

**Properties of poisonous gases that could be used for a gas attack.** These include:

- Chlorine gas (choking gas) - bleach odor, yellow-green color. Also phosgene and diphosgene are choking gases.
- Sulphur Mustard (SM) Mustard gas (vesicant or blister gas) - toxic, colorless, can smell of mustard/garlic/onions or have no smell.
- Nerve gases - Sarin, Tabun, Soman - odorless, colorless, and tasteless. The poisons enter through the skin, inhalation and ingestion, and death is very fast.

Since sarin was removed in 2013 following a UN resolution that aimed to avoid a US-led attack on the Syrian regime, there have been 126 cases of gas being used in Syria, and 125 of them were chlorine used by the regime. Chlorine should be an expected weapon of use in the future. Mustard gas already being used and will continue to be used. It's been used in Syria, fired from 8km away from ISIS, as well as against the Kurds at the end of August, carried in artillery shells.

**CHLORINE:**

Same precautions to be taken as with mustard gas, although the following needs to be noted:

**A yellow-green gas floating around with the strong smell of bleach.** Described it as pepper and pineapple. If you are exposed to chlorine gas, you may have trouble breathing or seeing and will feel a burning sensation.

Water mixed with Chlorine gas can turn into Hydrochloric acid, so be careful.

**Rinse any exposed parts of your body with plain water.** Eyes should be flushed for 10-15 minutes.

- Stay calm. Panicking may induce rapid breathing, causing you to inhale the gas.
- Try to turn your back against the wind.
- Don't eat or drink anything that may have been exposed to the gas.

**MUSTARD GAS**

This agent has been abused in the wars, due to ease of preparation, and use, low production cost, broad absorption, multi-organ effects, rapid penetration,

environmental stability, delayed effects on biological systems, and its power of disabling the military forces in battle fields.

### **Delivery and exposure to sulfur mustard:**

- **If sulfur mustard is released into the air as a vapor, people can be exposed through skin contact, eye contact, or breathing.**
- **Sulfur mustard vapor can be carried long distances by wind.**
- If sulfur mustard is released into water, people can be exposed by drinking the contaminated water or getting it on their skin.
- People can be exposed to liquid sulfur mustard by eating it or getting it on their skin.
- **Sulfur mustard can last from 1 to 2 days in the environment under average weather conditions and from weeks to months under very cold conditions.** At the moment the hot weather reduces the lifespan of the gas, where as freezing Kurdistan winters would increase the lifespan of the gas and thereby complicate matters.
- **Sulfur mustard breaks down slowly in the body, so repeated exposure may have a cumulative effect (that is, it can build up in the body).**
- Adverse health effects caused by sulfur mustard depend on how much people are exposed to, **how they were exposed (the route of exposure), and the length of time that people are exposed.**
- Sulfur mustard is a powerful irritant and blistering agent that damages the skin, eyes, and respiratory (breathing) tract.
- Sulfur mustard damages DNA, a vital component of cells in the body, especially in the bone marrow. This causes decreased formation of blood cells (aplastic anemia) or decreased red or white blood cells and platelets (pancytopenia).
- **Sulfur mustard vapor is heavier than air, so it will settle in low-lying areas.**

Predisposing factors for contamination with SM can include: high environmental temperature, lack of wind in the attacked area, being female and younger, white race (light complexion), stress, excessive sweating, oily skin, high PH of the skin, skin folds and thin areas of the body, skin infections, previous dermatitis, duration of exposure, dose of the poison, wider contact with the poison, scratching and massage of the involved skin area.

