A Thesis for the Degree of Doctor of Medicine

presented by

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NON-PULMONARY TUBERCULOSIS

A study of 100 cases of tuberculosis of bones, joints and glands with reference to the type of bacillus and its correlation with the clinical condition.

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I N D E X.

A. INTRODUCTION.

Probably no disease has been more widely studied than has tuberculosis. From the earliest time in history it would appear to have been a feature in communal life and its importance may be judged by the number of inquiries and commissions which have had for their object a study of its incidence and natural history. Even at the present time every measure, evolved by individuals and governing bodies, to improve the health and general hygiene of the community has in its background the spectre of tuberculosis.

Since the latter part of the nineteenth century the death-rate from tuberculosis has shown a more or less steady decline. In the case of the non-pulmonary forms of the disease occurring in Glasgow the death-rate began to decline in 1870.(1) At that time the rate was 1850 per 1,000,000, and since then with the exception of a few intermissions the reduction has been progressive, and reached its lowest recorded figure of 217 per 1,000,000 in 1934.

The introduction of compulsory notification of the non-pulmonary forms in July, 1914, gave an impetus to their study, and was the means of evolving the present scheme for their supervision and treatment. Since then the reduction in the annual number of notifications has been very considerable, the number falling from 1464 in 1915 to 677 in 1934.

This reduction in the death-rate from non-pulmonary tuberculosis over a period of sixty-four years, taken in conjunction with the reduction in its annual incidence since the inception

of notification in 1914, indicates a very considerable measure of control over the infectivity of all forms of the disease. The improvements in the conditions of life, social and hygienic, have no doubt played an important part in attaining this result. In recent years, however, the increasing hospitalisation of the highly infective pulmonary cases, and the closer supervision of the milk supply have contributed in no small measure, but the degree in which these factors have been operative is doubtful.

Coincident with the reductions in the incidence and death-rate during recent years there has been evidence of a change in the type of the disease. Fraser (2) of Edinburgh, investigating a series of cases of tuberculosis of bones and joints in 1912, found the causal agent to be of bovine origin in 63 per cent. Two years later, that is in 1914, Mitchell (3) also of Edinburgh, isolated a bovine bacillus from 90 per cent. of the cases of glandular tuberculosis. In 1932 Blacklock (4) completed an investigation into bone and joint tuberculosis occurring in the Glasgow area finding the bovine strain to be responsible for 34'6 per cent. of his cases. In other countries there has been a greater reduction of bovine infections, the lowest incidence of 4 per cent. being recorded by Price (5) of Toronto.

These bacteriological findings are of very considerable interest and importance, and suggest the need for extended observation in one particular area. If correctly interpreted they indicate that the control of bovine infections has been more effective than that of infections from human sources, and that future administrative measures must be directed towards the latter.

In most of the investigations hitherto undertaken it would appear that the cases investigated have through force of circumstance been more or less selected. It was felt, therefore, that it might prove useful if a series of cases were investigated where such circumstances did not exist. Accordingly the present enquiry deals with 100 consecutive cases who presented lesions which were available for examination, the strain of infecting organism isolated being typed and correlated with the clinical manifestations of the disease.

It is not claimed that the investigation is in any way complete. It is hoped, however, that others will undertake further enquiries along similar lines with a view to the understanding of the changes which are taking place in the natural history of the disease at the present time.

B. HISTORICAL SURVEY.

A survey of the literature on tuberculosis is one which, however brief it may be, must cover a considerable period of time. With the increasing knowledge of the natural history of the disease, it is but to be expected that methods of investigation should have been evolved to meet the widening outlook. Broadly considered the history of investigation may be divided into three phases. Initial observers, unaware of the causal agent, were concerned with the clinical manifestations of the disease, and to a lesser extent with its pathology. In this connection reference may be made to the works of Hippocrates, Sylvius, Stark, Laennec and others. In the second phase there was the discovery of the infective character of the disease and the isolation of the specific organism, with which the names of Villemin and Koch are associated. Lastly there was the evolution of a scheme of administrative control of the disease based on the clinical, pathological and bacteriological discoveries of the two previous phases. It is with the second phase that this investigation is mainly concerned, and in its correlation with the first.

The possibility of tuberculosis being an infective disease had been deduced from clinical observation by Klenhe as early as 1846. He was of the opinion that the disease could be conveyed to the human subject by infected cow's milk. It was not until 1865 that the question of the infectivity of the disease was definitely established. In that year Villemin (6) communicated to the Academy of Medicine of Paris the results of an experimental enquiry which he had undertaken. He was able to show that laboratory animals inoculated with material from cases of human and bovine

tuberculosis developed the characteristic lesions of that disease; he was able to show, in fact, that tuberculosis was a specific disease. His communication aroused acute controversy, particularly in France, and it was not until three years later that confirmation was forthcoming not only in that country but in England and Germany. In addition to establishing the fact that tuberculosis was a specific transmissable disease he observed in the course of his experimental work that pathological material from a bovine source was more virulent to rabbits than material from a human case of the disease, an observation of very great importance, the significance of which was not to be appreciated for many years.

The far reaching importance of Villemin's contribution to the etiology of the disease cannot be over estimated, and it may be said with truth that it paved the way for Koch's discovery and isolation of the tubercle bacillus in 1882.(7) It is claimed that Baumgarten was the first to see the bacillus in an unstained state but was unable to identify it. Koch however was able to demonstrate the bacillus using the aniline dyes of Erlich, to cultivate it and to establish beyond all doubt its etiological relationship to the disease.

Despite Villemin's observation on the different results produced by the inoculation of material from human and bovine cases of tuberculosis into rabbits, the unity of all forms of tuberculosis seems to have been generally accepted. It was not until 1889 that Rivolta(8) discovered a strain of tubercle bacillus in birds presenting different characters from those previously isolated from human and bovine sources. His observations were confirmed a year later

by Maffucci[9] who reached the same conclusions independently. The bovine bacillus was first identified as such by Theobald Smith[10] in 1897, who described its morphological and cultural characters, and contrasted its virulence with that of human strains. In the same year Dubard, Batillon and Terre[11] described the strain which produces tuberculosis in cold-blooded animals.

While these discoveries were significant, the importance of the bovine strain seems to have been under-estimated, and by no less an authority than Koch. At the British Congress on Tuberculosis in 1901 he stated his views as follows:- "I should estimate the extent of infection by the milk and flesh of tuberculous cattle, and the butter made from their milk, as hardly greater than that of hereditary transmission, and I therefore do not deem it advisable to take any measures against it".

A valuable contribution to the cultural differences was made by Theobald Smith in 1903, who observed their behaviour in glycerinated media and drew attention to its inhibitory action on bovine strains. In 1904 a measure of confirmation of Koch's statement before the British Congress was forthcoming when Orth published the results of 146 autopsies performed on children in whom he found only 1.37 per cent. of primary abdominal tuberculosis. Three years later, in 1907, he, however, repeated his work and found the figure on this occasion to be 12.3 per cent. Two other important investigations set in motion by Koch's pronouncement, and which published their results in 1910 and 1911 respectively, were then carried out by Parks and Krumwiede[12] in America and in this country by the British Royal Commission on Tuberculosis.[13]

With the progress of time the extent of our knowledge has been widened in several directions though no signal discovery has been made. Much information has been gained as to the distribution of these strains in the human subject in various countries of the world, and has been of service in the realm of preventive medicine. In 1932 an important communication was made by Blacklock (4) to which the present investigation may be regarded as complimentary.

C. SOURCE OF THE MATERIAL.

The patients who formed the basis of this investigation were children under 16 years who suffered from non-pulmonary tuberculosis, and were undergoing treatment in Mearnskirk Hospital for Children, Newton Mearns. The great majority of them were registered and resident in the City of Glasgow, only 3 per cent. belonging to outside areas. As this is the only hospital for the treatment of such cases arising in the city, and administered by the Corporation of Glasgow, it may be fairly said that the group of patients here dealt with is representative of the child population who develop such forms of the disease.

While no intentional selection has been made the nature of the disease inevitably compels it. Not all cases of non-pulmonary tuberculosis proceed to abscess or sinus formation, and so it happens that an investigation such as this is limited at the onset to these cases which do so, and to the comparatively small number where operative interference is necessary or a fatal termination to the specific illness occurs and post-mortem facilities are available.

The factors which determine abscess or sinus formation are not understood. It may be that they are individual characteristics, it may be that they are determined by anatomical considerations, it may be that they are associated with variations in the tubercle bacillus itself. Whatever the factors concerned are , it is necessary to determine the incidence of abscess and sinus formation, and to this end an analysis has been made of 200 consecutive dismissals during the year 1933 in relation to the parts

affected. The result is set out in Table 1.

TABLE 1.

Group.	Number in Group.	Percentage.				
		Abscess.	Sinus.	Abscess and Sinus.	Died.	Total Available Material.
Tuberculosis of spine.	47	34'0	4'25	8'5	-	46'7
Tuberculosis of Hip.	32	9'3	12'5	18'7	-	40'5
Tuberculosis of Knee.	29	10'3	12'8	6'8	3'4	33'3
Tuberculosis of Ankle.	17	23'6	5'8	52'9	5'8	88'1
Tubercular Dactylitis.	14	14'2	50'0	28'5	7'1	99'8
Tuberculosis of Glands.	27	11'1	18'5	40'7	-	70'3
Tuberculosis of Soft Tissues.	6	33'3	13'3	33'3	-	79'7
Miscellaneous Lesions.	28	21'4	39.2	28'5	3'5	82.6
Number in Section.	-	39	35	46	4	124

Total Percentage of Cases from which material could be obtained =62.

The table shows the lesions classified into eight groups according to the part of the body affected. It will be observed that the occurrence of abscess or sinus formation or both varies within wide limits, being highest in tubercular dactylitis (92'7 per cent.). More important however is the fact that in only 124 cases or 62 per cent. of the total would material have been available for bacteriological examination, and this must always be borne in mind when interpreting the results of the incidence of the types of tubercle bacilli.

D. NATURE OF THE MATERIAL.

The nature and immediate source of the material from which were isolated the various strains of tubercle bacilli, are presented in tabular form below. (Table 11.)

TABLE 11.

Nature of Specimen.	Source of Specimen.								Total.
	Spine.	Hip.	Knee.	Ankle.	Dactylitis.	Glands.	Soft Tissue.	Miscellaneous.	
Pus removed by Aspiration.	18	13	6	5	8	9	10	9	78
Glands removed by Operation.	-	-	-	-	-	2	-	-	2
Synovia " " "	-	1	1	-	-	-	-	-	2
Necrotic Tissue removed by Operation.	2	3	1	5	1	3	-	2	17
Glands removed by Autopsy.	-	-	-	-	-	1	-	-	1
Total:-	20	17	8	10	9	15	10	11	100

With one exception all the material removed was obtained ante-mortem, and on this account all strains of tubercle bacilli were isolated from actual clinical cases, cases in which actual tissue destruction had taken place, and not from patients who had died from some cause other than tuberculosis. In the single case from which the bacilli were isolated post-mortem the cause of death was a terminal tubercular broncho-pneumonia.

While the specimens were of a varied quality, the vast majority of them were in the form of pus removed by aspiration. The reason for this would appear to be the shortness of time which elapses between the diagnosis of the condition by the family doctor or the Tuberculosis Officer and the transference of the case to hospital. Indeed in many patients abscess formation does not occur until they have been resident in hospital for some time.

It will be seen from the table that only a small proportion of the material utilised (4 per cent.) was obtained as a result of operative procedures. This was not due to the rarity of operations on these cases, but solely to the fact that material had been obtained at an earlier stage in the treatment of the condition.

The group labelled "necrotic tissue removed by operation", and comprising 17 per cent. of the total, were all, with the exception of four, obtained from the process of scraping sinuses. The operations at which these remaining four specimens were obtained were as follows, sequestrectomy, the lesions being situated in the head of the humerus, the head of the femur, and the scaphoid bone respectively, and one during the operation of costo-transversectomy in a case of tuberculosis of the upper dorsal spine.

E. ISOLATION OF THE TUBERCLE BACILLUS.

(a) GENERAL.

As has been already shown, the sources of the material from which the tubercle bacilli were isolated were very varied. Specimens of pus, necrotic tissue, synovial membrane, and glandular tissue removed both during life and at post-mortem examinations were utilised. It is obvious, therefore, that material gathered from such widely different sources varied greatly in character and necessitated different methods of treatment.

(b) PRELIMINARY EXAMINATION.

All specimens were received at the laboratory within a few hours of having been removed from the patient, and were immediately subjected to microscopic examination. For this purpose two films were made, the first one being stained by Gabet's[14] modification of the Zhiel-Neelsen method. In this modification the film after fixation was immersed in a bath of strong carbol-fuchsin for three minutes, the bath being kept at a temperature of 60°C. in a small water-jacketed oven. Following this the film was washed in running water to remove the excess stain, decolourised and counter-stained in a second bath containing one per cent. methylene blue in twenty per cent. sulphuric acid. It was left in this mixture for from 8 to 10 minutes at room temperature, and after a final rinse in water was ready for examination. By this method a large number of slides could be treated quickly and easily at the same time.

The second film was stained by Gram's method in order to demonstrate the presence or absence of organisms other than the tubercle bacillus, a matter of considerable importance if direct cultures or inoculations were contemplated. Where the material under examination was of such a nature as to render the making of films difficult or impossible, this step was as a rule dispensed with as the methods of digestion and concentration destroyed any secondary infection which might be present.

(c) DIGESTIVE AND CONCENTRATION METHODS.

Difficulties in the isolation of the tubercle bacillus presented themselves early in the investigation. These were found to be due to one or more of the following causes.

(i) The presence of secondary infection.

(ii) Scantiness of tubercle bacilli in the specimen.

(iii) The nature of the tissue.

The presence of secondary infection revealed by the preliminary microscopic examination was found to depend to a great extent on the source of the material, being most formidable in specimens gathered at post-mortem examinations, and least so in material removed from abscesses under ordinary aseptic conditions.

Scantiness of tubercle bacilli in the specimen was another serious difficulty. A large percentage of the specimens examined were found to be completely devoid of all organisms, if the evidence of microscopic examination of stained films was

accepted, yet from many of these tubercle bacilli were successfully isolated by cultural and animal inoculation methods.

The nature of the tissue also presented occasional difficulties. Material such as enlarged glands, synovial membrane, and necrotic tissue, where the structure was firm and resistant, required some form of preliminary treatment to liberate the enclosed bacilli.

It was to overcome these difficulties that methods for killing the contaminating organisms, for concentrating the tubercle bacilli, and for the digestion of the enclosing tissue were adopted. Different workers have adopted different means to achieve these ends but the majority of them appear to have been chiefly concerned with ridding the specimen of organisms other than the tubercle bacillus.

Eastwood and Griffith (1914)[15] treated some of their specimens with a low concentration of antiformin. Cumming (1931)[16] in his investigation was chiefly worried by the presence of organisms such as Bacillus Welchii which if injected into a guinea-pig along with the specimen gave rise to premature death of the test animal. This unfortunate result was avoided by subjecting the specimen to the action of 4 per cent. sodium hydroxide and injecting it into a guinea-pig which had previously received 4 c.c. of anti-gas gangrene serum. Blacklock (1932)[4] adopted for this purpose a 7'5 per cent. concentration of antiformin which he kept in contact with the specimen for a period of from 20 to 30 minutes at 37° C.

These workers were, however, dealing with material removed at post-mortem examinations, material which must often

have been seriously contaminated, while in the present investigation the utilisation of such material was the exception rather than the rule. On this account, while the problem of the presence of contaminating organisms was always a present one, it did not take pride of place but ranked practically equal to the second difficulty mentioned, namely the scarcity of tubercle bacilli in the specimen. After a considerable amount of experimental work two substances were made use of, namely, antiformin and sulphuric acid.

(1) ANTIFORMIN.

The use of antiformin was introduced by Uhlenhuth and Xylander in 1908 (17). They found that this preparation had the power of disolving all organisms, which, unlike the tubercle bacillus, were unprovided with a waxy envelope. They also observed that it tended to concentrate the tubercle bacilli in the sediment. It was their method which Griffith used while working for the Royal Commission on Tuberculosis (13) and was found by him to give satisfactory results. In the present investigation where antiformin was used this was the method adopted. It was found to be specially suitable for certain types of specimen, such as those composed of lymphatic glands or synovial membrane. Not only did such specimens in some cases require to be freed from contaminating organisms, but they required also preliminary treatment to render them suitable for animal inoculation or direct cultural methods.

METHOD. The material under consideration was first cut up into small portions with a pair of sterile scissors, and ground up in a sterile mortar. Next it was transferred to a 20c.c. sterile glass bottle fitted with a cork. Antiformin was added in such a way as to make a 10 per cent. solution, the bottle firmly corked, and the contents mixed by thorough shaking. The bottle was then set aside in an incubator at 37° C for thirty minutes, being shaken from time to time.

The whole contents were next centrifugalised at high speed for at least fifteen minutes, by the end of which time a thick heavy deposit was found to have been thrown down to the bottom of the tube. The thick, syrupy, supernatant fluid was carefully poured off and an equal quantity of sterile distilled water added, the contents of the tube being well mixed by means of a thick platinum wire. This procedure of washing the sediment was carried through thrice by the end of which time the last traces of antiformin had been removed, and the specimen was suitable for inoculation into a guinea-pig or onto culture medium.

(11) SULPHURIC ACID.

The method of concentrating the tubercle bacilli present in a specimen by means of sulphuric acid was first recommended by Lowenstein (18) and Sumiyoski (19) in 1924.

METHOD. In the vast majority of cases a 6 per cent. solution of acid was found to be most suitable. This concentration of acid was added to an equal volume of the material under examin-

ation, well shaken up and allowed to stand for twenty to thirty minutes at 37°C. As in the case of antiformin this part of the proceedings was carried out in a 20c.c. sterile glass bottle with cork.

Following the period of incubation the material, now in the form of a thick creamy liquid, was poured into sterile centrifuge tubes and centrifugalised for a few minutes. at the end of this time a thick, smooth, creamy deposit was found to have been thrown down. This sediment was then washed thrice with distilled water.

As the investigation proceeded it was found that even after repeated washings the deposit still retained a considerable acidity which appeared to interfere slightly with the rapidity of growth. On account of this a washing of one per cent. sterile sodium bicarbonate was substituted for the second washing with sterile distilled water.

With specimens giving a thick deposit there often occurred, on the addition of sodium bicarbonate, a considerable evolution of gas, but on no occasion was this so marked as to cause difficulty by frothing or in any other way.

(iii) COMPARISON OF METHODS.

In practice the antiformin method was found to possess certain definite disadvantages. The thick, heavy liquor produced by the action of antiformin on specimens required prolonged centrifugalisation even at high speeds. This lengthened the time

required to test the specimen. Then again the resultant sediment tended to be coarse and lumpy, and often contained portions of undigested fibrinous material.

These undesirable characteristics of the sediment often presented real difficulty in animal inoculation and prevented the sediment from lending itself to the making of an even smooth layer on culture medium. It was also noted that some specimens inoculated on to culture medium failed to grow visibly for some considerable time, and indeed sometimes failed altogether. Whether this was due to the tubercle bacilli being better protected by some types of material than others, as noted by Uhlenhuth and Xylander (20) in 1909, or whether it was due to some strains being more susceptible to the action of antiformin than others, as noted by Donges (21) in 1913, was not determined, but on account of these difficulties it was decided to utilise some substance other than antiformin, and it was for this purpose that Sulphuric Acid was selected.

This latter method was found to be extremely valuable for easily emulsified material, and as the bulk of the material which came under examination consisted of pus, the method was found very satisfactory in practice. For highly fibrinous exudates or portions of tissue sulphuric acid was found to be unsuitable. Even in strengths up to 15 per cent. satisfactory digestion of the tissue did not occur, and for these specimens it was found necessary to use antiformin.

The sediment obtained from the use of Sulphuric Acid was of a uniform creamy consistency. As a rule it was of a yellowish white colour, but this varied, depending on the constitution of

the initial material, the presence of blood for example rendering the sediment a dark brown colour. A sediment of this type was found very suitable either for spreading on slopes of culture medium or for making an inoculum for guinea-pigs.

The presence of spores in a specimen called for the use of a higher concentration of acid, even up to 15 per cent. This required no alteration in the method. In this connection it is worthy of note that sulphuric acid was found most useful for the recovery of tubercle bacilli from cultures which had become contaminated by other organisms, spore bearing or otherwise. For this purpose the same procedure was carried out as has been detailed above, the material being scraped from the surface of the culture medium and treated exactly as if it was a specimen received from a patient. The resultant sediment was again either inoculated onto the surface of culture medium or into a guinea-pig. On account of the ease with which sulphuric acid could be handled, and the rapidity of the method, it was used where-ever possible in preference to antiformin.

(d) ISOLATION BY CULTURAL METHODS.

