THE FOCAL PULMONARY TUBERCULOSIS OF CHILDREN AND ADULTS.

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PLATES 68 TO 71.

(Received for publication, January 22, 1917.)

In order to obtain data concerning the relation of phthisis to tuberculous infection during childhood it has been desirable to determine the local frequency of infection among both children and adults. In a city such as St. Louis conditions of living differ widely from those in cities of the old world where the incidence of tuberculosis has heretofore been studied.

Statistics which have been obtained would be of little value if they had not demonstrated that here as in European cities tuberculous infection is well nigh universal among those who have reached adult life. A detailed examination of the localization and character of the lesions found in the lungs and elsewhere has furnished new data concerning tuberculous infection, for it has demonstrated that the healed or healing tuberculous lesions demonstrable in the lungs of many children and of nearly all adults have characters which serve to distinguish them from the progressive pulmonary tuberculosis of adults. They are identical with the tuberculosis of infancy and early childhood and exhibit little resemblance to the phthisis of adults.

The use of x-ray plates made from the lungs has proven an efficient means of determining the presence of healed tuberculous lesions within the substance of the organs. Since calcium salts are impervious to the x-rays very small calcified nodules may be readily identified in the plate (Figs. 1 to 9). Partially calcified foci containing caseous material of soft friable consistence are conspicuous in x-ray plates. Search for tuberculous lesions has been made in the lung hardened in formalin and, as far as necessary, cut into thin sections. In no in-

stance has the x-ray shadow been used as evidence of the presence of a calcified nodule. The difficulty of finding a nodule well depicted in the plate has often been great (Fig. 8), and in a number of instances no lesions would have been demonstrable without the aid of the plate. In one specimen a small intrapulmonary nodule obvious in the plate was long sought by careful palpation of sections from 0.5 to 1 cm. in thickness, and finally found within the angle at the bifurcation of a bronchus of medium size.

Lesions characterized by the presence of nodules which had undergone caseation were regarded as tuberculous. A calcified nodule surrounded by a fibrous capsule was regarded as a tuberculous lesion in which calcium had been deposited in caseous material. With few exceptions calcified nodules were found both within the substance of the lung and in regional lymphatic nodes at the hilus of that lobe in which the pulmonary lesion occurred. Although it is well known that tuberculous lesions in healing may form fibrous scars, fibrous nodules were not classified as tuberculous even when they formed wedge-shaped masses penetrating from the pleura into the substance of the apices. Wherever there was doubt concerning the nature of a lesion microscopic examination was made. In two instances tubercles were found by microscopic examination although none were recognized by the naked eye.

Pulmonary tuberculosis in infancy and early childhood is accom panied by enlargement and caseation of intrapulmonary bronchial and of tracheal lymph nodes. The pulmonary lesion may be situated in any part of the lungs and is not more frequently localized in the apices than elsewhere; there is indeed a tendency for the lesion to occupy the mid-part of either lung, frequently affecting the middle lobe on the right side or the corresponding part of the upper lobe on the left. There is in infancy little formation of fibrous tissue about the tuberculous lesion, but with increasing age encapsulation by fibrous tissue occurs more frequently. Cavities are much less frequently formed in children than in adults and usually occupy only a small part of the tuberculous lesion. Dissemination of tuberculosis frequently occurs and tuberculosis of the meninges, spleen, or other tissue is frequently associated with pulmonary tuberculosis and tuberculosis of bronchial lymphatic nodes.

Pulmonary tuberculosis of adults almost invariably affects the apices of the lungs. The disease tends to pursue a chronic course; there is often abundant formation of fibrous tissue and cavities are commonly present when the lesion is advanced. The disease does not implicate the regional lymphatic nodes at the hilus of the diseased lung. In the absence of acute miliary tuberculosis generalization with tuberculosis of the meninges, spleen, or other organs is uncommon unless the disease is approaching a fatal termination.

For the purpose of the present investigation the pulmonary tuberculous lesions which occur in childhood have been compared with those of adults. The age of 18 years has been arbitrarily selected as the line of division between adolescence and adult life. During the period within which autopsies were made upon fifty adults ninety-three children were examined. Tuberculosis was the cause of death in eleven children and in three adults; in the bodies of those who had died of other diseases, tuberculosis was found eleven times in children and forty-seven times in adults.

The incidence of tuberculosis at different ages is shown in Table I.

TABLE I.

Age.	No. of autopsies.	Tuberculosis.			
		Present.		Fatal.	Non-fatal.	In those who have died with other diseases.
Children.						
yrs.			*per cent*			*per cent*
Under 1	43	4	9.3	4	0	0
1– 2	16	1	6.2	1	0	0
2– 5	14	6	42.8	3	3	27.3
5–10	11	5	45.5	2	3	33.3
10–18	9	6	66.7	1	5	62.5
Adults.						
18–30	6	6	100	1	5	100
30–50	23	23	100	1	22	100
50–70	15	15	100	1	14	100
70+	6	6	100	0	6	100

The proportion of instances of fatal tuberculosis in Table I is of little significance since it depends upon the frequency with which tuberculosis is admitted to the two hospitals from which autopsies were obtained. Since all diseases are admitted to the St. Louis Children's Hospital the figures for children represent approximately the frequency of the disease in this city. Recognized tuberculosis is not usually admitted to the Barnes Hospital. When fatal tuberculosis is excluded the figures representing the incidence of tuberculous infection among those who have died of other diseases are an index of the frequency of infection in the general population. In most instances the anatomical characters of the lesion indicate that it has long existed in the body and bears no relation to the fatal illness. Before the age of 2 years the disease is almost always fatal, but later there is a progressive increase in the number of infected individuals. Evidence of infection has been found in all adults.

The result of this incidental study of the occurrence of tuberculosis in a small number of autopsies is in accord with the studies of Naegeli made in Zurich and of Burkhardt made in Dresden upon a far larger number of autopsies. Among adults Naegeli[1] found tuberculosis in 97 per cent and Burkhardt[2] in 90 per cent of all individuals.

A survey of tuberculosis which has been found furnishes a satisfactory basis for comparison between the lesions of infants and adolescents on the one hand and of adults on the other. The well known characters which distinguish the tuberculosis of childhood will be cited briefly.

Tuberculosis of Children.