**Mustard gas exposure, symptoms may not appear until 2 to 24 hours after exposure:**

- People may not know right away that they have been exposed, because sulfur mustard may not have a smell or have a smell that might not cause alarm.
- Typically, **signs and symptoms do not occur immediately**. Depending on the severity of the exposure, symptoms may not occur for up to 24 hours. Some people are more sensitive to sulfur mustard than are other people, and may have signs and symptoms sooner.
- Sulfur mustard can have the **following effects** on specific parts of the body:
  - **Skin: redness and itching of the skin** may occur 2 to 48 hours after exposure and may eventually change to **yellow blistering of the skin**.
  - **Eyes: irritation, pain, swelling, and tearing** may occur within 3 to 12 hours of a mild to moderate exposure. A severe exposure may cause signs and symptoms within 1 to 2 hours and may include the symptoms of a mild or moderate exposure plus **light sensitivity, severe pain, or blindness lasting up to 10 days**.
  - **Respiratory tract: runny nose, sneezing, hoarseness, bloody nose, sinus pain, shortness of breath, and cough** within 12 to 24 hours of a mild exposure and **within 2 to 4 hours of a severe exposure**.
  - **Digestive tract: abdominal pain, diarrhea, fever, nausea, and vomiting**.
  - **Bone marrow:** decreased formation of blood cells (aplastic anemia) or decreased red or white blood cells and platelets (pancytopenia) leading to weakness, bleeding and infections.
- Showing these signs and symptoms does not necessarily mean that a person has been exposed to sulfur mustard.

### What the long-term health effects may be

- **Exposure to sulfur mustard liquid is more likely to produce second- and third-degree burns and later scarring than is exposure to sulfur mustard vapor. Extensive skin burning can be fatal.**
- Extensive breathing in of the vapors can cause chronic respiratory disease, repeated respiratory infections, or death.
- Extensive eye exposure can cause permanent blindness.
- Exposure to sulfur mustard may increase a person's risk for lung and respiratory cancer.

Measures:

The "best" solution would be to **immediately flee the area**. Putting as much distance between yourself and the area of the attack. As soldiers I would not advocate

abandoning your post even if I don't suspect DAESH entering a contaminated area but you never know. **Multiple bunkers would be safer from a military strategic perspective.**

- make sure you have a **battery driven radio for warning and advice on when the gas cloud has passed.**
- **seal a bunker**, using simple improvised materials like plastic and heavy duty self tape.
- Remember that **some gases are heavier than air**. Mustard gas is one of those gasses. Preferably placing the bunker on as high a ground as possible without compromising safety by exposure to enemy fire. During these summer, hot temperatures ventilation may be an issue.
- the bunker should be **stocked with supplies, including weapons and fresh bottled water for drinking and washing.**
- heavy duty **rain clothing and rain boots** to protect against persistent agents and liquids.
- Make arrangements for **ventilating the bunker when the gas cloud has passed, Gas pockets can be lethal.**

**Move upwind and uphill.** Poison agents will move with the wind, and most of them are also heavier than air. **Fresh air is really the best you can do.** This really applies to any situation where you see smoke, vapor, or fog. You can also avoid touching any liquids or droplets. That's about it. Get decontaminated and seek medical evaluation and treatment.

Antidote: **No specific antidote is available. Some researchers have used calcium chloride and magnesium oxide powder as anti-gas powder for skin exposures.** Being wind ward or upwind from the gas and masks are the best precaution in preventing ocular and pulmonary complications. Protective equipment (masks and wind wards) reduce the severity of lung and eye lesions. Namely, when the rate of using of the protective equipment rises, severity of ocular and pulmonary lesions will significantly reduce.

Because **mustard gas is heavier than air, at the time of release, fighters should climb to a height of at least 10 meters above the ground in the attacked area. Therefore designated bunkers on high ground would be optimal.**

Sulfur mustard may remain in the liquid form on contaminated clothing and other devices for many hours or even days and it may affects the biological tissues.

**Therefore, When exposure occurs, all contaminated clothes should be removed from the body in the shortest possible being sure not to let the clothes touch your face or head. Cut the clothes off so that they don't need to make additional**

**contact with your skin as they're peeled off. Seal the clothes in plastic bags (Polyethylene) and then keeping that bag inside another plastic bag.**

Plastic gloves can be used to remove clothing.

Rescues and medical personnel are at risk for adverse effects, especially for skin blistering, if their bodies or their clothes come in contact with contaminated victims.

