Chemical and biological weapons:

the hazard for mankind

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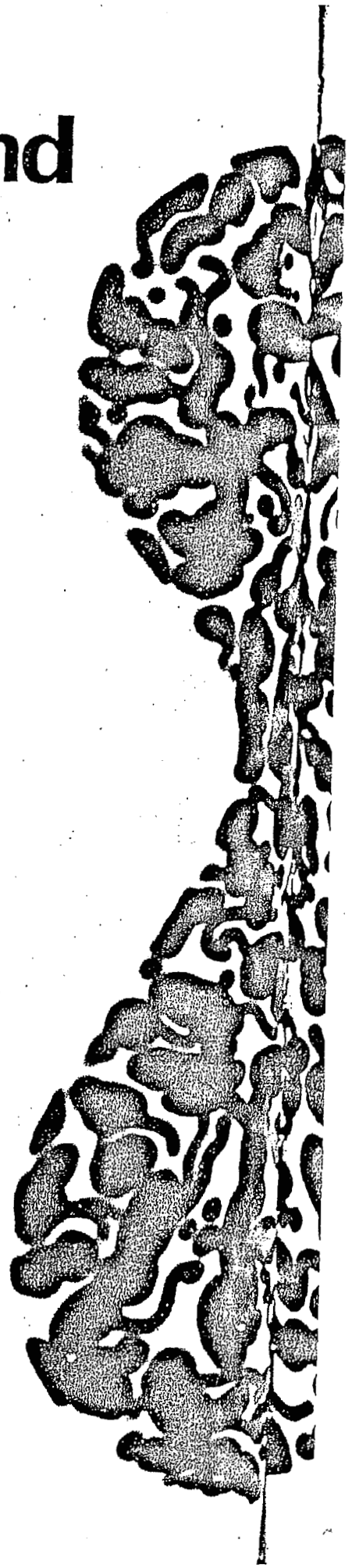


It is sometimes said that pure science is neutral, meaning that fundamental scientific discoveries can be applied for good or for ill. An area of science that is receiving much attention for its possible future consequences to the quality of human life is modern biology. During this century and especially within the past twenty years, we have learned a great deal about some of the most fundamental living processes. We have learned the chemical structure of genes. We know how they duplicate and how they provide a master guide to cellular activities. Much has also been learned about the basis of muscle contraction and the structure of membranes and the mechanism of nerve impulse transmission. New experimental methods and concepts are setting the stage for a successful attack on the problems of differentiation and development and for achieving an understanding of the functions of the brain.

All the new and forthcoming discoveries in fundamental biology are bound to have an important impact on our lives and those of our descendants. The application of these discoveries will open up new dimensions for the improvement of human life. Unfortunately, the misapplication of medicine and its allied sciences such as microbiology, biochemistry and pharmacology can also have the most perilous consequences for mankind. Perhaps the most destructive of all such consequences would be the unrestrained application of biology and chemistry to warfare.

Fortunately, there are strong restraints against chemical and biological warfare (CBW). During the past few years, increasing international attention has been given to the need for reaffirming the traditional restraints and for going beyond them by adopting new measures of arms control and disarmament for CB weapons.

In this article, I shall briefly discuss the nature of chemical and biological weapons. Then I shall describe some of the international efforts that are being undertaken to prevent the production and use of these weapons and some of the problems confronting these efforts.

Although work on CBW has been done largely in secret, many of the essential facts about the weapons have become available to the public through the recent publication of a number of expert reports. In 1968, the Secretary General of the United Nations, acting at the request of the General Assembly, brought together an international group of experts to prepare a report on the nature of CB weapons and the effects of their possible use *. Written for the non-technical reader, the UN report gives a good general discussion of CB weapons and their effects. A more technically detailed report, emphasizing the possible consequences of CB warfare for civilians, has been produced by a group of consultants to the World Health Organization ** appointed by the Director-General.

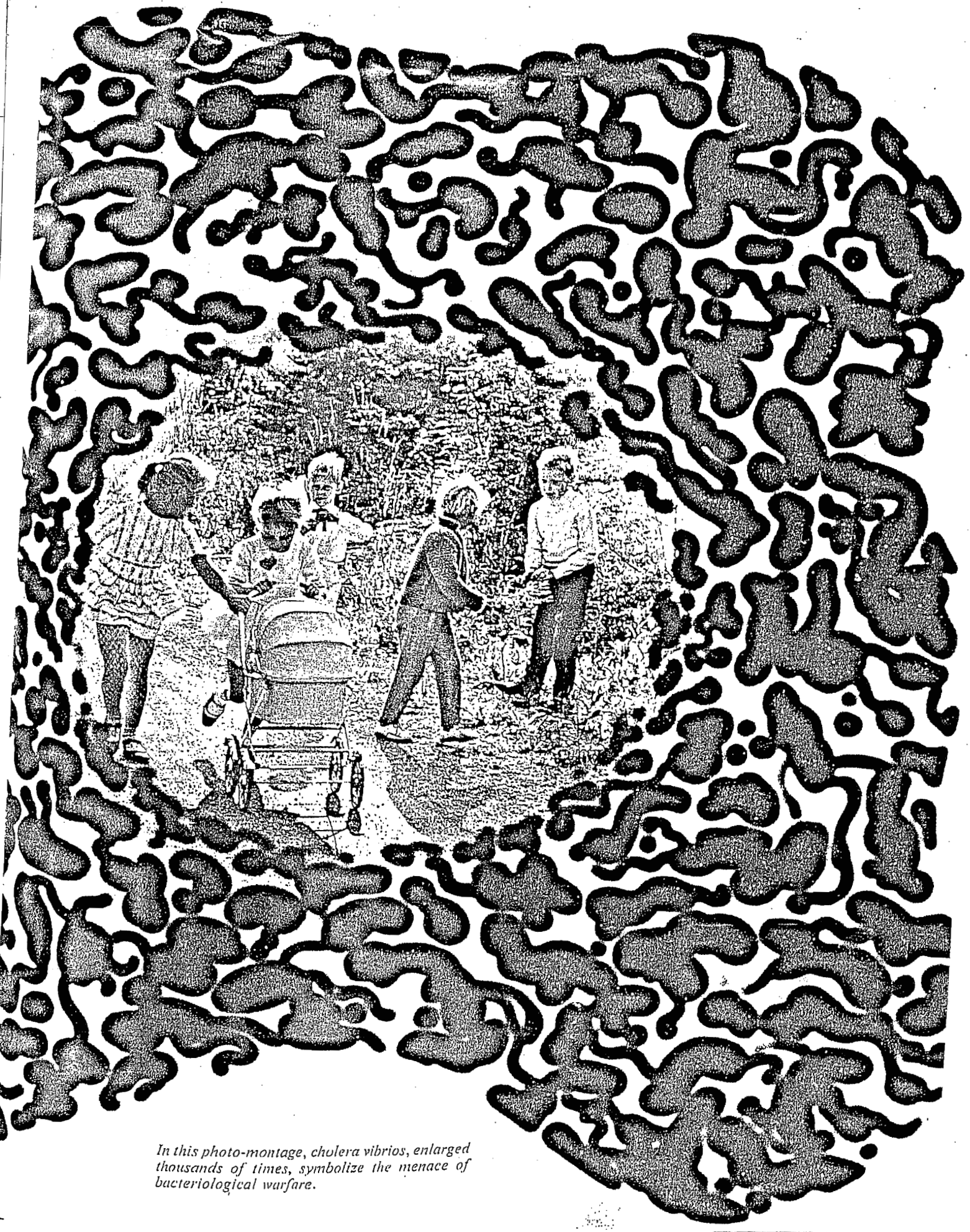
In spite of differences of emphasis and approach, the two reports come to similar conclusions. The summary of the WHO report is particularly relevant here:

1. Chemical and biological weapons pose a special threat to civilians.
2. The large-scale or, with some agents, even limited use of chemical and biological weapons could cause illness to a degree that would overwhelm existing health resources and facilities.
3. Large-scale use of chemical and biological weapons could also cause lasting changes of an unpredictable nature in man's environment.
4. The possible effects of chemical and biological weapons are subject to a high degree of uncertainty and unpredictability.