Location and Character of the Pulmonary Lesions of Childhood.— Tuberculosis of infancy has occurred five times and in all instances was fatal within the 1st or 2nd year of life (Text-fig. 1 and Fig. 1). Massive caseous lesions in some instances have implicated a considerable part of one lung but do not affect the apex more frequently than other parts. The middle lobe on the right side in one instance has been almost wholly caseous. Small cavities are occasionally formed. These lesions have exhibited no tendency to heal. After

[1] Naegeli, O., *Virchows Arch. path. Anat.*, 1900, clx, 426.

[2] Burkhardt, A., *Z. Hyg. u. Infectionskrankh.*, 1906, liii, 139.

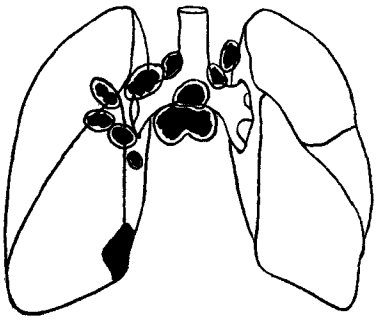
the end of the 2nd year tuberculous lesions have usually been small, seldom more than 1.5 cm. in diameter, and may be situated in any part of the lung substance (Text-figs. 2 to 6). They may be designated focal lesions and differ from the lesions of infancy only in size. A tendency to heal may be indicated by encapsulation of the caseous focus with fibrous tissue. In one instance an encapsulated caseous nodule has been found in a child only 2 years of age. The caseous material undergoes calcification and at first assumes a dry friable mortar-like consistency; later it is converted into material of stony hardness. Nodules consisting of a calcified center surrounded by a fibrous capsule and less than 1 cm. in diameter have been found in a considerable proportion of all children between the ages of 4 and 15 years (Figs. 2 and 3). More than two-thirds of all these tuberculous foci have been in contact with the pleural surface of the lung (Text-figs. 1, 4, and 6).

The study of Ghon[3] based upon a large number of observations has demonstrated the distribution of pulmonary tuberculous infection in children. The distribution of the lesion in the cases which I have studied is cited in order that the lesions of children and of adults may be compared. In most instances there has been only one focus of pulmonary tuberculosis (Text-figs. 1, 2, and 5); smaller nodules nearby may be obviously secondary to a larger lesion (Text-fig. 3). In three instances there have been two or more separate foci of infection (Text-fig. 6). The distribution of these lesions in the various lobes of the lung have been as follows: right upper lobe, 7; right middle lobe, 3; right lower lobe, 5; left upper lobe, 5; left lower lobe, 5. These figures are cited to show that the tuberculous lesions of childhood are impartially scattered in the substance of the lung. In one instance in a child 11 years of age tuberculosis had the usual characters of the phthisis of adults; the apices of both lungs were affected and cavities of considerable size occurred in both lungs. It is well known that fatal tuberculosis of this type is not uncommon after the 6th or 7th year.

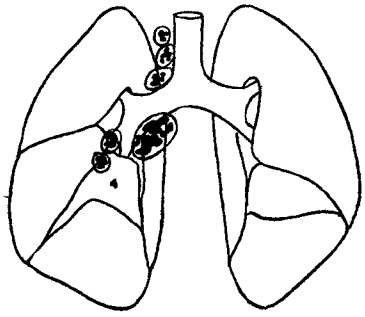
Relation of the Pulmonary Focus to Lesions in Regional Lymphatic Nodes.—The most conspicuous character of tuberculosis in children

[3] Ghon, A., Der primäre Lungenherd bei der Tuberkulose der Kinder, Berlin, 1912.

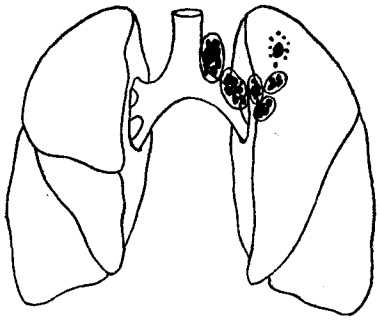
is the extent of involvement of regional lymphatic nodes. In nineteen instances caseous or calcified tuberculous lesions were found both in the substance of the lung and in the lymphatic nodes either



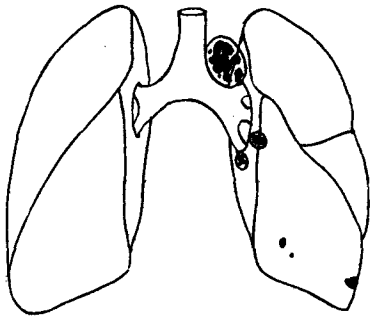
TEXT-FIG. 1. Posterior view of the lungs of a child, age 9 months, who died of pulmonary tuberculosis, meningitis, and general miliary tuberculosis. There is a caseous focus in the left lower lobe and tuberculosis of the regional lymphatic nodes. Compare with Fig. 1 showing the same lungs.



TEXT-FIG. 2. Median view of the lungs of a child, age 2½ years, who died of ileocolitis. There is a caseous focus in the right lower lobe and caseation of the regional lymphatic nodes.

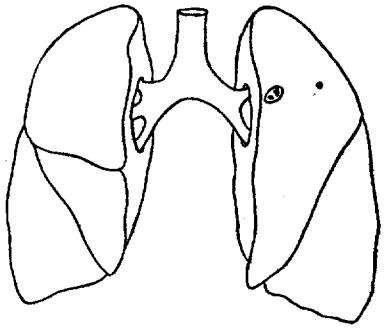


TEXT-FIG. 3. Anterior view of the lungs of a child, age 3 years, who died of postdiphtheritic paralysis and bronchopneumonia. There is a caseous focus surrounded by tubercles in the left upper lobe and caseation of the regional lymphatic nodes.

