sick continue in their present form, such patients will of course be admitted to them ; but if patients are to enter hospital only when they require skilled attention, some alternative to the general hospital or municipal home will be needed. The long-stay annexe is the alternative suggested, and it will be necessary to assign responsibility for it either to regional hospital boards or to local authorities. It is here placed under local authorities only because this seems consistent with Section 21 of the National Assistance Act. A different decision would of course alter the proportions indicated above, and would assign to regional' hospital boards three-quarters of the patients applying for admission to hospital.

Summary

The personal circumstances of 393 patients seeking admission to a hospital for the chronic sick were investigated by a social worker ; 335 of these were examined by a consultant who considered the problem of disposal in the light of social circumstances and medical requirements. Cases were recommended for care as follows: (a) In a general hospital (40%): patients who needed skilled nursing and/or medical attention once a week or more frequently. (b) In a mental institution (10%): patients who needed personal supervision because of their abnormal mental state. (c) In a long-stay annexe (24%): patients not requiring skilled nursing or weekly medical attention who could not be kept in their own homes. (d) At home (26%): patients who could be cared for at home.

If local authorities provide the long-stay annexe they will be responsible for about one-half the patients seeking admission to hospital ; if they do not, they will be responsible for about one-quarter—that is, only for patients who could remain at home. According to this decision regional hospital boards must accept one-half or three-quarters respectively in the two cases.

The maintenance of one-quarter of the patients in their own homes requires the provision of domiciliary medical and nursing services, and of a more complete domestic service than is now available.

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The Brussels Treaty Public Health Committee, set up in application of Article II of the Treaty, as a part of the efforts to be made by the five signatory powers—Belgium, France, Luxembourg, Netherlands, and the United Kingdom—to raise the standard of living of their peoples, held its sixth session in Edinburgh on September 7, 8, and 9, 1950, under the chairmanship of Sir Andrew Davidson, Chief Medical Officer of the Department of Health for Scotland. The committee began the study of the protection of the civil population from the health point of view in time of emergency. In the matter of the health control of sea traffic the committee decided to recommend the five Governments to introduce, from March 1, 1951, onwards, a uniform system which will enable the five countries to be treated as one single territory in this respect, as has been achieved under the uniform system for control of air traffic which has been in operation since February 1, 1950. The committee took note of the very useful results obtained from the visits of health personnel organized in 1949–50, during which period 40 doctors and specialists from the five countries travelled in the other Brussels Treaty countries to learn about current methods as well as the general administrative structure of public health services in those countries.

RADIOLOGICAL AND PATHOLOGICAL CORRELATION OF MILIARY TUBERCULOSIS OF LUNGS IN CHILDREN
WITH SPECIAL REFERENCE TO CHOROIDAL TUBERCLES

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Since the description of the radiological appearance of the lungs in miliary tuberculosis by Klieneberger (1908), Otten (1908), and Presuhn (1908), the diagnosis of this condition during life has become almost exclusively based on radiological findings. As early as 1911 Assmann (1911b) regarded the diagnosis of miliary tuberculosis as a triumph of x-ray examination. Most reference books offer no alternative method of diagnosis, and the impression gained is that this method is generally satisfactory. Nevertheless, some books recognize that the disease may be present for weeks before the typical snow-storm appearance develops, and that sometimes there is no radiological evidence of the disease at all (Amberson, 1947 ; Hill, 1948 ; Kayne et al., 1948 ; Nelson, 1948). Similar views are expressed by Axén (1941), Davis (1942), Gratzek (1941), and Rigler (1949). The literature refers to many unexpected necropsy findings of miliary tuberculosis where previous radiographs of the chest were negative (e.g., Baggenstoss et al., 1947 ; Lincoln, 1947 ; Löffler and Piotti, 1948 ; Rigler, 1949 ; Rubie and Mohun, 1949).

Three previous papers concerning the pathological and radiological correlation of miliary tuberculosis have been noted (Bronson et al., 1934 ; Steiner, 1937 ; Chapman and Whorton, 1946). A fourth study correlated clinical and pathological findings, without specifying radiographs as the method of clinical diagnosis (Lewison et al., 1931). These four studies deal almost exclusively with adult material (Table I).

TABLE I.—*Pathological and Radiological Correlation of Miliary Tuberculosis (Previous Work)*

Author	Total Positive at Necropsy	Diagnosed by Radiographs
Bronson et al. (1934)	9	5 (56%)
Steiner (1937)	46	22 (48%)
Chapman and Whorton (1946) ..	63	16 (25%)
		Diagnosed in Life
Lewison et al. (1931)	96	75* (78%)

* 9 further cases diagnosed in life did not have miliary tuberculosis at necropsy.

Specific treatment is now available for miliary tuberculosis. The earlier treatment is instituted the better are the results, and early diagnosis is therefore essential. This study is an attempt to investigate the accuracy and speed of the present methods of diagnosis.

Material and Methods

In a consecutive series of necropsies between January, 1947, and August, 1949, the pathological diagnosis of miliary tuberculosis was established in 52 children under 14. Tuberculous meningitis was present in all but two cases. During the same period 11 children died of

tuberculous meningitis, but necropsy did not reveal miliary tuberculosis. Radiographs of the chest taken within a fortnight of death were available for examination in all cases.

