COLLECTIVE FLUOROGRAPHY [1]

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TWO methods of x-ray analysis have been available for the thoracic survey of large groups of individuals. One, radiography, is expensive and impractical, while the other, fluoroscopy, requires the services of a considerable number of skilled specialists (about 150 per million examinations per annum).

Fig. 1. The first collective apparatus, installed by Dr. Manoel de Abreu in May, 1936, at the Hospital Allemao, Rio de Janeiro.

The method of fluorography or fluoroscopic screen photography, or indirect radiography, which has also been called roentgen photography, does, however, permit practical chest surveys of large groups effectively and at a low cost.

Indirect radiocinematography, an expensive method, is still in the experimental stage and may eventually be useful for certain types of research and teaching, but it is not to be confused with the method of roentgen photography utilized by the writer for tuberculosis prophylactic surveys.

Though fluorography was attempted long ago by many workers, the early results were unsatisfactory. Blyer (1896), MacIntyre, Porcher, Kohler, Lomon and Comandon, Cole, and others experimented with the method. In HH8, and later, in 1924, we attacked this problem diligently but were unable to obtain decisive or practical results. Then most of the work was directed exclusively to the solution of the problem of radiocinematography. More recently this has been accomplished by Reynolds, Djean, and Janker.

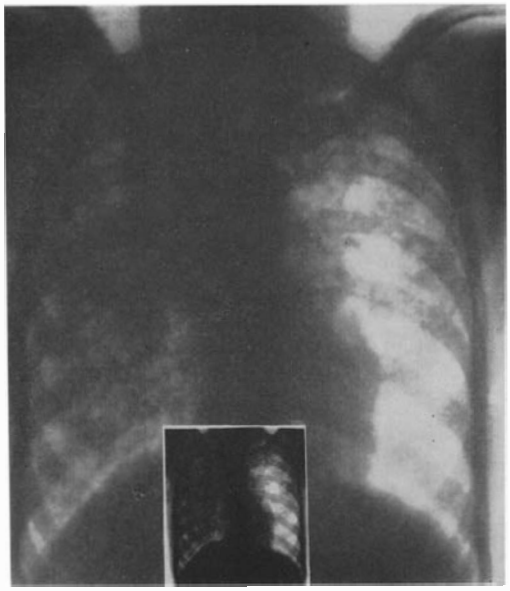

Fig. 2. One of the first films obtained by collective fluorography in May, 1936. Large infiltration on the right side and slight infiltration on the left.

We inaugurated the first installation of fluorographic apparatus for the purpose of carrying out a collective thoracic survey at the German Hospital of Rio de Janeiro, in HJ:-36; thus our priority cannot be contested.

In 1937 three additional centers were operating, one in the Public Health Department of Rio de Janeiro, one in the Navy Hospital, and one in the Public Health Department of Victoria.

At present,[2] due to the great interest

[1] This is one of a series of papers contributed by friends and former pupils of I. Seth Hirsch, M.D.

[2] Early in 1939.

aroused by this work, we have 25 installations in Brazil and many others in Argentina, Chile, Uruguay, Germany, France, etc. The method has also been carried to the United States by Dr. D. 0. N. Lindberg, of Decatur, Illinois, who, after his visit to us late in 1937, introduced fluorography in his sanitarium. Our attempts, in 1937, to interest American manufacturers in the construction of this apparatus were unsuccessful.

To-day, three years after the first practical results were achieved, collective fluorography is universally accepted. At the beginning of this work, there were many roentgenologists who expressed themselves in opposition to the procedure but have since become convinced as to its practicability.

Fig. 3. Roentgenphotographic apparatus "Manoel de Abreu" at Rio de Janeiro Public Health Department (June, 1937).

The objections with which we had to contend at the beginning were principally that since the initial roentgenological indications of tuberculosis are frequently very vague, fluorography would not show sufficient detail to demonstrate early tuberculosis, and that fluoroscopy in various planes was essential to diagnosis. Also, the wear and tear on x-ray tubes from the exposures on a large scale would make the procedure expensive.

In answer I quote from Professor Hans Holfelder (Introductory remarks of Professor Holfclder (17); "The present work of Dr. Abreu deserves the most widespread attention in the consideration of the question of a large-scale campaign against tuberculosis, since, for the first time in practice, a means has been found which, in my opinion, is capable of settling the problem of the proper position of roentgen diagnosis in the battle against tuberculosis." (*Fortschr. a. d. Geb. d. Rontgenstahlen,* 58, 183, 1938.)