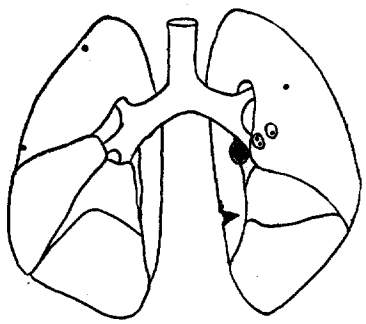


TEXT-FIG. 4. Posterior view of the lungs of a child, age 6 years, who died of otitis media and acute suppurative meningitis. There are three calcified nodules in the lower right lobe and in the regional lymphatic nodes. Compare with Fig. 2 from the same lungs.

within the lung near its hilus or in the adjacent peribronchial or tracheal nodes. In only one instance has a lesion been found in the lymphatic nodes although none was demonstrable in the substance of the lung. It is not improbable that small lesions may be overlooked. If caseation has failed to occur complete resolution of the lesion is possible. In one instance a tuberculous focus was found in the lung although none was found in the adjacent lymphatic nodes. In the child with apical tuberculosis mentioned above, the regional lymphatic nodes were enlarged and contained tubercles but were not caseous.



TEXT-FIG. 5. Anterior view of the lungs of a child, age 10 years, who died of osteomyelitis and pyemia. There is an encapsulated, caseous, and partly calcified nodule in the left upper lobe and a lymphatic node nearby contains encapsulated caseous nodules.



TEXT-FIG. 6. Median view of the lungs of a child, age 15 years, who died of an abscess of the brain and bronchopneumonia. There are calcified foci in the left upper and lower lobes and calcification of regional lymphatic nodes. In the right upper lobe there are encapsulated caseous foci but no caseation of the lymph nodes on this side. Compare with Fig. 3 from the same lungs.

Ghon, studying the tuberculosis of children, has shown the almost constant association of pulmonary lesions and lesions of the pulmonary and bronchial nodes. He has found that the pulmonary lesion often exhibits characters which indicate that it is older than the lesion of the adjacent lymphatic nodes and this observation he believes furnishes evidence that the pulmonary lesion is primary and the lymphatic foci are secondary. In several instances the specimens which

I have examined have exhibited a similar relation between pulmonary and lymphatic lesions; the lesion of the lung has been encapsulated whereas there has been no encapsulation of the lymphatic lesion.

The susceptibility of the lymphatic nodes of infants and very young children to tuberculosis is well shown by great enlargement and widespread caseation of the affected nodes. Masses of greatly enlarged almost wholly caseous lymphatic nodes occupy the hilus of the lung in which the pulmonary focus is situated, and similar masses fill the spaces between trachea and lung or the angle at the bifurcation of the trachea (Text-figs. 1 to 4). At a more advanced age there is less enlargement and caseation of regional lymphatic nodes and in children between the ages of 10 and 18 years it is not uncommon to find small caseous or calcified nodules in only one or two lymphatic nodes (Text-figs. 5 and 6).

Tuberculosis of Adults.

Table I shows that tuberculosis has been found in all of fifty individuals above the age of 18 years. The criteria previously described have been kept in mind and no lesions regarded as doubtful have been recorded as tuberculous. Tuberculous lesions characterized by the presence of fresh tubercles have been designated active tuberculosis. Lesions in which caseous foci are completely surrounded by fibrous tissue have been found much more frequently; in this group are included a considerable number of lesions in which the caseous material has a dry mortar-like consistence, is obviously partially calcified, and gives a conspicuous shadow upon the x-ray plate. Lesions in which a firmly calcified center is surrounded by a capsule of fibrous tissue have been classified as healed tuberculosis. Table II shows the frequency of active, encapsulated, and healed tuberculosis in the series of autopsies which have been studied. When active and encapsulated lesions occurred in the same individual the process has been listed as active; when encapsulated and calcified lesions occurred together the disease was classified as encapsulated. Tuberculosis was regarded as healed only when all the lesions were firmly calcified and surrounded by fibrous tissue.

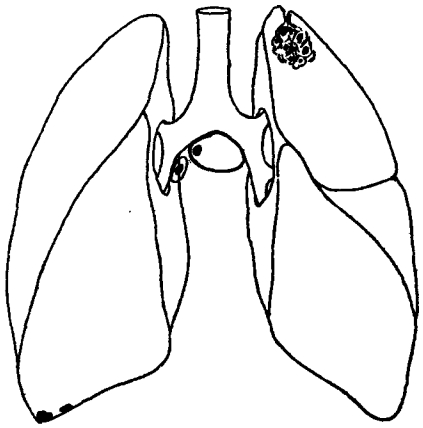
TABLE II.

Age.	No. of autopsies.	Active tuberculosis.		Encapsulated caseous lesions.		Healed tuberculosis.	
Children.							
yrs.			*per cent*		*per cent*		*per cent*
Under 1	43	4	9.3	0	0	0	0
1- 2	16	1	6.2	0	0	0	0
2- 5	14	5	35.7	1	7.1	0	0
5–10	11	2	18.2	1	9.1	2	18.2
10–18	9	1	11.1	4	44.4	1	11.1
Adults.							
18–30	6	1	16.7	3	50.0	2	33.3
30–50	23	2	8.7	12	52.2	9	39.1
50–70	15	2	13.3	7	46.7	6	40.0
70+	6	1	16.6	3	50.0	2	33.3

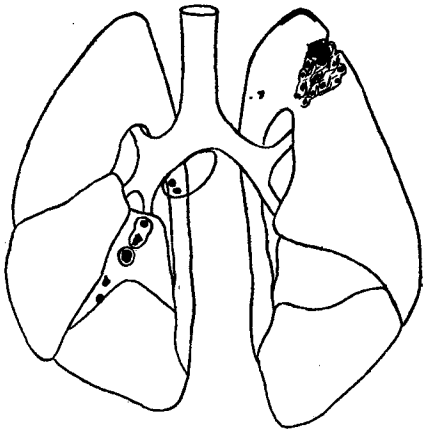
The table shows that active tuberculosis is very frequent between the ages of 2 and 10 years. These lesions are often of small size and undergo encapsulation. Latent or encapsulated tuberculosis is found in approximately half of all individuals over 10 years of age. Many of these lesions heal completely and a third of all adults have firmly calcified foci which represent former tuberculous infection.

The frequency of healed tuberculosis in the autopsies which I have studied is less than that found by Naegeli and by Burkhardt, and the proportion of latent encapsulated tuberculosis is greater. I have not recorded the pulmonary lesion as healed unless it has been compactly calcified and have excluded from the group of healed lesions cases in which caseous tuberculosis was found in regional lymphatic nodes.