### **Immediate body wash**

**Affected people should wash their body with plenty of fresh and clean water as soon as possible.**

In past incidents fighters had washed their hands and faces by the water available in the area, while they were not aware that the water was contaminated by the SM toxin. This was a reason for eye and skin problems in these veterans. Thus, we should make sure that the water is not contaminated before using it for eye and skin irrigation.

In these conditions, using mobile tanks or vehicles carrying clean water and showers will be very useful. Also, field centers equipped with healthy water should be established at the nearest safe place for treatment and rehabilitation facilities around the combat area.

**Washing the skin with 0.5% household bleach is also useful.**

With usage of adequate protective equipment, **injured people should be transferred to areas with humid climates. This would be advisable during the winter months.**

### **Decontamination of the area**

To reduce environmental pollution, Calcium hypochloride, stilbestrol or permanganate can be used to decontaminate areas.

### **Protective measures for residence in contaminated area**

The environmental sustainability of sulfur mustard is high. Hence the **agent is able to remain in soil for at least 10 years and it can persist in the clothes and be active in soil even for months at low temperatures.** It can be found with the concentrations of 1 to 25 milligrams per cubic meter in 6 to 12 inches in the soil around the combat zones. In addition, on the basis of the available researches, **people who live in polluted areas, even with no obvious symptoms at the time of exposure, may eventually develop mustard-induced complications, especially pulmonary complications.** Therefore, residence in high traffic areas should be prohibited in coming to the polluted area, until complete decontamination of area is performed.

### **Early preventive measures for injured people**

After chemical attacks, **even exposed people without symptoms should irrigate**

**their eyes for 5 - 15 minutes with copious amounts of healthy water, as soon as possible. Solutions other than clean water that are recommended for washing the eyes include: normal saline, sodium bicarbonate solution 1.5%, Dichloramine T 0.5 percent, sodium sulfate or magnesium sulfate, and zinc or boric acid.**

In cases of severe acute respiratory problems, a pseudo-membrane may be formed in the upper respiratory tract which may cause laryngospasm and stridor. This complication may lead to asphyxia and death. For prevention of death, there may be a need for an urgent tracheostomy and immediate treatment in the ICU.

**Also, diluted infant shampoo has been shown to be useful for eye decontamination.**

**Application of topical anesthetic eye drops should be avoided for both healthy and damaged cornea.**

Local steroids should also be avoided except in the presence of chemosis and epithelial edema.

**Pads and bandages should not be used for eye lesions, as the toxic effects of sulfur mustard may exacerbate its effect due to raised temperature in the injured eye leading to ocular lesions.**

**In the case of skin exposure, initially, we should use calcium chloride or magnesium oxide powder as the anti-gas agents immediately on the exposed areas of skin followed by washing with soap and water.**

In the case of gastrointestinal involvement, emesis should not be induced. After feeding 100 to 200 ml of milk, gastric lavage would be indicated.

Activated charcoal is not proven but not contraindicated.

## **Post preventive measures for injured people**

Acute effects of sulfur mustard-induced lesions gradually turn into a chronic phase. In this phase, our efforts should be focused on preventing further complications. For this purpose, the following points are suggested:

In the late phase, scarring and stenosis of the airways may occur. In these cases, removing debris by bronchoscopic maneuvers would be very useful and life-saving.

In the treatment of chronic lesions caused by sulfur mustard, corticosteroids are widely used. The long-term use of these drugs may cause undesirable effects such as growth inhibition, diabetes, muscle atrophy, osteoporosis, salt retention, dementia and opportunistic infections. Therefore, during the application of these medications, the injured victims should be made aware of these complications.

More than two-thirds of the chemical veterans with chronic bronchiolitis are overweight or obese. These patients should reduce their weights to prevent superimposing complications.

Treatment of magnesium deficiency in sulfur mustard-induced asthmatic patients can

decrease the side effects of asthma.

Some of the common medications used in lung diseases such as Theophylline have a negative impact on the quality of sleep for the victims. Therefore, such drugs should be substituted with other appropriate medications.

