has been adopted partly for convenience of argument, but largely because this explanation seems plausible. The fact that the anaesthesia in two of the cases extended well above the wound has led to the suggestion that it is of a functional nature. But even if we call it functional, does that carry us any further? Several controls have been tried, and patients with fractures, wounded joints, and other bad wounds of the limbs were tested, but in no case was a stocking anaesthesia discovered except in those who had arterial lesions.

Whatever the cause of the paralysis may be in these cases, it can hardly be attributed to ischaemia. In this connexion, it may be well to recall the cerebral disturbances which are apt to follow sudden obliteration, by operation or otherwise, of the lumen of the common carotid or internal carotid artery. These disturbances, severe and not rarely fatal, surely cannot be attributed to ischaemia, seeing what a liberal provision of collateral channels is present for supplying the brain with blood, and considering also the rapidity with which the cerebral symptoms develop.

CASE XII.

Pte. O. K., wounded on September 1st, 1916, was admitted on September 9th. He had been shot through the right neck. He stated that his left arm became paralysed at the instant he was hit; in fact, he thought the wound was in his arm. The projectile had clearly divided the internal carotid artery.

It is difficult to believe, in the absence of better evidence, that such an immediate paralysis could be brought about by ischaemia or embolism of the brain.

GENERAL CONCLUSIONS.

The currents of thought started by these cases are, however, not likely to lead us into any useful channel until we have a great many more clinical records to work upon, together with additional observations, including the electrical reactions of the affected muscles, the deformities produced, and the prognosis. It has not been possible to gather information on these points.

Although the importance of these paralytic effects of arterial injuries cannot at present be estimated, yet, until we are better informed as to prognosis, we may well be more reluctant in the future than we have been in the past to tie a main artery for the arrest of haemorrhage. We shall be more particular and persistent in our endeavours to find the exact source of bleeding, in the hope that it may prove to concern a branch only instead of the main trunk. And, in those instances in which the main trunk itself is wounded, we shall be more disposed to cure the leak by suture of the vessel, or failing this, to attempt an escape from the ill consequences of direct ligation by the temporary use of a Tuffier tube. Furthermore, when we are compelled by the nature of the case to tie a main artery, we shall take care to tie the main vein also; because, as Sir George Makins has pointed out, the results which follow ligation of both vessels are better than those which ensue upon a blockage of the main artery alone.

LITERATURE.

Though there is not much literature on this subject there is enough to give food for thought.

In the first place, the association of so-called ischaemic paralysis, of the type described by Volkmann, with injuries involving complete blockage of an artery, has been recorded by J. G. Sherrill,¹ Carl Hirschmann,² L. Verdelet,³ and others, although the association does not appear yet to have become a matter of general surgical knowledge. Further, H. Meige and Mme. Athanassio-Benisty⁴ have observed that the vasomotor, trophic, and secretory disturbances found in certain cases of nerve injury are not due directly to those nerve lesions, but are dependent on coincident arterial lesions, while Leriché⁵ has noted not only that so-called ischaemic paralysis may follow obliterating lesions of an artery, but has put forward the suggestion that the symptoms are the result not of the arterial wound, but of the concomitant injury to the sympathetic nerves which accompany the artery. He states, moreover, that if in such a case the whole of the obliterated segment of the artery be removed together with its nerve sheath the major part of the troubles disappear, the hand becomes warm, its colour changes, and the skin resumes its normal appearance, the fingers lose their stiffness in an appreciable measure, and, finally, the

pulse reappears at the wrist. Leriché has been able to demonstrate this in six cases, and in all the transformation was identical.

It is clear that if this pathology be established there is justification for a new title for paralysis of vascular origin, a title which shall include the two factors of ischaemia and sympathetic reflex disturbance.

Acknowledgments.—In conclusion, I should like to express my thanks to the medical officers, under whose care the cases quoted have been, for their friendly co-operation, to Colonel C. A. Ballance and Colonel Gordon Holmes for several helpful suggestions.

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A CASE OF RAT-BITE FEVER TREATED SUCCESSFULLY BY INJECTIONS OF NOVARSENOBILLON.

BY

GEORGE C. LOW, M.A., M.D.,
TEMPORARY CAPTAIN I.M.S.,

AND

R. P. COCKIN, M.A., M.D.,
LONDON SCHOOL OF TROPICAL MEDICINE.

RAT-BITE FEVER—Sodoku of the Japanese—is a comparatively rare disease. It was recognized, quite a long time ago now, by Miyake and others in Japan as a definite entity. Cases have also been reported from East Africa (Middleton, Horder, Cruickshank), in the United States of America, in France, and in Italy (Frugoni). As far as we are aware, our case is the first reported from East Africa or the tropics proper. The finding of the causative agent is of recent date. In 1915 Futaki and his fellow workers demonstrated the presence of long spirochaetes in the lymph glands of cases on the tenth to thirteenth day of the illness. Later they discovered in man, in the wound of the rat-bite, and in the blood of inoculated mice short, thick spirochaetes, and at first were unable to determine which of these two was the cause of the disease. Recent observations have, however, shown that the long and short forms are the same species, the long ones being old and found almost exclusively in human tissues, while the short ones are the young forms, and can be found in the blood of patients with the disease and in experimental mice (Kaneko and Okuda). Futaki's work has been confirmed by Kaneko and Okuda,¹ and it seems quite clear that rat-bite fever is another spirochaetal disease. According to the authors last named, the parasite can be found in the blood during the height of the disease.

