but the Schmitz bacillus again grew in a considerable number of colonies after plating out the stools.

The Schmitz bacillus was not found when some stools from the above cases were examined at a later date and when normal in character. No further cases of dysentery occurred amongst the troops in the same camp or hospital.

The blood serums of seven of the first series of patients taken nine and fifteen days after the onset of symptoms were tested for agglutinability of the Schmitz bacillus and the *B. pyocyaneus* isolated with negative results. Similar findings by the agglutination test on the Schmitz bacillus with the serums from cases at the hospital were obtained. Three strains isolated were submitted to the Michaelis acid test, but after two hours the result was negative in all tubes; after twenty-four hours' standing fine flocculi were obtained in tube No. 6.

It appears that these outbreaks were due to an intestinal intoxication dependent upon the proliferation and mild toxicity of the Schmitz bacillus, and that the pathological condition of the intestine present in more severe forms of bacillary dysentery did not develop. Intestinal disorder, often classed as physiological disturbance due to change of climate and of diet, is not infrequent amongst troops when they are transferred to a country and to conditions new to them, especially during summer months if that country be subtropical or tropical. But the clinical symptoms and signs observed differ from those seen in such a physiological state, and the direct microscopic and cultural results from stool examinations, which showed considerable numbers of the Schmitz bacillus during the time dysenteric stools were passed and none when the stools returned to normal, are such as lead me to accuse this micro-organism of playing some part in these outbreaks, if it be not the real causal agent. Moreover, I have not yet found the Schmitz bacillus in a stool from a patient without a history of dysentery, nor in normal stools.

The troops were allowed to eat raw fruit, and the water in the camp affected was at that period not chlorinated; in the adjoining camp it was. The sanitation officer did not trace the cause of the disease to these sources. The day preceding the second outbreak raw tomatoes had been bought and eaten by many of those who became ill. A similar clinical condition arose amongst troops in Malta after eating raw tomatoes in the summer of 1916.

The micro-organism above described has similar biological characters to the *B. ambiguus* described by Andrewes; his strains gave negative results when small or large doses of aerobic broth culture were injected into a rabbit's vein. Its morphological cultural and fermentative characters are similar to those described by Schmitz for his bacillus in an account of an outbreak of dysentery amongst Rumanian prisoners of war, but the symptoms it produced in man were much less severe, and it did not kill the rabbit as did the bacillus isolated by Schmitz.²

The extensive and valuable work of Captain Murray³ has shown that the bacilli described by Schmitz and Andrewes may be placed in one group, and it will be interesting to learn the comparative results with para-Shiga strains of Dudgeon and others from the Mediterranean littoral.

I beg to thank Lieut.-Colonel J. W. West, C.M.G., R.A.M.C., for permission to publish this article.

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ANAESTHETICS IN A BRITISH HOSPITAL WITH THE SERBIAN ARMY.

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THIS series of anaesthetics was commenced in August 1916, and continued until January, 1918. All the operations took place under canvas in the heart of a country with a subtropical climate. The nationality of the subjects treated was mainly Serbian. The Serbian soldiers were very fit and strong men between the ages of 18 and 50, most of whom had faced the hardship of war, not only during the present struggle, but in the previous Balkan campaigns, and practically all had led an outdoor life. The outstanding features from an anaesthetist's point of view

were their good physique, the sound state of their teeth and the absence of dentures; a large percentage did not smoke at all, and those that did were almost all cigarette smokers. A noticeable feature in the early stages was the fear of an anaesthetic. Special account had to be taken of endemic disease (malaria), and occasionally of the effects of dysentery and scurvy in their relation to cardiac complications.

In the first series many of the wounded were in a state of exhaustion on admission, owing to difficulties of transport. Where possible, these cases were allowed to rest for some hours before operation.

The methods of administration adopted were as follows:

1. Open administration of a mixture (ether 2 parts, chloroform 1 part), with and without previous administration of morphine.
2. McCardie's mitigated ether method with open E_2C_1 sequence (with and without previous administration of morphine and atropine).
3. Closed ether; sometimes with oxygen.
4. Nitrous oxide.
5. Nitrous oxide-ether sequence.
6. Nitrous oxide with oxygen (improvised).
7. Chloroform (Junker's bottle).
8. Combination of methods 1, 2, 3, and 6 with local anaesthesia.

