

III. You are asked to irrigate an eye, but you have no undine.

A. Which of the following would you use?

- a. A small tea-pot.
- b. A jug.
- c. A spoon.
- d. A feeding cup.
- e. A douche can with rubber tubing attached.
- f. A kettle.

B. Which of the following procedures would you adopt?

- a. Pour the lotion from a height in order to give the eye, which is very inflamed, a good wash out.
- b. Put the spout close to the eye and let the lotion run gently.
- c. Use a cotton-wool swab in place of the undine.
- d. Allow the lotion to run from the outer corner of the eye towards the nose.
- e. Use the lotion at 88° F., 110° F., 70° F., cold.

CHEMICAL WARFARE

By Miss HIGGINS, Lady Reading Hospital, Peshawar

List of Gases

Group 1: Tear gases, or lachrymators:

- (a) Ethyl-iodo acetate. Smells of pear drops.
- (b) Chlor-aceto-phenone. Smells of Ronuk.

Group 2: Sneezing gases or stermutators:

Di-phenol chloraisine. Sensory irritant.

Group 3: Lung irritants, or choking gases:

- (a) Chlorine. This is now out of date as it is too obvious by its smell.
- (b) Phosgene. Smells of rotten tobacco, much used in commerce.
- (c) Chloro-picric. More persistent than the other two, but evaporates very quickly.

Group 4: Blistering gases, or vesicant gases.

- (a) Mustard Gas. This is the greatest casualty producer, and is the one certain to be used again if chemical warfare is employed. Smells of garlic, onions, etc.
- (b) Lewisite. Named after an American, Professor Lewis. It is distinguished by a strong smell of geraniums; tingles and irritates the skin. The lesions are more easily prevented than treated. It is an arsenic compound with possibilities of arsenic poisoning.

Classification of Gases

Each group may contain many members which differ from each other chemically, but the members of each group have a similar action on the body, and produce similar first-aid problems.

The substances to be studied may be classified as belonging to the following groups: (1) Tear Gas. (2) Nose Irritant Gas.

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(3) Lung Irritant Gas. (4) Blister Gas. The term Gas is retained because it is convenient and has become sanctioned by use, but it is not an accurate description. Some are actually gases, some are liquids, and some are solids. The one thing they all have in common is that they are more or less *dangerous*, and *poisonous*.

One more group is found: poisonous substances met with in war but not actually used as offensive agents.

Tear Gases

Tear gas, as its name implies, acts upon the eyes. It produces great pain, profuse outpouring of tears, and spasm of the lids. The result may be serious interference with vision, even complete inability to see. (Inability to see does not necessarily mean blindness.) But the effect is normally only of a temporary nature. The members of this group do so little damage either to the eye or to the sight, that the question must arise as to whether first-aid is really necessary.

Treatment. Protection of the eyes from the poison, either by removal to fresh air, or by donning a respirator, plus simple washing of the eyes with warm water or some mild solution such as normal saline, is all that is required. The effect will disappear in a very short time. A few drops of chloroform on gauze or linen lessens the severity of the symptoms, but when many are affected it is doubtful if this could be done in war conditions. Above all, individuals affected by tear gas are easily frightened, so, presuming we have first-aiders at hand, keep their fears allayed. The first-aider and trained nurse with coolness and courage based on a thorough understanding of the situation, are of very great value, not only to the individual because it will quieten his fear of permanent injury, but also to the community.

Nose Irritants or Sneezing Gases

Symptoms produced are pain of rather sharp burning character in forehead, nose, face, teeth, gums, throat, and the upper part of the chest, and possibly also attacks of sneezing and coughing. Nausea or even vomiting sometimes accompanies these symptoms.

A special feature of this group is mental depression. A special watch must be kept for this symptom, and it must be accompanied by a firm though kind attitude of cheerfulness. In spite of the distress which must obviously be the result of so widespread an effect, little or no serious damage results. First-aid treatment consists in attempting to lessen the pain and discomfort. Nasal douching with warm weak Sodii Bicarb., 10 grs. to one pint, is sometimes helpful. Copious draughts of the same solution will help to relieve the vomiting, if present.

