WAR GASES

Nature.—The term "Gas", when used in connection with chemical warfare, includes any chemical substance, whether solid, liquid, or gas, which is employed in war for its poisonous or irritant effects on the human body.

As an illustration of a solid used as a war gas we have the small solid particles derived from arsenical compounds. These form a particulate cloud and act as nose irritants. Chlorine is a lung irritant and is a true gas well known to students of chemistry, although it may be readily liquified. Mustard gas when pure is a colourless, oily liquid, and attacks the skin either as a liquid or vapour. The technical product is a brown or black oil. All these are typical war gases.

In addition to having the necessary physiological action, the substance used as a war gas should be relatively cheap and easily produced from the raw materials readily available. Moreover, any liquid used as a war gas should have a reasonably high vapour pressure in order to provide adequate concentrations, and should also be rather stable and inactive chemically. These and other considerations, limit the number of suitable substances. Of three or four thousand substances experimented with during the war 1914-18 only about 5 were ever used in the field, and about a dozen were in active use at the end of the war. The number used is still reasonably small.

Classifications.—There is considerable variation among war gases as to physical and chemical properties, so that the most satisfactory method of classification is according to the effects produced on the human body.

(a) The Lung Irritants (known variously as Choking gases, Suffocants or Asphyxiants) are very deadly. They irritate the throat and lungs, leading to coughing and difficult breathing. Exposure to a strong concentration, even for a short time, may produce a fatal result.

(b) The Eye Irritants (Tear Gases or Lachrymators) cause intense smarting of the eyes and a copious flow of tears. They do not cause any permanent damage.

(c) Nose Irritants (Sternutators or Sneezing Gases) produce severe pain in the nose, throat and chest. They induce nausea and mental depression. The effects are not permanent, but are rather persistent.

(d) The Skin Irritants (Blister Gases or Vesicants) are very active on all parts of the body, and they penetrate through porous substances including ordinary clothing. Eyes, lungs, skin are all affected by these gases either in the vapour or liquid state, and deep and extensive blistering may result. The effects of exposure are somewhat delayed. No immediate discomfort is felt, which makes these gases doubly dangerous.

Some gases could be listed under two of the sections above. Chloropicrin, for example, is a tear-producing gas as well as an effective lung irritant. Certain other gases do not fit into the above scheme, a case in point being hydrocyanic acid, which has a paralyzing effect. The above classification is useful, however, in that it emphasizes the purpose for which the different gases are used and the harmful effects which may be looked for where these gases are present.

Gases are sometimes classified as persistent and non-persistent. Particulate clouds are generally non-persistent as they drift along with the wind and are rapidly

diluted with the atmosphere. This also applies very generally in the case of true gases. So that persistent gases are largely liquids and persistency depends on a number of factors, chief of which is the rate of evaporation. This in turn is related rather definitely to the vapour pressure. The lower the vapour pressure, the slower the rate of evaporation and the greater the persistence. Heat and high winds favour rapid evaporation with a consequent decrease in persistency. Gas in enclosed spaces will tend to be more persistent as the wind is unable to act freely upon it. Rain lowers persistency by washing the gas from the air, and in some cases by chemical action with the gas. Most war gases are heavier than air, the greater density preventing rapid diffusion.

Methods Employed in Releasing Gases.—An army in the field has at its disposal a variety of means for distributing gas. Gas may be stored in cylinders and released effectively from these at a distance of several thousand yards from the objective. Four-inch mortars are also employed, particularly when a high concentration is desired over a small area, and are effective at distances up to twenty-seven hundred yards. Artillery gas shells are frequently made use of and in mobile warfare generators may actually be employed in the field.

The methods which would likely be employed in a gas attack against civilians would be the dropping of bombs and the use of a spray from aircraft. Gas bombs contain an explosive charge sufficient to burst them. The sound of the explosion is much less than that of a high explosive bomb of similar weight, and so normally the two would not be confused. If the gas used is persistent, a dangerous concentration of vapour is produced and a sizeable area surrounding the bomb will be contaminated by

splashes. If aircraft are able to spray gas from a low altitude, they would also be able to produce fairly high concentration, but the area covered would be somewhat narrow and would follow the path of the plane. If spray is released from higher altitudes, a larger area would be covered, but the effectiveness would be diminished owing to the wide dissemination of the spray when it reaches the ground. Calm, dry weather is most suitable for the use of non-persistent gas, and persistent gas is most effectively used when there is present a high ground temperature and a slight breeze. When there is any movement of air, the area of danger is downwind from the point of release, and the danger from either method of attack is increased in a built-up area.

Contamination.—The use of this word signifies that a war gas, whether solid, liquid, or vapour, has polluted a substance. Contamination is particularly important in the case of blister gases. Both the liquid and the vapour of these gases penetrate porous substances, and these substances continue to yield poisonous vapour after any visible evidence of contamination has disappeared. If a person walks over or rubs against a contaminated surface, he would not only suffer injury himself, but his clothing would carry the contamination to others. Animals and vehicles may also become carriers of contamination. If food stuffs have been subjected to blister gas, they become agents of contamination and in serious cases would have to be destroyed.

Methods of Detection.—Our sense perceptions enable us to make use of the physical properties of gases in detecting and identifying them. In the cases of the more common gases, these properties are indicated in detail in

the table on p. 127. Perhaps the most important of these properties is the odour, particularly all war gases being distinctive in this respect. Mustard gas can be detected by smell in concentrations as low in 1 in 20 million and Lewisite in even greater dilutions. One difficulty in this connection is caused by the practice of releasing two gases simultaneously with the result that one odour masks the other. A gas scout should possess a well trained nose. Some principles governing "good smelling" are given below.

