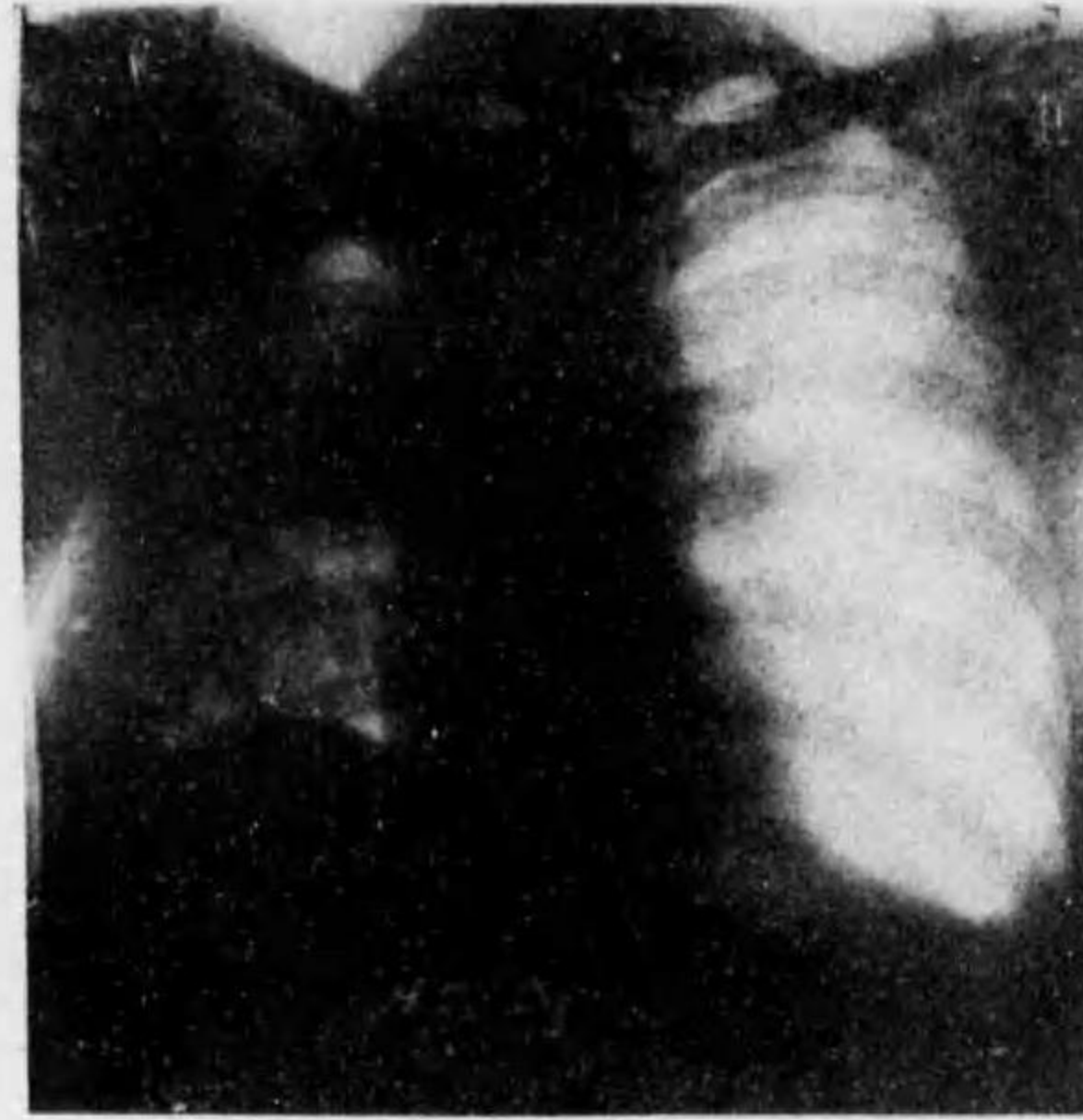
Case XXIII, Fig. 174, 2/26/25. or over two weeks after the previous picture. The "onion-root" shadow and surrounding infiltration now decidedly less than earlier pictures indicated.



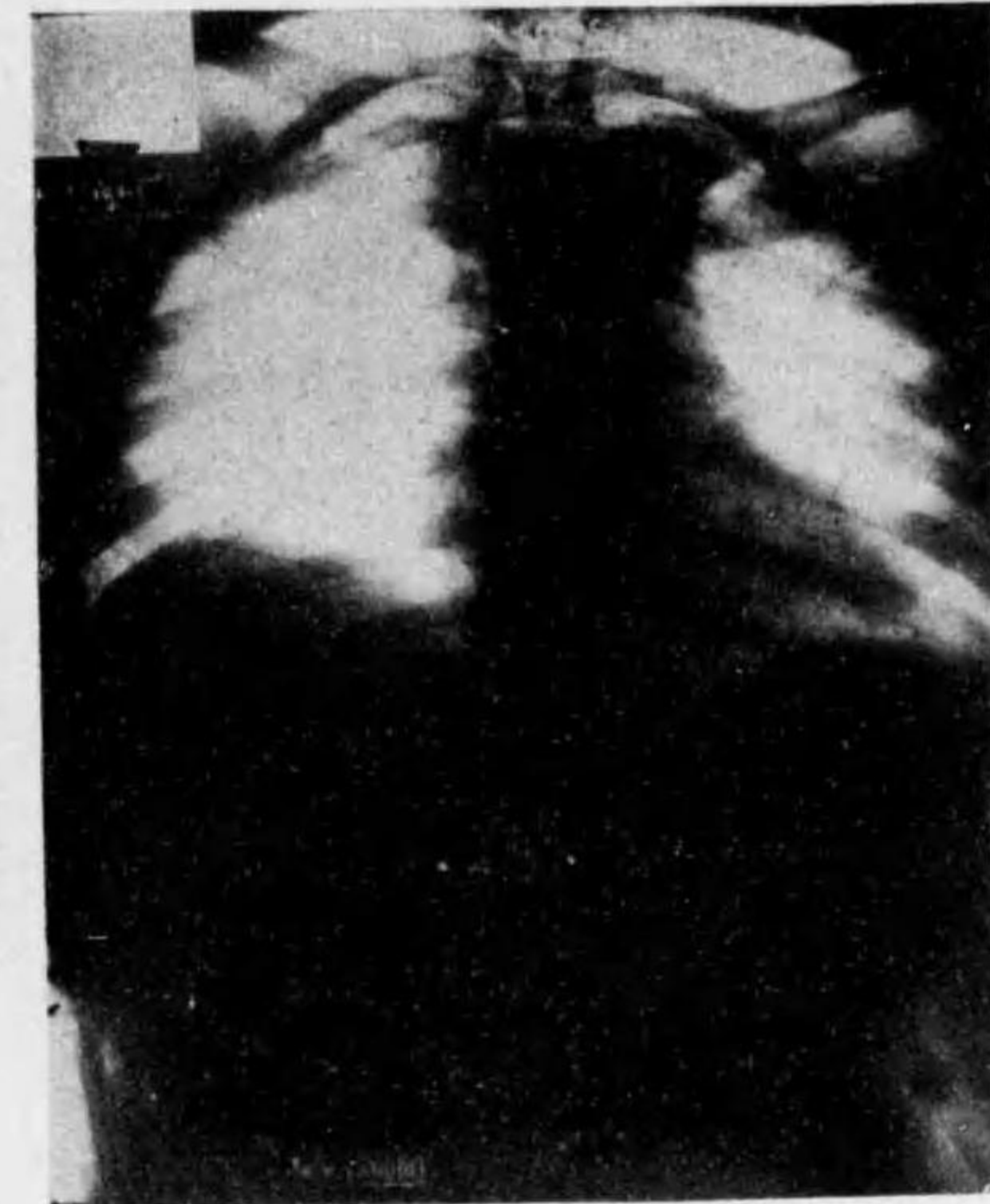
Case XXIV, Fig. 176. 2/26/21. Taken erect. About six weeks ago had child birth, followed by spontaneous pain in rt. chest and spitted out blood.



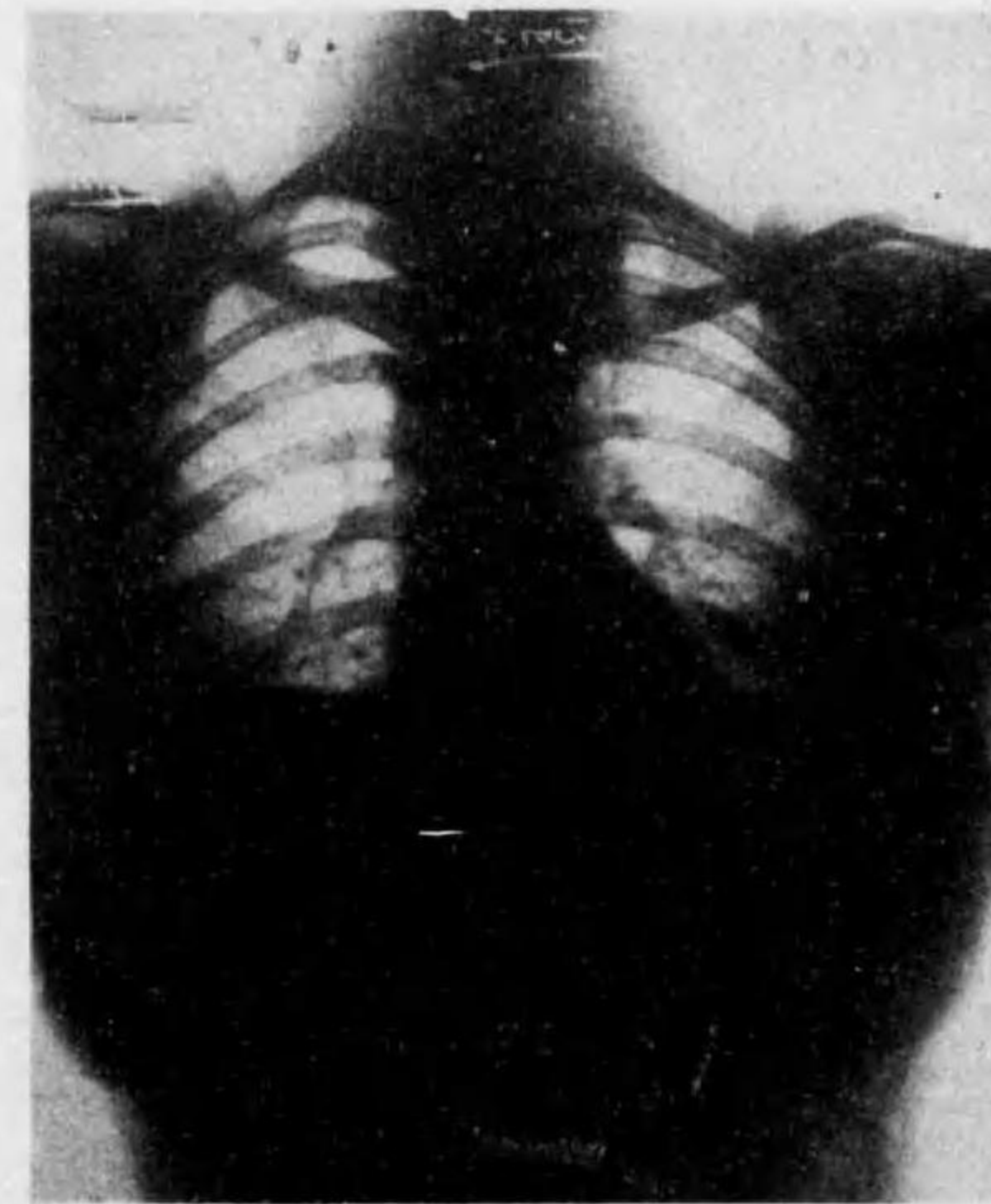
Case XXV, Fig. 178.



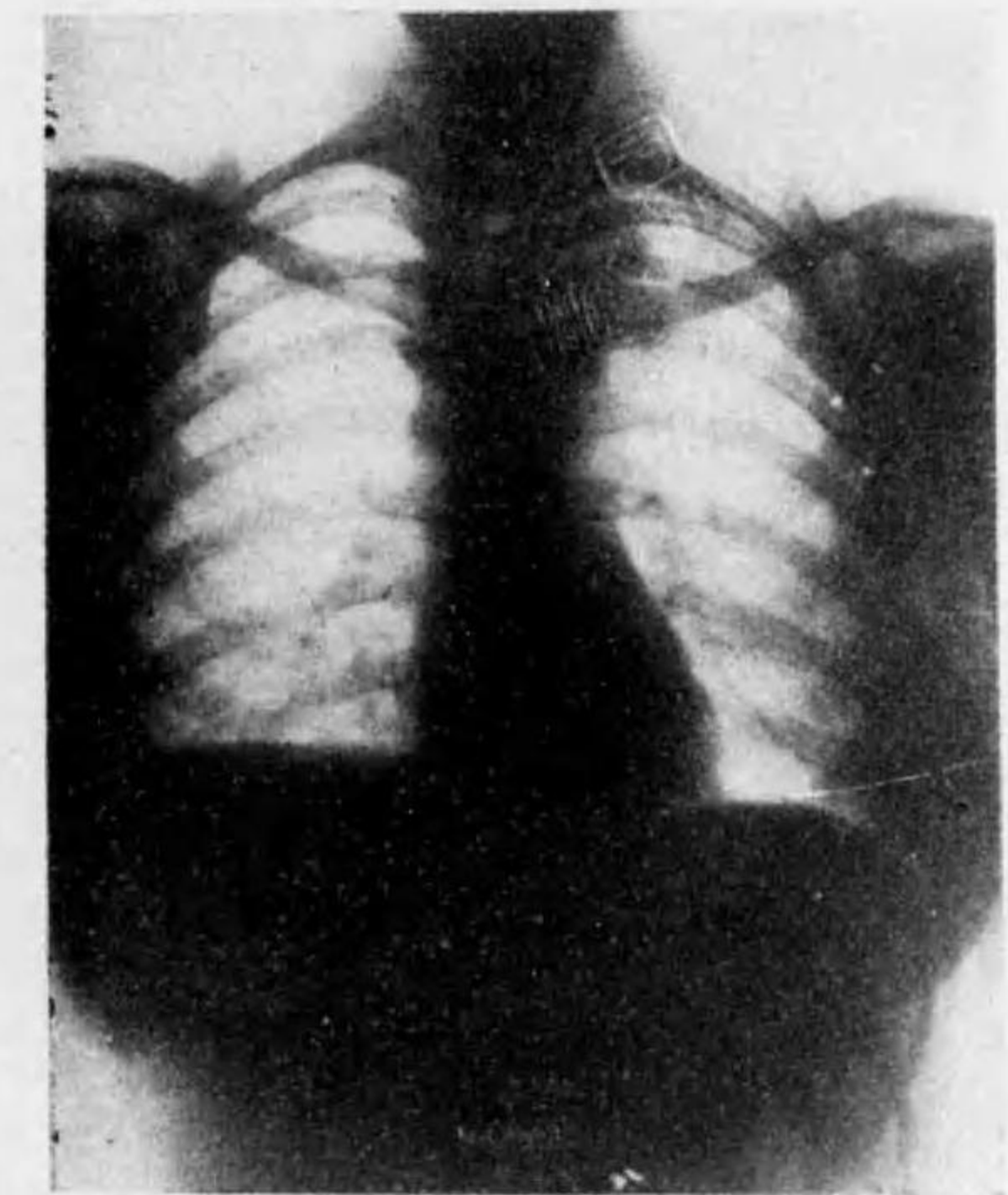
Case XXVI, Fig. 180, prone, 7/6/20. man, aged 36. Seven months ago had appendectomy followed by postoperative pneumonia from which he made complete recovery. Three weeks ago began with sudden chill and fever, but not sick enough for developing pneumonia. Dense shadow in inner-upper quadrant of rt. lung.



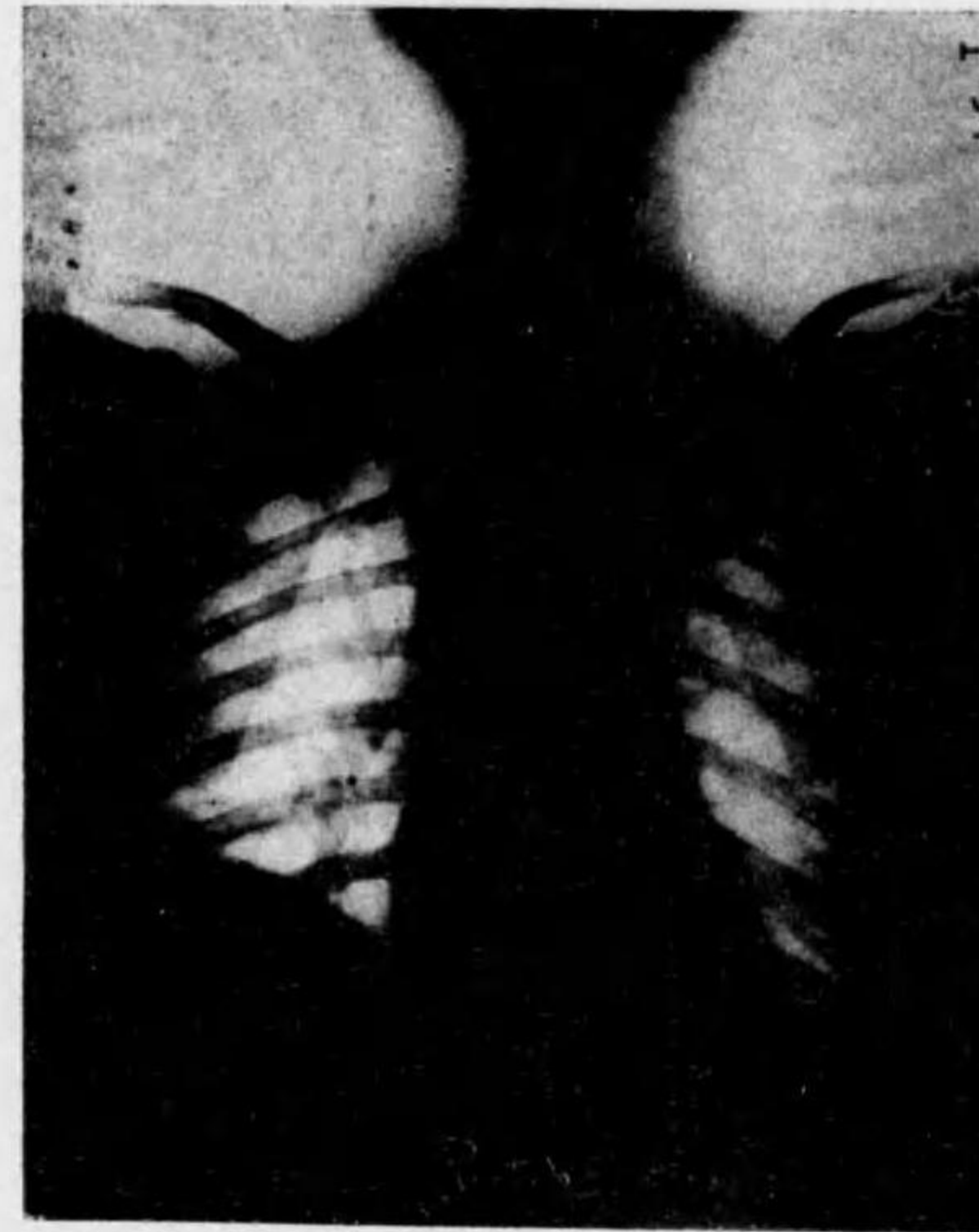
Case XXVII, Fig. 184, taken a week later focussed for spine whose edges show some induration(?) Other shadows are same. See Fig. of later periods.



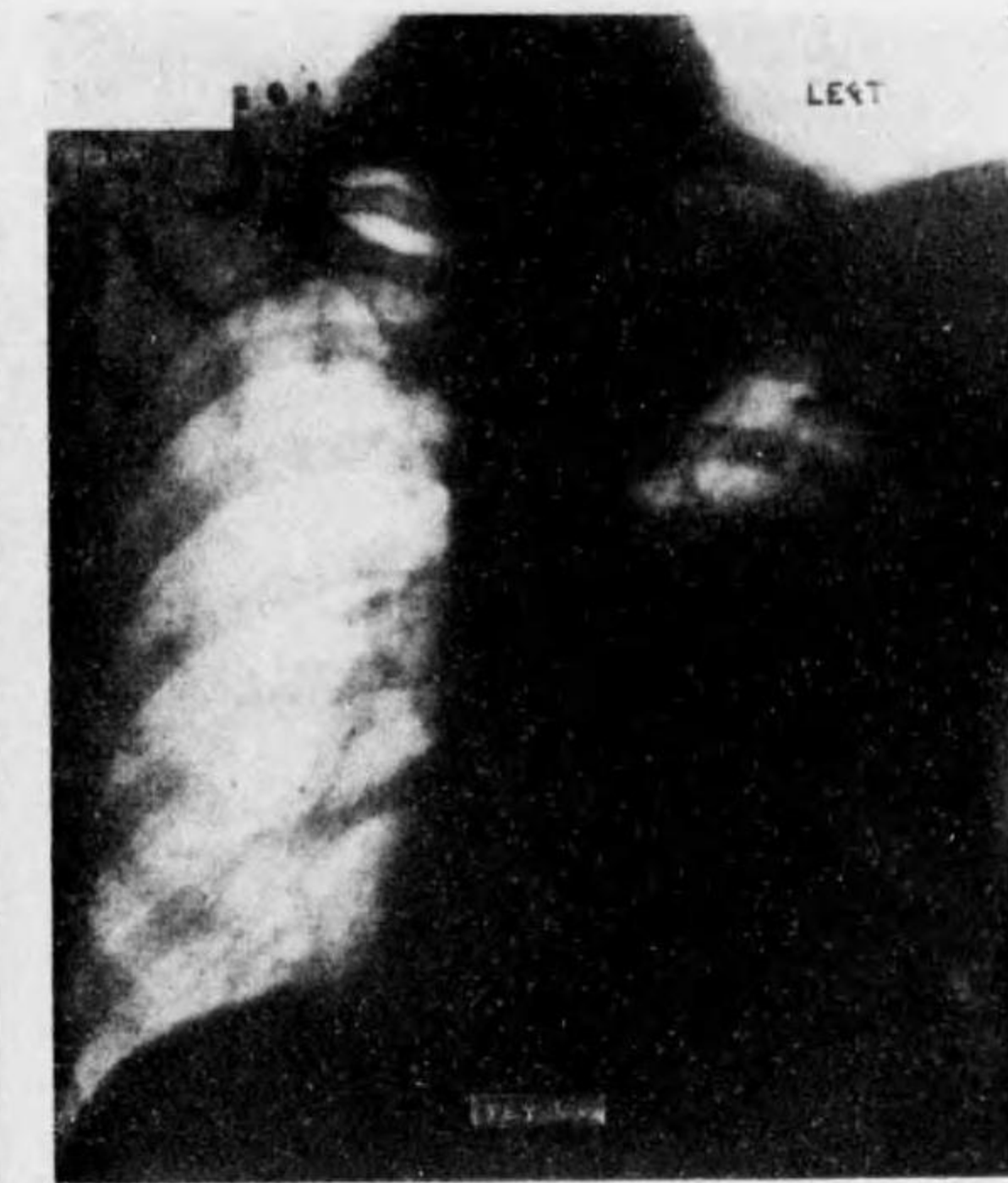
Case XXVII, Fig. 182. 11/12/23. Russian housewife, aged 26. Six weeks ago swallowed a chicken bone. Upper dorsal spine curved to the rt., wide mediastinal shadow on the left, for which there are many possibilities of interpretations.



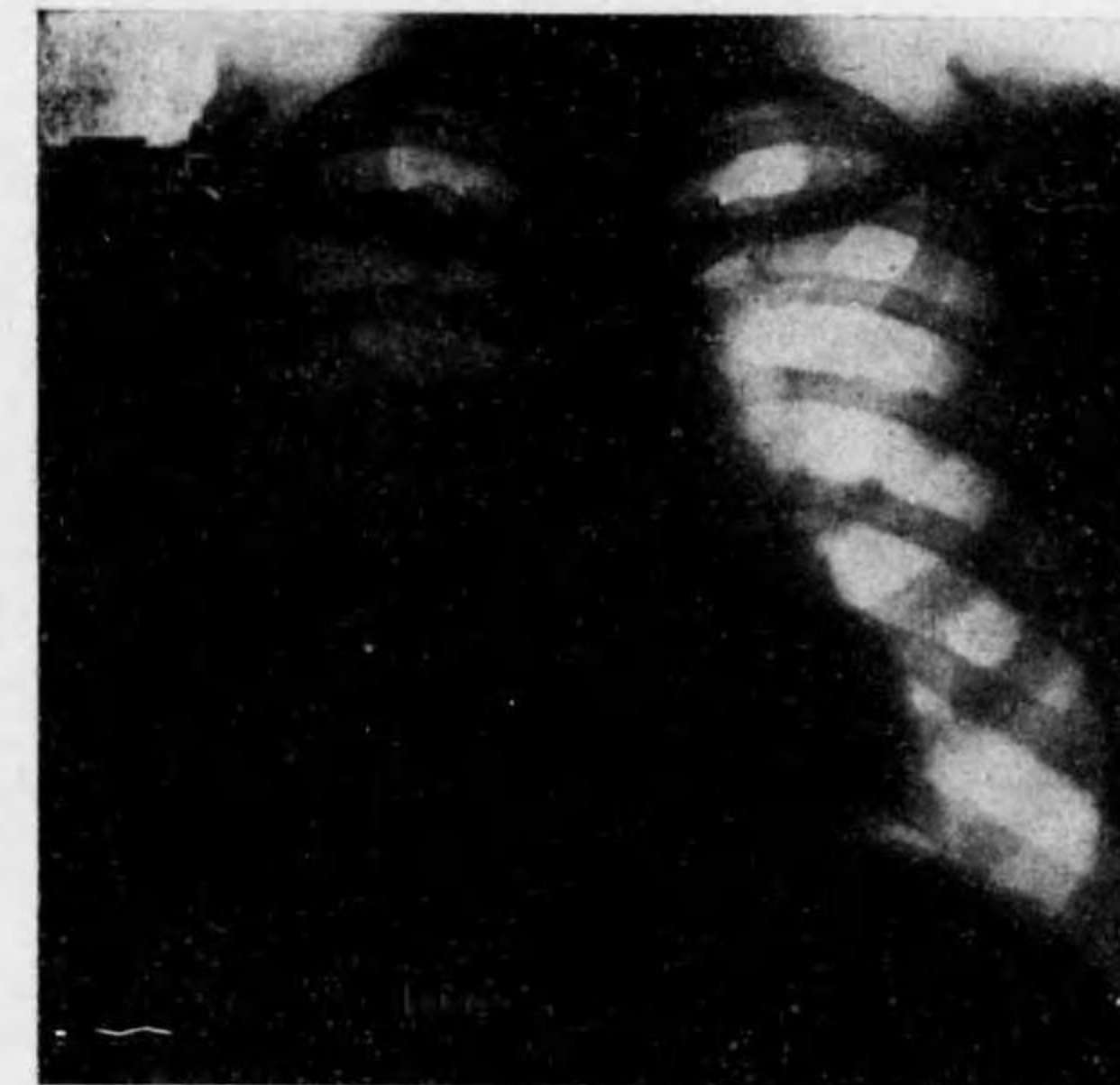
Case XXVII, Fig. 185.