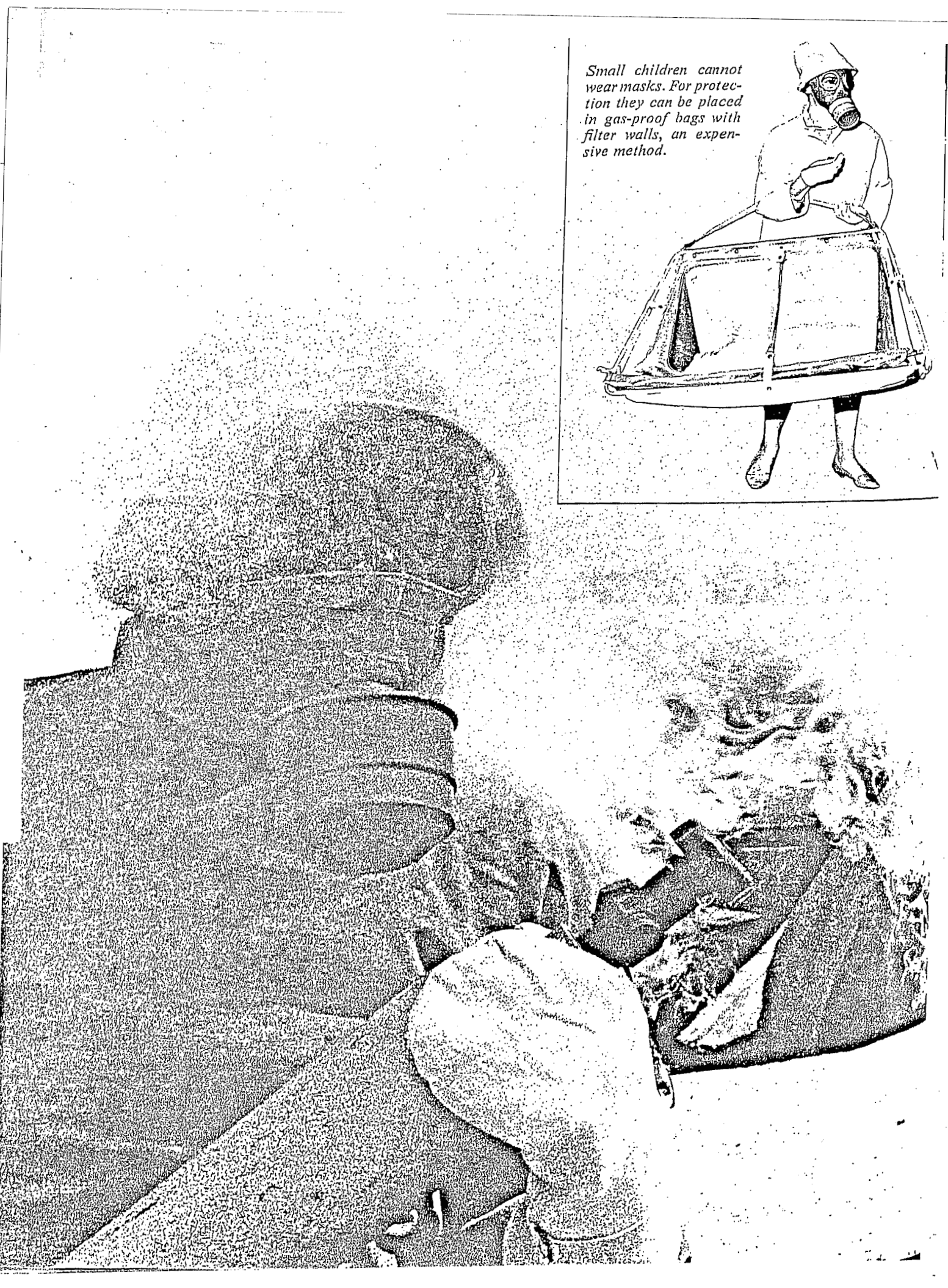
* United Nations (1969) "Chemical and bacteriological (biological) weapons and the effects of their possible use. Report of the Secretary-General." New York, 100 pages. (Sales No. E. 69.I.24).

** World Health Organization (1970) "Health aspects of chemical and biological weapons. Report of a WHO Group of Consultants." Geneva, 132 pages.

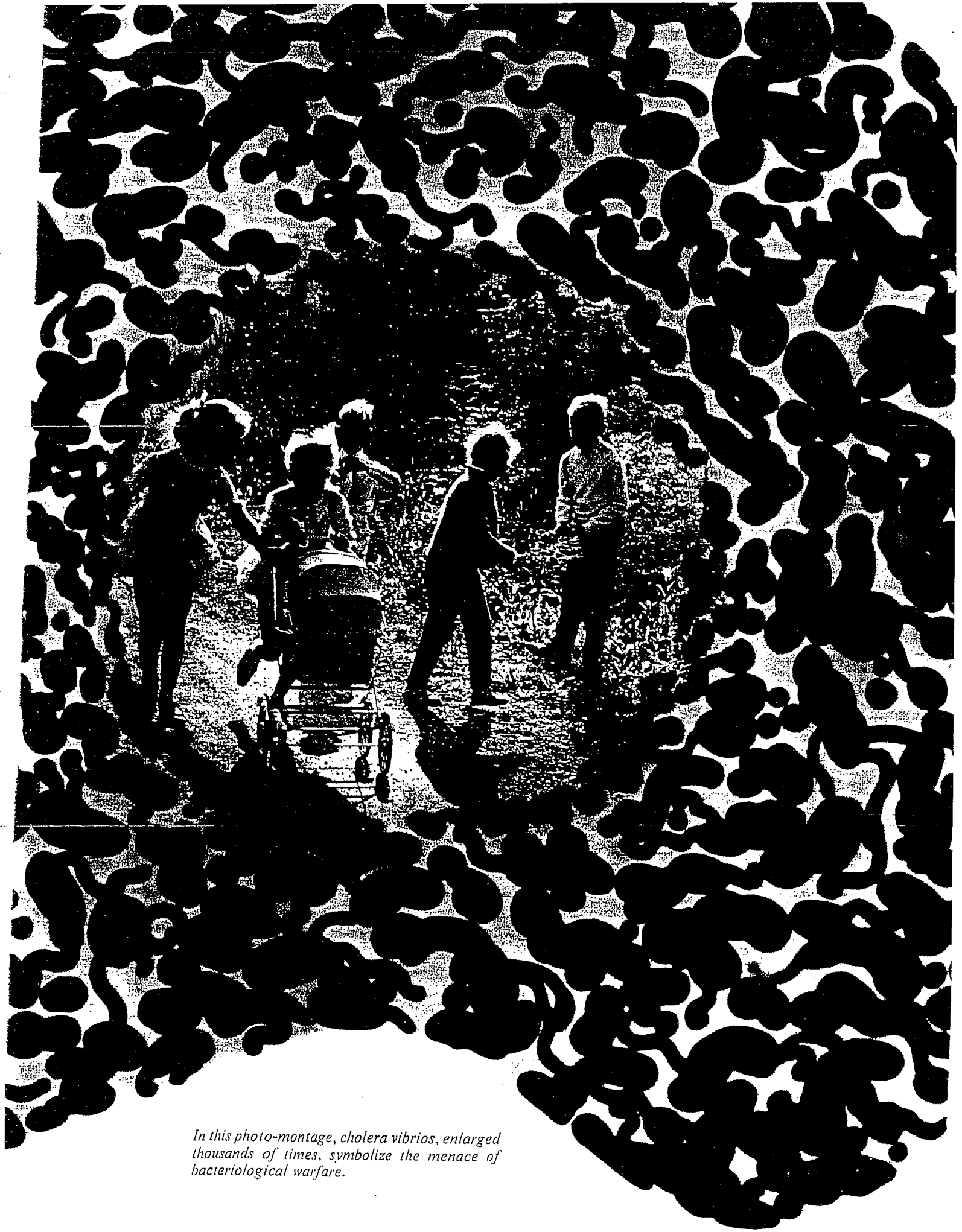
World Health. October 1970 no.18-29



In this photo-montage, cholera vibrios, enlarged thousands of times, symbolize the menace of bacteriological warfare.



