The possibility is stressed of this anomaly being present in older patients with congestive cardiac failure of obscure origin.

It has been shown that atrial septal defect and longevity are not incompatible.

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EPIDEMIC OF PULMONARY TUBERCULOSIS IN A CLOSED COMMUNITY

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The first scientific study of the epidemiology of tuberculosis was made by Villemin in 1868. He stressed the high incidence of the disease among those living in closed communities, such as prisoners, inmates of mental institutions, soldiers, and religious bodies. Tuberculosis among troops living in barracks was very common compared with those in the field or those living at home. He quoted, as an example, the Allied armies before Sebastopol during the winter of 1854-5. Although these troops were living under most unhygienic conditions, with poor food, and subjected to severe cold and excessive fatigue, cases of tuberculosis were rare. At this time the mortality rate in the Army due to tuberculosis varied between 5 and 12.5 per 1,000.

To-day we have the same modes of spread of the disease. It is only by the detection of early cases and by adopting strict precautions to prevent its transmission by the occasional "open" cases that we are able to improve on these figures. The following is an account of its rapid spread in a comparatively closed community in which normal precautions are taken but in which the opportunities for spread are so great.

The Closed Community

This community was a military band which returned to the United Kingdom from a tropical station at the end of September, 1954. Its members were given leave for four weeks before returning to barracks. In February, 1955, they went to Germany.

In peacetime, military bands have approximately forty members, mainly between the ages of 16 and 25 years. Few are married and live in quarters; the rest live together in barracks. Occasions arise, such as touring, when they all live together. Sleeping accommodation varies from station to station; while in the United Kingdom these men lived in rather old barracks and slept sixteen to a room, in Germany their barracks were excellent, and they slept four to a room. Food was good and there were ample facilities for recreation. These men are specialists and have little in common with other members of the regiment; their friends are usually other bandmen.

The regiment to which a military band belongs has little bearing on the background of its bandmen. They originate

from all parts of Britain, mainly large industrial cities. There is no reason to believe these people lacked natural immunity. When Mantoux tests were performed at the end of March, 1955, only one person under 21 years was Mantoux-negative. Of the seventeen members joining since, all are Mantoux-positive, none having received B.C.G.

The practice-room usually allocated to the band is a small one on the outskirts of the station, where their music does not interfere with other military activities. Rarely have they large particularly well-ventilated rooms.

On returning from tropical conditions to the wintry conditions in the United Kingdom, approximately half of the band developed some form of minor respiratory tract infection. Six of the finally proved cases experienced this change, which may have played a small part in lowering their resistance.

Presentation of Cases

On March 22, 1955, Case 1, a youth aged 17, reported sick with pleuritic pain in the right side of his chest. Clinically and radiologically he had a large right-sided pleural effusion. E.S.R. (Westergren) 38 mm./hour. White cells, 10,900 per c.mm. (polymorphs 69%, lymphocytes 27%, monocytes 4%). Aspirated pleural fluid: white cells, 4,900 per c.mm. (lymphocytes 80%); red cells, 6,400 per c.mm.; specific gravity, 1012. Gram stain: no organisms seen. Ziehl-Neelsen stain of concentrated fluid: scanty distribution of *Mycobacterium tuberculosis*. These organisms were later cultured. This patient produced no sputum, and no organisms were detected in his resting gastric juices. Mantoux 1:10,000 was positive.

There was no family history of tuberculosis or any known contact with the disease. He had joined the band four months previously while in the United Kingdom, and his contacts were confined to the members of the band and the bandmaster's family, whom he visited frequently. These contacts were x-rayed and two further cases found—Case 2 and the bandmaster's wife.

Case 2, a man aged 23, had an advanced fibro-caseous lesion spread throughout the left upper lobe. There were two medium-sized cavities, one at the apex and the other in the mid-zone. He gave a history of having had cough with sputum for four months, and on one occasion a small haemoptysis. For some time he had noticed that playing his clarinet had become more exhausting. E.S.R. (Westergren) 30 mm./hour. Sputum contained a scanty distribution of acid/alcohol-fast bacilli. He had slept in the next bed to a man with pulmonary tuberculosis in Hong Kong in 1952. The band had been x-rayed in Hong Kong and again in the United Kingdom in the summer of 1953, but no further cases were detected.

The bandmaster's wife had an early infiltrative lesion at the right apex. She had no symptoms and no signs. No organisms were isolated from her sputum or resting gastric juices. Case 1 was a frequent visitor to the bandmaster's home, and she had met Case 2 socially on several occasions.