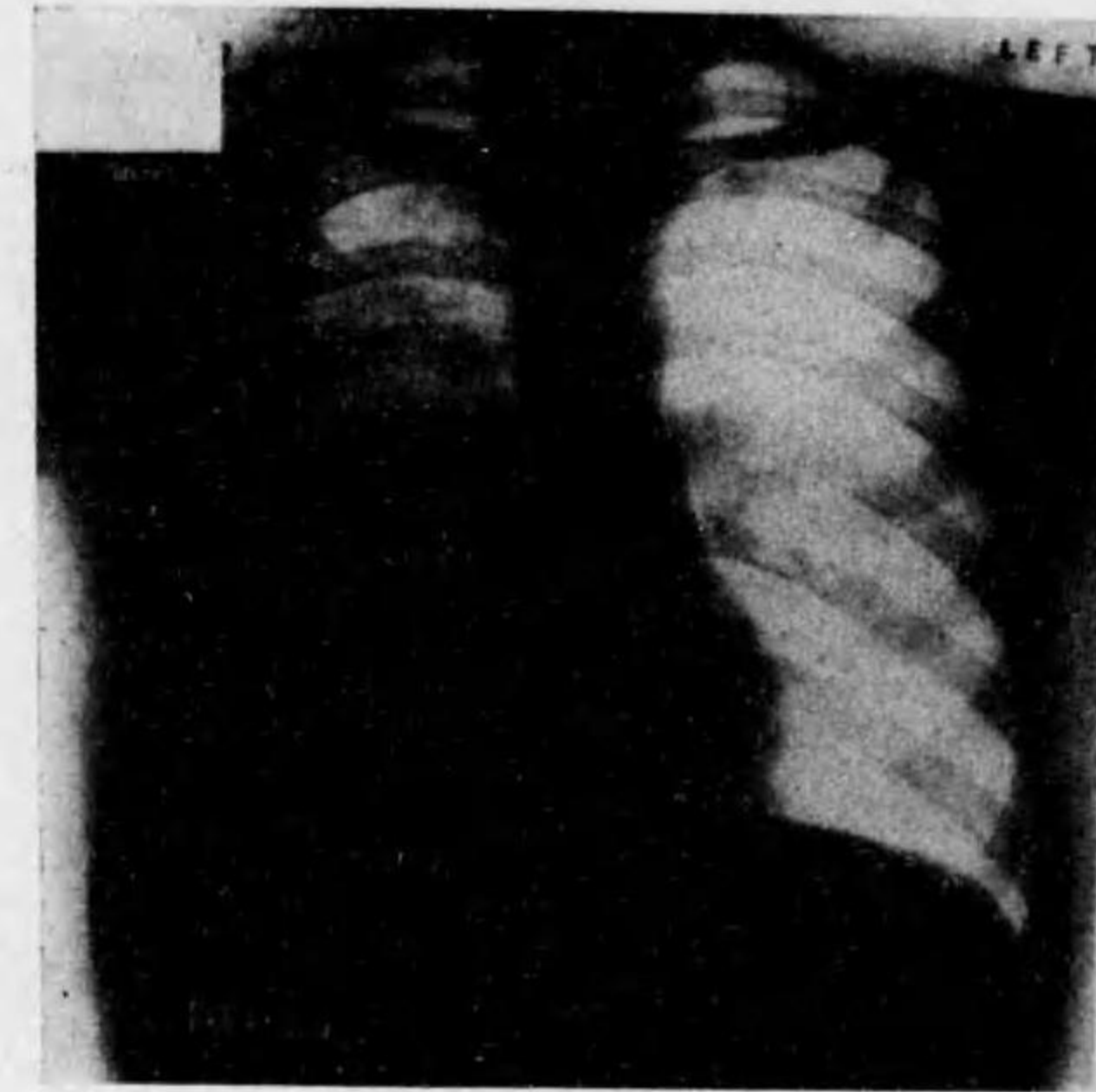
Case XXVII, Fig. 187, erect, 12/3 23.
or 4 weeks after the first picture showing
the same condition.



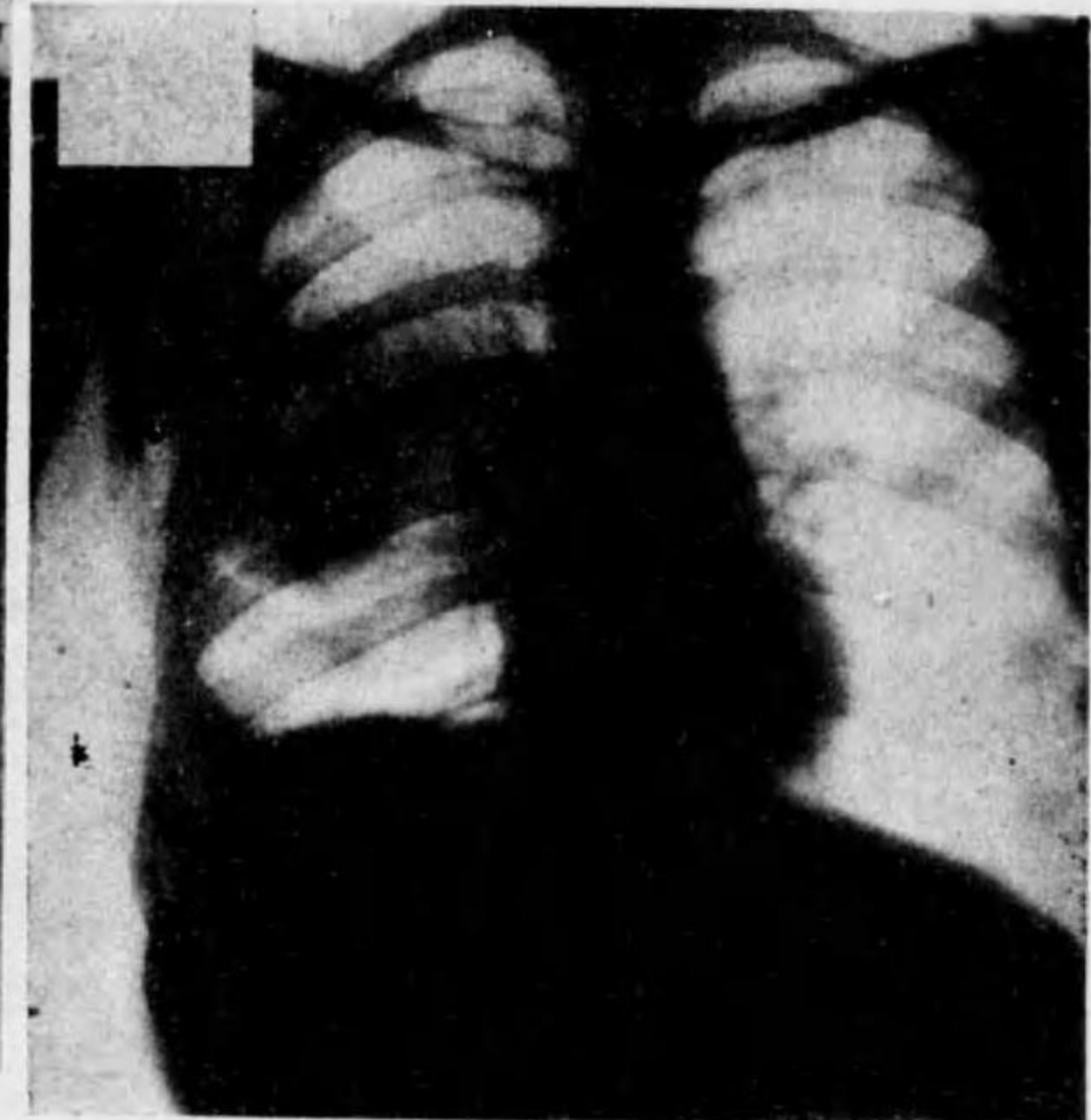
Case XXVIII, Fig. 189. Painter aged
69, had chronic bronchitis of many years'
duration. Left lung: a dense shadow with
central small less dense area. Marked
density covering the base. There is aerated
area at costo-phrenic angle. P. M.: abscess
of left lung, chronic suppurating bronchitis,
pleuritic adhesions, but no bronchiectasis.



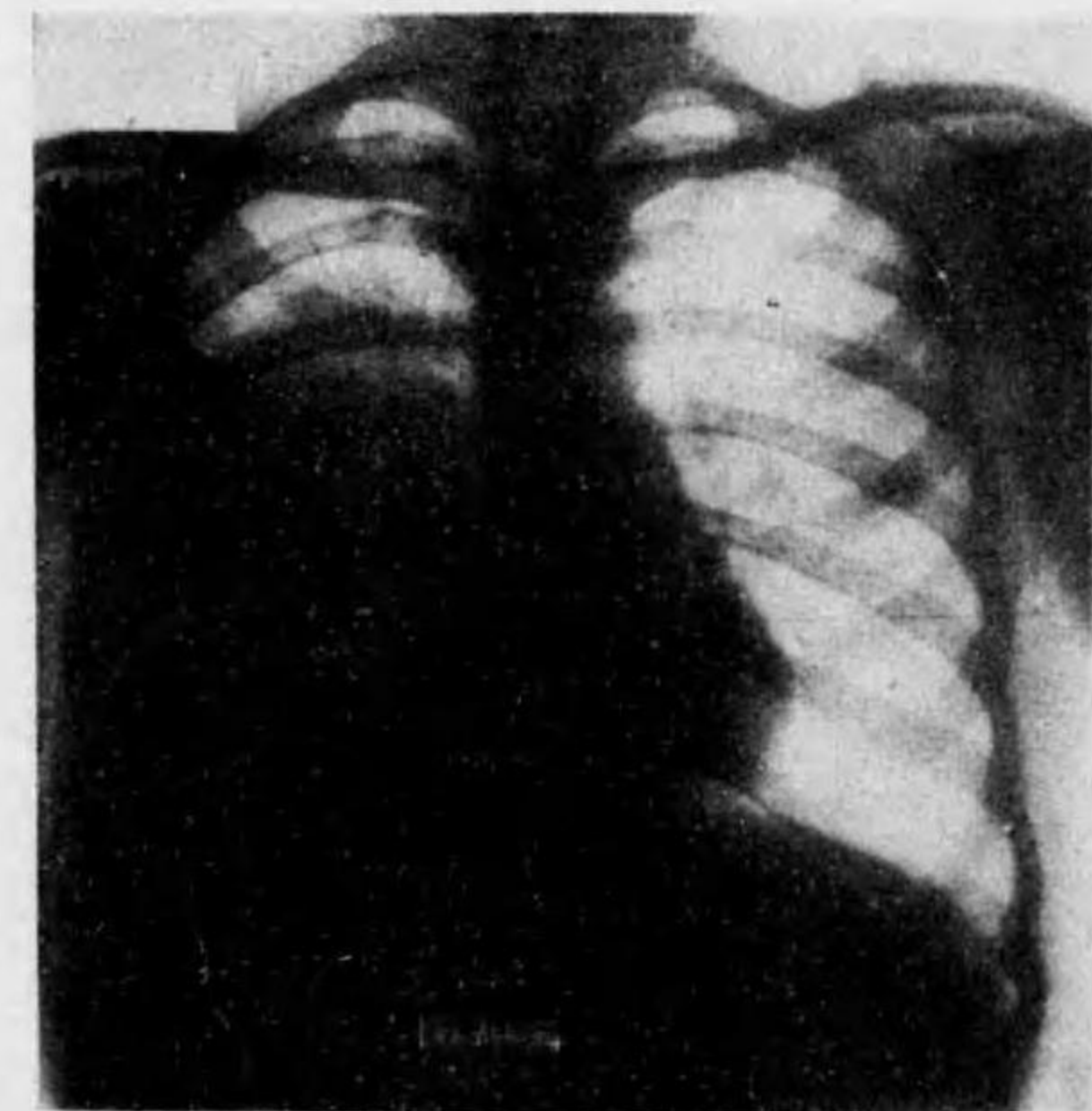
Case XXIX, Fig. 191, taken erect,
Dec. 18, 22. Man of 28, 18 days ago began
as pleurisy.



Case XXIX, Fig. 193 Taken a little over three weeks after the last xlm.



Case XXIX, Fig. 196: A week after the last picture, showing decided improvement.



Case XXIX, Fig. 195: Taken Jan. 29 th, '23. in prone position, ten days after thoracotomy. Increased haziness in lower 2/3 on ri. Much thickened pleura, Hardly any fluid at base. Both apices are clear.



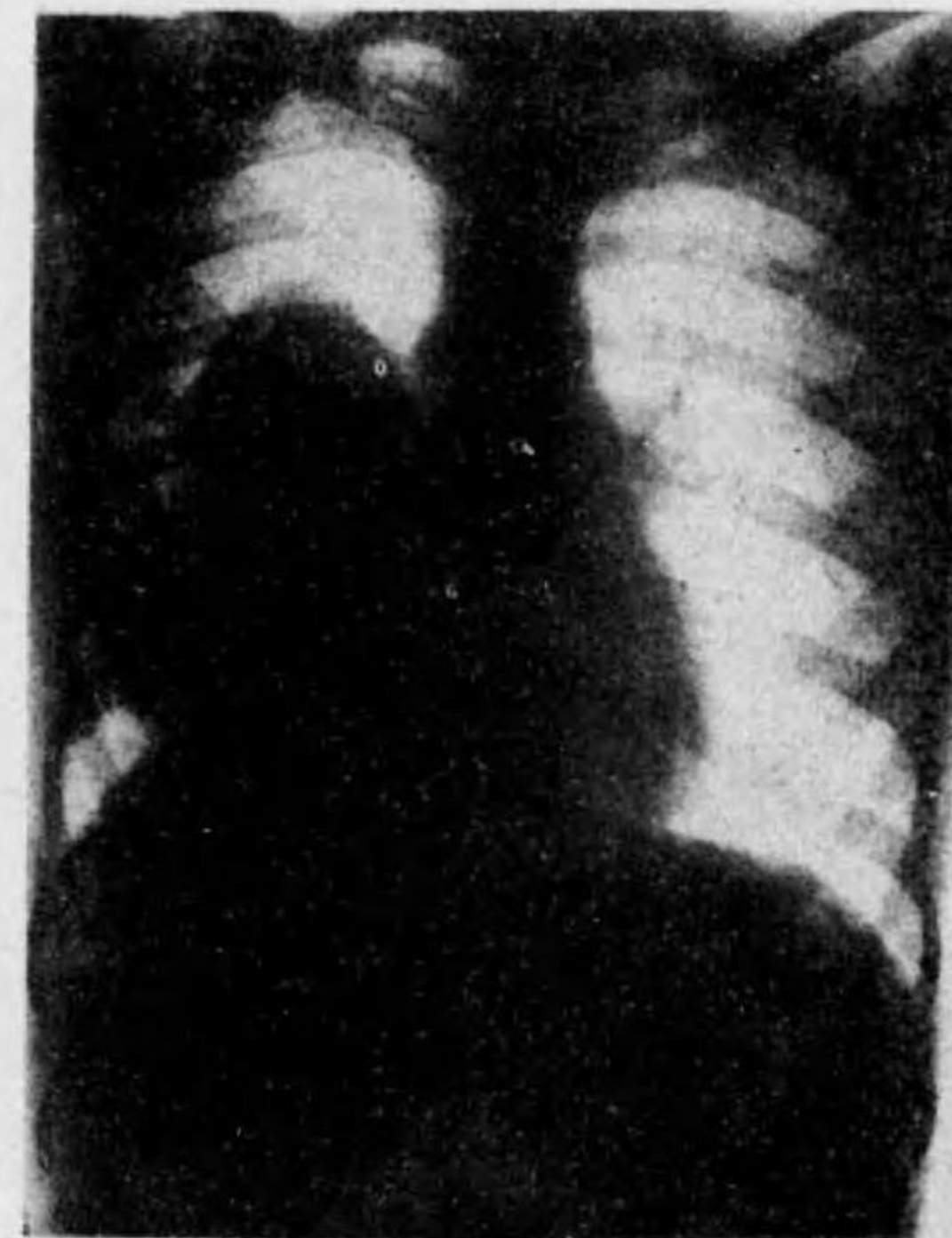
Case XXX, Fig. 198: Man, 67, slow onset three months ago with cough, expectoration and shortness of breath. Pt. died shortly after this was taken with sudden precordial pain. P. M. showed multiple abscesses in mid lobe; coronary block by emboli.



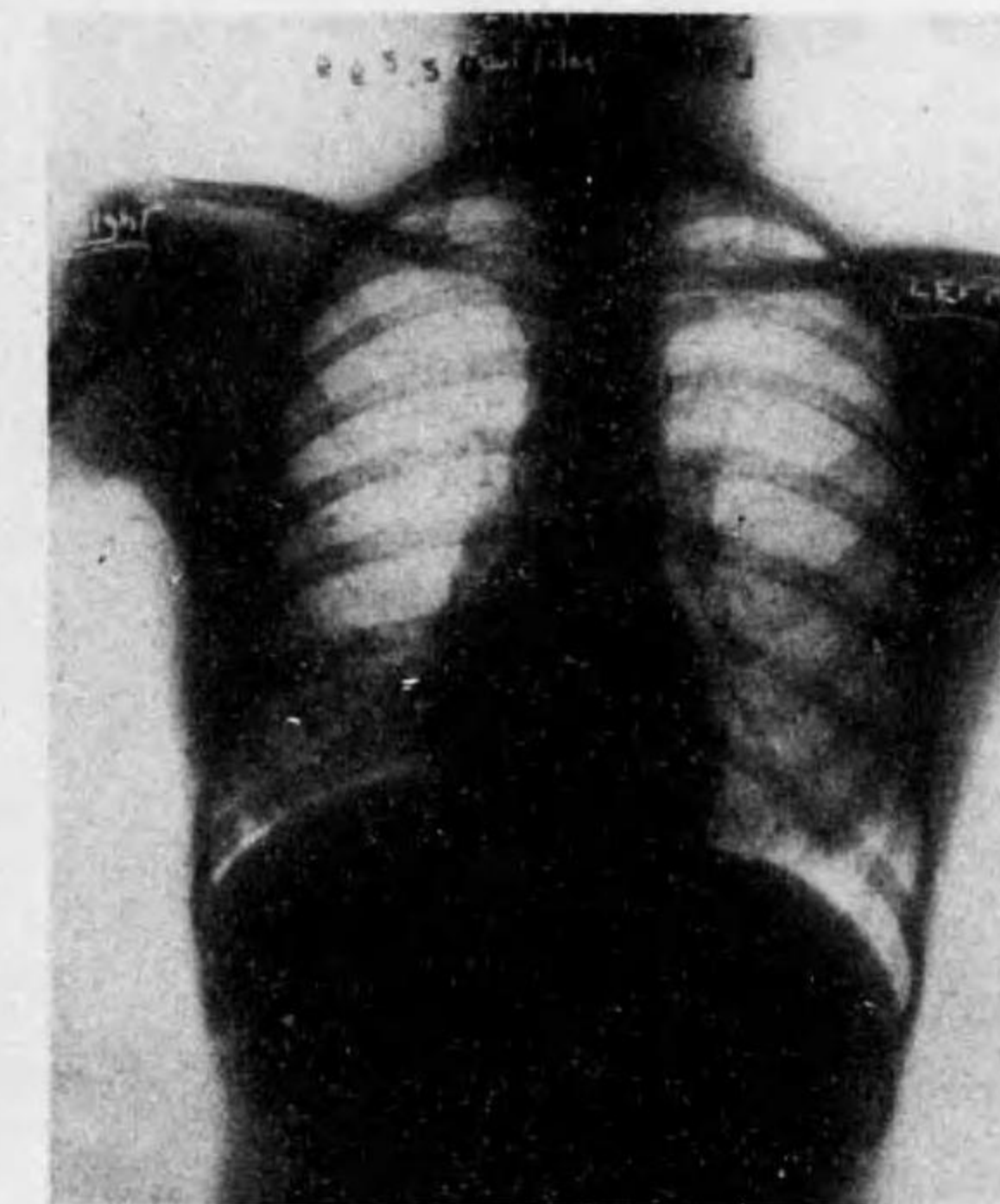
Case XXXI, Fig. 200, Pt. aged 15, three days after tonsillectomy developed lung complication. This was taken five days after the onset, or a week after operation.



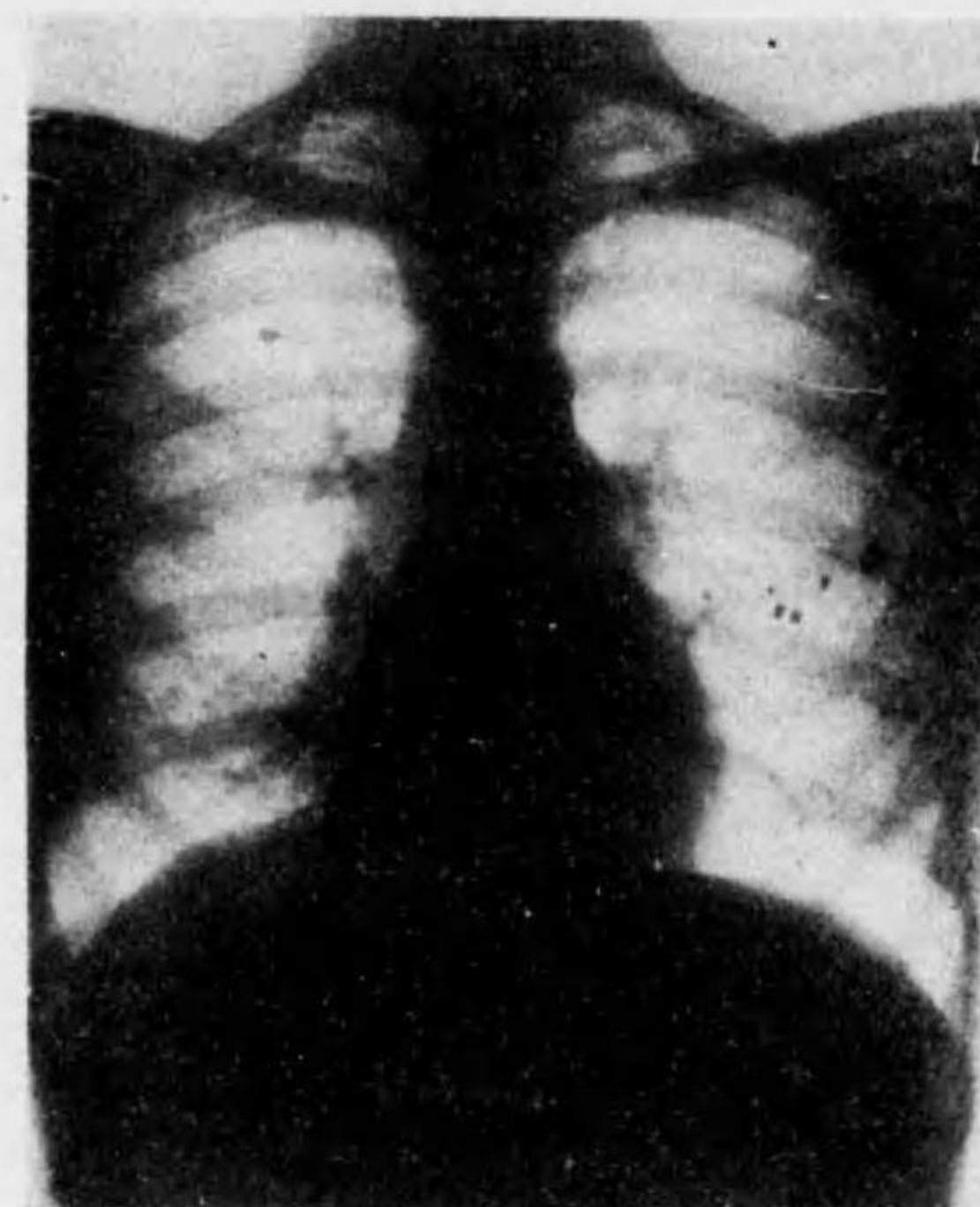
Case XXXI, Fig. 204, 12/28/20. After more treat by artificial pneumothorax.



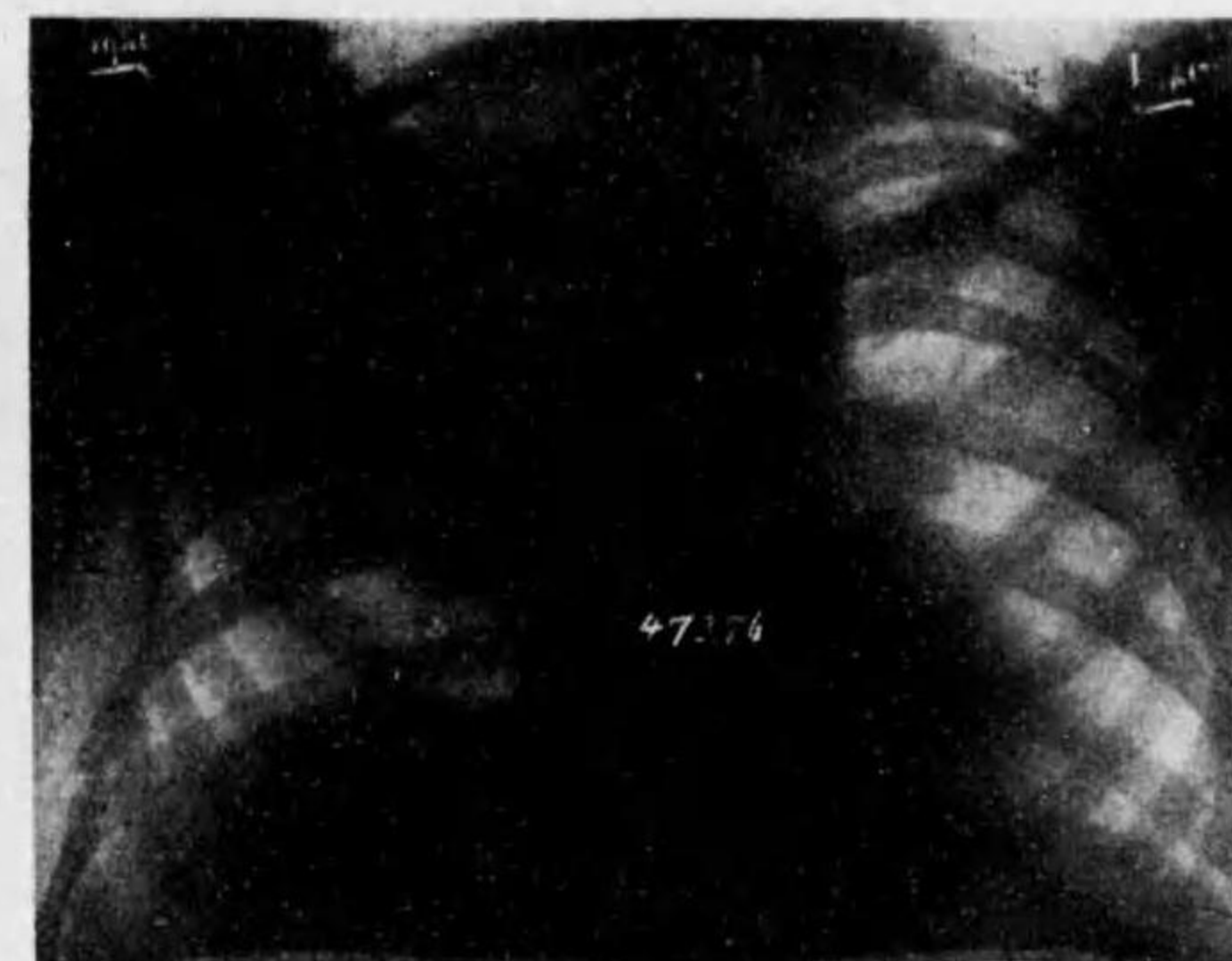
Case XXXI, Fig. 202, Taken erect 7 days after the previous film.



Case XXXI, Fig. 206, 5/2/22. Taken erect one and one half year the last film.



Case XXXI, Fig. 206 5/20/22. Taken for stereoscopic study.