Small children cannot wear masks. For protection they can be placed in gas-proof bags with filter walls, an expensive method.



In this photo-montage, cholera vibrios, enlarged thousands of times, symbolize the menace of bacteriological warfare.

Although advanced weapons systems would be required for the employment of chemical and biological agents on a militarily significant scale against large civilian targets, isolated and sabotage attacks not requiring highly sophisticated weapons systems could be effective against such targets in certain circumstances with some of these agents.

The weapons

The WHO report defines *chemical agents of warfare* as all substances employed for their toxic effects on man, animals, or plants. This definition excludes chemicals that exert their primary effects through physical force, fire, air deprivation, or reduced visibility such as high explosives, smoke, and incendiary substances.

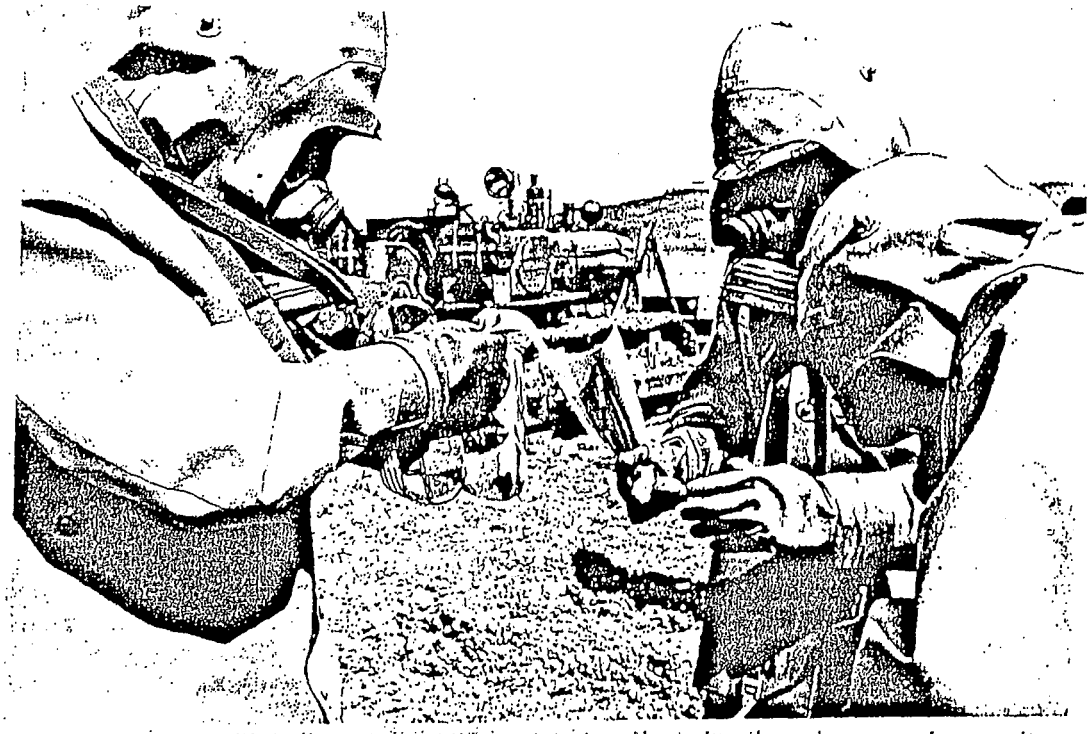
Biological warfare agents are those that depend for their effects on multiplication within the target organism. They could be used in war to cause disease or death in man, animals, or plants.

Chemical and biological weapons are linked together in the psychology, the customs, and the international law that restrain their use. There are also important areas of overlap in the technology of dispersal of these weapons and in the means for protection against them. Nevertheless, there are several general categories that may be distinguished and it is useful to do so in order to describe their nature and possible effects. I shall discuss five kinds of weapons:

1. Lethal biological weapons.
2. Incapacitating biological weapons.
3. Lethal chemical weapons.
4. Incapacitating chemical weapons.
5. Anti-plant agents.

The distinction between lethal and incapacitating is not clear-cut. This is particularly true under the extremely uncontrolled conditions of warfare. Even tear gas is used in war together with bullets and bombs to increase casualties by forcing men from protective cover and by reducing their ability to defend themselves. The distinction is further blurred by the existence of a continuous spectrum of agents from those that are highly lethal to those that in moderate dosages are usually incapaciting rather than lethal.

Let us first consider lethal biological weapons. They operate by disseminating clouds of disease germs over the target area or upwind from it. The germs would then be inhaled by the target population. The disease anthrax is an example. Caused by the bacterium *Bacillus anthracis*, it is mainly encountered as a disease of domesticated animals that is occasionally transmitted to man. Because it is not normally very contagious among humans, natural cases of anthrax are generally sporadic rather than epidemic. However, if the bacteria were sprayed in the air as an aerosol, human populations over very large areas could be infected and killed. The inhalation of about fifty thousand spores of *Bacillus anthracis*, a dose weighing less than a millionth of a gram, is believed to be enough to cause a fifty per cent chance of contracting pulmonary anthrax. Symptoms would first appear about a day after the attack. The onset might be mistaken for a common cold but this would be followed by severe coughing, cyanosis, respiratory failure and death. Untreated pulmonary anthrax is almost always fatal.



Protective suits and masks are becoming increasingly awkward and cumbersome. In war, it would be extremely difficult to protect the population.

The WHO report gives estimates of the area that can be covered by an attack with various biological agents under particular illustrative conditions. As an example of a "small-scale" attack the report assumes that one light bomber delivers ground functioning "bomblets" containing a total of fifty kilograms of dry powdered anthrax spores along a two kilometer line at right angles to the prevailing wind. It is assumed that the attacker chooses a time when the intensity of atmospheric turbulence is less than a certain level. Such stable atmospheric conditions occur rather commonly at night. The bomblets release the agent as a fine mist which then drifts over the target area. The calculation takes into account the dissemination efficiency of the bomblets, the decay rate of anthrax infectivity, the rate of vertical dilution in the atmosphere, the rate of deposition on the ground and the dose response curve for man. For such an attack with anthrax spores, the WHO report predicts a high mortality rate over at least twenty square kilometers. Although there are many uncertainties in the quantities that enter into the calculation, this estimate is deliberately conservative. The United Nations report in a similar discussion considers an attack by a large low flying bomber dispensing 10,000 kg of biological warfare agent along a one hundred kilometer line by means of a spray tank. The area in which a high casuality rate would occur following such an attack is estimated to be as large as one hundred thousand square kilometers, depending on the particular agent used.