Further cases presented as shown in the accompanying Table, either clinically or with abnormal chest x-ray finding during follow-up examination. The last cases (Nos. 9 and 10) were admitted to hospital at the beginning of May, 1956. There were no cases when mass miniature radiographs were taken at the end of December, 1955.

All family contacts of infected bandmen have been examined radiologically. No cases have been found. Case 2 had regularly seen his wife until going to Germany. She remains well.

Source of Infection

Myco. tuberculosis was isolated from three cases of this series. It was seen in the Ziehl-Neelsen stain and later cultured. In Case 1 the organisms were found in the pleural fluid; he produced no sputum, and no organisms were found in his resting gastric juices. X-ray examination revealed no pulmonary lesion to suggest he had had "open" pulmonary tuberculosis at any time. Case 2 had organisms in his sputum, and x-ray appearances were compatible with

"open" pulmonary tuberculosis. Case 6 was admitted to hospital for further investigation because a very faint shadow was seen at the left apex during follow-up x-ray examination. He had no symptoms and there were no chest signs. E.S.R. (Westergren) 2 mm./hr. A Ziehl-Neelsen stain of his first early-morning specimen of sputum showed a scanty distribution of acid/alcohol-fast bacilli identical with *Mycobacterium tuberculosis*. These organisms were later cultured from this specimen. None were isolated from numerous other specimens, and after further scrutiny of x-ray films, bronchoscopy, and laryngoscopy, no further evidence of a tuberculous lesion could be found. Cases 4 and 5 were in hospital at the time, but there is no reason to believe their sputum specimens were confused with that of Case 6, and, anyhow, there has been no reason to consider either of these cases as being "open." I cannot explain this.

Of the group, only Case 2 has been proved capable of infecting others. He probably contracted the disease in Hong Kong in 1952, but only recently had his lesion broken down and resulted in dissemination of bacilli. It will be noted that all the cases in this series were men attached to

the band before April, 1955, when Case 2 was admitted to hospital. There is no radiological evidence of active disease in any of the seventeen joining since.

Methods of Spread of the Disease

Via Musical Instruments.—Many older musicians have the impression that oboe and bassoon players are more prone to pulmonary tuberculosis than other members of the band—presumably because these instruments have a double reed and it was thought that they retain organisms. There appears to be no actual evidence to support this theory, and the type of instrument played is of no significance. Bandsmen are dissuaded from playing each other's instruments, but a certain amount of interchanging is carried on. However, this mode of spread probably had little part in the present minor epidemic, as the clarinet played by Case 2 was his personal property, and he was very reluctant to allow others to play it and was himself very reluctant to play other instruments. Case 10 was the instructor on the clarinet, and did occasionally play Case 2's instrument. Reeds last for one to two weeks, and there is no way of

Details of Cases

Case No., Age, Married, etc.	Date of Joining Band and Countries Visited Before Germany	Any Known Previous Contact with Tuberculosis	Instrument	Date of Admission to Hospital and How Detected	Type of Disease Symptoms	Living Accommodation
1. 17 yrs. Not married	Nov., 1954. U.K. only. Germany Feb., 1955	None. Mantoux 1: 10,000+	Oboe	22/3/55: Reported sick with symptoms and admitted to hospital	Pleuritic pain in right side of chest and breathlessness for five days. Clinically and radiologically a large right-sided pleural effusion	Lived in barracks

Band and contacts x-rayed at end of March, 1955 (large plates).

2. 24 yrs. Married	1948. Canal Zone, 1948-9. Hong Kong, 1949-52. Brit. Guiana Feb.-Nov., 1954. Germany, Feb., 1955	In contact with case of pulmonary tuberculosis in Hong Kong in 1952. Slept in same room. X-rayed—n.a.d.	B $\flat$ clarinet	1/4/55: Picked up when band x-rayed	Cough and sputum 4 months. Haemoptysis on one occasion. Had noticed he could not play his instrument as well. E.S.R. 30 mm./hr. Radiologically fibro-caseous lesion with cavities in left upper lobe	Lived in barracks during his one month in Germany and for part of time in U.K. Shared a room with three others; Cases 4 and 9 were in this room
3. 23 yrs. Married	1948. Canal Zone, 1948-9. U.K. Brit. Guiana, Feb.-Nov., 1954. U.K. Germany, Feb., 1955	None	E $\flat$ clarinet	26/5/55: Reported sick with symptoms and admitted to hospital	Pleuritic pain in left chest, fever and anorexia of 12 hours' duration. Clinically and radiologically a large left-sided pleural effusion	Lived with his family in quarters

Band and contacts x-rayed at beginning of June, 1955 (large plates).