Case XXXII, Fig. 212, Dec. 31/20, prone. Laborer, aged 33, 5 days ago began with acute lobar pneumonia. Homogeneous density in upper half of rt. lung; around root appears mottling. Hazy diaphragmatic region. Suggests pneumonia. See

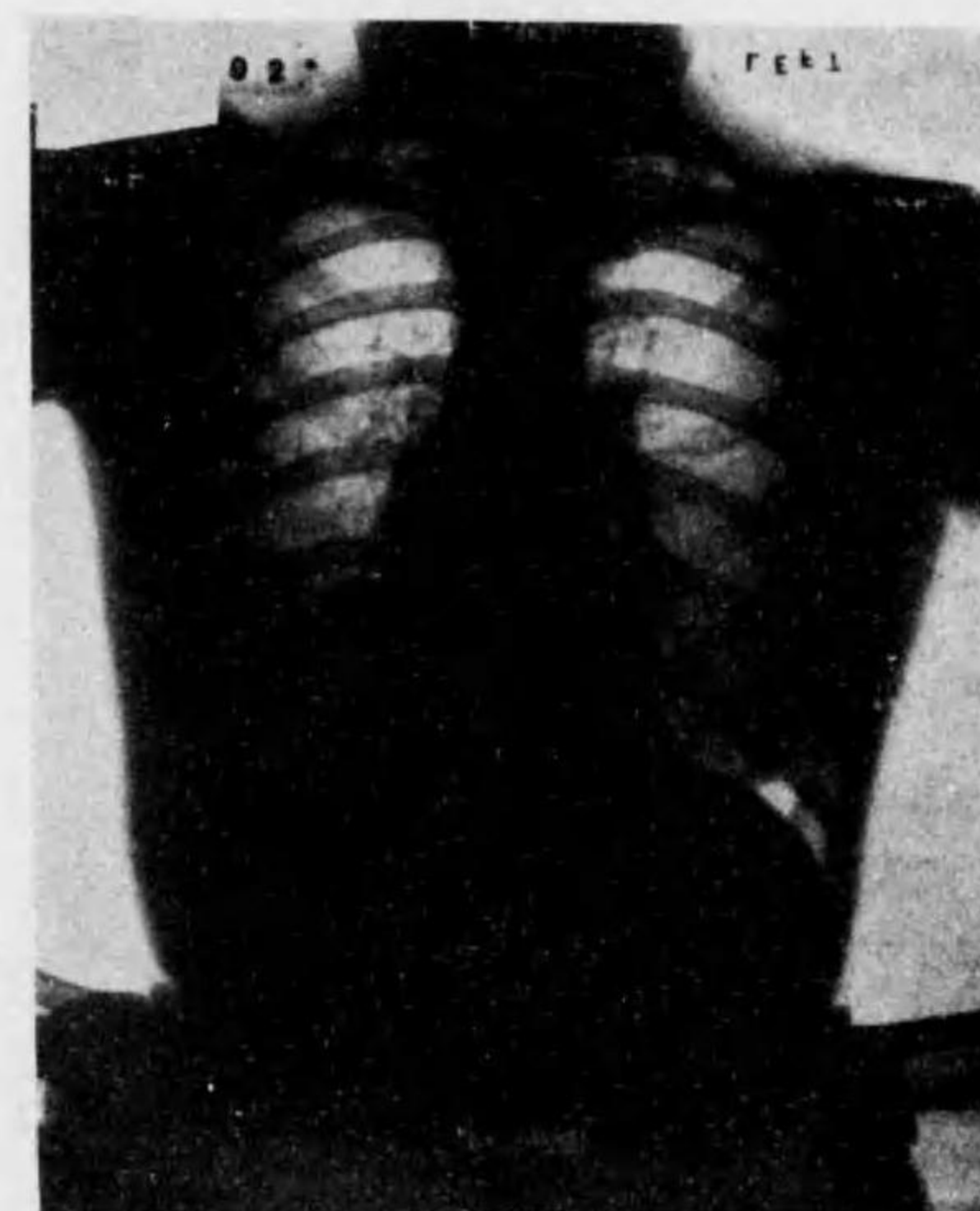
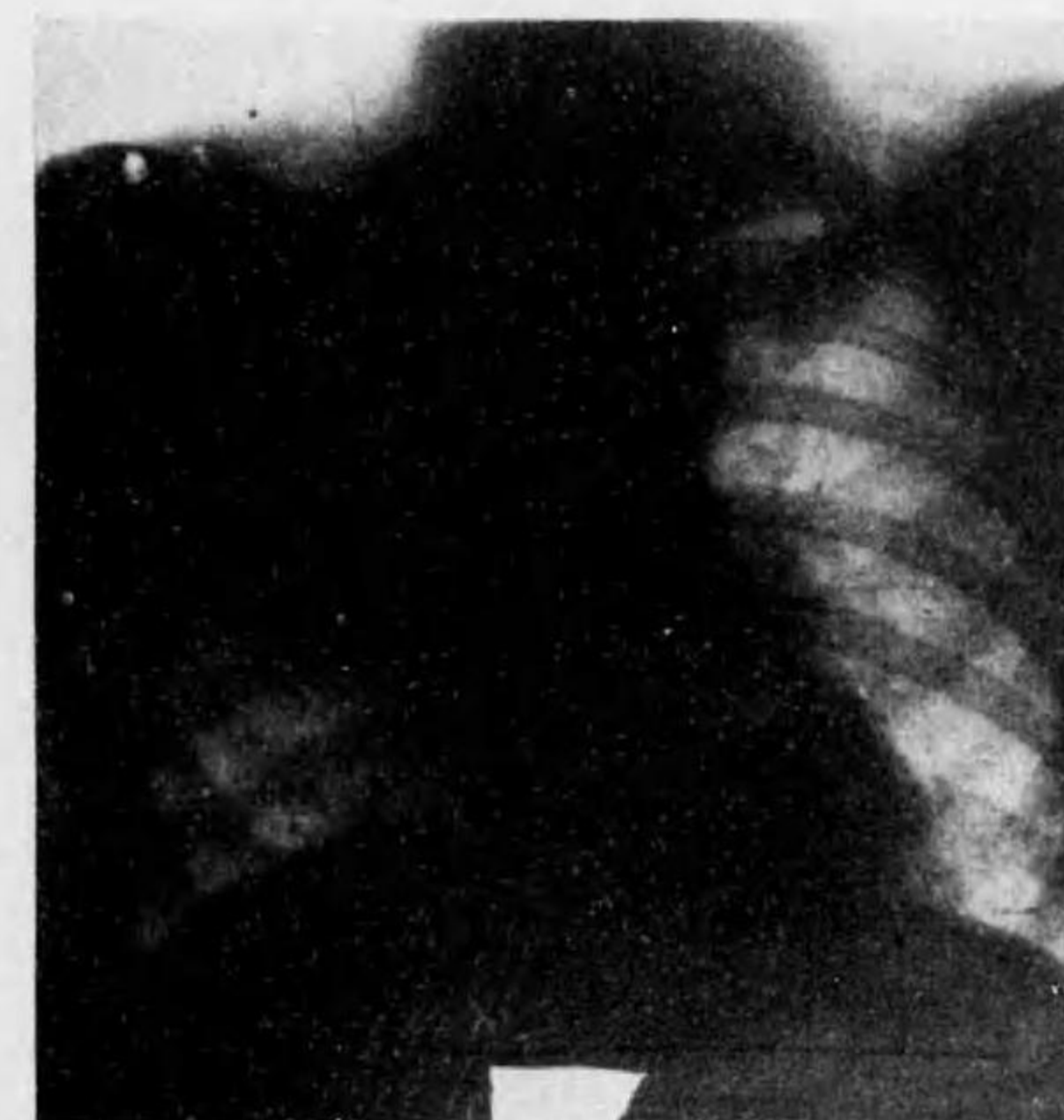


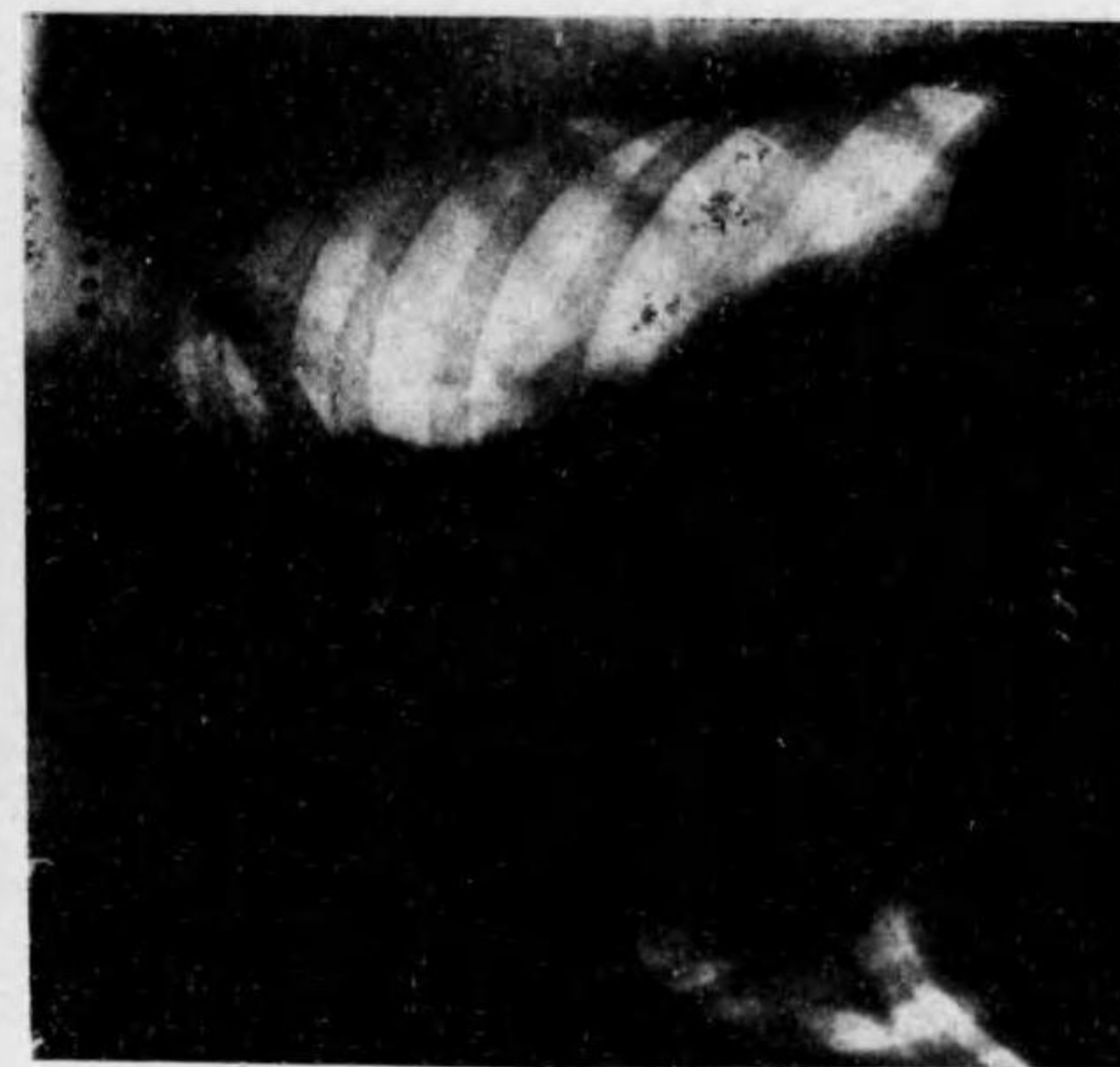
FIG. 210, Case XXXI, 5 months after last picture, or two years after the onset of the disease. Almost similar to previous pictures. Compare with Fig. 121-127.



Case XXXII, Fig. 214, erect, Jan. 10, '21. definite pneumonic shadow; suspicious cavity "tailed cirrus" cloudiness in rt. lower suggestive of the lesions if not epidemic influenza. No thickened pleura at base, which was due to poor film in Fig. 212.



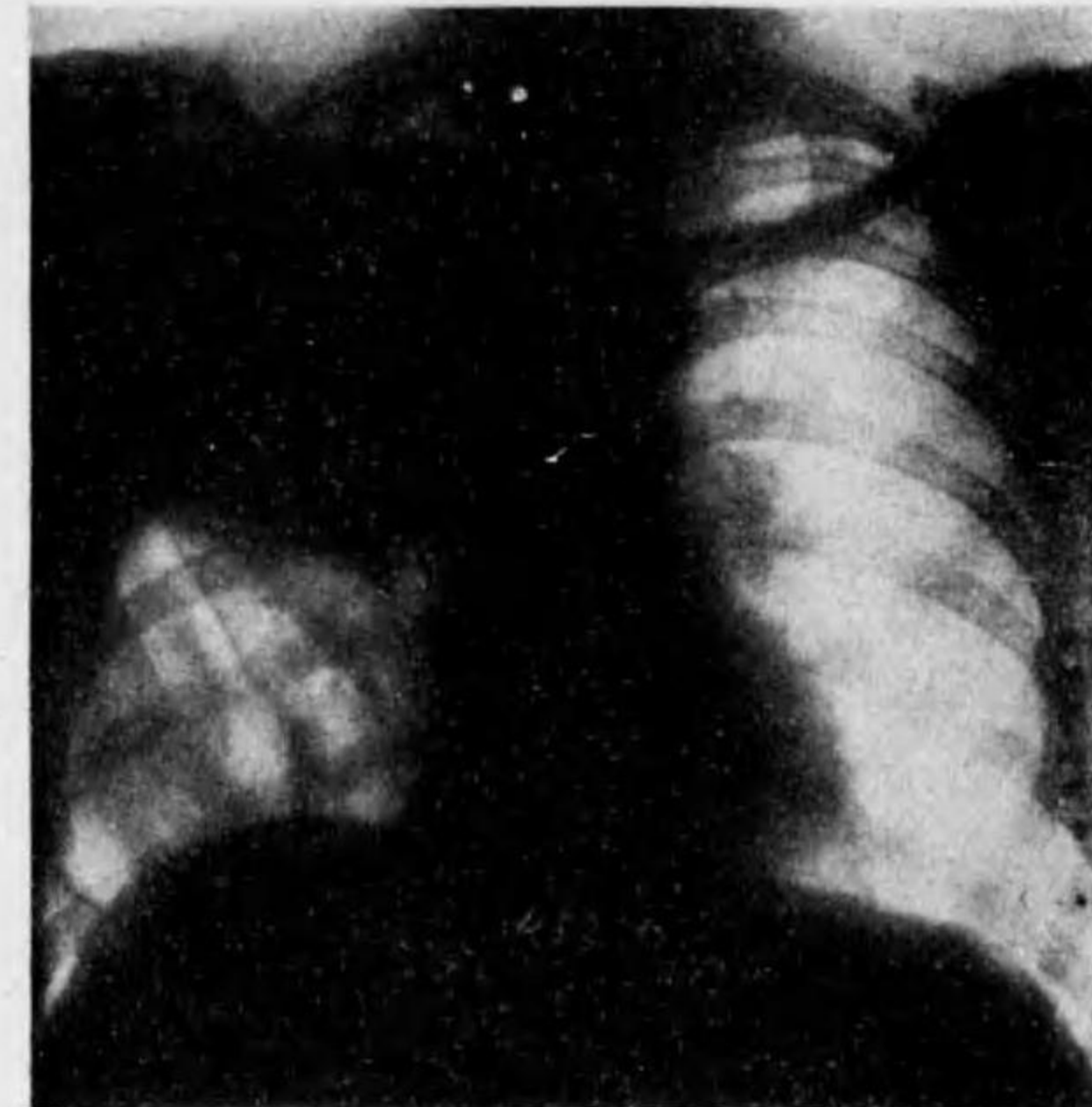
Case XXXII, Fig. 215, erect, 1/13/21. Similar to previous, except more spotted infiltrations. For nearly one year repeated sputum exam. were negative.



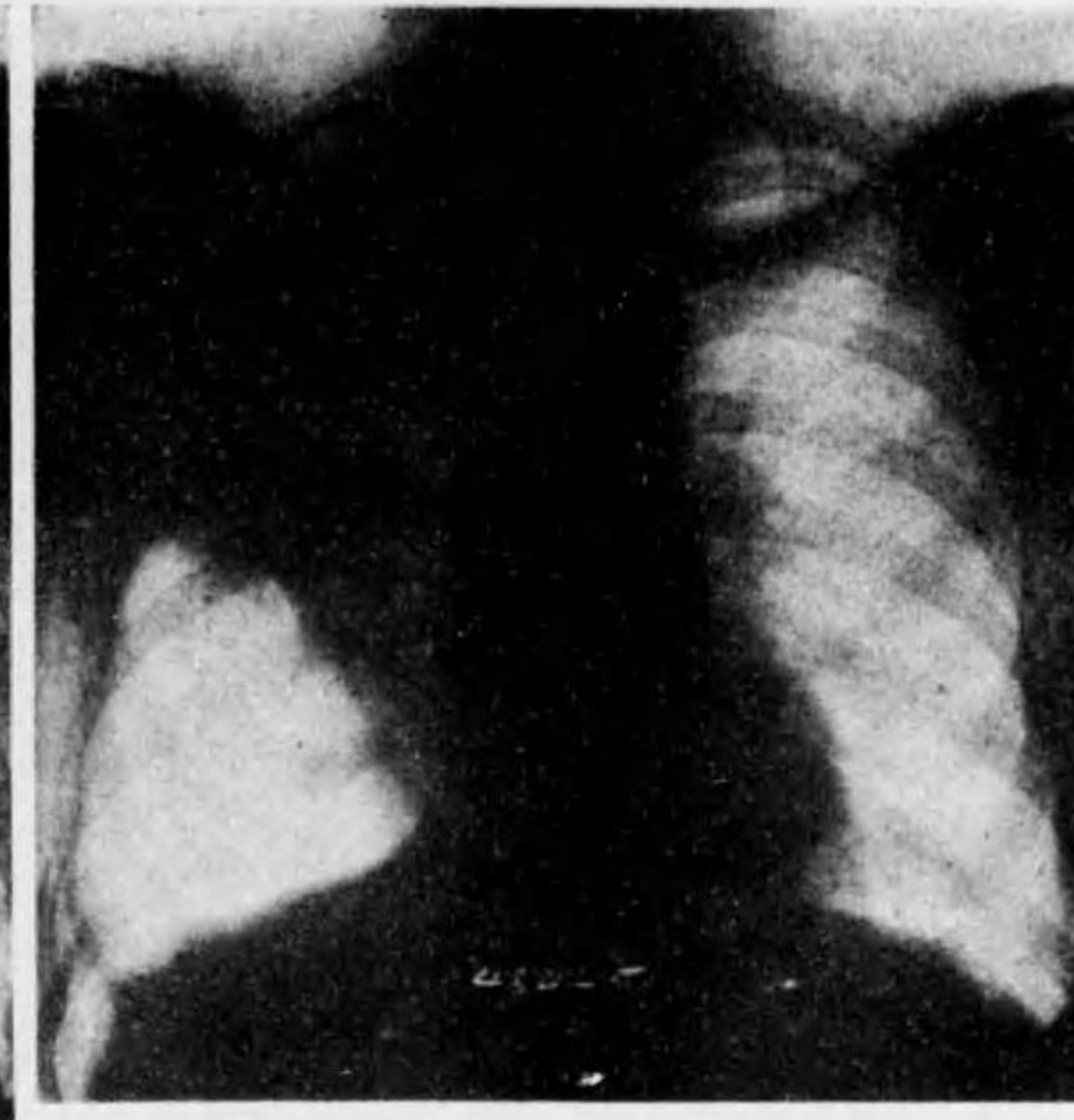
Case XXXII, Fig. 216, erect, 1/17/21. Similar pneumonic area, a few small caviations, result of A. P. T.



Case XXXII, Fig. 218, erect, 1/25/21. Similar pneumonic shadow, increased pneumothorax, etc. See text.



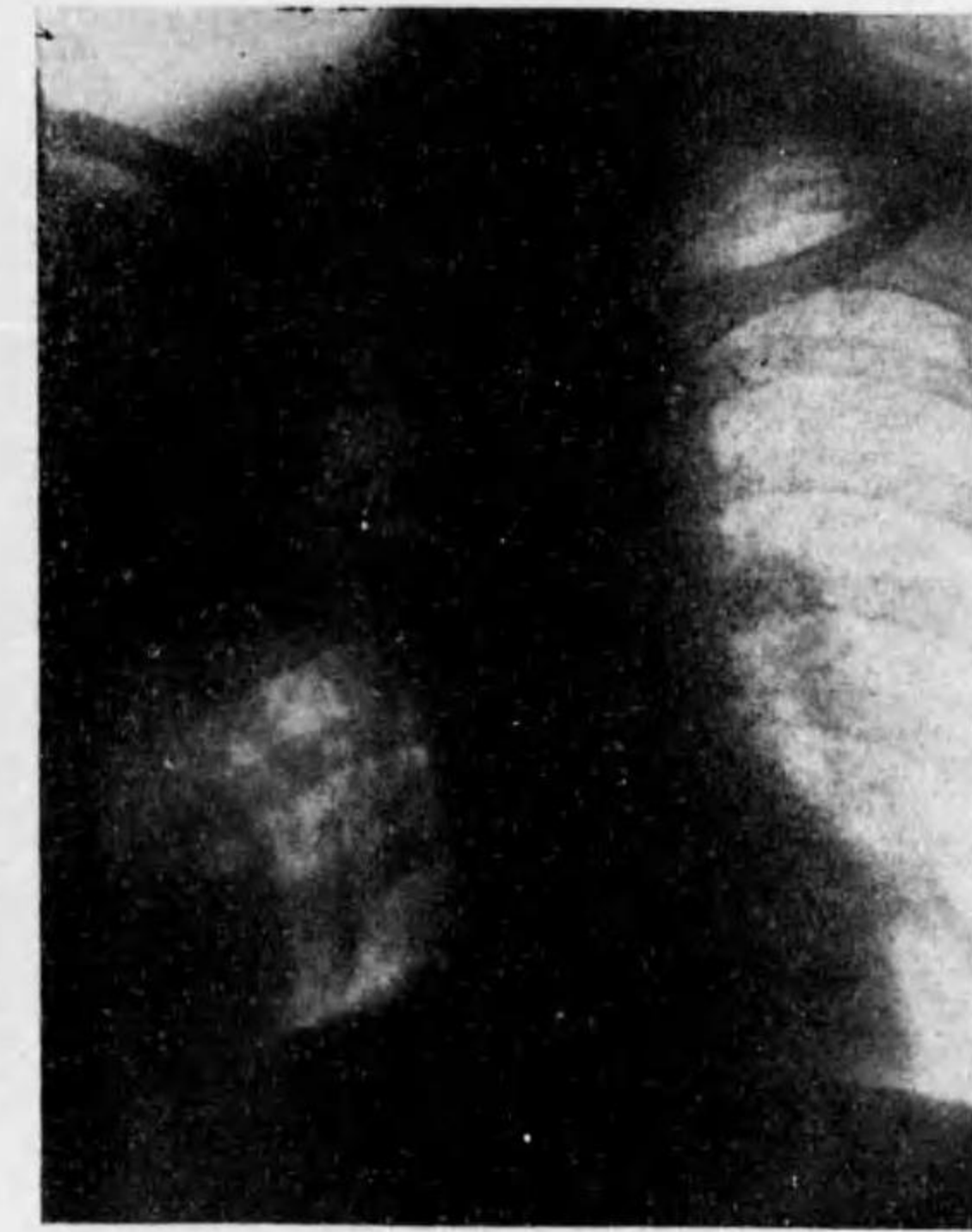
Case XXXII, Fig. 219, Prone, a month later. Still similar pneumonic shadow with several cavities with ragged walls; more amount of air with adhesions.



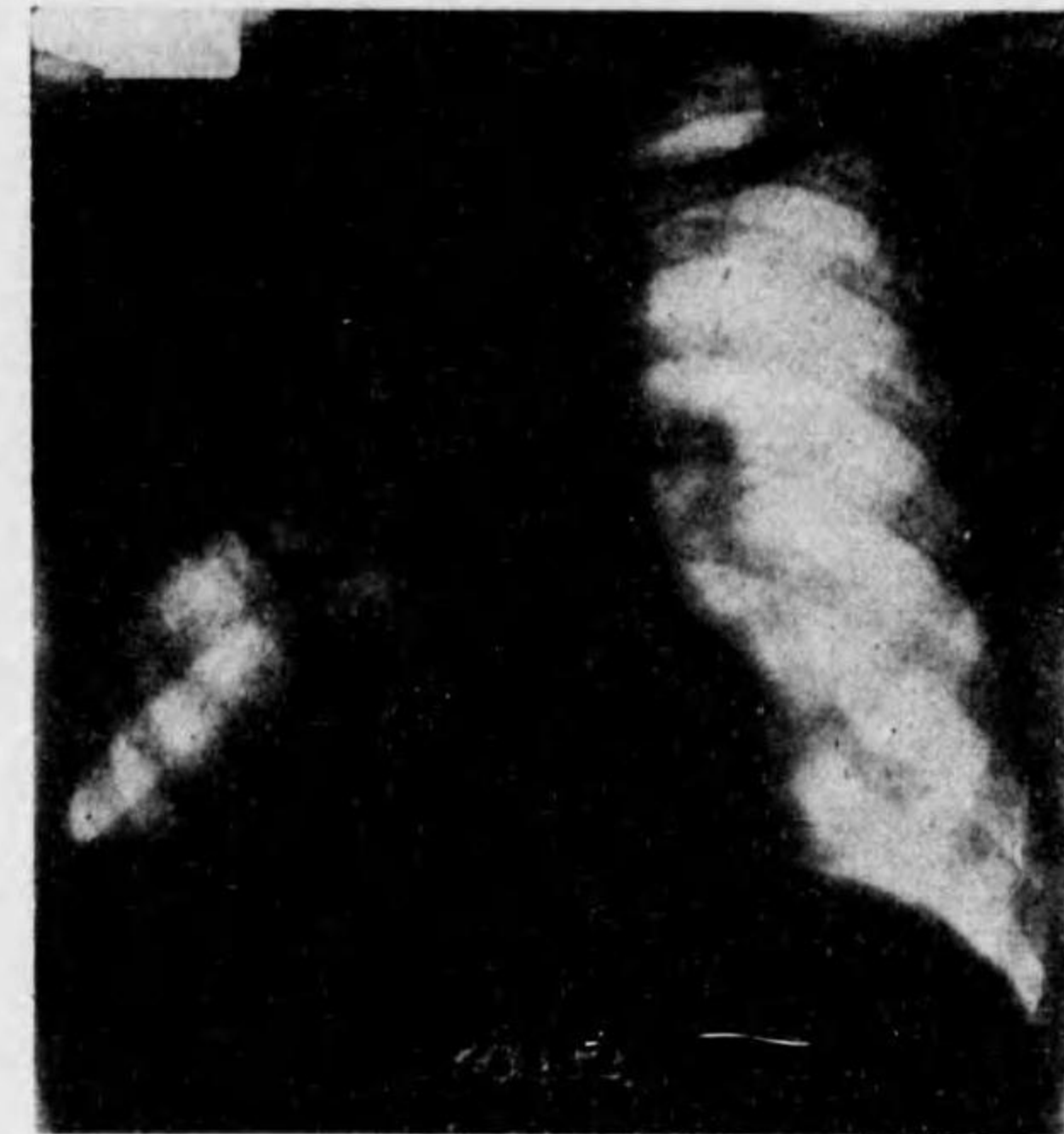
Case XXXII, Fig. 221, erect, 3/10/21. A large empty cavity now seen below the clavicle. Adhesion at rt. costo-phrenic angle.



Case XXXII, Fig. 220, erect, 3/7/21. Same pneumonic shadow with large pneumothorax. Adhesion with small amount of fluid at rt. costo-phrenic angle. Left lung markings increased, especially at root, may be due to engorgement.