For the primary cultivation of the tubercle bacillus the medium selected was that described by Petragnani (22). This medium contains glycerine, egg, potato-meal, and malachite green, and is prepared according to the following formula. In a beaker placed in a boiling water bath, are mixed together the following:- milk 300c.c., peptone 3 grams., potato-meal 12 grams, and two finely grated potatoes. The whole is stirred vigorously for 10 minutes and then allowed to remain in the bath for one hour, at

the end of which time it is removed and cooled to 60°C. To this is then added eight whole eggs, two egg yolks, 24 c.c. of glycerine, and 20 c.c. of a 2 per cent. aqueous solution of malachite green. The medium is now filtered through gauze and tubed. It is coagulated in slants at 90°C. for 1½ hours, sterilisation being carried out in the inspissator at 80°C. for 20 minutes on two successive days. The medium when completed is of a rich green colour.

The presence of malachite green is of great value in inhibiting the growth of cocci and coliform organisms should either of these accidentally gain entrance to the tube. Unfortunately it is of little value in preventing the growth of yeasts or moulds or in preventing the development of spores. Little trouble was, however, experienced from these contaminations during the investigation.

For the purpose of obtaining a growth of tubercle bacilli, two or three loopfulls of sediment from the treatment of a specimen by sulphuric acid were rubbed over the surface of the medium. The mouth of the tube was then flamed and a burning wool plug inserted. In order to prevent the medium from drying up, the tube was sealed at the time of the inoculation by an Eyre rubber cap. The tubes were incubated at 37°C.

Within a few days as growth appeared, a tendency for the rubber cap to become slightly concave was noted. This was found to be due to the absorption of air in the tube by the growing culture. In tubes in which the condition was allowed to persist there appeared to be a retardation in the rapidity of

growth. This was most noticeable at the beginning of the investigation when a practice was made of closing the tubes with paraffin wax. A key to the cause of the phenomenon can be found in the results of experiments made by Novy and Soule (1925)[23] who note that in order to obtain good growths of tubercle bacilli an abundant supply of oxygen is required.

In order to allow as much oxygen as possible to enter the tube and at the same time to prevent the medium from drying up, air was allowed to enter the tube through a hypodermic needle, with which the cap was pierced, as soon as it was seen to have become concave. In this way oxygen was introduced into the tube to replace that used up by the growing culture.

Other media have been recommended for the primary culture of the tubercle bacillus after digestive and concentration methods of treatment of the specimen. Corper and Uyei[24] in 1928 suggested a glycerine-potato chrystal violet medium, while Sweaney and Evanoff[25] in 1930 suggested a special cream egg medium. The method detailed above, however, was found to give the most uniformly satisfactory results.

(e) ISOLATION BY ANIMAL INOCULATION.

In the isolation of the tubercle bacillus by the biological method the laboratory animal used was the guinea-pig, by reason of its high susceptibility to artificial infection. The inoculum prepared by one or other of the concentration methods was mixed with an equal volume of sterile Bouillon and about 1c.c. of the mixture injected into the animal by means of a sterile hypodermic syringe.

The route chosen for the inoculation was the intra-peritoneal. It was considered superior to the subcutaneous by reason of the more rapid development of the lesions and their more general character. There was also less tendency to the formation of an abscess at the site of inoculation with its risk of secondary infection.

The inoculated animals, which had not previously died, were killed on the twenty-eighth day, by a mixture of coal-gas and chloroform. The post-mortem examination was carried out in the usual way, the animal being pinned out by its four legs on a wooden board. The skin of the thorax and abdomen was sterilised by soaking it with methylated spirit and thereafter igniting it. The examination was then carried out with aseptic precautions.

Portions of the lesions developing in the successfully inoculated animals were removed for cultural purposes, and here again Petragnani's medium proved invaluable. From animals which had developed an abscess at the site of inoculation the isolation was comparatively simple and rapid. The lymphatic glands, inguinal, mesenteric and post-sternal were also very suitable for the recovery of the organism. The spleen, even when extensively infected, was not so successful a source, and the growth was always later in making its appearance.

(f) COMPARISON OF METHODS.

A comparison between the cultural and animal inoculation methods of isolating the tubercle bacillus is not easily made.

Both methods have points to recommend them.

Isolation by cultural methods is easily done; it requires less room, as, for example, an animal house could be dispensed with. Its greatest advantage is the rapidity, compared with other methods, with which results are obtained. On the other hand, cultural methods do not appear to be quite so certain as animal inoculation. It would appear that a heavier infection of tubercle bacilli is required to give a positive result in culture.

Isolation by the biological method is very much slower, requiring more than double the time taken by the cultural method. On the other hand, it rarely fails, and would appear to be rather more sensitive. In the latter part of the investigation a practice was made of carrying out both methods simultaneously. In this way if the cultural method yielded a negative result there still remained a second opportunity of isolating the organisms. This was of special value in those cases where specimens were rare or difficult to obtain.

F. DETERMINATION OF TYPE OF THE TUBERCLE BACILLUS.

In the differentiation between the human and bovine strains of tubercle bacilli use has been made of two fundamental discoveries, (1) the inhibitory effect of glycerine on the growth of the latter in culture, as first shown by Theobald Smith in 1903 (10) and (2) their relatively high virulence when experimentally inoculated into rabbits as described by Villemin (6) in his original memoir in 1865. The basis of differentiation between the strains is thus cultural and biological, and is quantitative rather than qualitative.

It was the practice throughout the investigation to make a sub-culture from the original growth on Petragnani's medium whenever it appeared usually about the eighteenth day. The medium employed for subculture was Dorset's egg prepared as described by him in 1902, (26) except that Bouillon was substituted for water as a dilutent. This subculture on Dorset's egg medium was the basis of the subsequent tests that were made.

The separation of the tubercle bacilli into two groups, human and bovine, was accomplished by either cultural or biological means. Occasionally a combination of these methods was employed.

(a) DETERMINATION OF TYPE BY CULTURAL MEANS.

The strains of organisms which were selected for examination by cultural methods only were those presenting a luxurious growth on primary culture. Taking advantage of the inhibitory effect of glycerine, subcultures were made on 2 per cent. agar

slopes containing 3, 6 and 9 per cent. glycerine respectively, on Dorset's egg medium containing 5 per cent. glycerine, and on glycerine potato. All the media was obtained according to the formulae given in Muir and Ritchie's Manuel of Bacteriology. The use of glycerine potato was thought to be desirable with a view to studying the pigmentation of cultures. Park and his co-workers in 1910 came to the conclusion that pigmentation on this medium was non-specific. Blacklock, on the other hand, is quite definite that the production of pigment is not a feature of bovine strains.

These five culture tubes, with a subculture on Dorset's egg, were incubated together at 37°C. and were examined at weekly intervals as to the degree and character of the growth. The examinations were continued for five weeks by which time the growth appeared to have reached its maximum. The first set of five tubes containing glycerinated media were then discarded and a second set inoculated from the subculture on Dorset's egg medium. The procedure was repeated a third time in order to ensure that the cultural characteristics were of a constant nature.

As has been seen care was taken to ensure that each generation seeded onto glycerine containing medium had come directly from medium which did not contain it, namely Dorset's egg. In this way any tendency of the bacilli to adapt themselves to growth in the presence of glycerine was eliminated as far as possible. It is worthy of note that in the case of luxuriantly growing bovine strains reported by Park and Krumwiede (12) in 1910, and Griffith (27) in 1920, the bacilli had

had been transferred directly from one glycerine containing medium to another.

If the growth of a particular strain was eugonic in character in all three generations the bacilli were considered to be of human type. If, however, growth in any generation did not appear to come up to the standard fixed by the British Royal Commission in 1911, to denote bacilli of eugonic type, the strain was subjected to a further biological test.

(b) DETERMINATION OF TYPE BY BIOLOGICAL MEANS.

(i) BY GUINEA-PIG.

The majority of strains were originally inoculated into guine-pigs for the primary isolation of the bacillus. A careful study of the post-mortem findings in these animals in the light of the subsequent diagnosis of the type of the bacillus revealed no connection of note. This would appear to be in accordance with the views expressed by The Royal Commission in 1911 (28), which stated that although the bovine bacillus was rather more virulent towards guinea-pigs than the human type, this could only be demonstrated by comparative experiments in which carefully graded doses were used.

(ii) BY RABBIT.

For the determination of the type of bacillus by the biological method the rabbit was invariably used. Animals

Of not less than 1000 grams. were chosen because they appeared to be less disturbed by the immediate effects of the inoculation, and further, they seemed less susceptible to the intercurrent diseases which terminated life before the completion of the experiment. Another feature of some practical significance was that owing to the route chosen for inoculation the smaller the animal the more difficult it became.

The route selected for inoculation was the intravenous, a marginal vein of one or other ear being used. This method was found to be superior to the subcutaneous or the intraperitoneal, in that a smaller amount of inoculum was required and the results of inoculation were more constant and speedily attained. The time factor is an important one where the accommodation of the animal house is limited, and the intravenous route therefore permits of a greater turnover in a given time.

The dose adopted was that recommended by the British Royal Commission in 1911 (29) and found most suitable by Blacklock 1932, (4) namely 0'01 of a millegramme of culture. This quantity was not however strictly adhered to, but an attempt was made to vary the dosage with the body weight of the animal. To achieve this purpose, for every additional 500 grams. of body weight, the initial dose was increased by a further 0'01 of a millegramme of culture.

To measure the dose of tubercle bacilli the following procedure was adopted. A series of six 10c.c. centrifuge tubes was selected and the tubes numbered by means of a diamond

point. After being carefully cleaned and dried their weights to three places of decimals were recorded. When not in use these tubes were stored in spirit. Before use they were placed in a clean dish to dry, the excess spirit being driven off in the incubator.

A portion of the culture to be tested was now removed from the surface of the medium by means of a stout platinum wire and placed in a tube. Cultures on Dorset's egg not more than 21 days old were used for this purpose. The tube and the portion of the culture was then weighed and the weight of the actual bacillary mass determined. This weight was usually in the region of 2 to 3 millegrammes.

The reduction of this weight of 2 to 3 millegrammes to that of 0'01 or 0'02 of a millegramme at first presented some difficulty but was eventually accomplished by means of a series of increasing dilutions. The bacillary mass was ground up at the bottom of the tube with a glass rod fused at one end to form a knob. When it was well titurated a few drops of sterile distilled water were added and the grinding continued. Gradually more water was added and in this way a bacillary emulsion was formed. From this emulsion subsequent dilutions were made so that the required dose was contained in 1c.c. of sterile distilled water. The appropriate amount was introduced into the marginal vein of a rabbit's ear. For this purpose a Mantoux syringe and an intradermal type of needle were used.

All rabbits which had not previously died were killed on the 62nd day after inoculation. This period was selected because by this time the majority of those inoculated with a

bovine strain were dead. On the other hand those so inoculated but still living presented unmistakable post-mortem appearances. This procedure effected a considerable saving of time. A record of the weight of each animal taken at 14 day intervals was kept, thus any significant loss of weight could be correlated with the post-mortem findings.

(iii) FOCI OF DOUBTFUL ORIGIN.

As the investigation proceeded, from time to time foci were found post-mortem whose true character was not apparent on macroscopic examination. All such foci regarding which there was any doubt were subjected to further study. The first step taken to the discovery of their actual nature was the making and staining by Zhiel-Neelsen's method of films from them. If acid-fast bacilli having the morphological characteristics of tubercle bacilli were demonstrated microscopically in these films, the lesions were presumed to be of tubercular origin.

On the other hand, if bacilli were not so demonstrated the whole focus was removed and embedded in paraffin wax. Sections cut from these blocks were stained by Zhiel-Neelsen's method and with Haemalum and Eosin, and an attempt made to demonstrate their nature. Any focus in which both these examinations were negative was regarded, for the purpose of the investigation, to be of non-tubercular origin.

G. RESULTS.

(a) MORPHOLOGICAL APPEARANCES OF THE TUBERCLE BACILLI.

The morphological appearances presented by the bacilli comprising each strain were carefully studied with a view to determining whether or not it would be possible to correlate their appearances with the type of organism. For this purpose all the bacilli examined were classified in three sections according to their length and the presence or absence of beading. In table ... III the details of this classification are set out.

TABLE ... III.

Site of Lesion.	Total	Long Solid Forms		Long Beaded Forms		Medium Sized Forms		Short Forms		Mixed	
		Human	Bovine	Human	Bovine	Human	Bovine	Human	Bovine	Human	Bovine
Spine	20	2	-	3	-	5	1	4	1	3	1
Hip	17	2	-	2	-	3	1	6	-	3	-
Ankle	8	2	-	-	-	2	1	3	-	-	-
Knee	8	-	-	2	-	2	-	3	1	-	-
Dactylitis	9	4	-	1	-	-	-	4	-	-	-
Glands	15	3	1	2	-	2	-	4	1	2	-
Soft Tissue	13	1	-	2	-	1	1	8	-	-	-
Miscellaneous	10	2	-	-	-	2	-	3	-	3	-
Totals	100	16	1	12	-	17	4	35	3	11	1

It would appear from the above table that the length of the tubercle bacilli is not in any way related to

its type. This finding appears to be in accordance with these of the Royal Commission (1907)[30], Park and Krumwiede (1910)[31], and Blacklock (1932)[32]. It will be observed, however, that beading was seen only in these bacilli of some relative length, but when one remembers how extremely short some of the other organisms were this does not seem altogether difficult to understand.

(b) ISOLATION EXPERIMENTS.

(1) STRAINS ISOLATED BY DIRECT INOCULATION OF CULTURE MEDIA.

Of the 100 specimens dealt with during the investigation 54 of them were inoculated onto Petragnani's medium after treatment with sulphuric acid. In order to determine the efficiency of this method the sediment obtained after the treatment of the specimen with sulphuric acid was, with 5 exceptions, divided into two portions one of which was seeded onto the culture medium while the other was inoculated intraperitoneally into a control guinea-pig. In the 5 exceptions the sediment was used only to inoculate the culture medium, no control animal being utilised.

Of the 49 specimens so tested, 47 were proved to contain living tubercle bacilli by guinea-pig inoculation, while 2 failed to produce any sign of this disease in these animals. Both these specimens however produced growths of tubercle bacilli on Petragnani's medium, and these were proved to be virulent by subsequent guinea-pig inoculation. In examining the 47 specimens which caused tuberculosis in their corresponding guinea-pigs we

find that 44 of them produced growth on culture medium while 3 did not. Thus growth occurred directly on Petragnani's medium in 93 per cent. of proved tubercular specimens. The details of this experiment are set out in Table IV.

TABLE IV.

Group.	Total.	Number of Specimens.	
		Culture +ve.	Culture -ve.
Guinea-pig Tubercular.	47	44	3
" " Non-Tubercular.	2	2	-
" "Not Inoculated.	5	5	-
Total:-	54	51	3

It is desired to point out that only one tube of medium was inoculated from each specimen, and that the percentage of success does not refer to the result obtained after inoculating several tubes from which growth might only be obtained in one.

The average time taken for definite visible growth to appear was 18 days. The shortest time was 11 and the longest 32 days. It was found however that if the tubes were opened on the second or third day after inoculation, and films made from their surface, a great increase in the number of tubercle bacilli could be seen microscopically.

In table V. the average times taken for definite, unmistakable growth of tubercle bacilli to appear on Petragnani's medium are noted.

TABLE V.

Lesion.	Number of Cases.	Average Time (Days).
Spine.	11	18
Hip.	10	15
Knee.	3	17
Ankle.	2	25
Soft Tissue.	5	16
Glands.	7	22
Dactylitis.	5	18
Rib.	2	16
Elbow.	2	19
Foot.	1	21
Humeral Shaft.	1	17
Wrist.	1	18
Os. Calcis.	1	22
Total:-	51	18

In the column headed "lesion" the site from which the specimen of pathological material was obtained is noted, and opposite it the number of such cases examined. The times vary considerably from one group to another, this being particularly so with the "ankle group". No certain reason can be advanced for this fluctuation. There was no difference in procedure from

one group to another. As far as could be ascertained all the material used was of uniform character, although the possibility of small variations in the medium, especially in the egg content must be borne in mind.

(11) STRAINS ISOLATED BY GUINEA-PIG INOCULATION.

This method was employed either alone or along with the direct cultural method for the isolation of all except five of the strains utilised throughout the investigation. It was successful in every case but the two, already referred to in the previous sub-section, from which virulent tubercle bacilli were obtained by the direct cultural method simultaneously carried out.

A practice of killing those guinea-pigs, not already dead, on the twenty-eighth day after inoculation was carried out, and was found satisfactory. Portions of tubercular tissue removed from these animals was seeded onto culture medium. At the beginning of the investigation Dorset's egg medium was used for this purpose but with the introduction of Petragnani's medium a saving of from ten to twelve days was effected in the time taken to obtain definite visible growth. The total time taken by the whole procedure was from five to six weeks, being composed of twenty-eight days from the time of inoculation of the guinea-pig till its killing, and aproximately twelve days for growth to appear on culture medium. It was noted that the time taken for growth to appear in culture, when using Petragnani's medium, was slightly less when the material inoculated

was derived from a tubercular guinea-pig than when it was obtained from the actual clinical case. Even with the saving of time it will be seen that this method cannot compare for speed and ease with the direct cultural one.

On the other hand, the guinea-pig inoculation method of isolating tubercle bacilli although slower is more certain. As has been already stated, there were only two failures in ninety-five attempts, that is it failed in 2'1 per cent. of cases, as compared with the direct cultural method which was unsuccessful in 6 per cent. of cases.

(C) DETERMINATION OF TYPE.

Either cultural or biological means or a combination of both was used to determine the type of the isolated tubercle bacilli. In table VI. are set out the numbers so treated, each group of cases being considered separately.

TABLE VI.

Group.	Number Typed.								
	Culturally.			Biologically.			Both Methods.		
	Total	Human	Bovine	Total	Human	Bovine	Total	Human	Bovine
Spine.	5	5	-	14	11	3	-	-	-
Hip.	9	9	-	6	6	-	2	1	1
Ankle.	1	1	-	6	5	1	-	-	-
Knee.	3	3	-	4	3	1	-	-	-
Dactylitis.	6	6	-	2	2	-	1	1	-
Glands.	-	-	-	15	13	2	-	-	-
Soft Tissue.	7	7	-	8	7	1	-	-	-
Miscellaneous.	6	6	-	5	5	-	-	-	-
Total:-	37	37	-	60	52	8	3	2	1

(i) DETERMINATION BY CULTURAL MEANS.

In forty strains this method was adopted, the behaviour of the bacilli when grown on glycerine containing medium being studied in three consecutive generations. In thirty-seven of the strains the growth in all three generations was definitely eugonic, and they were classed as of human type without further examination. The remaining three strains failed to produce eugonic growths in one or more generations, and were retained for further examination by biological means. They thus comprise the strains considered in the next subsection.

(ii) DETERMINATION OF TYPE BY CULTURAL AND BIOLOGICAL METHODS.

Two of these three strains were obtained from lesions involving the hip joint, the remaining one being from a case of bilateral dactylitis with involvement of the left elbow joint. Of the two strains derived from hip lesions one was eventually proved to be bovine. It was extremely dysgonic in the first two generations on glycerine medium, no third generation was investigated, examination by this means being stopped after the second generation had failed to respond. Its dysgonic character was specially marked in the case of the glycerine potato medium. By biological test it was typically bovine the rabbit showing generalised tuberculosis accompanied by great loss of weight.

The second strain isolated from a case of hip joint

Disease to be so treated, grew poorly in the second and third generations but produced only minimal lesions in the rabbit. The third strain, that isolated from the case of dactylitis, appeared to be a true dysgonic human strain in that it produced unsatisfactory growths on all glycerine medium, and in all three generations, but only minimal lesions in a rabbit.

(iii) DETERMINATION OF TYPE BY BIOLOGICAL MEANS.

The majority of strains which came under examination during the investigation were tested in this way, a total of sixty being so treated. Of this number fifty-two produced only minimal lesions in the lungs and kidneys of the inoculated rabbits, and were consequently classed as being of human origin. On the other hand, eight produced generalised tuberculosis in the rabbits accompanied by great loss of weight. In five cases the rabbit died within forty-eight days of the date of inoculation, while in the remaining three cases the lesions were of a definitely progressive nature.

In table VII., a detailed study of the lesions found in ninety-three guinea-pigs inoculated intraperitoneally with pathological material, containing virulent tubercle bacilli, obtained from ninety-three separate cases of the disease, is made.

TABLE VII. (over)

TABLE VII.

Site of Lesion.	Human Strains.		Bovine Strains.	
	Number	Per Cent.	Number.	Per Cent.
Spleen.	83	97'6	8	100'0
Post Sternal Glands.	74	87'0	8	100'0
Inguinal Glands.	51	60'0	3	37'5
Abscess at Inoc.Site.	29	34'1	3	37'5
Liver.	21	24'7	1	12'5
Peritoneum.	21	24'7	3	37'5
Omentum.	8	9'4	-	-
Lungs.	4	4'7	-	-
Number of Guinea-pigs.	85		8	

The table is divided into sections in the light of the subsequent determination of the type of the tubercle bacillus. Examination of the table shows that except for the apparent failure of the bovine strains to produce lesions in the lungs and omentum there is no appreciable difference in the post-mortem appearances between guinea-pigs inoculated with human or bovine strains. When the smallness of the number of human strains which produced lesions in the lungs and omentum is considered, the failure of bovine strains to produce such lesions becomes of even less significance.

