tions than before, particularly with regard to sterilization of the benches after contact with glassware containing *Br. abortus* cultures, hand and arm ablutions, and general alertness as to the risk of infection. Gloves were worn, possible contamination by splashing was rigorously guarded against, and the bench was covered with izal for twenty-four hours after each session. Nevertheless a further case arose in the senior laboratory assistant, eleven months after the onset of the first case (i.e., after subculture of the strain for three years). This person was exposed to the organism only in the periodic preparation, from Roux bottles, of culture washings, which were poured slowly through a very wide glass funnel into an Erlenmeyer flask. At the time of infection a sulphanilamide-resistant strain which had developed from the stock strain after culture in sulphanilamide broth (Green, 1940) was being grown in bulk in Roux bottles. It is of interest that the strain of *Br. abortus* obtained from a blood culture previous to sulphapyridine treatment still retained about the same degree of resistance to sulphanilamide as the original infecting strain. This case ran a less severe course than the first, but did not become apyrexial for three months, though there was no serious relapse after giving an intensive course of sulphapyridine one month after the development of clinical symptoms.

The third case was that of another laboratory assistant, whose illness started one month after that of Case 2. He had assisted Case 2 in preparing the washings from the Roux bottles, but had not been near a culture of *Br. abortus* for one month, as all work with this organism was completely suspended and the preparation room was cleaned and disinfected when Case 2 was diagnosed. He also had a typical, fairly severe attack of undulant fever, which subsided naturally after about four months' illness.

Possible Source of Infection

There was, of course, nothing in the nature of an epidemic infection, and infection in every case may have occurred through some recognized channel such as a skin abrasion, droplet infection, or from contaminated fingers to the mouth. In all three cases, however, the individuals were not aware of any such contamination, and the second and third patients (in whom a great degree of caution had been induced by the occurrence and history of the first case) were certain that such contamination did not occur. Undoubtedly close contact with cultures was necessary for infection, as no case occurred in other members of the laboratory staff who were not working with the organism, whilst one member had assisted in the work for over two years without being clinically infected, though his serum agglutinated at one time at a titre of 1 in 100.

It is suggested as a possibility (without any concrete evidence) that infection was due to inhalation of contaminated air in the vicinity of large concentrations of *Br. abortus* growing on solid media. It is conceivable that, where the cultures had become rather dry, air currents (induced by Bunsen burners, etc.) could dislodge organisms from surface cultures. It should be noted also that Cases 2 and 3 were infected by a sulphanilamide-resistant strain. A large proportion of the cultures to which Case 1 was exposed were also grown in and subcultured from media containing sulphanilamide. It is therefore possible that after exposure to sulphanilamide the organism had become more virulent or invasive than the stock strain.

Commentary

This record does not supplement our knowledge of the alternative paths of infection in man by the pathogenic *Brucella* group, which in the natural infection is commonly via the alimentary tract. It is published rather as

a warning that *Br. abortus* under laboratory conditions is a potentially highly dangerous organism and that the conditions governing its infectivity are still not completely understood. It is of particular interest that in Case 3 clinical symptoms did not appear until one month after any possible direct exposure to *Br. abortus* cultures, which would fix the incubation period in this case at a minimum of one month.

The cause of the outbreak of *Br. melitensis* infection occurring at Michigan appears superficially much more mysterious than that described here, nor do the present observations throw any light on it, except to add some support to the possibility of air-borne infection. They do, however, indicate that there may be another quite unrecognized mode of infection, the nature of which, from both the academic and the practical standpoints, it would be of value to know. Progress might be made if the details of laboratory infection of all types were more often reported.

Summary

Three cases of undulant fever are reported, due to laboratory infection by a stock strain of *Br. abortus* which had been continuously subcultured for two to three years.

In two cases the infecting strain was known to be sulphanilamide-resistant.

In no case was the exact site of entry of the organism established, and it is suggested that air-borne infection from surface cultures is a possibility.

A grateful acknowledgment is due to Prof. E. J. Wayne, who undertook the medical care of two of the cases.

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A CONVULSION DURING NON-CONVULSIVE FARADIC SHOCK THERAPY

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Following on the promising results obtained by Berkwitz (1940) of Minneapolis, an investigation is being carried out on the therapeutic effect of non-convulsive faradic shock treatment in mental disease. This method is reputed to give as good results as the ordinary cardiazol or electrical convulsive therapy without the dangers consequent on the convulsions—namely, fractures of vertebrae, lesions of the brain, and abscesses of the lung—reports of which are becoming ever more frequent (Polatin and others, 1939; Bennett and Fitzpatrick, 1939; Hamsa and Bennett, 1939; Blair, 1940).

The apparatus and technique used are very similar to those employed by Berkwitz. The faradic current is produced by an ordinary induction coil such as is used in most massage departments for muscle stimulation; and this is driven by a 6-volt dry battery. The electrodes are applied to the patient's temples, the current is switched full on, and then fifteen shocks of half a second's duration are given at intervals of half a second, varying the on-off key of the coil to make and break the current. During this period the patient is fully conscious. Each shock produces a spasmodic contraction of the muscles of the face and neck, and is described as feeling "like a bang on the head." Immediately after the series of shocks a 5% solution of pentothal sodium is injected intravenously. Enough is injected to produce a surgical anaesthesia lasting 5 to 10 minutes, and while the patient is coming round he is in an ideal state for psychotherapy. Apparently the faradic shock shakes him up and establishes

rapport, and the barbiturate produces a state of increased suggestibility. Intensive psychotherapy in the form of general and specific suggestion and persuasion is carried out in every case.