Interpretation of Radiographs

When a discrepancy between the radiological and postmortem findings became apparent it was decided to obtain a wider opinion on the x-ray appearances. Accordingly the films were referred to an independent panel of two radiologists and two paediatricians.

The assessors were informed that all these deaths were from tuberculosis and were asked to make a radiological diagnosis of the presence, doubtful presence, or absence of miliary tuberculosis. The usual marks of identification had been removed from the films and each assessor was unaware of the others' diagnoses. The reports of the four assessors were analysed, along with those of Dr. Lodge (consultant radiologist to the hospital) and one of us (J. L.). The majority vote was accepted as the diagnosis. Eleven cases came to necropsy after the survey of the assessors was completed. The findings of the assessors, however, had been so consistent that it was regarded as justifiable to take the report of Dr. Lodge and one of us (J. L.) and include the eleven cases in the series. In the analysis of the results four radiologically doubtful cases will be included with those reported as negative, because many children with similar radiographs prove never to have miliary tuberculosis.

Ophthalmoscopy

In all but four children the fundus oculi had been examined for the presence of choroidal tubercles. The examination was carried out by the technique of Illingworth and Wright (1948) in the earlier cases, and under rectal thiopentone anaesthesia later (Lorber, 1950).

Morbid Anatomy of the Lungs (J. L. E.)

Before opening the chest the trachea was clamped in order to minimize collapse of the lungs. Blocks for histological examination were taken from at least one lobe of the lung quite separate from the one containing the primary focus. In many cases the blocks were taken from all lobes.

The criteria for diagnosis of miliary tuberculosis were either (a) the presence of macroscopic miliary tubercles throughout the lung at necropsy, or (b) the presence of miliary tubercles in sections taken from lobes of the lung not containing the site of primary focus.

The identification of miliary tubercles on histological examination was not difficult, except in some cases in which differentiation was required between small lymph follicles near bronchioles and early tubercles. The identity of a tubercle was not accepted unless it was typical, contained well-developed epithelial-cell foci and areas of necrosis, or was shown to contain acid-fast bacilli.

In several instances miliary tubercles had been found within the lobe containing the primary focus, but were absent in the block from a distal part of the lung. These were excluded from the cases reported here.

The diameters of the tubercles were measured from their extreme edges, using the microscope stage scale. The tubercles were classified according to the size of their majority into three groups : (a) less than 0.5 mm., (b) 0.5–1 mm., and (c) over 1 mm. in diameter. They were also classified according to their type into primarily cellular, necrotic, or fibrous groups. An estimate was made of the concentration of tubercles seen in the pleura and in the cut surface of the lobes and of the numbers of tubercles present per square centimetre of section.

Results

In 12 of the 52 cases miliary tuberculosis was diagnosed radiologically on the last film taken before death. Choroidal tubercles were seen in 10 of the 11 cases examined. At necropsy all showed macroscopic miliary tubercles of the lung, numbering 5 to 20 per $cm.^2$, and on histological examination all the tubercles were over 0.5 mm. in diameter, half being over 1 mm.

In the remaining 40 cases miliary tuberculosis was not diagnosed on the last radiograph taken before death. In six cases miliary tuberculosis was diagnosed radiologically at an earlier stage of the disease, but owing to streptomycin therapy was no longer apparent on the final examination. At necropsy macroscopic miliary tuberculosis was present in all of them. In five of these six cases choroidal tubercles had been found. It will be noted, therefore, that of the 17 patients examined in the radiologically positive group 15 had choroidal tubercles.

In 34 children there was never radiological evidence of miliary tuberculosis, yet at necropsy this was seen macroscopically in 23 and microscopically in the remaining 11. Choroidal tubercles were present in 10 of 31 examined—a significantly lower proportion than in those with radiological evidence of miliary tuberculosis. The miliary tubercles in this series varied in number from 1 to 6 per $cm.^2$ of section and the majority were 0.5 mm. or less in diameter.

It will be seen, therefore, that miliary tuberculosis was diagnosed radiologically in only 18 of 52 cases established at necropsy. Choroidal tubercles were seen in life in 25 of 48 children examined. Using both methods of diagnosis, 28 of 52 cases were diagnosed correctly during life. These results are summarized in Tables II and III.

TABLE II.—*Pathological and Radiological Correlation of Miliary Tuberculosis (Present Study)*

	No. of Cases	Positive Macroscopically at Necropsy	Positive Microscopically Only
Radiologically positive	12	12	0
Radiologically positive on admission only, not in last radiograph before death	6	6	0
Radiologically negative or doubtful	34	23	11
Total	52	41	11

TABLE III.—*Correlation of Choroidal Tubercles with Miliary Tuberculosis*

	No.	Choroidal Tubercles Present
Radiologically positive at any time ..	17	15
Radiologically negative or doubtful ..	31	10
Total cases	48	25 (52%)
Cases dying of tuberculosis without miliary disease	11	0

Discussion

The factors rendering miliary tubercle in the lungs visible on radiographs have been the subject of many experiments and observations. In the opinion of many, the number and size of the tubercles are the major factors responsible (Ott, 1930 ; Dale, 1932 ; Rigler, 1949). Achelis and Nunokawa (1910), Ott (1930), and Schinz et al. (1939) thought that the appearance is due to superimposition of the shadows cast by many tubercles in the same line of the Roentgen rays, but according to others (Assmann, 1911a ; Haudek, 1911 ; von Dehn and Weinschenk, 1924) the picture obtained represents the individual tubercles lying nearest to the film. Assmann (1911a) x-rayed narrow slices

of lung tissue with miliary tuberculosis and these films gave similar appearances to those of the whole lung.