Tuberculous lesions of the lungs may be separated into two sharply definable groups: (1) Lesions occupying the apices of the lungs, tending to spread diffusely through the tissue of the apex and unaccompanied by caseation (or calcification) of the regional lymphatic nodes represent what is generally regarded as the usual type of tuberculosis of adults (Text-figs. 7 and 8). This lesion which is often fatal may undergo complete healing and in a considerable proportion of autopsies upon individuals who have presented no evidence of



TEXT-FIG. 7. Posterior view of the lungs of a negro, age 39 years, who died of aneurysm of the aorta. There are two calcified nodules in the lower left lobe and similar nodules in the regional lymphatic nodes. There is a diffuse tuberculous lesion with caseation and fibrosis at the apex of the right lung. There is no caseation of the lymphatic nodes on the right side.



TEXT-FIG. 8. Median view of the lungs of a white man, age 74 years, who died of general arteriosclerosis, chronic diffuse nephritis, and fibrous myocarditis. There are calcified nodules in the right lower lobe and calcified and caseous foci in the regional lymphatic nodes. Near the apex of the left upper lobe is a diffuse tuberculous lesion with caseation and fibrosis. There is no caseation of the lymphatic nodes on the left side.

pulmonary tuberculosis the apex of one or both lungs is occupied by an area of diffuse fibrous induration within which occur caseous or calcified nodules. For convenience I shall designate this lesion apical tuberculosis. (2) The second group consists of circumscribed lesions situated in any part of the lung, not more frequently in the upper parts of the upper lobes than elsewhere, and accompanied by similar caseous or calcified lesions of the regional lymphatic nodes (Text-figs. 9 to 20). In the lungs of adults who have died with disease other than tuberculosis this is the commonest type of tuberculosis. These lesions have the distribution and characters of the circumscribed tuberculous lesions which begin to appear after the 2nd year of life and during later childhood are often found to be encapsulated and even calcified. They may be designated focal tuberculosis.

The relative frequency of the two types of pulmonary tuberculosis in the present series of autopsies is shown in Table III.

TABLE III.

Age.	No. of autopsies.	Focal pulmonary tuberculosis.		Apical tuberculosis.	
Children.					
yrs.			*per cent*		*per cent*
Under 1	43	4	9.3	0	0
1– 2	16	1	6.2	0	0
2– 5	14	6	42.8	0	0
5–10	11	5	45.5	0	0
10–18	9	5	55.5	1	11.1
Adults.					
18–30	6	5	83.3	1	16.7
30–50	23	21	91.3	3	13.0
50–70	15	14	93.3	4	26.7
70+	6	6	100.0	3	50.0

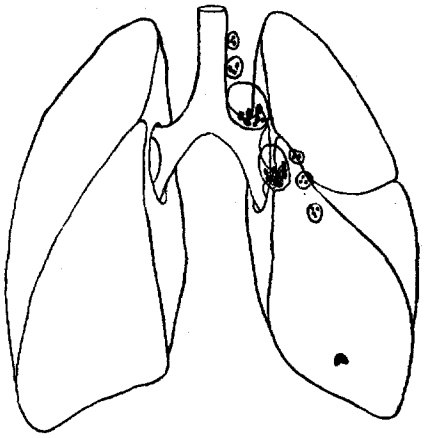
It is noteworthy that the incidence of focal tuberculosis increases continuously after the 2nd year of life. Comparison with Table I shows that the focal type of tuberculosis is frequently fatal in early childhood whereas after the 10th year it is rarely a cause of death. At the age of 18 a large proportion of all individuals have acquired these focal lesions but a few have escaped; at least 92 per cent of all

adults possess focal lesions. Apical phthisis in the present series of autopsies makes its appearance at the age of 11 years and subsequently apical lesions increase in frequency from adolescence to old age. The existence of focal lesions on the one hand does not preclude the occurrence of apical tuberculosis. On the other hand, in one instance of apical tuberculosis between the 18th and 30th years there was no focal lesion and apical tuberculosis was associated with caseous tuberculosis of the regional lymphatic nodes and general miliary tuberculosis. I shall discuss the relation of focal to apical tuberculosis in a subsequent paper.

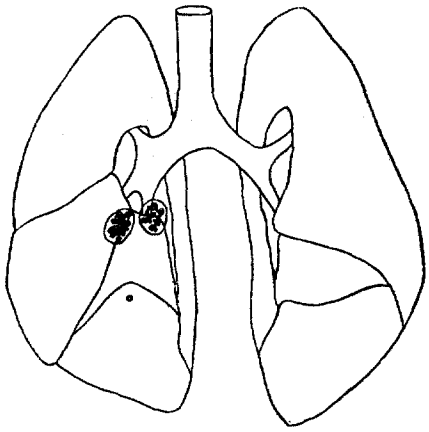
Location and Characters of the Focal Tuberculosis of Adults.—The circumscribed tuberculous foci which occur in the lungs of adults do not differ in character and distribution from those which are found in older children. They rarely exceed 1 cm. in diameter and the smaller nodules perhaps not more than 1 mm. across are found with much difficulty even when they are calcified and cast a conspicuous shadow upon the x-ray plate. Attention is often first attracted to these pulmonary nodules by the more conspicuous lesions almost always present in the regional lymphatic nodes.

In the greater number of lungs there is only one focus of tuberculous infection (Text-figs. 9 to 12); when small nodules are near a relatively large focus they have been regarded as secondary to it (Text-figs. 13 and 14). In about a third of the autopsies studied two foci of pulmonary infection have been present (Text-figs. 15 to 18), and in several instances three (Text-fig. 19), four, or more foci have been found. In one instance (Text-fig. 20 and Fig. 9) in the absence of any evidence of healed miliary tuberculosis in other organs a great number of firmly calcified nodules varying in size were sprinkled throughout the lungs so that every lobe contained numerous foci of infection.