The results so far obtained are promising, but sufficient cases have not yet been treated to allow of a statistical evaluation of the efficacy of the method. It is, however, considered advisable to publish the following case at this stage as an illustration that this treatment is not entirely free from risks. Also it shows the occurrence of a hitherto undescribed sensitization to the faradic current, as a result of which a major convulsion was produced by a potential only a fiftieth of the strength of that used in normal electric convulsive therapy (Berkwitz, 1940).

Case Report

A married man aged 30, a metal-spinner, was admitted to the Winson Green Mental Hospital on August 21, 1940, as a case of acute mania, following on various environmental difficulties. There was no personal or family history of epilepsy or mental disorder. He was elated, overactive, and euphoric. He showed a well-marked "flight of ideas" and had visual and auditory hallucinations. He was disorientated for time and place, and was completely devoid of insight into his condition.

Three weeks in hospital caused no appreciable change in his condition. On September 2 a course of prolonged narcosis was started, but on its completion he appeared much the same. On September 24 some carious teeth were extracted, and on November 18 tonsillectomy was performed. By that time he had become a little quieter, but there was no significant improvement. He was still excited, disorientated, and acutely hallucinated. On January 11, 1941, a course of faradic shock therapy was started. Treatment was carried out once daily for six days. An immediate improvement was noted. After the second treatment he was much quieter and became correctly orientated. After the third session he was allowed up out of bed. After the fourth session he started to do some light ward work and his hallucinations had disappeared. The same strength of current was used every day, but it was noticed that as his mental condition improved the effect of the shocks seemed to increase. He became apprehensive of the treatment, but since he was now fairly rational it was easy to persuade him to continue.

On the fifth day the shocks had a very marked effect, and he screamed and struggled each time the current was switched on. When he recovered he seemed almost normal and discussed the various factors which had led to his breakdown. He described his illness as having been like a dream and his hallucinations as having been excessive imagination. On the sixth day he was very apprehensive, and so it was decided to cut down the current to three-quarters of the usual dose. But despite this his reaction to the shocks seemed greater than ever, and after twelve shocks he went into a convulsion which resembled in every way that usually produced by azoman or cardiazol. It consisted of a tonic stage followed by a well-marked clonic stage, the whole lasting two minutes. During this time he became pulseless and very cyanosed, his face eventually going quite black. At the end of the fit an intravenous injection of pentothal sodium was given as usual, and he woke up twenty-three minutes later with complete amnesia for the actual period of treatment.

Subsequently he has appeared quiet and rational and has discussed his illness at great length with perfect insight; but he has complained bitterly of pain and tenderness in his upper dorsal vertebrae. He says he feels as though he has been "kicked in the back." A radiograph showed no abnormality.

In view of his satisfactory mental condition and the possibility of further convulsions producing crush fractures of the vertebrae it was decided to terminate the treatment at this stage.

Discussion

Berkwitz (1940) has shown that the resistance of the patient's head between the two electrodes is fairly con-

stant at 10,000 ohms and that the average current flowing during a shock is about 10 mA. A much higher current than this is often used clinically in muscle and nerve stimulation without producing tissue damage, so the chief benefit claimed for faradic shock treatment is its safety, in that the current used is too small to produce burns or unconsciousness or convulsions.

The therapeutic efficacy of the treatment in the above case is undoubted. A bad case of acute mania which had resisted other forms of non-convulsive therapy was brought back to normality within six days; but with increasing normality came a strange increase in sensitivity to the faradic current, and finally a major convulsion, with all its dangers, was caused by a current three-quarters of the normal strength—a current which other patients can tolerate with equanimity. It would appear as though some cumulative physical change which was associated with the improvement of his mental condition was taking place in the patient's brain, and that this change also involved his sensitivity to faradic stimulation.

Further investigation along these lines may well lead to some satisfactory explanation of the mode of action of shock and convulsive therapy in mental disorder.

Summary

A brief account is given of faradic shock therapy. The reason for its preference to other forms of similar therapy is that it normally does not give any dangerous convulsions.

A case of acute mania successfully treated by this method is described.

An account is given of how the patient became increasingly sensitized to the faradic current until eventually a small current produced a major convulsion.

My thanks are due to Dr. J. J. O'Reilly, medical superintendent of Winson Green Mental Hospital, for his help and for permission to publish an account of this case.

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Clinical Memoranda

Convulsions under Anaesthesia

As the subject of ether convulsions has been much to the fore of late, and there is little agreement among writers as to the pathology or treatment of this grave condition, it may be of some value to record the first case of this kind that has occurred under my care.

CASE REPORT

The patient, a weedy boy aged 12, was admitted to hospital extremely ill with acute appendicitis of three days' standing. He appeared severely toxic; the temperature was 100°, the pulse 124, and he had marked right-sided abdominal rigidity. Cardiac examination showed gross dilatation of the heart to the anterior axillary line, associated with a soft systolic murmur all over the praecordium. This appeared to be the result of rheumatic carditis, possibly following a severe attack of measles at the age of 6.

Premedication consisted of atropine sulphate, 1/100 grain; and owing to his extremely poor general condition an intravenous glucose-saline drip was started before operation and was continued. Anaesthesia was quietly induced with 5 c.cm. of ethyl chloride and maintained by open ether on a lint-covered mask, covered again by lint and towel. Oxygen was administered under the mask continuously, and at no time was there any sign of cyanosis or hyperoxygenation. The anaesthesia