of gastric ulcer. In the present state of knowledge it is the only method which brings relief to a number of victims of the disease. While such is the case there is sure to be controversy as to methods. I have striven to present these problems to you, and have suggested what I regard as the best solutions to them.

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THE TYPE OF TUBERCLE BACILLUS COMMONLY PRESENT IN TUBERCULOUS LESIONS IN BONES AND JOINTS.

Two Cases with Unusual Numbers of Tubercle Bacilli in the Discharges.

BY

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THE question whether tuberculosis of bones and joints is commonly caused by drinking milk from a tuberculous cow, or by inhaling tubercle bacilli derived from some human being, is, for the sake of prevention, not without practical importance. Yet it is one on which current medical opinion seems to be imperfectly informed, for, in conversation, one too often hears it taken for granted that such cases are usually caused by tubercle bacilli of bovine type. This is assuredly not the case.

The Royal Commission on Tuberculosis of 1901-11, Park and Krumwiede in the United States, and the committee of the Gesundheitsamte appointed in 1901 to investigate the role of the bovine type of tubercle bacillus in human tuberculosis, all agreed in finding that the tubercle bacillus present in the great majority of the cases of bone and joint disease which they investigated was of the human type. Cases from which the bovine type of bacillus was obtained occurred, but they were uncommon.

Then in 1912 came J. Fraser, who, having investigated 70 cases of tuberculosis of bones and joints in the Research Laboratories of the Royal College of Physicians in Edinburgh, came to the surprising conclusion that no fewer than 41, or 57 per cent. of them, yielded tubercle bacilli of bovine type alone; that 3 gave a mixture of both mammalian types; and that only 26, or 37 per cent., yielded the human type alone.

These findings were so different from those of all other observers, who agreed in putting the proportion of such cases infected with the human bacillus as high as 80 per cent. or more, that they were not received without criticism by bacteriologists who had worked in this field. Nevertheless, it seems that it is just these exceptional results obtained in Scotland that have attracted the attention of English physicians, rather than the far more extensive investigations made in this country.

It therefore seems worth while calling attention to the fact that A. S. Griffith, F. Griffith, and A. Eastwood, than whom no more experienced workers in this field (all trained in the school of the Royal Commission, 1901-11) could be

found, working for the old Local Government Board and the Medical Research Council, have made a most comprehensive study of the types of tubercle bacilli present in various kinds of human tuberculosis. This study, which has extended over twenty years, and, so far as bone and joint tuberculosis is concerned, embraces five different investigations, now includes close on six hundred (598) cases of this kind in which the type of tubercle bacillus has been fully determined.

This is the total dealt with by A. S. Griffith in his dissertation for the degree of Ph.D.Camb. in 1926. It includes 14 cases investigated by the Royal Commission, as well as a number in which the cultures were made, not from material taken directly from the bone or joint, but from some other lesion. For this reason I prefer to quote from a paper by the same author entitled "Tuberculosis of bovine origin in the human subject," read at the eleventh National Conference on Maternity and Infant Welfare held in London on July 5th to 7th, 1927. It deals with 541 cases of bone and joint tuberculosis, with the result that 81.3 per cent. of them were found to be caused by tubercle bacilli of the human type. This percentage refers to patients of all ages; if one takes only children under 5 years of age (102 cases), the percentage so infected naturally falls; but even here it is over 70 per cent. Under 10 years (327 cases) it is 75 per cent. This total includes a few cases from Scotland. These, in a somewhat earlier paper by the same author,¹ are separated from the English cases, with the result that a lower proportion of infections with the human type of bacillus is found in them than in those from England and Wales. The difference, however, is not great; for Scotland the percentage of infections with the human type of bacillus is 71.4 (28 cases), while for England and Wales it is 81.7 (389 cases). For children under 10 the corresponding percentages work out at 63.6 and 75.4 respectively.

Frequency of Tubercle Bacilli of Human Type in Tuberculosis of Bones and Joints.

	No. of Cases.	Percentage with Human Type.
All ages	541	81.3
Under 10 years	327	74.6
Under 5 years	102	70.6

English and Scottish Cases Compared.