From our eminent colleague, Dr. R. Vaccarezza, President of the Argentine League Against Tuberculosis, we have received a communication from which we quote the following: "My gratitude was greater for having had the opportunity of learning your roentgen photographic method which I studied closely. Its application in social work I consider one of the greatest medical conquests of recent time." (Aug. 2, 1927.)

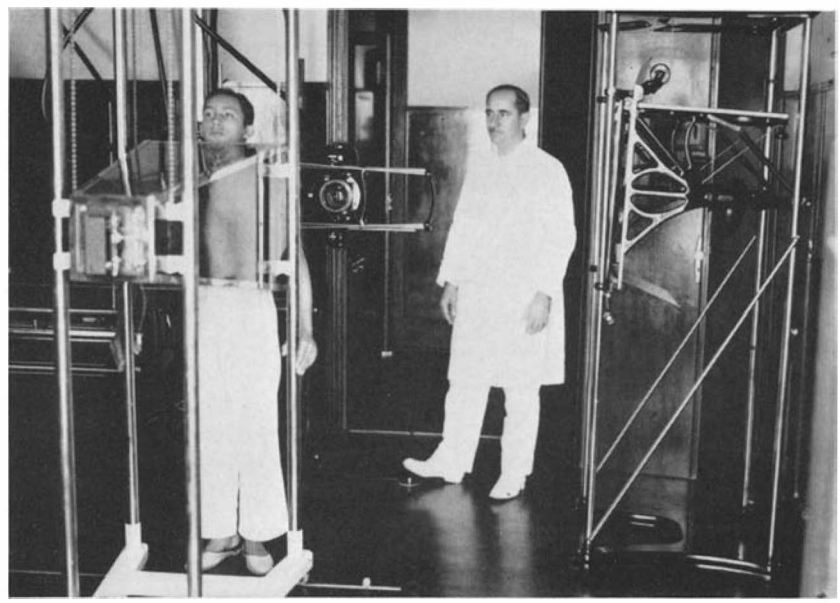

Fig. 4. The roentgenphotographic apparatus "Manoel de Abreu" at the Marine Center of Rio de Janeiro (August, 1937).

The technic used in the beginning of our work was as follows:

1. Four-valve rectifier apparatus.
2. Water-cooled 10 kw. line focus tube.
3. G. E. Patterson screen or Siemen's Super-astral screen without yellow varnish.
4. Objective Zeiss F LS.
5. Objective screen distance 90 cm.
6. X-ray tube-screen distance 60 cm.
7. Film, 35 mm. Agfa Isochrome F (28 Sch.).
8. Adult average chest, 10 ma., 80 kv., from 0.3 to 0.4 second.
9. Children, 100 ma., 100 kv., from 0.03 to 0.05 second.

Under these conditions, 35,000 fluoro-

graphs were made at the Public Health Department without damage to the tube.

Later modifications introduced are:

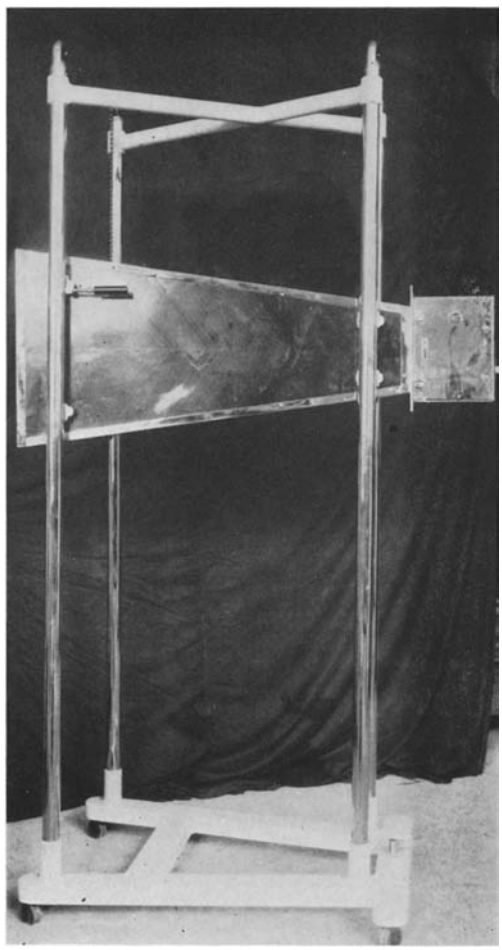

Fig. 5. The four-column apparatus built at the beginning of 1937, and inaugurated at the Health Department of Rio de Janeiro in June, 1937. Observe the special "collective" camera.