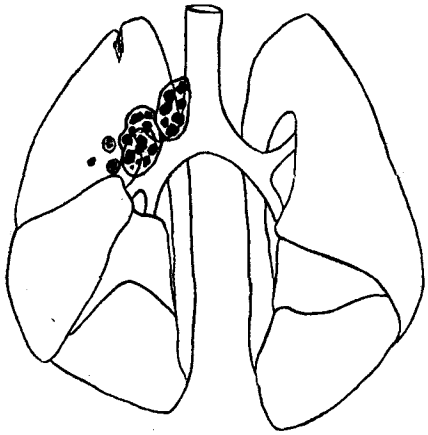
The distribution of focal tuberculous lesions in the lobes of the lung has been as follows: right upper lobe, 17; right middle lobe 5; right lower lobe 15; left upper lobe 14; left lower lobe 15. The distribution of these lesions in the adult lung is almost identical with that in the lungs of children and occurs in the different lobes in approximate proportion to their volume. Nearly one-half of these focal lesions are situated immediately below the pleural surface (Text-



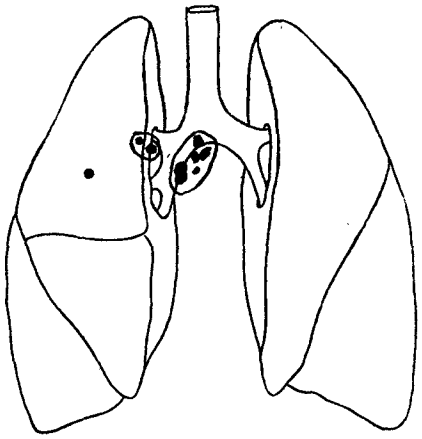
TEXT-FIG. 9. Posterior view of the lungs of a white man, age 19 years, who died of acromegaly, adenoma of the hypophysis, and bronchopneumonia. There is an encapsulated caseous focus in the right lower lobe and similar nodules in the regional lymphatic nodes.



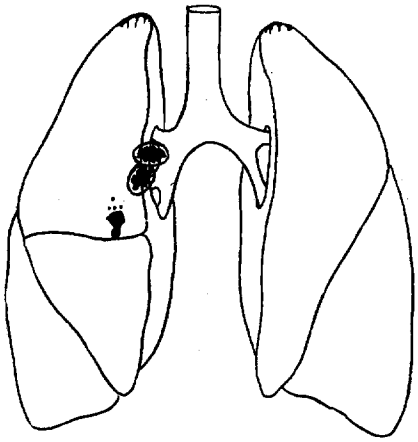
TEXT-FIG. 10. Median view of the lungs of a white man, age 35 years, who died of Hodgkin's disease, chronic diffuse nephritis, and cirrhosis of the liver. There are encapsulated, partially calcified caseous foci in the lower right lobe and in adjacent lymphatic nodes.



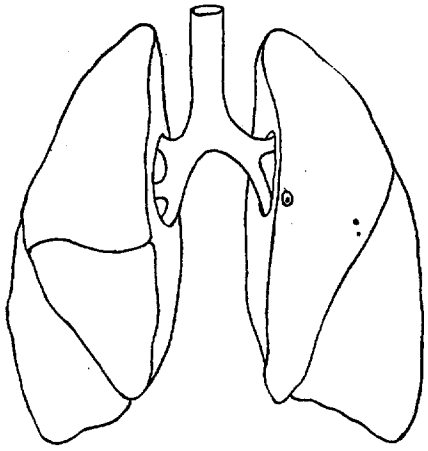
TEXT-FIG. 11. Median view of the lungs of a white woman, age 18 years, who died of typhoid fever. There are encapsulated, partially calcified, caseous foci in the right upper lobe and in adjacent lymphatic nodes.



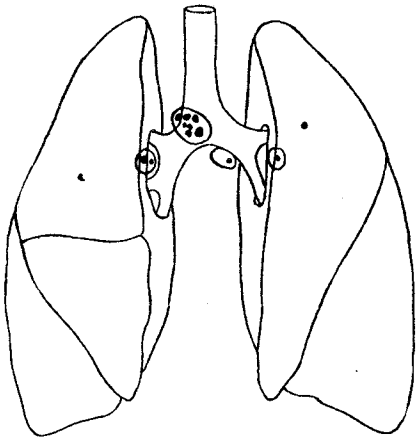
TEXT-FIG. 12. Anterior view of the lungs of a white woman, age 30 years, who died of Hodgkin's disease. There are encapsulated nodules in the right upper lobe and in adjacent lymphatic nodes.



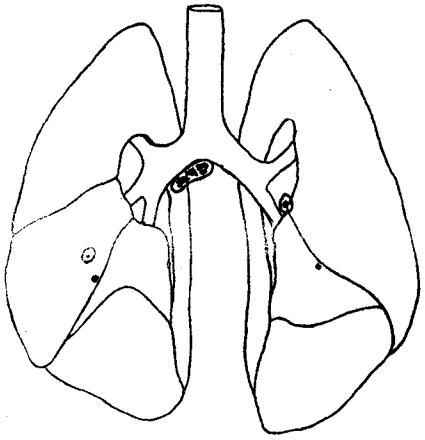
TEXT-FIG. 13. Anterior view of the lungs of a white woman, age 34 years, who died of Addison's disease, and tuberculosis of the adrenal glands, spleen, and left Fallopian tube. There are encapsulated, partially calcified, caseous nodules in the right upper lobe and in adjacent lymphatic nodes. These lesions appear to be older than those of the adrenal and spleen, etc. Compare with Fig. 4.



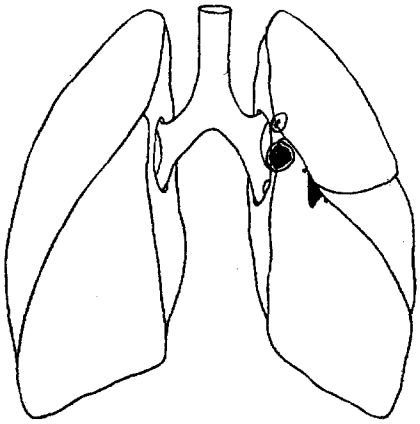
TEXT-FIG. 14. Anterior view of the lungs of a white man, age 56 years, who died of general arteriosclerosis, small granular kidneys, and hypertrophy of the heart. Inconspicuous calcified nodules occur in the left upper lobe and in a lymphatic node. Compare with Fig. 7.