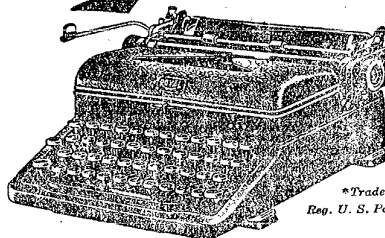
This gas associated with tear gas is easily recognised by the the early symptoms the patient develops.

There is a very definite tendency for the symptoms to continue getting worse for some time after removal from the poisonous atmosphere. This is important to remember. It is also alarming to the individual. The symptoms may get worse after donning

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the respirator, and the confidence of the wearer may be severely shaken. He may think his respirator is leaking; he may even discard it, thus exposing himself to other and more deadly gases which may be present at the same time.

Lung Irritants or Pulmonary Gases

These are the most serious from the point of view of life, and produce the most serious casualties and the highest death rate.

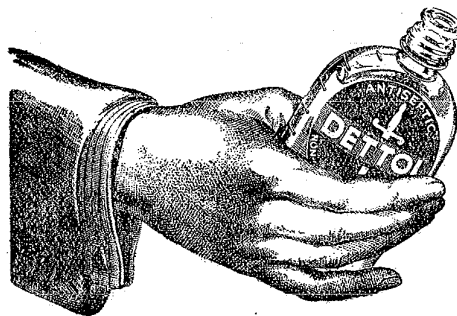
The first-aid treatment rests on a physiological basis. The materials act on the lung tissue and have only a relatively unimportant effect on the bronchi, trachea, and throat. The breathing apparatus consists of the air passages, and the air cells or alveoli. Breathing only as far as the alveolus is not really breathing at all; it is merely a pumping action to draw air in and out. True respiration occurs in the alveoli, and it is these that are affected. The bronchiole ends in an alveolar sac lined with mucous membrane. Around the mucous membrane are the blood vessels of the pulmonary circulation. In the alveolus oxygen passes from the blood into the air through the mucous membrane, so that the body takes in oxygen and gets rid of carbon dioxide. If carbon dioxide is in excess in the blood, it stimulates the respiratory centre, causing panting, bluish tinge in the blood, and increased force and frequency of the heart beat. If the oxygen supply is diminished, it causes the opposite results: there is a tendency to collapse, the patient is pale, breathing is depressed, and the heart action is rapid and feeble.

When the lungs are affected by gas, three things happen:

1. The mucous membrane swells.
2. Fluid is poured out by the mucous membrane, a protective mechanism to wash away the irritant.
3. Fluid is poured out of the blood vessels, and collects between the blood vessels and the mucous membrane, causing oedema of the lungs.

These all help to form a barrier between the blood and the air which interferes with the outflow of carbon dioxide and the intake of oxygen. One of the most serious things that can happen to the body is the cutting off of the oxygen supply. The body cells depend on a regular supply of oxygen for life, and at once begin to die if it is cut off. These cases suffer from a lack of oxygen which may prove fatal, also carbon dioxide is dammed up in the body by the barrier. Both these factors will be present and one or other will predominate: which factor is the greater in any case will depend on the concentration of the gas, and on the first-aid treatment. The lack of oxygen is the more important.

Treatment. Rest. On the degree of rest provided may depend the patient's chance of life, and, in slight cases, the chance that the condition will not become serious. Rest is important because these people are suffering from lack of oxygen. During sleep, oxygen consumption is always going on in maintaining the action of the heart and of the muscles of respiration. Any form of exercise calls for increased consumption of oxygen. In treating these patients



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the object is to keep the consumption of oxygen as low as possible. Complete rest includes:

Mental rest.

Physiological rest. Warm nourishing fluids, no alcohol.

Physical rest. "Stretcher case" as in military term (*i.e.*, the patient must not walk but be carried).

Treatment of lung irritants: (1) Administration of oxygen. (2) Venesection. (3) Intravenous infusion.

1. *Administration of oxygen* may be carried out by tube and funnel. The objections are: (a) The amount administered cannot be checked accurately, and wastage is an important matter from the point of view of distribution and supply in wartime. Oxygen is always available in the country, as it is much used in commerce at the present day, but in time of war it becomes a matter of extreme importance to be sure that the available supply is not wasted. (b) There is no way of attaching the funnel to the patient, and as the majority are restless and there may be no individual attention available that fact may result in 100% loss of gas, through the patient moving his face. (c) There is unavoidable 50% loss of oxygen as the gas is flowing continuously, and no gas can enter the patient's lungs during expiration.