In patients with photophobia, using dark sunglasses is recommended.

The use of petroleum jelly to prevent sticking of the eyelid edges is useful.

**To prevent corneal perforation, victims with the mustard eye injuries should not stay in hot and dry areas and use artificial tears.** In addition, exposed people should avoid jobs such as sewing and driving for long hours since these conditions exacerbate the dryness of the eyes and increases the risk of corneal perforation.

Some complications such as COPD, pruritus, visual problems and mental disorders affect the quality of life in exposed people. In addition, quality of life in victims who exercise has been improved compared to those who are not active enough.

Depression is very common among the chemical victims and the most important complication is suicide which could be prevented to some extent.

Retrospective study conducted on 1463 deaths among the chemical victims, have investigated the causes of suicide. The mechanism of suicide were self-hanging, intentional self-poisoning, suffocation and use of firearms with decreasing order of frequencies. These researchers have stated that suicide is one of the causes of death among the veterans that occur at young ages (less than 40 years). Therefore, in order to prevent the suicide in victims with chemical injuries, especially those who are suffering from depression, they should be monitored regularly.

Unnamed EXPERT source referred me to this information on open source. Not verified.

**When the skin is hot as a result of combat, and in hot countries, the results obtained by all preventive methods of decontamination of the skin are inferior to those obtained when the skin is cool and dry so the need for prompt action is even greater under these conditions.**

In the event of **liquid mustard gas contamination**, cleansing of the skin may be effected by--

(a) ***Bleach treatment.***- Thoroughly rubbing in, for one minute, either bleach ointment (*ointment, anti-gas, No. 1*), or *aqueous bleach paste*, over the affected area. **This procedure chemically neutralizes the mustard gas.**

The ointment is the more portable of the two, and the more readily available to all personnel in the field. As a first step in the prevention of burns, **when the**

contamination is small and localized, thorough rubbing with the ointment is the method of choice. For extensive contamination by the liquid, however, a thorough inunction with aqueous bleach paste will be found more easy of application.

When the operation is completed, the ointment should be wiped off, or, if the aqueous paste was used, the affected part should be flushed with water - the object being, in each case, to remove surplus bleach from a potentially injured area. Bleach will destroy free mustard gas quickly, but it will also irritate the skin if left in contact with it. Care must be taken to prevent access of the bleach to the eyes. Bleach ointment or paste should *not* be used if an erythema has already developed as it will aggravate the condition.

Actual vesication of the skin by drops from mustard gas spray may be avoided if preventive treatment be undertaken within a minute or two after contamination. Even though the delay be longer, bleach will still be the method of choice so long as liquid mustard gas is visible on the skin, as it will mitigate the severity of the resulting burn.

Bleach ointment (Ointment, anti-gas, No. 1) is made by mixing equal parts, by weight, of "supertropical" bleaching powder (i.e. "Bleaching Powder, 30 per cent.") and white petroleum jelly, while the aqueous bleach paste consists of "supertropical" bleaching powder mixed to a creamy consistency with water - roughly, one part of the powder to one or two parts of water by volume. The ointment keeps well, while the aqueous paste retains its effectiveness in temperate climates for several weeks if it be stored in enamelled containers with well fitting lids. Bleaching Powder is ordinary chloride of lime, while supertropical bleach is ordinary bleaching powder stabilized by the addition of quick-lime and fulfilling certain conditions of stability and chlorine content.

Ordinary bleaching powder is more irritating to the skin than the supertropical variety, but in the absence of the latter it is quite suitable for preventive treatment when made up as an ointment with white petroleum jelly, or into a paste with water, provided prolonged storage is not contemplated.

**The use of white petroleum jelly is specified since yellow petroleum jelly ("vaseline") in contact with bleach may generate heat and may even lead to combustion on storage. The latter may, however, be used in emergencies for immediate application.**

The mixing of ointments should be thorough and uniform and in the proportion (by weight) of one part of bleach to one of white petroleum jelly. If the mixing is to be



carried out in bulk, the employment of a mill is advocated in order to ensure the required uniform consistency.

