powder* is satisfactory and well tolerated. It is used exactly as the magnesium sulphate, or applied by means of an insufflator, twice a week. One word of warning is needed. In adults with good hearing and old-standing, minimal, inoffensive discharge, it is sometimes best to rely on regular cleansing and not to attempt to obtain healing, since this may be achieved only at the expense of auditory function.

To treatment on these lines the response is usually rapid and satisfactory. Failure may be due to unsuspected nasal infection or to some general condition, such as debility, diabetes, syphilis, etc. Granulations ("polypi") must be removed before treatment can be effective: they are due occasionally to syphilis, but nearly always indicate osteitis. If, in a chronic case, the discharge continues offensive or frankly purulent despite six weeks of careful treatment, the cause is practically certain to be osteitis, as a rule with cholesteatoma. The question of operation should then be seriously considered. The risk of a grave complication, though not negligible, may be slight, but an enormous amount of chronic ill-health is directly due to persistent mastoid infection.³ Almost invariably in these cases the acellular type of mastoid is found. On the other hand, one seldom has to operate for primary acute mastoiditis on persons (except infants) with acellular mastoids, probably because the aditus affords relatively good drainage for the small area beyond it. With material, old-standing deafness there is nearly always disease of the ossicles, and nothing short of the radical mastoid operation is effectual; but children show such great powers of recovery that the tympanum should be conserved unless manifestly seriously diseased.

In acute otitis media the need for operation may, of course, arise quite early, sometimes indeed before the onset of discharge. The general condition affords a better guide than local signs, pain, tenderness, or even oedema. Quite a number of "acute mastoids" recover completely without operation, though perhaps it is only after considerable experience that one can forecast the course of any given case. In influenzal otitis, when there is considerable deafness, the question of operation assumes early importance—I have seen irreparable damage to hearing within ten days of onset—but if four weeks from the start of any acute otitis the ear has not healed, or at least is not quite definitely healing, the decision as to operation must by no means be postponed. It is true that children often recover good hearing after many months of otorrhoea, but the proportion falls steadily month by month, and much more rapidly in adults. If the opposite ear is deaf there is an additional reason for urging early operation in the acute case. A week never passes but I see patients whose hearing has been sacrificed by a refusal promptly to recognize that meatal treatment is not in fact succeeding. The simple (Schwartz) mastoidectomy is a safe operation, and the functional results are extremely gratifying.¹ The ear is the organ of hearing, not a drainage tube for a diseased mastoid.

SUMMARY

1. Suppurative otitis media begins in early life, a large proportion during the first two years.
2. It is suggested that adenoids and teething catarrhs are symptoms of hypovitaminosis.
3. All wet meatal applications are condemned.
4. As long as discharge is free treatment should be careful removal of this, and application of powdered magnesium sulphate.

* Iodine one part, boric acid 100; rub together into a fine powder and keep well stoppered, as the iodine is volatile. Not to be used after mercurochrome.

5. When discharge is less persistent a powder of iodine 1 part and boric acid 100 is recommended.

6. The importance of early operation as a means of saving hearing is emphasized.

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SOME NOTES ON INDUSTRIAL ANTHRAX ITS DIAGNOSIS AND TREATMENT

BY

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Bradford and district have the unenviable reputation of being the chief centre of industrial anthrax in this country. It was here that the name of "wool-sorter's disease" was coined, and "*maladie de Bradford*" is the name still given in France to pulmonary anthrax. This relative frequency of the disease in the West Riding and the courtesy of colleagues have enabled me to see and take notes of 340 cases of cutaneous anthrax and of twenty-four cases of pulmonary and gastro-intestinal anthrax.

SOURCE AND MODE OF INFECTION

The source of infection can in some cases be ascertained with certainty, as when a butcher contracts cutaneous anthrax from slaughtering a beast subsequently found to have suffered from splenic fever, or when anthrax bacilli have been cultivated from a sample of yarn previously handled by the patient. On another occasion anthrax bacilli were grown from both warp and weft handled by a patient, from the remainder of the raw material from which warp and weft had been spun, from portions of the same raw material bought by firms in two distant towns, and finally from clippings of cardigan jackets which had been made from the same material before its infectivity had been discovered. At other times the source of infection is left in doubt, either because the patient had been in contact with more than one species of dangerous wool or hair, or because the material handled by him had already been worked up and had left the factory by the time the investigation could be conducted.