4. 20 yrs. Not married	1954. Brit. Guiana, Feb.-Nov., 1954. U.K. Germany, Feb., 1955	None. Mantoux 1: 10,000+ 31/3/55	French horn	11/6/55: Picked up when band x-rayed	Symptom-free. No signs. E.S.R. 2 mm./hr. Very early infiltrative lesion right apex	Lived in barracks. Slept in same room as Case 2 while in Germany—i.e., 1 month
5. 24 yrs. Married	1952. Hong Kong, 1952. Brit. Guiana, Feb.-Nov., 1954. U.K. Germany, Feb., 1955	Not in contact with case in Hong Kong	Cornet	11/6/55: Picked up when band x-rayed	Symptom-free. No signs. E.S.R. 17 mm./hr. Early infiltrative lesion right apex	Lived in barracks
6. 25 yrs. Married	1945. Canal Zone, 1948-9. Hong Kong, 1949-52. Brit. Guiana, Feb.-Nov., 1954. U.K. Germany, Feb., 1955	In Hong Kong, 1952. Contact of case there. X-rayed—n.a.d.	B $\flat$ clarinet, saxophone	11/6/55: Picked up when band x-rayed	Symptom-free. No signs. E.S.R. 2 mm./hr. Admitted because of two faint opacities seen at left apex on x-ray examination. Sputum $\times 3$ —A.A.F.Bs. seen and cultured from one. Sent to U.K. for further investigation. No lesion found	Lived in married quarters

Whole band had chest x-ray films taken at end of September, 1955 (large plates).

7. 19 yrs. Married (Aug., 1955)	1953. Brit. Guiana, Feb.-Nov., 1954. U.K. Germany, Feb., 1955	None. Mantoux 1: 10,000+ 31/3/55	B $\flat$ clarinet	26/9/55: Picked up when band x-rayed	Symptom-free. No signs. E.S.R. 5 mm./hr. Small segmental collapse right middle lobe with pronounced hilar shadow	Lived in barracks. Married 3 months before development of disease
8. 16 yrs. Not married	1955. U.K. Germany, Feb., 1955	None. Mantoux 1: 10,000+ 31/3/55	B $\flat$ clarinet	30/9/55: Picked up when band x-rayed	Symptom-free. Diminished movement at left apex, otherwise no signs. E.S.R. 7 mm./hr. Early infiltrative lesion left infraclavicular region	Lived in barracks

Band and contacts x-rayed at end of December, 1955 (M.M.R.). No cases

Band and contacts x-rayed at beginning of May, 1956 (large plates)

9. 22 yrs. Married (Dec., 1955)	1954. U.K. Germany, Feb., 1955	None. Mantoux—neg. in Oct., 1954	Saxophone	5/5/56: Picked up when band x-rayed	Slight fatigue, otherwise symptom-free. No signs. E.S.R. 5 mm./hr. Radiologically an early infiltrative lesion left apex	Lived in barracks. Slept in same room as Case 2 while in Germany—i.e., 1 month
10. 24 yrs. Married	1946. Hong Kong, Brit. Guiana, U.K. Germany, Feb., 1955	2 brothers with tuberculosis. Last saw them in Aug., 1953	B $\flat$ clarinet	5/5/56: Picked up when band x-rayed	Symptom-free. No signs. E.S.R. 3 mm./hr. Radiologically an early infiltrative lesion	Lived in married quarters 1 year. Slept in same room as case in Hong Kong in 1952

disinfecting them. Each player seems to have a pocket reserved in which to keep his reed, at least keeping it "clean."

Brass mouthpieces are regularly soaked in Condy's red fluid (a mixture of sodium sulphate and sodium permanganate).

Dust and Droplet Infection.—For approximately six hours a day, five days a week, this group of 40 men play together, usually in a small poorly ventilated room.