*(b) Ointment, anti-gas, No. 2* is composed of Chloramine-T in a vanishing cream base. It is used like ointment, anti-gas, No. 1, but need not be wiped off. The ointment can be rubbed into the hands as a prophylactic against mustard gas and lewisite, but its use for this purpose on more tender parts of the body is contra-indicated as it has an irritant action on the skin.

*(c) Repeated swabbing of the contaminated area with petrol, methylated spirit, kerosene, carbon tetrachloride (Pyrene liquid) or other solvent of liquid mustard gas. It is important to remember that these solvents do not destroy the gas, but merely dissolve it ; hence the swabbing must be confined strictly to the contaminated area, and must be repeated.*

This method is effective if carried out by skilled individuals, and solvents are within easy reach; certain precautions, however, are necessary. **Oilskin or rubber gloves must be used if available;** otherwise, the swab should be only partly moistened with the solvent, and it should be held between finger and thumb by the dry portion or preferably in forceps; the wet portion is then applied to the contaminated skin so as to soak up the liquid contamination, care being taken that none of the solvent runs over the skin of either the subject or operator; the contaminated swab is then discarded and the process is repeated for several minutes with fresh swabs, or as long as the characteristic odour of the gas persists on the skin. **Thorough washing with soap and water, if available, will complete the treatment; the contaminated swabs must, of course, be destroyed by burning or burying and the gloves and forceps decontaminated.**

One disadvantage of this method in the hands of unskilled persons is that the solvent is apt to "run" on the skin and cause burns on areas comparatively far removed from the original site of contamination; a further disadvantage is the liability of the operating fingers to become contaminated in the absence of gloves. Employed with care and intelligence, however, the method is valuable in emergencies such as may occur in aerodromes, among mechanized transport, and in other situations where mustard gas solvents are readily available.

*(d) Scrubbing with soap and water, using hard soap and frequent changes of water. **This process does not destroy the mustard gas, but merely removes it in the lather; the scrubbing must, therefore, be confined to the contaminated area, and the operator's hands should be safeguarded, if possible, by suitable gloves.***

If the liquid contamination is small, the time and trouble of this method

If the liquid contamination be small, localized and of known situation, this is an effective method of removing it if carried out promptly. In any case, vesication of the skin is usually prevented if the treatment is not delayed beyond five minutes, though an erythema will probably result.

**With a gross contamination, or when the drops of liquid mustard gas are multiple, the results of scrubbing with soap and water are unfavourable, as it is difficult to avoid spreading the contaminant in the soapy lather to surrounding areas. In these circumstances bleach treatment is the method to adopt if available.**

Where erythema has already begun, washing off with a solvent should be used, as the other methods are themselves somewhat an already inflamed skin.

**Should it not be possible, however, to deal with such a contamination until some time has elapsed, thorough washing should still be carried out at the first available opportunity in the hope of mitigating the degree of burning.**

After contamination with the *vapour* of mustard gas, i.e. after exposure to an atmosphere contaminated with the gas, or when the outer clothing has been sprayed, or has otherwise come in contact with the liquid form of the gas, preventive treatment should consist of a rapid removal of all equipment, followed possibly by a thorough washing of the whole body surface with soap and water, preferably under a shower.

*Preventive treatment of special areas:* apart from the skin surfaces, the only other areas to which preventive treatment can be extended are the eyes and the nasal and pharyngeal mucous membranes.

**Contamination of the eye by liquid mustard gas presents a very serious problem. In order to reduce this risk to a minimum eye-shields have been issued as a protection against surprise by aircraft spray. If these eyeshields are properly worn droplets of mustard gas should not gain access to the eyes.** If, however, in the absence of an eyeshield, a drop of liquid mustard gas does fall into the eye the resultant injury can be lessened, provided that the drop is small, if the eye can be immediately flushed out thoroughly with water from a water-bottle or any other available source. With a large drop flushing will do some good, but it will probably fail to prevent serious injury to the eye and permanent impairment of vision. The treatment must therefore take precedence over other decontamination measures, e.g. the use of Anti-Gas ointment.