Microbes

Among the lethal biological agents that might be considered for military use are the viruses of Eastern equine encephalitis and yellow fever, the rickettsia causing Rocky Mountain spotted fever and the bacteria causing anthrax, plague, cholera, glanders and melioidosis. There are moderately effective vaccines and antibiotics against some of these diseases but none against others. Moreover, such protection could be overwhelmed by a massive attack and for some agents antibiotics can be circumvented by the use of specially bred drug-resistant strains of the microoganism chosen by the attacker. Protection can be

Although strategic chemical weapons would add little to the already enormous destructive capability of the nuclear powers, the proliferation of these agent weapons among the non-nuclear nations would simply increase the scope for terror and threat in international relations and increase

given by gas masks or air-filtered shelters if there is advance warning of an attack, but no satisfactory early warning device has been developed. Even if warning were available, the protection of a civilian population would be an enormous task. The provision of gas masks and shelters, and the maintenance of discipline for their use would require a major and sustained economic and political effort. Even then, reliable protection of civilian populations against a determined biological attack could not be guaranteed.

The next category of weapons to be considered is incapacitating biological weapons. An example is Venezuelan equine encephalitis. This disease, caused by a virus, is characterized by severe headache, nausea and prostration. In natural epidemics, the case fatality rate from Venezuelan equine encephalitis is generally less than 0.5 per cent. Whereas lethal biological weapons such as anthrax could be considered for strategic attacks on populations over large areas, it has been suggested that incapacitating agents might be used in certain tactical situations to reduce the fighting efficiency of the other side, as, for example, before an invasion. Nevertheless, substantial numbers of civilians, particularly infants and the infirm, would almost inevitably be killed by any widespread dissemination of incapacitating biological agents. This would be true even if the overall case fatality rate is only a few tenths of a per cent. Moreover, there is the possibility that the fatality rate under military conditions might be much higher than the rate estimated from natural occurrences of the disease, or from laboratory experiments under controlled conditions.

It is not likely that biological warfare agents would be deliberately chosen to be contagious to man. To do so would maximize the risk of spreading disease far beyond the intended target, endangering the territory of the attacker and his allies. Nevertheless, the unnatural and highly uncontrolled conditions inherent in military operations create the possibility that wide-spread epidemics would be unintentionally started or that dangerous foci of infection would be established in man or animals. There is also danger that the bacteria or viruses used in an attack or even in a field test could subsequently emerge from exposed populations of humans, rodents, birds, or other exposed animals in modified or mutated forms possessing increased persistence, virulence and contagiousness for man.

From the foregoing, it should be clear that biological weapons could kill and incapacitate human populations over vast areas and that even the development and testing of these weapons could pose a threat to all mankind.

Although biological weapons could be a terrible menace, the threat they present seems now to be receeding. After a White House review of a biological weapons programme that went forward out of its own momentum without any careful attention from high civilian officials, the United States has decided unilaterally to renounce the development, production, possession and use of all biological weapons. Great Britain has proposed a draft convention under which all nations would renounce biological weapons and the UN Secretary General and the Security Council would investigate charges of violations. The Soviet Union together with eight other socialist countries have put forward a draft convention for a ban on biological weapons and on chemical weapons as well. Charges of violations would also be referred to the Security Council. Several other nations including the Netherlands, Austria, the Federal Republic of Germany, and Canada have given assurances that they will not produce biological weapons. Indeed, there doesn't seem to be any serious interest in acquiring these weapons in any nation. In this respect, the time is propitious for international agreement on biological disarmament. However, whether this can be secured may ultimately depend on progress in chemical arms control and disarmament, for in many respects the two are closely linked.

Nerve gases

Chemical weapons present a much more immediate problem. They were used in World War I in great quantity and are now stockpiled by the United States and the Soviet Union and are also possessed by several other nations. Modern lethal chemical weapons are the nerve agents, first developed but not used during World War II. These chemicals are hundreds of times more poisonous than the gases of World War I. They kill when inhaled or when deposited as liquid droplets on the skin. The term "nerve gas" derives from the fact that these poisons operate by interfering with the transmission of nerve impulses. They inactivate the enzyme cholinesterase, which normally functions to terminate the transmission of a nerve impulse. After exposure to nerve agent, excitation continues without control. This causes blurring of vision, intense salivation, convulsions and death from repiratory and circulatory failure.

The first nerve gases to be produced were the so-called G agents, of w[hich] sarin or GB is probably the most impor[tant]. Sarin is isopropyl methylphosphonof[luo]ridate, a volatile liquid that evapor[ates] at room temperature to a colourless a[nd] odourless gas. Weapons containing it p[ro]duce a spray which then evaporates, cr[eat]ing a respiratory hazard for unprote[cted] persons. The lethal exposure for ma[n] estimated at 100 mg minutes per c[ubic] meter. This means, for example, that a m[an] would accumulate a lethal dose in o[ne] minute if the concentration of sarin in [the] air were 100 mg per cubic meter.

A gas mask can provide good pro[tec]tion against sarin. When properly wo[rn] modern gas masks are capable of reduc[ing] the concentration of all known war g[ases] by a factor of approximately one hund[red] thousand. In addition, there are chemi[cal] antidotes for nerve agents that can prov[ide] protection if the dose of the agent is [not] very great and if the antidote is admin[is]tered promptly.

Another class of nerve agent appro[xi]mately ten times more poisonous than [the] G agents was discovered in the 19[50]s. They are the so-called "V" agents. [The] United States is known to stockpile a[gent] VX. Its formula is still secret although a WHO report suggests that it is ethyl [S]-dimethylaminoethyl methylphosphonoth[io]olate. Also a liquid but much less volat[ile] than sarin, VX is lethal either when inhal[ed] or when deposited on the skin. VX a[cts] somewhat more slowly than sarin b[ut] still can kill within a few minutes of [an] exposure. Because it is relatively n[on]volatile, VX can be used to contamin[ate] the ground and objects on which it is deposited, making an area hazardous f[or] many days. The lethal dose of VX app[lied] to the skin has been estimated to be f[rom] two to ten mg depending on the site of application. Since contact with even a small droplet of VX can be fatal, adequate protection requires the wearing of a spec[ial] suit as well as a gas mask. The wearing of protective suits and masks is extremely cumbersome. They are mechanically awk[ward] and the build-up of body heat is a serious problem. Fighting efficiency would be severely reduced by the wearing of [the] protective equipment and also by the strict observation of various special precau[tions] necessary for survival in a [nuc]lear chemical environment. For tactical use against an enemy without protective equip[ment], lethal chemicals would be dev[astating].

"No studies have yet been published on [the] long-term effects in man of exposure to [CS] (a tear gas), despite the increased use of [the] agent by police and military [forces] the world" notes [the]

...g. Against an enemy possessing suits ...masks and able to impose the wearing ...ch gear on one's own troops by the ...t of retaliation in kind, lethal che...al weapons would greatly complicate ...battlefield without giving either side ...or advantage. This consideration acts ...courage the use of chemical weapons ...st modern armies. Unfortunately, it ...also act as an incentive for the use ...chemicals against forces unable to ...d themselves and against civilians.

Lethal chemical weapons could be used ...the strategic attack of urban popula...s. A medium bomber or a converted ...mercial air transport can deliver ...ugh nerve agent to kill a high propor...n of unprotected persons throughout ...central region of a large city. For ...mple, in a calculation similar to that ...e for the area coverage capability of ...hrax spores, the WHO report estimates ...at an airborne attack across the wind ...g a two kilometer line releasing four ...s of nerve agent over a city would cause ...casualties over an area of between two ...d forty square kilometers, depending ...the specific nerve agent and types ...munitions employed. Given adequate ...ming, a highly disciplined population ...uld be defended against such an attack ...a combination of gas masks, protective ...lters and antidote therapy. As with ...fense against biological attack, appro...ate defensive measures would entail ...at economic outlays and the kind of ...d discipline that can be maintained ...ly in a political atmosphere of extreme ...sion. Although strategic chemical weap...s would add little to the already enor...s destructive capability of the nuclear ...owers, the proliferation of nerve agent ...apons among the non-nuclear nations ...uld simply increase the scope for terror ...d threat in international relations and ...uld further increase the world's preoc...pation with military preparations.

