OBSERVATIONS ON THE PATHOLOGY OF
BARCOO ROT (VELD SORE?);

WITH SUGGESTIONS AS TO TREATMENT.

BY

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By the middle of the summer of 1916 a number of men of the Anzac Mounted Division, which had been operating in the desert east of the Suez Canal for upwards of six months, suffered from spreading superficial ulcers on the back of the hands, extensor surface of the forearms, and, to a less extent, on the back of the feet and on the shins. The ulceration resembles that met with amongst bushmen in the back-blocks of Australia, and is known locally as barcoo rot. It was recognized by the men as the same disease they had seen or experienced in Australia.

Superficial ulcers were also troublesome during the Boer war. They affected troops kept on trek on the high veld, and the disease was labelled "veld sore." A short description of veld sore and its pathology was given by Ogston (1901). Two years later Bishop Harman (1903-4) published a detailed study of veld sore, and I gather from his description that veld sore and barcoo rot are closely allied, if not identical diseases. According to Harman the disease affected Boers and British alike whilst campaigning, but natives were free from it. The Boers did not suffer whilst dwelling on their farms. Harman (loc. cit., pp. 8 and 9) is satisfied from the epidemiological data that the restricted range in diet during operations on the veld is an essential factor in bringing about the condition.

Dolbey (1901) concludes from his experience that troops were not liable to veld sore until they have been at least three months in the country. Life during the dry weather in the Australian back-blocks, and campaigning on the high veld or the Sinai desert present conditions which are not unlike. In all three cases water for washing is minimal; prolonged subsistence upon bread, biscuit, and salt or tinned meat, with lack of fresh vegetables, is the rule. Further, appropriate dressing of the sores in the early stages is difficult or impossible whilst the patient continues his occupation. Like veld sore, barcoo rot is difficult to cure in the above conditions, but readily yields to treatment when the patient comes into one of the towns. To what extent this is to be attributed to facilities for greater cleanliness, appropriate surgical dressing, or to dietetic improvements, is uncertain.

Brief Description of Barcoo Rot.

The patient may remember abrading the skin, but whether or not, the first sign is usually a bleb or blister containing thin watery pus and surrounded by an area of slightly inflamed skin. The blister may be the size of a sixpence, or even larger, but before it reaches this size it is generally broken. The denuded surface shows little tendency to heal, but slowly extends at its margins, at the same time deepening until there are no more epithelial structures left. The ulcer, however, remains shallow, and it is unusual for the fibrous layer of the skin to be destroyed unless it becomes infected with virulent staphylococci. The glands are not inflamed unless secondary infection occurs, and there are no constitutional symptoms.

When healing has occurred areas of glossy skin, more or less denuded of hairs and sweat glands, are left. Cicatrization does not occur unless the true skin is destroyed. Infection of fresh areas of skin in the neighbourhood is usual, so that the patient has several ulcers of different ages. The disease in its minor forms is extremely annoying and, when the ulcers have become large, incapacitating.

The symptoms and pathological findings have no resemblance to the slowly evolving leishmaniasis known under the names of *Bouton du Nil*, *Clou de Biskra*, *Bouton du Caire*, etc.

Observations on the Pathology of Barcoo Rot.

On a visit to an outlying field ambulance I was shown twenty men admitted for obstinate ulcers of considerable extent. The ulcers were shallow, mostly on the back of the hands and wrists—that is, in areas exposed to small injuries, and rich in hairs. The smooth surfaces were

free from ulcers, and the progress of an ulcer appeared to be inhibited as soon as it extended to a hairless portion of skin.

It seemed advisable to examine the state of the hair follicles, both within and around the ulcers, and I plucked a number both from the base of the ulcer and from the reddened slightly swollen skin at the margin; many of the hairs were loose. I wrapped the hairs in paper moistened with 70 per cent. glycerine for transport. On my return to the laboratory the hairs were stained by Gram's method and counterstained very slightly with weak fuchsin, dehydrated, and examined in clove oil or balsam. In all of the hairs withdrawn from the base of the ulcers, and in many from the inflamed margin, Gram-positive microbes were present in the hair sheath. They were mostly cocci, but in the hairs from three of the cases bacilli, which at the time I took to be diphtheroids, were also present. The infection extended usually to the lower end of the hair follicle.

Some of these cases were subsequently removed to No. 3 Australian General Hospital, Cairo, for observation and study. They were placed under the care of my comrade Captain Maclure, to whom I am much indebted for his kind co-operation.