1. Kodak Super XX film (32 Sch.) or Agfa Isopan I.S.S. (31 Sch.).

2. Average adult chest, 50 ma., 55 kv., from 0.2 to 0.3 second.

3. Children, 100 ma., 50 kv., from 0.03 to 0.05 second.

With half wave apparatus, without rectification, we advise 70 kv., leaving the other factors unchanged.

The 35 mm. film size is preferred because it is easily available and inexpensive (about one cent per record). We are convinced that the small image, 2.4 cm. square, has a perfection of detail completely adequate for a diagnostic survey. Teleradiography and planigraphy must often be used as supplements for an individual case.

TABLE I.—COMPARISON OF EXPENSE OF THREE METHODS, FOR ONE MILLION EXAMINATIONS ANNUALLY

Radiography	$900,000
Radioscopy	340,000
Roentgen Photography	112,000

It is erroneous to believe that the greater detail obtainable with instantaneous teleradiography permits a finer diagnosis of tuberculosis. Our investigation of the limit of visibility of pulmonary lesions indicates that such visibility is mainly determined by radiogeometry, that is, by the angle of incidence of the radiation on the surfaces bounding different densities. If the incidence on the surface of a lesion is parallel or tangent, the visibility is clear; if, however, it is oblique or transverse with an obliquity greater than 22.5 degrees, the images are faint or may even vanish. Thus, in the best teleradiography, processes having a volume from 20 to 100 c.c. are not visible. We believe that frequently roentgen photography at various angles, such as anterior and posterior descending directions, has the advantage over teleradiography of showing faintly visible or invisible lesions.

The diagnosis of all or almost all cases of pulmonary tuberculosis by means of roentgen photography will assist in directing the social campaign against tuberculosis to meet the threat presented by the individual. The hazard, according to our conception, is dependent upon the relation between afflicted persons and children or adolescents.

The categories of decreasing hazards are three: (*a*) permanent contact (common domicile); (*b*) indirect or transitory contact; (*c*) absence of contact.

The approximate data for the city of Rio de Janiero are shown in Table II.

Thus, among the 687,000 persons living together with children, 2 per cent suffer from disease (13,740). Of these, 5,000 are the greatest hazard due to their close intercourse with children. The scale of hazard is as follows: mothers, 4.4.; female servants, 4.25; female relatives, 2.8; fathers, 2.8; male servants, 2.66; male relatives, 2.