(1) Don't inhale deeply: only the nose can smell: sniff!

(2) Only smell once: repeated smelling dulls the perception.

(3) First smell, then reflect: ability to recollect smells can be acquired with practice. Learn smells by heart.

(4) After smelling, breathe out strongly through the nose several times. Don't make a new smell-test until the effects of the last have disappeared.

The sense of sight is employed in gas detection almost if not quite as often as the sense of smell. For example, Chlorine has a characteristic yellow-green colour, unless much water vapour is present, when it appears whitish. If sufficiently concentrated the particulate arsenical smokes used as nose irritants are also white and opaque.

The gases may also be identified after they have acted in characteristic fashion on the observer, but to wait for this physiological effect is to invite disaster, particularly in the case of lung irritants or blister gases.

There are various chemical tests which may be applied to determine the nature of the gas used, but a discussion of these is beyond the scope of this text.

WAR GAS	Chemical Formula	Some Properties	Vapour Density N.T.P. Air=1	Vapour Pressure at 200 C. Mms. of Mercury	Odour	Freezing or melting point in oC.	Boiling Point in oC. at normal pressure	'Persistence' at 200 C. App. relative time for evaporation water=1
Throat and Lung Irritants								
Chlorine	Cl_2	Yellow Green Gas—corrodes metals, and rots clothing especially in presence of moisture.	2.5	5031	Pungent bleaching powder.	—102	—33.6	N.P. gas
Phosgene	Carbonyl chloride $COCl_2$	Colourless gas.	3.5	1173	Musty hay.	—118	+8.2	N.P. gas
Diphosgene	Trichloromethyl chloroformate: $Cl.COOCCl_3$	Colourless, mobile liquid. quite volatile.	6.9	10.3	In vapour state. musty hay.	—57	128	.38
Chloropicrin	Trichloronitromethane $CCl_3.NO_2$	Colourless, oily fluid. Vapour is lachrymatory.	5.7	18.3	Vapour is sweetish, penetrating.	—69	112	.23
Lachrymators K. S. K.	Ethyl Iodoacetate $CH_2I.COOEt$	Colourless, heavy oil. Technical product is yellow to brown.	7.4	.54	"Pear drop."	—21	179	6.9
B. B. C.	Bromobenzyl cyanide $Ph.CHBr.CN$	Yellow crystals when pure. Technical product brown oily liquid.	6.8	.012	Bittersweet, "sour-fruit."	+25.4	242	325
C. A. P.	Chloracetophenone $Ph.CO.CH_2Cl$	White crystalline solid used in Particulate cloud. Irritates skin.	5.3	.013	Aromatic "apple-blossom."	+58	244	N.P. cloud
Nose Irritants								
D. A.	Diphenyl chlorarsine Ph_2AsCl	White crystals when pure.	When heated these give off a particulate cloud, usually invisible except at point of release.	.0005	Aromatic irritant	+38	333	N.P. cloud
D. C.	Diphenyl cyanarsine Ph_2AsCN	Colourless prisms.		.0002	Bitter almonds.	+33	377	
D. M.	Diphenylamine chlorarsine $N.H.:(C_6H_4)_2:AsCl$	Yellow crystals. Technical product greenish brown.			None.	+195	410	
Vesicants Mustard Gas	Dichlorodiethyl sulphide $S(CH_2CH_2Cl)_2$	Colourless liquid, great power of penetration. Technical product—brown or black oil.	5.4	.11	Mustard or garlic, horse radish	+14.4	217	38
Lewisite	Chlorovinyl dichlorarsine $ClCH=CH.AsCl_2$	Colourless, oily liquid. Technical product black. Great power of penetration. Irritates nose and throat.	7.2	.4	Strong smell of geraniums.	—5	190	9.5

Personal Protection Against Gas.—The most common personal protection is provided by the various types of respirators. In Great Britain, the Government has supplied gas masks to the whole population, and no doubt the Canadian Government will do likewise should it be thought that enemy gas attacks are imminent.

Types of Respirators.—There are three general types of respirators issued in Great Britain and one cannot do better in this connection than to refer to the British A.R.P. Training Manual No. 1 for a description of these articles.

A. R. P. Training Manual No. 1.
His Majesty's Stationery Office, 1941.
Pages 44-54 with illustrations.

Anti-gas Clothing. Pages 54-56.

Protection of food and military supplies against effects of gas.

Province of Ontario C.D.C. Handbook No. 2. Pages 48-51.

(Grade XII)

The Grade XII Course in Civilian Defence is a practical training course which enables the student to translate into action much of the information supplied in the preceding pages. An outline of the Course appears on pages 11 and 12 of the Syllabus. Full information regarding the training of the various groups may be found in the A.R P. Handbooks listed on page 13 and in *Protection of Schools and School Children* (Dominion Government, Ottawa) and *Protection of School Children and School Property* (Office of the U.S. Civilian Defense, Washington, D.C.).

MAP READING

Notes and Exercises

This section is made up of facts and definitions, with explanations sufficient for a good grounding in the subject. The Manual of Military Map Reading issued by the War Office should be available for reference, and of course, copies of the maps should be in the hands of the pupils, preferably maps of their own locality. With this in mind many of the exercise problems have been purposely made suggestive rather than definite, so that they may be fitted to any locality or map.

The order of treatment differs somewhat from that of the course of study, but will be found to be a logical sequence for teaching purposes.