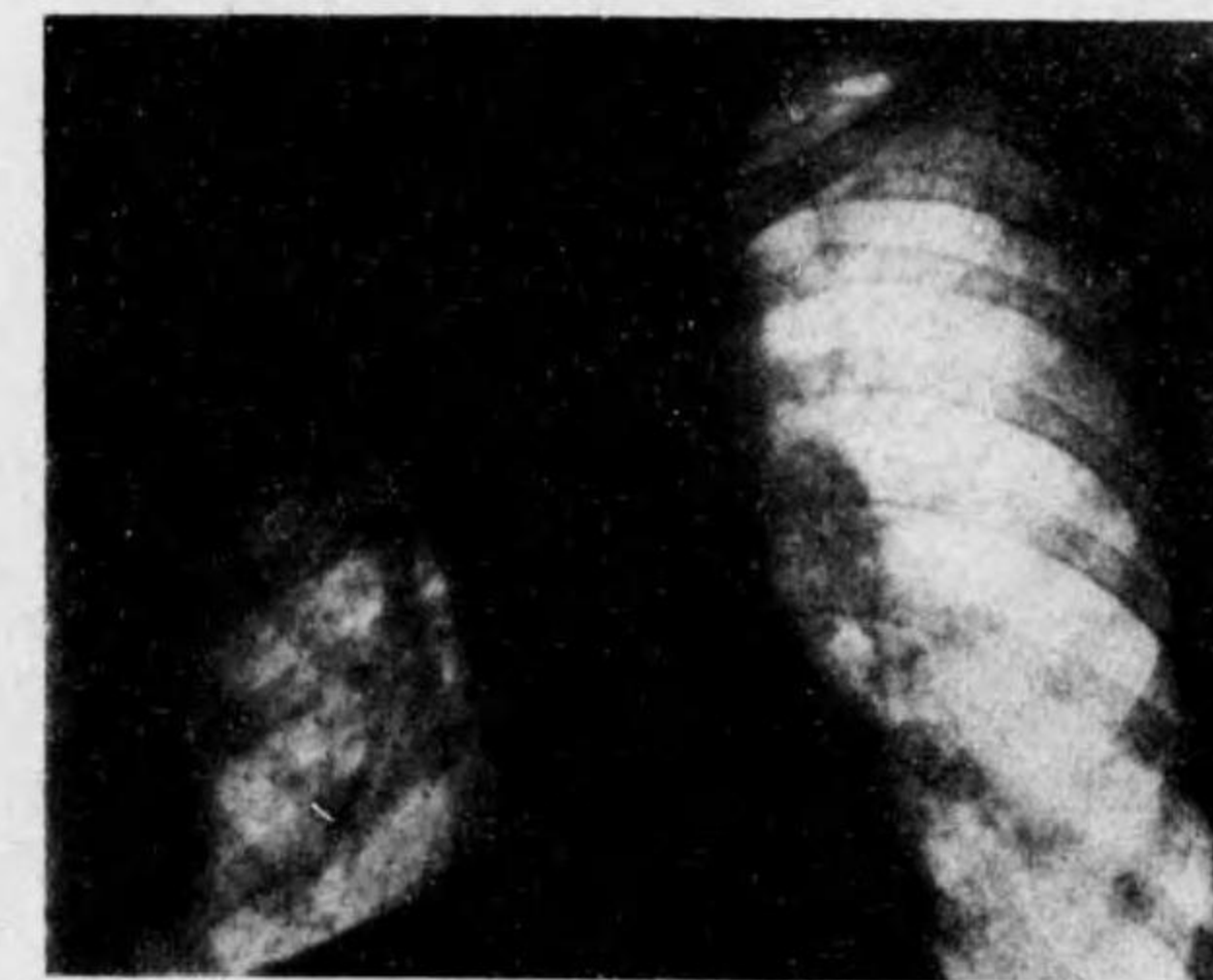
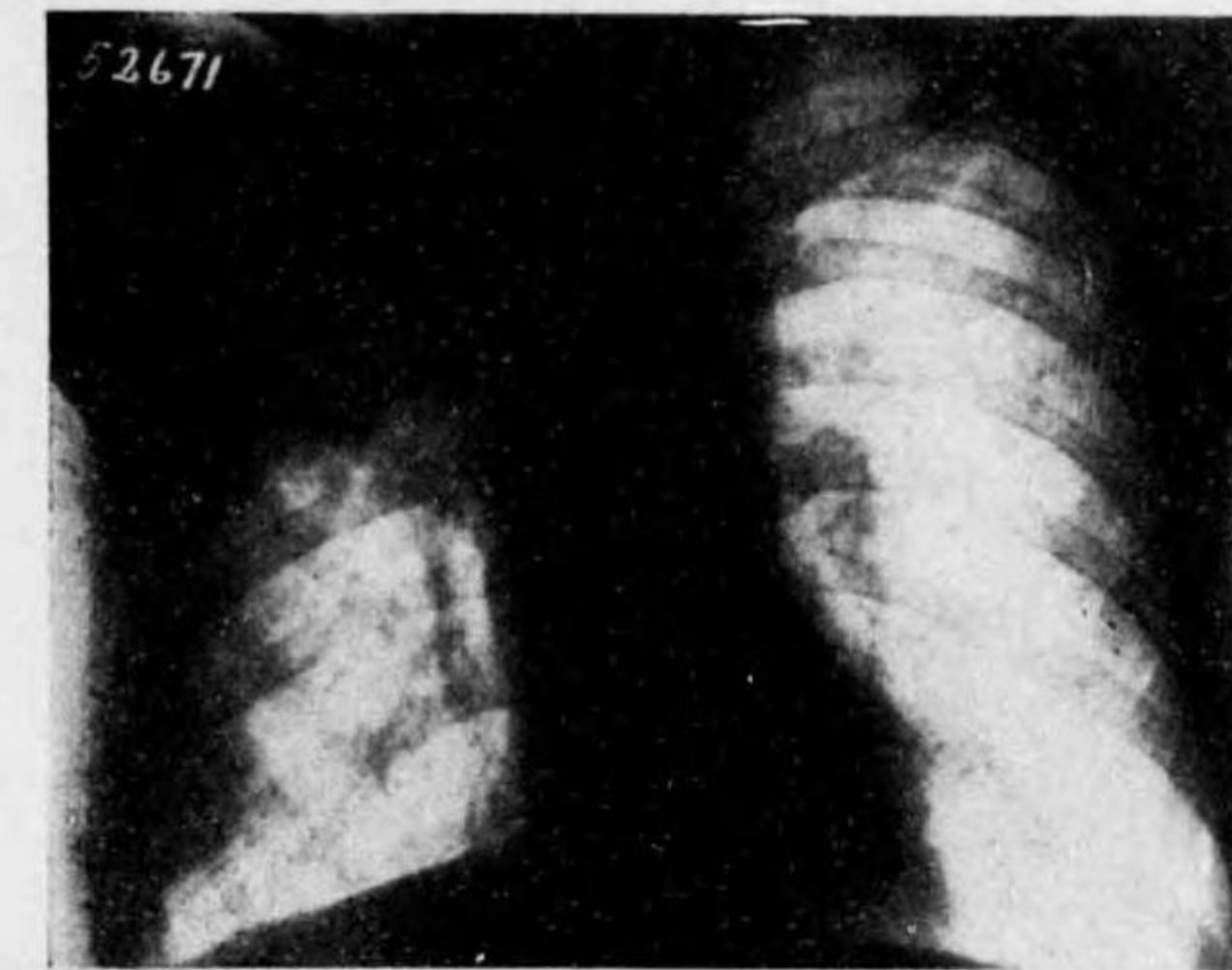


Case XXXII, Fig. 224, erect, 7/7/21. Shadow now quite fibrous, except peripherally where it is hazy due to thickened pleura and adhesions. Many cavitations, lower lung re-expanded. Sacculated pleural fluid at rt. costo-phrenic region.

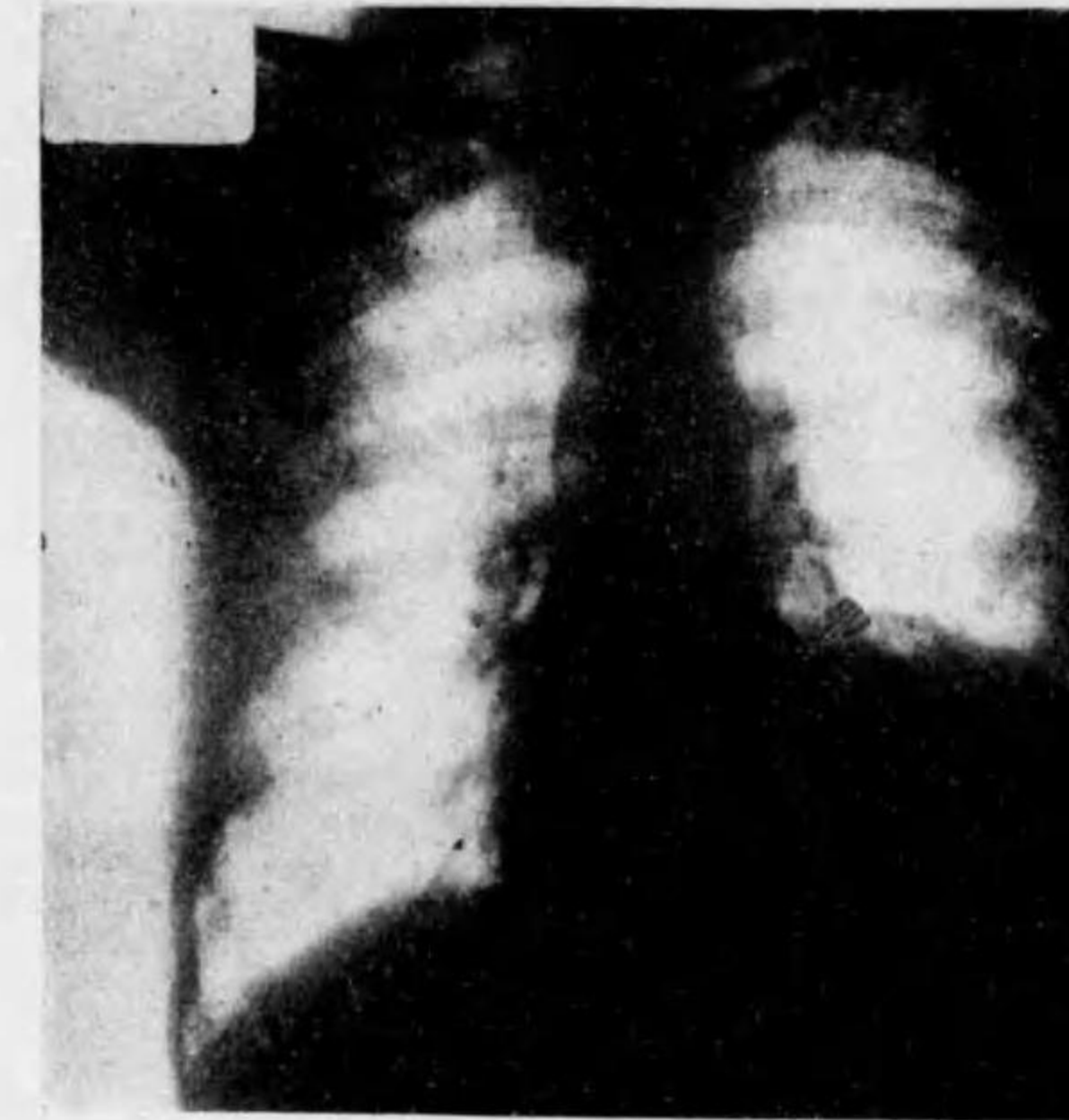


Case XXXII, Fig. 223 erect, 4/6/21.
Similar shadow with definitely lobulated
cavity. Fluid level at base.

Fig. 227-a, Case XXXII, a week
after the last, in erect position.
Similar as before. The upper lung
field appears more fibrous and
pleura thickened.



Case XXXII, Fig. 226, erect,
12/6/21. Diffuse haziness in rt.
upper, "fibro-cirrus" cloudiness
in lower portion, and sacculated
hydro-pneumthorax.



Case XXXIII, Fig. 228. Man aged 26. Had chronic bronchitis since age of five. In 1912 had tonsillectomy, which was followed by empyema, operated; in 1915 resection of rib for lung abscess. This film was taken on 6/9/21.

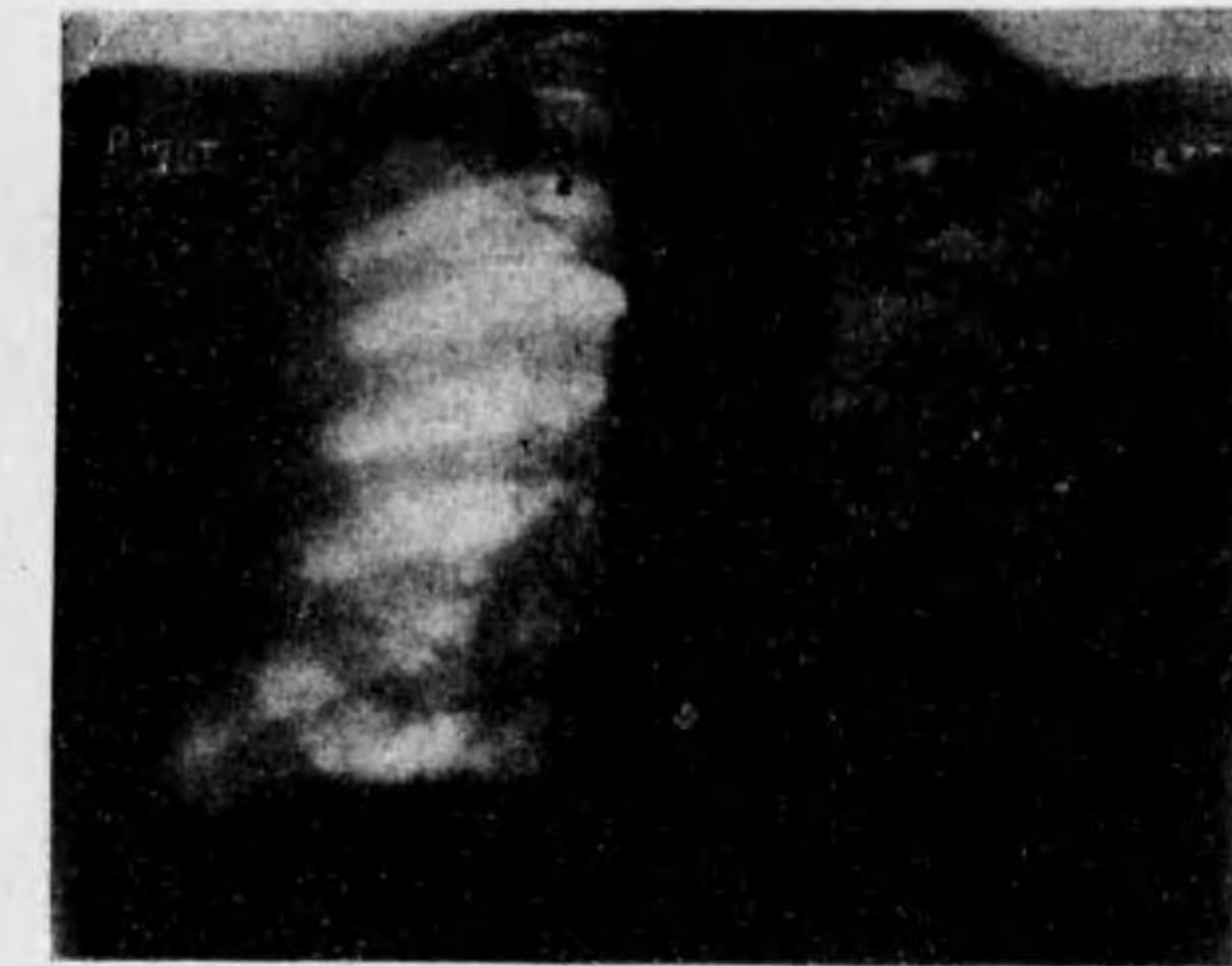
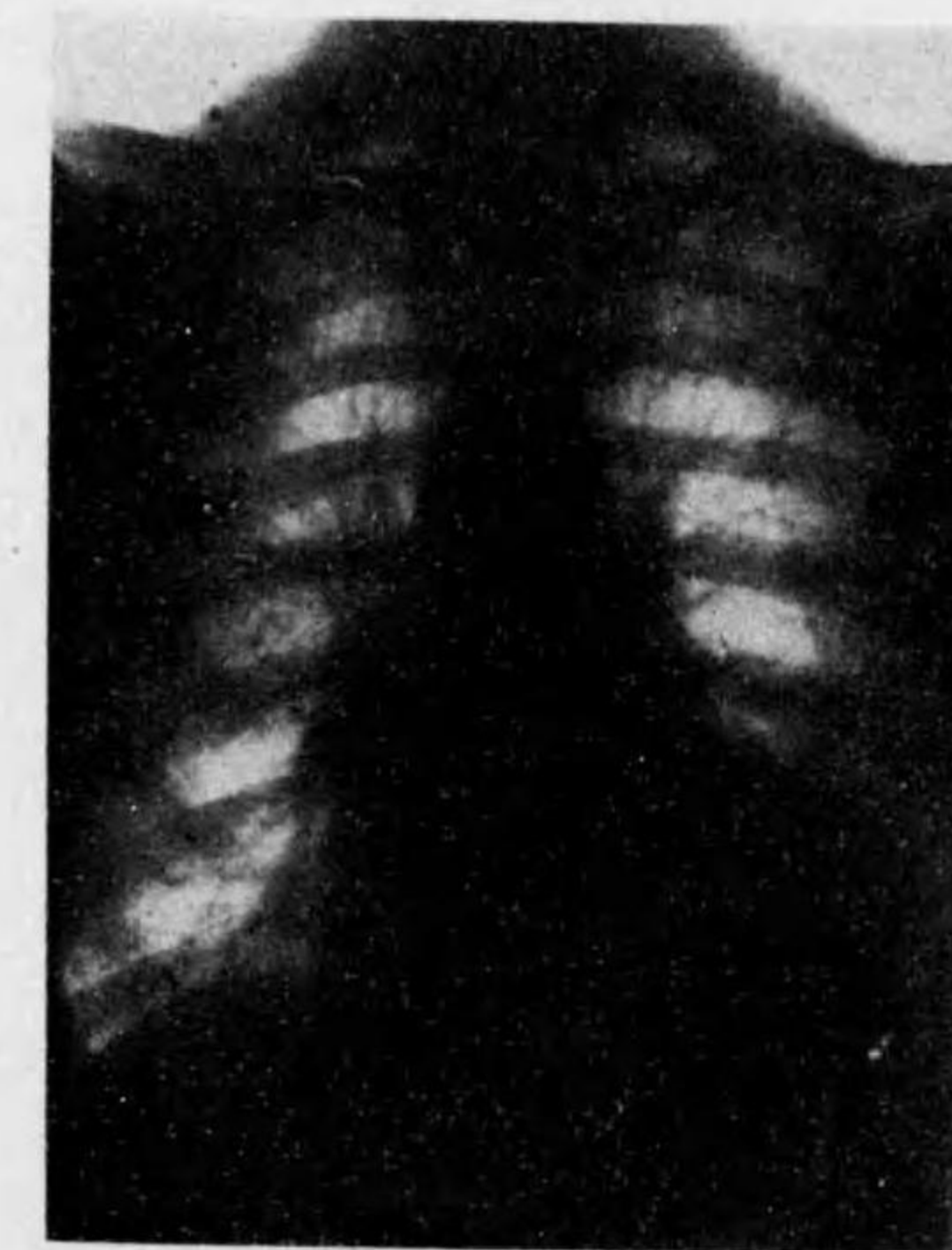


Fig. 231, Case XXXIV. Patient, alcoholic, aged 58, began with subacute cough and expectoration, which was later followed by dyspnea and fever. X-ray taken in erect position, 7/3/24.



Case XXXIII, Fig. 230, June 10, '21. Erect, after Artificial pneumothorax without result due to dense adhesions.

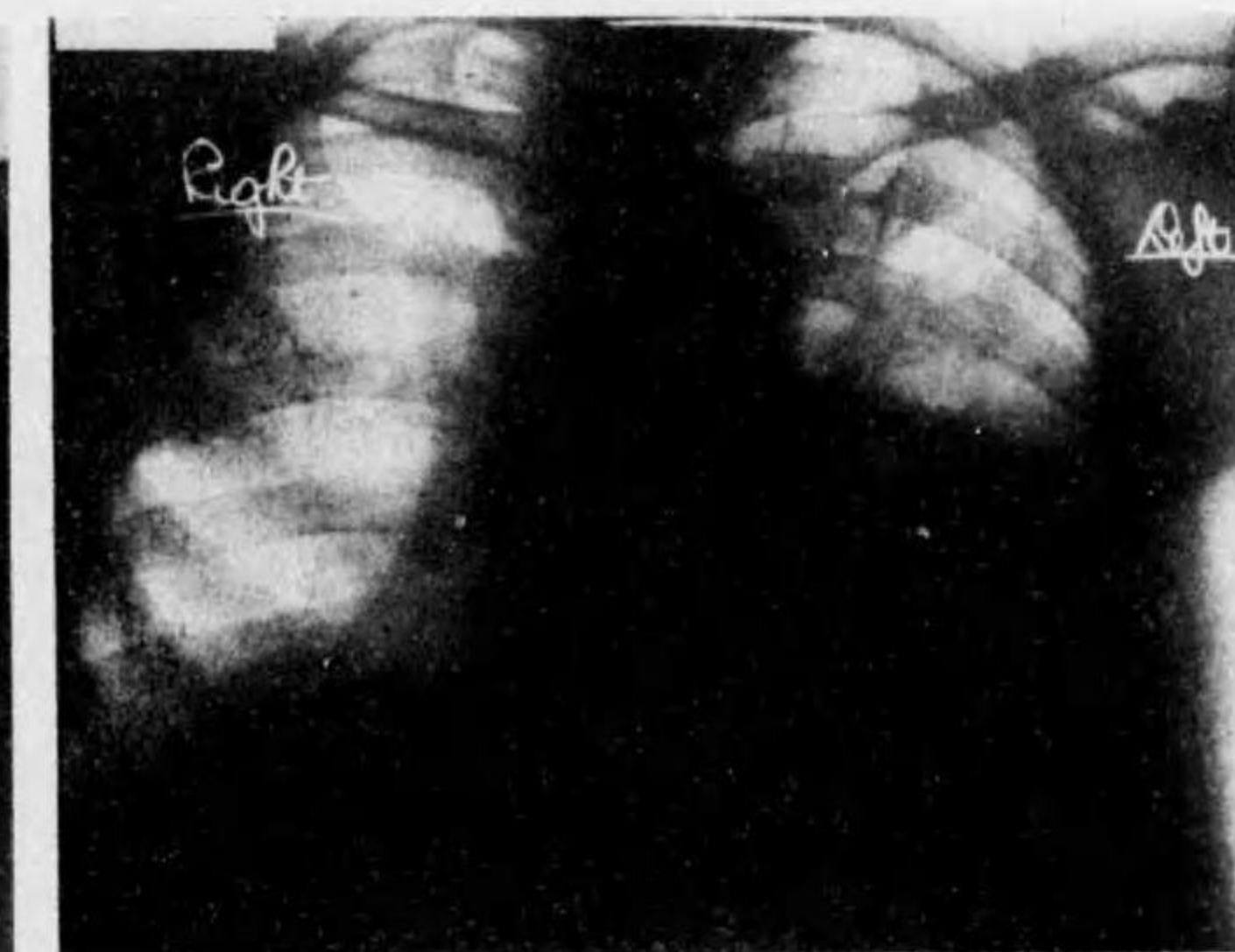
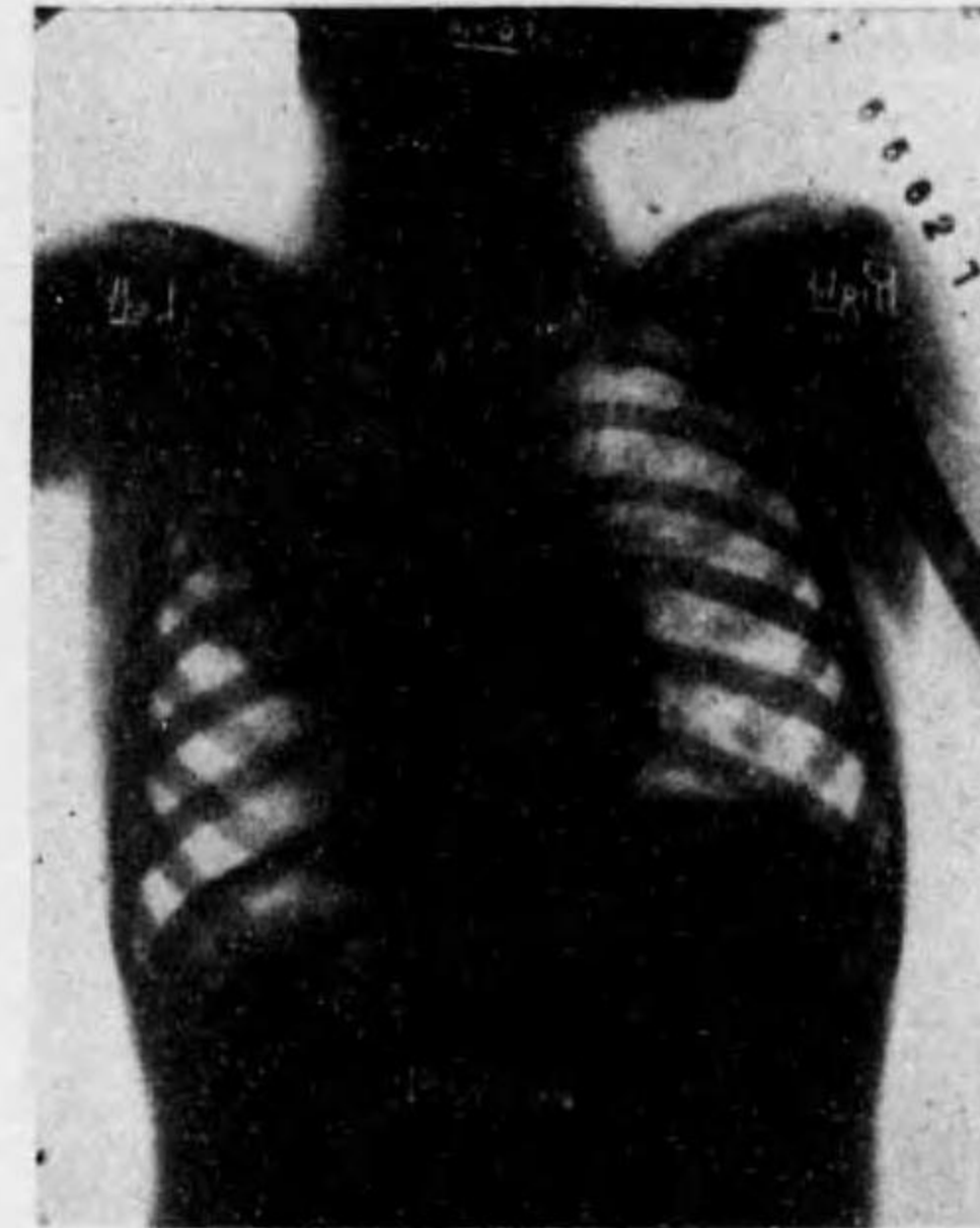
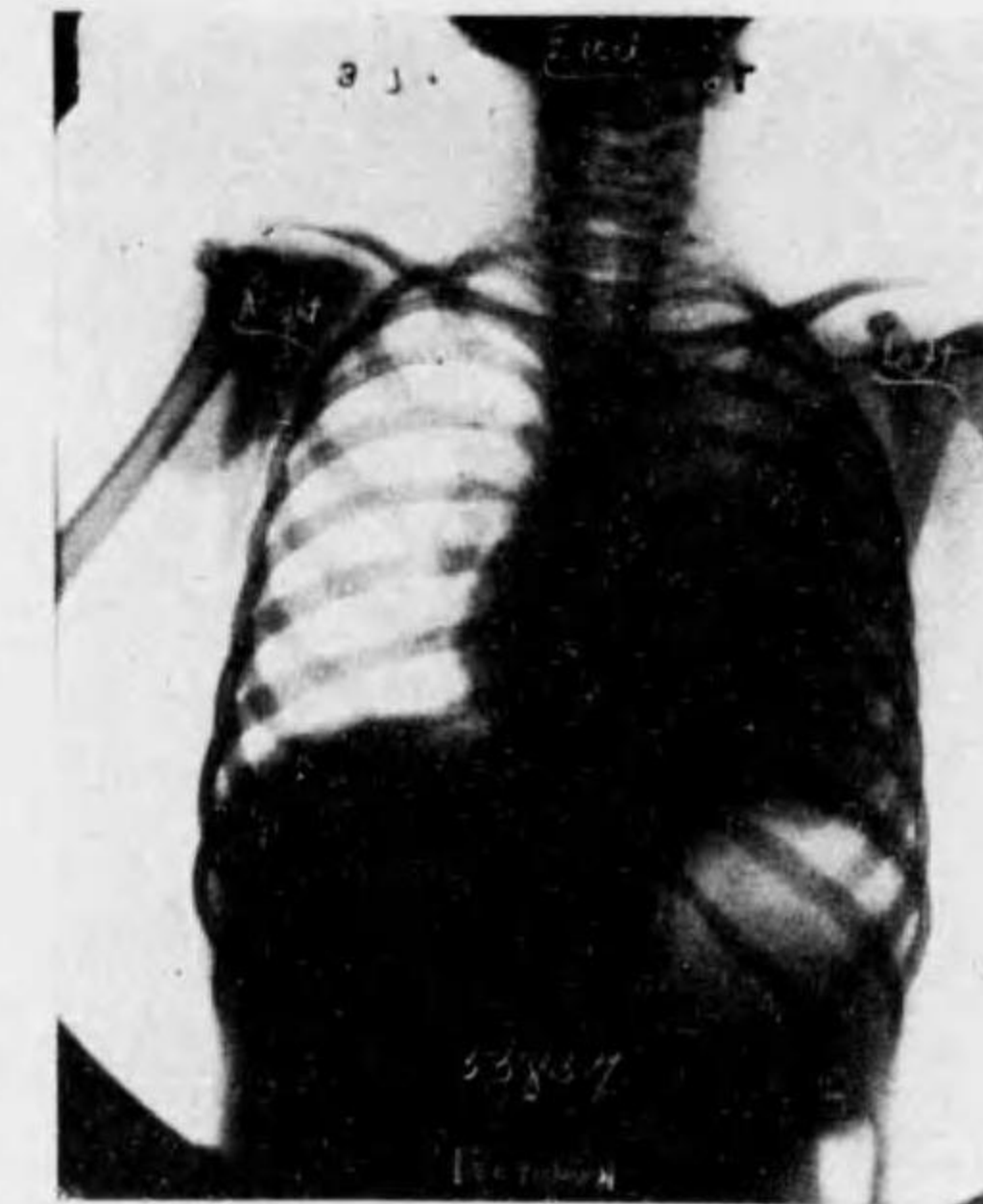


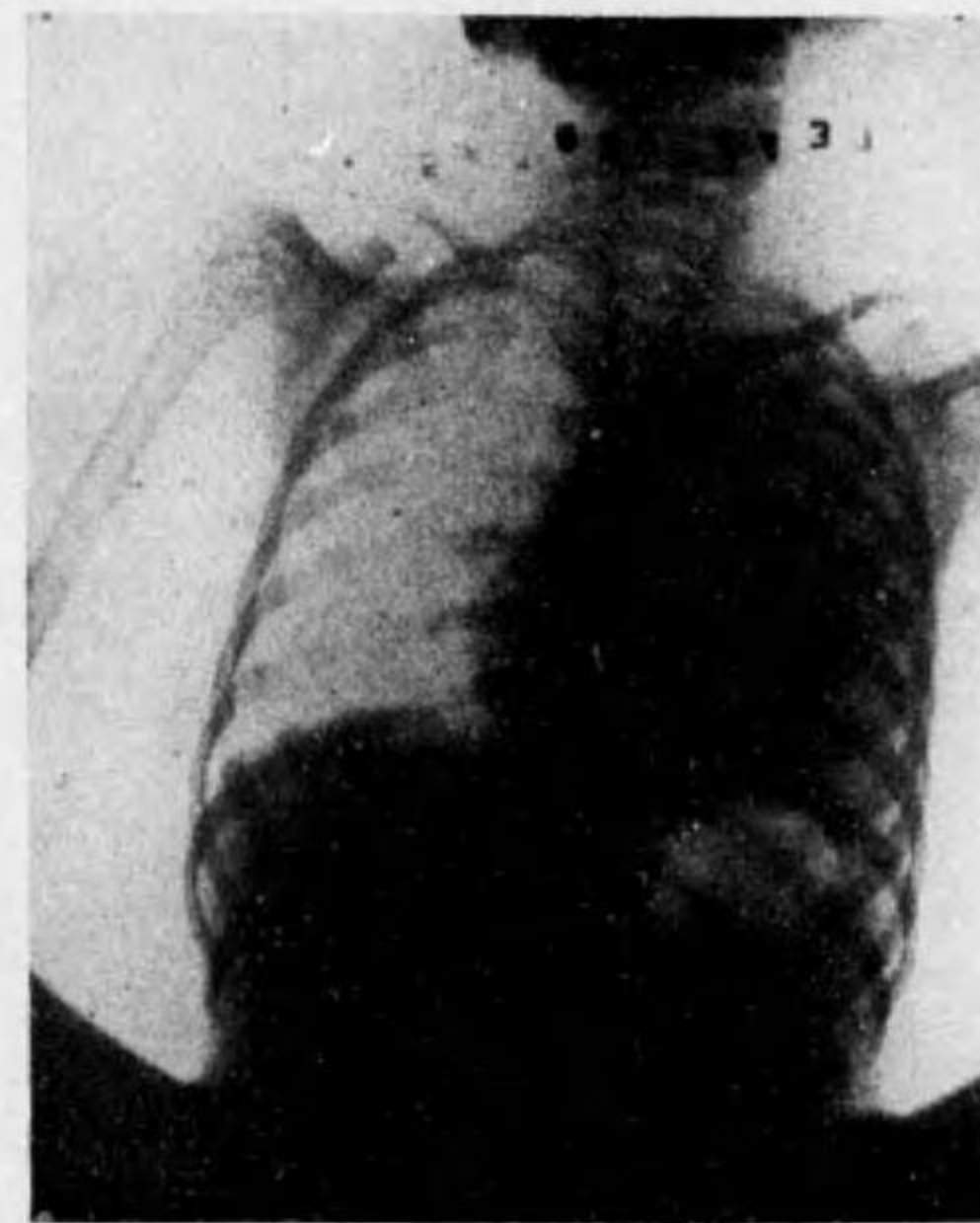
Fig. 233, Case XXXIV. taken a week after the last picture.