(d) INCIDENCE OF BOVINE TUBERCULOSIS IN 100 CASES.

In the course of this investigation 100 strains of

tubercle bacilli isolated from 100 unselected cases of tuberculosis of bones and joints and glands have been studied. In this series of 100 cases the bovine tubercle bacillus was only found to be the cause of nine. While it must be admitted that what is probably the most prolific source of bovine infected cases, namely abdominal tuberculosis, has not been considered, yet the percentage of bovine strains is much lower than any other previously recorded in this country.

In table V111. the site of the lesion, the number of cases in each group, and the percentage of these caused by the bovine bacillus are set out, the whole being divided into the two age groups, 0 to 5 years and 5 to 15 years.

TABLE V111.

Group.	No. of Cases.	0-5years.			5-15years.			All Ages. Per Cent. Bovine.
		No. Human.	No. Bovine.	Per Cent. Bovine.	No. Human.	No. Bovine.	Per Cent. Bovine.	
Tuberculosis of Spine.	19	8	0	0'0	8	3	27'2	15'7
Tuberculosis of Hip.	17	5	1	16'6	11	0	0'0	5'8
Tuberculosis of Knee.	7	1	1	50'0	5	0	0'0	14'2
Tuberculosis of Ankle and Os Calcis.	7	1	0	0'0	5	1	16'6	14'2
Tuberculosis of Dactylitis.	9	8	0	0'0	1	0	0'0	0'0
Tuberculosis of Glands.	15	4	1	20'0	9	1	10'0	13'3
Tuberculosis of Soft Tissues.	15	3	0	0'0	11	1	8'3	6'6
Tuberculosis of Miscellaneous Lesions.	11	7	0	0'0	4	0	0'0	0'0
Total:-	100	37	3	7'5	54	6	10'0	9'0

In the group designated "tuberculosis of soft tissues", and comprising 15 cases, the lesions were situated in close proximity to bones or joints of one or other of the limbs, but without showing any actual involvement of the bony structure. In the "miscellaneous" group consisting of 11 cases, the following lesions were grouped together. In 3 cases the elbow joint was affected, in one of which both joints were involved, in 3 the ribs were the site of the lesions, while in 2 the humerus was the part affected. One of these cases also showed the presence of disease in the shafts of the tibia and fibula on opposite sides. In the remaining 3 cases the lesions were situated in the left shoulder joint, the left ulna, and the right scaphoid bone respectively.

If all these cases in which the lesions were situated in the bone, joints and associated tissues, be grouped together as "bone and joint tuberculosis", and the cases of glandular origin be considered separately, the result may be represented as in table IX.

TABLE IX.

Group.	No. of Cases.	0-5years.			5-15years.			All Ages Per Cent. Bovine.
		No. Human.	No. Bovine.	Per Cent. Bovine.	No. Human.	No. Bovine.	Per Cent. Bovine.	
Tuberculosis of bones and Joints.	85	33	2	5'7	45	5	10'0	8'2
Tuberculosis of Glands.	15	4	1	20'0	9	1	10'0	13'3
Total:-	100	37	3	7'5	54	6	10'0	9'0

From the above table it will be seen that the results obtained for tuberculosis of glands are much lower than any previously recorded in this country, while these obtained for lesions of bones and joints, while lower than any previously recorded in Scotland or England, are not so low as these published by Park and Krumwiede in 1910 or Price in 1932. In order to render the comparison of the results of the present investigation with some of the principal figures previously published, these have been set out in tabular form, the present series being repeated at the foot of the table for convenience.

TABLE I.

Author.		Per Cent. Bovine.		No. of Cases.	Area Examined.
		Glands.	Bones and Joints.		
Park and Krumwiede (31)	1910.	42'1	4'4	166	Germany, Switzerland, Denmark, United States.
Fraser, (2)	1912.	-	62'8	70	Edinburgh.
Mitchell. (3)	1914.	90'2	-	72	"
Griffith, A.S. (34)	1915.	71'4	-	7	E. Scotland.
" " (35)	1930.	58'7	-	-	England.
Price, R.M. (5)	1932.	43'2	4'0	112	Toronto.
Blacklock (4)	1932.	64'3	34'6	54	W. Scotland.
Griffith and Summers (33)	1933.	-	45'2	53	S.W. Scotland.
Present Investigation.	1934.	13'3	8'2	100	Glasgow & District.

M. CORRELATION OF THE TYPE OF BACILLUS WITH THE CLINICAL MANIFESTATIONS.

(a) SPINES.

(1) 16 CASES OF SPINAL TUBERCULOSIS CAUSED BY THE HUMAN TYPE OF BACILLUS.

CASE 1.

This patient, who has always been a somewhat weakly child, was a girl of four years of age. Her tendency to ill-health had become increasingly evident during the year immediately preceding her admission to hospital. No history of previous tuberculosis was found in her family, and no record of trauma was obtained.

On admission the Mantoux Test was found to be positive. A definite kyphosis was present in the lumbar region of the spine and an abscess was found in the Right Psoas sheath reaching the surface in the Right Iliac Fossa. It is now sixteen months since she was admitted to the hospital and the disease has not yet become inactive, so that in all probability she has suffered from active tuberculosis for at least two years.

Radiologically an advanced tubercular lesion was seen to be involving the bodies of the 1st and 2nd Lumbar Vertebrae. The first Lumbar Vertebra was seen to be affected to a greater extent than the second and the Right Side more than the Left.

Tubercle bacilli were isolated from the abscess pus by both cultural and animal inoculation methods. They were seen microscopically to be of medium length, acid-fast, and regularly staining. Their eugonic character was proved by cultural means.

CASE 2.

This patient, a boy of four years, had previously undergone hospital treatment for rickets when an infant, and for the

CASE 1.

DISEASE OF L. V. 1 AND 2.

past three years his health had been very poor. One week before his admission to Mearnskirk Hospital pain had been experienced in the Lumbar Region of the spine accompanied by swelling. There was no record of trauma or of previous tuberculosis in his family.

On admission to hospital an angular deformity was present in the Lumbar Spine accompanied by flexion of the left hip joint. An abscess was pointing in the left lumbar region. The Mantoux Test was positive. After a period of twelve months treatment the condition became inactive.

Radiologically disease was seen to involve the bodies of the 4th and 5th Lumbar Vertebrae. The lesion appeared to be of an epiphyseal type and to be accompanied by considerable bone destruction especially marked in the body of the 4th Lumbar Vertebra. The presence of a large abscess was also noted.

As in the previous case, cultural and animal inoculation methods were employed to isolate the causal organisms from the abscess pus. They were seen microscopically to be short, acid-fast, regularly staining bacilli. Cultural means were employed to demonstrate their eugonic character.

CASE 3.

This girl, aged 6 years, was admitted to hospital after two years of ill-health. No record of trauma or of tuberculosis in her family was obtained.

On admission the Mantoux Test was found to be positive. A sharp angular deformity was present in the Dorso-Lumbar Spine, but no abscess was palpable. This, however, made its appearance eighteen months later immediately below the right costal margin in the Posterior Axillary line. It is only recently that the

Case 2.

Disease of L. V. 4 and 5.

disease has healed, so that she has suffered, for at least two years, from active tuberculosis.

Radiological examination of the spine revealed the presence of disease in the lower Three Dorsal Vertebrae. The lesion would appear to have begun as a central osteomyelitis causing considerable collapse of the bodies. A large paravertebral abscess was present and there was some erosion of the 12th rib.

The strain of tubercle bacilli which was isolated by cultural means alone, was found microscopically to consist of both long and short members. That it was of human type was demonstrated by biological means.

CASE 4.

This boy, aged five years, was admitted after one year of considerable ill-health, during a portion of which time he had been treated in the Royal Hospital for Sick Children, Glasgow. His family history contained no evidence of tuberculosis, and no record of trauma was obtained.

Examination on admission revealed marked hydrocephalus accompanied by gross mental deficiency. A slight kyphosis was present in the Lumbar Spine, and the Mantoux Test was positive. After having been under treatment for one year, the disease was found to have spread to the left hip joint. It is now two years and seven months since he first came under treatment in this hospital, and as the disease is still active he would appear to have been suffering from active tuberculosis for at least three and a half years.

Radiologically the disease was found to be situated

Case 3.

Disease of D.V. 10 to L.V. 1.
With Abscess.

Case 4.

Erosion of Lumbar Vertebrae.

in the 3rd, 4th and 5th Lumbar Vertebrae, and to have caused very considerable destruction of the bodies.

Tubercle bacilli, which were found microscopically to be of medium length, were isolated by animal inoculation methods only. Their eugonic character was determined by cultural test.

CASE 5.

The only illness of note from which this patient, a girl of thirteen years, had suffered from was a severe attack of "Influenza" one year prior to her admission to the hospital. During the intervening time, although not actually confined to bed, she had been unwell, experiencing loss of weight and general lassitude.

Examination on admission revealed the presence of an angular kyphosis in the Lumbar Region of the spine. The Mantoux Test was positive. Definite tubercular disease was also found in the left Great Toe. No abscess formation was present at this time but this made its appearance six months later in the right loin, while one month after this another appeared over the Right Ankle drawing attention to the presence of disease in the right Astragulus.

It was not until she had been under treatment for two years and nine months, or three years and nine months after her initial illness, that the disease became inactive.

Radiologically the disease was seen to be situated in the bodies of the 1st, 2nd and 3rd Lumbar Vertebrae. The lesion appeared to have commenced in the epiphysis of the 2nd Lumbar Vertebra.

Short, regularly staining acid-fast bacilli were isolated from the abscess pus by animal inoculation means. They were found to be eugonic by cultural test.

CASE 5.

DISEASE OF L. V. 1 AND 2.

CASE 6.

This was a girl aged six years. She had been apparently quite well until two months before her admission, when it was noticed that she was walking with a stoop, and a swelling was observed in the left Lumbar Region. No record of any injury could be obtained, and her family history was negative for tuberculosis.

On examination when admitted to hospital a large abscess was found extending from the level of the 10th left rib in the posterior scapular line round into the left Iliac Fossa. There was also a small sharp angulation in the Lumbo-Dorsal Spine. The Mantoux Test was positive.

After undergoing treatment for six months the child developed scarlet fever from which she appeared to make a good recovery, except that the abscess which had been gradually disappearing, began again to collect. This was followed very soon by the development of a sinus.

The patient, who is still in hospital, has now undergone eighteen months of treatment, and the disease is still unhealed, so that as far as can be estimated the condition has been in a state of activity for twenty months.

Radiologically the seat of the disease appeared to be the bodies of the 12th Dorsal and the 1st Lumbar Vertebrae. The lesion which is of an epiphyseal type had caused considerable destruction of bone, especially in the 12th Dorsal Vertebra.

The causal organisms, found microscopically to be long and beaded, were isolated by both animal inoculation and cultural means. Biological methods were used to demonstrate the human character of this strain.

Case 6.

Disease of D.V. 12 to L.V. 1.

CASE 7.

This patient, a boy of thirteen years, had been a chronic invalid practically all his life, and the tubercular nature of his condition had been recognised when he was little more than one year old. Two previous periods of institutional treatment had been given but had both been interrupted by his parents removing him from hospital contrary to medical advice. No record of trauma was obtained, but his family history was bad, one sister having died of tubercular meningitis, while both his paternal uncle and aunt suffered from that disease.

On admission to hospital a very marked kyphosis was present involving all the Dorsal Vertebrae and having its apex at the 8th. The sternum was very prominent, being pushed forward in such a way as to cause great deformity of the chest wall. A large abscess was present in the Right Lumbar Region.

After a period of treatment lasting twenty-one months, during the greater part of which, owing to the size of the deformity, the patient had to be nursed on his face, the lesion became inactive. It is very difficult to estimate with any degree of accuracy the duration of activity in the lesion, but it would appear to have been many years.

Radiological examination revealed the presence of very extensive disease of the lower dorsal and upper two Lumbar Vertebrae, but owing to the extreme destruction of the bodies it is impossible to determine any of the details.

Tubercle bacilli were isolated from the abscess pus by animal inoculation methods. Microscopically they were seen to be short, regularly staining, acid-fast organisms. The human

CASE 7.

EROSION OF LOWER DORSAL AND
1ST LUMBAR SPINES.

character of the strain was demonstrated by biological means.

CASE 8.

This patient, a girl of three years, had been apparently well until seven months before her admission to this hospital, when her health began to fail and signs of spinal mischief appeared. Her family history was negative for tuberculosis and no record of trauma was obtained. On admission the Mantoux Test was found to be positive. Her general condition was poor and there was an appearance of considerable shortening of her neck. A moderate degree of angulation was present in the upper dorsal and lower cervical regions of the spine. After she had been under treatment for two months abscess formation appeared over the left olecronon process.

It was not until she had been under treatment for two years that it was possible to regard the lesion as inactive.

Radiologically active disease with abscess formation was seen to involve the 3rd, 4th and 5th Cervical Vertebrae. The disease had the appearance of a diffuse osteomyelitis.

The tubercle bacilli isolated from this case were obtained from the pus of the olecronon abscess. They were isolated and typed by biological means, and when examined microscopically were found to be long, non-beaded, acid-fast organisms.

CASE 9.

This patient, who was a boy of three years, sustained a fall four months before his admission to hospital. Very shortly after this it was noticed that he appeared to have difficulty in walking. There was no history of tuberculosis in his family.

On admission the Mantoux Test was found to be positive. A definite kyphotic deformity was present in the lower dorsal

CASE 9.

DISEASE OF D.V.12 AND COMPLETE EROSION OF L.V.1.

spine but no abscess formation was present. Fourteen months later, however, this picture was altered by the appearance of an abscess in the Right Iliac Fossa, which, despite all attempts to prevent it, went on to sinus formation two months later.

After a period of twenty-six months treatment, the disease became inactive, so that he had suffered from active tuberculosis for about two and a half years.

Radiological examination of the spine revealed the presence of disease in the bodies of the 12th Dorsal and 1st Lumbar Vertebrae. The 12th Dorsal Vertebra appeared to be the more extensively affected, only a vestige of bone being left, while the 1st Lumbar was affected chiefly on the upper surface of the body.

When examined microscopically the tubercle bacilli, isolated by animal inoculation means, were found to be long, slender and beaded. Their eugonic character was tested by cultural methods.

CASE 10.

This boy, aged thirteen years, has a history of pain in the upper Dorsal Region of the Spine, followed by swelling, for nine months before his admission to hospital. This does not appear to have been sufficiently severe to confine him to bed, and he apparently got about fairly well until one week before his admission, when owing to the onset of spasticity of the lower limbs he was forced to take to bed. There was no record of trauma, and no history of previous tuberculosis in his family.

On admission the Mantoux Test was found to be positive. A moderate kyphosis was present in the dorsal region accompanied

CASE 10.

LARGE PARAVERTREBAL
ABSCESS.

by pain in the left side of the back. His lower limbs were very spastic, all the reflexes being exaggerated. Ankle and patellar clonus and Bahinski's sign were present. Unfortunately his condition became steadily worse, and he developed clonic spasm of the muscles of the lower limbs, accompanied by loss of sensation below the level of the umbilicus. This was followed in a short time by incontinence of bowel and bladder. Five months after his admission to hospital the operation of costo-transversectomy was performed on the 8th rib and adjacent transverse process in order to relieve the symptoms, in which respect it was successful. A paravertebral abscess was found in the region of the 7th, 8th and 9th Dorsal Vertebrae which was opened and drained.

It is now a year and nine months since the appearance of the first symptom, and although his general condition has improved somewhat the disease is not yet inactive.

Radiological examination shows the presence of osteomyelitis of the 7th, 8th and 9th Dorsal Vertebrae accompanied by a large paravertebral abscess. The body of the 8th Dorsal Vertebra appears to have largely collapsed and to have assumed a wedge shape.

Tubercle bacilli were isolated both culturally and biologically from the material removed at operation. Microscopically both long and short forms were present. Biological means were used to demonstrate the human character of this strain.

CASE 11.

After a period of four months previous illness, this child, a boy of three years, was admitted to Mearnskirk Hospital. There was no record of trauma, and no history of previous tuberculosis in his family.

Examination on admission demonstrated the presence of disease in the left sacro-iliac joint accompanied by abscess formation which reached the surface in the upper and outer quadrant of the left gluteal region. The Mantoux Test was positive.

He has now been under treatment for a period of two years, and the condition has only recently become inactive, so that there has been in all twenty-eight months of active tuberculosis.

Radiological examination showed the presence of tubercular osteomyelitis involving the left sacro-iliac joint.

Tubercle bacilli, found microscopically to be of medium length and non-beaded, were isolated from the abscess pus by animal inoculation methods. When subjected to biological test they were proved to be of human type.

CASE 12.

This girl, aged three years, was admitted with a history of injury to her back, having fallen from a chair in her home. Her family history was not good, her father having suffered from pulmonary tuberculosis.

On admission, old-standing tubercular glands were found on both sides of her neck. There was a sharp angulation of the Lumbo-Dorsal Spine with a large abscess to the right of it, and considerable spasm of the lateral spinal muscles was present in the dorsal region. The Mantoux Test was positive.

It was not until two and a half years of treatment that the condition became inactive.

Radiological examination revealed an unexpected distribution of the disease, there being two separate areas involved. One of these extended from the 4th to the 7th Dorsal Vertebrae, while the other involved the 11th, 12th and 1st Lumbar Vertebrae.

CASE 11.

DISEASE OF L. SACRO-ILIAC JOINT AND ILIUM.

CASE 12.

EXTENSIVE DISEASE OF LOWER DORSAL VERTEBRAE.

While both these areas appear to have produced an abscess, it was only that of the lower one which had come to the surface. In both cases the disease had attacked the vertebral bodies alone causing considerable destruction, a feature which appeared to be more marked in the lower lesion.

The infecting strain of tubercle bacilli was isolated from this case by animal inoculation methods only. Microscopically the bacilli were seen to be of medium length and evenly staining, while their type was demonstrated by biological test.

CASE 13.

Although this patient, a boy of nine years, had been in poor health for two years, it was not until a few months before his admission to hospital that symptoms of spinal mischief appeared. There was no history of tuberculosis in his family, and no record of injury.

On admission there was a definite kyphotic deformity in the upper lumbar region of the spine accompanied by spasm of the lateral spinal muscles of that region. Six months later an abscess appeared in the left lumbar region, which, however, soon disappeared. Within one month of this he developed Scarlet Fever, and about the same time the abscess re-appeared and went on, on this occasion, to sinus formation. Thirteen months later a further collection of pus made its appearance in the right thigh having apparently tracked down the right psoas sheath. The Mantoux Test was positive.

Although it is now four years since he first came under treatment, it is only recently that the abscesses have disappeared, and the disease is as yet radiologically active.

CASE 13.

DISEASE OF D.V. 12 TO L.V. 3 WITH
DESTRUCTION OF L.V. 1 AND 2.

Radiological examination of the affected portion of the spine revealed the presence of tubercular osteomyelitis of the 12th Dorsal and 1st, 2nd and 3rd Lumbar Vertebrae. The bodies of the 1st and 2nd Lumbar Vertebrae were extensively destroyed, while only the contiguous surfaces of the 12th Dorsal and 3rd Lumbar Vertebrae were affected. The uncommon presence of a bone bridge was noted.

The strain of tubercle bacilli isolated from this case was so obtained by both animal inoculation and direct cultural methods. Microscopically it was shown to consist of both short and long members and was proved to be of human type by biological means.

CASE 14.

This patient, a girl of six years, was admitted after only one month of previous illness. No evidence of previous tuberculosis in her family and no record of injury were obtained.

On admission a moderate degree of kyphosis was present in the lumbar region of the spine, and an abscess was apparent in the right psoas sheath palpable immediately above the right inguinal ligament. The knee-jerks were markedly increased. It is now over two years since this patient first came under treatment for her spinal lesion and the condition is still active.

Radiological examination demonstrated the presence of disease in the lower three Lumbar Vertebrae. Here again it has taken the form of an osteomyelitis of the bodies, but there are also several loose pieces of bone.

The causal organisms were obtained from the abscess pus by direct cultural methods. Microscopically they were seen to be long, stout, evenly staining acid-fast organisms. Their type

Case 14.

Disease of D.V. 10, 11 and 12.

was determined by biological means.

CASE 15.

This patient, a girl of three years, has a history of six months of indefinite ill-health before admission to hospital. Her family history was negative for tuberculosis, and there was no record of trauma.

On admission the child was found to be in very poor condition. There was marked deformity of the lumbar portion of the spine and a profusely discharging sinus was present on the inner side of the left thigh. The Mantoux Test was positive.

After three months treatment in hospital an abscess appeared in the right thigh which, despite all efforts to prevent it, broke down to form a sinus. This patient has now been under treatment for three years and the condition is as yet unhealed, so that she would appear to have suffered from active tuberculosis for approximately three and a half years.