The mode of infection, on the other hand, is often left in doubt. There can be none when the patient has, for example, been able to trace infection to a prick from the pin of a preparing machine through which infected mohair was found to have passed, or when a farm-hand with chapped hands and wrists had been detailed to assist a butcher, and subsequently presented five separate pustules, all of the same age, on these parts. In most cases the mode of entry cannot be determined. I have examined bacteriologically the scrapings from under the nails of all the workpeople employed in a factory from which cases of anthrax frequently reached me, without success. A schoolboy died of an anthrax pustule in the cheek: he had played football during the dinner-hour with some lads clad in the overalls worn by them while handling East Indian wool. While an abrasion here probably afforded an entry to the virus, there was no evidence as to its mode of entry in the case of a lad who died of a malignant pustule after sleeping on some sacking

which had contained Persian wool. Pimples are often claimed to be the point of entry, but it is difficult to see how they could be unless they had been injured and blood had been drawn. In many cases there is no history of a lesion of the skin, and it is supposed that the infecting spores may be passed mechanically along hairs to their roots, and thus initiate the "pustule." The clothes of workers may convey the infection: three women contracted the disease washing their husbands' overalls; and a wool-sorter who had been away from his work because of a broken arm died of pulmonary anthrax after a street fight, in which he had received a "dusting."

CUTANEOUS ANTHRAX

Cutaneous anthrax is naturally seen with greatest frequency on exposed parts, and of these some are more easily infected than others, the occupation being sometimes the determining factor—as in that of tanners, in whom, as a result of their mode of carrying the hides, the neck is a frequent site of the pustule. It is, however, a curious fact that the skin of the fingers is rarely attacked. On the other hand, I have seen "malignant pustules" on the shin, on the thigh, and even on the abdominal wall and between a woman's breasts.

The appearance of cutaneous anthrax varies. Its most common form, the "malignant pustule," is often said to be a characteristic structure when fully developed. This is an error. Given a vaccine pock on an unusual site, such as the angle of the mouth, the eyelid, or the cheek, accompanied as it often is in these situations by much redness and swelling of the surrounding parts, then mere inspection will fail to find distinguishing features. A history may help, as the vaccine pock takes somewhat longer to attain maturity: even this may deceive. The presence of a recently vaccinated member of the household may give our thoughts the right direction. The following case was more difficult. A lad employed upon dangerous wool had a "pustule" on the side of the neck; there was no one in the house who had been vaccinated. On closer questioning I discovered that the boy was wearing the clothes which his elder brother had discarded after having been vaccinated on joining the Army some weeks before. Streptococcal and pneumococcal infection of the skin may also produce lesions indistinguishable clinically from anthrax; this is true not only of the rare erysipelatous variety of anthrax, but of the "malignant pustule" also. I have once seen the hay bacillus give rise to a similar lesion. In other words, the diagnosis of cutaneous anthrax is primarily a bacteriological one. If this be applicable to the diagnosis of the mature classical "pustule," it is doubly so to the aberrant forms. Instead of the coal-black central eschar surrounded by a ring of vesicles upon an angry, red, and brawny base, we may find the eschar only without any vesicles, or the vesicles may be set some distance from the former; in other cases—and these are not necessarily early ones—bullae may predominate, a relatively small eschar lying among them; or one or two bullae may alone be present. In a fatal case of cutaneous anthrax of the wrist a white oedema replaced the red inflammatory area, and on it was one large flaccid bulla containing blood-stained serum. In another fatal case a similar white oedema disfigured a girl's chin and neck, but there was no vesicle or bulla, only a tiny black eschar, the size of a pin's head, on the point of the chin. In some instances the redness and inflammatory oedema may be almost absent, while in others it may involve a whole limb, or, extending over face, neck, and chest, give these parts gigantic proportions. If, then, a bacteriological examination is necessary for the diagnosis even of the fully developed lesion, it is more than ever necessary if the disease is to be recognized in its early stages, when most amenable to