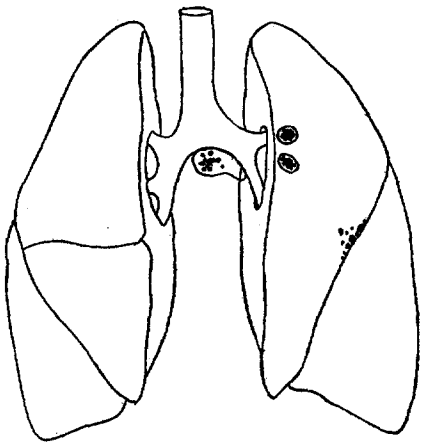
TEXT-FIG. 15. Anterior view of the lungs of a white man, age 71 years, who died of general arteriosclerosis, small granular kidneys, and hypertrophy and dilatation of the heart. There are two calcified nodules in the lungs and calcified and encapsulated caseous lesions in the lymphatic nodes.



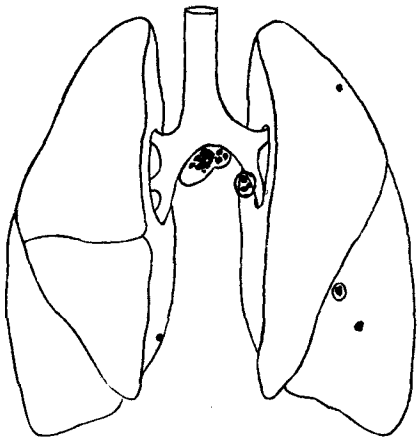
TEXT-FIG. 16. Median view of the lungs of a white woman, age 48 years, who died following an operation for carcinoma of the cervix uteri. There are calcified and encapsulated caseous nodules in the lungs and in the lymphatic nodes. Compare with Fig. 5.



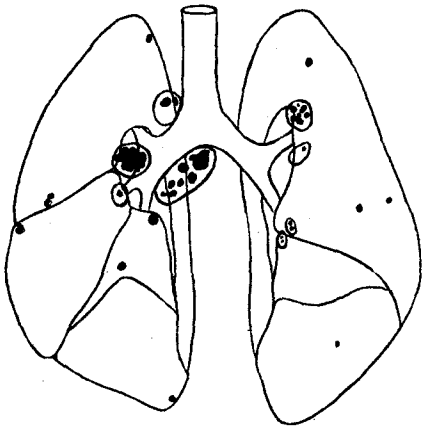
TEXT-FIG. 17. Posterior view of the lungs of a white man, age 80 years, who died of cirrhosis of the liver and chronic endocarditis. There is a calcified mass below the pleura of the right lower lobe and small calcified nodules occur in the pleura nearby. There is a calcified nodule in the right upper lobe and the lymphatic nodes at the hilus of the right lung are partially calcified.



TEXT-FIG. 18. Anterior view of the lungs of a white man, age 46 years, who died of æstivo-autumnal malaria. There is a group of calcified nodules in contact with the interlobular pleura of the left upper lobe. There is a calcified nodule in the right lower lobe. There are partially calcified lymphatic nodes at the hilus of the left lung but none on the right side. Compare with Fig. 6 from the same lungs.



TEXT-FIG. 19. Anterior view of the lungs of a white woman, age 50 years, who died of small granular kidneys, arteriosclerosis, and dysentery. There are multiple calcified nodules in the lungs and similar lesions in the lymphatic nodes. Compare with Fig. 8 from the same lungs.



TEXT-FIG. 20. Median view of the lungs of a negress, age 36 years, who died following panhysterectomy for myomata of the uterus. There are multiple calcified nodules in all the lobes and numerous partially calcified lymphatic nodes. Compare with Fig. 9 from the same lungs. The text-figure shows only those nodules which were identified in the lung. The x-ray plate shows the presence of a far larger number of calcified nodules.

figs. 13, 17, 18, 20, etc.). It is not uncommon to find a calcified nodule immediately below the puckered pleura and about it upon the adjacent pleura a group of small nodules (Text-figs. 17 and 18 and Fig. 6). Fibrous adhesions usually bind together the adjacent pleural surfaces.

In children freshly caseous focal lesions are predominant, whereas in adults encapsulated or calcified nodules are much more common. The following classification serves to indicate the character of the focal lesions which were found in adults: freshly caseous, 1; caseous and encapsulated, 5; caseous and encapsulated with beginning deposit of calcium salts producing dry chalky or mortar-like material, 12; firmly calcified, 48. In two instances tuberculous foci were found in the substance of the lung but none were found in lymphatic nodes.

Relation of the Pulmonary Tuberculous Focus to Tuberculosis of the Regional Lymphatic Nodes.—When a localized focus of active or pre-existing tuberculous infection has been found in one of the lobes of the lung a similar lesion, with few exceptions, has been found in intrapulmonary lymphatic nodes nearby or in intra- or extrapulmonary nodes near the hilus of the lobe affected (Text-figs. 9 to 20). In instances in which pulmonary lesions occurred in more than one lobe tuberculous lesions have been usually found in regional lymphatic nodes corresponding to each of the affected lobes (Text-figs. 15 to 17); but occasionally with multiple lesions some were unaccompanied by lesions of the adjacent lymphatic nodes (Text-figs. 18 and 19). The lesion of the lymphatic node is usually larger and more readily found than the pulmonary lesion and frequently there is a chain of tuberculous nodes beginning in the lung and extending along the corresponding bronchus to one or the other side of the trachea (Text-figs. 9 and 11). In correspondence with the distribution of tuberculosis often seen in childhood a large mass of nodes containing calcified nodules is found in adults at the bifurcation of the trachea and in the spaces above the bronchi between the trachea and lung (Text-figs. 9, 11, 12, 18, 19, and 20). Text-figs. 7 to 20 and Figs. 4 to 9 indicate the size and distribution of the lesions of the lymphatic nodes and their position in relation to the pulmonary lesion. In most instances irregular calcified masses occur within indurated lymphatic nodes deeply pigmented with carbon particles. In other instances

spherical nodules 2 or 3 mm. in diameter consisting of a caseous or partially calcified mortar-like center and a thick fibrous capsule are scattered within the substance of enlarged pigmented lymphatic nodes. Freshly caseous lesions are rarely seen in adults. The lesion of the regional lymphatic node is usually similar to that within the lung, both being either caseous or calcified, but in eight instances the pulmonary focus was firmly calcified whereas the lymphatic lesion was caseous. In two instances this relation was reversed.

