used. It is only necessary to glance at the *Revista de Sanidad de Guerra* to see the cases reported there. For example, in an article by Dr. V. Goyames on transfusion of blood in two hospitals in Madrid, sixty-one transfusions were given for gas gangrene. In Madrid also there was a hospital devoted entirely to the treatment of this condition. I have information that gas gangrene was a frequent complication among the wounded of General Franco's army, and appeals were made to certain countries to send quantities of anti-gas-gangrene serum for treatment. And both the Republican Army and the Army of General Franco fought on the same soil and under the same climate. I maintain, therefore, that if in Catalonia gas gangrene disappeared, this was due to the technique which our surgeons employed.

Confirmation and Opinion of Foreign Surgeons

As is well known, at the end of the war in Catalonia a retreat from the country of nearly half a million persons took place. Among these refugees were over 10,000 wounded, nearly all with wounds of the extremities, who went to France. Numbers were evacuated in the army ambulances, but many thousands went across the frontier walking with plasters that covered and immobilized open fractures. Several hospitals were organized in France attended by surgeons of "La Santé Militaire Française," who did all they could to deal with this unprecedented influx of wounded. During the early days of the retreat the French doctors were amazed by the arrival of thousands of soldiers—many on foot—in bad general condition due to fatigue and hunger, with plasters smelling offensively, under which were extensive wounds. Many amputations of urgency were performed because the surgeons feared the development of gas gangrene.

A short time later reports were presented to medical societies in different parts of France on the observations made by these surgeons, who previously had little experience of the closed method of treating compound fractures. The general consensus of opinion was that the results were eminently satisfactory, serious infections being extremely rare.

Dr. M. Arnaud reported to the Academy of Surgery in Paris (May, 1939) the results he had seen in 800 wounded from Catalonia, the majority of whom had been treated by the closed method. He was surprised to see only one case of gas gangrene.

All the wounded who came to France during the evacuation of Catalonia arrived after many days of travelling from one place to another under the psychological and material conditions of an army in full defeat, which in every war always produce the greatest mortality. In spite of these bad conditions the testimony of these French military surgeons is proof of the value of this method.

I hope that this evidence will be sufficient to encourage my British colleagues, and I am sure that the result of treatment of compound fractures in the present war will be very different from that of the great war.

** The discussion of Dr. Trueta's paper is reported at page 1106 this week.

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ANAESTHESIA IN WAR TIME

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Although the anaesthetic problems peculiar to modern warfare remain unformulated, the basic principles of anaesthesia, whatever these problems may be, will remain unaltered. These principles are the maintenance of a clear airway, the recognition of the signs of anaesthesia, and the avoidance of an overdose of the anaesthetic drug. The problems will undoubtedly include (1) the supervision by the anaesthetist of several unconscious patients at the same time; (2) the anaesthetizing of shocked or exsanguinated patients, and of patients heavily morphinized; (3) the danger of fire and explosion if explosive gases (ether, vinesthene, or cyclopropane) are used; and, because of the physically depressed state of the patients and the lack of skilled anaesthetists, (4) the problem of applying restorative measures to patients *in extremis*.

Experience of the last war has suggested that air raids will result in casualties so numerous as to make their adequate treatment impossible. The medical practitioner with any surgical knowledge will be pressed into surgical duties, so that the few delegated to anaesthesia will be responsible for the supervision of more than one anaesthetized patient. In this task the anaesthetist will obviously be helped if he can call on intelligent though only partially trained assistants. To prepare for this a series of fifteen lectures on the basic principles of anaesthesia was given at Oxford at the outbreak of war. Among those who attended were dental practitioners (the B.D.A. was circularized locally and the response was encouraging), retired medical practitioners, and laboratory attendants experienced in anaesthesia in animals. A similar series of lectures could be arranged at any other large centre to ensure that in an emergency the anaesthetist could have the assistance of helpers with some knowledge of the care of the unconscious patient.

Choosing the Anaesthetic

Too much stress has been laid on the use of particular anaesthetic drugs for particular conditions. While it is undeniable that the specialist can attain refinements of anaesthesia with drugs such as cyclopropane and pentothal, this fact has overshadowed the truth that safe anaesthesia can be furnished by so-called old-fashioned means by comparatively inexperienced anaesthetists provided they apply a sound knowledge of the basic principles of anaesthesia. During the past few years there has been so much talk of new anaesthetic drugs and techniques that many doctors are hesitant about offering their services as anaesthetists in war time because they know nothing about "these new-fangled anaesthetics."