treatment. A spot not unlike a flea-bite in size, shape, and colour, crowned perhaps by a tiny vesicle or by a minute abrasion, may meet the disappointed view of the spectators of a demonstration; yet anthrax bacilli will have been found in the contents of the vesicle or in the serum obtained from the denuded area after gentle scraping with a scalpel. A further difficulty is introduced at times by the applications of homely remedies, such as cobbler's wax or poultices, which may profoundly alter the natural appearance of the lesion.

A few slides, a watery solution of methylene-blue, gentian-violet, or fuchsine, and a 1/6 inch objective are all that is needful. So rarely has the microscope failed us that it would be a mistake to postpone specific treatment until cultural confirmation shall have been obtained; but as anthrax is a disease to which the Workmen's Compensation Act applies such confirmation should always be sought. If the serum has to be sent to a distant laboratory it is best to dry some of it on threads, on slides, or on sterilized fragments of earthenware, and not to forward it in capillary tubes only, as the serum often possesses bactericidal properties. It is strange that relatively little constitutional disturbance may accompany extensive local changes, and this disproportion, though not characteristic of anthrax, is yet suggestive, especially in the erysipelatous variety, in which a "pustule" is absent.

ANTHRAX OF RESPIRATORY AND ALIMENTARY SYSTEMS

Thus, once the possibility of cutaneous anthrax occurs to the mind the diagnosis is generally easy—not so the diagnosis of anthrax of the respiratory system and of the alimentary tract. Of the latter I have seen only one case, in consultation with Dr. Marshall, late of Halifax, who had made the diagnosis by a microscopical examination of the blood-stained vomit. I have, however, seen two cases in which the stomach became infected secondarily, serum having trickled, from the nose in the one, and from the forehead in the other, into the mouth. The possibility of achlorhydria in these patients was unfortunately not considered. Three infections occurred in the upper respiratory tract—one affecting a nasal passage, a second the right tonsil, and the third the tissues between the epiglottis and the anterior pillar of the fauces: only the first case survived. The twenty-three pulmonary cases all ended fatally. In one the diagnosis was made reasonably early by use of the opsonic index, while in a second the disease was strongly suspected on clinical grounds. The diagnostic history of the remaining twenty-one cases was as follows: in four cases no medical advice was sought; in eight the patients were dying when advice was sought; in four suspicion was aroused only by sudden and unexpected death; in five no suspicion was aroused till collapse occurred. Though this shows how rarely an opportunity is given for considering the possibility of internal anthrax at an early stage, and how ambiguous and relatively innocent the initial symptoms may be, yet occasionally the constellation of the symptoms is so unusual as to call for special consideration, as when joint pains and precordial oppression, or joint pains and glandular enlargement, are complained of. It is conceivable that when suspicion has been aroused the estimation of the opsonic index, or the bacteriological examination of blood drawn from the affected lung, may confirm it. The examination of a pleural effusion will rarely benefit the patient, as these effusions are usually of late occurrence; nor will the examination of cerebro-spinal fluid when there is cerebral involvement. Recovery from internal anthrax is very rare. I find no record of such recovery in the clinical notes left by the late Dr. J. H. Bell, nor have I seen one. The late Dr. Wm. Mitchell of this city published notes of one alleged case of

recovery, but the diagnosis had not been confirmed bacteriologically.