Of the tuberculous lesions which have occurred in the lymphatic nodes and are unaccompanied by lesions of the lung two consist of typical gray fibroid tubercles identified by microscopic examination and three are calcified nodules. In one specimen a large lymphatic node at the bifurcation of the trachea contains firmly calcified foci: in a second a minute calcified nodule is found with the aid of an x-ray plate in a lymphatic node near the hilus of the left upper lobe and a minute shadow of similar size occurs in the lung substance nearby, but careful examination has failed to reveal a pulmonary lesion. In a third instance a calcified nodule surrounded by a fibrous capsule 4 mm. in diameter occurs in a lymphatic node below the bifurcation of the trachea and a second similar nodule occurs in a lymph node above the left bronchus; a pearly white nodule 2 mm. in diameter is found in the substance of the left lower lobe but there is no evidence of caseation or of calcification. The characters of these lesions suggest no doubt that they are identical with similar lesions found in association with tuberculous foci in the lung substance.

The foregoing observations have shown that tuberculous infection is practically universal. Dissemination of the disease among adults is so widespread that readily recognizable tuberculous lesions have been found in all of fifty individuals above the age of 18 years. First infection in almost all of those who reach adult life occurs in childhood and has the characters of a first infection in animals since it tends to implicate regional lymphatic nodes. Koch showed that a second infection of an animal already tuberculous shows greater tendency to heal and does not extend to regional lymphatic nodes, and this observation has been confirmed by numerous observers. Apical tuberculosis usually exhibits the characters of a second infection, since it pursues a chronic course and is unaccompanied by tuberculosis of regional lymphatic nodes.

CONCLUSIONS.

Evidence of tuberculous infection has been found in the lungs of all of fifty adults who have been examined. Approximately one-half of all adults have encapsulated lesions of the lungs or bronchial lymphatic nodes, whereas in one-third pulmonary and lymphatic lesions are firmly calcified and completely healed.

Tuberculous pulmonary lesions of adults who have died of diseases other than tuberculosis are of two types: (1) apical tuberculosis similar to the usual type of fatal phthisis and unaccompanied by caseation of the regional lymphatic nodes; (2) focal tuberculosis not more commonly situated in the apices of the lungs than elsewhere and accompanied by caseation (or calcification) of the adjacent lymphatic nodes.

Focal pulmonary tuberculosis of adults is identical with the tuberculosis of childhood. It occurs in at least 92 per cent of all adults. It may be acquired between the ages of 2 and 10 years but in more than half of all individuals (in this city) makes its appearance between the ages of 10 and 18 years.

Tuberculosis of children does not select the apices of the lungs, is accompanied by massive tuberculosis of regional lymphatic nodes, and exhibits the characters of tuberculosis in a freshly infected animal, whereas tuberculosis which occurs in the pulmonary apices of adults has the characters of a second infection. Almost all human beings are spontaneously "vaccinated" with tuberculosis before they reach adult life.

EXPLANATION OF PLATES.

PLATE 68.

FIG. 1. X-ray plate of the lungs of a child, age 9 months. The shadows correspond to caseous foci at the base of the lower left lobe and in the regional lymphatic nodes as shown in Text-fig. 1.

FIG. 2. X-ray plate of the lungs of a child, age 6 years, showing the calcified foci indicated in Text-fig. 4.

FIG. 3. X-ray plate of the left lung of a child, age 15 years, showing the calcified foci depicted in Text-fig 6.

PLATE 69.

FIG. 4. X-ray plate of the lungs of a white woman, age 34 years, who died of Addison's disease. The positions of the right and left lungs are reversed. Compare with Text-fig. 13 which shows the position of the tuberculous lesions indicated by shadows in the plate.

FIG. 5. X-ray plate of the lungs of a white woman, age 48 years. The positions of the right and left lungs are reversed. Compare with Text-fig. 16 from the same lungs.

PLATE 70.

FIG. 6. X-ray plate of the lungs of a white man, age 46 years. The positions of the right and left lungs are reversed. Compare with Text-fig. 18 from the same lungs.

FIG. 7. X-ray plate of the lungs of a white man, age 56 years, showing small calcified nodules which were found in the lungs with much difficulty. Compare with Text-fig. 14 from the same lungs.

PLATE 71.

FIG. 8. X-ray plate of the lungs of a white woman, age 50 years. The positions of the right and left lungs are reversed. Compare with Text-fig. 19 from the same lungs.

FIG. 9. X-ray plate of the lungs of a negress, age 36 years, showing a large number of calcified nodules in both lungs and in lymphatic nodes. The positions of the right and left lungs are reversed. Compare with Text-fig. 20 from the same lungs.

FIG. 1.

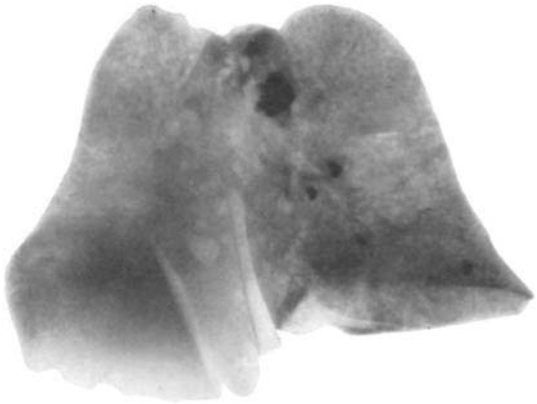


FIG. 2.

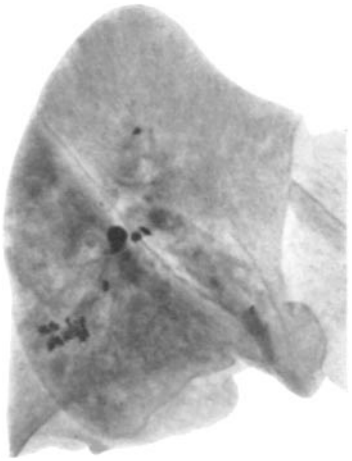


FIG. 3.

(Opie: Focal Pulmonary Tuberculosis.)