Infection of the hair follicles was confirmed by microscopical examination of fresh material, and cultures from the bases of removed hairs and from the contents of early blebs were made upon blood agar and ordinary agar. *Staphylococcus albus* was the predominating organism, but some *S. citreus* and a few *S. aureus* were also present. In one case a diphtheroid was abundant. This proved to be *B. diphtheriae*,* but I did not discover this until some time afterwards. Diphtheroids are not uncommon in lesions of the skin, such as ulcers, vaccinia pustules, impetigo, and eczema,† and I regarded it as a chance concomitant of the staphylococcal infection, and did not investigate it further at the time. The case differed in no obvious way from the others, and there were no constitutional symptoms at the time.

The microbial infection of the hair follicles appeared to be confined to the connective tissue sheaths, except in very badly affected hairs, in which the base was disorganized and the layers of the root sheaths unrecognizable.

The pus from the early blisters before they were broken afforded only growths of staphylococci. I generally found there was a hair, often a very small one, passing through them, and the follicle of the hair was invariably infected with staphylococci.

The cocci cultivated were, as mentioned above, mostly varieties of *Staphylococcus albus*, with a few *S. aureus* and *S. citreus*. Their virulence is presumably low, for in uncomplicated cases there is no tendency to invade the true skin, and no involvement of the lymph glands occurs.

A few experiments were made upon the biochemical characters and pathogenicity of some of the cocci isolated. Six white staphylococci colonies, derived from four patients, were examined as to their action on milk and gelatine and their fermentation of lactose and mannite. They all clotted milk and liquefied gelatine with varying rapidity, and fermented lactose. None fermented mannite. They were not haemolytic for human blood as tested by Eijkmann's agar plate method. They appear, therefore, to correspond to Welch's *Staphylococcus epidermidis albus*, as defined by Gordon (1906).

The cultures of *Staphylococcus aureus* and two of *S. citreus* from hair follicles which were tested in the same way, fermented mannite. I could not make a number of experiments on animals, but two rabbits injected intravenously with 2 c.cm. of a broth culture of the white cocci and one with the same quantity of the broth culture from the *aureus* colonies were not made manifestly ill.

My observations on the bacteriology of barcoo rot are in general accord with those of Ogston (1901) and Harman (1904) upon veld sore. Ogston and Harman, however, make no mention of any infection of the hair follicles. Ogston saw only Gram-positive cocci in fluid from the edge of ulcers. Harman cultivated only staphylococci from the

* Fatal for guinea-pigs in doses of 0.5 c.cm. eighteen hours' broth culture in thirty hours; 0.1 c.cm. antitoxin protected against 2.5 c.cm.

† The records of the finding of diphtheroid bacilli in skin lesions are collected by Graham Smith in Chapter IX of his book in collaboration with Nuttall, *The Bacteriology of Diphtheria*, Cambridge University Press, 1903.

unbroken vesicles. These gave the cultural characters of *Staphylococcus pyogenes aureus*, but grew rather more abundantly on culture media than a virulent strain with which they were compared. They were not virulent for rabbits. Harman was much impressed by the resistance to heat, to the effects of drying, and to the action of corrosive sublimate possessed by his cultures, but this was not, I think, greater than has been met with in some strains of staphylococci.

The epidemiology of veld sore was carefully studied by Harman, but he could find no indication that the infection spread from one to another among the troops, and barcoo rot affects men living in solitude. Neither disease seems to be associated with particular occupations. It would seem probable that barcoo rot, and possibly veld sore too, is due to the infection of the epidermal structures with staphylococci of low virulence, such as abound upon the skin. In barcoo rot the infection of hair follicles is apparently the common way in which it begins, and the usual manner in which it spreads at the margin of the ulcer.

Harman's view of the pathology of veld sore I take to be that under ordinary nutritive conditions the skin cocci of low virulence are not able to "make good" against the local defences, but that in the case of men too long upon a restricted diet the defence is weakened, and they are able to infect the epidermal structures but not the true skin. He regards it, in fact, as a minor scorbutic manifestation. This may well be, but improper dressing and neglect of the sores also play an important part, for I have seen them heal up rapidly under appropriate dressings when no improvement in diet was possible. The fact recorded by Harman that the African natives did not suffer whereas the Boers did suggests, however, that lack of washing and of simple surgical dressing is alone an inadequate explanation.

Treatment of Barcoo Rot.

In hospital the ulcers generally heal up slowly under any sort of wet antiseptic dressing, but are very difficult to deal with in the field. A wet dressing is unhandy when a man has to go about his business and it is difficult or impossible to change it sufficiently frequently. Moreover, in a hot climate it soon becomes converted into a dry dressing and adheres to the ulcer.