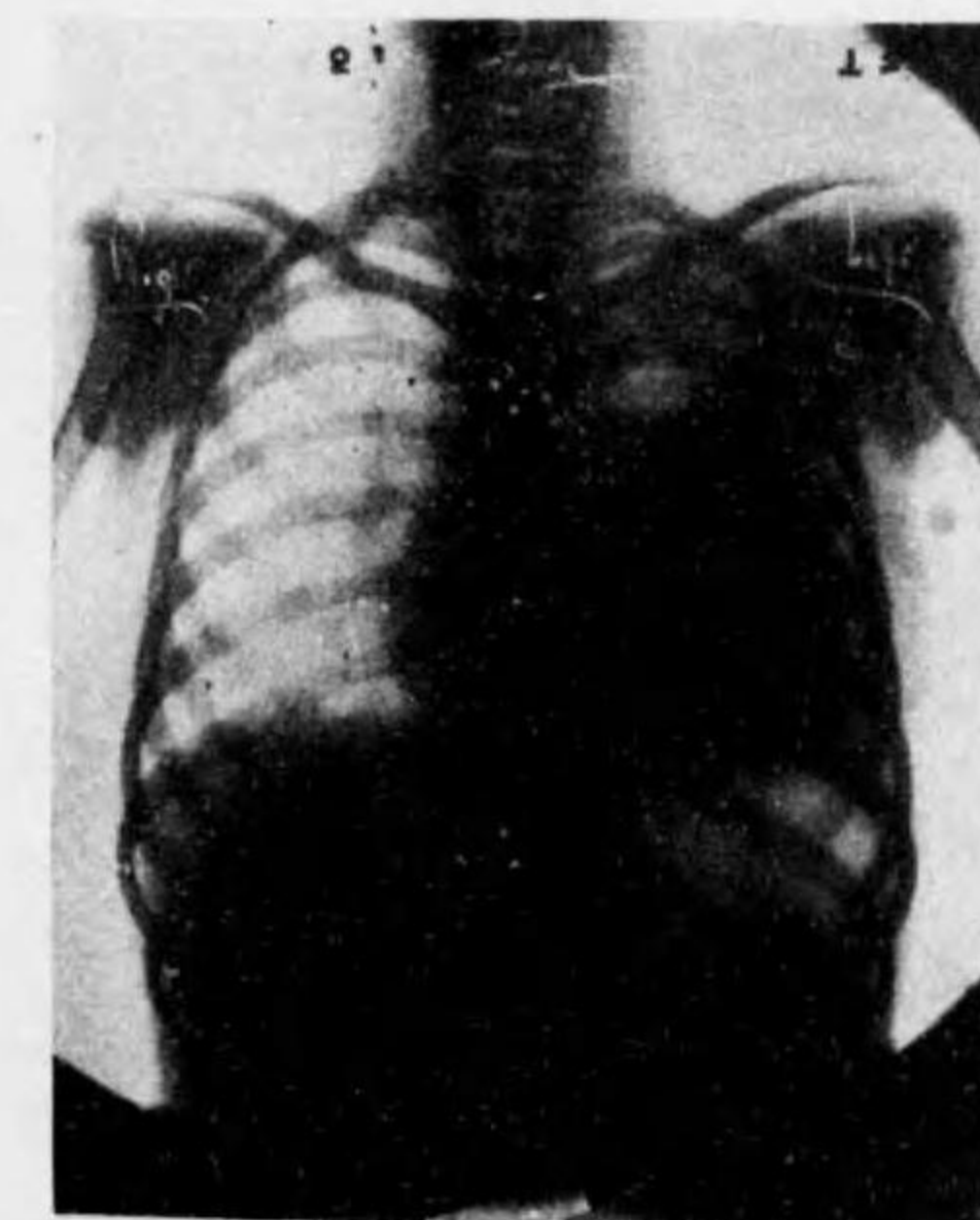
Case XXXV, Fig. 235, June 13/22. Explained in Fig. 236. Three months ago pt. had acute pneumonia on the rt. lung with slow recovery; then had another acute involvement on the left side which rapidly formed abscess.



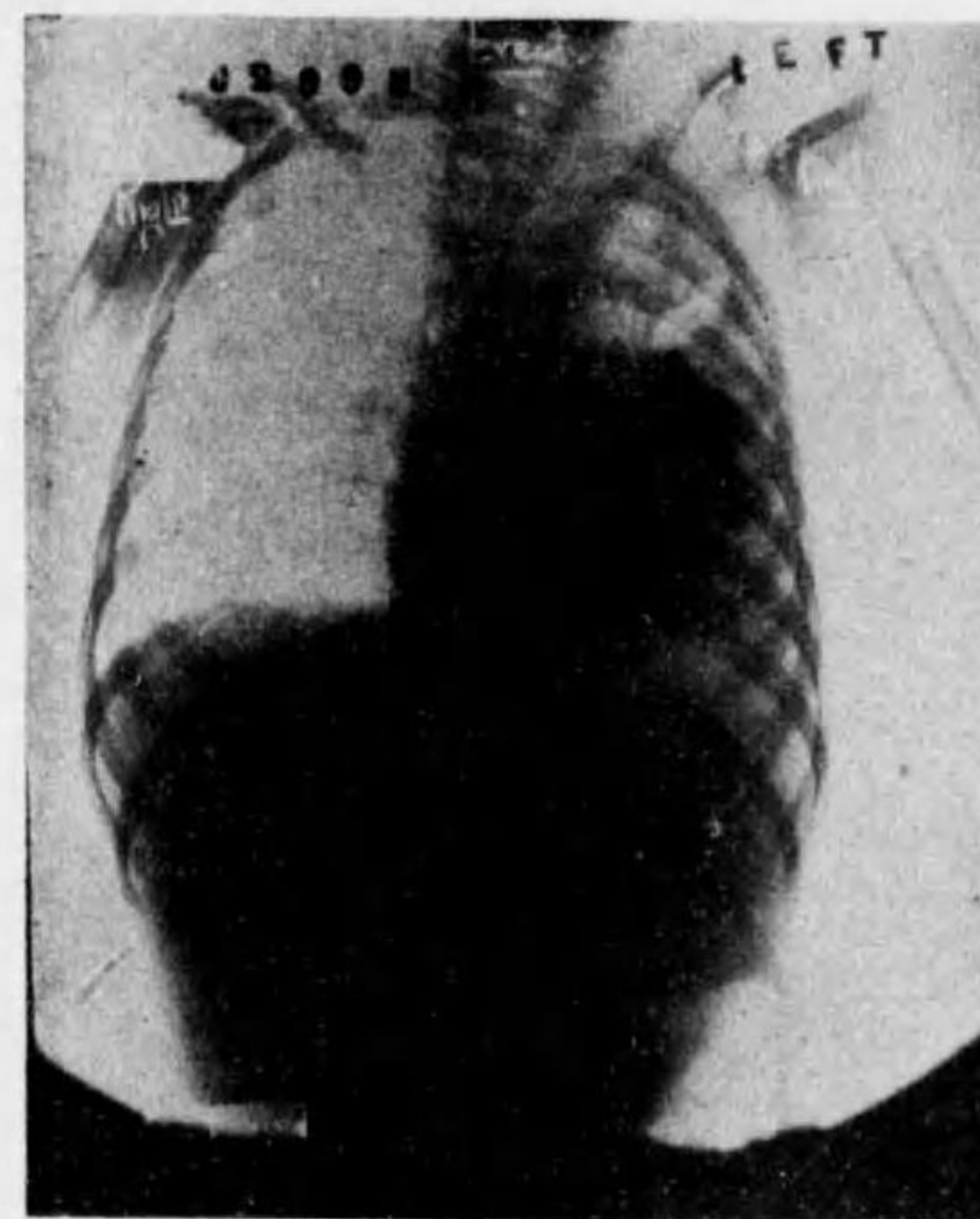
Case XXXV, Fig. 239, 6/26/22. Erect. See Fig. 239, 6/26/22. Erect.



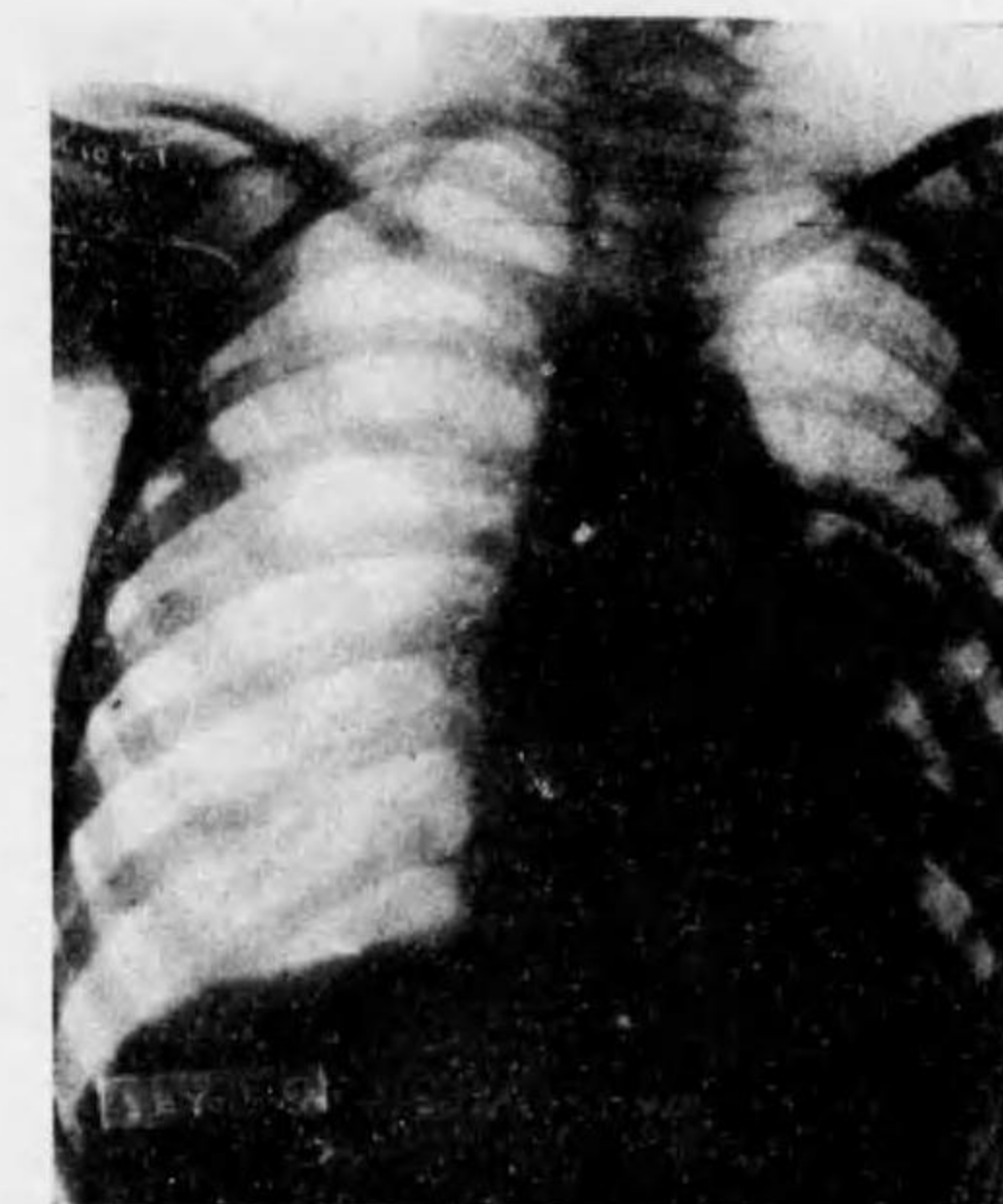
Case XXXV, Fig. 237, 6/21/22.



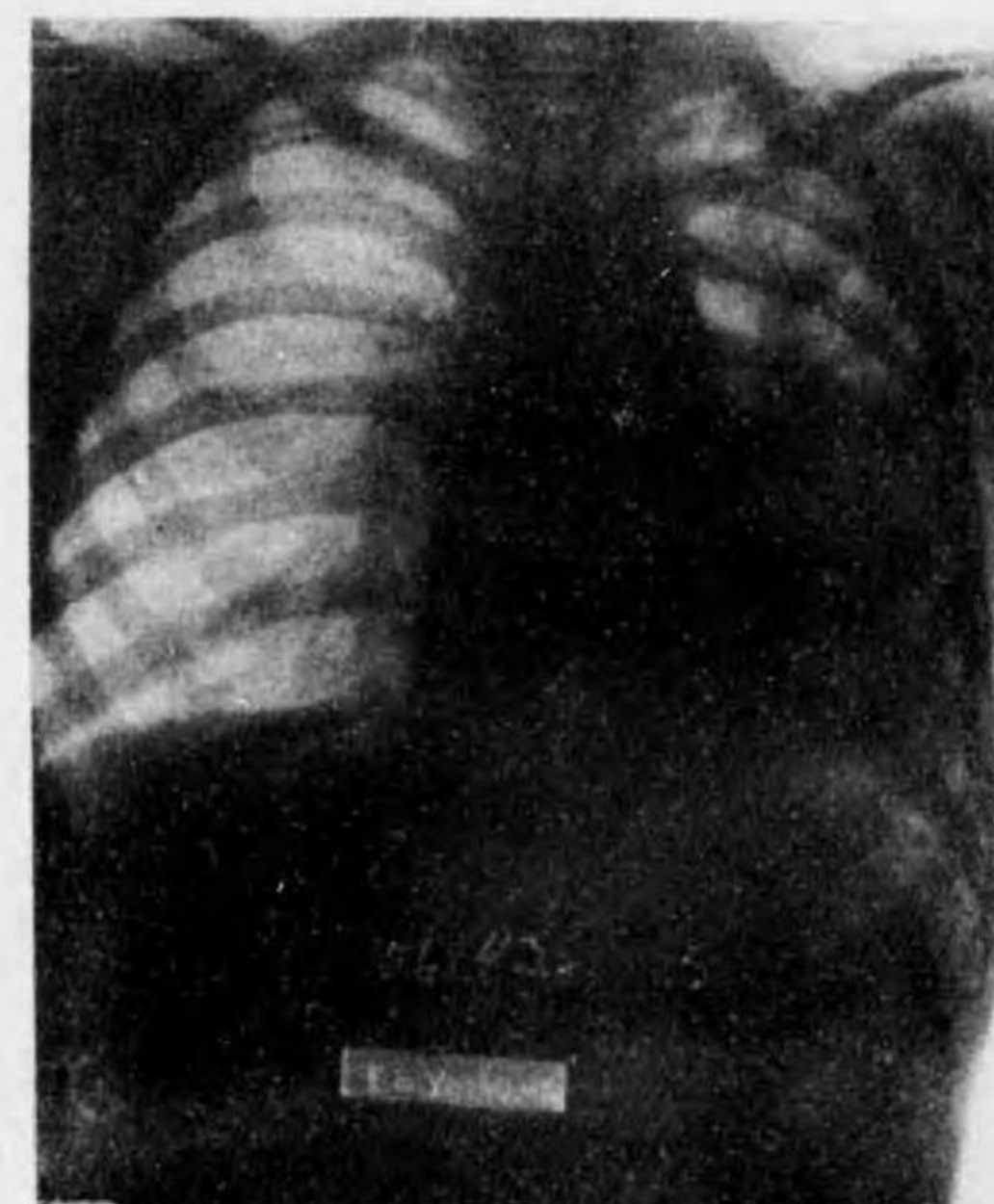
Case XXXV, Fig. 241, taken in prone position, 7/7/22. After operated.



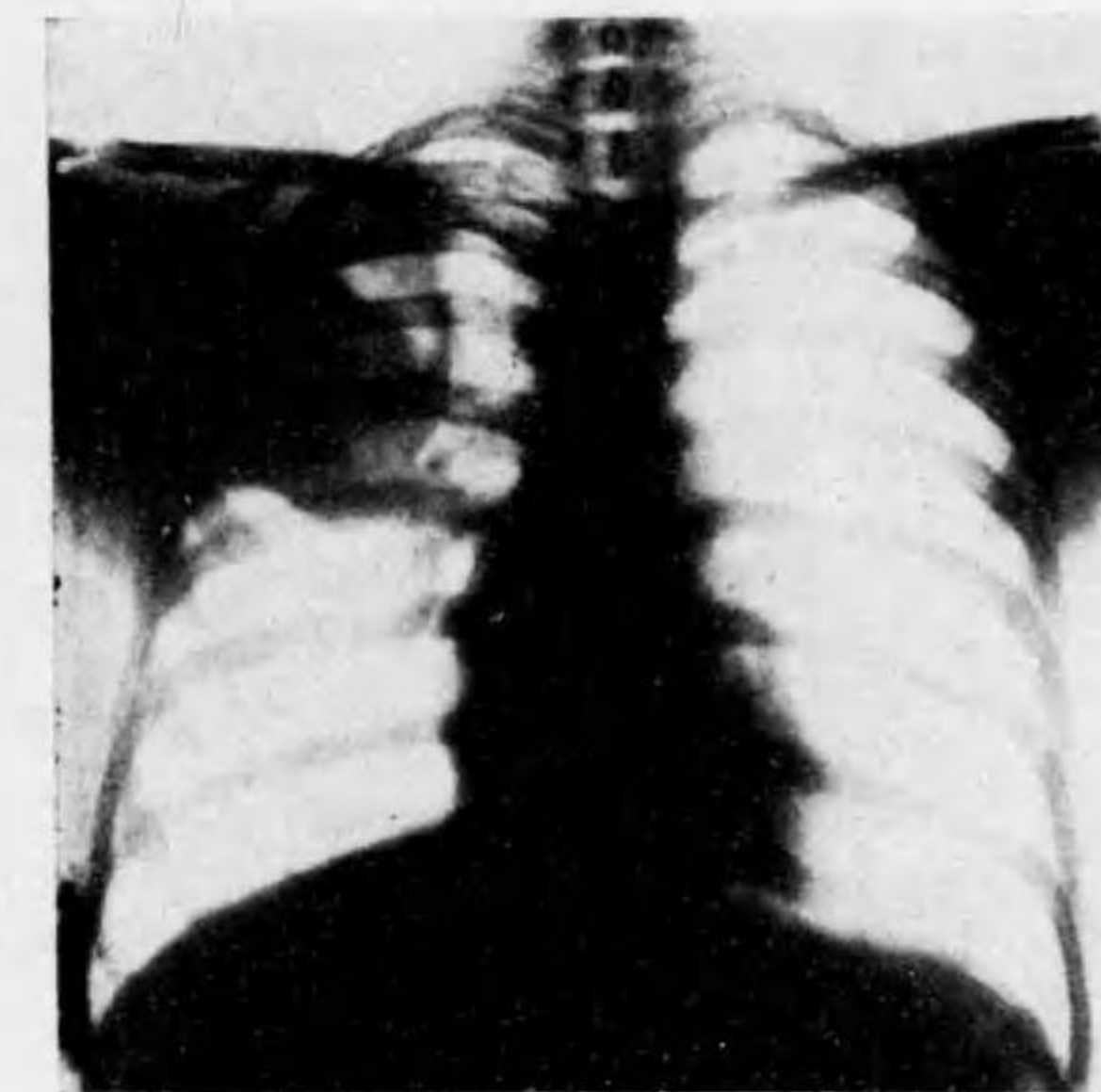
Case XXXV, Fig. 243, 8/7/22.



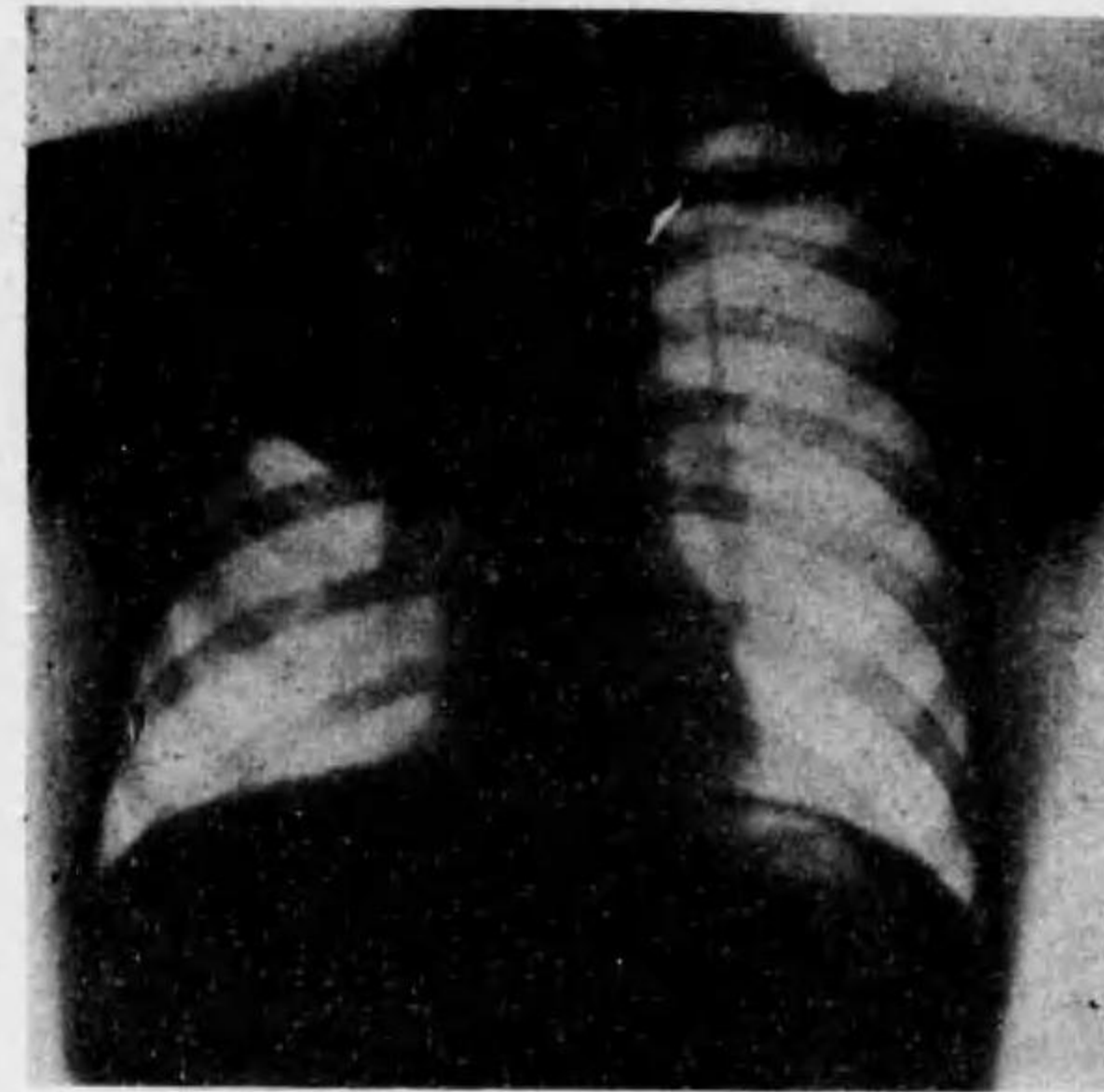
Case XXXV, Fig. 247, Taken over a year since last picture, 11/5/23. In erect position.



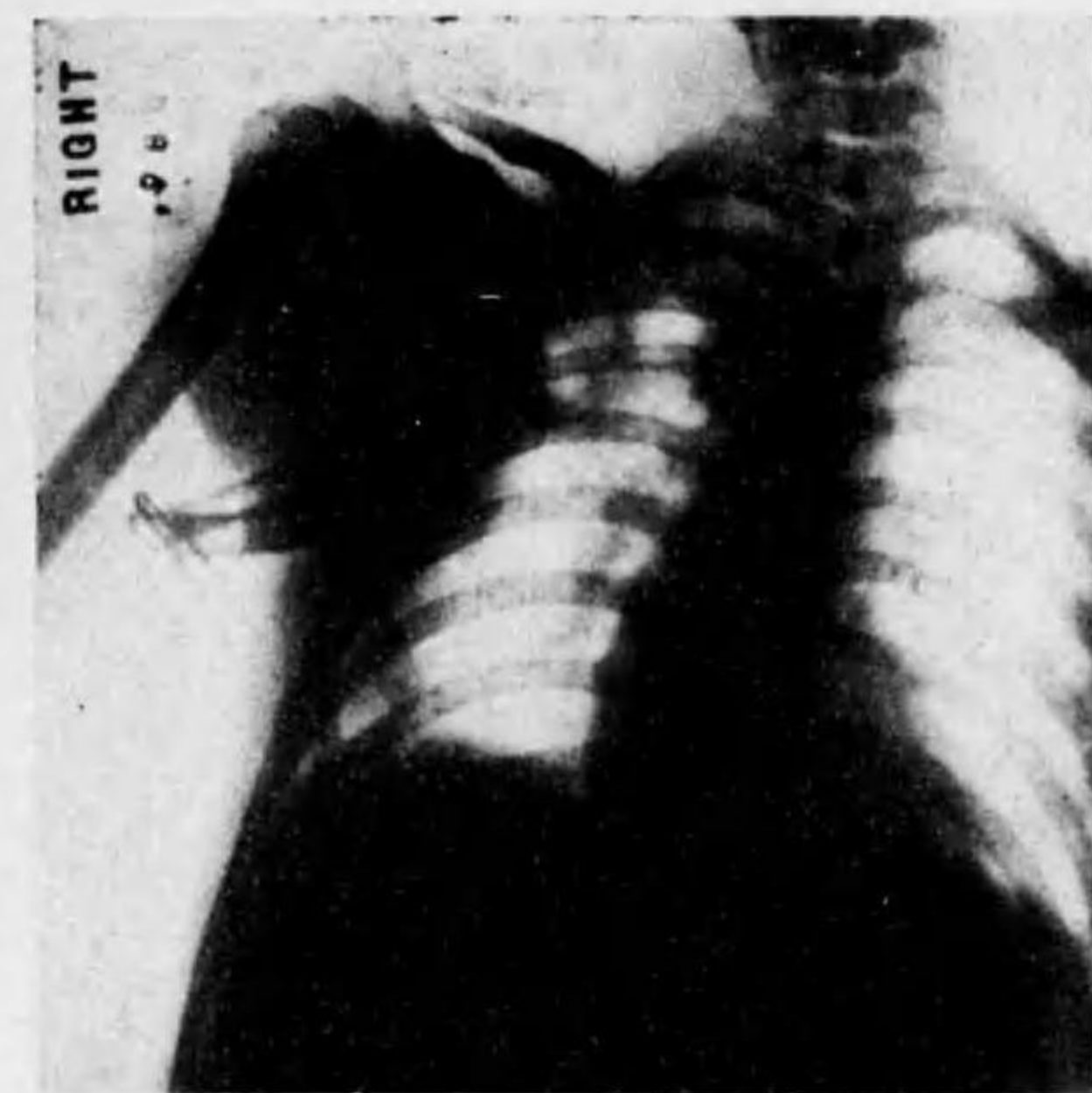
Case XXXV, Fig. 245.