In view of the very serious results that may ensue from the penetration of liquid mustard gas into the eye, and the obvious difficulty of flushing out the eye immediately

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**in the field, too much stress cannot be laid on the importance of wearing eyeshields.**

If inflammation of the eyes is caused by prolonged exposure to the vapour of mustard gas emanating from the ground or other contaminated objects, such irrigation cannot be expected to have much effect since the poison has been slowly absorbed over a considerable period of time. Since, however, aircraft spray must be regarded as a potential weapon and there may be uncertainty in any given instance whether exposure has been to spray, vapour or to both, the initial routine treatment should be irrigation with water for three to five minutes. This treatment can do no harm, and in some cases it may help to reduce the subsequent effects: it should, therefore, never be omitted.

*(2) Curative treatment.*

*(a) Treatment of the eyes.* - The value of initial flushing out of the **eyes with water or saline** has already been considered.

By the time the casualty is seen there is sure to be some degree of conjunctivitis, accompanied by swelling of the eyelids, and photophobia. It is important to open the eyelids so as to let the man see that he is not blind. Fear that the sight has been permanently affected can be very real, and reassurance on this point will have an important psychological effect.

After this, instil a few drops of a non-irritating antiseptic and repeat this four times daily. Experiments on animals suggest that ALBUCID SOLUBLE (2.5 per cent. solution) is probably the best drug to use for this purpose. ALBUCID SOLUBLE is one of the sulphonamide derivatives which forms a neutral solution with water. Stronger antiseptics should never be used, as they have been proved to be ineffective and may do harm.

Albucid will be supplied in 5 c.c. ampoules of 30 per cent. solution. The contents of one ampoule diluted to 60 c.c. will give a 2.5 per cent. solution.

Never use repeated irrigation of the eyes, i.e. never irrigate except at the onset unless the discharge is very copious. Experimental work has shown that repeated (e.g. 2 hourly) irrigation is a bad form of treatment and increases the severity of the lesion. If the discharge is very severe, wash it out with normal saline night and morning before instilling Albucid.

If blepharospasm is sufficient to close the eyelids completely, instil 1 per cent. atropine drops and get the case seen by an ophthalmic surgeon *at once* for two reasons :

(i) So that mild cases may be diagnosed as such and not transferred as severe

(i) So that mild cases may be diagnosed as such and not mistaken as severe casualties. This will lessen the development of "functional" cases and therefore reduce the drain on the fighting troops.

(ii) So that severe cases may be diagnosed as such and thus complications be avoided.

The eyes should not be bandaged nor closely covered since free drainage of the discharge is essential, but a forehead shade is permissible. Such a shade can be easily improvised from brown paper or other material.

Never instil liquid paraffin (or other oily drops) during the first few hours, but after that it may be used to prevent the lids from becoming adherent.

Many of the casualties caused by exposure to vapour are likely to be mild. None the less such casualties may at first be unable to see owing to the swelling of the eyelids and pain, and the early photophobia, which has a genuine cause, may be succeeded by a functional photophobia which unduly protracts convalescence. If this is to be avoided and the mild cases returned to full duty without avoidable delay, it is essential to remove the eye shade as soon as possible and to make the casualty confident that he need fear no permanent injury to the eye nor impairment of vision. General tonic treatment, and suitable exercise that will keep the casualty from brooding on his condition, will hasten his recovery.

**Mustard gas has, as the experience of the last war showed, a very high casualty producing value, and undue wastage of the fighting troops can only be prevented by taking trouble over the treatment of the milder casualties so as to minimize the time spent either in the hospital or the convalescent camp.**

It is, of course, the casualties who have been exposed for a considerable time to a heavy concentration of vapour, and in particular those cases in which a drop of liquid mustard gas has entered the eye, that offer the most difficult problem, and it is these cases which demand the most careful attention of the ophthalmic specialist from the start if the effects of the grave injuries which are so likely to result are to be minimized.

