broth, and incubated for forty-eight hours at 37° C. Two of the tubes showed cloudiness. Subculture of these on agar plates gave a growth of circular, convex, translucent colonies which microscopically showed small Gram-negative organisms distinctly more bacilliform than *Br. melitensis*. They did not ferment any sugar, and gave an alkaline reaction in litmus milk.

This organism was agglutinated by serums prepared from three undoubted strains of *Br. abortus*, with end-points as follows:

1. Swine strain of *Br. abortus*... up to 1 in 2,500
2. "Abortus No. 5" ... up to 1 in 1,250
3. "Bang" (Oxford strain) ... up to 1 in 500

It is important to note that these serums were prepared by injecting rabbits with living cultures. The standard agglutinating serum of Oxford (prepared from dead cultures) did not cause any agglutination. The organism was not agglutinated by serums prepared from two undoubted strains of *Br. melitensis*, but it is significant that a serum prepared from a strain of *Br. paramelitensis* gave an agglutination up to 1 in 500.

A serum was prepared by injecting a rabbit intravenously with increasing doses of living cultures of the organism under examination. This serum agglutinated thirteen different strains of *Brucella*, the highest end-point (1 in 1,250) being given by the swine strain of *Br. abortus*.

The patient's blood serum agglutinated twenty-two different strains of the *Brucella* group, giving titres up to 1 in 250 with *Br. melitensis* and *Br. paramelitensis* strains, and up to 1 in 2,500 with the swine strain of *Br. abortus*. Using the standard agglutinable cultures of Oxford, and of the Royal Army Medical College, the *Br. abortus* cultures agglutinated up to titre, but the *Br. melitensis* cultures did not agglutinate up to more than half the full titre.

An autogenous vaccine was prepared and its administration commenced after the last relapse. Up to the time of writing (March 28th, 1930) the patient has remained free from any further symptoms of the disease.

The strain of *Br. abortus* isolated from this patient grew readily from the urine in ordinary media, and in the absence of an atmosphere of CO₂. This, together with the results of the agglutination tests given above, suggests that it belongs to the swine variety.

REFERENCE.

- ¹ Nightingale and Wilson (1929): *Lancet*, cexvii, 1143.

A CASE OF BRUCELLA ABORTUS INFECTION.

BY

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UNDULANT fever due to the organism which sets up epizootic abortion in cattle, goats, sheep, and swine has been described as "a disease of the future," and also as a possible addition to the lengthening list of occupational diseases, for it has its highest incidence among those who have direct contact with cattle, live or dead. In 1924 and 1925 ten cases only were recorded in the United States, but in 1928 and the early months of 1929, when physicians had become more widely aware of the disease, over a thousand cases were reported in forty-two States. In Denmark 222 cases were brought to light during the first year when the disease was systematically sought.

The case about to be described is the second reported to have occurred in Wales and the fifteenth or sixteenth recorded in Great Britain. Possibly, however, the number of cases recorded is not a true measure of the incidence of human infection. It has been suggested also that there is a real extension of the disease in most countries, coincident with more frequent and widespread epizootics of abortion among cattle; in this connexion may be cited cases recently reported from New Zealand by Gilmour and Ludbrook and by L. J. F. Bull.

Wilson and Nutt, investigating the mixed milks from herds in Cheshire, Lancashire, Derbyshire, Staffordshire, and Northumberland, established the presence of *Br. abortus* in 8.8 per cent. of the samples. Although the mortality is very low (about 2 per cent.) and permanent impairment of health apparently rare, incapacity is often of long

duration, many cases being ill for one or even two years. The record of the following case may therefore prove of interest, especially as it exemplifies many salient signs and symptoms of the disease.

On January 6th last one of us was called to see a farmer, aged 53, who had lived all his life in the same locality in Pembrokeshire. He definitely became ill on January 2nd with headache, backache, and nausea, but for a week prior to that he had felt vaguely unwell, getting very fatigued and having to lie down in the afternoons. When first seen he had a temperature of 103°, with a pulse of 96. He had a violent cough, and complained of much headache, restlessness, and insomnia. The heart sounds were rather poorly defined, and the breath sounds were defective at the right base. He was bringing up a type of copious white sputum, which led to the suspicion of some degree of pulmonary oedema. At this time the case was thought to be influenza.

During the days immediately following the temperature remained at 102°, with a relatively slow but feeble and intermittent pulse. The blood pressure (85/125) seemed much below what one would expect in a plethoric man of his age. There was a trace of albumin in the urine. The patient complained of very heavy drenching morning sweats and severe pains in the calves of the legs. There were no definite rigors, and no mention was made of any peculiar odour of the perspiration.