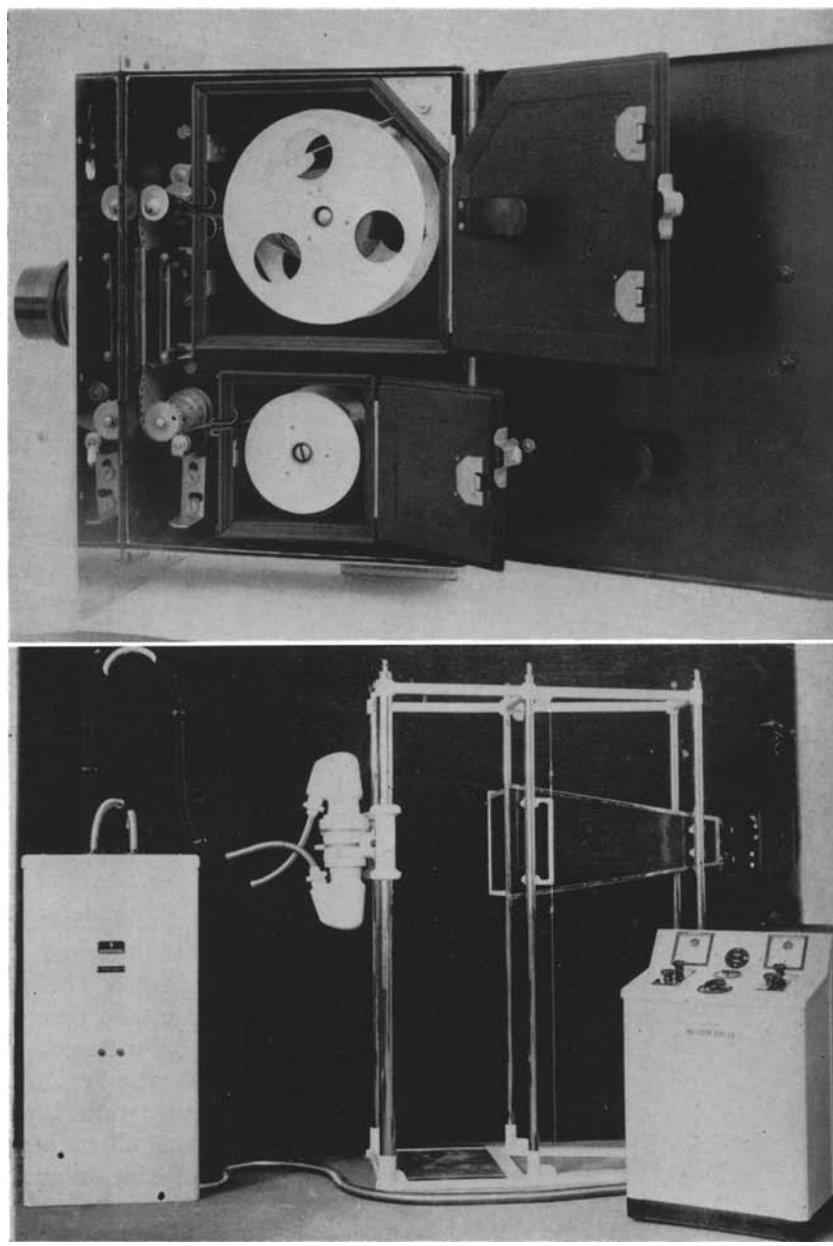

Fig. 6. The special "collective" camera used since 1937, with the 60 mm. film bobbin.
Fig. 7. The latest type of collective fluorographic apparatus with six columns, built in 1938, first installed at the Assistencia Municipal, Rio de Janeiro.

parents, 3,750 servants, and 5,000 relatives and friends. The females among these—mothers, servants, and relatives—present

The legislative measures which would

assure this campaign for a general survey should be based on the health examination already obligatory for those employed in certain occupations (collective). It would be sufficient if such health examinations were: first, required periodically with roentgen photography; second, extended to all workshops, homes, teaching, and sport centers; third, required not only of workmen, soldiers, teachers, students, and sportsmen, but also of members of their respective families and people sharing their homes.

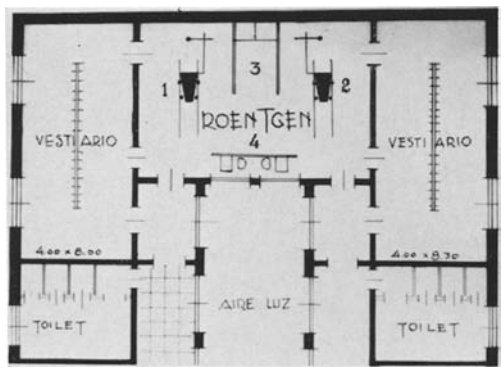

Fig. 8. The Argentine Center of Thoracic Census with two roentgenphotographic apparatus "Manoel de Abreu," under Dr. Vaccarezza's direction, to be inaugurated in Buenos Aires, May, 1939. 1 and 2, apparatus; 3 and 4, x-ray protectors.

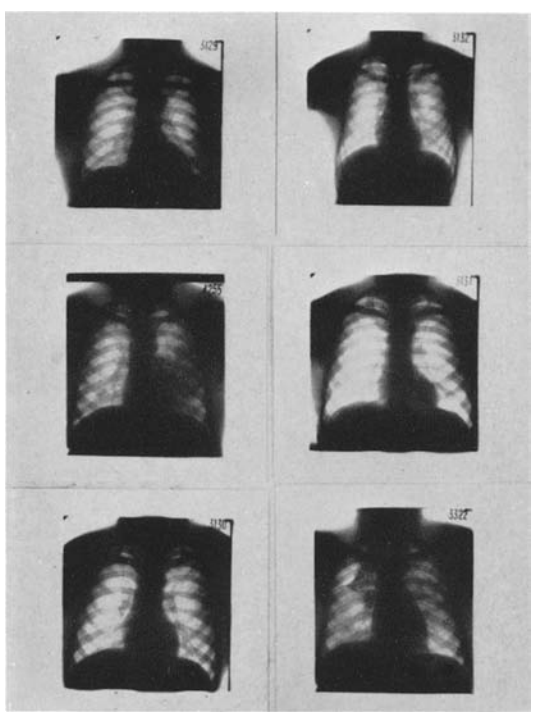

Fig. 9. Fluorographic prints, natural size.