Methods 1 and 2 were the most frequently employed; they were given in a series of cases, with and without previous alkaloidal administration, and the results were compared. The cases which had not had a previous injection of alkaloids were in general head cases and thoracic injuries. The administration of E_2C_1 mixture was sometimes preceded by $\frac{1}{2}$ to 1 drachm of chloroform given drop by drop on a Schimmelbusch frame covered with 12-ply gauze and a layer of lint (with a small hole the size of half a crown in the centre) over all. In this method the morphine when given was in doses of $\frac{1}{4}$ or $\frac{1}{2}$ grain one hour to one hour and a half before operation, as nearly as it could be gauged. At this stage no atropine was given.

The anaesthesia obtained was as a whole very satisfactory. Induction was rather slow (about six to eight minutes on the average), and in cases newly admitted from the trenches it was often accompanied by great excitement and struggling, whether morphine had been given or not. The maintenance of anaesthesia was as a rule even and regular; there was little vomiting, and no respiratory disturbance or salivation. It was noted that those patients who had morphine took a little less anaesthetic, and generally the induction was quieter and a little quicker. Signs of shock on the table were absent, except in a few cases where the operation had been prolonged and severe, or where haemorrhage had occurred. The period of recovery was quiescent.

1. E_2C_1 —Schimmelbusch, Frame.

The following summary shows the quantities of anaesthetic used:

- (a) With preliminary morphine: 333 operations; average length of operation 37.9 minutes; average quantity per operation 11.3 drachms; or, taking an operation of thirty minutes' duration, 8.7 drachms.
- (b) Without preliminary morphine: 231 operations; average length of operation 33.1 minutes; average quantity per operation 10.6 drachms; or, taking an operation of thirty minutes' duration, 9.6 drachms.

It will be noted that there is not a big difference in the quantities used in the two classes, the cause being chiefly absence of the ideal conditions for complete success with preliminary alkaloids, such as quietness of surroundings, subdued light, and smooth transport from ward tents to theatre. However, the other benefits were obtained. With regard to the quantities used as compared with open ether administration, the figures given by Silk¹ and others are 6 to 8 ounces an hour, or even 8 to 10 ounces an hour in Malta.

2. McCardie's Mitigated Ether.

In this procedure a Clover apparatus is used into which 1 oz. of ether, with half a drachm of chloroform, are placed in the container, and 21 minims of E_2C_1 mixture in the bag. The facepiece is closely and firmly applied; induction is commenced by rebreathing from the bag only for forty to sixty seconds, and followed by turning on the mitigated ether. Watch is kept for cyanosis, and if this appears (which is rare), one or two breaths of air are given. Induction was almost always easy, quiet, and rapid, taking four or five minutes. Anaesthesia with these quantities lasted from fourteen to twenty minutes, when, if the operation required it, open E_2C_1 followed.

Those cases which had a previous alkaloidal administration were given morphine gr. $\frac{1}{4}$ and atropine gr. $\frac{1}{16}$, half an hour before operation as nearly as possible.

The advantages gained from this method were confirmatory of those claimed by McCardie,² namely—

1. The respiratory irritation due to ether vapour by the closed method is much mitigated by the addition of a small quantity of chloroform.
2. The addition of chloroform in this amount distinctly saves the work of the heart and lungs in a long or severe operation.
3. The mixture is practically as safe as ether alone.
4. It is valuable as a routine method of inducing anaesthesia, being safe and rapid.
5. A few drops of E_2C_1 mixture are preferable to ethyl chloride as a preliminary to the administration of the mitigated ether.
6. For maintenance of anaesthesia E_2C_1 mixture by the open method is preferable to even mitigated ether, owing to the prevalence of respiratory irritability in soldiers.

The following summary shows the total quantities of anaesthetic used with and without previous alkaloids:

- (a) With alkaloids: 214 operations; average length of operation 30.1 minutes; average quantity used 13.2 drachms; or, for operation of 30 minutes, 13.12 drachms.
- (b) Without alkaloids: 100 operations; average length of operation 29.06 minutes; average quantity used 14.4 drachms; or, for operation of 30 minutes, 14.7 drachms (that is, including the original 1 ounce of ether and half a drachm of chloroform put into the Clover inhaler).

3. Closed Ether.

This was only used in 65 cases, 26 with previous alkaloidal treatment and 39 without.

- (a) With alkaloids: 26 operations; average length of operation 42.03 minutes; average quantity used 17.8 drachms; or, reduced down to an operation of 30 minutes, 12.6 drachms.
- (b) Without alkaloids: 39 operations; average length of operation 35.1 minutes; average quantity used 16.1 drachms; or, reduced down to an operation of 30 minutes, 13.6 drachms.