	No. of Cases.	Percentage with Human Type.
Scottish cases, all ages	28	71.0
English cases, all ages	389	81.7
Scottish cases, under 10	22	63.6
English cases, under 10	288	75.4

Thus from this exhaustive and competent investigation we may conclude, indeed, that infection from the tuberculous cow is a good deal commoner in Scotland than it is south of the border. But it must be pointed out that the proportion of human infections in Scottish cases found by the English authors—namely, 71.4 per cent.—is very different from the 37 per cent. (or if we include the mixed cases, 41 per cent.) found by Fraser.

The fact is that bone and joint tuberculosis commonly results from tubercle bacilli being transported to the part from some tuberculous focus (often a small and unsuspected one in some lymphatic gland) by the blood stream. In this respect it falls into line with other haematogenous kinds of tubercle—namely, with general tuberculosis, tuberculous meningitis, and genito-urinary tuberculosis, in each of which the proportion of infections caused by the human type of tubercle bacillus has been found to be in the neighbourhood of 82 per cent. In tuberculous meningitis it is even a little higher still.

It can therefore be stated positively that in England and Wales the great majority of cases of bone and joint tuberculosis are caused by bacilli of human type, derived from another case of human tuberculosis, and that they have nothing to do with the cow. Cases of bovine origin do indeed occur, and in very young infants constitute nearly a third of the total, but taking all ages together they do not amount to one-fifth.

It is interesting to note that in tuberculosis of the vertebral column bovine infections are rather commoner than in tuberculosis of the hip, and that in this latter condition they are somewhat more frequent than in tuberculosis of the knee. The higher incidence in the spine is

explained by Griffith on the ground that some of these lesions are caused by direct infection from the abdominal cavity, where, of course, as it is well known, the ratio of infection with the bovine to that with the human type of bacillus is high.

Significance of Numbers of Tubercle Bacilli in the Discharges from a Tuberculous Joint.

Two samples of pus from tuberculous joints which came to this laboratory attracted my attention on account of the unusual numbers of tubercle bacilli they contained. The severity of the disease turned out to be unusual also, and it seems that the numbers of bacilli in joint cases may have some prognostic significance. These cases, therefore, seem to be worth reporting.

A married woman, aged 38, was admitted to Addenbrooke's Hospital, Cambridge, on June 23rd, 1927, on account of severe pain in the left ankle. She came under the care of Mr. W. H. Bowen, to whom I am indebted for notes of the case. On admission there was a swelling on the outer side of the joint. This was aspirated five days after admission. The fluid then taken was sent to me on account of the numbers of tubercle bacilli which were visible in stained films made from it. As is well known, the bacilli in such specimens are, as a rule, either few in number or not to be seen; but in this specimen they were so numerous that it was difficult to believe that one was not looking at a rich sample of tuberculous sputum; another unusual point was that there were well-formed pus cells present. Here was a case, then, worth investigating, and I proceeded to determine the type of the tubercle bacilli.

The clinical course of the case showed a disease of great activity. The history on admission was seven weeks only, and consisted chiefly of severe pain in the left ankle, especially at night. The joint appeared to be exquisitely painful on the only occasion that I saw the patient. Soon after admission it was immobilized on a poroplastic splint; but seventeen days later it was necessary to aspirate again, and 20 c.cm. of caseous fluid was then removed. The disease progressed rapidly, and it became imperative to amputate the limb. This was done forty-four days after admission. But though the wound healed the condition of the patient did not improve. On the contrary, she rapidly went downhill, and died of meningitis on November 11th, seven months after symptoms had first appeared in the joint. Tubercle bacilli were found a few days before death in cerebro-spinal fluid removed by lumbar puncture. Mr. Bowen writes: "The outstanding feature of the case was the rapidity of the process; also very noteworthy was the persistence of pain in the joint."

After death there were found marked signs of cerebral tubercle: excess of fluid, flattening of convolutions, tubercles in the basement membranes, dilatation of ventricles. In both lungs were some old fibrous scars at the apex, and here and elsewhere recent foci commencing to break down into little cavities with caseous walls; in the rest of the lung tissue diffuse miliary tubercles. A few minute tubercles were seen on the surface of the liver, but none in kidneys or spleen. The mesenteric glands and peritoneum were normal. The bronchial glands were much enlarged and beginning to show small caseating foci.

The original sample of pus, so rich in tubercle bacilli, had arrived in my absence, and I was unable to deal with it. Three weeks later I obtained a second, in which tubercle bacilli were present, but not in anything like the numbers originally seen, and pus cells were now absent. From this sample animals were inoculated and a culture raised from a tuberculous guinea-pig. The culture grew luxuriantly, and formed voluminous nodular growths on glycerin-potato and glycerin-agar, and, on suitable batches of glycerin-serum, it produced a yellow growth.