SUPPLEMENTARY CASE. Fig. 255 Jan. 20th, 1926. Erect, antero-posterior position. A dense shadow in right upper axillary region, consisting of a hollow cavity above and a dense infiltrating area of triangular shape below. Some aerated lung tissue between the cavity shadow and the mediastinum; the lower lung field is well aerated; right apex hazy. No pathology observed in the left lung. See the text.



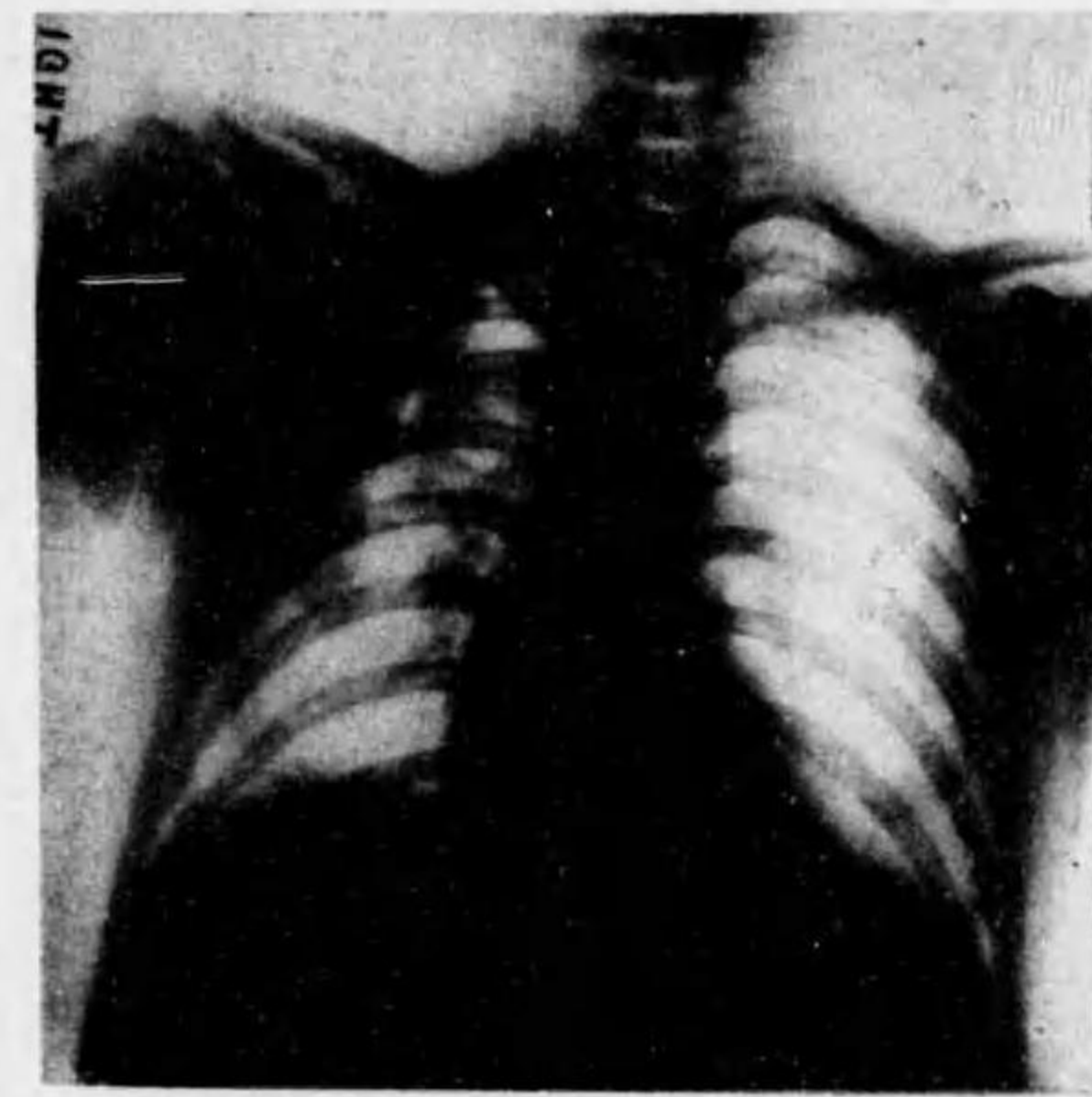
SUPPLEMENTARY CASE; Fig. 256. Taken 9 days after in erect position. Presents the similar picture, but the shadow has extended medially, cavity is larger containing definite fluid level and it is more definitely walled off. The lower lung field is uninvolved. Both costo-phrenic angles are clear.



SUPPLEMENTARY CASE: Fig. 258 Taken erect on 2/13/26, or 9 days after operation. Now only a small faint shadow of the cavity is left with much diminished surrounding infiltration. The hilar shadows are accentuated; the haziness at right apex is probably due to thickened pleura. The rest of the lung fields appears normal.



SUPPLEMENTARY CASE: Fig. 257. Lateral erect position taken on Feb. 3rd, 1926. Complete ebonization in upper extremity and a region shortly below. The lower density has shape of flattened out triangle with straight base above and apex pointing downward. Between the two shadows there is an arch formation indicating the upper wall of the cavity. There is a zone of aerated lung tissue between the anterior thoracic wall and the cavity shadow, which extends as far back to the posterior wall. Costo-phrenic angle is clear.



SUPPLEMENTARY CASE: Fig. 259. Taken on the same day as Fig. 258, but after the tube drains were removed. It shows much diminished density at axilla, and faint gaps where pieces of ribs were removed. Patient was off bed on the 14th day after the operation, and now raising practically nothing and the temperature is flat (Feb. 26th, 1926)

**THE CLINICAL DIAGNOSIS OF GALL-BLADDER
DISEASE AND THE VALUE OF MODERN
ROENTGENOLOGY.**

By EDWARD E. YOSHII.

Exhaustive studies on the gall-bladder have been made from various angles, and it seems as though little can now be added after these brilliant works. The purpose of this paper is, therefore, to discuss the best clinical applications of the facts presented by these eminent investigators and to report on correlated clinical and Roentgenological study in 225 cases of gall-bladder disease.

The clinical diagnosis of gall-bladder diseases will remain difficult. In so called "Text Book" gall-bladder colic the matter of diagnosis is simple, but to the writer's knowledge, this type of cases occurs only in less than 28% of all the cases, and in the rest of them, each case presents a new phase of diagnostic difficulty. Many of the cases of the latter group would undoubtedly have been veiled under elusive terms or left unaded until grave complications ensued, unless most advanced modern diagnostic measures have been resorted to.

SYMPTOMATOLOGY: The right upper quadrant presents many allied conditions to cholecystitis; gastric and duodenal ulcer, appendicitis, gastric malignancy and its metastasis to gall-bladder and liver, carcinoma of the ascending colon, slowly perforating peptic or duodenal ulcer, some cases of syphilitic liver, septic endocarditis with secondary infection of the liver and biliary passages, diseases of pancreas, and occasionally septic right kidney, less frequently Angina Pectoris, Pott's Disease and Syphilis spine represent the group of diseases, which often, either in origin or in attending symptoms, are related to the right upper quadrant of the abdomen, and therefore, on many occasions cholecystitis may require differential diagnosis from these conditions.

The characteristic clinical manifestation of gall-bladder disease is pain in the right upper quadrant; it is the most common symptoms to all, and is often the initiating key-note which will arouse suspicion of the existing disease. Intense, agonizing, cramp-like pain, centered in the region of the right costal margin, radiating directly to the right back or around the right side up to the right scapula and the right shoulder regions, usually having no relation to meals, often occurring in the midnight or early in the morning, not relieved by soda or bismuth and often requiring a hyperdermic, is the true gall-bladder colic.

Anatomy of the phrenic nerve and its relation to the referred pain: Such characteristic radiation of pain becomes more clear when we look upon the nerve supply of the gall-bladder region.

The capsules of the liver and the gall-bladder receive nerve fibres from the phrenics, therefore, in gall-bladder disease afferent impulses are carried back to the IIIrd and IVth Cervical segments of the cord through the sensory fibres of the right phrenic and thus produce reflex pain in the right shoulder region. The phrenic nerve also passes filaments to the pericardium, which explains the well known clinical fact that some patients with biliary tract infection are awakened in the night by intense pain about the region of the heart called forth by the phrenic nerve communication.

Furthermore, the liver and the gall-bladder receive their sympathetic innervation from the Semilunar Ganglion, the connector fibres running from the Vth to IXth thoracic segments of the cord. These are the same segments that supply the stomach. The visceromotor reflex, however, which results from the inflammation of the liver and gall-bladder, shows itself in the right rectus instead of the left rectus. The viscerosensory reflex expresses itself in the epigastrium in much the same way as the sensory reflex from the stomach, but more to the right of the medium line. It may follow the costal margin and at times is found in the back in the zones of the Vth to IXth intercostal nerves.

The liver and gall-bladder, aside from the visceromotor and viscerosensory reflexes in the superficial body structures, just described, show parasympathetic motor and sensory reflexes in other organs. These may be particularly well recognized in the stomach and the intestinal tracts, by hyperchlorhydria and gastric hypermotility, spastic constipation, colicky pains and intestinal stasis. This becomes exceedingly important at times in the Roentgenographic and Roentgenoscopic diagnosis of the affections of the gall-bladder, which will be referred to in the later sections.

The pain which is intermittent in character, may last from a few hours to a few days, and this is usually followed by a quiescent period, during which the patient may be absolutely free from pain, or may have more or less constant soreness in the right hypochondrium associated with other vague digestive symptoms, until the same severe colicky pains return. In the presence of this periodicity of the attacks the diagnosis is still more certain. In the majority of cases there is a gradual shortening of the free period between the acute attacks, as the disease runs its course. Naturally, all sorts of modifications to this pain and its radiation are encountered. It may radiate to both scapulae and shoulders, may not go higher up than angles of scapulae, may be centered more in the epigastrium with rare radiation elsewhere, may radiate to the left shoulder and not to the right, or may be made constant in the left hypochondrium. In one case of this series the pain was noted most constant in the left hypochondrium with the upward radiation to the left shoulder and to the left arm, closely simulating Angina Pectoris.

Sometimes the pain radiates downward to the right lumbar and the right iliac region simulating an appendicular colic.

In a few cases of the series, the pain radiated backward and as far down to the testicle or vagina, leading to a tentative diagnosis of renal colic.

Many patients had pain occurring from 1/2 to three hours after meals, some almost regularly one to two hours after meals, strongly suggestive of the presence of peptic or duodenal ulcer.

Very often the pain may be of a more or less constant aching character associated with other digestive symptoms, and not of such characteristic colicky type.

These anomalies of pain, both in location and character can be attributed to anatomical variations, frequently due to the secondary changes or adhesions to the neighboring structures.

ASSOCIATED SYMPTOMS OF GALL-BLADDER COLIC

VOMITING. In nearly half of the cases nausea and vomiting were associated symptoms. The vomitus was of a bilious character. Patients often obtain relief from pain by vomiting. Such gastric irritations are naturally expected when the nerve innervation of this region is recalled.

CONSTIPATION. This was complained of by majority of the patients.

ERUCTATIONS. Eructations of gas and gaseous distention in the region of the stomach is very common among chronic cases, especially between the acute attacks.

JAUNDICE. When this is present, usually is of the obstructive type due to stone or in some, due to constriction of the bile passages by adhesions and edema. Jaundice usually comes and goes. If it is of a persistent type, it is often indicative of malignant growth. Advanced secondary changes in the liver—a biliary cirrhosis—usually present more or less constant jaundice.

While surgery has given much hope, the operative risk being very low in selected cases, a much more serious condition exists when the disease becomes complicated with biliary cirrhosis, or inflammation of the pancreas.

The study of jaundice is, therefore, very important. Van den Bergh, Aschoff and Mann taught us how to estimate the degree of jaundice and much about the physiology of liver; and we are indebted to McNee, who developed a practical standard for clinical application in estimating the degree of jaundice. According to Bernheim's work (1) the average normal icteric index in healthy individuals is between 4 and 6.0. In cases of macroscopically noticeable jaundice it was found to be always above 15 and anything between these two figures indicates latent icterus.

Most of the cases of this series were tested for icteric index, with the following results:

Total cases examined	...	...	...	...	...	...	...	...	...	156
Apparent jaundice at time of exam.	...	...	...	...	...	...	...	...	...	32
Negative	"	"	"	"	"	"	"	"	...	124
History of jaundice (visible)	...	...	...	...	...	...	...	...	...	37
Latent plus apparent jaundice	...	...	...	...	...	...	...	...	...	156 or 100 percent.

Many haemorrhagic conditions are said to show latent or apparent icterus, such as pneumonia, duodenal ulcer, active tuberculosis, malaria and typhoid, besides other causes which are known to produce jaundice. Almost all gall-bladder cases in this series showed latent icterus, so that it may be said that, in doubtful cases, icteric index below normal has its negative significance, while very high icteric index speaks for gall-bladder involvement in the absence of other causative factors.

The traditional saying "fair, fat, forty, in a woman belching gas" is again endorsed by the findings in this series as a good picture of gall-bladder disease. Out of total 225 cases, 163 females and 62 males; obesity was present in 40%, well nourished in 56%, and the remaining figure constituted underweight.

Age occurrence: Among 225 cases:

Below 25	...	...	...	...	...	...	...	...	...	23 cases
Between 25-35	...	...	...	...	...	...	...	...	...	48 "
" 35-45	...	...	...	...	...	...	...	...	...	67 "
" 45-55	...	...	...	...	...	...	...	...	...	52 "
" 55-up	...	...	...	...	...	...	...	...	...	35 "

Children are not immune to this disease; Carey 2) reported a large gall-stone 2.5 cm. in diameter, obstructing common duct in a girl of 9.

The average case of cholecystitis showed slight rise of temperature of 37.8 C. to 38. C, and leukocytosis average varying from 10,000 to 15,000.

According to Deaver, 3), chills, fever, and sweats are not uncommon in suppurating cholecystitis, fever and leukocytosis are insignificant in cases without complications.

Only about 2 percent of the cases of the present series presented definite symptoms of Charcot's Fever.

Out of 225 cases, stones were present in 138 cases.

Eight cases of carcinoma, one case of teratoma of gall-bladder and one case of Echinococcus cyst were found complicating gall-stones.

PHYSICAL SIGNS

There are not many physical signs in gall-bladder disease. The most common signs are moderate spasm and tenderness in the right hypochondrium. Tenderness on deep palpation, especially while patient takes a deep inspiration is characteristic. The liver edge is often palpable, and there may be felt indefinite mass under the right costal margin, indicating inflamed or distended gall-bladder. Sometimes there is associated tenderness in McBurney's point, and the case may be easily mistaken for acute or chronic appendicitis. Co-existing appendicitis is not rare.

Graham and his co-workers 4) have shown clinically and experimentally that cholecystitis does not exist without hepatitis, characterized clinically by an enlarged, tender liver, fever and leukocytosis, and microscopically by an extensive pericholangitis with round cell infiltration. The infection invariably begins in the liver carried there from some distant focus through the portal system, and travels to the gall-bladder by way of the rich lymphatic supply. Even after eradication of the original distant focus, re-infection occurs from the gall-bladder to the liver and a vicious circle is established.

Here a reference to the Lyon's test may not be amiss. Since the publication of the Lyon-Meltzer's 5-6) method of diagnosis, it found many adherents in many countries in the world within the last few years; however, in the face of other definite diagnostic methods, criticism has increased until now there is little of it left that has not been discredited as of diagnostic significance. On a number of cases in this series this test was tried, but it was not found helpful enough to compensate for the discomforts and inconvenience to the patient, not to mention the time and labor spent by the laboratory men. However, in doubtful cases, when other modern diagnostic facilities can not be obtained, it should be a part of the routine diagnostic procedure.

Regarding the application of it for treatment, it may be added that such conservative drainage obviously can not remove the lesion existing in the walls of the gall-bladder; but it is a valuable adjunct in the treatment of the co-existing hepatitis, if present. Bassler 7) summarizes his experiences with non-surgical drainage as "The less the pathology, the more the benefit" Again Lyon states "Cholelithiasis remains entirely beyond the scope of this treatment."

Gall-bladder lesions are the most frequent cause of gastro-intestinal motor disturbances. Blackford 8) found that 20% of 1,650 cases with gastro-intestinal symptoms were due to cholecystitis. Relative frequency of abdominal organic diseases causing dyspepsia in his series was found to be, gastric ulcer 1, gastric carcinoma 2, appendicitis 4, duodenal ulcer 6 and gall-bladder 12.

To enumerate the frequency of each symptom, according to Blackford's series 8) Pain 96, radiation of pain 51, indigestion 86, nausea 76, vomiting 73, constipation 62, eructation of gas 59, chills and fever 62, jaundice 55, and itching 13.

In the absence of such a characteristic colicky pain, as emphasized in the preceding chapter, much uncertainty attends the attempt to diagnose chronic cholecystitis. Soreness, tenderness, constant dull pain, dyspepsia, particularly evidenced by belching and flatus, and many remote symptoms may result from a chronic inflammation of the gall-bladder.

Many patients had characteristic paroxysmal attacks of gall-stone colic, and they did not show any stone at operation. Gibbon (18) states, "a patient can have all of these and still not have stone." Severity of attacks does not necessarily speak for the intensity of the pathological process. There are occasional cases met with, having all the acute symptoms while at operation we find a normal-appearing gall-bladder.

Bearse (9) says, "When the symptoms of gall-bladder disease are such that an operation is indicated, a normal appearing gall-bladder does not mean that the diagnosis was incorrect. In such cases the interior of gall-bladder should be inspected; the finding of a strawberry mucosa, minute particles of cholesterin on the gauze, and stagnant or stringy bile are evidence of pathology. Since the disease is in the gall-bladder walls, cholecystectomy is the operation of choice."

On the other hand, finding a markedly distended gall-bladder does not always mean that the gall-bladder is pathological. Recent work of Boyden at Harvard demonstrated that the fullness of the gall-bladder depends largely upon the kind of food taken. "Starvation" gall-bladder is always tense, in about an hour and twenty minutes after certain foods are taken, it begins to empty, and in a few hours it is quite flaccid and remains so for some time.

An embarrassing situation with which a surgeon is frequently confronted is to find an apparently normal gall-bladder on opening the abdomen, when he had every reason to believe there would be definite evidence of disease. Undoubtedly this is sometimes the result of mistaken diagnosis. In other cases, however, unrecognizable disease exists which will be relieved by removal of the gall-bladder. The cause of the symptoms may possibly lie in the liver or pancreas, or in some functional disturbance in the biliary tract.

Symptoms may return after cholecystectomy. In one case of the present series a patient returned a few months after the removal of her gall-bladder, with a soft cholesterin stone obstructing the common duct. Gall-stones may occur in the liver, such a case was reported very recently by Judd and Burden (10).

Judd (11) studied together 400 cases which were graded according to the pathological diagnosis of the specimen immediately after removal, and found that if a patient had a typical history of cholecystic disease, with characteristic colicky pain, he would be relieved of his symptoms if the gall-bladder were removed, whether or not it showed recognizable disease, that cholecystitis-grade I (catarrhal type to strawberry type,—in which the clinical manifestations were definite but disease un-

recognizable at operation, cholecystectomy was followed by cure in a higher percentage than in the case in which the disease of the gall-bladder was graded II, III, or IV, and that if the patient's symptoms were of the chronic dyspeptic type or if the predominant features were soreness, tenderness and aching in the side, the likelihood of cholecystectomy promoting cure was not great.

Mathews (12) states "I have a number of cases under observation that I feel would be better off if I had removed their gall-bladders, but at the time of operations there was no discernible pathology, therefore they were not removed. I have never seen harm come from the absence of the gall-bladder, in spite of the theoretical objections that have been advanced against the removal."

GALL-BLADDER AS A FOCUS OF INFECTION.

It has been repeatedly shown that the diseased gall-bladder may be focus for systemic infection resulting in rheumatism and cardiovascular disease—Adams (13). Willius has shown that in 55% of the cases of cardiovascular disease with which cholecystitis is associated, definite benefit and modification of the cardiac symptoms will follow removal of the diseased gall-bladder.

Holmes (14) believes that inflammation of the cardiac muscles occurs in every general toxemia if sufficiently prolonged, but it shows a remarkable tendency to appear (which often happens quite suddenly) in the course of chronic gall-bladder disease or cholecystitis.

Sometimes a diseased gall-bladder produces anginal pain. One such case was observed in the writer's series. Similar cases were reported by Riesman (15) and Babcock (16). Whether this is due to secondary myocardial involvement or simply reflex functional manifestation can not be stated. Differentiation from true cardiac disease can only be made in such cases by electrocardiographic investigation and by elimination of gall-bladder disease by Roentgenography.

The association of migraine with diseased gall-bladder is another problem in which the questions of pathogenesis and diagnosis are concerned. It occurs too frequently to be considered merely a coincidence. In the absence of true biliary colic, the gall-bladder may never be considered responsible for migraine.

So called "abdominal migraine" requires careful clinical differentiation from gall-bladder disease. Several such cases were reported by Blitzsten and Brans (17).

The discussion so far brings up the following points:

1. Clinical symptoms of gall-bladder disease are extremely variable, and it is dangerous to make a snap diagnosis based on the clinical symptoms alone. In regard to this, Gibbon (18) expressed his opinion as "The making of a snap diagnosis has been a stumbling block long enough and often enough in the experience of us all. A little

more time given to other possibilities will often change the apparently brilliant snap diagnosis into a different and saner one and sometimes save the operator much chagrin"

2. Definite clinical symptoms do not always indicate definite pathological changes in the gall-bladder, but they may be present in normal appearing gall-bladder.

3. Definite clinical symptoms, even in the absence of apparent pathological process, may be relieved by cholecystectomy.

4. Roentgenology has now come to the front in the diagnosis of obscure cases, and in confirming the clinical diagnosis.

Encouraged by these extremely interesting points thus brought out in recent years, the writer made a study, through the courtesy of the Staff of the New York Hospital, of 225 consecutive cases, which have occurred there during the eighteen months beginning January 1925. He has attempted to show to what extent, quantitatively and qualitatively, modern Roentgenology has helped the clinician and the surgeon, and to what extent gall-bladder visualization technique has its practical value and has its relationship to other Roentgenologic findings in the diagnosis of gall-bladder disease.

Too brief a period has elapsed since the development of cholecystography by Graham-Cole-Copher (19-20) definitely to fix its real value, further experiments and well compiled clinical correlations being indispensable for the perfection of the technique and for its wider utilization.

CLINICAL DIAGNOSTIC INDEX.

Gall-Bladder cases may be classified into the following five groups according to the clinical symptoms that they manifest when they present themselves for examination.

I. Cases which present characteristic symptoms of biliary colic and positive physical findings. These will be stated for convenience as "Clinical Diagnostic Index," 4 plus group or (++++).

II. Cases in which the symptoms are less definite and in which gastro-intestinal features are somewhat prominent, or 3 plus group (+++).

III. Cases in which the gastro-intestinal and gall-bladder symptoms play an equal part, as 2 plus group (++) .

IV. Cases in which gall-bladder symptoms are insignificant and chiefly the feature of gastro-intestinal disturbance, as 1 plus group (+).

V. Cases in which the symptoms suggest extra-gastric intestinal causes, as the negative group (-).

C.D.I. 4 plus is a case for "text-book" diagnosis, so to speak. 65 cases out of total 225 were of this type, or 28%.

C.D.I. 3 plus is a case which may require certain technique and art of elimination of other possibilities before reaching definite diagnosis. There were 51 of these, or 22.9%.

C.D.I. 2 plus cases are those which require very careful clinical analysis and other diagnostic methods for confirmation. These constituted 42 cases, or 19.2%.

C.D.I. 1 plus cases are those in which no existence of gall-bladder disease can be suspected clinically. They consisted of 48 cases, or 21.5%.

C.D.I. Negative cases in which far fetched tentative diagnosis were made, such as neurosis, renal calculi or constipation, consisted of 19 cases, or 8.4%.

Roughly 50% of the cases in this series could be diagnosed by clinical means alone, and in the remaining half no such diagnosis could be made without the aid of X-ray or of exploratory laparotomy.

Among 133 cases operated on, 64 were of the group C.D.I. +++ and +++++, while 69 cases belonged to the groups III, IV, and V.

Among 64 operated cases of C.D.I. +++ and +++++ groups, 35 or roughly 50% of them were operated on after clinical diagnosis alone, while in the remaining groups, only 11 cases, or 18%, were operated on after clinical diagnosis alone. Of these 11 cases, the pre-operative diagnosis were respectively, chronic appendicitis in 6, acute appendicitis in 2, gastric ulcer in 1, epigastric hernia in 1, and the remaining one was primarily operated on for uterine fibroid; the diseased gall-bladder in all these cases was found accidentally, while this was the chief cause for the symptoms. In other word, in none of these cases gall-bladder disease was diagnosed clinically.

One case of group III (+++) was operated on for acute appendicitis, but diseased gall-bladder was found, while the appendix was normal.

The total operative mortality was 19 or 8.44%; eliminating those cases where failure was inevitable, i.e. two old age patients with necrotic gall-bladder, 4 cases of carcinoma of gall-bladder and common duct, one with moderately advanced cirrhosis of liver and one with coronary arteriosclerosis, the mortality would be less than 5%.

The following case illustrations will indicate the importance of careful clinical analysis for reaching definite diagnosis.

Case No. 222. Man aged 31, complained of pain right side, sometimes radiating down to the testicle, of several months' duration, strongly suggesting renal colic. The barium series revealed a marked deformity, which suggested duodenal ulcer. Laparotomy showed gall-bladder quite thickened, edematous and adherent to the first part of the duodenum, otherwise no lesion in the duodenum. Appendix had congenital band, but not diseased. Cholecystectomy and cure.

Case No. 215. M. K., woman of 49, periodic attacks of epigastric pain of 8 months' duration, with radiation to the left shoulder and the left arm, sometimes to the right shoulder, leading to the Clinical diagnosis of Angina-Pectoris; the Graham test, however, indicated abnormal response to the dye. Operation—strawberry gall-bladder, recovery.

ROENTGENOLOGY IN GALL-BLADDER DISEASE.

Figures in the preceding chapter strongly illustrate the usefulness of Roentgenograms in the gall-bladder disease in that it raised the indication for operation by 80% among group III, IV and V cases.

If the use of X-ray were, however, to visualize only opaque calcium stones for the diagnosis of gall-bladder disease, its value would be very small. The following results were obtained in such examinations among the series:

Total examined	...	...	...	...	...	96
Visualized gall-bladder	...	...	...	...	...	14 (14%)
Visualized gall-bladder, mottling within...	...	...	...	...	...	19 (20%)
Mottling only in G.B. region	...	...	...	...	...	15 (16%)
Visible stones, including definite negative shadows	...	...	...	...	...	15 (16%)
Negative	...	...	...	...	...	33 (34%)

The above findings will make gross negative 85% and absolute positive 15% so far as direct evidence for gall-stones is concerned.

The direct Roentgen ray evidence of cholecystitis or cholelithiasis is not entirely satisfactory for diagnostic purpose. Ordinarily the gall-bladder does not cast a sufficient shadow to be easily demonstrated on the plate or film. A distended or full gall-bladder may cast a shadow, but this condition may exist in normal but "fasting" gall-bladder. It has also been proved many times by operation or autopsy that a normal gall-bladder often casts a shadow. A visualized gall-bladder does, therefore, not necessarily mean a diseased gall-bladder, although some still hold an opposite view. Zinc (21) states that "Visualization of gall-bladder without dye, while occasionally seen in gall-bladder disease, not infrequently occurs in normal cases. This also applies to the indirect signs."

CASE ILLUSTRATION.

S.R. woman aged 60, had sudden typical onset of gall-bladder colic; icteric index 11.5. Graham test was unsuccessful due to poor preparation of the pills which resisted absorption and long remained in the intestinal tract. The film, however, showed a direct shadow of a large stone lying close to the body of the third lumbar vertebra. Operation showed a large stone, 5. cm. in diameter, on which the gall-bladder was found contracted. Microscopically the wall of the gall-bladder revealed exudative, productive cholecystitis with necrotic area.