*(b) Treatment of the respiratory tract.* The early *rhinitis* is usually overshadowed by the condition of the eyes; should there be pain and distressing discharge, it may be treated with copious warm douches of sodium bicarbonate in 5 per cent. solution several times daily. In the rare cases where a persistent muco-purulent discharge, associated with ulceration and occasionally with epistaxis, is long continued, an astringent lotion containing zinc sulphate gr. 1 with boric lotion oz. 1, will be found

helpful

repirat.

*Laryngitis and tracheitis.* - The laryngeal irritation is best dealt with by topical treatment such as laryngeal spraying with medicinal liquid paraffin, or by the inhalation of steam from a pint of boiling water containing a teaspoonful of a mixture of menthol grs. 10 in Tinct. Benzoini Co. oz. 1. The harsh, dry cough may also be eased by breathing through a perforated metal mask containing a pad of gauze moistened hourly with drops of some volatile antiseptic mixture such as:

Menthol . . . . gr. 20

Chloroform . . . min. 60

Creosote . . . . ,, 60

Oil. Eucalypti . . ,, 20

Liq. Iodi. Mitis ,, 30

Sp. Vini. Rect. .. to one ounce.

The menthol in such a solution will help to alleviate the paroxysmal coughing which may otherwise result if such an anaesthetic as simple ether has to be used to allow operative treatment of an accompanying wound.

*Broncho-pneumonia.* - As the majority of deaths from mustard gas in the Great War were due to secondary infections of the respiratory tract, treatment should be directed, from the outset, towards combating the bacterial invasion of the bronchi.

As a preliminary step against extraneous infection, all cases of mustard gas poisoning in which the respiratory tract is involved must be kept apart from other patients suffering from infective pulmonary disorders; they should, if possible, be segregated in special wards, and the onset of broncho-pneumonia in one of them should entail his isolation.

In the various stages of the broncho-pneumonia, treatment is symptomatic and follows the recognized rules of procedure, including the employment of expectorants where the muco-pus is tenacious and difficult of expulsion. It may be stated here that the prophylactic venesection advocated for phosgene cases, which is of value in the early treatment of pulmonary oedema, has no place in the treatment of mustard gas cases, though occasionally it may be indicated at a later stage to relieve the right heart of embarrassment and cyanosis induced by a diffuse bronchopneumonia. The same may be said of oxygen therapy, which, although essential in the pulmonary oedema caused by phosgene, is only indicated occasionally and at a late stage in mustard gas

by prosgene, is only indicated occasionally and at a late stage in mustard gas poisoning when cyanosis is established as the result of grave and widespread pulmonary damage.

(c) *Treatment of the skin.* - As in other regions of the body, sepsis following skin contamination is the most potent factor in delaying the satisfactory healing of skin burns. When it is remembered that the skin surfaces of troops in the field under war conditions are unavoidably dirty, and that mustard gas penetrates, and in so doing devitalizes the skin. it is obvious that early preventive treatment is of paramount importance inasmuch as it will lessen the severity of the skin burns and reduce the risk of sepsis, and that any curative treatment should have some antiseptic value.

**As a preliminary to all local treatment it is essential to cleanse the skin as thoroughly as its damaged condition permits, and to clip short all hair, if any, on the affected area. It may be useful to repeat here that the application of bleach in any form to a skin which is already showing signs of damage will aggravate the ensuing burn. It must also be noted that skin surfaces damaged by mustard gas are exceedingly susceptible to trauma, and that even the continued pressure of an ill-fitting bandage may lead to an extension of the damage.**

As treatment will vary according to the nature and degree of the burns, it will be best to consider these in detail:

(i) *Erythema:* Mild cases which do not proceed beyond an erythema heal spontaneously, with possibly some desquamation and pigmentation. They may be compared with sunburns in severity and discomfort, and clear up just as readily. If the skin is unbroken a mildly antiseptic dusting powder may be applied. A suitable formula is zinc oxide, boric acid and chalk in equal parts.

(ii) *Vesication:* It is this stage that will afford a critical test of successful treatment through the elimination of secondary infection, as the devitalization of the tissues in this case is much more profound.