Steiner (1937) held that the histological nature of lesions was more important than their size and number. In his series of 46 cases, the 16 in which epithelioid tubercles without caseation predominated showed no radiological abnormalities. Where, however, central caseation predominated in the tubercles, these produced the characteristic radiological appearance regardless of the size and number of the lesions. Blacklock (1932) divided miliary tubercles into acute and subacute types according to their histological structure, and pointed out that it was the larger subacute type of lesion which gave the typical snowstorm appearance, while the smaller acute lesions may not show at all, unless particularly abundant.

An attempt was made in this study to correlate the histological structure of the tubercles with the radiological diagnosis. No direct relationship was found. Our findings confirm the views of the previous writers that size and numbers matter most. The radiographs were positive when the majority of the tubercles were over 1 mm. in diameter and their number was 5 to 20 per cm.^{2} In the x-ray-negative group the tubercles were mostly under 0.5 mm. wide and their numbers ranged from 1 to 6 per cm.^{2}

The frequency with which miliary tuberculosis could not be diagnosed by radiographs in this series is in substantial agreement with the findings of Bronson et al. (1934), Steiner (1937), and Chapman and Whorton (1946) (Table I). It must, however, be pointed out that all patients with negative radiographs in this series died of coexistent meningitis. It is therefore possible that if untreated cases survived longer the lesions might have become visible radiologically. It is clear that when miliary tuberculosis can be diagnosed radiologically the disease is already in an advanced stage. For early diagnosis, therefore, other methods are required.

The thorough examination of the fundus oculi is one such method. In this series it gave positive evidence in 25 of 48 cases. Of the clinico-pathological studies mentioned, only Chapman and Whorton (1946) refer to the help that choroidal tubercles may give in the diagnosis, but these were seen in only one of their 63 cases. The incidence of choroidal tubercles in miliary tuberculosis, however, has been discussed by several writers and full references were given by Illingworth and Wright (1948). They found choroidal tubercles in 60% of 42 cases. Choroidal tubercles appear early in the disease, being found at the first or second examination. The same finding also holds true for the 12 positive cases in this series, which were not included in those discussed by Illingworth and Wright. Furthermore, choroidal tubercles at the first examination are often in a stage of development which is thought to denote that they must have been present for at least several weeks. Consequently these cases could have been diagnosed by ophthalmoscopy at an earlier stage of the disease.

Choroidal tubercles were not seen in tuberculous meningitis in which miliary tuberculosis was subsequently excluded by histological examination. This experience agrees with that of Bernard et al. (1949), who never found choroidal tubercles in adults suffering from tuberculous meningitis and where miliary tuberculosis was not present at the same time. In a very exceptional case choroidal tubercles may be found in primary tuberculosis, but, as the few children in whom this was observed are still alive, miliary tuberculosis cannot definitely be excluded. Therefore it may be assumed that, if a child's clinical condition is suggestive of miliary tuberculosis, the presence of early choroidal tubercles proves the diagnosis, irrespective of x-ray findings or a normal cerebrospinal fluid.

Using the combination of the two most widely accepted methods of diagnosis of miliary tuberculosis, only 27 of 48 cases were diagnosed in life, or little over half the total. This observation suggests that more sensitive methods of diagnosis are required. We have no personal experience with bone-marrow biopsy. This method has been used (Schleicher, 1946) but must be regarded as being in an experimental stage.

Summary

The accuracy and speed of the present methods of diagnosis of miliary tuberculosis in life were analysed. The material consisted of 52 consecutive children with histologically proved miliary tuberculosis of the lung.

Radiographs of the chest taken within 14 days of death were available in all cases. The fundus oculi was examined for choroidal tubercles in 48 children.

Eighteen, or only about one-third of the cases, were diagnosed by x-ray examination by a panel of experts. In 25 of 48 cases choroidal tubercles were seen. Altogether 28 of 52 cases were diagnosed in life.

Histological observations suggested that the number and the size of tubercles were the major factors in the production of the diagnostic x-ray appearances.

The tubercles were more numerous and larger in the 18 x-ray-positive than in the 34 x-ray-negative cases. Choroidal tubercles were present in a significantly higher proportion in the former (15 of 17) than in the latter (10 of 31).

Clinical features consistent with miliary tuberculosis and the presence of early choroidal tubercles establish the diagnosis irrespective of the radiological findings.

The present methods of diagnosis of miliary tuberculosis are not sensitive enough.

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