Hata, in a paper published in 1912,² refers to eight cases of rat-bite fever treated by salvarsan. The results were striking; all symptoms quickly disappeared, and most of the cases were cured. Two relapsed, but in them the dose had only been small—namely, 0.3 and 0.4 gram. Since then other cases treated in a similar manner have been reported upon, and the recent discovery that the malady is a spirochaetal one fits in well with the undoubted efficacy of salvarsan and its derivatives in curing it.

The following is the history of a case we have treated recently:

Mr. H., aged 25, on January 31st, 1917, when in East Africa, was bitten by a rat on the back of the right forearm. He was sleeping in a mosquito net, and the rat attacked him through this, inflicting a severe bite. This healed up and was practically gone when, some seven days later, pain commenced at the site and the place swelled up. Fever then appeared, and with this a rash broke out on the body. Later the glands in the right axilla enlarged, and following this a general adenitis was noticed. On the twelfth day, after onset of symptoms, the bite, which had now broken down, was lanced and some pus escaped. About the twentieth day severe joint and bone pains came on, and the throat also became inflamed and very sore. The condition improved, but quickly relapsed, and between that time and the present (January 31st, 1918)—namely, a year—patient can count nineteen relapses at varying intervals. There was a severe one in May, 1917. Complicating the real rat-bite symptoms, however, the patient had also suffered from malaria, and it is not certain which of the two infections was responsible for the different bouts of pyrexia. Malarial parasites were found in the blood in August, 1917, during an attack

Previous Illnesses.—Dysentery, much malaria (before the rat bite), never syphilis (he was very definite as to this), no history of tick fever, but here again the possibility of this disease is not excluded, as he has been in areas where it prevailed, and some of his friends had actually suffered from it; phlebotomus fever December, 1916.

First Examination.—The patient was seen first by one of us (G. C. L.) on September 25th, 1917, having been sent by Dr. A. M. Elliot for examination. He was then fairly well, and was only complaining of getting tired easily and of headaches. He looked a little sallow, was slightly anaemic, the spleen was palpable, and the glands in the right axilla and in the posterior triangles of the neck were definitely enlarged. The urine was normal, the blood showed no malarial parasites, but there was a definite large mononuclear increase. A diagnosis of rat-bite fever and malaria was made, and the patient was instructed to present himself immediately if any signs of a relapse appeared.

Second Examination.—On December 10th, 1917, he came again. On December 3rd he had an attack of fever in the middle of the day, for which he had to go to bed; the temperature rose to 104° F. This attack responded to aspirin and quinine, but he still complained of pain in the glands and in the back of the neck with more or less constant headache. The glands in the neck areas were big and very tender to palpation. They were also easily palpable in the other areas. Dusky coloured purplish-red eruption over trunk and neck and on the arm which had been bitten, its appearance being best described by the term blotchy. It was very typical of the eruption described in papers on this disease. Bones tender, no malarial parasites in the blood, no trypanosomes, no spirochaetes. Relapse of the rat-bite disease was diagnosed.

Treatment.—He could not begin treatment that day, but came to hospital on December 17th. The rash was then fading, but the glands were still tender and enlarged. We then decided that we should give him a course of novarsenobillon, and he had 0.4 gram that afternoon. He stood the injection quite well, and went home that evening. The second injection, 0.6 gram, was given on January 3rd, 1918. The eruption was gone, and the glands were very much smaller, being difficult to palpate. There had been no more fever, and the patient expressed himself as feeling much fitter. Bearing in mind the experience of Hata with relapses after one small dose, we thought it better to give a third and final injection on January 25th (0.9 gram). This produced chilliness and a slight rigor. A careful examination on that day did not reveal any more signs of the disease, the glands could not be felt, there was no trace of any eruption, no rise of temperature, and all the pain in the neck, together with the headache, had completely disappeared. On January 28th he expressed himself as feeling all right, with the exception of getting fairly easily tired and slight pain in his legs. In view of his malarial element, he was told to take 5 grains of quinine twice a day for the next three months.

As already stated, two or at the most three injections of salvarsan or its derivatives seem to cure rat-bite disease completely. The interest in this case lies in the double infection, which rendered the diagnosis more difficult. A Wassermann test was done before the treatment was begun. It was positive, as is usually the case in other spirochaetal diseases. Clinically, there never was any suspicion of syphilis, the history of the bite, the way the symptoms developed after it, the typical nature of the eruption, and the relapses all being characteristic of rat-bite disease.³ The same remarks apply to trypanosomiasis, which had to be considered in the differential diagnosis. In addition, no trypanosomes were found in the blood, and the eruption was not the same as is met with in that disease.