Radiological examination of the spine revealed tubercular osteomyelitis of the bodies of the 3rd, 4th and 5th Lumbar Vertebrae. There was great destruction of bone and several sequestra were present.

Tubercle bacilli isolated from the right psoas pus by animal inoculation methods were seen microscopically to be long, thin, beaded organisms. When tested biologically they were found to be of human type.

CASE 16.

This boy, aged six years, presented only a short history of pain in the left leg and difficulty in walking of five weeks duration. There was no evidence of tuberculosis in his

CASE 15.

LESION OF L.V. 3, 4 AND 5 WITH MARKED INVOLVEMENT OF L.V. 4.

family and no history of trauma.

Examination on admission disclosed no abnormality of the left leg but considerable boarding of the spinal muscles in the Lumbar Region. Passive movement of the spine caused extreme pain. Two months after admission an abscess tracking down the Right Psoas Sheath made its appearance in the Right Iliac Fossa. In spite of this however the lesion became inactive after only one year of treatment.

Radiological examination showed the presence of tubercular disease of the bodies of the 4th and 5th Lumbar Vertebrae and the presence of a large abscess.

The isolation of tubercle bacilli from the abscess pus of this case was carried out by both cultural and animal inoculation methods. The bacilli were found microscopically to be very short, regularly staining, acid-fast organisms. By biological test they were proved to be of human type.

(ii) 3 CASES OF SPINAL TUBERCULOSIS CAUSED BY THE BOVINE TYPE OF TUBERCLE BACILLUS.

CASE 17.

This patient was a girl of seven years. She had previously undergone two years of hospital treatment for the spinal lesion before her transfer to Mearnskirk Hospital. There was a history of tuberculosis in one of her uncles but none in her own immediate family. There was no record of trauma.

On admission there was a slight kyphosis of the Mid Lumbar Spine, and an abscess was present in the Right Psoas Sheath. The Mantoux Test was positive.

Case 16.

Lesion of L.V. 4 and 5.

After two and a half years of treatment further abscess formation made its appearance in the Left Psoas Sheath, and it was not until three years and three months after her admission that the disease became inactive. From the foregoing record it would appear that this girl had suffered from active tuberculosis for over five years.

Radiologically there was seen to be disease of the bodies of the 2nd to the 5th Lumbar Vertebrae. The 3rd was extensively destroyed and several loose pieces of bone were present.

The tubercle bacilli isolated from this case by animal inoculation methods were seen microscopically to be of medium length and regularly staining. Their bovine character was demonstrated by biological means.

CASE 18.

This boy, aged seven years, presented a definite history of symptoms related to his back of fourteen months duration before his admission to Mearnskirk Hospital. During a period of this time, immediately prior to his admission to this hospital, he had undergone treatment in the Royal Hospital for Sick Children, Glasgow. There was no history of previous tuberculosis in his family, and no record of injury to his spine.

Clinical examination on admission revealed no evidence of spinal trouble other than the presence of a large abscess which appeared to be lying in the Right Psoas Sheath, and it was only radiological examination which showed the seat of the disease to be the sacrum.

This boy has now undergone sixteen months of treatment and the abscess is still present in spite of having been repeatedly

CASE 17.

DISEASE OF L.V. 2 TO 5, WITH GREAT DESTRUCTION OF L.V. 3 AND SEVERAL SEQUESTRA.

emptied by aspiration. He has, as far as can be determined, suffered from active tuberculosis for the past two and a half years.

Radiological examination demonstrated the presence of a tubercular osteomyelitis of the upper portion of the sacrum. The disease is causing considerable destruction and several small sequestra are present.

Tubercle bacilli were isolated from the abscess pus by both cultural and animal inoculation methods. Microscopically they were seen to be short, evenly staining organisms which when subjected to biological test were of definitely bovine type.

CASE 19.

This boy, aged twelve years, was admitted after having been unwell for the preceding twenty-two months. As in the previous case, a portion of the time had been spent in the Royal Hospital for Sick Children, Glasgow. His family history contained no record of previous tuberculosis and there was no history of trauma.

Examination on admission revealed a well marked kyphosis accompanied by rigidity of the lateral spinalmuscles in the Lumbo-Dorsal region of the spine. An abscess which was present to the left of the affected vertebrae extended into the Left Thigh. The Mantoux Test was positive.

One month later a further collection of pus made its appearance in the Right Psoas Sheath.

This patient failed to respond to treatment and exactly one year later there was a further extension of the disease at this time into the left hip. The patient died five months later and unfortunately permission for a Post Mortem examination was not obtained. In all this boy had suffered for over five years from active tuberculosis.

CASE 18.

INVOLVEMENT OF THE SACRUM.

Radiological examination showed the presence of tubercular disease involving the bodies of the 9th to 12th Dorsal Vertebrae and of the first Lumbar. There was very considerable tissue destruction and a large paravertebral abscess was present.

The strain of infecting tubercle bacilli isolated from this case by animal inoculation methods was seen microscopically to consist of both long and short members. Their bovine nature was demonstrated by biological means.

SPINES.

SUMMARY.

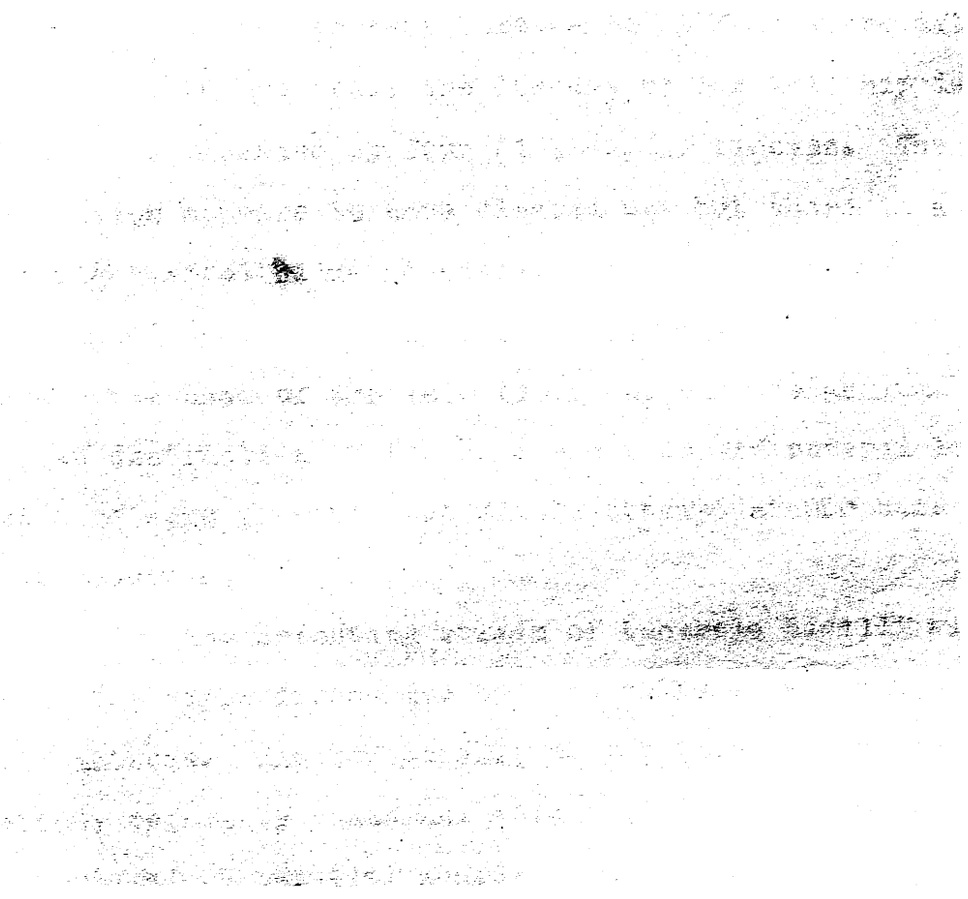
Type	Number of Cases	Trauma Present in -	Familiar Tuberculosis in -	Average Age. Years.	Average Duration of Activity
Human	16	12.5%	18.7%	$6\frac{10}{12}$	$3\frac{8}{12}$
Bovine	3	0	33.3%	$8\frac{8}{12}$	$3\frac{7}{12}$

In the above table an attempt has been made to lay out in an easily visualised form the more important features of this group of nineteen cases of spinal tuberculosis taken as a whole. When the cases of human origin are compared with those of bovine origin, the most striking features would appear to be the absence of previous trauma in the "bovine" section and the comparatively high incidence of previous familiar tuberculosis when compared with the "human" section. There is also a slightly higher average age in the case of patients whose lesion has been caused by the bovine type of bacillus. In spite of these

differences it is, however, noteworthy that the average duration of activity is similar for both sections.

In making these comparisons, however, it is most important to draw attention to the small numbers in each group and the consequent danger of forming opinions on these figures alone.

With regard to the radiological appearances of the individual cases, while an attempt has been made to record apparent differences in the lesions, it has not been found possible to observe any alteration in the disease process as it occurs in cases caused by bacilli of human or bovine type.



(b) HIPS.

(1) 16 CASES OF TUBERCULOSIS OF THE HIP CAUSED BY THE HUMAN TYPE OF TUBERCLE BACILLUS.

CASE 1.

This was a boy aged nine years, who, three months before admission, fell from a swing. There was no history of tuberculosis in his family. On admission, examination of his left hip, which was held flexed at 20°, showed considerable limitation of all movements except external rotation. No abscess formation was present. There was a right basal pleurisy but no intra-pulmonary disease was apparent. The Mantoux Test was positive. Eight months later an abscess appeared behind and slightly below the left great trochanter, subsequently to give rise to the formation of sinuses.

At the present time, exactly four years after his admission to hospital, the disease of the left hip is still active and is accompanied by four discharging sinuses. The pleuritic condition appears to have cleared up, but there is a suggestion of right sided hilum adenitis.

Radiologically the disease was found involving extensively the head of the left femur and the acetabulum. There was great destruction of the head and neck and several loose pieces of bone were present, but little attempt at new bone formation was observed.

The infecting strain of tubercle bacilli was isolated from the sinus discharges by both cultural and animal inoculation methods. Microscopically it was found to consist of short, stout, regularly staining, acid-fast bacilli. Their type was determined by cultural means.

Case 1.

Disease of head of L. Femur and
Acetabulum with Sequestrum
formation.

CASE 2.

This boy, aged four, was admitted after a period of illness, the chief symptom of which appears to have been pain in the left hip. His mother had suffered from pulmonary tuberculosis but no history of trauma was obtained.

Examination on admission revealed active disease of the left hip, and the presence of an abscess above the right knee. Owing to the destruction which had taken place in the hip joint the femur tended to dislocate very easily. The Mantoux Test was positive. Two years after admission an abscess developed in relation to the left hip, and it was not until fully a year later that the condition became inactive. The right knee which was also the seat of disease became inactive some time before this. In this case there is a record of 5½ years of active tuberculosis.

Radiological examination of the left hip revealed extensive disease of the head and neck of the femur and also of the acetabulum. The femur was dislocated upwards.

Tubercle bacilli were isolated from the hip abscess pus by guinea-pig inoculation. They were seen microscopically to be short, regular, acid-fast organisms, and were proved by cultural means to be eugonic.

CASE 3.

This patient, a boy aged nine years, underwent a previous course of treatment in Mearnskirk Hospital of five months duration. On this occasion his condition had been diagnosed as Tabes Mesenterica, and while this was undoubtedly present, he also suffered from transient pains in the right hip accompanied by a limp. He was

CASE 2.

SECONDARY INVOLVEMENT OF
Rt KNEE.

treated in extension for three months, and as all symptoms disappeared, and all radiological examinations had been completely negative he was dismissed home apparently well.

Four months later he was re-admitted with acute pain in the right hip of three weeks duration. On examination the right hip was found slightly flexed, the leg being abducted and externally rotated. All movements were markedly limited but no abscess was present. Six months after admission however an abscess appeared on the inner side of the right thigh and went on eventually to sinus formation. His family history was negative for tuberculosis and there was no record of injury. The Mantoux test was positive. It was not until three years after his re-admission that it was possible to say that the disease was inactive, that represents a period of activity of about three and a half years.

Radiologically there was seen to be extensive disease involving the head and neck of the femur and the acetabulum. Sequestra were present, and there was but little attempt at new bone formation.

Tubercle bacilli were isolated in this case by animal inoculation methods. They were seen microscopically to be of medium length and to stain evenly. Biological test showed them to be of human type.

CASE 4.

This patient was a girl aged six years. She had been unwell for almost three years previously, latterly suffering from a definite limp. Her family history was uninstructive, and there was no record of injury.

Case 3.

Extensive destruction of Head and Neck of Rt. Femur and also the Acetabulum.

Examination on admission revealed definite disease of the right hip, but no abscess formation was present. The Mantoux Test was positive. As the case progressed the presence of a large sequestrum became apparent, and ten months after her admission this was removed. The wound healed rapidly and the disease became inactive at the end of a further fourteen months. In this case there is a history of at least three years of active tuberculosis.

Radiologically the disease was seen to involve chiefly the neck of the right femur, where a sequestrum was present, and also the ilial portion of the acetabulum.

Tubercle bacilli were isolated from the material removed during the course of the sequestrectomy. They were seen microscopically to be long, evenly staining bacilli, and were found by cultural means to be eugonic.

CASE 5.

This patient was a boy of four years who had been unwell for the previous two years, having suffered from attacks of pain and limping in the left leg which had been worse during the past year. His family history was negative for tuberculosis, and there was no record of injury.

On admission there was some flexion of the left hip with shortening and abduction of the left leg. The hip joint was completely fixed by spasm. The Mantoux Test was positive. Four months after his admission an abscess made its appearance in the left thigh. It is now twenty-one months since the child first came under observation and the condition is not yet inactive, so that in all probability the disease has been present and active for almost three years.

Case 4.

Disease of Rt. Femoral neck
with Sequestrum.

Case 5.

Lesion in Lt. Femoral Head
and Acetabulum, causing
"Wandering Acetabulum."

Radiologically there is disease involving the head of the left femur, and to a lesser extent the neck. Disease is also present in the acetabulum, and the condition of "wandering acetabulum" is present. The outline of the abscess can also be seen.

The infecting strain of the tubercle bacillus was isolated from the abscess pus by both animal inoculation and cultural methods. Microscopically they were seen to be short, stout, acid-fast bacilli whose eugonic character was demonstrated by cultural means.

CASE 6.

This girl, aged thirteen and a half years, has only a short history of four months illness prior to admission. During this time she suffered from intermittent pain in the right hip which gave her a slight limp. There was no history of previous tuberculosis or injury in her family.

On admission the right hip was held flexed, the leg being adducted and externally rotated. The Mantoux Test was positive. Approximately one year after her admission an abscess appeared just below Ploupart's ligament on the right side, and despite repeated aspirations it broke down six months later to form a sinus. It is now more than two and a half years since her arrival in Mearnskirk Hospital and the disease is still active, so that up to the present she has suffered from active tuberculosis for three years.

Radiologically there is extensive disease of the head of the right femur and of the acetabulum. There are some small sequestra but the destruction is not gross.

The infecting tubercle bacilli isolated by biological methods were seen microscopically to consist of both long

CASE 6.

DISEASE OF RT FEMORAL HEAD
AND ACETABULUM.

and short members, the long ones being beaded. They were found by cultural means to be eugonic.

CASE 7.

The first symptom observed in this case, that of a boy aged five years, appears to have been a tendency to limp accompanied by pain in the right knee. This occurred five months before his admission to Mearnskirk Hospital. There is a history of his paternal aunt having died from tuberculosis, but his mother and father appeared healthy. No history of trauma was obtained.

Examination of the right hip joint revealed flexion with abduction of the right thigh. No abscess formation was present. He also suffered from pulmonary tuberculosis of a fibrotic type affecting the upper part of the right lung and displacing the heart to that side. The Mantoux Test was positive.

Seven months after his admission to hospital an abscess developed in the right thigh. The disease became inactive nine months later or two years after the onset of the limp.

Radiologically there was extensive disease of the head and neck of the right femur and of the acetabulum with cavity formation in the bone.

Tubercle bacilli were isolated from the abscess pus by both animal inoculation and cultural methods. Microscopically they were seen to be short rod shaped organisms, staining regularly. In type, they were found, by biological means, to be human.

CASE 8.

This boy, aged ten years, had been in poor health for fifteen months before his admission to hospital. No history

Case 8.

Disease of Lft Femoral Head and Neck and Acetabulum, with Dislocation upwards.

was obtained of tuberculosis in his family or of injury to his leg.

On admission his left hip was flexed 10^{o} and no movement was possible on account of the spasm of the surrounding muscles. The Mantoux Test was positive. After he had been under treatment for four months an abscess appeared in the anterior aspect of the left thigh. As he has now been under treatment for sixteen months and the disease is still active, it can be said that his ill-health has lasted for at least two years.

Radiologically very active disease of the head, neck and acetabulum of the left hip can be seen. There is considerable sclerosis, and the femur is dislocated upwards.

Tubercle bacilli were isolated from the abscess pus by both cultural and animal inoculation methods. Microscopically they were seen to be of a short stout type. Their eugonic characteristics were elicited by cultural means.

CASE 9.

This boy, aged nine and a half years, was admitted after two years of indefinite ill-health. There was no history of tuberculosis in his family or of his having sustained any injury.

Clinical examination revealed two areas of disease. Over the right shoulder was situated an abscess about the size of a plum. There was however no pain, and practically no limitation of movement. There was also disease of the left hip. Here again all movements were practically full except abduction which was slightly limited. No abscess was present in relation to the hip and did not appear until some months later. The Mantoux Test was positive. After receiving fifteen months treatment the disease became inactive. It is difficult to state for how long the disease had been active, but it would appear to have been for over two years.

Radiologically no bone lesion was found in the right

Case 9.

Lesion of Ilium above Acetabulum.

shoulder, but tuberculosis giving rise to bone destruction and periosteal reaction was found to involve the ilium immediately above the acetabulum, and to be threatening the joint which, however, remained free.

Tubercle bacilli were isolated from the abscess pus of both shoulder and hip lesions by cultural and animal inoculation methods. They were found microscopically to be of a long beaded type. Their eugonic characteristics were demonstrated by cultural means.

CASE 10.

This girl, aged ten years, exhibited her first symptom five months before her admission to hospital. It took the form of a limp which was followed two months later by pain in the left hip. Her family history was negative for tuberculosis, and there was no record of any injury having been sustained.

Examination of the affected hip on admission revealed slight abduction and marked limitation of rotation. No abscess was present at this time but this appeared one month later. The Mantoux Test was positive. The patient has now been under treatment for one year and the condition is as yet unhealed, so that active tuberculosis has been present for one year and five months.

Radiologically there was seen to be active, early tuberculosis of the ilial portion of the acetabulum.

Tubercle bacilli were isolated from the abscess pus both culturally and by guinea-pig inoculation. Microscopically there were seen to be both short and long types present. When tested biologically they were found to be of human type.

Case 10.

Disease of Iliac portion of Acetabulum.

CASE 11.

This patient, a girl of eight years, had been under treatment in Oban Sanatorium for pulmonary tuberculosis when she developed disease of the left hip. Her family history was bad, her mother and sister having both suffered from tuberculosis. The sister had died. No history of injury was obtained. She was transferred to Mearnskirk Hospital six months after the discovery of the hip lesion.

Examination on admission revealed the left hip to be flexed and adducted, and no movement of the joint was possible. Slight fulness suggestive of an abscess was present below the left great trochanter. This developed two months later into a definite abscess. The Mantoux Test was positive. Seven months after admission she developed albuminuria and experienced several attacks of renal colic. Tubercle bacilli were isolated from the urine. No definite intrapulmonary condition was found, the lung lesion being confined to a right basal pleurisy. The hip lesion is still active, so that there is a history of eighteen months active tuberculosis.

Radiological examination showed the presence of active disease in the head of the left femur and acetabulum. The condition of "wandering acetabulum" is present and there is subluxation of the femur.

Tubercle bacilli were isolated from the case by guinea-pig inoculation only. They were seen microscopically to be of a long slender type but no beading was observed. Their type was determined by biological means.

Case II.

Disease of Lft Femoral Head and Acetabulum. Sublaxation of Femur and "Wandering Acetabulum"

Present

CASE 12.

The onset of this patient's illness, a girl aged fourteen years, was only four months before her admission to hospital. During part of this time she was under treatment in the Western Infirmary, Glasgow, where her condition was diagnosed. Her family history was negative for tuberculosis, and there was no history of trauma.

On admission the Mantoux Test was found to be positive. There appeared to be advanced tuberculosis of the right hip but no abscess was present. She failed completely to respond to treatment, and ten months later developed an abscess in relation to the right hip. The disease continued to advance, the abscess breaking down to form several sinuses and being eventually incised in an attempt to establish free drainage. Finally in an effort to save the patient's life her right leg was disarticulated at the hip joint, but in spite of all treatment she died three years after the disease had first been diagnosed.

Radiological examination revealed extensive disease involving the head of the right femur and the acetabulum. The disease appeared to have begun in the centre of the bone where sequestrum formation was present.