Plate I. Shows an unusually large stone, a direct evidence. Many small, rounded dense shadows found in the intestinal lumen are unabsorbed pills of dye substance, the preparation of which was not perfected in the early period for rapid absorption.

PLATE I.

S.R., woman, aged sixty, had sudden attack of gall-bladder colic. This indicates a direct evidence of an unusually large gall-stone in the gall-bladder, confirmed by operation. There are also shadows of many pills unabsorbed, lying in the lumen of ascending colon.



THE SECONDARY EVIDENCE.

Since the publication of papers by Cole and Imboden of New York, George and Leonard of Boston, regarding the "Secondary Evidence" of the gall-bladder disease, these signs have been looked for with increasing enthusiasm by number of Roentgenologists and gastroenterologists. Belden (22) in his recent paper in regard to its importance, went so far as to state "No gall-bladder examination is complete without a Roentgenoscopic examination of the stomach and duodenum and a Roentgenographic examination when possible."

From time to time, abdominal surgery has proved that various vague gastrointestinal symptoms simulating organic diseases were produced by adhesions. Morris referred to them as "cobwebs in the attic," later Harris described what is now known as Harris Band, and other type described what is known as Jackson's membrane.

A majority of these veils or bands and adhesions are considered inflammatory products while very few of them are undoubtedly congenital in origin. In the right upper quadrant, a diseased gall-bladder is chiefly blamed for the production of these adhesions, and they can easily be demonstrated in the Roentgenogram if carefully sought.

Abnormal shadows produced by various pathological changes in the gastrointestinal tracts, whether they are due to cancer, ulcer, gall-bladder-adhesions, spasm or membrane can be differentiated, although in some cases extreme difficulties are met with so that only a vague statement is possible that this may be due either to an ulcer, gall-bladder-adhesions or a veil, even after painstaking clinical correlation, although such Roentgenological evidence warrants the surgeon to look for veils if he fails to recognize other organic lesions. Two cases of the present series presented characteristic clinical symptoms and exact Roentgenologic pictures of duodenal ulcer, but at operation there was found a strong broad band of adhesions between the gall-bladder and the first part of the duodenum, producing an exact picture of the deformity, while no other abnormality was found in either case.

The deformities which constitute the secondary evidence of gall-bladder disease may be enumerated in the following order according to their frequency of occurrence, in this series and also as collaborated by Belden's (22) findings.

I. SECONDARY CHANGES DUE TO ADHESIONS.

(a) Changes in the first portion of duodenum:

1. Deformity of the cap or the first portion of the duodenum, known as "spider leg" or "saw-tooth" irregularities—fine zig-zag irregularities found on the outlines at the apex and the greater curvature side of the duodenum. Plate II, Fig. 1, 3, 4.

2. Fixation of the first and the second portions of the duodenum and tenderness to palpation during Roentgenoscopy. Plate II, Fig. 3 and 4.

3. Complete loss of the normal outline of the cap assuming a tubular shape as if constricted by a band of adhesions. Plate II, Fig. 3.

4. Definite filling defect produced by adhesions, or a combination of true ulcer at the site of the adhesions. Plate II, Fig. 3.

(b) Changes in the second portion of, or the descending limb of the duodenum.

1. The most common deformity in this region is a "picking up" or displacement to the right, narrowing and fixation. This displacement to the right frequently produces an appearance on the film as though the fundus of the gall-bladder were outlined by the descending limb of the duodenum. Plate II, Fig. 4, Plate III, Fig. 5. One also gets the impression that the duodenum is plastered to some structures beneath the liver. The fixation of the second portion taken in conjunction with the adhesions about the first portion of the duodenum frequently results in a sharp angulation, or kinking between the first and second portions of the duodenum. This is best demonstrated in the oblique position. Gastric retention is not an uncommon finding and this may lead to the diagnosis of organic disease. One such case was observed in this series, although this could be clinically disproved.

2. Narrowing at one point of the descending limb, is usually due to a single band of adhesion. In one case, a bulging deformity on the duodenum was found characteristic of a diverticulus, but at the operation this was proved to be a simple pouch-like protrusion on the wall of duodenum caused by a band of adhesion from the gall-bladder constricting the lumen at its lower level. Two such cases were noted in this series.

(c) Adhesions to colon:

1. Fixation of the hepatic flexure is perhaps the most important finding and one which when present is almost pathognomonic of gall-bladder disease. This consists of a picking up and pulling out a small portion of the wall of the colon appearing fixed under the liver or at the gall-bladder region. By palpation under the Roentgenoscope the fixation can be better demonstrated. Laparotomy often reveals a gall-bladder which is completely surrounded by a thick layer of omentum which includes this portion of colon. The importance of eliminating other sources of such fixation in this region, such as a long retrocecal appendix, tuberculous peritonitis or omental adhesions from other causes and congenital bands, needs no mentioning.

2. Fixation to proximal portion of transverse colon may also occur producing a sharp angulation, spoken of by George as "pseudohepatic flexure."

II. DEFORMITY DUE TO PRESSURE.

Deformity of the stomach or duodenum due to direct pressure from a distended gall-bladder produces a characteristic concave curve, smooth in outline, representing a portion of the gall-bladder against the wall of stomach or duodenum, known as the "Half shadow of George." Plate II, Figure 1-4.

The deformity of the duodenum is usually on its greater curvature side. This may occasionally occur on the lesser curvature side from a centrally placed gall-bladder, and in rare cases it may appear scalloped, or intented due to the pressure from large stones within the gall-bladder.

Pressure deformities on the stomach usually occur along the outer curvature of the antrum and are best seen in the prone position, which forces the antrum into the upper right quadrant, thus causing it to come in contact with the distended gall-bladder. A markedly enlarged gall-bladder is responsible in most of the cases for the deformities, but one must bear in mind that an abnormal contour of the liver, a movable kidney, or extra-gastric new growth may also produce a similar defect.

III. REFLEX SPASM.

I. Reflex spasm and hypertonicity of the stomach wall are caused by diseased gall-bladder and by secondary adhesions about the pyloric region. Such spastic conditions may be mistaken for "Niche" on the film, and Roentgenoscopy is more dependable in this regard. Plate II, Fig. 4.

II. Narrowing of the pylorus and antrum of the stomach, which gives it a tubular appearance, is probably due to reflex spasm. Plate III, Fig. 7.

III. There is another deformity of the antrum of the stomach spoken of by Cole as "Tenting." He considers this pathognomonic. It is as though a stick had been pushed up beneath a tent which causes a pyramidal appearance and destroys the usual relation between the greater curvature side of the antrum and the greater curvature side of the Cap. These two should make nearly a straight line in normal case. This sign is found only in the erect position. Plate III, Fig. 8.

In the differentiation of some of the deformities caused by adhesions, from those of ulcer, it may be stated in general that adhesions give the greatest deformities at the time when the stomach is full rather than when it is partially empty. Generally, the reverse is the case with duodenal ulcer, in which the most characteristic deformities become defined up to a certain point during emptying of the stomach, while the deformities and defects from the gall-bladder adhesions tend to gradually disappear as the stomach empties and relaxes.

PLATE II.

SKETCHES FROM ACTUAL CASES SHOWING SECONDARY EVIDENCE.

Figure 1. "Half shadow of George" caused by the pressure from a distended gall-bladder.

Figure 2. Flattening of duodenal cap due to the pressure from a centrally placed distended gall-bladder.

Figure 3. Again demonstrates filling defect in the cap due to the gall-bladder, and the displacement of the duodenum and its fixation by one band of adhesions from the gall-bladder, which was demonstrated at operation.

Figure 4. Demonstrates the displacement and narrowing of the second portion of the duodenum by adhesions. The position of "Saw-tooth" irregularities seems to outline the fundus of the gall-bladder, which was later proved by operation.

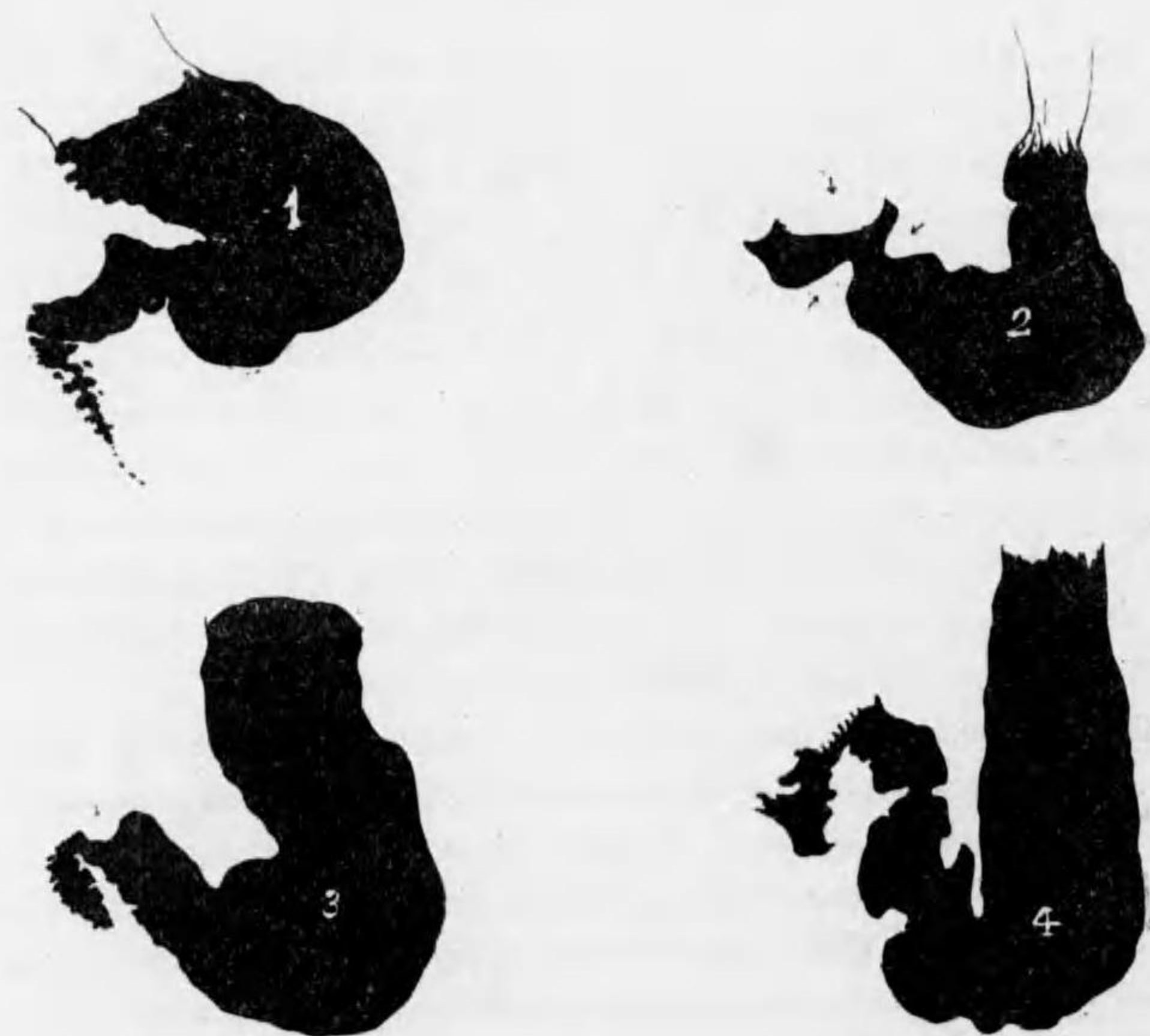


PLATE III.

DIAGRAMS INDICATING THE SECONDARY EVIDENCE.

Figure 5. Shows adhesions and production of "Saw-tooth" irregularities of the second portion of duodenum in the region of gall-bladder beneath the liver.

Figure 6. Another characteristic deformity caused by the adhesions between the cap and the gall-bladder. The cap is elongated and appears picked upward.

Figure 7. Narrowing of antrum and pylorus and tubular effect due to spasm.

Figure 8. Diagram showing so called "Tenting" deformity of the cap and the Antrum. The usual relation between them giving a tubular appearance and picked toward the right.



Fig. 5.

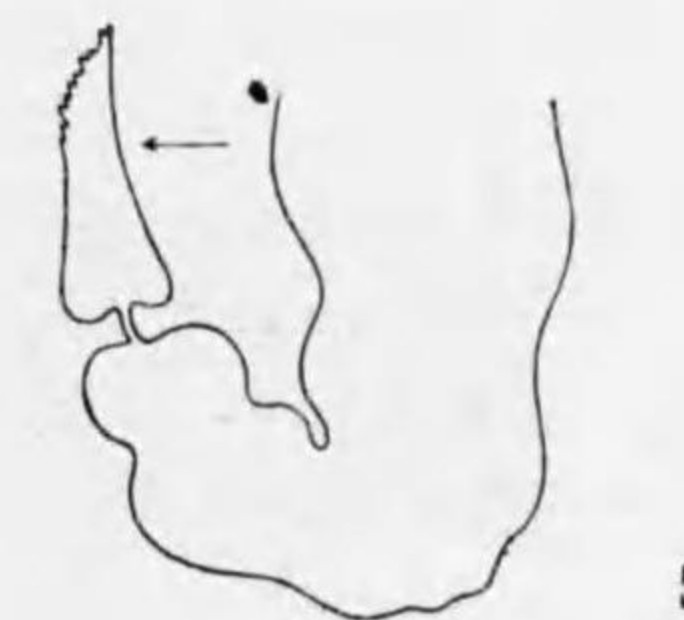


Fig. 6.



Fig. 7.

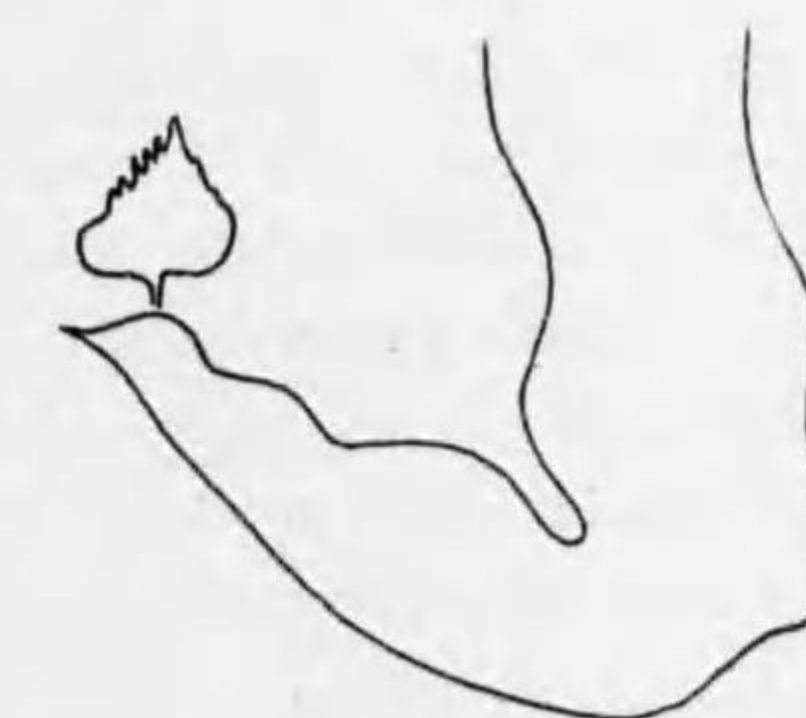


Fig. 8.

Among the 225 cases of gall-bladder disease of the present series, 62 cases were examined for secondary evidence by Roentgenography, and the finding were as follows:

Total cases examined	...	...	...	...	...	...	...	...	...	62
Confirmed by operation	...	...	...	...	...	...	...	...	...	19
" " Graham test only	...	...	...	...	...	...	...	...	...	9
" " operation and Graham Test	...	...	...	...	...	...	...	...	...	12
" " definite clinical evidence	...	...	...	...	...	...	...	...	...	5
Not confirmed	...	...	...	...	...	...	...	...	...	13
Negative findings	...	...	...	...	...	...	...	...	...	4

Gross positive findings may be figured at 93.5%. One case out of 19 confirmed by operation, was found to be due to diseased appendix, gall-bladder being normal. Out of five cases confirmed by clinical evidence, two were proved by direct evidence, and one was due to carcinoma of the gall-bladder. Out of thirteen unconfirmed cases, two were negative to the Graham Test. Of four negative cases, one was due to adhesion between the omentum, the first portion of the duodenum and the gall-bladder, which contained many stones, another was associated with chronic appendicitis and adhesions around the gall-bladder to the omentum, and still another was positive to the Graham Test. Subtracting these negative and unsuccessful cases, the value of the secondary evidence (absolutely positive) may be estimated at 72%.

39 out of 58 positive cases showed secondary evidence in its first degree, i.e. combinations of saw tooth irregularities, adhesions, picking up and spasms, plus pressure deformities in some. The remaining cases were of second degree or combinations of only a few of the minor signs.

The peculiar result obtained in this analysis is that in 7 of the positive group in the first degree, no adhesions around the gall-bladder were noticed at time of operation or at autopsy and the stomach and duodenum were apparently normal; four similar cases were met with among the group of the second degree.

In some cases, in which the existence of gall-bladder diseases was not shown by the visualization test, and which were therefore filed under different diagnosis, there was definite secondary evidence present, which might be attributed to various other causes, such as splanchnoptosis, diverticulitis or chronic appendicitis. Aside from fixations and adhesions, the writer is inclined to believe that the secondary evidence may also be due to spasticity and hypermotility. He feels however, that Mill's remarks "gall-bladder secondaries occur so seldom when actual gall-bladder disease is present, that when they do occur their value is questionable" requires much modification

By some, the secondary evidence is considered of value only in long standing chronic cases; but the writer feels that, according to the result obtained in this series,

the secondary evidence can be applied in general to the diagnosis of gall-bladder disease provided that in doubtful cases they are carefully checked up with clinical evidence and if possible by the Graham test, for the following reasons:

1. Many patients with gall-bladder disease had suffered from vague digestive symptoms long before they presented themselves for examination;
2. The average duration of their clinical history is one to two years.
3. Patients with acute onset and even with previous record of health, frequently showed more or less adhesions around gall-bladder regions at operations;
4. Adhesions caused by exudative inflammation are formed in a rather short time;
5. Secondary evidence may occur without any great changes around the gall-bladder.
6. Its value is increased by correlation with the visualization test.

SECONDARY EVIDENCE BY FLUOROSCOPY.

In all, 88 cases were observed in this series Roentgenoscopically, out of which positive secondary evidence was obtained in 56 cases or 63.5% and negative in 32 cases or 36.5% as against absolutely positive 72% or gross positive 93.5% of the Roentgenography, and absolutely negative 6.66% (or gross negative 28.%) of the latter group.

Roentgenoscopy is more accurate and definite than Roentgenography in regard to the secondary evidence because the former method is more simple and the palpation can be incorporated with it. In cases in which both methods were utilized, Roentgenogram was always positive whenever fluoroscopy was positive, although latter method often failed when evidences were obtained on films. This discrepancy may be attributed to the fact that Fluoroscopy is more collaborative due to the fact that by palpation pathological shadows may be differentiated from momentary spasm which would be shown on the film. It may be added that, other things being equal, pathological shadows are more easily picked upon the film.

ILLUSTRATIONS OF DIFICULT CASES.

Case No. 134, F.R. Man of 30, long history and diagnosis of duodenal ulcer. Barium series showed gastric retention and irregular cap leading to the confirmation of the clinical diagnosis. Operation for duodenal ulcer, but instead of, a chronic gall-bladder and a dense band stretching between the gall-bladder and duodenum causing the exact deformity of the latter and no duodenal ulcer. Cholecystectomy and cure.

Case No. 137 very similar to above, but Graham test revealed gall-bladder pathology for which cholecystectomy performed leading to recovery.

Case No. 116 R.S. woman aged 32, had typical periodic attacks of gall-stone colics, icteric index 7.8. Usual gastric series and Fluoroscopic examinations were negative except adhesion of hepatic

flexure of colon to gall-bladder region. Operation showed dense adhesions around gall-bladder to omentum and first part of duodenum, many stones in gall-bladder—cholecystectomy and cure.

Case 107 F.C. woman of 50, clinical diagnostic index of 3 plus, icteric index 12.5. Usual barium series indicated large 6 hours retention and constricted duodenum, diagnosed as post-pyloric ulcer. Operation—small constricted gall-bladder containing many stones, 1/2 to 2 cm. in diameters; slight congestion of peritoneal coat of duodenum but no pathology inside. Cholecystectomy with cure.

Case No. R.G. woman aged 46, characteristic attacks of gall-stone colics, gastric series showed definite secondary evidence. Operation—gall-bladder appeared normal, free, contained a few small stones; recovery.

Case No. 103. V.W. clinical diagnostic index 2 plus, barium series showed definite secondary evidence. Operation—gall-bladder normal, no adhesions, no stones, no pathology in stomach, duodenum or appendix microscopically mild catarrhal cholecystitis; cholecystectomy with recovery.

Few other such cases were observed. Pathological pictures resembling secondaries due to the gall-bladder disease require elimination of other possibilities before decision; Chronic appendicitis, multiple diverticulitis may be also responsible. Cholecystography now comes as a great help.

CHOLECYSTOGRAPHY.

Prior to the development of the Graham-Cole-Copher method (20) in the diagnosis of gall-bladder disease, the service of Roentgenology in this line it may be said were not great. While the direct evidence of gall-bladder disease can be obtained in only about 15-20%, the clinical diagnosis of gall-bladder disease is never simple in the absence of clear cut text book symptoms, but the majority of the cases present new differential problems. Roughly 28% of the cases are fitted for "text book" diagnosis (4 plus cases), and less than 50% of cases can be clinically diagnosed (4 and 3 plus cases). Although the secondary evidence comes as a great help, there is accompanying inconvenience and its value is not so great unless it is sought by experienced Roentgenologists.

Although the present experience with the Graham test is still meagre, nevertheless one can anticipate its greater usefulness in the near future when the method is more elaborate and more generally used, because of its simplicity and accuracy.

Even exploratory operations fall short in the early cases, for eye and finger often fail to detect an early cholecystitis and occasional small stones. In early cholecystitis, only microscopical evidence of an interstitial or mucosal inflammation exists. In cholecystography we have a method that will give reliable information in these cases if proper technique is followed.

Judd (23) expressed his opinion as "It may be that this examination affords more certain evidence than direct palpation or microscopic study. It is impossible to deny this contention in the face of many operations that brought complete relief from

clearly visualized. Marked changes in the mucosa prevent normal concentration of the dye. The results, therefore, are poor shadows or delayed appearance of shadows. Adhesions and changes in the musculature of gall-bladder interfere with proper evacuation of its contents, hence no reaction to intake of food.

KINDS OF DYE. Regarding the question of relative advantages or superiorities of different marks of the dye, the writer refrains entering into thorough discussion of the matter, because there seems to be enough room yet for elaborations; but suffice it to say that this has been discussed by several writers, such as Graham and others (24) Gosset and Loewy (25) Sabatini and Milani (26).

PROCEDURE.

There are no two methods of administration of the dye, namely intravenous and oral, each having its own merits and demerits.

Objections to intravenous method are generally considered to be:

1. Not very simple, requiring all the aseptic precautions.
2. There are various techniques in intravenous method, some preferring divided doses.
3. Reactions may be very severe.
4. Tissue necrosis at point of injection, due to extravasation.
5. Phlebitis.
6. Contraindications of intravenous method may be enumerated as:

- a. Extensive hepatic destruction, which applies also for the oral administration.
- b. Hypertension.
- c. Cardiac disease, especially auricular fibrillation, or cases in which there is extensive myocardial damage.
- d. Hyperthyroidism.

METHOD OF OBSERVATION.—4 or 5 hours after the intravenous administration of the dye the first film is taken for reading, then at 8 hours period. At this time (the second film) there is slight decrease in the size of gall-bladder but increase in its density. At about a 24 hours period the size and density of the shadow are usually greatly reduced, often to complete disappearance. Plate IV, Fig. c.

According to Mills, gall-bladder motility is influenced by personal habitus, it is poor in a slender, asthenic individual, and vigorous in the stout, hypersthenic type.

Silverman (27) and later Stewart (28) have shown a great reduction in size of the gall-bladder shadow following magnesium sulphate administration through a duodenal tube, the same phenomenon occurring from one to two hours after a meal rich in fats.

symptoms, although the gall-bladder presented no evidence of disease. The diagnosis of cholecystitis has not been helped by microscopic study of the section."

Zinc (21) stated "The rule we now follow is to remove all gall-bladders showing a definitely positive cholecystogram."

The principles of visualization of the gall-bladder depends on the following physiological factors:

Non-radiotransparent dye substance given to the patient is first taken up by the liver and excreted by the liver cells. The excreted dye substance enters the gall-bladder through the bile duct. Normal mucus lining of the gall-bladder has concentrating ability of this dye substance, which is said to be largely dependent on the condition of the regional lymphatics.

During fasting period, the gall-bladder is tensely distended with bile substance; when food is taken, especially things rich in fats, it causes the gall-bladder to contract and empty itself. A normal healthy gall-bladder is visualized under the influence of the dye stuff on the film as a uniformly opaque shadow whose outline is smooth and uniform. In about one hour after the intake of food stuffs, especially rich in fatty substance such as butter and cream, the shadow will commence to shrink down to less than one third of its former size, as illustrated diagrammatically in Plate IV, Fig. a, b and c.

In the pathological gall-bladder, various variations will be shown, in its density, uniformity of the shade and its outline, which will be presently described in later sections. One should bear in mind that normal gall-bladder may not be visualized when the cystic duct is obstructed by congenital defect or otherwise, and that the outline may be uneven with perfectly normal gall-bladder when such a film is taken exactly at the time of peristaltic constriction.

Stones may be shown generally in one of these four ways:

1. A positive shadow,
2. A negative shadow.
3. A negative shadow with a ring around.
4. Irregularly rarefied areas or mottling.

It frequently happens that ordinary invisible stones are made visible in positive shadows after the influence of the dye, certain composition of stones having greater absorbability of the dye. For the same reason peripheral absorption of the dye produces a ring formation surrounding a rarefied area. No dye is permitted to enter the gall-bladder when the latter is distended with numerous stones, when its duct is obstructed by a single stone, or when the duct is temporarily closed by induration or by external pressure, consequently no shadows are obtained.

A small sclerotic gall-bladder full of viscid stringy bile is for the same reason not

A shadow, faint or absent until 24 hours' period probably indicates microscopic, if not gross, mucosal lesion. Sedimentation of the dye perhaps indicates hypomotility or probably stones.

Definite opinion regarding the intravenous method versus oral administration of the dye can not be given at this moment, because the majority of the cases of the present series have been studied by oral method alone; however, suffice it to say that there were a few cases which gave alarming reactions after intravenous administration, that the check-up by intravenous method upon those in whom oral method was thought to have given erroneous results, gave the same findings, and finally, that satisfactory results were obtained by oral method alone in most of the cases.

Zinc (21) basing his conclusions on the result obtained in 663 patients, in which 513 were intravenous and 150 oral cases, considers intravenous route is far superior to oral method. According to this author, not only that the usual objections associated with the intravenous method were not substantiated, but in oral cases, 10 percent of them were nauseated and vomited, while 25 percent of them had mild epigastric discomfort, lumbar pain and mild diarrhea.

Zinc also stated, "a great deal of accuracy in the diagnosis of early gall-bladder disease must be sacrificed if the more simple method of oral administration is employed."

THE ORAL ADMINISTRATION.

On account of certain inconveniences that are met with intravenous administration of the dye, such as occasional difficulty to find suitable veins, especially among fat women and the consequent danger of extravasation, and as the dye has to be given repeated doses in some, the oral administration is considered more simple and safe for the office practice; according to Stewart (29) it is "simple and efficient." In this method, however, various factors must be given consideration in order to make the test successful.

1. Gastro-intestinal mucosa of certain individuals may be extraordinarily sensitive to the chemical.
2. Normal gastro-intestinal tract may be made hypersensitive by certain kind of food or medicaments previously taken.
3. Presence of inflammatory condition in small or large bowels may delay absorption or decompose the dye.
4. Capsules may be disintegrated in the stomach, and are either vomited or combined with HCl. to form an insoluble acid salt.

5. Before giving the pills or capsules proper selection of the dye products and personal equation of each patient should be considered and due precautions accordingly taken.

6. Assurance must be given that the patient has followed exact directions in the course of the examination.

PROCEDURE.

Patient takes a dose of laxative in the evening followed by a simple soap suds enema in the morning. At 6 P.M. he or she takes a supper consisting of cereal, cream, milk, bread and butter, etc. strong cathartics and food stuffs liable to produce gas should be avoided during the 24 hours preceding the administration of the dye substance. A preliminary radiogram may be taken of the gall-bladder region between 1 to 3 P.M.