This method was adopted in several cases of a severe type, such as high amputations, and also in slight cases. In the first it was often accompanied by oxygen and occasionally warmed by placing a little hot water in the bag, as recommended by Beresford Kingsford.³ I abandoned it for general use on account of various well known disadvantages, such as respiratory discomfort, salivation (particularly prevalent in Serbs), and also the objection by some patients to a closed apparatus. The addition of oxygen helped materially in lessening the amount given, and easing induction.

4. Nitrous Oxide.

This was given frequently for minor operations in 111 cases, including some dental ones. The apparatus in use was of the simple ordinary variety, with an arrangement for rebreathing. It was found very efficient, especially if given by the rebreathing method with intervals of air breathing according to stage of narcosis, the aim always being to avoid any cyanosis. The use of a rubber dental prop, as Boyle suggests, is a great advantage; it aids induction and ensures easy ingress for the gas or air, especially if there is the slightest sign of nasal obstruction.

5. Nitrous Oxide-Ether Sequence.

This was adopted in some forty-five cases, and gave very satisfactory results. The type of case generally chosen was the minor or short operation, and in which there had been no antecedent alkaloidal preparation. Here again the rubber dental mouth prop is advantageous.

6. Nitrous Oxide with Oxygen.

This was employed only twice, in an improvised fashion, owing to the lack of any suitable apparatus, such as that recommended by Captain A. S. Wilson.⁴ Rough and ready as the method was, it proved of great value in two cases of amputation of the thigh, in which the patients were very weak from chronic sepsis. In both novocain was injected at the site of amputation, and in one $\frac{1}{4}$ grain of morphine was given one and a half hours before. The operations were performed quickly, there were no signs of shock, and recovery from anaesthesia was rapid and without any incident, such as vomiting.

7. Chloroform.

This was only used in operations on the face and lower jaw by means of a Junker's bottle. The proportion of these cases was not large, and no special difficulties were met with. The chloroform was introduced by means of a soft rubber catheter passed five inches down the nose.

8. Local Anaesthesia.

This was frequently used alone or in conjunction with a general anaesthetic in operations on the head and chest, and for amputations. It certainly aided in diminishing the amount of anaesthetic used, and in limiting shock or disturbance during section of nerve trunks. In thoracic operations the method is of great value.

GENERAL REMARKS.

By the use of alkaloids liability to shock on the table is decidedly diminished, and the amount of anaesthetic required is less. The period of recovery is of a more quiescent character. It is contraindicated in cranial cases, especially where mentality is impaired, and in the recently severely wounded who are already suffering from shock. Care should be taken when any heart muscle weakness exists or is suspected from such causes as malaria or chronic sepsis.

The choice of anaesthetic should be based on such considerations as the following:

1. Whether the wound is of a severe character and accompanied by shock.
2. The period of time that has elapsed since its infliction.
3. Whether haemorrhage has occurred or is likely to occur.
4. Whether an acute infection is present (notably gas infections) and the operation is likely to be of the nature of an amputation.

It is in the last named cases, that the greatest dangers are likely to be met, but these are considerably diminished if the patient can have some hours' rest in bed with the application of external warmth. In such cases the best results have been obtained with an induction by McCardie's method, or warmed ether, and oxygen.

In abdominal cases McCardie's method was used with advantage, followed by ordinary closed ether and oxygen, if necessary. The use of oxygen is insisted on, as it acts as a stimulant, improving the anaesthesia and diminishing the amount of anaesthetic used.

I am specially in agreement with Captain Geoffrey Marshall's⁵ remarks on the choice of gas and oxygen in wounds of the limbs requiring amputation, and the withholding of morphine. His recommendation of it for smaller operations as a routine method is very timely.

For the average type of case which has been in hospital a little time and for operations of expediency the best results have been obtained by McCardie's method, and, secondly, by the open administration of E_2C_1 mixture. These have the advantage of simplicity, ease, quietness of induction, and economy.

After-Results.

In some cases in which haemorrhage had occurred the use of E_2C_1 mixture was followed by collapse, which caused anxiety and necessitated the administration of intravenous saline.

Vomiting did not often occur during the course of operation, but chiefly when the patient was moved, in the application of dressings or transference to a stretcher. In the wards it occurred very seldom. There were no cases of delayed chloroform poisoning.

Chest complications were very few in number—more than four or five in all (two of bronchopneumonia of a mild type, and the rest bronchitis). All recovered.

There were no fatalities.

I have to thank the operating surgeons, Major G. P. Mills and Lieutenant John H. Watson, for their constant help and suggestions, and the other members of the unit with whom I was associated in the work.

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