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HOME DISINFECTION IN PULMONARY TUBERCULOSIS.

By E. L. DOVE, M.B.,

RESEARCH WORKER IN THE HYGIENE DEPARTMENT OF
UNIVERSITY COLLEGE, LONDON.

The object of the following experiments was to indicate the simplest, cheapest, and most available means of countering the risks incurred when a sufferer from consumption shares living and sleeping rooms with others. It is doubtless the poor who run the greatest risk, more particularly because of their crowded circumstances and the greater difficulties they experience in adopting the necessary precautions; to them efficient chemical disinfectants are prohibitive in cost, and when distributed gratuitously by the local sanitary authority they are generally employed in a manner which gives but little security.

In the selection of measures to meet their needs regard must be had to the fact that, mainly owing to the increasing use of gas stoves, there is often no open fire (for at least many months of the year) for burning sputum, infected dust, paper handkerchiefs, etc. Therefore the advice here offered is based on the use of hot water, and the aim has been to define how this agent may be simply and effectively employed.

Floors.—Pieces of board were scrubbed and thoroughly disinfected and dried. They were then smeared with a thin layer of sputum containing tubercle bacilli. This was covered and allowed to dry, and on the following day one piece was scrubbed with hot water (as hot as could be borne) and yellow soap in the proportion usually employed in washing floors. This piece was then covered and allowed to dry, after which washings and scrapings of the infected surface into sterilized water were inoculated into guinea-pigs. Two out of three experiments gave negative results, the non-scrubbed board giving positive results in each case. The conditions of this experiment were those of very gross contamination, far in excess of what would occur in actual practice; and so it may be assumed that the process of good scrubbing with hot water and yellow soap will suffice in actual practice.

Experiments were made to ascertain whether soap in the proportion usually employed for scrubbing floors has any disinfectant value, since soap itself is practically sterile. The test organism employed was *Staphylococcus epidermidis* Welch, and the soapy water used was at a temperature (140° F.) well below the thermal death point of the organism. The results indicated that the soap had only a very slight effect, and that its only material value is the aid it renders in the collection and removal of dirt (with associated organisms) from infected surfaces.

Handkerchiefs, Pillow-slips, etc.—The ordinary staphylococcus of the skin (*S. epidermidis* Welch) obtained by rubbing a little broth on the skin of the hands and distributing a loopful of this over agar slopes was employed as a preliminary test organism. A pure culture was obtained on agar slopes, and it was found that the growths were killed by exposure for twenty minutes to a temperature of 75° C. in the form of moist heat; whereas the tubercle bacillus is destroyed at 70° C. in the same time. This staphylococcus is a more convenient germ to employ in preliminary experiments than the tubercle bacillus, the thermal death point of both organisms being about the same and the former germ being easy to cultivate.

Tuberculous sputum was sterilized by steaming for twenty minutes, and inoculated with growths of the staphylococcus. Sterilized strips of linen were soaked in this, then placed in cold sterilized water and gradually brought to the boiling point. Directly the water boiled the strips were removed and cultures made from the drops of fluid pressed out of them. In four sets of experiments there were no growths, while the control slips in every case furnished growths.

Boiling water was removed from the gas, and similarly inoculated strips of linen were immediately immersed and left for half an hour in the very hot water; they were then removed and efforts made to cultivate the germ. Again in four cases there were no growths on the strips so exposed, while all the control strips immersed in warm water furnished growths.

One pint of tap water was boiled and at once poured into a cold sterilized quart basin. Four strips of sterilized linen soaked in sterilized sputum which had subsequently been inoculated with the staphylococcus were immersed in the water and left there for fifteen minutes. The strips were then removed, and in no case was it possible to obtain growth from the water pressed out of the linen strip. The temperature to which the slips were exposed was at the commencement 90° to 92.5° C., and at the end 63° to 67° C. Control slips placed in warm water (50° to 60° C.) gave positive results.

Similar experiments were made with the basin filled with sterilized handkerchiefs and inoculated strips placed between them, the aim being to deal with as many handkerchiefs as practicable, provided they were just covered by a layer of water. After fifteen minutes the slips were removed and agar slopes inoculated with the water pressed from them. Controls in warm water gave positive results; but seven out of eight were negative from the slips exposed to a commencing temperature of 86° to 88° C., and an end temperature of 62° to 65° C.

For confirmatory purposes the last experiment was repeated with sputum considerably infected with tubercle bacilli. After twenty minutes the strips were removed and the material from them filtered and inoculated into guinea-pigs. In the control strips only warm water was employed. Two months after inoculation the three control guinea-pigs had enlarged caseating glands on the side of inoculation; both by *post mortem* and microscopical examination the infection was shown to be due to the tubercle bacillus. The nine guinea-pigs which had been inoculated from the strips exposed to nearly boiling water were healthy, except one, which had an enlarged femoral gland on the side of inoculation.

I desire to acknowledge my indebtedness to Professor H. R. Kenwood for valuable advice and assistance in connexion with the foregoing experimental work and the statement in which I have embodied it.