The tubercle bacilli isolated from the hip joint by animal inoculation methods were found microscopically to be short, regular acid-fast organisms. They were proved to be eugonic by cultural means.

CASE 13.

This boy, aged four years, had previously undergone a course of treatment for tuberculosis of the ankle joint and

CASE 12.

DISEASE OF Rt FEMORAL HEAD AND ACETABULUM. SEQUESTRA ARE PRESENT.

had been dismissed well. A few months after his dismissal he experienced pain in the left hip joint and was re-admitted one month later. There was no record of tuberculosis in his family, and no history of injury.

Examination revealed the left hip to be flexed and the thigh to be abducted and externally rotated. No movement was permitted at the hip on account of the muscular spasm. The Mantoux Test was positive. Three months later an abscess formed to persist for a year and then to break down and give rise to a sinus. It is now eighteen months since he was re-admitted and as yet there is no evidence of any attempt at healing on the part of the hip joint disease.

Radiologically the disease was seen to be situated in the head of the femur and in the acetabulum. There was considerable destruction of bone with consequent tendency to dislocate.

Tubercle bacilli isolated by cultural and animal inoculation methods were found to be short and stout when examined microscopically. Their eugonic character was proved by cultural means.

CASE 14.

This boy, aged nine years, had previously undergone three years treatment in Robroyston Hospital before he was transferred to Mearnskirk Hospital. His family history was bad, both his mother and his maternal uncle having died from pulmonary tuberculosis. There was no definite history of injury.

Examination on admission showed the left leg to be shortened and everted and revealed the presence of an abscess over the outer aspect of the left thigh. The Mantoux Test was

Case 13.

Disease of Rt Femoral Head
and Acetabulum.

positive. This patient has now been under treatment in the hospital for seventeen months and the disease is still active. In all he has received four and a half years of hospital treatment without the hip lesion healing completely.

Radiologically extensive disease was seen to be involving the head and neck of the femur and the acetabulum. Two distinct areas can be seen in the lesion, an old calcified area and an area of active disease in the lower part of the acetabulum.

Tubercle bacilli were isolated from this case by both biological and cultural means, while the determination of type was carried out by biological methods. Microscopically there were seen to be of a short, stout nature.

CASE 15.

This patient, a boy of three years of age, had been apparently well until five months before his admission to hospital when he developed a limp. No evidence was obtained of tuberculosis in his family or of injury to his hip.

On admission the right leg was slightly abducted but with the exception of slight limitation of rotation all the movements of the right hip were free. No abscess was present at this time but this developed ten months later. The Mantoux Test was positive. The progress of the disease has not been satisfactory, and from its original position in the head of the femur it has extended to involve the femoral neck and the acetabulum, and while it is now two years since his admission to hospital the condition is still active.

Radiologically the lesion was seen originally as a small area of disease in the right femoral head.

The strain of tubercle bacilli isolated both culturally

CASE 14.

EXTENSIVE DISEASE OF HEAD, NECK AND ACETABULUM, AT THE LOWER PART OF WHICH A MORE RECENT FOCUS CAN BE SEEN.

and by animal inoculation was found microscopically to consist of both long and short members. It was proved to be of human type by biological test.

CASE 16.

This patient, a girl of eleven years, was transferred from Robroyston Hospital where she had already undergone eighteen months treatment, and appeared to have been ailing for six months before this. No history of injury was obtained, but her mother had died from pulmonary tuberculosis some years previously.

On admission her left hip joint was flexed to 30° and fixed by spasm. The left thigh was abducted and the Mantoux Test was positive. After having undergone two and a half years immobilisation during which time the disease appeared to be quiescent, an abscess developed in relation to her left hip, and it was not until three years and eight months after her admission to Mearnskirk Hospital that the disease became inactive. In this case there is a record of five years and eight months of active tuberculosis.

Radiologically the picture was interesting in that it presented an atypical appearance. The femur with its large flattened head, and little bone destruction was reminiscent of an infective arthritis. There was considerable loss of joint space.

Tubercle bacilli were isolated from the abscess pus by guinea-pig inoculation. They were seen microscopically to be long and slender, but no beading was present. Their type was proved by biological means.

Case 16.

Disease of Lt Femur showing large flat head and little bone destruction.

(11) 1 CASE OF TUBERCULOSIS OF THE HIP CAUSED BY THE BOVINE TYPE OF TUBERCLE BACILLUS.

CASE 17.

The lesion in this case, that of a girl aged two and a half years, made its appearance after she had undergone a severe attack of measles and pneumonia, the first symptom being pain in the affected joint. Her family history was negative and there was no record of injury.

On admission one month later there was found to be considerable spasm of the muscles surrounding the right hip. The hip itself was flexed and the thigh adducted. No abscess was present and did not appear until five months later. The Mantoux Test was positive. The patient has now been under treatment for approximately three years and the disease is still active.

Radiologically there is extensive disease of all the hip structures with loss of the femoral head and sublaxation of the femur.

Tubercle bacilli isolated from this case by guinea-pig inoculation were found microscopically to be of medium length. Their dysgonic nature being first discovered by cultural test, their ultimate typing was carried out by biological means.

Case 17.

Disease of Rt Femoral Head and Neck and Acetabulum.

H I P S.

SUMMARY.

Type.	Number of Cases.	Trauma Present In -	Familiar Tuberculosis In -	Average Age. Years.	Average duration of Activity. Years.
Human.	16	6'25%	31'25%	8	3 1/12.
Bovine.	1	-	-	2 6/12	3.

As before, in the case of tuberculosis of the spine, a brief table has been drawn up to bring out the salient features of the cases under review. In this group, in which the lesion is involving the hip joint, it is of interest to note that the duration of active disease is practically identical no matter the type of the infecting organism, and furthermore it is only a few months shorter than that for tuberculosis of the spine. Here again, as when the lesion was situated in the spine, it has not been possible to observe any difference in the disease caused by bacilli of the human or bovine types, by radiological appearances. To attempt to draw any conclusions from the absence of a positive family history or the absence of trauma in the very small "bovine" group would be to invite criticism, and would serve no useful purpose.

(C) KNEES.

(1) 6 CASES OF TUBERCULOSIS OF THE KNEE JOINT CAUSED BY THE HUMAN TYPE OF TUBERCLE BACILLUS.

CASE 1.

This boy, aged eleven years, had, previous to his admission to Mearnskirk Hospital, undergone treatment for the same lesion in three other institutions for periods of four months, four years, and five months respectively. The condition appears to have made its appearance in the right knee when the boy was about five years old and to have followed a fall, the first symptom being pain and swelling of the affected joint. His family history was bad his father being a sufferer from pulmonary tuberculosis, from which condition his mother had previously died.

On admission the Mantoux Test was found to be positive. The patient was poorly nourished, and his right knee was flexed to 170^{o} and fixed. A discharging sinus was present over the head of the right fibula. This sinus healed two months after his admission, and the disease was radiologically inactive two months later. The knee joint was excised and the patient dismissed well.

Radiological examination showed disease to be present in the outer condyle of the right femur and tibia. Considerable synovial thickening was also present.

Tubercle bacilli were isolated by the guinea-pig method only. Microscopically they were seen to be of medium length, stout, and evenly staining. Their eugonic character was proved by cultural means.

CASE 2.

This was a girl of seven years, who three months prior

Case 1.

Rt Femur and Tibia, disease of outer Condyle.

to admission had fallen and injured her right knee. All pain soon disappeared, and with the exception of a slight limp she remained well until the pain returned a few days before her admission to hospital. There was no record of tuberculosis in her family.

On admission the Mantoux Test was found positive. The right knee was held flexed at 160^{o} and all movements were limited by pain. A fluctuant swelling was present below and to the inner side of the patella. As time went on sequestrum formation made itself apparent, the abscess was incised and the sequestrum removed. At this time the disease appeared to involve condyle of the femur. It is now seventeen months since her admission to hospital, or twenty months since her fall, and not only is the disease still active but it involves the whole femoral epiphysis.

Radiologically the disease was seen to be involving the inner condyle of the right femur . Sequestrum formation was present and great synovial thickening.

The tubercle bacilli obtained from this case were isolated both by animal inoculation and direct cultural methods. Microscopically they were seen to be medium length, regularly staining, acid-fast organisms. Their type was demonstrated by biological means.

CASE 3.

This boy,aged nine years, was admitted after three months illness, the chief sign of which was swelling of the right knee. No history of injury to the joint was obtained. His mother had died some time previously from pulmonary tuberculosis.

On admission the Mantoux Test was found to be positive. The right knee was held flexed apparently by spasm and was consider-

Case 2.

Rt Femur.

Disease of Inner Condyle with Sequestrum

ably swollen but no bone lesion was found. The child did well and the disease appeared to have become inactive. An attempt to arthrodese the knee was then made but on opening the joint the condition appeared to be active and nothing further was attempted. Six months later an acute tubercular infection of the bone appeared which went on to abscess formation. It is now two years and ten months since the first sign of swelling appeared, and although the condition is improving it is not yet inactive.

Radiological examination after the attempted arthrodesis showed active disease involving all the structures of the knee with marked rarefaction of the bones.

The strain of tubercle bacilli isolated from this case was obtained from a portion of synovial membrane removed at operation. It was isolated by both animal inoculation and direct cultural methods. Microscopically the bacilli were seen to be short, regular, acid-fast organisms, and were proved to be of human type by biological means.

CASE 4.

This was a boy of eleven years who presented a history of injury to his left knee nine months before his admission to hospital. The injury had been followed by swelling which had persisted. There was no record of tuberculosis in his family.

On admission the Mantoux Test was found to be positive. The left knee was swollen and painful, movement being limited. Abscess formation was present, and in spite of aspiration, a sinus developed later. The condition however improved steadily and the knee was arthrodesed two years and eight months after his initial injury.

Radiologically the disease was seen to involve all the structures of the knee joint, and to be accompanied by marked rarefaction of the bone.

Tubercle bacilli, of a long beaded type, were isolated

Case 3.

Tuberculosis of Rt Knee with marked Rarefaction of Bone.

Case 4.

Lft Knee – Disease of all structures.

from the abscess pus by animal inoculation. Their eugonic character was demonstrated by cultural means.

CASE 5.

This boy, aged four years, has only a few months history of pain and swelling of the right knee before his admission to hospital. There was no record of tuberculosis in his family or of trauma.

On admission the Mantoux Test was found to be positive. The right knee was held flexed, and all movements were extremely painful. Although abscess formation was present no evidence of any bone involvement was found at this time. It was not until six months after his admission to hospital that the disease process began to involve the lower end of the femur and then the tibial head. Eventually three and a half years after his admission to hospital the condition became inactive.

Radiological examination performed after the disease had involved the bone showed gross destruction of femoral and tibial epiphyses with considerable involvement of the synovial tissue.

Tubercle bacilli having a short acid-fast form were isolated from the abscess pus by animal inoculation. They were proved by biological means to be of human type.

CASE 6.

This boy, aged ten years, has a short previous history of only three weeks. His father had died of pulmonary tuberculosis but no record of injury was obtained.

On admission the Mantoux Test was found to be positive, and there was extensive involvement of the lower half of the left

Case 5.

Gross destruction of femoral and tibial epiphyses.

Case 6.

Lt Knee showing great periosteal thickening and new bone formation.

femur extending into the knee joint. Two months after his admission an abscess developed in connection with the affected joint. From this time on the disease appeared to gain the upper hand and the patient became steadily worse. Five months after admission the disease invaded the right hip, and shortly afterwards signs of pulmonary involvement appeared. At this time owing to the extensive nature of the left knee lesion the left leg was amputated in an attempt to reduce the toxaemia. This measure was only partially successful, and the patient died one year after admission.

Radiological examination of the affected knee revealed a marked degree of periosteal reaction and new bone formation.

Post mortem examination demonstrated the presence of advanced disease of the right hip joint and the left knee, miliary tuberculosis of the lungs and splenic involvement.

Tubercle bacilli were isolated from the abscess pus by both direct cultural and animal inoculation methods. They were seen microscopically to be short, regular, acid-fast organisms, and were proved to be eugonic by cultural means.

(11) I CASE OF TUBERCULOSIS OF THE KNEE JOINT CAUSED BY THE BOVINE TYPE OF TUBERCLE BACILLUS.

CASE 7.

This patient, a girl aged three years, was convalescing from measles when pain and swelling appeared in the left knee. Her family history was negative for tuberculosis and there was no record of trauma.

On admission the Mantoux Test was found to be positive. The left knee joint was swollen and held flexed. No abscess formation was present and no bone involvement was apparent, this however appeared six months later. Four months later the left hip was

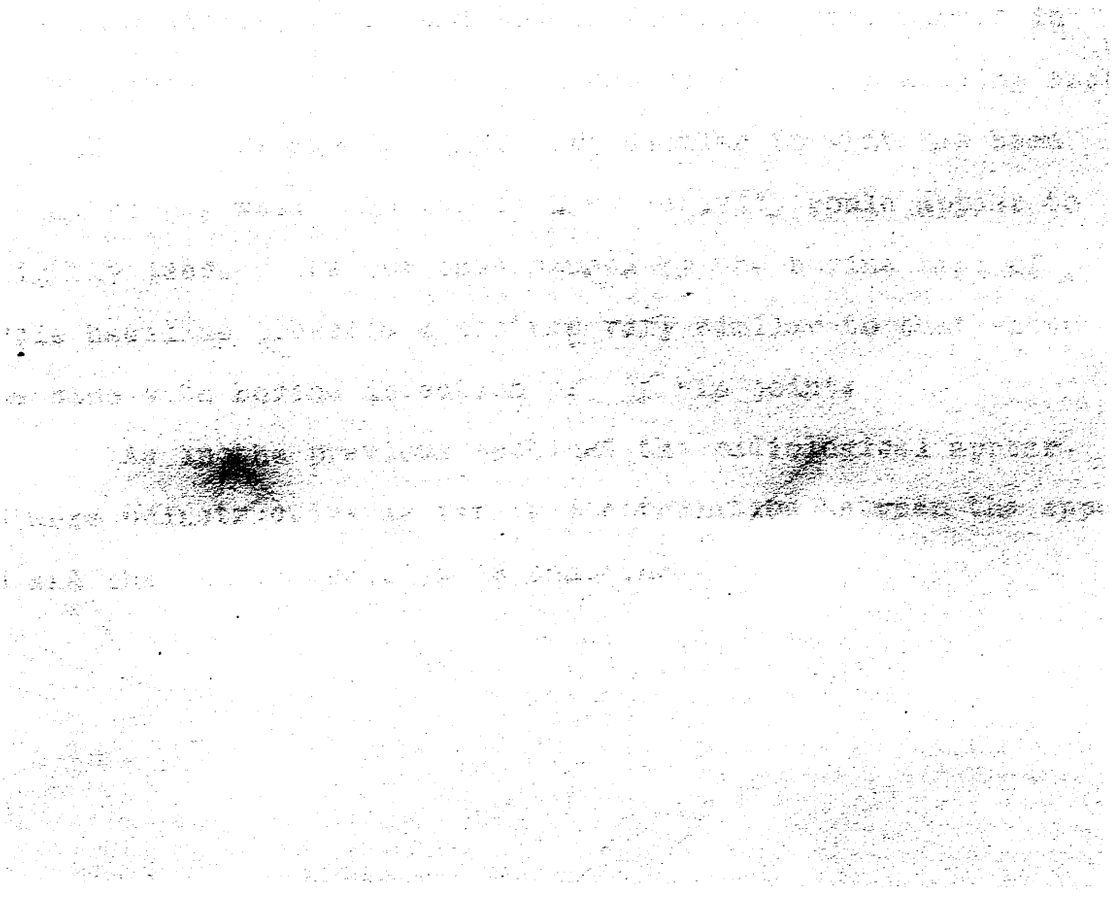
Case 7.

Disease of all structures of L^th Knee.

found to be affected, and four months later an abscess appeared in relation to it. It is now three years since she was admitted, and although improving the lesion is not healed yet.

Radiological examination of the affected bone revealed very active disease involving all the structures of the knee joint but especially the femoral epiphysis.

Tubercle bacilli were isolated from the hip abscess pus by guinea-pig inoculation. Microscopically they were seen to be short, acid-fast organisms. They were proved to be of human type by biological test.



K N E E S.

SUMMARY.

Type.	Number of Cases.	Trauma Present In -	Familiar Tuberculosis In -	Average Age. (Years)	Average Duration of Activity.
Human.	6	50%	50%	8 8/12.	2 6/12 yrs.
Bovine.	1	-	-	3	3 yrs.

In this group of cases six of them were caused by the human type of tubercle bacillus and one by the bovine type. Among those caused by the human bacillus a much higher percentage of cases with a history of trauma and of previous tuberculosis in their families was found than in either of the two preceding sections. The average age is again very similar to what has been observed before, while the duration of activity would appear to be slightly less. The one case caused by the bovine type of tubercle bacillus presents a picture very similar to that shown by the case with bovine infection of the hip joint.

As in the previous sections the radiological appearances were uninstructive as far as a correlation between the appearances and the causal organism is concerned.

(d) ANKLE AND OS CALCIS.

(1) 6 CASES OF TUBERCULOSIS OF THE ANKLE JOINT OR OF THE OS CALCIS CAUSED BY THE HUMAN TYPE OF TUBERCLE BACILLUS.

CASE 1.

This girl, aged twelve years, was admitted after having undergone some months of previous treatment for tubercular disease in the region of both ankles. No history of injury was present nor was there any record of tuberculosis in her family.

Examination on admission revealed that both ankles were swollen and a discharging sinus was present on both sides, while more detailed study showed the disease to be located in both os calces. The Mantoux Test was positive. After having been under treatment for one year the disease healed leaving the ankle joint movements unimpaired.

Radiological examination revealed the presence of encysted tuberculosis of the anterior portions of the os calcis on both sides. The condition was more marked on the right than on the left.

The strain of tubercle bacilli isolated from this case was obtained by guinea-pig inoculation. Microscopically they were seen to be short, regularly staining, acid-fast bacilli which when subjected to biological test proved to be of human type.

CASE 2.

This patient was a boy of eleven years. Four years prior to his admission to Mearnskirk Hospital he had undergone a course of institutional treatment for tubercular disease of the left os calcis. Four months before admission to this hospital the disease of the left os calcis had again become active. There was no history of trauma and no record of tuberculosis in his family.

Case 1.

Encysted Tuberculosis of anterior portion of os calcis.

Case 2.

Disease of Lft os calcis.

Examination on admission revealed the presence of an old, partially broken down scar situated just posteriorly to the left external malleolus. All movements of the joint were, however, free. A discharging sinus was also present over the middle third of the left humerus, marked thickening being present at the lower end of that bone. The Mantoux Test was positive.

This boy has now been under treatment for eight months and the condition is still active, so that, if the previous term of treatment be excluded, there is a record of one year of active tuberculosis in the os calcis.

Radiological examination showed the presence of extensive disease of the left os calcis, but no evidence of sequestrum formation.

The strain of tubercle bacilli isolated from this case was obtained by the direct cultural method. Microscopically they were seen to be short, regularly staining, acid-fast bacilli. Their type was determined by biological means.

CASE 3.

This boy, aged eighteen months, was admitted after only four weeks of swelling of the left ankle. No history of injury was recorded, but his mother suffered from pulmonary tuberculosis.

On admission to hospital an abscess about the size of a walnut was seen lying over the left external malleolus. All movement at the ankle joint was restricted and painful. The Mantoux Test was positive. After a period of eight months treatment the condition became inactive.

Radiologically the disease appeared to be chiefly one of the soft tissue, but a small area of disease could be made out at the lower end of the left fibula.

Tubercle bacilli were isolated from this case by guinea-pig inoculation methods. Microscopically they were seen to be of medium length, and were found to be of human type by biological means.

CASE 4.

This boy, aged twelve years, was admitted from the Sick Children's Hospital, Glasgow, where he had been taken four months previously on account of pain and swelling of both ankles. A definite history of trauma a week previous to the onset of the first symptoms was obtained, the patient having fallen from a see-saw and injured both feet. No record of previous tuberculosis in his family was found.

Examination on admission revealed swelling of both ankles, a discharging sinus being present on the left side. The Mantoux Test was positive. This boy has been under treatment for fifteen months and as yet there is no diminution in the activity of the disease process, so that over all he has a history of nineteen months of active tuberculosis.

Radiologically, wide spread involvement of both ankles was seen. The astragalus and the lower ends of both tibiae and fibulae were involved, an outstanding feature being the tremendous rarefaction present in the surrounding bony structures.

The strain of tubercle bacilli isolated from this case was obtained by both cultural and guinea-pig inoculation methods. Microscopically they were seen to be medium length, acid-fast bacilli. Their type was demonstrated by biological means.

CASE 5.

This patient, a girl aged thirteen years, received an

Case 4.

Involvement of Astragulus, Tibia and Fibula

Case 4.

Showing Rarefaction of Surrounding Structures.

injury to her right heel while playing hockey. Following the injury she experienced pain in the affected part and was treated with massage and electricity. Seven months after the onset of the pain she was admitted to hospital. No history of tuberculosis was found in her family.