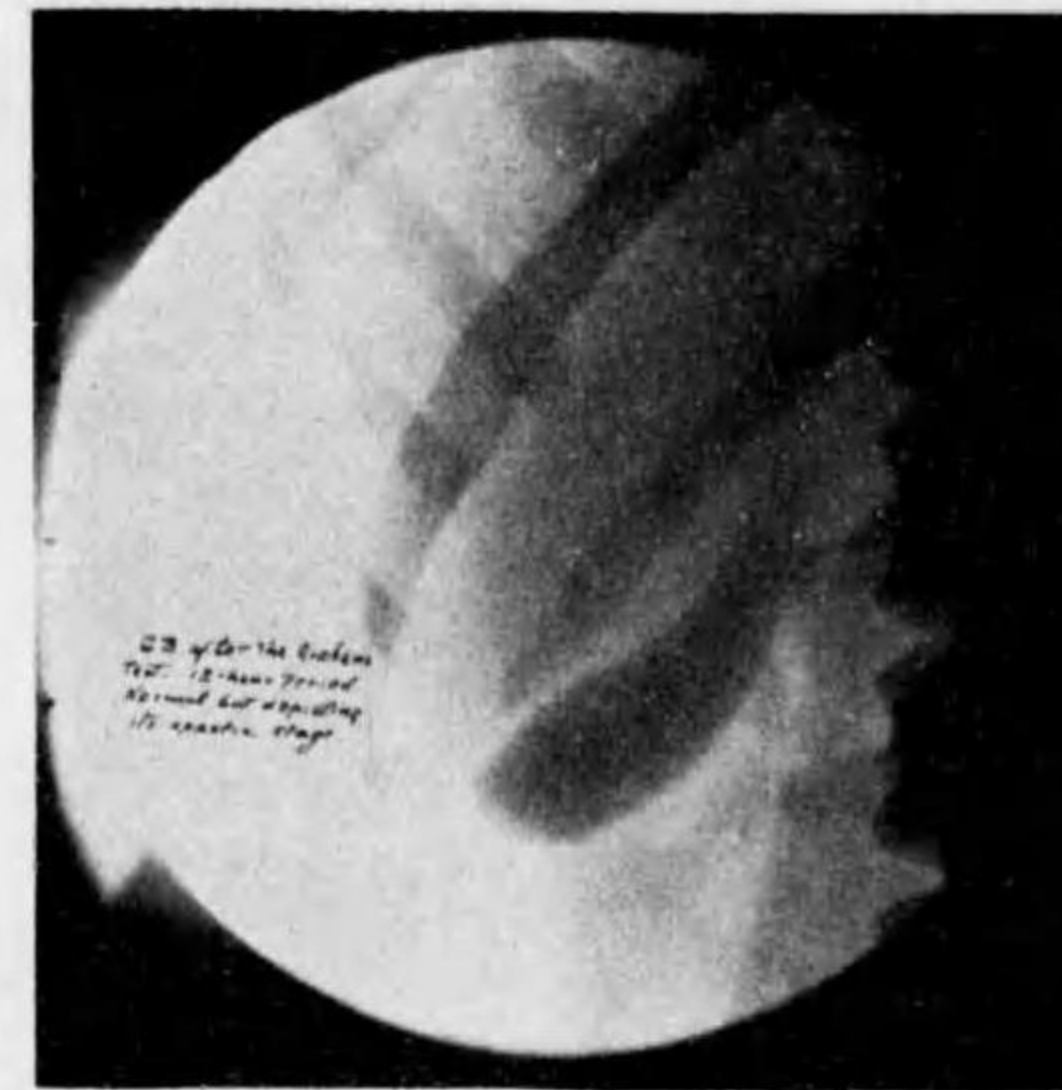
Ten capsules of phenoltetraiodophthalein of 5 grains ($1/3$ gm.) each are given to the patient, or twelve such capsules to a large person. At 8.15 P.M. patient takes 10 grains ($2/3$ gm.) of sodium-bicarbonate with $1/3$ glassful of water. Adequate amount of Tincture Belladonna or Tr. Hyoscyamus may be given in hypersensitive individuals. Then the patient is directed to take two given capsules at 9 P.M. with $1/3$ glassful of water, then the rest of the capsules every 15 minutes, two at a time until all the capsules are taken, while lying on his right side throughout the taking, and shall sleep in this position during the night.

Stewart (29) advises as follows: "for the average patient weighing 150 pounds the contents of one ampule of "Iodeikon" (Mallinckrodt) is placed in eight No. 3 gelatin capsules. Increase or decrease number of capsules, at the rate of one capsule for every 25 pounds of body weight. The preparation is made at the office with the patient in order to insure freshness of the capsules. A preliminary examination of the gall-bladder is made in the ordinary manner at about 3 P.M. (Before patient begins to take the capsules in the evening.)"

In the morning no breakfast is taken, except plenty of water, and the patient returns for Roentgenography. The first film is taken 12 hours after capsules were administered; the second film is taken about 4 hours still later, or 16 hours after the capsules; at this time the shadow of gall-bladder is slightly smaller than on previous occasions, but more dense, the liver shadow is also accentuated. As soon as the film is finished, the patient takes his first meal of the day, a hearty meal rich in fats. The third film is then taken, one hour after such meal or at 17th hour after the capsules. At this time the gall-bladder shadow is usually about $1/3$ or less of pre-meal size. The kidney shadow is now quite densely shown. A confirmatory 36 hour film

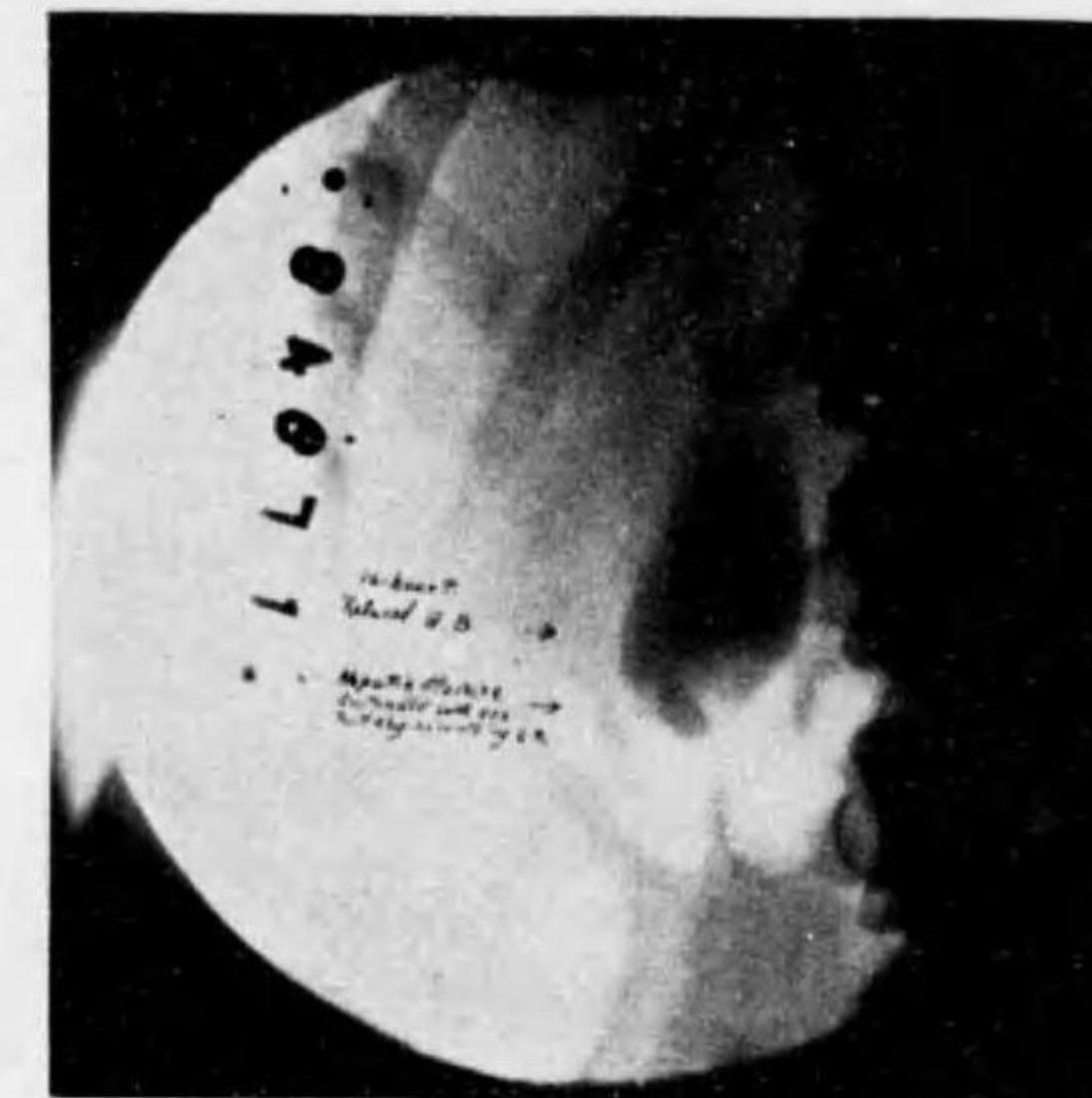
PLATE IV.

DIAGRAMMATIC REPRESENTATION OF CHOLECYSTOGRAMS OF A NORMAL GALL-BLADDER.

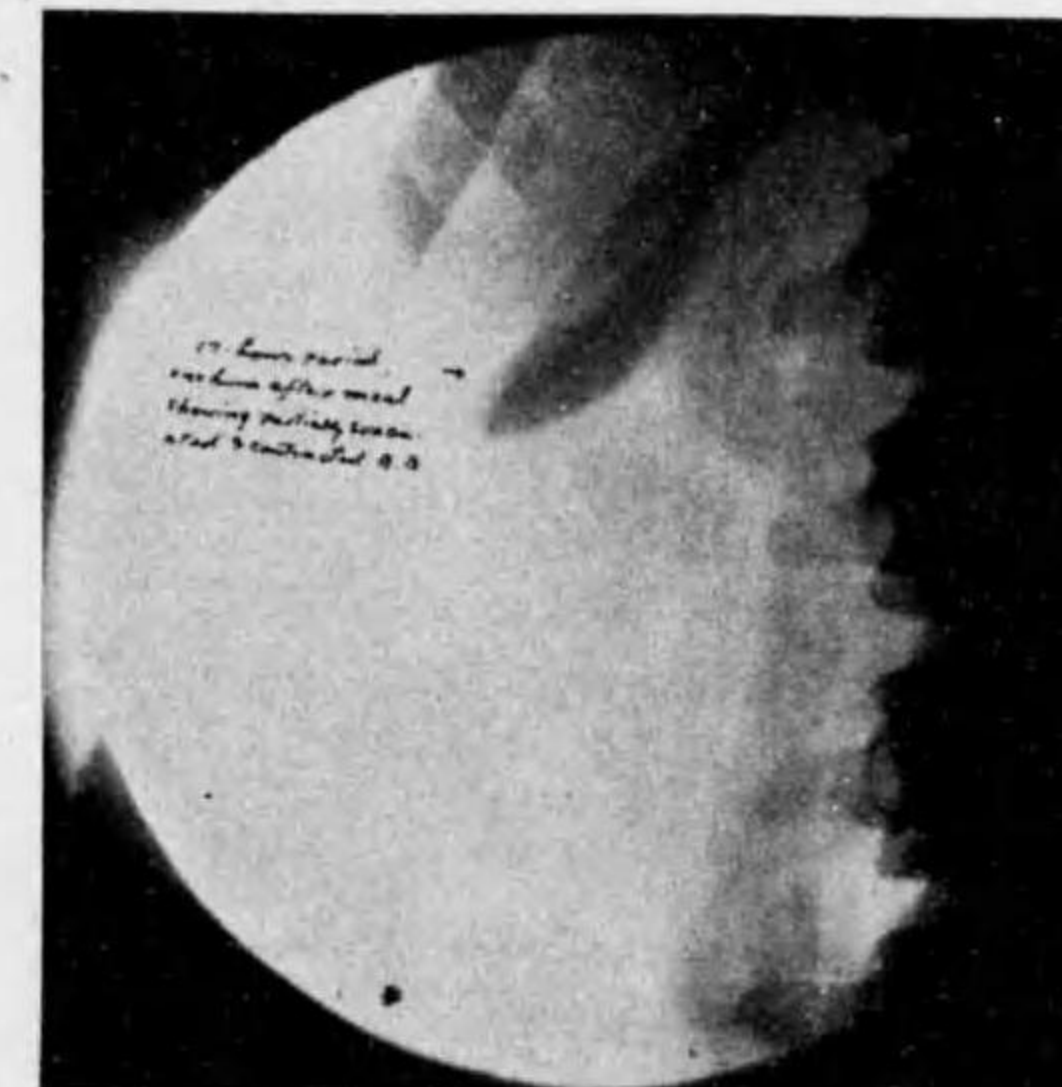


a. Twelve hours after the intake of the dye. Pear shaped shadow of uniform density and of smooth outline.

b. Sixteen hours after the dye. It is slightly smaller, but denser as represented by more crowded dots and heavy outline.



c. One hour after ingestion of food. It is of uniform density but much smaller than previous occasions.



may be taken, at which period the gall-bladder shadow should have completely disappeared in all normal cases. Plate IV, Fig. a, b, c.

The method of radiation should be standardized according to the thickness of the body of each patient, and each time the same standard should be maintained in the same patient.

Before giving definite opinion on the films, one must be sure that the dye substance has been thoroughly absorbed, and that the patient has followed directions exactly. The evidence for the absorption of the dye may be relied on the following two points:

- (1) No dye residue remain unabsorbed in the intestinal lumen.
- (2) The shadows of liver and kidney well accentuated.

One may raise a suspicion that the liver might not have been functioning properly so that the dye may not be excreted. This question can be safely disregarded except in known cases of advanced cirrhosis or malignancy, based on the recent work of Mann and Ballman (30) of Mayo Foundation, who proved experimentally that partial removal of the liver has little demonstrable effect on the rate of disappearance of moderate amount of dyes injected into the blood, that there is an enormous factor of safety in the amount of hepatic tissue normally available and that the liver stubbornly maintains its activity so much so that it may be stated that hepatic insufficiency and death are concomittant. A moderately damaged liver does not interdict the use of sodium tetraiodophenolphthalein—Fried and Whitaker (31).

The accentuation of the kidney shadow at 17th hour can not be well explained at present, it may be, however, that excreted dye substance by the liver was picked up by the blood stream and later concentrated in the kidney for excretion; some hold that this is due to starvation, which the writer doubt.

FINDINGS IN GRAHAM TEST IN THIS SERIES

Confirmed by operation	57
" " " pos-negative	1
" " " neg-positive	1
Confirmed by direct evidence	5
" " secondary evidence	5
" " " " and clinical... ..	4
" " " " and direct	2
" " definite clinical evidence	1
Not confirmed	8
Primary failure	2
Negative findings (clinically 2 plus)	2
<hr/>	
Total cases examined... ..	88

The above findings indicate 96.5 percent confirmed by operation; taking out 8 non-confirmed cases, 2 primary failures and 2 negative findings the absolutely positive may be put at 86.4 percent.

Checked by intravenous method in four cases examinations repeated in four cases by oral method, all gave the same results. Of the two primary failure cases, one had violent reaction by vomiting and diarrhea, while the other was due to castor oil previously taken.

According to the recent report of Zinc (21) among his 131 cases which were operated on, 103 gall-bladders removed, of which 97 (94.25%) confirmed pathologic, and 28 were considered normal and not removed.

CASE ILLUSTRATION.

O.B., woman of 36, clinical diagnostic index 4 plus. The Graham test showed visualized gall-bladder with defective motility, containing four or more rounded negative areas—Plate V. Operation showed gall-bladder covered with fatty layer, slightly large, wall thickened, did not empty on pressure, found several faceted stones, size of mulberry; stomach and duodenum normal, cholecystectomy with recovery. Plate V.

A FEW POINTS IN READING FILMS.

Gas in duodenum or colon interferes with the gall-bladder shadow; when no shadows are obtained it requires a check up on the technique; transhepatic gall-bladder or congenital absence of gall-bladder or double gall-bladder have been reported—Bryan (32), Hobhouse (33), Hoffman and Jackson (34), Knox (35), Rycroft (36) and Schachner (37).

Occasional abnormal lobes of liver (Riedel's lobe) and highly placed small kidney shadows may be mistaken for the gall-bladder shadow; stones in the liver substance—Judd and Burden (10) and stones in kidney may be mistaken for gall-stones. Pazzi (38) described such a difficult case and method of differentiation.

Diabetics occasional present vague chronic dyspeptic symptoms suggestive of chronic cholecystitis, they frequently show abnormal reaction to Graham test. Some undoubtedly may be due to diseased gall-bladder, but their habitus also may give rise to these abnormal reactions.

New growths around gall-bladder and duct may present characteristic gall-bladder symptoms and abnormal reactions to the cholecystography. There is, however, usually high and more or less persistent icteric index.

ANALYSIS OF GRAHAM TEST FINDINGS

The findings of cholecystography may be summarized in the following headings:

- I. Visualized normally.
- II. Intermediate.
- III. Not visualized.
- I. Normal visualization:
 - a. Normal reaction.
 - b. Normal reaction but mottling within the shadow.
 - c. Defective motility.
 - d. Defective motility and some mottling.

The above may be combined with one or more of the following conditions:

- 1. Adhesion.
- 2. Defective outline.
- 3. Negative shadow of stone.
- 4. Positive shadow of stone.
- II. Intermediate:
 - a. Poorly visualized, plus defective motility.
 - b. Poorly visualized, plus mottling.
 - c. Poorly visualized, plus mottling and defective motility.

These may be combined with any of the above conditions, 1, 2, 4.

- III. Not visualized:
 - a. Mottling only.
 - b. Not visualized at all.

Again these may be complicated with any of the conditions, 1 (usually hepatic flexure) or 4.

ANALYSIS OF CASES OF CHOLECYSTOGRAPHY.

- I. A—Normal reaction does not absolutely mean absence of disease. If clinical symptoms warrant a repeated examination if possible by intravenous method, may bring up pathological shadow or reaction.....12.9%.
- I. B—Mottling—indicated many stones and the clinical symptoms—symptoms of this group marked.....9.6%.
- I. C—Defective motility—from mild catarrhal cholecystitis to "Strawberry" type were found and the clinical symptoms were not characteristic. In cases complicated by adhesions or negative stone shadows there was definite chronic cholecystitis and the clinical symptoms were marked.....18%.

- I. D—In cases with the defective motility and mottling, there was more advanced chronic cholecystitis associated with many stones. Where stones were not found, there was markedly productive and exudative inflammation. The clinical symptoms in this group varied from Cl. Diag. Index 1 plus to 4 plus.....14.5%.
- II. A, B, C—Since the pathological findings in all these groups were similar, these are considered together in one group. Adhesions about the walls of gall-bladders were usually quite frequent. Microscopically the gall-bladder showed varied stages of chronic cholecystitis, from atrophy to necrosis, containing either a few large stones or many small stones, viscid bile and pus. The clinical symptoms were marked in all these cases.....22.5%.
- III. A—Cases indicated by simply mottling in the gall-bladder region showed marked changes in the gall-bladder, from atrophic to necrotic cholecystitis; and if the gall-bladder was not packed with numerous stones, its duct was obstructed by a large stone.....8%.
- III. B—When the shadow is entirely absent a faulty technique must be first considered. In this group one case showed normal gall-bladder while the majority showed advanced stage of chronic cholecystitis containing many stones or sand, obstructing the cystic ducts. In one case there were no stones but the adhesions around the ampulla were so great as to obstruct the duct. The clinical manifestations in these two groups were characteristic—14.5%.

SUMMARIES.

1. Only 28% of gall-bladder disease cases present "text-book" clinical symptoms, and 50% of them can be definitely diagnosed clinically, while the remainder of the cases depends on Roentgenologic examination.
2. While the clinical diagnosis of gall-bladder disease still remains difficult, and whereas the latent infected gall-bladder plays an important part in interfering with the general welfare of the body, all available methods should be used for its detection in order to institute early treatment.
3. The diagnosis of a cholecystitis by direct evidence is obtained in 15—20%, by secondary evidence in 72%, and by the Graham test in 83%.
4. Roentgenological diagnosis and clinical study should always be carefully correlated, especially in cases in which surgical interference is considered.
5. Well defined secondary evidence may be obtained in cases in which there are no definite adhesions around the gall-bladder.
6. A band of adhesions from a diseased gall-bladder to the duodenum may produce the exact clinical picture of duodenal ulcer, and Roentgenologically and

- clinically a filling defect thus produced may well be mistaken for an organic lesion of the duodenum in the presence of six-hour retention which occurs sometimes.
7. Mild disease of gall-bladder may often give definite abnormality in cholecystography and produce definite clinical symptoms. Severity of the symptom is no index to the degree of pathological changes.
 8. Definite findings in Graham test (not simply positive or negative) correlated with clinical findings, and if possible with anatomical findings should be recorded, for in this way alone our clinical knowledge may be increased.
 9. The Graham test may show only a slight abnormality, but anatomically there may be a rather marked adhesion around the gall-bladder with only a slight change in the mucosa. In such a case a definite secondary evidence may be obtained contradictory to the Graham findings.
 10. Cholecystography is indispensable in differentiating pathological shadows obtained in Roentgenoscopy and Roentgenography; as due to gastric, duodenal, appendicular or gall-bladder adhesions. It is important, in cases where pressure deformities are produced on the stomach and duodenum, to know whether these are due to an anomaly of the liver, kidney, a new growth or a distended gall-bladder.
 11. As the laboratory and Roentgenological diagnostic methods become routine, the clinical study of cases becomes more and more important, and the clinician's task more difficult as there is a possible danger of being misled by erroneous conclusions derived from the findings of the other methods.
 12. The writer hopes that the cases here studied, although small in number and in facts deducted, may yet stimulate enthusiastic discussions and the appearance of more reports on the subject.

"The Past has taught its Lesson—the Present has its Duty;
and the Future its Hope"—Ridpath.

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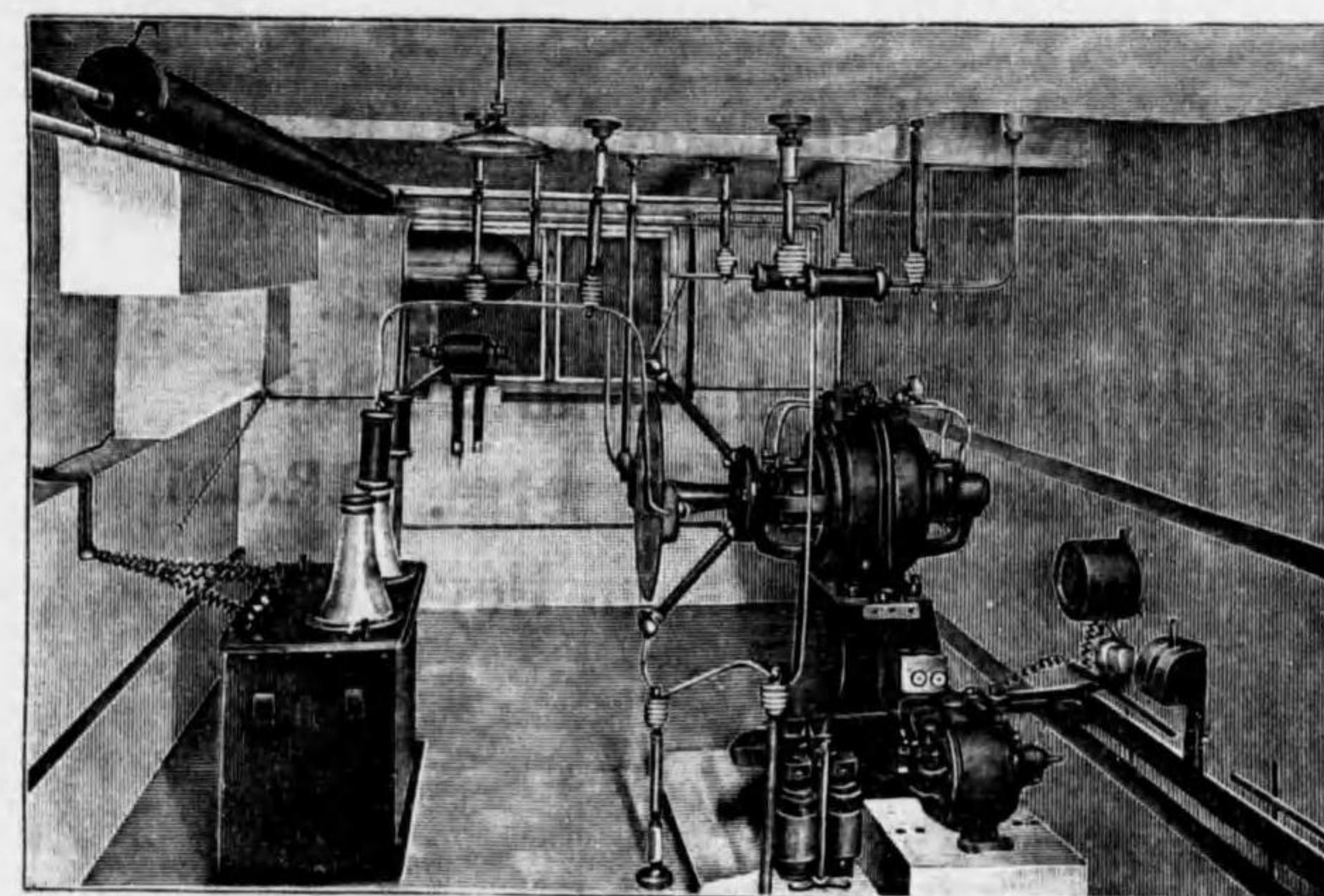


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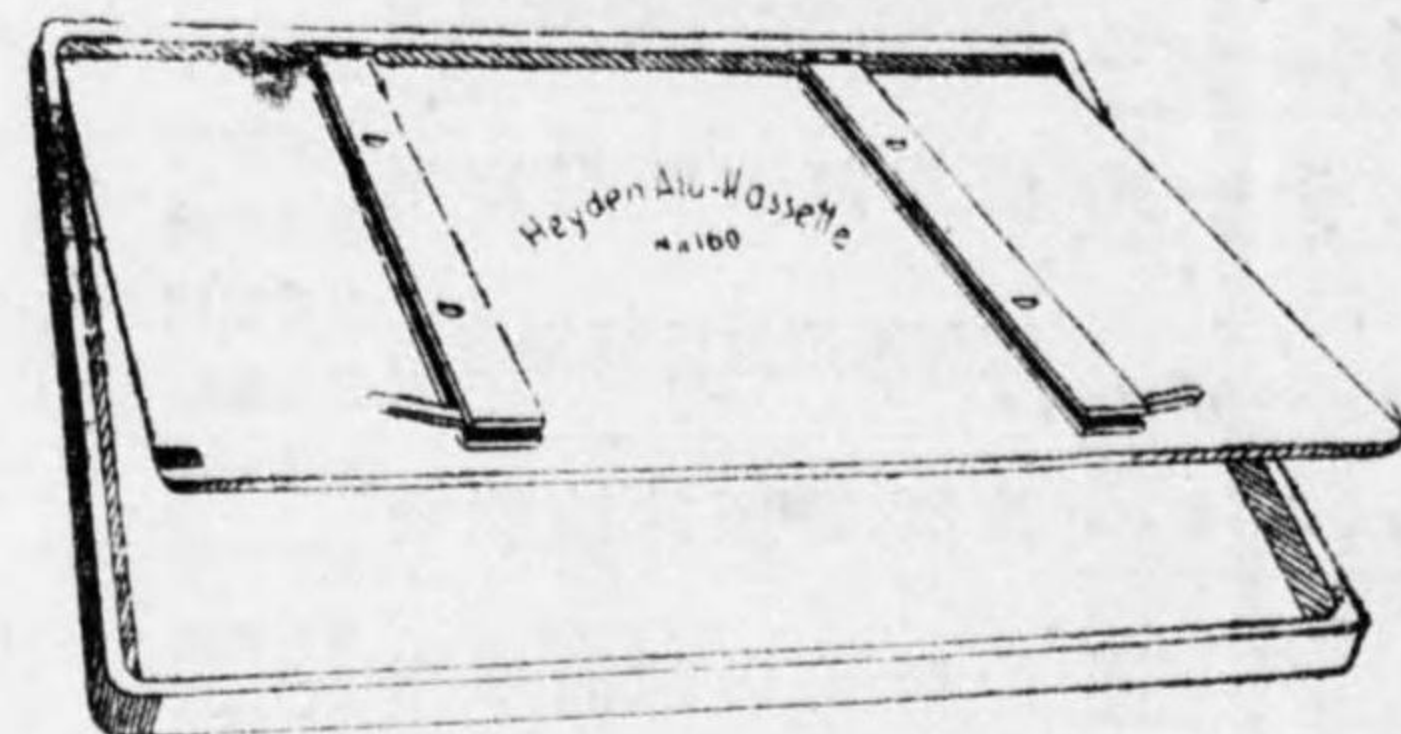
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