The generalization of anthrax is largely embolic, as is shown by the distribution and structure of the secondary intestinal lesions, the emboli being derived from thrombosed veins in the area of the primary focus. It is very doubtful whether the bacilli multiply in the blood stream. Their presence in it is not necessarily a sign of impending death. I have on several occasions been able to cultivate them from the blood, and yet the patients recovered. A sign of ill omen is delirium. Consciousness to the last is a characteristic of anthrax. Often the patient feels the approach of death: "I am done for" is a common expression, but now and again this feeling is absent. "How do you feel?" a dying patient was asked, as he lay pulseless: "Oh, nicely, only a bit weak," he replied, turned on to his side, and died. On another occasion the anxious family doctor called upon his dying patient at 1 a.m., expecting to find the family about the bed. To his surprise the house was in darkness: all had gone to bed and were vexed—the patient included—at being disturbed "without reason"; the man died four hours later. Delirium almost always indicates involvement—haemorrhagic in nature—of the meninges; this pia-arachnoid haemorrhage is often so extensive as to cover the whole brain and even to extend to the coverings of the cord.

PROGNOSIS

The prognosis of anthrax, and especially of the cutaneous variety, depends largely on an early diagnosis. This is best ensured by the appointment in centres in which industrial anthrax is known to occur of a medical practitioner whose duty it shall be to examine every operative presenting suspicious symptoms. To this end the Factory Department of the Home Office has issued an illustrated monitory poster to be hung up in the factories and workshops. This plan has been adopted in Bradford, and its results are shown in the accompanying diagram,

The first of each group consists of patients first seen by specially appointed practitioners; the second of each group consists of patients first seen by other practitioners.

in which mild, moderately severe, and severe cases are arranged according to the day of the disease on which the diagnosis was made, and as to whether seen by a general practitioner or by the appointed examiner. The advantage of the system is obvious. The comparison thus made is a fair one, as all the patients were treated in the same institution and on the same principles.

TREATMENT

The treatment of cutaneous anthrax used to be excision whenever the site of the "pustule" permitted. We have now for many years discarded excision, reserving it for those cases in which the "pustule" is very small and on a site notoriously apt to favour rapid extension, such as the neck. Excision is still claimed by some to be the safer method, the accidental entry of bacilli into the operation wound being considered of no moment. It is true that successful infection depends upon the number of germs introduced into the tissues. That number may on occasion be so small as not to be dangerous, but the veins beneath the "pustule" are often extensively thrombosed, the thrombi crowded with bacilli, and I have seen disastrous results follow their section. With the abandonment of excision as a routine method of treatment our results have improved, the mortality of the last 200 cases of cutaneous anthrax being only 5 per cent. It is not possible to compare these results with those obtained by others: their figures are often too small, and prognosis depends so much upon factors not referred to in their statistics, such as the frequency with which certain sites have been affected, the stage in which treatment was begun, and the nature of the infecting material. It is obvious, for instance, that statistics which include many cases of pustules on the neck cannot be justly compared with those in which most of the lesions have occupied less dangerous sites. When excision is decided upon, the greatest possible care must be taken to avoid infection of the wound. A rise in temperature a day or two after the operation may indicate its occurrence; but fever is not a necessary accompaniment. At the Bradford Royal Infirmary excision has now been replaced in most cases by the injection of salvarsan and of anti-anthrax serum. Since 1911 it has been my practice whenever I have used salvarsan to give two moderately large doses, the size of the dose being relative to the sex, age, and constitution of the patient, generally with an interval of a day. It is rarely necessary to give more, and I have never deemed it desirable to give—as I have heard have been given elsewhere—daily injections of some magnitude for a whole week. With no other treatment but this I have seen fever subside rapidly, with a coincident general improvement; but we usually combine it with the older method of injecting, intravenously or subcutaneously, anti-anthrax serum.

First introduced in 1899 Sclavo's serum has been almost solely employed. The results attending its administration appear to us to have been so good that the use of other serums seemed scarcely justifiable. Only during the war, when Sclavo's serum was for a time unobtainable, did we employ Mulford's serum, with success in the few cases in which it was given. The initial dose of either serum has since 1908 been 80 c.cm., followed by 60 c.cm. on the following day. Sometimes the dose of 80 c.cm. was repeated, and injections up to a total of 300 c.cm. have been given with no ill effects other than the usual joint pains and urticarial eruptions. The relative values of these remedies are uncertain; salvarsan, however, offers the advantage of being easily obtainable. Whichever method of treatment is chosen, one condition must in every case be fulfilled: the part affected *must* be put at rest. The necessity of this was brought home to me many years ago by the relative mortality of patients with malignant pustules on the wrist and on the forearm: of eleven with pustules on the wrist seven died; and of a similar number with pustules on the forearm, none. The greater mobility of the former is the obvious explanation. If a limb is the site, it is carefully splinted, and if an arm, it is also supported on a pillow. If the head or neck is affected,