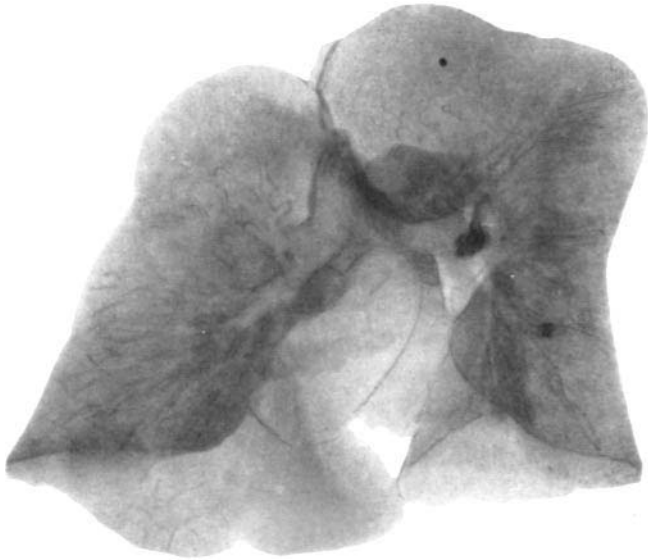


FIG. 4.

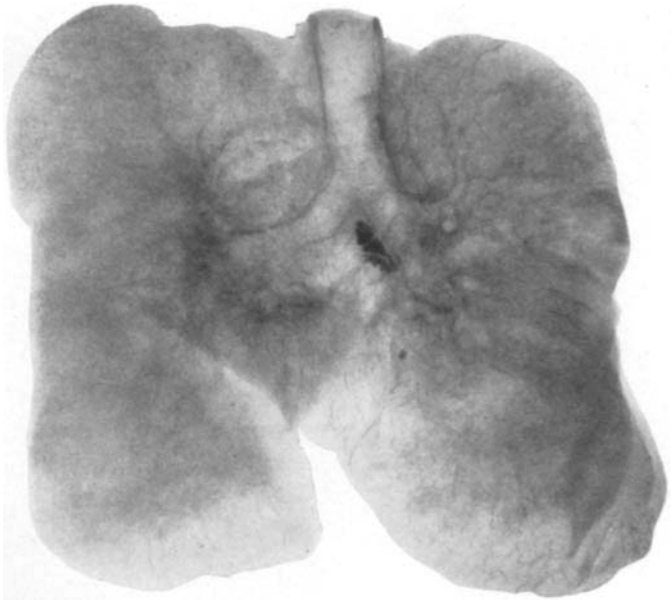


FIG. 5.

(Opie: Focal Pulmonary Tuberculosis.)

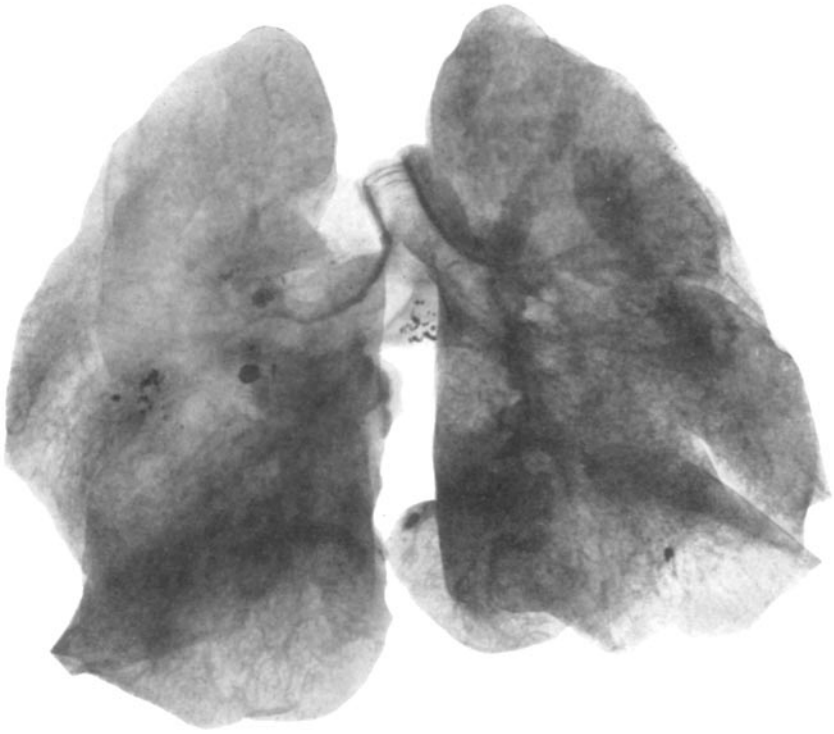


FIG. 6.

FIG. 7.

(Opie: Focal Pulmonary Tuberculosis.)

FIG. 8.

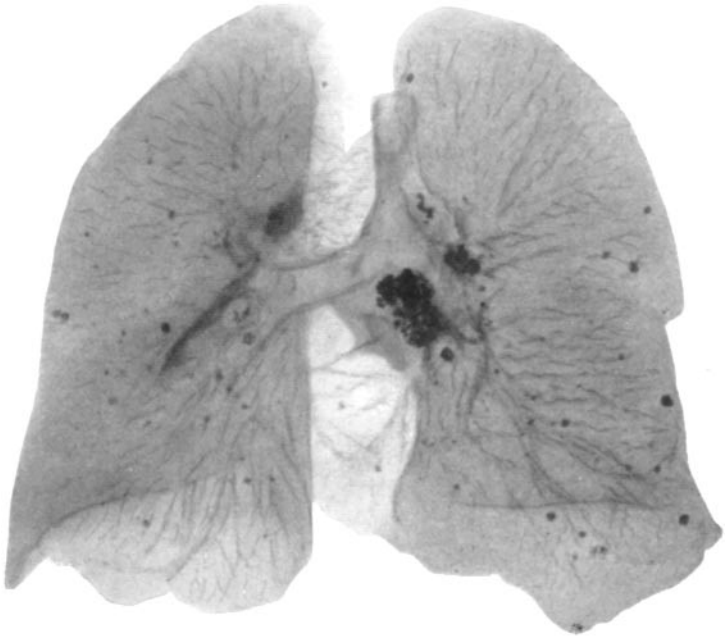


FIG. 9.

(Opie: Focal Pulmonary Tuberculosis.)