Poisoned weapons

It is also important to consider the ...ssible role of lethal chemical weapons ...a "low level" conflicts. Today such con...ts are fought with high explosive and ...ne weapons which individually have ...ited area effect. Although such wars ...n be exceedingly destructive, they be...me so only when enormous quantities ...l weapons are used. Many of the types ...f munitions used in limited war, however, ...uld be filled with lethal chemicals. In ...s way, the "kill area" of light-weight ...unitions such as mortar shells and rockets ...uld be increased by a factor of as much as one hundred. Even though combatants could be provided with protective equipment, such weapons would be devastating to military units caught unprepared and to civilians, especially in densely populated urban areas.

There is an additional class of toxic agents which under our definition would be classed as chemicals but which have important similarities with biological weapons. These are the so-called toxins. They are poisonous substances produced by living organisms including plants, animals and bacteria. Examples are ricin from the castor bean, chironex toxin from a jelly fish, and botulinal toxin from the bacterium *Clostridium botulinum*. The above-mentioned toxins are highly lethal to man. Others, such as the staphylococcus enterotoxin, the substance responsible for common food poisoning, usually have an incapacitating effect that is only temporary.

Toxins are not capable of multiplication within the body. That is why they may be regarded as chemicals. Nevertheless, the toxins produced by bacteria often cause symptoms similar to those caused by the bacterial infection itself. Thus, toxin weapons, both in terms of the means of their production and the symptoms they can cause are closely related to biological weapons. Another similarity lies in the manner in which toxin weapons might be used. Certain toxins are considerably more poisonous than the most toxic nerve agents known. An example is botulinal toxin which the WHO report estimates to be over a hundred times more poisonous than VX. If botulinal toxin could be stabilized against deterioration in the air, extremely small amounts could be used for the attack of very great areas. Thus, if toxin weapons can be brought to anything like their full military potential, their area coverage capability would begin to rival that of germ weapons. Because of these similarities between toxins and germ weapons, the United States included toxins in its renunciation of biological weapons.

Because toxins are not absorbed effectively through the skin, gas masks would provide protection as would shelters fitted with special air filters. Protection can also be afforded by prior immunization with a specific toxoid, but each toxoid is effective only against a particular kind of toxin and for some toxins the margin of protection is not enough to be of practical significance. Any attempt to defend civilian populations against attack with toxin weapons would run into essentially the same extremely difficult problems that are posed by other chemical and biological weapons.

The only all-out employment of chemical warfare in which both sides used gas without restraint occurred during World War I. The first gas munitions used were tear gas grenades developed before the war for riot control and brought to the front as personal weapons by former police officiers. Subsequently, artillery shells filled with agents that cause visual impairment, respiratory irritation, and vomiting were introduced by both sides. These chemicals, collectively known as harassing agents, or short-term incapacitants, caused few direct casualties but were employed throughout the war in order to reduce the fighting efficiency of soldiers.

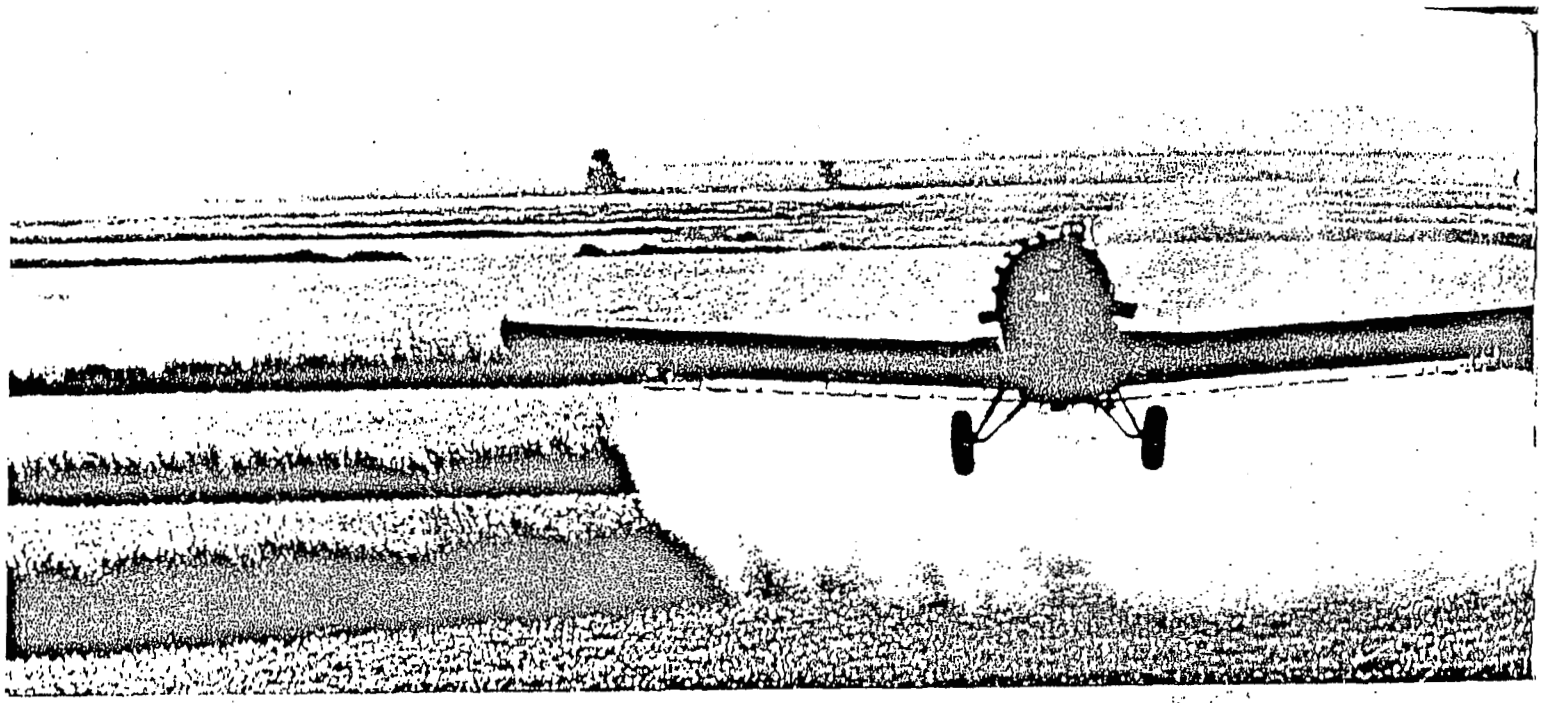
Psycho-chemicals

Modern incapacitating chemical weapons are of two types: one with effects lasting considerably beyond the period of exposure and one with brief effects. An example of the longer lasting type is the United States agent known as BZ. This is a psycho-chemical, the identity of which is still secret although the WHO report speculates that it belongs to the family known as benzilates. BZ is a solid that can be dispersed as an aerosol to be inhaled by persons in the target area. It effects both physical and mental processes causing blurred vision, disorientation and confusion. Its incapacitating effects can last for several days.

Although a great deal of effort has been made to find an incapacitating chemical weapon without undesirable side effects, none has been found. Although BZ was at one time portrayed as a satisfactory incapacitant, it is no longer so regarded, even in military circles. It can elicit unpredictable and often violent behaviour. Men highly motivated to fight may do so more tenaciously under its influence. Furthermore, BZ has serious effects on the body's water balance and temperature regulating mechanisms that could lead to death, particularly under hot, dry conditions.