Examination demonstrated the presence of an abscess situated below the left external malleolus. There was considerable tenderness of the os calcis and the ankle was painful on movement. The Mantoux Test was positive. Four months after her admission to Hospital an effusion appeared at the base of the right lung but was apparently unaccompanied by intrapulmonary disease. It is now eight months since this patient was admitted and the disease is still active, so that there is a record of fifteen months active tuberculosis with tendency to spread.

The tubercle bacilli isolated from the abscess pus were so obtained by both direct cultural and animal inoculation methods. microscopic examination showed them to be long, slender, acid-fast organisms. They were found by biological means to be of human type.

CASE 6.

This girl, aged twelve years, received an injury to the toes of her right foot nine months before her admission to this hospital, and as a result of this the second and third toes of her right foot had been previously amputated.

Examination on admission revealed active disease with swelling and abscess formation in the region of both ankles. The amputation wounds of the second and third right toes were unhealed. In addition to this three other lesions were present. One in the left elbow which was swollen, held flexed and had a discharging sinus, one in the left submaxillary gland, and the third was in the

Case 5.

Disease of lower portion of Lft Os. Calcis with Sequestrum formation.

Case 6.

Disease of Lft Tibial Epiphysis and Astragulus.

bone at the angle of the lower jaw on the right side. The Mantoux Test was positive. All these lesions were active and remained so for two years and five months when it was possible to say that with the exception of the lower jaw, they had all healed.

Radiological examination of the left ankle revealed disease in the tibial epiphysis and in the astragalus, while on the right side the ankle joint had escaped, the disease process attacking instead the astragalo-calcaneo joint.

The infecting strain of tubercle bacilli were isolated from the left ankle lesion by the guinea-pig inoculation method. Microscopic examination showed the organisms to be short, stout, regularly staining acid-fast bacilli. Their eugonic character was determined by cultural means.

(11) I CASE OF TUBERCULOSIS OF THE OS CALCIS CAUSED BY THE BOVINE TYPE OF TUBERCLE BACILLUS.

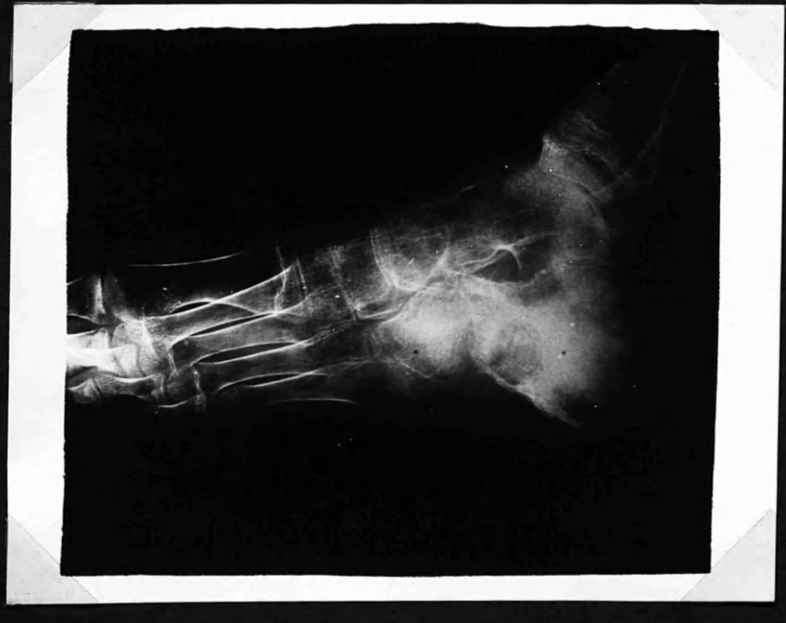
CASE 7.

This patient was a boy of twelve years, who was admitted on account of pain and swelling of the left foot of five months duration. There was no history of trauma, and no history of tuberculosis in his family.

On admission the Mantoux Test was positive. A large abscess was present below and anterior to the left external malleolus, the left foot being much swollen and discoloured. A pleuritic condition was present at the base of the left lung with adhesion and elevation of the diaphragm. All forms of treatment have been tried, but still, two years and nine months after the initial onset, the condition remains active.

Radiologically the disease was seen to involve the left

Case 7.



Disease of Lt. Os Calcis and Cuboid.

os calcis and cuboid. The astragalus and scaphoid bones although not definitely diseased were very suspicious.

The strain of tubercle bacilli isolated from this case was so obtained by animal inoculation methods. Microscopically it was found to be composed of medium length, regularly staining, acid-fast bacilli. Their type was determined by biological means.

ANKLE AND OS CALCIS.

SUMMARY.

Type.	Number of Cases.	Trauma Present In -	Familiar Tuberculosis In -	Average Age. (Years)	Average Duration of Activity.
Human.	6	50%	16'6%	10 3/12	1 4/12 yrs.
Bovine.	1	-	-	12.	2 9/12 yrs.

In this group of cases the same high incidence of trauma is present as was seen in the case of lesions of the knee joint. in those cases caused by the human type of tubercle bacillus. The average duration of activity is less than has been seen in any of the previous groups.

Regarding the case caused by the bovine type of bacillus little can be said beyond that not only is the duration of activity, as shown on the table, longer than in the "human" group, but also that this case is not yet inactive.

Radiologically no difference was found between the two types of disease.

(e) DACTYLITIS.

9 CASES OF DACTYLITIS CAUSED BY THE HUMAN TYPE OF TUBERCLE BACILLUS.

CASE 1.

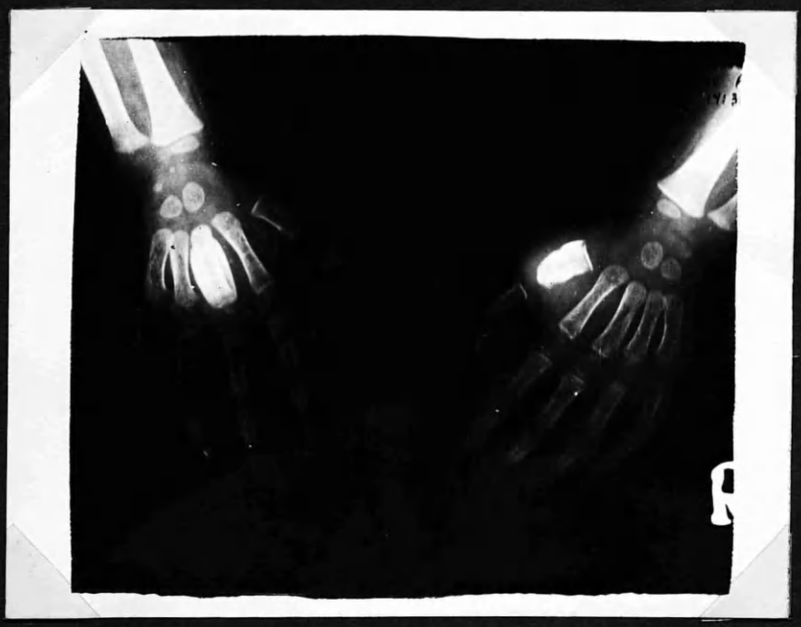
This patient, a boy of eighteen months, had been in ill health for some time, but the first definite appearance of the present lesion was four weeks before his admission to hospital, when the dorsum of his left hand began to swell. No history of trauma was obtained, but his sister suffered from tuberculous adenitis.

On admission the Mantoux Test was found to be positive. A firm indurated swelling was present over the dorsum of the left hand involving practically the whole of the metacarpus, while over the first metacarpal of the right hand was a fluctuant swelling which required aspiration. Swelling was also present over the phalanges of the toes, on the right side, the second toe being involved, while on the left side the fourth toe was the seat of disease. All these lesions went on to abscess formation during residence, and were incised and scraped. It is now twenty months since the first swelling appeared, and it is as yet impossible to say that all the lesions are inactive.

Radiological examination revealed the presence of the hypertrophic form of tuberculosis situated in the first right and the fourth left metacarpals. In the feet a similar state of affairs existed in the second right proximal phalanx, and in the fourth left middle phalanx.

Tubercle bacilli were isolated in this case by guinea-pig inoculation only. Microscopically they were seen to be long, thin, beaded organisms. Their eugonic character was determined by cultural means.

Case 1.



Hypertrophic disease of 1st Rt and 3rd Lft Metacarpals.

CASE 2.

This patient was a girl of one year. The first sign was noticed six months before admission, when swelling of the right hand appeared. No record of trauma or of previous tuberculosis in the patient's family were obtained.

On admission the Mantoux Test was found to be positive. Numerous lesions were found situated as follows - The left hand, left foot, right hand and upper part of right tibia. Abscess formation was present over the left hand and foot, while a tuberculid was present over the right elbow. After having been under treatment for one month an abscess appeared on the left knee. It is now twentysix months since the first swelling appeared, and although some of the lesions have healed, the majority are still in an active state.

Radiological examination confirmed the presence of disease in those sites already mentioned. At all points the disease process presented the same picture, namely that of an osteomyelitis which just failed to be classed as hypertrophic owing to the lack of sufficient new bone formation.

From this case tubercle bacilli were isolated by both cultural and animal inoculation methods. Microscopically they were short, regular acid-fast organisms. Their eugonic character was tested by cultural means.

CASE 3.

This patient, a boy of four years, was reported to have received an injury to his left hand which was followed by swelling, eighteen months before his admission to hospital. No history of tuberculosis was found in his family.

On admission the Mantoux Test was found to be positive. There was extensive disease of all the carpals and metacarpals.

CASE 2.

DISEASE OF 1ST L.T. METATARSAL.

After he had been under treatment for ten months swelling appeared in the left elbow, and tubercular disease was found here radiologically. It was only after three years' treatment that it was possible to dismiss this boy as healed, swelling having been present in the left hand for at least one year before this.

Radiological examination revealed the presence of extensive disease involving all the carpals of both hands and all the metacarpals with the exception of the first of both hands. In the metacarpals the disease appeared to be of a hypertrophic variety and on the right side to involve chiefly the bases of the bones. The lesion involving the left olecranon was of a similar type.

The tubercle bacilli obtained from this patient were isolated by guinea-pig inoculation. Microscopically they were seen to be long, slender, non-beaded organisms whose type was determined by biological test.

CASE 4.

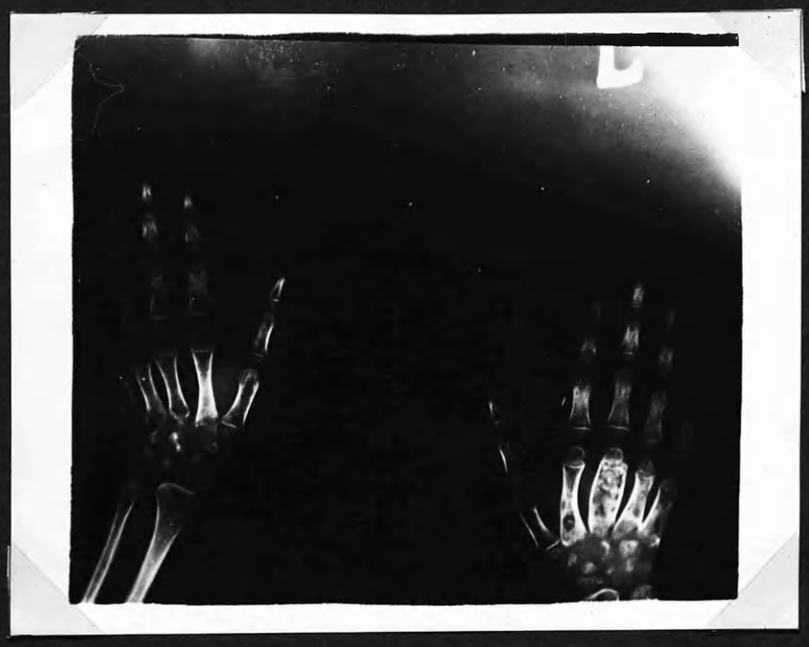
Six months before admission this patient, a girl of one year, had developed swellings over the dorsum of both hands. No history of trauma was obtained, but her mother had suffered from tubercular adenitis.

On admission the Mantoux Test was found to be positive. Abscesses which required several aspirations were present over both hands, and a massive lesion was found in the right lung. It is now thirteen months since the development of the first swelling and the condition is not yet inactive.

Radiological examination revealed the presence of disease of a hypertrophic type of the third left and fifth right metacarpals.

Tubercle bacilli were isolated by both cultural and animal

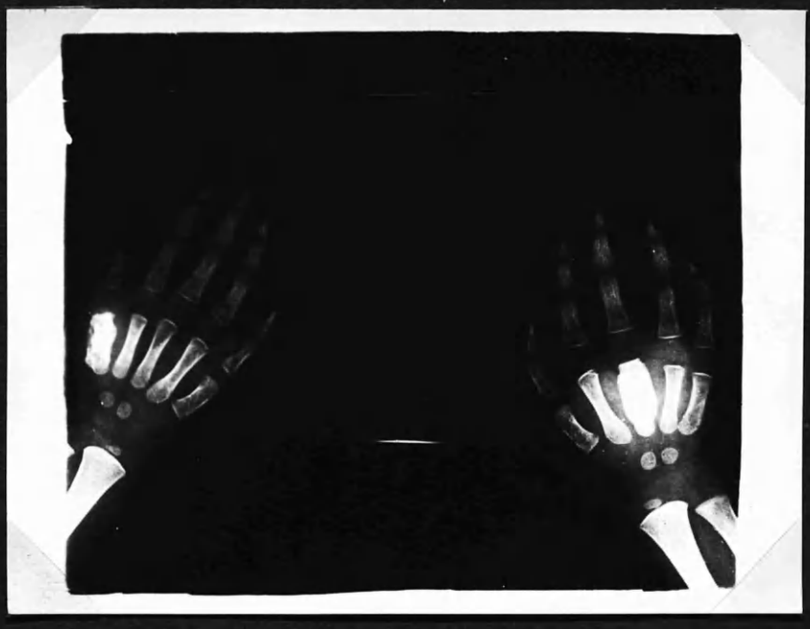
Case 3.



Involvement of all carpals and all metacarpals except first.

Disease of Lt Olecronon.

Case 4.



Hypertrophic disease of 3rd Rt and 5th Lt Metacarpals.

inoculation methods. Microscopically they were short, regularly staining, acid-fast organisms, which when tested by cultural means were proved to be eugonic.

CASE 5.

This patient, a girl of one year, had been unwell for at least nine months before admission, during a portion of which time swelling had been present in both hands. No record of injury was obtained but her father suffered from pulmonary tuberculosis.

On admission the Mantoux Test was found to be positive. Swelling of both hands was present with abscess formation of the 5th finger of the right hand. From the time of her admission she developed one lesion after another, until four months after admission lesions were also present in the lower ends of both tibiae and right fibula, and at the upper end of the right ulna. It is now two years and eight months since her initial illness and these various lesions are still active.

Radiologically lesions of a hypertrophic type were visible in the third right metacarpal and in the first and second left metacarpals and in the proximal phalanx of the first finger. The lesion involving the upper end of the right ulna appeared to be of a similar nature.

Tubercle bacilli were isolated by both animal inoculation and cultural means. Microscopically they were short, regular organisms which when tested by cultural means were found to be eugonic.

CASE 6.

This patient, a girl of fourteen years, had undergone treatment in the Victoria Infirmary, Glasgow, for axillary and inguinal adenitis, six months before her admission to this hosp-

Case 5.

Lesions of 3rd Rt and 1st and 2nd Lft Metacarpals.

Case 7.

Hypertrophic lesions of

2nd and 4th Metacarpals of Lft Hand.

2nd Metacarpal and 4th Prox. Phalanx of Rt Hand.

ital. One month before her admission signs of tuberculosis appeared in the left foot. There was no record of previous tuberculosis in her family and no history of injury.

On admission the Mantoux Test was found to be positive. There was some swelling and considerable tenderness of the left foot. Further examination revealed extensive disease throughout the tarsus and metatarsus. There did not, however, appear to be any involvement of the ankle joint. Although it is now nineteen months since she first came under treatment, and thirteen months since the first sign of involvement of the left foot, the condition is not yet inactive.

Radiological examination of the left foot revealed the presence of extensive active disease of the cuboid bone with involvement of the adjacent joints.

Tubercle bacilli were isolated by both cultural and animal inoculation means. Microscopically they were seen to be long, evenly staining organisms. Their eugonic character was demonstrated by cultural means.

CASE 7.

This patient, a boy of five years, was admitted after one month of illness during which time he had been treated with ultra-violet light without obvious benefit. There was no record of previous tuberculosis in his family, but there was a history of contact in his own home with a lodger suffering from pulmonary tuberculosis. No history of injury was obtained.

On admission the Mantoux Test was found to be positive, and there was swelling of both hands and of the fourth right proximal phalanx. A discharging ulcer was present below the chin but this healed rapidly and did not appear to have any connection with

Case 8.

Lft Hand.

Rt Hand.

Hypertrophic disease in metacarpals and phalanges.

Rt Foot. Lft Foot.

Hypertrophic lesions of the metatarsals.

bone. After a period of eight months from the first sign of the disease the condition appeared to have become inactive.

Radiological examination revealed the presence of tuberculosis of a hypertrophic type situated in the second right metacarpal, and in the fourth right proximal phalanx. A similar type of lesion was present in the second and fourth left metacarpals.

Tubercle bacilli were isolated by both cultural and animal inoculation methods. Microscopically they were short, regularly staining organisms. Their type was proved by biological test.

CASE 8.

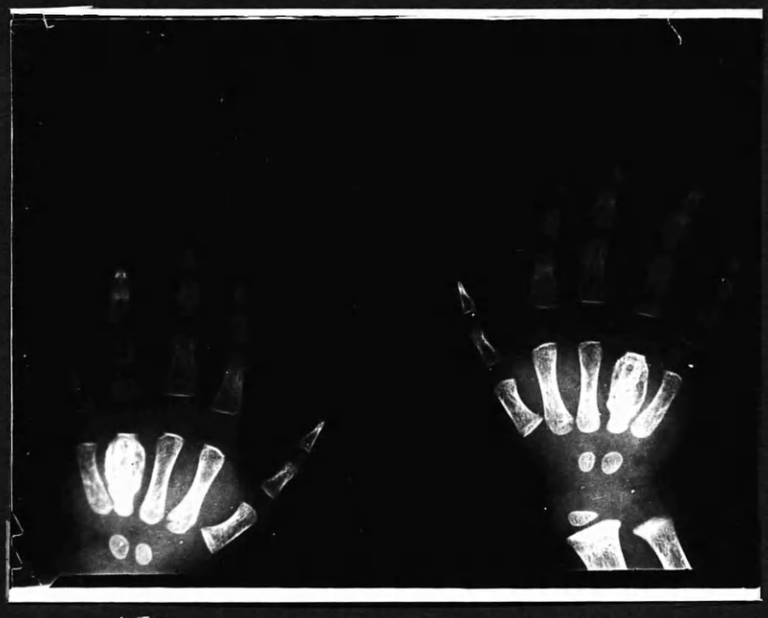
This boy, a child of eighteen months, had first shown signs of illness when swelling developed in both hands three months before admission. This was soon followed by swelling of both feet. His family history was negative for tuberculosis and there was no record of trauma.

On admission the Mantoux Test was found to be positive. Both hands and feet were swollen and painful. An abscess was present over the left elbow in the soft tissues, and there was active disease of the lower two-thirds of the right lung. He failed completely to react to treatment and died five months after his admission to hospital.

Radiological examination revealed the presence of typical hypertrophic tuberculosis situated in the metacarpals and metatarsals of both feet.

The strain of tubercle bacilli isolated from this case was obtained by cultural means alone. Microscopically it was seen to consist of both long and short members. Its eugonic nature was demonstrated by cultural means.

Case. 9.



L^th R^t

Hypertrophic disease of Metacarpals.

CASE 9.

This boy, aged eighteen months, first came under suspicion on account of swelling on the dorsum of both hands six months before his admission to hospital. His family history was negative, and there was no record of trauma.

On admission the Mantoux Test was found to be positive. Both hands were swollen but at this time no abscess formation was present. This however developed later and went on to sinus formation. Eventually two years and two months after the swelling was first noticed the condition appears to have become inactive.

Radiologically hypertrophic disease was seen situated in the fourth right and fourth left metacarpals.

Tubercle bacilli were isolated by guinea-pig inoculation. Microscopically they were seen to be long, thin, acid-fast organisms. Their eugonic character was demonstrated by cultural means.

D A C T Y L I T I S.

SUMMARY.

Type.	Number of Cases.	Trauma Present in -	Familiar Tuberculosis in -	Average Age. (Years)	Average duration of Activity.
Human.	9	11'1%	33'3%	3 6/12.	1 6/12 yrs.
Bovine.	-	-	-	-	-

In this group of cases of dactylitis all were caused by the human type of tubercle bacillus. The average duration of activity was practically similar to that for disease of the ankle and os calcis, while the patients tended to be considerably younger than those suffering from any other lesions. Radiologically the lesions were mostly of a hypertrophic type.

(f) MISCELLANEOUS LESIONS.

(i) 11 cases of bone or joint tuberculosis caused by the human type of tubercle bacillus.