Any available cleansing treatment in use in surgical practice will suffice for the undamaged skin surrounding the burn itself. In the last war extensive use was made of Eusol and of Dakin's solution for the treatment of burns, but they are too painful for continued use on raw surfaces. Picric acid and similar powerful germicides are undesirable because of the toxic symptoms that may follow their absorption, while ointments and pastes are, as a rule, contra-indicated because of their tendency to seal up discharges; for the same reason powders are undesirable as they are apt to produce crusts which retain the discharge.

When *discrete circumscribed blisters* make their appearance they should be evacuated

When discrete, circumscribed blisters make their appearance they should be evacuated, under aseptic conditions, by means of a hypodermic syringe or a sterile needle, gentle pressure being applied, if necessary, upon the walls of the blister with a sterile swab to ensure complete evacuation ; the intact epithelium should then be allowed to collapse and seal down the raw, sensitive surface underneath. This evacuation of fluid from blisters may have to be repeated, in some cases, owing to the continued oozing of serum from the raw area. The further treatment of these circumscribed vesicles consists in the application of dry sterile dressings.

**Larger blistered areas require more elaborate treatment. The lesion itself, and a large area of the surrounding skin which may ultimately show damage, should be cleaned with a non-irritating antiseptic, e.g., Dettol (20 per cent. solution). The blisters, unless already broken, should be punctured when they become tense.**

Since the exudation in such cases is very copious, it is no good using a tanning treatment at the start, as any coagulum formed will be floated off by the continued exudation, and it will be impossible to secure a firm protective scab. The long duration of the exudation depends in part on the fact that the action of the poison continues for a considerable time after it has been absorbed by the skin, and the damage is therefore progressive. Measures which result in a reduction of the local oedema are therefore desirable.

Treatment at this stage with Amyl. Salicylate helps to dry up the exudation, reduces the surrounding oedema and erythema, and diminishes the pain, irritation and discomfort. A pad of gauze soaked in amyl salicylate, and wrung out, should be applied and covered with cellophane and a thin layer of cotton wool which should be lightly bandaged. The pad should be changed either once or twice a day.

When the exudation has subsided and the wound is dry, at the end of several days, if progress is unsatisfactory, amyl salicylate may be discontinued, and a dressing of crude cod liver oil (of *neutral* reaction) may be substituted after removing any loose fragments of blister skin.

Amyl salicylate must not be used for burns of the face since its vapour is irritant to the eyes. The only objection to amyl salicylate is its clinging, sweet smell.

In the absence of amyl salicylate, a pad of sterile gauze wrung out in sterile normal saline should be applied to the burn in the early stages, being changed as often as it becomes soaked with exudation. As soon as the exudation has diminished sufficiently, the blister skin should be removed and the area treated with triple dye solution, or gentian violet jelly, as in the case of a thermal burn. Triple dye or cod liver oil should

in any case be used for burns on the face. Triple dye should be used for the treatment

In any case be used for burns on the face. Triple dye should be used for the treatment of burns associated with wounds, e.g. compound fractures. Tannic acid or one of its preparations, e.g., Tannafax, can be substituted for triple dye, but it is not so successful in forming a satisfactory and adherent coagulum. Tannic acid should not be used for burns of the face or hands.

**The healing of mustard gas burns is a slow process. In the case of the deeper burns a granulating area may be left, and treatment with a stimulating ointment, e.g., scarlet red ointment, may be helpful, care being taken not to damage the new granulation tissue.**

**Severe burns in the neighbourhood of a joint may demand immobilization until healing is well advanced.**

If the burn becomes septic, or there is deep necrosis of the skin, mildly antiseptic baths may be useful and soothing, warm hip baths of isotonic salt solution allaying the intense irritation of mustard gas burns of the genitalia. Starch poultices, hot compresses or fomentations may also prove of service - in fact any treatment suitable for other septic conditions of the skin. There is nothing to contraindicate the use of powdered sulphanilamide on the wound.