By nasal catheter. This is better than the tube and funnel method as there is no gap, because the oxygen passes down the air passages directly; there is no possibility of the patient moving away as the apparatus is attached to him. Objections to the nasal catheter: (a) there is still 50% loss of the oxygen as it is flowing during expiration; (b) there is no record of the amount given.

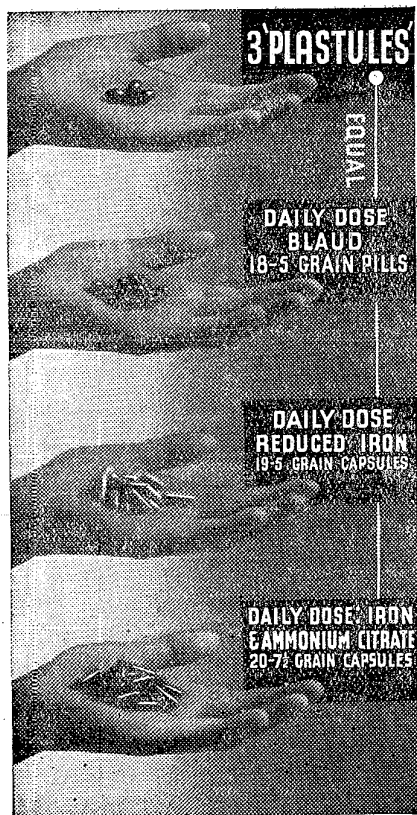
By Haldane's Oxygen Gas Apparatus. This method is recommended for adoption if obtainable. The mask, so constructed that there is *no waste*, fits over the patient's face, and has an indicator which shows the rate of flow. This is generally set at 3 (meaning 3 litres of oxygen given per minute). If necessary the flow may be increased. The advantages of this apparatus are: (a) it shows the amount of oxygen in the cylinder; (b) it shows the rate of flow; (c) no oxygen is lost during expiration, the air escaping by a special valve.

Oxygen given subcutaneously is not any use. It is too slow in its effects.

The cases will divide themselves into two classes: (1) Purple or Blue; (2) Grey. If the patient has great difficulty in getting rid of the carbon dioxide he will come under the "blue" class; he will be restless, excited, with panting respirations, full bounding pulse, and all the appearance of being dramatically ill. If the patient is suffering from lack of oxygen he belongs to the "grey" class; he will be collapsed, comatose, with shallow sighing respiration, rapid feeble pulse. Cases divide themselves fairly definitely into one of these classes. It must be remembered that the extreme "blue" case is less seriously ill than the "grey" case, for it is much worse to be short of oxygen than to have excess of carbon dioxide. Both classes need oxygen to restore the balance, for in



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both cases there is lack of oxygen. Both remain in their own classes, and do not under treatment pass from one type to the other. Oxygen is administered for 25 minutes, and discontinued for 5, and this is repeated until the patient shows improvement or dies within 48 hours. An accurate record must be kept of the times of giving oxygen, the patient's colour, pulse and general condition. The patients will probably be troubled by vomiting and by coughing up fluid from the oedema of the lung. They will be restless and appear delirious. They have to be fed and generally nursed, and it may be a very difficult task, but as far as possible the nursing aims at not interfering with the oxygen administration.

2. *Venesection* is done in "blue" cases where the heart is being overworked, up to half a pint of blood being removed.

3. *Intravenous infusion* is adopted where it is suspected that oedema is so intense that the blood has become concentrated and thick as in cholera. In such cases the blood is not concerned with itself primarily but with the body cells and has drained itself to give them fluid, as in advanced cholera, so that the blood is of a tarry consistency, which gives the heart very hard work in forcing this sticky fluid round the body. Thus intravenous infusion of either normal saline or gum acacia solution is very helpful.

So there are three forms of treatment: oxygen always; sometimes venesection; sometimes intravenous infusion. The rest of the treatment and nursing is not specific and is just as for serious lung diseases.

Blistering Gases

These so-called gases are not gases, but liquids which steadily and slowly give off *poison vapour*, causing chemical burns, culminating in blistering and ulcers in any portion of the living body, inside or out, with which they come into contact.