Harman found that if the ulcers were thoroughly cleaned up, powdered with calomel and covered with cotton-wool, the last being affixed by strapping, good results followed. This method is satisfactory for small ulcers, but the cleaning up must be very efficiently performed.

In view of the observations on the pathology of barcoo rot described above, it seemed not unlikely that the infection of the hair follicles was largely responsible for the continuance of the ulcerative process in the centre, and its progress at the margins of the ulcer. An infected hair follicle is like a foreign body, and healing will not occur until it is either sterilized or ulcerated out. Acting upon this idea I removed the hair or hairs traversing the early blebs, and found that these healed straight away. The patients soon realized the efficacy of early removal of the hair follicles in suppressing these secondary infections, and undertook this part of the treatment themselves. Next, working on the principle employed to restrict a bush fire by burning an area in front of it, I attacked the larger ulcers, removing the hairs from their base and around their margins, and was pleased to find that the ulcerative process was stayed, and healing commenced at once.

The extensive ulcers in the floors of which no epithelial structures remain, naturally take a long time to heal, but this period Captain Maclure abbreviated by the transplantation of numerous snippets of skin from the abdomen.

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A SIMPLE DEVICE FOR THE GROWTH OF ANAEROBES ON PLATES.

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MUCH of the confusion that exists in the literature on anaerobes is due to the difficulty of growing these organisms in pure culture. In the case of most aerobic organisms a plating out process is a relatively simple operation, and but little trouble is experienced in getting pure cultures of any organism provided that the medium used be suitable for its growth. The anaerobes, on the other hand, exhibit symbiosis to an extraordinary degree, so that an apparently pure culture of one organism, which gives fixed and regular reactions through a series of sub-cultures, may yet prove in the end to be contaminated. The *B. enteritidis sporogenes* of Klein, for example, was ultimately found to consist of a non-motile sugar-splitting organism together with a motile proteoclast; and there are doubtless other instances of this confusion to be found in the literature on anaerobes.

All the anaerobes we have so far isolated from wounds belong to one or other of two main groups. They are either sugar fermenters or they are protein digesters, and it has been found possible by varying the constituents of a nutrient medium to encourage the development of one or other type of organisms. Thus a mixture containing *B. welchii*, when planted into a medium containing sugar fermentable by this organism, will yield a culture in which *B. welchii* preponderates, and in which the development of other organisms is at first held in abeyance. By a series of replants in such a sugar-containing medium at suitable intervals—a process, that is, of intensive culture—it becomes possible to get a relatively pure growth of *B. welchii*. This result, however, marks but the first stage in isolation, and the subsequent purification of the culture can be effected only by repeatedly picking off isolated colonies from the surface of some solid medium. Slopes in tubes are inconvenient for the purpose, and recourse must be had to plates.

There are two methods in general use for putting up anaerobic plate cultures. In the first the plates are placed in some air-tight receptacle from which oxygen is removed by absorption, by exhaustion, or by combustion with hydrogen. This method has its disadvantages in that the receptacle is as a rule bulky, and takes up much space in an incubator. It is, moreover, difficult to determine the progress of growth without opening up the whole apparatus.

The second method consists in the incubation of each culture plate separately, and the device which embraces this principle, and which is perhaps best known to British workers, is the capsule devised by McLeod. This consists of a glass plate of special design superimposed on a porcelain receptacle containing pyrogallic acid and soda. The apparatus is very efficient, but it has the disadvantage that the amount of available surface space is small, and also that it is not always easy to see the colonies against the white background of porcelain.

The device herein described is a cheap and practical application of the second principle so as to use the material that can be found in any laboratory. Drugs in powder are now exported to France in cardboard cylinders, which are provided with metal tops and bottoms. These can be found in any hospital dispensary. The metal top consists of a circular disc or lid, which when pushed down fits tightly into a supporting flange, the principle being one which is used extensively in trade for tins containing paints, enamels, glaxo, etc. The combination of supporting flange and lid (see diagram) presents a circular groove or trench on both its upper and lower aspects, and so forms a suitable coupling adjustment for the two halves of a Petri dish of suitable size.

The diagram represents the apparatus in cross section, A being the flange and B the lid. The upper surface of the lid B is painted with black enamel, and its centre is occupied by a central aperture, o.

Method of Use.

1. The grooves on both the upper and the lower surfaces of the flange and lid are filled with plasticine. One or two teaspoonfuls of pyrogallic acid in powder are placed in the lower