It cannot be emphasized too strongly to the occasional anaesthetist that safety in anaesthesia does not lie in attempting a multitude of techniques or in learning the actions of a wide range of drugs but in gaining experience in the use of one anaesthetic agent. The drug chosen is of minor importance provided it is administered skilfully. We know of hospitals in the United States in each of

which a different type of anaesthetic drug is used almost exclusively. In one hospital in New York City nothing but spinal anaesthesia is employed for general surgical operations, including thyroidectomy and mastectomy. In another hospital cyclopropane only is used, while a third favours nitrous oxide, and in a fourth practically nothing but ether is employed. The anaesthetists of these hospitals extol the merits of the particular drug they use, yet it is striking to find a negligible variation in the gravity or number of complications caused by the anaesthetic either during the operation or in the post-operative period. The reason is that each anaesthetist has mastered his own particular technique. An inexperienced anaesthetist would soon encounter difficulties and dangers if he attempted similar methods. The specialist anaesthetist should be competent to provide any form of anaesthesia required. The occasional anaesthetist is recommended to use what opportunity he has to master one drug only—and that drug should be ether.

Merits of Ether

Whichever of the many techniques or drugs an anaesthetist may favour he will change to ether if he encounters difficulties which prevent him providing satisfactory operating conditions. This drug, discovered almost a hundred years ago, has never lost its pride of place as the safest and most reliable of anaesthetics. A further tribute to the safety of ether is that in other countries ether is administered thousands of times annually by nurse anaesthetists. Although these nurses have had special training there is no other anaesthetic drug with which they could be allowed so much freedom. Often the method is somewhat crude, but because of the safety of ether it can seldom be said that the life of the patient is endangered.

Induction with ether, if enough time is allowed, need not be unpleasant. If it is rushed, however, the feelings experienced by the patient are disagreeable and provoke resistance. If a quick induction is required an intravenous injection of evipan may be given. The technique of continuous intravenous barbiturate anaesthesia requires special training, is fraught with certain difficulties and dangers, and is not to be recommended to the occasional anaesthetist. A "one-shot" injection of evipan, however, is a simple affair, quickly learnt, and of great value. For an adult 0.2 to 0.5 gramme, according to the anaesthetic resistance of the patient, provides a pleasant and quick method of producing unconsciousness deep enough to allow ether anaesthesia to be superimposed. As soon as the injection is finished the administration of ether is begun, and it is continued as rapidly as the patient will tolerate it. Because of its rapid excretion the effect of the small dose of evipan is very transient. After a few minutes the depth of unconsciousness is attributable for all practical purposes to the ether used. Alternative drugs to ensure a rapid induction are vinesthene and ethyl chloride. Provided the practitioner is familiar with the use of chloroform a mixture of chloroform and ether may be employed. Whatever drug is chosen for induction a change is made to ether immediately respiration becomes automatic. Whether ether is given by Clover's inhaler, the "open" method or by bubbling air, oxygen, or gas-and-oxygen over or through ether matters little.

From personal experience (R. R. M.) in the hospitals in Spain during the Spanish War we learnt the difficulties of anaesthetizing unprepared patients, particularly since no nitrous oxide, oxygen, or in fact any anaesthetic material beyond a bottle of ether was available. These difficulties were emphasized in operations on the head and neck. Since atropine was not obtainable we were greatly

handicapped by the secretion of a large amount of mucus. Atropine should be given before every operation in which ether is to be administered. If given subcutaneously it takes ten to fifteen minutes to act. Given intravenously it becomes effective almost at once. The only anaesthetic apparatus available was an outfit consisting of a laryngoscope and endotracheal tubes which we had taken with us.

The Endotracheal Tube

By passing an endotracheal tube and attaching it to an ordinary tin (such as a container for motor oil) in the top of which two or three small holes had been bored, a simple apparatus (Fig. 1) was made which enabled us to

FIG. 1.

fulfil the essentials of anaesthesia for the repair of wounds around the head and neck region—that is, the maintenance of safe anaesthesia without encroaching on the part being operated upon. An almost identical technique was originally suggested by Flagg.

If the anaesthetist has time to spare, let him devote it not to learning how to administer different anaesthetic agents but to learning how to pass an endotracheal tube. The ability to do this will increase his sphere of utility enormously. Early experience should be gained in the

FIG. 2.—Position for laryngoscopy.

post-mortem room. Later by passing a laryngoscope at the completion of any operation he can familiarize himself with the view of the larynx in the living. Exposure of the cords is facilitated by an adequate depth of anaesthesia, the preliminary spraying of the throat and larynx with cocaine, and the introduction of a support under the head in such a way as to flex the neck and extend the head (Fig. 2).

The importance of the maintenance of a free airway cannot be over-estimated. Once unconsciousness is

reached this duty devolves on the anaesthetist. A free airway can generally be maintained by pressing the angle of the jaw forward so as to lift the tongue out of the laryngeal entrance, but once anaesthesia is deep enough the introduction of a metal airway (Waters's or Connell's) will do much to ensure safety and to lessen the work of the anaesthetist. Hospitals are advised to have a plentiful supply of airways. Other essential equipment includes Mason's gags and tongue forceps. Emergency substitutes for the latter are towel clips or large safety-pins. Since any patient who has to be anaesthetized for an emergency operation may have a full stomach the incidence of vomiting during anaesthesia will be increased. Swab-holders for sponging out the throat should therefore be at hand.