These substances are very poisonous and very persistent, remaining active for days and even weeks. They penetrate most materials, metal, glass and good tiles being exceptions. A material to make overalls to protect the body has been made which keeps them out for four hours, otherwise they soak into all clothes and tissues with which they come into contact. Blistering gas is very difficult to detect; it can be seen when in large enough quantities to make an oily stain. It is said to smell like mustard, that is, it causes a tingling sensation in the nose. (Four to twelve hours may elapse before lesions begin to develop.) Blistering gases produce: (a) erythema (skin has bright red appearance, like a blush); (b) blisters; (c) ulcers.

Widespread erythema will be found around the eyes, or where the skin is moist, e.g., the armpits. It is very trying, as it is accompanied by intense irritation which is increased by warmth, and interferes with sleep.

Treatment of lesions.

1. *Erythema*. To allay the irritation the following may be tried, but it is very difficult to relieve. Evaporating lotion, dusting powders, permanganate solution, oxidising solutions of all kinds.

2. *Blisters*. The skin should not be removed, as the part is very sensitive, but care taken that the fluid does not lie on

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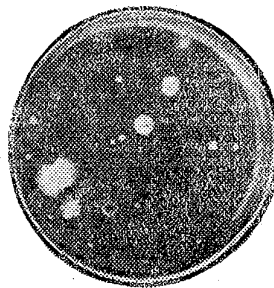
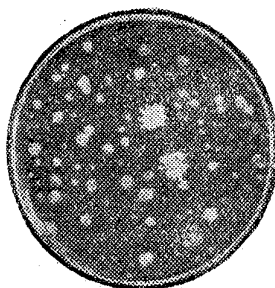
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the surrounding area. A dry dressing is then applied. Pain is non-existent, but the part is very tender.

3. *Ulcers.* No specific form of treatment has been found. It is a chemical burn of the first degree. There is less shock but more tenderness than a dermal burn, and it is on a deep-seated damaged area. The burn is treated as a dermal burn, using either tannic acid, picric, etc. These lesions take a long time to heal and very often become septic, but as the damaged area has a depleted blood supply the poison does not get rapidly into the system. There is therefore very little toxæmia of any kind. Tannafax, and compresses of tea, are suitable dressings. (Greases, ointments, oils, and flour should have no place in the first-aid or after-treatment of burns and scalds.) The majority of these cases recover, although slowly. The greatest difficulty is to combat mental apathy; the patient gets so tired and morbid that he does not want to get well. A simple treatment, universally obtainable, and one which can be used by the individual, is a complete wash with soap and water, which is therefore the best prevention. The eyes, being the most vulnerable of all parts of the body, require immediate irrigation with saline; the external parts should be washed with soap and water. The patient on arrival should be treated as an infectious case, as neither he nor anyone knows whether he has been contaminated by mustard gas or ulcers. The patient is stripped by a person dressed in specially prepared material. The clothes when removed from the patient should be put in the open air. After removal of the clothes the patient should be wrapped in a sheet. His eyes are then bathed. He is sent to bathe, with instructions to wash and scrub thoroughly, so as to remove any contamination. A shower bath is best, but an ordinary bath will do. After the bath he is given a towel,—*not before*, or he will infect it. He is then given clean clothing and treated as a suspect.

Protection. The Army respirator affords complete protection for the respiratory tract if it is put on in time. For mustard gas, special protective clothing made of Wigan cloth, similar to oilskin, is worn. It is a complete suit covering the whole body. Gum boots are worn on the feet, and a mask on the face.

If the eyes are affected, the sight may be permanently affected by the burning of the cornea. Photophobia (intolerance of light) and pain are present. Frequent lavage, atropin, yellow oxide of mercury ointment, and protection from the light are essential. Further treatment is castor oil; and apply flaps smeared with vaseline or castor oil. Ice flaps may be used.

Treatment. If the vapour has been inhaled, the patient may have a hard metallic cough, due to burning of the larynx. He may acquire a serious and even fatal lung condition, if the gas gets to the lung in sufficient strength; there is nothing efficient in the way of treatment. If the vapour is swallowed, inflammation of the lining of the stomach ensues, and acute gastritis. As far as treatment proper is concerned there is nothing very specific to differentiate these burns from any others.