Cornet (1889) considered that the chief source of infection in pulmonary tuberculosis was dust arising from dried sputum. He collected 140 specimens of dust from various situations, such as hospitals and rooms occupied by tuberculous patients, and from 40 of them tubercle bacilli were isolated. Bandsmen may not expectorate in their practice-room, but probably the constant drip of condensation fluid and saliva from the end of an instrument such as the clarinet is more effective in disseminating the disease. To-day we do not consider that this method of spread is as important as was stressed by Cornet—particularly so in temperate climates, where the fluid takes a long time to evaporate before leaving the bacilli with the dust particles. However, for a temperate climate conditions are optimum in such a situation.

It is accepted that most cases of pulmonary tuberculosis result from the inhalation of infected droplets. Besides the usual coughing and sneezing, the bandsman with "open" pulmonary tuberculosis is exhaling much more air than the average infected person and with much greater force. This extra force keeps the droplets airborne longer and aids in increasing the concentration of bacilli in the restricted atmosphere. In order to get a quick and deep inspiration the instrument-player breathes in through his mouth, the protective mechanism of the nose and sinuses therefore being by-passed. It will be seen from the diagram of the

□ OPEN CASE

▨ CASES WITH "CLOSED" PULMONARY TUBERCULOSIS

Diagram showing approximate seating of military band.

approximate seating arrangement of this band that the infected contacts, with the exception of Cases 4 and 5, sat near Case 2.

For one month before Case 2 was admitted to hospital Cases 4 and 9, and a fourth man, had slept in the same room. This was a pleasant, well-ventilated room, but probably this close contact was responsible for their contracting the disease.

Discussion and Suggestions on Prevention

There is no evidence to suggest that pulmonary tuberculosis is an occupational hazard of the instrument-player in the same sense as it is among workers in silica dust. Provided no "open" case is introduced into the closed community of the military bandsman, he runs no particular risk. However, once this does happen his living and working conditions are optimum for the dissemination of the disease. To a less degree the average confined, dark theatre orchestra pit supplies similar working conditions. Most civilian brass bands have such limited funds that their prac-

tice-rooms are usually small and dingy. In all these conditions exists this danger of rapid dissemination of any infectious disease that is transmitted by modes similar to those of pulmonary tuberculosis.

The first case presented in March, 1955, after having been in contact with the only "open" case for 10 weeks. The last cases were detected in May, 1956. Case 9, too, had known Case 2 for only 10 weeks. This is another example of how variable the period may be before pulmonary tuberculosis manifests itself after the original infection, which in all cases appears to have occurred before April, 1955.

Most of the precautions necessary to minimize this risk come under the usual principles adopted in preventive medicine.

1. *Stimulating Artificial Immunity if Natural Immunity is Not Present.*—Mantoux-testing should be routine in all persons under 21 years. If negative, B.C.G. should be offered.

2. *Minimizing Modes of Transmission.*—Public health authorities, military or civilian, should regularly visit practice-rooms, insisting on these being large, well-ventilated, and light. Damp sweeping of rooms cuts down dust transmission; interchanging of instruments should be strongly discouraged and mouthpieces regularly disinfected. This is best performed by boiling brass mouthpieces or washing them thoroughly, as with wooden instruments and instruments made of plastic materials, with soap, a 1% solution of white cyllin ("izal"), and water.

3. *Early Elimination of Infected Cases by Routine Chest X-ray Examination.*—Bandsmen should be encouraged to report any respiratory tract symptoms and be forbidden to play until they have fully recovered.

Contacts have been x-rayed at approximately three- to four-monthly intervals and have been carefully observed for symptoms suggesting disease. Cases have still been found radiologically that one feels could have been detected one or two months earlier had x-ray examination been performed at shorter intervals. Previous films taken during the past year have been scrutinized and no evidence suggestive of disease has been seen. This stresses the need for repeat x-ray examination of contacts in such a community as this at as short intervals as practicable. This is probably every three months.

Summary

An account is given of the rapid spread of pulmonary tuberculosis in a closed community, a military band. The first case presented in March, 1955, with a large pleural effusion, and between then and May, 1956, eight other bandsmen and the bandmaster's wife either presented clinically with some form of pulmonary tuberculosis or were detected during regular follow-up radiological investigation. Among this group only one case was found to have "open" pulmonary tuberculosis.

The various modes of spread have been discussed, particularly in relation to the bandsman's occupation. It is concluded that generally his present working conditions and the atmosphere he creates when blowing his instrument greatly facilitate the spread of pulmonary tuberculosis.

Suggestions are made on how the dissemination of pulmonary tuberculosis could be minimized. It is stressed how important it is to insist upon prolonged follow-up investigation of contacts, x-raying them at three-monthly intervals.

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