CASE 1.

This patient, a boy of 6 years, had previously received hospital treatment following on injury to his right foot, the foot at this time being swollen and painful. There was no history of tuberculosis in his family.

On admission the Mantoux Test was positive. His right foot was swollen and painful and a discharging sinus was present over the dorsum. This sinus was scraped and the condition improved temporarily, only to relapse later, when signs of toxic absorption appeared and the inguinal glands on that side became swollen. In order to save the child's life the foot was amputated in the middle $\frac{1}{3}$ of the leg. At this time also abscess formation appeared in the inguinal glands and they were incised. Following this healing occurred rapidly and the patient was dismissed well one year after his accident.

Radiological examination on admission revealed the disease to be situated in the scaphoid bone. Owing to the greatly increased density, the appearance was very similar to that seen in Kohler's disease.

Tubercle bacilli were isolated from the sinus by both cultural and animal inoculation methods. No tubercle bacilli were, however, isolated from the pus of the inguinal glands, which contained abundant streptococci. Biological test showed the isolated bacilli to be of human type.

CASE 2.

Two years prior to his admission to hospital this boy, aged 7 years, had experienced tenderness and slight swelling in the region of the left breast. His family history was free from tuberculosis and there was no record of his having received any injury.

Case. 1.

Tubercular Disease of Rt Scaphoid Bone.

On admission the Mantoux Test was positive and a fluctuant abscess about the size of a plum was present deep to the left nipple. This abscess required repeated aspirations, but eventually disappeared.

Radiological examination showed the presence of disease in the 4th left rib, in which a small area of disease with cavity formation could be seen.

The tubercle bacilli isolated from this case were so obtained by animal inoculation methods. Microscopically they were seen to be short, evenly staining organisms. Their type was demonstrated by biological means.

CASE 3.

This patient, who was 1½ years of age, developed her first sign 4 months before her admission to hospital. At this time swelling appeared in the region of the right ankle. No record of injury was obtained, but her family history was bad. Her father, one brother and her paternal cousin were all sufferers from tuberculosis.

On admission the Mantoux Test was found positive. On the outer aspect of the lower $\frac{1}{3}$ of the right leg an indurated swelling was present, over which was situated a small sinus. A small fluctuant area was present over the anterior aspect of the middle $\frac{1}{3}$ of the left tibia, and there was considerable semi-solid swelling of the left elbow. After a period of treatment lasting over 13 months all these lesions appeared to have become inactive; therefore this child had suffered from active tuberculosis for 17 months.

Radiologically bone disease was found in three sites, namely, the lower end of the right fibula, the middle $\frac{1}{3}$ of the left tibia, and the lower $\frac{1}{3}$ of the left humerus. In no case was the adjacent bone affected.

Case. 3.

Tubercular disease of mid. 1/3
of the Rt. Tibia.

Tubercle bacilli were isolated from the abscess pus by both cultural and animal inoculation methods. Microscopically they were long, regularly staining organisms. They were proved to be eugonic by cultural means.

CASE 4.

This boy, aged 1½ years, was admitted with a history of having fallen down stairs and bruised his chest. Three weeks after this accident a swelling appeared 2" from the left border of the sternum and at the level of the 7th costal cartilage. His sister was at that time a patient in Mearnskirk Hospital suffering from tuberculosis of the hip joint.

On admission the Mantoux Test was found to be positive. An abscess was found situated as described above. After several aspirations it unfortunately broke down and was eventually scraped, a small sequestrum being removed. After having been under treatment for 11 months the sinus appeared to be firmly healed and the patient was dismissed well. As far as can be estimated the disease appears to have been active for 11 months.

Radiologically there was very definite disease of the 7th left rib, but at some distance from where the abscess appeared. The affected portion of the bone itself was considerably thickened and sequestrum formation could be seen.

Tubercle bacilli were isolated from this case by both cultural and animal inoculation methods. Microscopically they were seen as long, evenly staining organisms. Their eugonic character was demonstrated by cultural means.

CASE 5.

This patient, a boy of 13 years, had previously undergone a course of treatment in the hospital, which was interrupted by his parents removing him against medical advice. His family history was negative and there was no record of trauma.

CASE. H.

LESION OF 7TH LFT RIB.

On admission the Mantoux Test was positive. It was seen that his previous lesion had broken down to form an ulcer about the size of a five-shilling piece, situated over the upper part of the sternum. A diffuse swelling was present immediately below the angle of the right scapula; this, however, rapidly disappeared. After a period of 5 months' treatment he was again removed by his parents, and although the condition was much improved, it was not healed. Taking into consideration the length of time the lesion had been present on the first occasion, it would appear that he had suffered from active tuberculosis for at least 1½ years.

Radiologically the only area in which disease was definitely demonstrated was in the 10th left rib at a point approximately 6" from the spinal column.

Tubercle bacilli isolated from the discharges of this case, by both cultural and animal inoculation methods, were seen microscopically to be both short and long organisms. When tested by biological methods they were found to be of human type.

CASE 6.

This patient, a boy of 9 years, fell while playing and injured his left wrist 7 months before his admission to hospital, and again 5 months later. His wrist began to swell 4 months before admission, and refused to subside. There was no record of tuberculosis in his family.

On admission the Mantoux Test was positive. His left wrist was swollen and discoloration was present over the lower end of the ulna. Movement at the wrist joint was slightly limited. An abscess, which made its appearance below the swelling, subsided after being aspirated several times.

It is now 9 months since he was admitted, and the condition seems now to be inactive: in all, there is a history of at least 1 year of tuberculous activity.

Radiologically there was slight bone involvement with periostitis at the lower end of the left ulna. Considerable thickening of the soft tissues was present.

The strain of tubercle bacilli isolated from this case was so obtained by both cultural and animal inoculation methods. Microscopically they were seen to be short, regular, acid-fast organisms. When tested by cultural means they were found to be eugonic.

CASE 7.

This patient was a girl of 5 years of age. She had suffered from a lesion of her right great toe, which had been regarded as a chilblain for over 18 months before her admission to hospital. Her family history was negative for tuberculosis, and no record of injury was obtained.

On admission the Mantoux Test was found to be positive. Two abscesses were present - one over the right great toe and the other over the inner condyle of the left humerus. Both required repeated aspirations, but owing to the extent of the disease in the toe it was eventually amputated. It is now 11 months since her admission, and although the toe amputation wound is firmly healed, the elbow is still active and presents a discharging sinus. In this case there is a history of almost 1½ years of active tuberculosis.

Radiological examination revealed the presence of active tubercular disease of the 1st proximal phalynx of the right great toe; the disease at this site appeared to be hypertrophic. A more extensive but similar type of lesion could be seen in the lower $\frac{1}{3}$ of the left humerus.

Tubercle bacilli were isolated from the pus from the left elbow by both cultural and animal inoculation methods. Microscopically they were seen to be regularly staining acid-fast organisms of medium length. Their eugonic character was demonstrated by cultural means.

CASE. 7.

EROSION OF 1ST RT PROXIMAL PHALYNX.

CASE 8.

One month before her admission to hospital, this patient, a girl of 4 years, fell and is reported to have sustained an injury to her right elbow. There was no record of tuberculosis in her family.

On admission the Mantoux Test was found to be positive. The right elbow was held flexed at 20°, and was swollen, an abscess being present behind the lower part of the humerus. There was some discoloration, and thickening extended up to the junction of the middle and lower thirds. Unfortunately after she had been under treatment for some months the abscess broke down to give rise to a sinus, and about the same time signs of intra-pulmonary involvement appeared. She has now been under treatment for 15 months, and although there has been considerable diminution in the activity of the disease, neither the osteitic nor the pulmonary lesions are healed.

Radiological examination revealed the presence of osteitic thickening of the lower end of the right humerus.

Tubercle bacilli were isolated by animal inoculation alone. Microscopically they were seen to be short, regularly staining acid-fast bacilli. Their eugonic character was demonstrated by cultural means.

CASE 9.

This patient, a girl of 1½ years, sustained a blow on her left elbow 3 months before her admission to hospital. Following this her elbow began to swell and the diagnosis was made radiologically. Her family history was bad, her mother having died of pulmonary tuberculosis.

On admission the Mantoux Test was positive. The left elbow was swollen and held flexed chiefly by pain. An abscess 1" in diameter was present over the upper end of the left ulna. Swelling and tenderness were present over the dorsum of the left

Case. 9.

Great Periosteal thickening of
Lower end Rt Humerus.

hand and definite tubercular involvement of both lungs was apparent. After she had been under treatment for 3 months swelling and pain appeared in the right elbow joint. It is now 1 year since she sustained her original injury, and the disease is still active.

Radiological examination revealed bone disease to be present in 2nd left metacarpal and in the upper $\frac{1}{3}$ of the left ulna. Examination of the right elbow at a later date showed destruction of the lower end of the right humerus, with periosteal thickening of the lower $\frac{1}{3}$ of the shaft.

The strain of tubercle bacilli isolated from this case by cultural means was seen, microscopically, to consist of both long and short acid-fast organisms. They were found to be eugonic by cultural means.

CASE 10.

This boy, aged 4 years, had suffered from a swelling on the left side of his back for 5 months before his admission to hospital. His father had died some time previously from tuberculosis. No history of trauma was obtained.

On admission the Mantoux Test was found to be positive. An abscess was present below the left pectoralis major and a sinus discharging below the right gluteal fold. There was no limitation of movement in the left shoulder joint, but definite disease was present in the left humeral shaft. This area was eventually opened up and a large sequestrum removed. After having been under treatment for 18 months, or 23 months after the development of the first sign, the condition appeared to have become inactive.

Radiological examination revealed the presence of disease of the upper portion of the left humeral shaft just below the epiphyseal plate. A large cavity was present, in the centre of which a sequestrum was lying.

Tubercle bacilli were isolated by the animal inoculation method. They were seen microscopically to be short regular acid-

fast/

Case. 10.

Lesion of upper end of Lt. Humerus,
with Cavity and Sequestrum formation.

organisms. When subjected to biological test they were found to be of human type.

CASE 11.

This patient, a boy of 3 years, presented a history of injury to his right elbow 2 months before his admission to hospital, the elbow becoming swollen about this time. There was no record of any previous tuberculosis in his family.

On admission the Mantoux Test was positive. The right elbow was fixed at 120° by spasm, and considerable pain was experienced on attempted movement. A fluctuant abscess was present over the outer side of the joint, which required repeated aspirations, but which was eventually incised and scraped. After having been under treatment for 11 months, or 13 months from his first symptom, the condition became inactive.

Radiological examination revealed disease of the olecranon process of the right ulna. There was but little periosteal reaction. It was doubtful whether or not the lower end of the humerus had been involved.

Tubercle bacilli were isolated from the abscess pus by animal inoculation methods only. Microscopically they were seen to be medium length, acid-fast organisms. Their type was demonstrated by biological means.

MISCELLANEOUS LESIONS.

SUMMARY.

Type	Number of Cases	Trauma Present in -	Familiar Tuberculosis in -	Average Age (Years)	Average duration of Activity
Human	11	45.4%	45.4%	5	$1\frac{3}{12}$ yrs.
Bovine	-	-	-	-	-

In this group the length of activity is the shortest found for cases showing involvement of bone, while the incidence of trauma and of familiar tuberculosis is amongst the highest recorded. The radiological appearances of the lesions were of a varied character and did not appear to follow any definite sequence.

(g) SOFT TISSUE LESIONS.

(i) 14 cases of tuberculosis of the soft tissues caused by tubercle bacilli of the human type.

CASE 1.

This boy, who was 6 years of age, presented a history of injury followed by swelling and abscess formation of the left thigh 6 months before admission. There was no history of tuberculosis in his family.

On admission his general condition was good. The Mantoux Test was found to be positive. Three sinuses were present in the left thigh, the upper one in the inguinal region and the other two at a lower level on the inner side among the adductor muscles. An abscess about the size of an orange was present over the medial femoral condyle, and it broke down eventually to form a sinus. Following treatment the sinuses healed and the patient was dismissed well 9 months after his admission to hospital. Over all, the child appeared to have suffered from active tuberculosis for at least 14 months.

Radiological examination of the left femur revealed no abnormality in the bone.

Tubercle bacilli were isolated from the abscess pus by the animal inoculation method. Microscopically they were seen to be of medium length and stout. Their eugonic character was demonstrated by cultural means.

CASE 2.

This patient was a girl of 10 years, who, 5 months before admission, fell and injured her right hip. Two months later she began to lose weight and show signs of general debility. One month before admission she complained of pain in the right groin, while 2 weeks before admission she complained of pain in the left groin, and began to limp. Her maternal aunt had died from tuberculosis, while her cousin suffered from tuberculosis of the wrist joint.

On admission the Mantoux Test was found to be positive. Examination of both hip joints and of the spine failed to reveal any abnormality. These clinical findings were confirmed radiologically. An abscess was present in the right lumbar region at the level of the upper lumbar vertebrae. Repeated examinations failed to disclose any bone focus as the origin of the disease.

It is now 10 months since she was first admitted, or 1 year since the lesion originally appeared, and although the lesion is much improved, it is not yet healed.

Tubercle bacilli were isolated from the abscess pus by animal inoculation methods. Microscopically they were seen to be short, regular, acid-fast organisms. Their type was proved by biological means.

CASE 3.

This patient, a girl of 10½ years, has only a short history of disability of 2 months' duration prior to admission to hospital. The first symptom noted was pain in the left hip. No history of trauma was obtained, but several of her paternal relatives had suffered from pulmonary tuberculosis.

On admission the Mantoux Test was positive. There was no deformity of the left hip, but the movements of rotation and abduction were limited, and an abscess was present over the left

great trochanter. Radiological examination of the pelvis and lumbar spine was negative. It is now 9 months since the first symptom appeared, and although the abscess has largely disappeared, the condition has not yet healed.

The strain of tubercle bacilli isolated from the abscess pus was so obtained by both direct cultural and animal inoculation methods. Microscopically they were short, stout, regularly staining, acid-fast organisms. When subjected to biological test they were found to be of human type.

CASE 4.

This boy, aged 11 years, had previously undergone treatment in Mearnskirk Hospital for pulmonary tuberculosis. One year later he was re-admitted with an abscess situated over his right scapula. No history of injury was obtained, but his family record was bad. His mother suffered from pulmonary tuberculosis, while his two brothers had been treated in Mearnskirk Hospital at various times for non-pulmonary tuberculous lesions and his sister for a pulmonary condition.

On admission the Mantoux Test was positive and an abscess about 1½" in diameter was present over the right scapula. All movements of the shoulder joint were free and painless. Radiological examination of the affected parts was negative. After he had been under treatment for 6 months, swelling appeared in the region of the left knee joint. At first there was slight limitation of full flexion, but as the swelling began to subside, free movement was restored. Here again radiological examination proved negative. After he had undergone a period of 18 months' treatment the condition appeared to be healed. There was never any sign of renewed activity of the pulmonary lesion.

It is difficult to state accurately the length of time this boy had suffered from active tuberculosis, but if the pulmonary lesion be neglected, it may be stated as approximately 20 months of

active non-pulmonary tuberculosis.

Tubercle bacilli were isolated from the knee abscess pus by animal inoculation methods. Microscopically they were seen to have a long-headed appearance and were of human type by biological test.

CASE 5.

This girl, aged 3 years, appears to have been unwell for over 1 year before her admission to hospital, following an attack of measles. Her family history was negative for tuberculosis, and there was no history of trauma.

This case was admitted as one of the lumbo-sacral spine. The Mantoux Test was positive, and an abscess was present over the upper part of the sacrum. A sinus with a foul-smelling discharge was present over the right mastoid process, while another, also discharging, was situated over an enlarged gland on the posterior border of the right sterno-mastoid. After being scraped out and packed with iodoform both these sinuses healed, and whether or not they were of tubercular origin was not definitely proved. The sacral abscess required repeated aspiration, but it eventually dried up and was excised. At this operation the abscess cavity was found to be a cyst-like sac attached to the sacrum by a solid stalk. Its contents consisted of pus and two hard bodies like lemon seeds.

Radiological examination of the lumbo-sacral spine was quite negative.

Tubercle bacilli were isolated from the pus of the sacral abscess by animal inoculation methods. Microscopic examination showed them to be short, acid-fast organisms, which, when subjected to biological test, proved to be of human type.

CASE 6.

This girl, aged 10 years, was admitted after having been ill for about 6 months. There was no history of trauma, but her

father suffered from pulmonary tuberculosis.

On admission her general condition was poor. The Mantoux Test was positive and abscesses were present over both wrists and the outer side of the left ankle. Radiological examination of these sites revealed no bone disease. After she had been under treatment for 13 months she developed an acute broncho-pneumonic phthisis, from which she died 1 month later. Post-mortem examination served only to confirm the clinical findings.

Tubercle bacilli were isolated by cultural methods from the abscess pus, and were found microscopically to be short, stout, acid-fast organisms. When subjected to cultural test they proved to be eugonic.

CASE 7.

This patient, a boy of two years, has a history of having fallen 6 months before his admission to hospital. Two months later a swelling was observed over the right ankle. His father suffered from pulmonary tuberculosis.

On admission the Mantoux Test was found to be positive, and swelling was present over the right internal malleolus. There was, however, no limitation or pain on movement. The right knee joint was also swollen, but not painful. There was no limitation of movement and no free fluid in the joint. In addition to these lesions the soft tissues of the 1st finger of the left hand were swollen, and, lastly, active tuberculosis was present in both lungs.

Radiological examination failed to reveal bone disease in any of the lesions, but it showed considerable thickening of the soft tissues. A few weeks after admission the swelling of the right malleolus became fluctuant and required aspiration. It is now 7 months since this child was admitted, and although he is much improved, he is still far from healed. He has thus suffered from active tuberculosis for at least 1 year.

Tubercle bacilli were isolated by both cultural and animal inoculation methods from the pus of the right ankle abscess. Microscopically they were seen to be long, thin and headed. Their type was proved by biological means.

CASE 8.

This boy, aged 13 years, had a history of 1 year of ill-health, characterised chiefly by abdominal discomfort and occasional sickness. His family history was bad, two sisters having recently died from tuberculosis. There was no history of trauma.

On admission the Mantoux Test was positive. Three superficial abscesses, each about 1" in diameter, were present on the left arm. Generalised tenderness was present all over the abdomen. No masses were palpable, but definite signs of peritonitis were present. A large pleural effusion was present on the right side. This boy made a good recovery, and after having been under treatment for 8 months was dismissed well.

Tubercle bacilli were isolated from the pus of the forearm abscess by both cultural and animal inoculation methods. Microscopically they were short, evenly staining, acid-fast organisms. Their eugonic character was demonstrated by cultural means.

CASE 9.

Six weeks prior to her admission to hospital, this girl, aged 8 years, developed a series of abscesses. Her family history was negative for tuberculosis and there was no history of trauma.

On admission the Mantoux Test was found to be positive, and abscesses were present on the left arm and forearm and on the left calf. The lungs were clear. All the abscesses required aspiration, to which treatment they yielded, with the exception of that on the left forearm, which broke down to form a sinus. Six months after her admission all the lesions were healed, and she was dismissed well. Radiological examination of both arms and tibiae revealed no bone disease.

Tubercle bacilli were isolated from the abscess pus by both cultural and animal inoculation methods. Microscopically they were short, regular staining, acid-fast organisms. Their eugonic character was demonstrated by cultural test.

CASE 10.

This girl, aged 10 years, suffered from scarlet fever immediately prior to the onset of her tubercular lesions. During her convalescence from fever and 3 weeks before her admission to this hospital she complained of pain and swelling of the right forearm, which was followed in a few days by swelling of the left knee. There was no history of injury, but her family history was positive for tuberculosis, her mother having died about 1 year previously of pulmonary disease.

On admission the Mantoux Test was found to be positive. A fluctuant swelling about the size of an egg was present on the right forearm. The left knee was swollen, movement being limited by pain. The forearm abscess required several aspirations, but not so the knee. Radiological examination of the affected parts revealed no bone disease, and after a period of 13 months' treatment she was dismissed well.

Tubercle bacilli were isolated by animal inoculation methods from material removed from the arm abscess. Microscopically they were seen to be long, thin, evenly staining organisms. Their eugonic character was demonstrated by cultural means.

CASE 11.

This patient, a boy of 14 years, took ill only a few weeks before his admission to hospital. His first symptoms were cough and sickness. His family history was negative for tuberculosis, and no record of trauma was obtained.

On admission the Mantoux Test was found to be positive, and definite effusion was present in the left pleural cavity. An abscess was present over the left ulnar styloid process, which required aspiration. One month after admission a large abscess formed in his right calf. This abscess was deep and extensive, and, in order to secure suitable drainage, was incised. After 8 months of treatment all lesions healed and he was dismissed soon after.

Tubercle bacilli were isolated from both the arm and the leg abscesses by animal inoculation. Microscopically they were seen to be long, headed, comma-shaped organisms. In character, as proved by cultural methods, they were eugonic.

CASE 12.

This patient, a boy of 3 years, first experienced trouble when his right calf became swollen and painful 4 months prior to his admission to hospital. His family history was negative for tuberculosis, and there was no record of injury.