The principal short-term incapacitant or harassing agent now in military use is CS. This compound, ortho-chlorobenzylidenemalononitrile was first synthesized in the 1920s. After World War II, it was developed as a riot control agent. When employed in warfare, it is more accurately described as a harassing agent or short-term incapacitant. A very large quantity of this material, over fifteen million pounds, has been employed in the fighting in Vietnam.

CS is a white solid which when dispersed in the air as a fine powder or smoke is highly irritating to the eyes, nose, respiratory tract, and, at high doses, to the skin.



A light plane spraying insecticides to increase food production. It is just as easy to spray chemicals that can defoliate large areas.

CS causes intense irritation even at concentrations in the range of one mg per cubic meter. Symptoms generally pass within minutes after exposure ends if the dosage is not too great. However, when used in warfare, dosages are sometimes high enough to cause severe blisters and burns that take several days to heal.

Published estimates of lethal doses of CS for healthy adults vary from 25,000 to 150,000 mg minutes per cubic meter. They are based on extrapolation from results of tests on laboratory animals and may not be correct for man. Clearly, there is a very large difference between the lethal dosage of CS and the quantity inhaled by a person during a brief exposure to concentrations such as those generally used by properly trained police for riot control purposes. Nevertheless, many types of military CS weapons produce much higher concentrations of the agent than do police munitions and it may readily be calculated that exposures in certain battlefield situations will considerably exceed the dosages thought to be lethal for man.

A newer form of this agent is designated CS2. It is a powder consisting of micron-size particles treated with silica gel and a silicone compound to improve its moisture resistence. CS2 can be effective in the field for several weeks. It is reintroduced into the air by the wind and the movement of people and vehicles. This form of CS is used to contaminate territory and field fortifications in order to deny them to the other side.

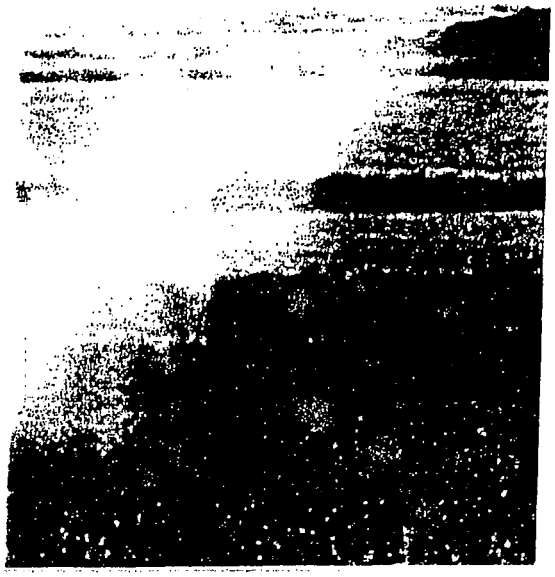
Since a gas mask provides good protection against CS, the main incentive to use it in warfare is when facing unsophisticated or poorly equipped forces.

It is sometimes proposed that incapacitating agents be used in order to make war more humane. There is good reason, however, to expect just the opposite effect. If incapacitating chemical weapons are introduced into a war in which lethal weapons such as bombs, bullets and flame are already in use, there will be great pressure to use the incapacitants in close coordination with the lethal weapons already in service in order to increase the the overall effectiveness of military operations. This has been the experience whenever incapacitating chemicals have been introduced into warfare from World War I to the present time.

Plant killers

The last weapons we shall consider are anti-plant agents. These may be either biological or chemical. Chief among the biological agents that could be used to attack plant life are certain fungi which attack food crops. The spores of such agricultural scourges as rice blast and wheat rust could be deliberately released over an enemy's territory in order to destroy his food supply. Such an attack would represent an extreme form of anti-population warfare since it would leave military forces and installations intact for a long time, exerting its military effect only slowly and indirectly by subjecting the civilian population to starvation. Anti-crop biological weapons are included in the recent U.S. renunciation of biological weaponry and there does not now seem to be any serious interest in these weapons on the part of any nation.

A very different picture is presented by the chemical anti-plant weapons. The extensive use of chemical herbicides in warfare is quite recent, having so far occurred only in Indochina. Some five million acres of forest land have been chemically defoliated in order to improve visibility for military reconnaissance and to deny territory to opposing forces. The chemicals are sprayed by low flying aircraft, each flight covering approximately 300 acres. Anti-plant chemicals have also been sprayed on some five hundred thousand acres of crops in Vietnam, in order to deprive opposing forces of food. The chemicals used for defoliation are derivatives of 2, 4-dichlorophenoxyacetic acid (2,4-D) and 2, 4, 5- trichlorophenoxyacetic acid (2, 4, 5-T) as well as a compound known as picloram. The principal anti-crop chemical that has been used is sodium dimethyl arsinate. These same compounds have previously been used with good results in many parts of the world for beneficial purposes such as selective weed control in agriculture and forest management. However, when used in war, herbicides are applied at concentrations much higher than generally used domestically, over larger contiguous areas, and under much less careful control to avoid damage to the civil economy, the ecology, and human health. In Vietnam, the use of 2, 4, 5-T has recently been suspended because of findings that this chemical and some of the impurities it contains cause birth defects when fed to pregnant laboratory animals. The large-scale military employment of antiplant chemicals poses ecological and public health problems of which not very much is known but which



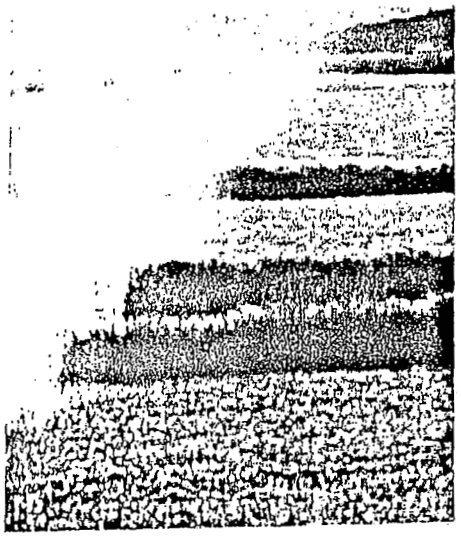
A lethal dose of nerve gas here seen in solid form compared with a matchstick. Fifty of people receiving this dose on the bare skin would die.

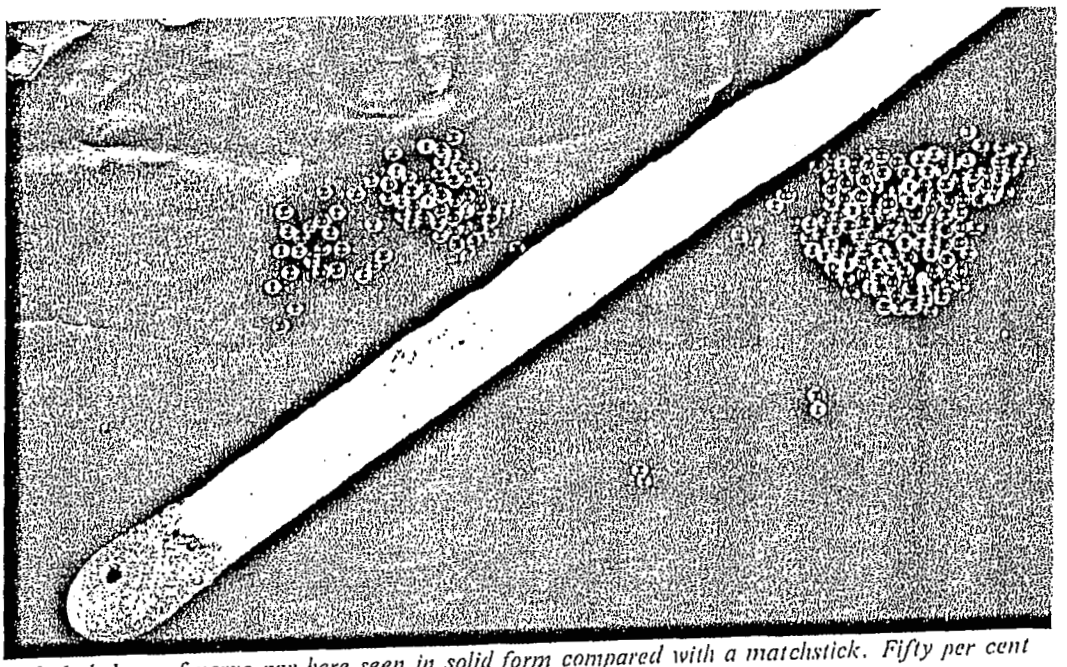
be quite serious. Anti-plant chemicals could certainly be used in many conflicts as agents of starvation and economic warfare against the civil population. Because of the ease with which this tactic can be practised, it could be difficult to stop once the precedent is set.