On January 12th the spleen, which was rather soft, could just be palpated below the costal arch. This observation, along with the history of insidious onset, the comparative (though not complete) absence of upper respiratory catarrh, and the fact that no one else in the house had developed influenza, led to a suspicion of paratyphoid, and a blood specimen was sent to the Beck Laboratory. Serum from this, of the tenth definite day of illness, was tested for agglutination power by the Dreyer technique against *B. typhosus* and paratyphoid A and B, with negative results even in low dilutions.

In view of the occupation of the patient and the knowledge that *Br. abortus* infection in man may be acquired from cattle, a further agglutination test with *Br. abortus* (Oxford emulsion) was made, and strong agglutination found up to a dilution of 1 in 2,500. This is well beyond the limit of any non-significant response, and indicated past or present infection by this organism. As cases of "undulant fever" are found to give positive agglutination also with *Br. melitensis*, the organism of Mediterranean fever, the serum was also tested with an emulsion of the latter obtained from Messrs. Burroughs Wellcome and Co.; this test proved positive to a dilution of 1 in 2,500 also.

It is still a moot point whether the two organisms, *Br. abortus* and *Br. melitensis*, are to be regarded as identical or whether they represent two closely allied species. Their clinical effects on the human subject appear to be similar, and both organisms have been shown to produce abortion in the cow. It may be significant that *abortus* cases have been studied chiefly from cow-borne infections, whether direct or through cow's milk, whereas our knowledge of *melitensis* cases comes chiefly from infections arising through goat's milk. It may well be that passage of the organism through the cow and the goat respectively may produce slight serological differences in organisms originally identical.

In the case under consideration there have been no opportunities of isolating the organism, and therefore no agglutinin absorption experiments have been possible. The very definite serological reactions, however, coupled with the very complete clinical picture and the history of the environment and circumstances of the patient, would seem to have established beyond reasonable doubt that this illness was due to infection by *Br. abortus*.

Further inquiries made in the patient's locality brought out evidence that: (a) epidemic abortion was especially rife among cattle in the village where the patient lived; this was vouched for by the local veterinary surgeon; (b) four of the patient's cows had "lost their calves" during the preceding six months; (c) he last had a cow abort about three weeks before he definitely became ill; into that cow he had inserted pessaries manually "to help to clear her up."

The further clinical course may be summarized thus:

On January 14th the temperature in the evening was down to 100°, with pulse of 84. The cardiac condition had improved, and the spleen could only just be felt. Sweats were still complained of, there were still loud rales at both bases, and resonance and breath sounds were impaired at the right base. On January 15th the chest signs were more pronounced, the temperature was 101°, and the pulse 84; there was some pain in the left cheek. On the

night of the 16th he was reported to have been very restless, dyspnoeic, and feverish all night. On January 17th he suddenly coughed up several "gushes of slimy liquid yellow stuff like beaten-up eggs," and it was suspected that a pulmonary abscess or empyema might have formed and ruptured into a bronchus. The patient stated that the dyspnoea eased markedly after this event. When seen at 8 p.m. the temperature was 102°, pulse 84, respirations 30. There was no marked change in the chest signs, and there was still complaint of heavy sweats and pains in the calves.

On January 22nd the temperature was down to 99°. The appetite was good, and the general aspect remarkably good considering the severity of the illness. On the 25th the temperature was 98°, pulse 60, respirations 20; there were still rales at the bases, but no splenic enlargement and no sweats or pains in the legs. Since then there has been no recrudescence of the fever.

This case would appear to have exemplified several outstanding characteristics of the disease as observed in the extensive American outbreaks. The "afternoon fatigability," headaches, and especially backaches, during the stage of onset; the enlarged spleen, the peculiar heavy sweats, the severe pains in the calves of the legs, the relative bradycardia, myocardial involvement, and low blood pressure—all these features figure very prominently in Bierring's detailed description of 150 cases of the disease studied by him in Iowa between 1926 and 1929. In the American descriptions there is no special mention of pulmonary complications, but oedema of the lung is described by Carmichael Low and by Wheeler and Jack as being a frequent event in the closely allied Malta fever.

It is characteristic that only one member of the household was affected. "The disease, though epizootic among cattle, is remarkably discrete among human beings," so that "the typical case is generally the only one in a district, and multiple cases in one house have only once been encountered." (Charles and Warren.)

The mode of transmission is also of interest. Most of the cases previously recorded in Great Britain would appear to have been due to the drinking of infected milk, but here infection would seem to have been due to manual contact with the vagina of the infected cow. The subsequent route of the infection may have been through the unbroken skin of the hand rather than by ingestion of food soiled by the imperfectly cleansed hand; Hardy experimentally infected guinea-pigs more readily through the shaved unabrased skin than through the alimentary tract.