TABLE II

Population	2,000,000
Minors	500,000 (25%)
Homes with children	125,000 (4 children each)
Parents	250,000 (2 to each home)
Servants in general	187,000 (1.5 per home)
Other adults in homes	250,000 (2 per home)
Total number of adults in homes	687,000 (5.5 per home)
Tuberculosis mortality	7,000 per annum
Number of tuberculous persons	40,000 (5.7 × mortality)

In this way there would be established a new and efficacious campaign against tuberculosis—a center for complete thoracic survey. Such a center should be equipped with social and statistical service and three roentgen photographic installations capable of completing 3,000 examinations daily, or 85,000 per month, or about 1,000,000 a year.

The thoracic survey center should, in addition to making the diagnosis, have control of all persons either tuberculous or suspected of being infected with the disease. Unknown tuberculous persons would then disappear. The social status of those individuals who present a hazard and of those who are menaced by exposure would be known to the health authorities. The thoracic survey would permit early diagnosis by means of roentgen photography of all the population and enable the dispensaries to operate with the utmost efficiency.

Systematic prophylaxis would at once solve the problem regarding suspects in our homes (servants and friends) who number 4,375. These persons would, without any expense, be summarily withdrawn from homes with children and adolescents. There would remain 2,500 tuberculous

parents with 5,000 children threatened or already infected. In this group, the children as well as their parents must be cared for with our present and future facilities.

The sanitation and prophylactic system based on hospital dispensaries failed, because a complete thoracic survey has until now not been made. Tuberculosis pro-