Preventing CBW

The most important international effort to prevent the use of chemical and biological weapons is the Geneva Protocol of 1925. It prohibits "the use in war of asphyxiating, poisonous, or other gases, and of all analogous liquids, materials, or devices" and "the use of bacteriological methods of warfare". The second phrase is now interpreted as including all forms of biological warfare. More than 80 nations are now parties to the Geneva Protocol including all important military powers, all members of the Warsaw Pact, the People's Republic of China and all members of the North Atlantic Treaty Organization except the United States. Ironically, although the United States instigated the Geneva Protocol and signed it in 1925, the Senate failed to approve the treaty when it was debated in 1926. Years later, the Protocol was returned to the White House where it still remains. Last year, however, President Nixon announced that he would submit the Protocol to the Senate anew, for its advice and consent to ratification. This submission is expected in the very near future.

A technician places a rabbit in a storage shed





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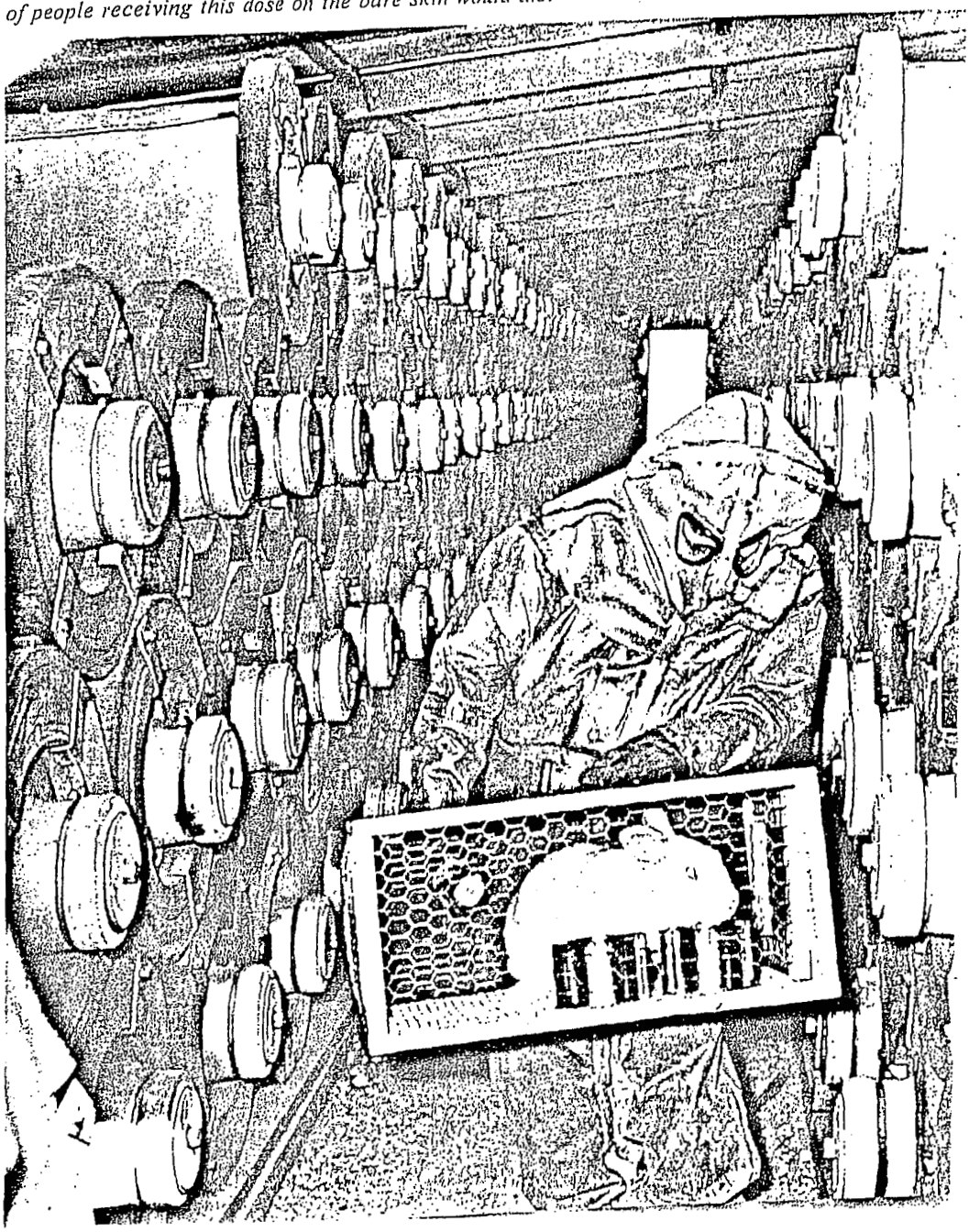
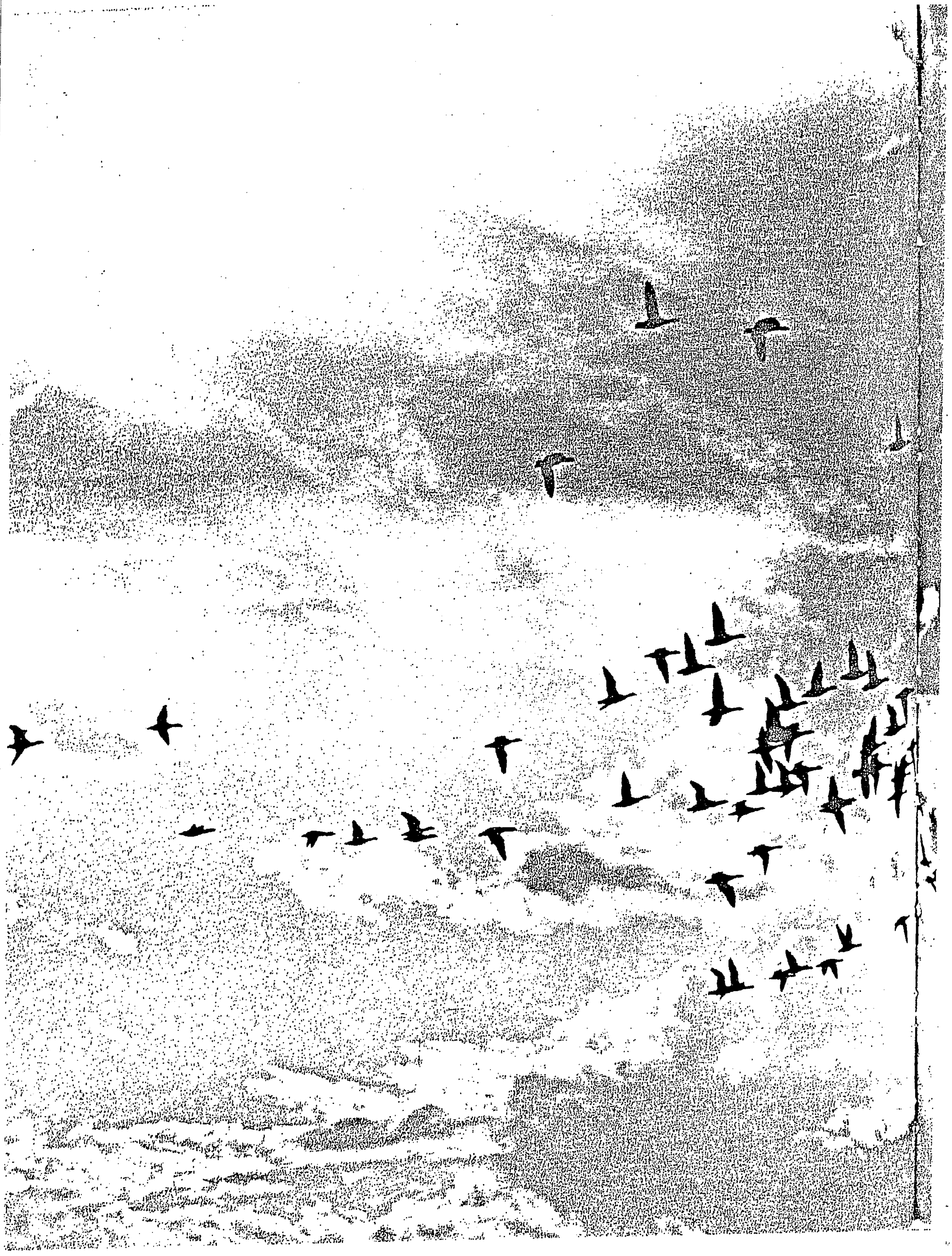
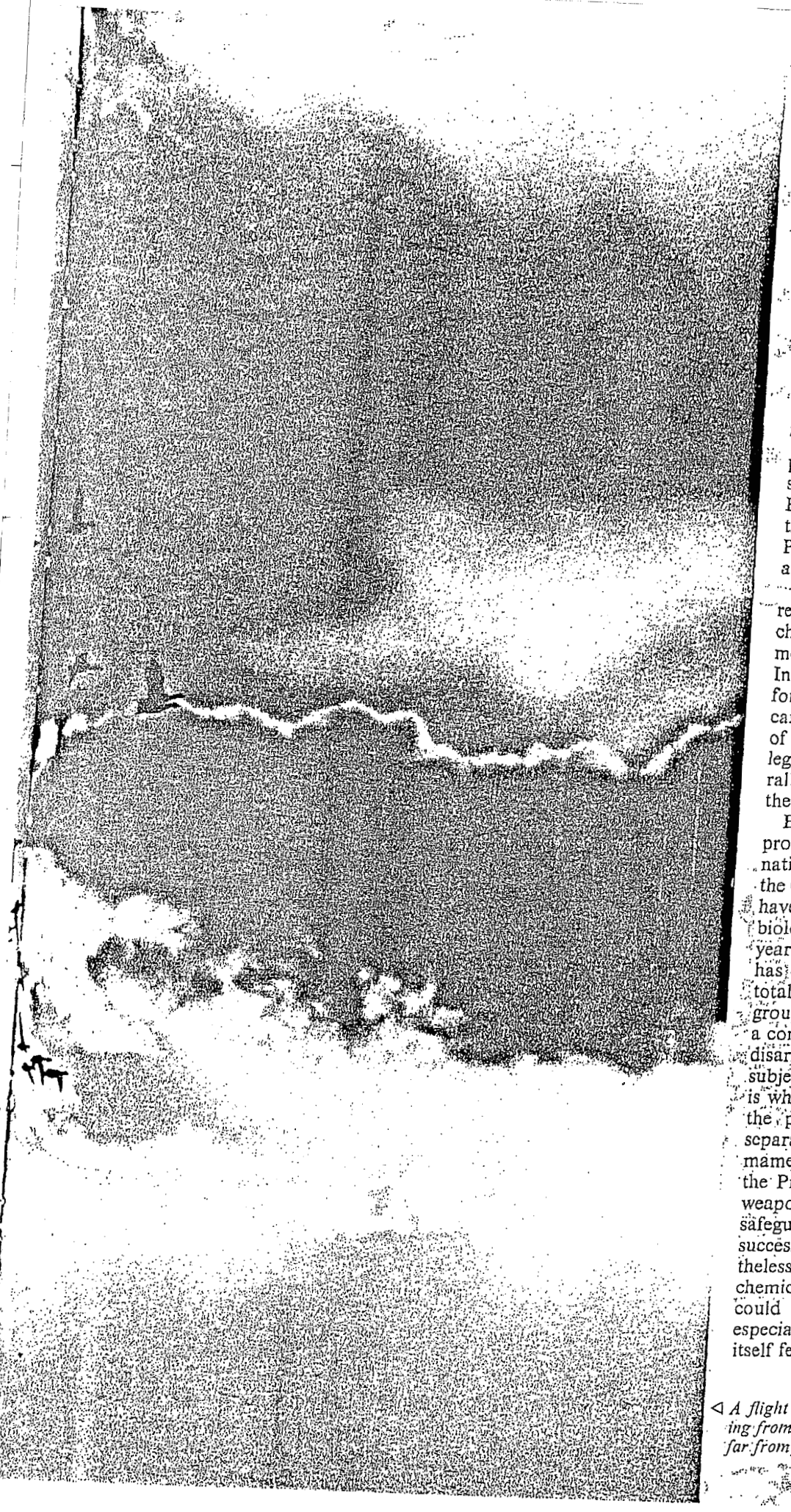