The question of prophylaxis is naturally an important and a thorny one if the disease should really prove to be more common than has been thought hitherto. Most recent writers seem to regard direct contact infection as being much more important than milk-borne infection, and they look to the veterinarian for the first steps towards the eradication of the disease among cattle. In France the disease among cattle is already notifiable. Hardy sums up the prophylactic aspect of the problem thus:

"A conservative attitude is justified since it appears obvious that the disease is not a new one, but one newly recognized. Deaths are very few, serious sequelae are infrequent, and acute suffering is unusual, but there is now occurring an undetermined and probably severe economic loss. In preventing this, the livestock and dairy industries will apparently be concerned, and a prematurely attempted eradication of contagious abortion would prove both ineffective and disastrous. . . . Much economic waste, and even impairment of human health through decreased consumption of milk, may be avoided by acting wisely and quietly."

We wish to thank Mr. Watson, veterinary surgeon at Haverfordwest, for information regarding the prevalence of epizootic abortion among cattle in the locality concerned.

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NOTE ON A FURTHER CASE OF UNDULANT (BR. ABORTUS) FEVER OCCURRING IN SCOTLAND.

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CONSIDERABLE attention has recently been directed towards the possibility of infection of the human subject by *Br. abortus*. The organism is known to be responsible for wide-spread disease among cattle, while its presence in milk as sold to the public has been repeatedly demonstrated. It may also be noted that the present precautions and requirements in the production of "graded" milks provide no efficient safeguards against the dissemination of this organism, even in milk of the highest class. The question of spread of the disease from animals to man is thus one of considerable importance in relation to public health.

In view of this it may be of interest to record the history and bacteriological findings of a case which recently occurred in the private practice of one of us (W. H. W.). The diagnosis rests on the evidence provided by the serological reactions of the patient's serum, but, as in the case in Glasgow described by Cruickshank and Cruickshank,¹ the presumption is very strong that *Br. abortus* was the causative organism.

History and Clinical Course.

A technical chemist, aged 34, residing in Edinburgh, was seen on January 7th, 1930, when he reported to be medically examined for life assurance. He was found to have a temperature of 102° F., though he felt well. He stated that on January 1st he had had a shivering attack at 1 p.m., but had been able to carry on his work up to the time of examination. After January 7th he was seen daily. Each day about 1 p.m. he had a shivering attack, which passed off after sweating in the evening. The fever was distinctly undulant in character, the diurnal rise increasing and diminishing in a regular way. The temperature chart showed a marked periodicity, waves of five to seven days' duration being noted. The evening temperature, taken in the axilla, varied from 98.4° to 102° F. Sweating was not excessive. For a few days at the commencement of the condition cough was present, occurring only in the afternoon and evening when the temperature rose. The patient thereafter had no particular complaint. He never looked ill, and was always bright and cheerful. At this time Dr. Guy, city tuberculosis officer, seen in consultation, considered that the condition was not tuberculous.

Treatment was symptomatic, the diet being fluid while the fever continued. Cold sponging gave much comfort. Quinine sulphate and quinine hydrochloride were given in doses of 10 grains three times a day. The quinine appeared to have no influence on the height of the temperature, but following its use the onset of the daily rise was delayed from 1 p.m. till 6 p.m. The fever continued till February 16th; since that date it has not recurred, and the patient is again at work after a satisfactory convalescence.

Bacteriological Findings.

The patient's serum, submitted for examination approximately four weeks after the supposed onset of the condition, did not agglutinate *B. typhosus*, *B. paratyphosus* A, or *B. paratyphosus* B. In view of the history, further reactions were carried out with available strains of *Br. abortus* and *Br. melitensis*. The serum agglutinated strains of both organisms in high titre. The emulsions used in these reactions were suspensions in 0.85 per cent. saline of living organisms from forty-eight-hour agar slope cultures.

The results were as follows, final readings being made after eighteen hours in each case.

Strain.	End Titre.
<i>Br. abortus</i> (Bang)	1 in 3,200
<i>Br. abortus</i> (Hog)	1 in 1,600
<i>Br. abortus</i> (Barker)	1 in 3,200
<i>Br. abortus</i> (T)	1 in 6,400
<i>Br. melitensis</i> (stock strain)	1 in 3,200
<i>Br. melitensis</i> (Group II)	1 in 1,600
<i>Br. melitensis</i> (Arkwright)	1 in 800

Agglutinin Absorption.

Absorption of the serum by *Br. abortus* (Bang) removed agglutinins for all strains of *Br. abortus* and *Br. melitensis*. Absorption by the three *Br. melitensis* strains removed only agglutinins for these strains, the same high agglutination titres for *Br. abortus*