then sandbags are applied and the head is kept in position by a folded towel carried across the forehead and fixed beneath the sandbags.

The internal administration of sulphur has been advised ; with what justification based upon experience I know not. I have used chrom-argentum in one case, which ended in recovery ; it has been claimed that very severe cases have been cured by the sole administration of it

intravenously. In China (Hankow), I am told by Dr. E. F. Wills, certain leaves are credited with curative properties, and samples have reached me ; but as only two authenticated cases have, to my knowledge, been so treated—with recovery, it is true—I have not felt justified in applying the leaves to the exclusion of every other remedy—the only method by which their claim to utility can be vindicated.

AN IMPROVED PATTERN OF THE REVOLVING SPINAL BED

BY

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Three years ago I published an account of a special reversible spinal bed (*Journal*, January 11th, 1930). Since that time the value and utility of this appliance has been abundantly demonstrated by the experience of others as well as myself. But a difficulty in its use has also been experienced, and this has been overcome by the design of a new model.

The principle of the bed is to enclose the patient in a cage, which, supported on a bed-frame, could be revolved. When the patient is lying on his back the front of the cage can be removed, and when he has been turned over the back can be exposed by removing the back part of the cage. In the original model the cage was flat behind and in front—that is, it was shaped like a parallelogram in transverse section. The difficulties met with in the use of this pattern were twofold. First, it was necessary to pack the patient very tightly in the cage by a number of pillows, in order to prevent him from slipping sideways in the act of turning him over. Secondly, it was difficult to adapt the same cage for thin or stout patients, and this, too, could only be done by packing with pillows in the case of a small patient.

The new model illustrated here overcomes both these difficulties. The cage is oval or elliptical in transverse section. The patient lies in a trough, formed by a shaped mattress, in two halves, lying on the curved framework of the cage. This has another advantage, in addition to the firmer fixation, when being turned. It is that the patient's body is kept more

rigid when lying on his back in this trough than it was when he lay on a flat mattress: he cannot roll from side to side, and this prevention of rolling is certainly desirable in cases of spinal affections, whether tuberculous or traumatic. The front of the cage is also curved in transverse section, and this is more easily explained by reference to the illustration than by description. In the upper figure the cage is open, the front portion being thrown back and lying against the sides of the bed. In the lower figure the cage is shut, as it would be when the patient is about to be turned over. In this position the patient lies held quite snugly all round his

body and legs by the mattresses, and there is no need for any packing pillows. When he is being turned he is held just as securely when half-way round, on his side, as he is when lying on his face, or on his back, so that the turning can be done as slowly as desired. The oval shape of the frame makes it easy to adapt it to patients of different girth. The curved metal bars of the frame overlap for rather more than six inches, and can be locked in any one of six different positions, so that as this varying amount of overlap occurs behind as well as in front, the circumference of the oval frame can be varied by 12 inches. The arrangement of the bedpan may be made in one of two ways. There is a gap between the back mattresses opposite to the buttocks. This can be occupied by a round cushion or the bedpan, or, if the patient is incontinent, or if a nurse is not in constant attendance, the bedpan is placed outside the cage supported on a special metal arm, which can be swung into place or outwards as may be desired.

I have found this type of bed-frame of the utmost service for all kinds of serious spinal disease, and especially for those necessitating bone grafting or laminectomy. Then, too, fractures of the spine, with or without paraplegia, almost demand some such appliance. The back, the buttocks, and the skin require daily attention to prevent bed-sores, and it is almost impossible to move such a patient without great risk and great pain, unless