A technician places a rabbit in a storage shed for deadly nerve-gas. Rabbits react quickly if there are any leaks. ▷





Whether or not the Geneva Protocol prohibits the use in war of harassing gas and anti-plant chemicals is a subject of some dispute. Most nations that have declared their views have held that these agents are prohibited by the Protocol. Last winter, at the United Nations General Assembly, a group of twenty-one non-aligned nations co-sponsored a resolution holding that the Protocol prohibits the use in war of all chemical agents directed at men, animals or plants. The resolution was passed by a vote of eighty to three with thirty-six abstentions.

Certainly, the Protocol is an important factor in maintaining the expectation that gas and germs will not be used in war. This expectation helps to prevent the proliferation of chemical weapons. Dissension regarding the meaning of the Protocol weakens its psychological effectiveness and endangers the utility of the Protocol as a clear standard for agreement among belligerants.

It is not known whether the difference regarding harassing gases and anti-plant chemicals will be resolved. One possible mechanism would be a request to the International Court of Justice at the Hague for an advisory opinion. Such an opinion can be requested by the General Assembly of the United Nations. The moral and legal force of the Court could provide a rallying point for universal agreement on the scope of the Protocol.

Beyond the Geneva Protocol which prohibits the *use* of CB weapons, the nations represented at the Conference of the Committee on Disarmament at Geneva have given high priority to chemical and biological disarmament proposals this year. As already mentioned, Great Britain has proposed a convention that would totally prohibit biological weapons. A group of socialist nations has introduced a convention that would include chemical disarmament as well. One of the main subjects of debate at the Geneva talks is whether or not it is advisable to attack the problem of biological disarmament separately from that of chemical disarmament. Arguments over the scope of the Protocol, the separation of B from C weapons, and the provision of acceptable safeguards will present obstacles to the success of negotiations at Geneva. Nevertheless, there are several approaches to chemical and biological disarmament that could lead to substantive agreements, especially if world public opinion makes itself felt. ■

◁ *A flight of geese could carry diseases resulting from bacteriological warfare over frontiers far from the original site of combat.*