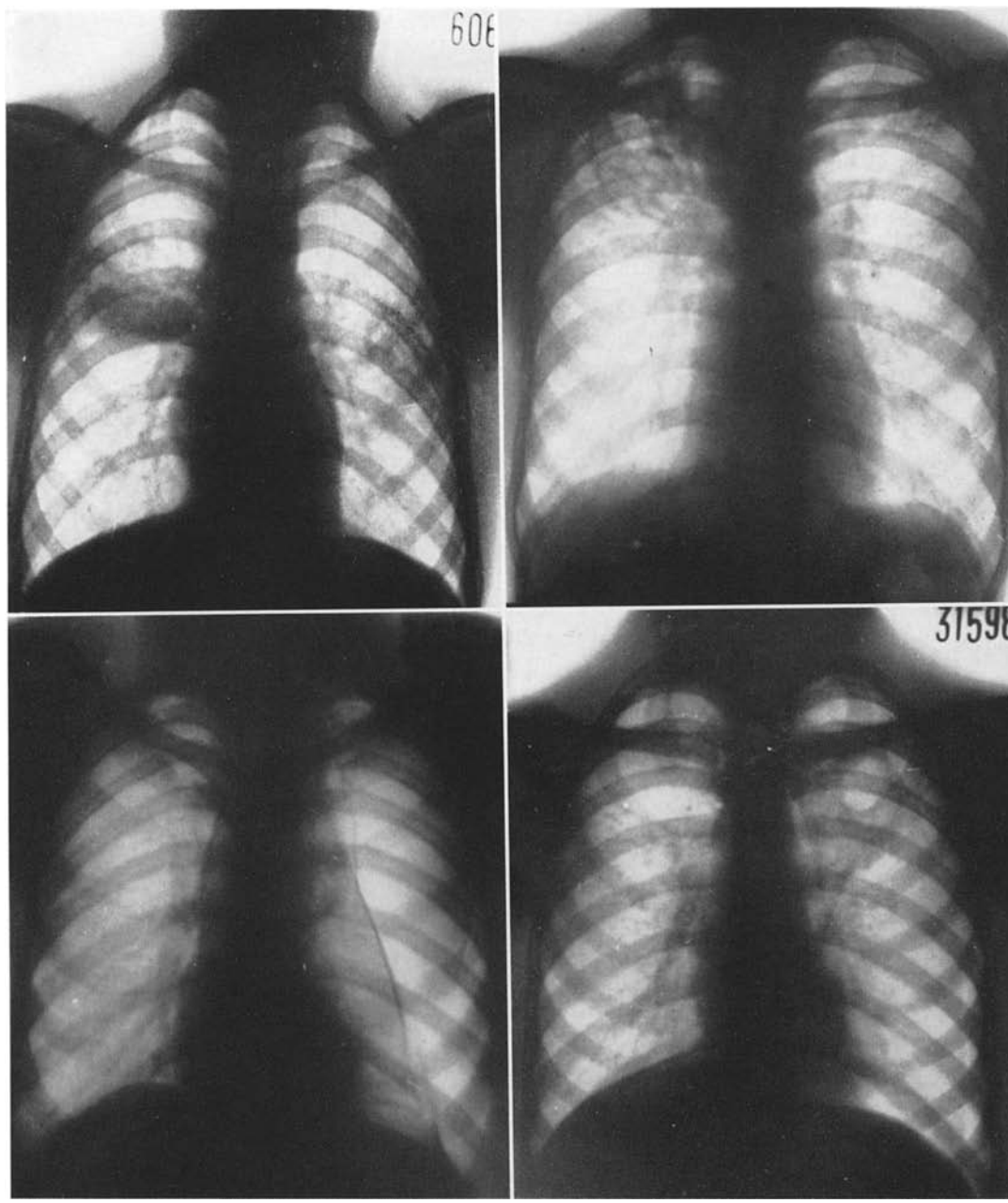

Fig. 10 (*upper left*). Enlarged fluorography. Infiltration in the region of the small right interlobar fissure. The left lung shows a small cavity between hilus and costal borders.

Fig. 11 (*upper right*). Fibroid tuberculosis of the upper right lobe. Undiagnosed, but discovered by the chest collective examination.

Fig. 12 (*lower left*). Left pneumothorax. The collapse therapy control at the Health Department of Rio de Janeiro is done only by fluorography, in two views: postero-anterior and right or left oblique.

Fig. 13 (*lower right*). A cavity in the upper right lobe. Another case of undiagnosed tuberculosis discovered by the collective examination.

phylaxis cannot be secured by treatment and isolation of a small percentage of tuberculous persons. On the contrary, it would be based on the discovery of all infectious foci followed by the isolation of all dangerous persons and protection of all those threatened and in a receptive condition.