On admission the Mantoux Test was positive, and a small abscess was present over the external aspect of the middle of the right thigh, a larger abscess, about 2" in diameter, being present in the medial aspect of the right calf. The skin over the calf abscess was discoloured and threatening to break down. After several aspirations the abscesses dried up and healed fairly rapidly. This patient was under treatment for 6 months, so that, in all, the condition had been active for about 9 months.

CASE 13.

This patient, a girl of 11 years, developed, 4 weeks before admission, a small swelling over the right edge of the sternum, and very shortly after this a swelling in front of the left elbow. Her parents attributed this latter swelling to her occupation - that of an errand girl - as she was in the habit of carrying/

carrying heavy baskets in the "crook" of her left arm. Her family history was negative.

On admission the Mantoux Test was found to be positive. The whole left elbow was swollen and held slightly flexed; all movement was limited by pain, and an abscess was situated over the anticubital fossa. A purplish indurated area, 1" in diameter, was situated just to the side of the right sternal margin at the 5th and 6th costochondral junctions. A third lesion found at this time, which took the form of a tender indurated swelling about the size of a walnut, situated at the junction of the middle and lower thirds on the outer aspect of the left calf, developed later into an abscess.

Radiological examination of the affected areas revealed no bone involvement. After a period of treatment extending over 14 months, or 18 months after the appearance of the first sign, this girl was dismissed well.

Tubercle bacilli were isolated from the abscess pus by animal inoculation methods. They were microscopically seen to be short, regularly staining, acid-fast organisms, and were found by biological test to be of human type.

CASE 14.

This patient, a girl of 16 years, was admitted after having been unwell for almost 2 years before admission. During this period her chief symptom appears to have been transient pain in the right hip joint, accompanied by limping. No history of injury to this region was obtained, but her father was found to suffer from pulmonary tuberculosis.

On admission the Mantoux Test was found positive. The right thigh was held flexed at the hip and adducted. It was held by spasm in this position, and all movement was painful. Two

sinuses were present over the right inguinal ligament and an abscess was situated over the upper and outer aspect of the right thigh. Repeated attempts to trace any of the sinuses to a bone focus or to reveal the presence of bone disease in any part have been quite useless. She has now been under treatment for 1 year, but there is no improvement in the local condition, while the general condition is, if anything, worse.

Tubercle bacilli were isolated from the abscess pus by guinea-pig inoculation. Microscopically they were seen to be evenly staining, acid-fast bacilli, which when tested by biological means proved to be eugonic.

(ii) <u>One case of tuberculosis of the soft tissues caused by tubercle bacilli of bovine type</u>.

<u>CASE 15</u>.

This patient, a boy of 6 years, had been ill for only 1 month before his admission to hospital, the first sign being the development of an abscess behind the right ear. His family history was negative, and no record of trauma was obtained.

On admission the Mantoux Test was found positive, and disease was noted at two sites. The first of these has already been mentioned, namely, behind the right ear. This abscess, from which pus was removed by aspiration, had no connection with bone. The second site was in the middle third of the left calf, where a fairly large abscess was present, this also being aspirated. Radiologically there was no evidence of bone disease. After he had been under treatment for about 2 months he experienced recurrent attacks of headache and vomiting. These attacks extended over a period of about 10 days, at the end of which time definite signs of meningeal involvement appeared. He died 3 months after admission.

Post-mortem examination revealed the presence of basal meningitis but no sign of the disease having spread from the right ear to involve the meninges.

Tubercle bacilli isolated from the pus of the left calf abscess, by both cultural and animal inoculation methods, were found microscopically to be medium length, evenly staining organisms. When subjected to biological test they were proved to be of bovine type.

SOFT TISSUE LESIONS.

S U M M A R Y.

Type	Number of Cases	Trauma Present in -	Familiar Tuberculosis in -	Average Age (Years)	Average duration of Activity
Human	14	28.5%	57.1%	$9\frac{1}{12}$	11 months
Bovine	1	-	-	6	3 months*

*Died.

Those cases caused by the human type of tubercle bacillus present the highest incidence of familiar tuberculosis met with thus far. The duration of activity, as might be expected, in cases with no bone involvement, was relatively short. Owing to the death of the case caused by the bovine bacillus, it is not possible to compare the figures for the duration of activity.

(h) G L A N D S.

(i) 13 cases of tubercular adenitis, not including any intra-abdominal or intra-thoracic lesions, caused by the human type of tubercle bacillus.

CASE 1.

This patient, a boy of 3 years, had been unwell since suffering from measles 1 year prior to his admission to hospital. This attack of measles appears to have been complicated by pneumonia and mastoiditis, the latter requiring operative

treatment, and the lymphatic glands of his neck appear to have been swollen from this date. No record of tuberculosis in his family was elicited.

On admission the Mantoux Test was found to be positive. His general condition was poor, and glands enlarged to almost 1" in diameter were found in both sides of his neck, while on the right side abscess formation was present. He made good progress up to a point, after which the glands of the left side failed to decrease in size and were excised. Following this procedure he made rapid progress, and was dismissed 1 year after his admission in apparent good health.

The tubercle bacilli isolated from this case were so obtained by both direct cultural and animal inoculation methods. When tested by biological means they were found to be of human type.

CASE 2.

This boy, aged 3 years, had been in poor health since an attack of measles almost 2 years previously. His brother had died from pulmonary tuberculosis.

On admission to hospital the Mantoux Test was found to be positive. Enlarged glands were present in both sides of his neck, and there was an abscess in the supra-sternal notch. Radiological examination revealed the presence of enlarged glands at both lung roots, but no intra-pulmonary disease was seen. Two months after his admission to hospital he suddenly developed signs of meningeal involvement, from which he died. Unfortunately permission was not obtained for an autopsy.

The strain of tubercle bacilli isolated from this case was obtained by direct cultural and animal inoculation methods from the supra-sternal abscess. Microscopically they were seen to be medium length, beaded bacilli. Their type was demonstrated by biological means.

CASE 3.

This girl, aged 7 years, was admitted after glandular swelling had been present for 10 months. No history of tuberculosis could be found in her family.

On admission the Mantoux Test was found positive. Her general condition was poor. A diffuse, indurated swelling of glandular origin was present in the left side of the neck, and a sinus, which had developed 10 days before admission, was situated over it. It is now 13 months since she was admitted, and the condition, although much improved, is still present.

The tubercle bacilli isolated from this case were so obtained by animal inoculation method only. Microscopically they were seen to be short, regularly staining, acid-fast bacilli. They were found by biological test to be of human type.

CASE 4.

This child, a girl of 2 years, was admitted after only 3 weeks' illness for observation, as it was then thought probable that she was developing an intra-pulmonary lesion. Her family history was negative, and she had had no infectious diseases.

On admission the Mantoux Test was positive, and apart from slight hilum adenitis no other lesion was found. Six months later, however, she developed a glandular swelling on the right side of her neck, which went on rapidly to abscess formation. It is now a year since her admission and 6 months since the development of the cervical adenitis, but the condition is still active.

Tubercle bacilli were isolated by animal inoculation methods from the cervical abscess pus. Microscopically they were long, evenly staining bacilli, whose type was proved by biological means.

CASE 5.

This boy, aged 12 years, had suffered from right-sided cervical adenitis for 4 months before admission. For $2\frac{1}{2}$ months of this time he had received ultra-violet light treatment without apparent benefit to the local condition. He had suffered from measles in infancy. His family history was negative.

On admission enlarged glands were found situated in the posterior triangle on the right side of the neck. After a period of general treatment they were excised, and the patient was dismissed well 8 months after admission.

Tubercle bacilli were isolated from the excised glands by direct cultural methods. Microscopically they were seen to be short, stout, regularly staining, acid-fast bacilli. Their type was proved by biological means.

CASE 6.

This boy, aged 9 years, had undergone a period of hospital treatment 5 years before for tuberculous disease of the soft tissues of the left knee and the right foot. His family history was bad, his father having died from pulmonary tuberculosis.

On admission the Mantoux Test was found to be positive. Examination revealed the presence of enlarged glands in the anterior and posterior triangles of the right side of his neck. On the left side a red fluctuant area was present over the upper $\frac{1}{3}$ of the sterno-mastoid. Enlarged glands were present in the right femoral triangle, complicated by several small sinuses. Healed scars were present over the left knee and right foot. After a period of 1 year's treatment he was dismissed well.

The tubercle bacilli isolated from this case were so obtained from the gland on the left side of the neck by animal inoculation methods. Microscopically they were seen to

be short, regular staining, acid-fast bacilli. They were found by biological means to be of human type.

CASE 7.

This patient, a girl of 3½ years, had suffered from enlargement of the left cervical glands for approximately 3 years before admission to hospital. The condition had been aggravated by an attack of scarlet fever 2 years before admission, at which time the gland mass had been incised. Two of patient's cousins suffered from tuberculosis.

On admission the Mantoux Test was found to be positive. Two semi-discrete gland masses were present in relation to a healed scar on the left side of the neck. A considerable area of induration was present round the scar. These gland masses did not subside to any extent under general treatment, and were eventually excised. The patient was dismissed well 10 months after admission.

The strain of tubercle bacilli isolated from this case by animal inoculation means was found microscopically to contain both long and short members, both regularly staining and acid-fast. Biological test revealed them to be of human type.

CASE 8.

This boy, aged 12 years, had, following an attack of measles, been under treatment in a convalescent home for general debility, and during this period developed adenitis of the right side of the neck. No evidence of tuberculosis was found in his family.

On transference to Mearnskirk Hospital the Mantoux Test was found to be positive. A large fluctuant gland about the size of a hen's egg was present in the right posterior triangle of the neck, the overlying skin being inflamed. Following a

course of treatment involving aspiration of the abscess and eventually excision of the gland mass, he was dismissed well 7 months after his admission to hospital.

Tubercle bacilli were isolated from the gland mass by animal inoculation methods. Microscopically they were seen to be long, thin, evenly staining, acid-fast organisms. Biological test proved them to be of human type.

CASE 9.

This patient, a girl of 6 years, appeared to have always been a weakly child. She had suffered from measles, whooping-cough and chickenpox. There was also a history of tubercular ulceration of the eyes, but her family history contained no record of tuberculosis. Seven weeks before her admission to hospital swelling of the glands in the right side of her neck was observed.

On admission her general condition was extremely poor. The Mantoux Test was positive, and healed ulcers were present on the right cornea, along with a severe conjunctivitis and marked photophobia. The skin over the gland mass was discoloured and pierced by numerous small discharging sinuses. The patient, however, responded fairly well to treatment and was dismissed apparently well 11 months after admission.

The strain of tubercle bacilli, isolated from the glandular abscess by animal inoculation methods, was found microscopically to consist of both long and short members, all of which were evenly staining and acid fast. They were shown to be of human type by biological test.

CASE 10.

This patient, a boy of 4 years, had experienced enlargement of the glands in the right side of his neck for 5 months

before his admission to hospital. No record of tuberculosis was obtained in his family.

On admission there were several enlarged glands situated in the right side of his neck, one of which, the largest, was fluctuant. The Mantoux Test was positive. After a period of general treatment, during which little improvement was made in the local condition, the fluctuant gland mass was incised and scraped. After this procedure healing occurred with remarkable rapidity, and he was dismissed well after 9 months of hospital treatment.

The causal organisms were isolated from the affected glands by animal inoculation, and were found microscopically to be tubercle bacilli of a long, headed variety. They were proved by biological means to be of human type.

CASE 11.

This patient, a girl of 8 years, was admitted after a period of 2 years' ill health. She had previously suffered from measles, whooping-cough and chickenpox. Her family history contained no record of tuberculosis.

The Mantoux Test was positive on admission. Examination revealed the presence of multiple gland masses, both solid and fluctuant, in both sides of the neck, and along the lower border of the jaw, especially on the right side. A discharging sinus was present and a crusted sinus was present on the right leg, lower third.

Radiological examination failed to reveal any bone lesions of either the mandible or the lower limb. After several surgical procedures involving incision and scraping of the glands, combined with general treatment, she was dismissed well 8 months after admission.

Tubercle bacilli of a long, headed type were isolated from this case by both direct cultural and animal inoculation methods. Their type was determined by biological test.

CASE 12.

This boy, aged 7 years, had a history of gradually increasing swelling of the glands in both sides of his neck, of 2 months' duration. He had previously suffered from measles and chickenpox. His family history was negative for tuberculosis.

On admission the Mantoux Test was positive, and enlargement of the glands in the anterior triangles of the neck was present, with abscess formation on both sides. In addition to general treatment, the glandular abscesses were incised and scraped. He was dismissed well 6 months after admission.

Tubercle bacilli obtained from this case were isolated by animal inoculation methods. Microscopically they were seen to be short, regularly staining, acid-fast bacilli. Biological test showed them to be of human type.

CASE 13.

This girl, aged 12 years, was admitted after 1 year of ill health. Her family history was negative for tuberculosis.

On admission the child was very ill, and her general condition was extremely poor. The Mantoux Test was negative. A large mass of glands was present in the left axilla, and there was extensive disease of both lungs, with cavitation in the left. Her general condition gradually deteriorated, and she died 3 months after admission.

Post-mortem examination revealed extensive tubercular disease of both lungs. Apart from the left axilla, enlarged glands were present in the mediastinum and abdomen. Extensive ulceration of the ilium was present.

Tubercle bacilli were isolated by the animal inoculation method from material removed post-mortem. They were found microscopically to be long, slender, evenly staining organisms. Their type was demonstrated by biological means.

(ii) 2 cases of glandular tuberculosis caused by the bovine type of tubercle bacillus.

CASE 14.

This girl, aged 5 years, has a history of 5 months' intermittent glandular enlargement. Following an attack of scarlet fever she experienced enlargement of the glands below the mandible on the left side. These, however, subsided, no surgical treatment being necessary. Two months later she developed measles, and the glands again became enlarged. This time, however, they failed to subside and were incised. There was no history of tuberculosis in her family.

On admission the Mantoux Test was found to be positive. Her general condition was poor. Enlarged glands were present just below the mandible on the left side, an abscess and two sinuses being situated over them. After a period of 9 months' treatment the condition healed and the patient was dismissed well.

Tubercle bacilli were isolated from the glandular abscess by both cultural and animal inoculation methods. Microscopically they were seen to be long and slender. They were proved to be of bovine type by biological test.

CASE 15.

This patient was a boy of 7 years, who had had enlargement of the cervical glands for 4 months before his admission to hospital. It worthy of note that he had never suffered from any infectious disease, but that his father, one sister and two brothers had suffered from tuberculosis.

On admission the Mantoux Test was positive. Two large masses of glands were present on the right side of the neck, and a discharging sinus was present in the left cheek just anterior to the external auditory meatus. The gland masses were incised and scraped, and the patient was dismissed well 8 months after his

admission to hospital.

Tubercle bacilli were isolated from the abscess pus by cultural means alone. They were seen microscopically to be short, stout, acid-fast organisms. Their type was demonstrated by biological means.

GLANDULAR TUBERCULOSIS.

S U M M A R Y.

Type	Number of Cases	Familiar Tuberculosis in -	Average Age (Years)	Average duration of Activity
Human	13	23.0%	$6\frac{4}{12}$	$1\frac{11}{12}$ years
Bovine	2	50.0%	6	$1\frac{1}{12}$ "

In this group of cases a remarkable similarity between those caused by the human and those caused by the bovine types of tubercle bacilli can be seen so far as the average duration of activity and the average ages are concerned. It does not seem reasonable to compare the incidence of familiar tuberculosis in the two groups in view of the fewness of the bovine cases.

I. C O N C L U S I O N S.

A review of the 100 cases which have been studied reveals several features of interest. Boys are attacked more frequently than girls in the proportion of 5 to 4, a ratio which is true for cases caused by both human and bovine types of tubercle bacilli. Of the 91 cases caused by the human type of tubercle bacillus, 51 were males and 40 females, while of the 9 cases caused by bovine infection, 5 were males and 4 were females. Little difference exists, however, in the average ages of the two groups of patients, the bovine group nevertheless showing an increase over the human group of 9 months.

A large difference exists between the figures for the average duration of activity. Those cases due to human infection had an average duration of 1 year and 10 months, while those caused by the bovine type of bacillus had an average duration of activity of 3 years and 1 month, almost double. This also showed itself in another way, in that the majority of cases of bovine infection did not respond to treatment quite so rapidly as those of human origin.

There did not appear to be any difference in the rapidity of tissue destruction between the two groups of cases, nor was it possible to discover any increase in the time taken for abscess formation to appear, when one group was compared with another. Similarly with the development of sinuses, the type of the causal organism, whether human or bovine, did not appear to play any part, but this occurrence was dependent rather on the presence or absence of secondary infection.

Tuberculer complications, by which is meant a spread of disease from its original site, appeared to be more frequent in those cases caused by the bovine type of bacillus. Of 91 cases infected by the human type of tubercle bacillus, tubercular com-

plications/

occurred in 11 or 12.1 per cent., while in 9 cases caused by bovine infection complications occurred in 3 or 33.3 per cent. This latter percentage was obtained from rather small figures, and it is perhaps unwise to lay too much stress on it.

Familiar tuberculosis was found in a considerable number of cases, no matter from which source the causal organism was derived. Those caused by the human type of tubercle bacillus exhibited 34.06 per cent. of familiar tuberculosis, while those infected by the bovine type of organism showed 22.2 per cent.

In Table $\dot{\text{XI}}$ the principal features are set out. Each section has been considered separately, and is divided into two by the division of cases of human from those of bovine origin.

TABLE XI

Site of Lesion	Type of Bacillus	Number of Cases	Trauma Present in -	Familiar Tuberculosis in -	Average Age (Years)	Average duration of Activity (Yrs)
SPINE	Human	16	12.5%	18.7%	$6\frac{10}{12}$	$3\frac{8}{12}$
	Bovine	3	-	33.3%	$8\frac{8}{12}$	$3\frac{7}{12}$
HIPS	Human	16	6.25%	31.25%	8	$3\frac{1}{12}$
	Bovine	1	-	-	$2\frac{6}{12}$	3
KNEE	Human	6	50.0%	50.0%	$8\frac{8}{12}$	$2\frac{6}{12}$
	Bovine	1	-	-	3	3
ANKLE and OS CALCIS	Human	6	50.0%	16.6%	$10\frac{3}{12}$	$1\frac{4}{12}$
	Bovine	1	-	-	12	$2\frac{9}{12}$
DACTYLITIS	Human	9	11.1%	33.3%	$3\frac{6}{12}$	$1\frac{6}{12}$
	Bovine	-	-	-	-	-
MISCELLAN.	Human	11	45.4%	45.4%	5	$1\frac{3}{12}$
	Bovine	-	-	-	-	-
SOFT TISSUES	Human	14	28.5%	57.1%	$9\frac{1}{12}$	$\frac{11}{12}$
	Bovine	1	-	-	6	$\frac{3}{12}$
GLANDS	Human	13	-	23.0%	$6\frac{4}{12}$	$1\frac{11}{12}$
	Bovine	2	-	50.0%	6	$1\frac{1}{12}$
TOTAL	Human	91	20.8%	34.06%	$6\frac{1}{12}$	$1\frac{10}{12}$
	Bovine	9	-	22.2%	$6\frac{10}{12}$	$3\frac{1}{12}$

Of the 100 cases considered in this investigation 8 died, and the details of these cases are presented in tabular form below - Table $\overline{\text{XII}}$. In all cases the cause of death was tuberculosis, and of these, 6 were caused by the human type of bacillus and 2 by the bovine. Of the 91 human strains examined 6.5 per cent. caused death, while of the 9 bovine strains 22.2 per cent. caused death.

TABLE $\overline{\text{XII}}$

Type of Causal Organism	Number of Deaths	Trauma Present In -	Familiar Tuberculosis in -	Average Age (Years)	Average Duration of Activity (Years)
Human	6	-	50.0%	$8\frac{6}{12}$	$1\frac{5}{12}$
Bovine	2	-	-	9	$1\frac{11}{12}$

In the conclusions drawn from the study of 100 cases of non-pulmonary tuberculosis occurring in children under 15 years of age, the points of interest which have emerged are summed up below:-

1. The incidence of the disease was higher in boys than in girls in the proportion of 5:4.

2. The causal agent was found to be a human strain in 91 cases and of bovine origin in 9 cases.

3. The incidence of sex in relation to the bacillary strain was found to be the same as for the group as a whole.

4. The age at onset was practically the same in the two groups.

5. A considerable difference was observed in the duration of activity. In the cases due to human infection the average period was 1 year and 10 months, while in those from which the bovine type of bacillus was isolated, the average duration was 3 years and 1 month, that is, practically double.

6. From the clinical aspect there did not appear to be any difference in the rapidity and degree of tissue destruction between the two groups, nor was any correlation established between the formation of abscess or sinus and the strain of infecting organism. Complications were more frequently observed in the cases in which the infection was bovine, there being 3 or 33 per cent. as against 11 or 12.1 per cent. in the other and larger group.

7. Familiar tuberculosis was found in a considerable number of cases.

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