The Shocked Patient

It is essential to recognize that the shocked, exsanguinated, or heavily morphinized patient is already well on the way towards anaesthesia. Such depressed patients *could*, if necessary, be anaesthetized safely by the specialist with any type of anaesthetic—cyclopropane, evipan, ether, nitrous oxide, etc. He recognizes that the required depth of anaesthesia is achieved, in a patient depressed by any means, by a much smaller dose of the anaesthetic drug than would be needed for the same patient in normal health. Here again the occasional anaesthetist is safer with ether. If an overdose of this anaesthetic is given it is probable that removal of the mask and immediate institution of artificial respiration will result in prompt recovery. There is not the same safety margin with any other anaesthetic agent. If a patient has been heavily morphinized little anaesthetic will be needed subsequently, since morphine itself, if given in sufficiently large dosage, will provide full anaesthesia. The fact that major operations such as appendicectomy or hysterectomy have been performed under morphine alone emphasizes the part it plays in diminishing the subsequent amount of anaesthetic needed to produce the desired stage of unconsciousness.

Treatment of Respiratory Failure

Respiratory failure is an emergency which will often have to be faced in war-time anaesthesia. By shock or exsanguination or heavy morphinization the respiratory centre is depressed, and further depression from an overdose of an anaesthetic or deprivation of oxygen will easily result in respiratory failure. If each patient cannot have the undivided attention of a skilled anaesthetist the incidence of this emergency will necessarily be increased. The anaesthetist here must use his hands and not rely on drugs. He must remove the anaesthetic mask, confirm that the airway is clear, and supply oxygen. CO_2 plays no part in the treatment of patients suffering from respiratory failure. The Oxford inflator is the simplest and most effective way of inflating the patient's lungs with oxygen. If this small piece of apparatus is not available some other method of artificial respiration must be instituted without delay.

Chloroform

Although we subscribe to the view that the use of chloroform is rarely justified in peace time we are not satisfied that it will not have a place in war-time surgery. Since it is non-inflammable and portable, and its vapour is comparatively non-irritating, it will inevitably be used by many who would diligently avoid it in hospital practice in peace time. There are four well-recognized causes of death from chloroform.

1. Writers during the last century describe sudden death from psychological causes during induction or early in

operation. Half the deaths from chloroform have occurred within fifteen minutes of the start of induction, and these sudden deaths have rightly instilled fear into the anaesthetist. Adrenaline can produce ventricular fibrillation in man and animals. Chloroform sensitizes the organism to adrenaline, so that a smaller dose will produce this result. There is now a strong clinical impression that suppressed fear of anaesthesia or operation leads to liberation of the patient's own adrenaline into his blood stream in quantities sufficient, if the patient is susceptible, to produce ventricular fibrillation in a heart sensitized by chloroform. Deaths from this cause will occur independently of the skill and experience of the anaesthetist. These sudden deaths occur notoriously in the fit nervous patient who is dreading operation. Since it can reasonably be suggested that the patient from the battlefield or air raid who is shocked and exhausted will suffer not from excess but from depletion of adrenaline, it is possible that death from ventricular fibrillation is unlikely to occur during chloroform anaesthesia in war casualties. In this connexion it should be remembered that fear immediately before operation can now be overcome by the use of basal anaesthetics, of which avertin, nembutal, and evipan are familiar examples. Basal anaesthesia should therefore protect the patient against this cause of sudden death.

2. Death may occur from the direct action of strong chloroform vapour (above 4 per cent.) on the cardiac musculature of susceptible patients. The danger from too strong a vapour can be avoided by the use of appropriate apparatus or by taking care not to pour too much chloroform on to the mask.

3. There may be death from paralysis of the respiratory centre by overdosage. This is heralded by increasing depression of respiration, and can be avoided by paying attention to respiratory signs. Should it occur artificial respiration must be instituted at once.

4. Death may also arise from delayed chloroform poisoning. This grave complication is more likely to happen in exhausted patients, in those depleted of tissue fluids, and in those who have been deprived of food for some time. The danger is intensified with increasing debility of the patient and with the amount of chloroform given.

Vinesthene

Vinesthene is becoming increasingly popular as an anaesthetic for the trivial operations of general practice. Although this drug has been found unreliable in producing the deep muscular relaxation often required for abdominal surgery, it has a sphere of usefulness in extra-abdominal surgery which may be of particular value in war casualties. Its advantages include portability, quick induction and recovery, and comparative freedom from after-effects. The excessive salivation which may result from its use can be prevented by atropine.

An invitation from the Queen of Italy has been conveyed to Viscount Dawson of Penn by the British Ambassador in Rome for the visit to Italy of a doctor from Great Britain for the purpose of studying a method of treating encephalitis lethargica which has been discovered by a distinguished Italian scientist, Signor Giuseppe Panegrossi. The method of treatment in question is known to some extent in this country, and is in fact being used at the Northern Hospital (London County Council), where an encephalitis unit is situated. Lord Dawson suggested that Dr. G. A. Borthwick, the medical superintendent of that hospital, should accept the invitation, and the London County Council has given Dr. Borthwick the necessary leave with pay.