Four rabbits were injected intraperitoneally with 10 mg. of bacilli from young serum cultures. They were killed about four months later, fat and well grown. With one exception the lesions did not exceed those usual after such an injection of tubercle bacilli of human type—namely, a few little lightly encysted collections of caseo-purulent matter in the peritoneal cavity; but in one animal paralysis of the hind legs had occurred, and at the *post-mortem* examination a tuberculous lesion was found in one of the vertebrae, pressing on the spinal cord. Such a lesion is not unknown after injections of tubercle bacilli of human type into the rabbit; both Griffith and myself have met with it, and its presence in this case in no way weakens the conclusion that the bacillus with which we were dealing belonged to the human type. This strain of bacilli has since been used for many other experiments having a different object, and it has all along shown that low degree of virulence and inability to produce a progressive disease in the rabbit which is characteristic of the type. For the guinea-pig it proved virulent, and caused fatal tuberculosis.

The second case was that of a tuberculous wrist-joint in a man aged 69 years. As in the other case, it was the tubercle bacilli in the pus from the joint that first excited my interest in it; but they were not so numerous as in the first sample from that case. Some were seen in most of the fields; the largest number seen in any one field was five.

For the clinical history I am indebted to Dr. Christopher Tylor of Long Melford, Suffolk. The disease in the joint came on after a slight injury caused by jarring it severely when using an axe. About the same time the patient developed a cough, and had physical signs indicating tuberculous mischief in the lungs. The disease in the wrist-joint then became more acute, and there was evidence of fluid. Six months after the commencement he was sent to Addenbrooke's Hospital, Cambridge, where an operation was performed by Mr. Cooke, who let out a large quantity of pus, curetted the walls of the abscess cavity and the bones, and closed the wound without drainage. A few days later the patient returned to his home. After this the pulmonary disease advanced rapidly, and he died a few weeks after his discharge from the hospital. No *post-mortem* examination was made.

A culture raised from a guinea-pig inoculated from the pus showed all the characters of the human type, and produced voluminous nodular growths on glycerin-potato, wrinkled films on glycerin-agar, and pigmented growth on certain batches of serum.

Two rabbits inoculated intraperitoneally with 10 mg. of serum culture on September 22nd remained well, and when killed two months later were well-grown, fat animals, with no sign of tubercle beyond the usual little collections of caseo-purulent matter lightly encysted in a thin membrane (which one so frequently sees in the peritoneal cavities of rabbits injected with the human type of bacillus), and in one of the animals a little wedge-shaped streak of chronic tuberculous disease in one kidney.

There can therefore be no doubt that in this case, as in the other, the tubercle bacilli concerned were of the human type, and we may conclude that the fact that numerous tubercle bacilli are visible in stained specimens of pus from tuberculous joints is not inconsistent with an infection caused by bacilli derived from another case of human tuberculosis.

The unusually rapid course and the fatal termination in these two cases, selected only because there were large numbers of tubercle bacilli visible in the discharges, raise the question whether the presence of these bacilli in numbers such as these cases showed would justify a grave prognosis. One hesitates to draw this conclusion from two instances, but they at least call for further observations of cases of a similar kind.

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EARLY DETECTION OF TUBERCLE BACILLI IN SPUTUM:

PRACTICAL METHODS OF OBTAINING SATISFACTORY
SPECIMENS.

BY

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THE importance of the early detection of tubercle bacilli in the sputum has been most strongly insisted on by Dr. Chandler and by various correspondents in recent issues of the *British Medical Journal*. I can heartily endorse their views, and I propose, therefore, to describe some very practical means for applying them in cases of difficulty such as not infrequently present themselves.

In many of these cases in which the general clinical evidence is in favour of the diagnosis of tuberculosis the report on the sputum supplied by the patient is that no tubercle bacilli have been found. As often as not this is because a good specimen of the sputum has not been obtained. Many patients seem to be unable to eject the liquid from the bronchi, but involuntarily swallow and spit little more than frothy saliva from the mouth. By means of *coaxing*, and urging them to "shoot it out into the bowl" while the head is kept down over it, a better specimen may often be obtained. If this fails, an active cough reflex may be excited by getting the patient to sniff