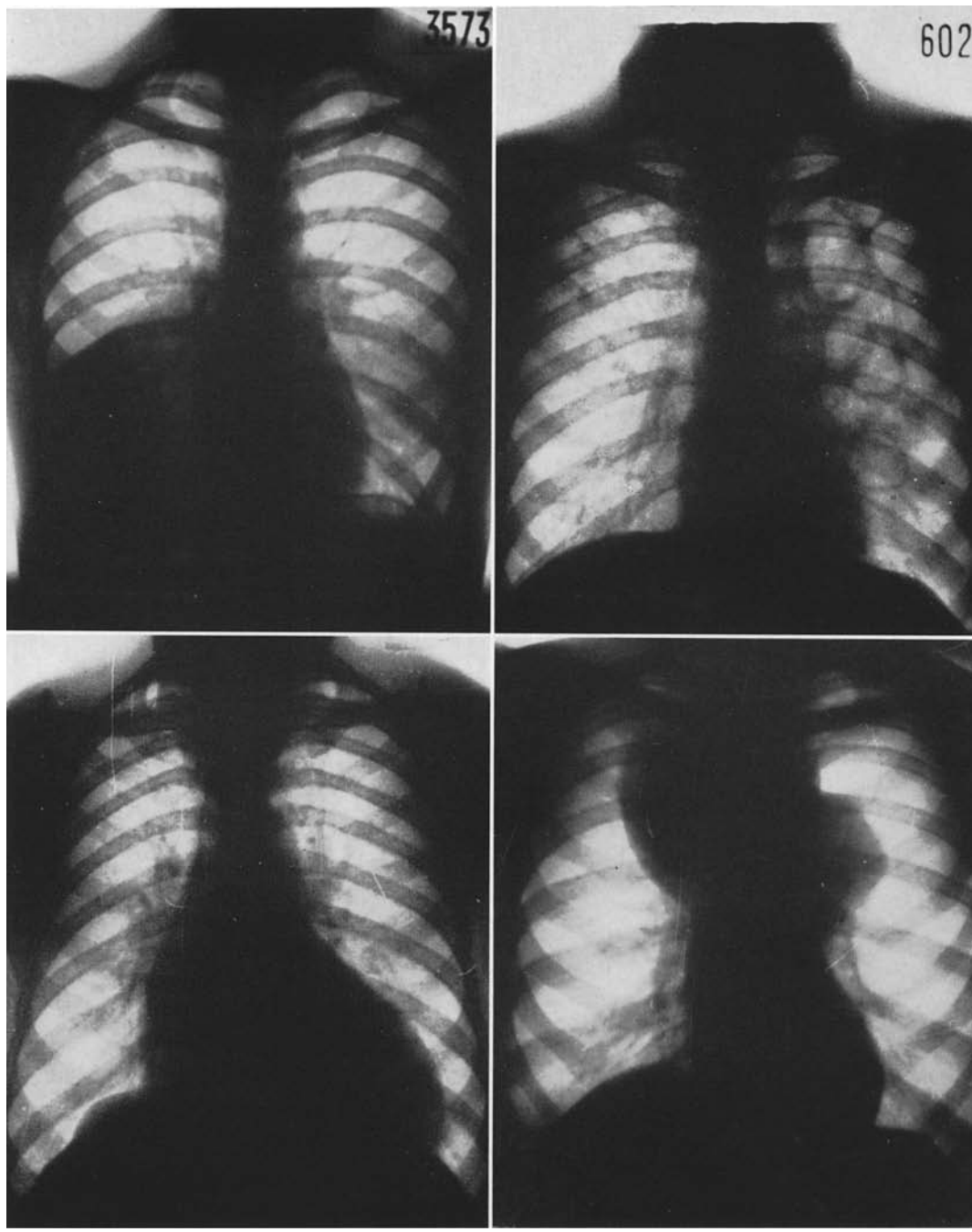

Fig. 14 (*upper left*). Consolidation at the right base.
Fig. 15 (*upper right*). Multiple cavities in left lung. Discrete foci on right side.
Fig. 16 (*lower left*). Aortic insufficiency; hypertrophy of the left ventricle.
Fig. 17 (*lower right*). Aortitis and large aneurysm of the ascending aorta revealed by collective fluorography.

We add that, in addition to tuberculosis, we simultaneously check the cardiovascular system, having in view the frequency of syphilitic aortitis in Brazil.

Systematic fluoroscopy as a control in collapse therapy has been abandoned by us and replaced with advantage by fluorography prior to insufflation. The description of the new method may be found in our book published early in 1938 (14).

Finally, we employ fluorography with planigraphy; in this way we can take a great number of sections at various angles with no expense.

REFERENCES[3]

(1) DE ABREU, MANOEL: Previous Note about Collective Fluorography. Med. and Surg. Soc. of Rio de Janeiro, July, 1936.

(2) Idem: Roentgenphotography: Process and Apparatus. Lung Tuberculosis: Social Census, Radiography, and Radioscopy. Collective Roentgenphotography. Rev. Assn. Paulista de med., **9,** 313–324, December, 1936.

(3) Report of Brasilian Tuberculosis Society on Manoel de Abreu's Method on Collective Thoracic Examination. September, 1936.

(4) DE ABREU, MANOEL: Roentgenphotography: Technic and Apparatus for Roentgenphotography and Thoracic Census. Día méd., **37,** Buenos Aires, 1937.

(5) MAZZEI, E. S.: The Roentgenphotography of Manoel de Abreu. Día méd., **37,** Buenos Aires, 1937.

(6) DE ABREU, MANOEL: New Ways on Tuberculosis Prophylaxis. Surg. and Phar. Jour., Rio de Janeiro, May, 1937.

(7) Idem: New Directions on Tuberculosis Prophylaxis. Día méd., **43,** Buenos Aires, 1937.

(8) Idem: Roentgenphotography: Technic and Apparatus. Día méd., **10,** 157–160, Feb. 28, 1938.

(9) MAZZEI, E. S.: Roentgenphotography. Argentina Med. Assn. Jour., Buenos Aires, May 20, 1938.

(10) VACCAREZZA, R.: Report for the Argentine League against Tuberculosis, Buenos Aires, 1937.

(11) DE PAULA, ALOYSIO, and BENEDETTI, F.: Present Orientation on Tuberculosis Dispensary. Hygienic Arch., **7,** November, 1937.

(12) FONTENELLE, J. P.: Annual Report of Federal District Public Health Department. Rio de Janeiro, 1937.

(13) BARRETO, J. DE BARROS: National Public Health Department Report, Rio de Janeiro, 1937.

(14) DE ABREU, MANOEL: Roentgenphotographic Thoracic Census (226 pages, 18 figures, 14 plates.) Published by O Globo Library, Porto Alegre, 1938 (delivered to the editor in July, 1937).

(15) Idem: Collective Fluorography. Seventh Pan-American Congress of the Havana Medical Association, January, 1938. (Introduced by Dr. José Pratts.)

(16) DE PAULA, ALOYSIO: Collective Roentgenologic Examination against Tuberculosis: Manoel de Abreu's Method and its Results. Lectures during the South American Medical Congress at Montevideo, January, 1938. Rev. de tuberc. d. Uruguay, **7,** 129–152, 1938.

(17) HOLFELDER, HANS: Presentation of Dr. Manoel de Abreu's Works on Collective Fluorography. Frankfurt, Germany, February, 1938.

(18) DE ABREU, MANOEL: Actual Situation of Roentgenphotography on Tuberculosis Prophylaxis. Official report presented to the First Regional Tuberculosis Congress, Rio de Janeiro, May, 1938.

(19) NEVES, JAYME SANTOS: Fight against Tuberculosis at Esperito Santos State and Manoel de Abreu's Method. First Regional Congress of Tuberculosis, Rio de Janeiro, May, 1938.

(20) DE ABREU, MANOEL: Technic and Apparatus for Collective Fluorography (Indirect Roentgenography). Ztschr. f. Tuberk., **80,** 70–91, 1938.

(21) Idem: Collective Radiophotography. Jour. de radiol. et d'électrol., **22,** 232–235, May, 1938.

(22) COELHO, JOAO: The Radiophotography of Manoel de Abreu. Presse méd., **46,** 1032, June 25, 1938.

MORE RECENT REFERENCES

(1) DE ABREU, MANOEL, DE PAULA, ALOYSIO, and BENEDETTI, F.: Argentine Archives of Respiratory Apparatus, special number on M. de Abreu's Roentgenphotography, May, July, 1938.

(2) DE PAULA, ALOYSIO: First Results of Roentgenphotography of Manoel de Abreu. Lecture at the Paulista Medical Society, Aug. 18, 1938.

(3) DE ABREU, MANOEL: Zwei Jahre kollektive Röntgenphotographie. Fortschr. a. d. Geb. d. Röntgenstrahlen, **58,** 574–587, December, 1938.

(4) DE PAULA, ALOYSIO, and BENEDETTI, F.: Epidemiological Dispensary. Roentgenphotography as Fundamental Work at the Tuberculosis Dispensary. Folha Med., Sept. 5, 1938.

(5) DE PAULA, ALOYSIO: Tuberculosis, 1 vol., 58 pages. S. P. E. S. Edition, 1938.

(6) PAULINO, FERNANDO: The Results of 15,000 Roentgenphotographs. Sixth National Congress of Medicine, at Cordoba (R. Argentine), Oct. 16–21, 1938.

(7) RONNEAUX, G.: Note on the Roentgenphotography of Manoel de Abreu. Bull. et mém. Soc. d'électro-radiol. méd. de France, **26,** 624–627, November, 1938.

(8) RONNEAUX, G., DEGAND, F., WATTEZ, E., and SAGET: Essay on the Application of Roentgenphotography in Pulmonary Stratigraphy. Bull. et mém. Soc. d'électro-radiol. méd. de France, **26,** 687–693, December, 1938.

(9) YANKER, ROBERT: Leuchtschirmphotographie Röntgenreihenuntersuchung. Leipzig, 1938.

(10) SAYE, L., and CAUBERRERE, N. L.: The Practice of the Method of de Abreu for the Collective Diagnosis of Tuberculosis. Presse méd., March 25, 1939.

(11) BARRETO, J. DE BARROS: Federal Health Services in 1938, pp. 52, 53, Rio de Janeiro, 1939.

(12) MARINHO, ABELARDO, DE PAULA, ALOYSIO, ASSIS, ARLINDO, CARNEIRO, FERNANDO, and PITANGA, GENESIO: Tuberculosis and Social Provision, p. 15, May, 1939.

[3] Collective Fluorographic Bibliography from 1936, 1937, to the beginning of 1938.