Description of document:	Twelve (12) Reports from the Army Foreign Science and Technology Center (FASTC) Concerning Biological Warfare, Anticrop Warfare, Chemical Warfare and Electromagnetics, 1965 - 1968, released by the Defense Intelligence Agency
Requested date:	24-April-2012
Released date:	06-September-2013
Posted date:	17-March-2014
Source of document:	Commander, US Army Intelligence and Security Command Freedom of Information/Privacy Office ATTN: IAMG-C-FOI 4552 Pike Road Fort George G. Meade, MD 20755-5995 Fax: (301) 677-2956 Email: FOIA/Privacy Office Online FOIA Request Form
Note:	Reports included listed on following page

INCLUDED REPORTS

1. Army Foreign Science And Technology Center (FSTC) Translation: Possibilities Of Chemical Warfare Agents, Country: France, November 1965, FCTC 381-T65-391
2. Army Foreign Science And Technology Center Publication No. FSTC 381-3082, Sino-Soviet Bloc Chemical and Biological Warfare Weapon Systems (U), June 1965
3. Army Foreign Science And Technology Center Study, Foreign Crop R&D Activities Related to Anticrop Warfare (U), September 1966, FSTC-CS-03-10-66
4. Army Foreign Science And Technology Center Publication No. FSTC-CS-03-02-67, Natural Plant and Animal Toxins (R&D for Military Toxic Agents)-Foreign (U), December 1967
5. Army Foreign Science And Technology Center Study, CW Materiel--North Vietnam (U), October 1967, FSTC-CS-03-04-67
6. Army Foreign Science And Technology Center Study, BW Programs (Profile of Personalities, Institutions, And Activities) - Asian Communist Countries (U), March 1968, FSTC-CS-03-06-68
7. Defense Intelligence Agency (DIA) Study, Crop Vulnerability (R&D): Warsaw Pact and Asian Communist Countries (U), October 1968, FSTC-CS-03-12-68-INT
8. Defense Intelligence Agency (DIA) Publication No. FSTC-CS-03-3-68-INT, Virology (BW-Related)--USSR (U), April 1968
9. Foreign Materiel Exploitation Memo Rpt., FSTC CR-20-37-66, Arrow Poisons, Central African Republic MCN-26414 Thru MCN-26416 (U), 1966(?)
10. Defense Intelligence Agency (DIA) Study, Electromagnetic Propagation through the Earth’s Crust (U), April 1968, FSTC-CS-01-08-67-INT
11. Army Foreign Science And Technology Center Study, Communist Bloc Facilities For BW Field Testing (U), February 1965, FSTC 381-2016
12. Army Foreign Science And Technology Center Study, BW-Related Insect Vector Research in the Sino-Soviet Bloc (U), February 1965, FSTC 381-2017

DEPARTMENT OF THE ARMY
UNITED STATES ARMY INTELLIGENCE AND SECURITY COMMAND
FREEDOM OF INFORMATION/PRIVACY OFFICE
FORT GEORGE G. MEADE, MARYLAND 20755-5995

REPLY TO
ATTENTION OF:

Freedom of Information/
Privacy Office

06 SEP 2013

This is in further response to your Freedom of Information Act (FOIA) request of April 24, 2012, for a copy of each of the following reports: FSTC-381T-65-391 - Possibilities of Chemical Warfare Agents (1965); FSTC-381T-65-302 - Improving the analysis of product service life and quality...(1965); FSTC-381T-64-153 - Secret Space (1965); FSTC-381T-65-408 - Wine in Cans (1965); FSTC-381T-65-377 - Two years of observation of telluric currents at Irkutsk (1965); FSTC-381T-65-300 - Kilogram Kilopond (1965); ARC85-CBW-065010194 - Sino-Soviet Bloc Chemical and Biological Warfare Weapons Systems (1965); FSTC-CS-03-10-66 - Foreign Crop R&D Activities Related to Anticrop Warfare (1966); FSTC-CS-03-02-67 - Natural Plant and Animal Toxins (1967); FSTC-CS-03-04-67 - CW Material, North Vietnam (1967); FSTC-CS-03-06-68 - BW Programs (1968); FSTC-CS-03-12-68-INT - Crop Vulnerability (R&D) Warsaw Pact and Asian Communist Countries (1968); FSTC-CS-03-03-68-INT - Virology (BW Related) USSR (1968); FSTC-CR-20-37-66 - Arrow Poisons, Central African Republic (1966); FSTC-CS-01-08-67-INT - Electromagnetic Propagation through the Earth's Crust (1968); FSTC 381-2016 - Communist Bloc Facilities for BW Field Testing (1965); FSTC 381-2017 - BW-Related Insect Vector Research in the Sino-Soviet Bloc (1965); FSTC 381-2031 - Estimate of Soviet Radiological Capabilities 1965-1980 (1965) and FSTC 381-4007 - Soviet Basic Research in Stimulated Emission of Nuclear Radiation (1965) and supplements our response of May 7, 2012.

As noted in our letter, the search has been completed with another element of this command and records have been returned to this office for our review and direct response to you. Please note: No record responsive to your request was located for FSTC-381T-64-153 Secret Space (1965).

We have completed a mandatory declassification review in accordance with Executive Order (EO) 13526. As a result of this review, information has been sanitized and 371 pages are denied in their entirety, as the information is currently and properly classified SECRET and CONFIDENTIAL according to Sections 1.2 (a)(2), 1.2 (a)(3), 1.4 (c), 1.4 (e) and 1.4 (h) of EO 13526. This information is exempt from the public disclosure provisions of the FOIA pursuant to Title 5 U.S. Code 552 (b)(1). It is not possible to reasonably segregate meaningful portions of the withheld pages for release. A brief explanation of the applicable sections follows:

Section 1.2 (a)(2) of EO 13526 provides that information shall be classified SECRET if its unauthorized disclosure reasonably could be expected to cause serious damage to the national security.

Section 1.2 (a)(3) of EO 13526 provides that information shall be classified CONFIDENTIAL if its unauthorized disclosure reasonably could be expected to cause damage to the national security.

Section 1.4 (c) of EO 13526, provides that information pertaining to intelligence activities, intelligence sources or methods, and cryptologic information shall be considered for classification protection.

Section 1.4 (e) of EO 13526 provides that information pertaining to scientific, technological or economic matters relating to national security which includes defense against transnational terrorism shall be considered for classification protection.

Section 1.4 (h) of EO 12526, provides that information concerning weapons of mass destruction shall be considered for classification protection.

The deleted information is also exempt from automatic declassification in accordance with EO 13526, Section 3.3(b)(1) because its release would clearly and demonstrably be expected to reveal the identity of a confidential human source, a human intelligence source, a relationship with an intelligence or security service of a foreign government or international organization, or a nonhuman intelligence source; or impair the effectiveness of an intelligence method currently in use, available for use, or under development.

Since the release of the information deleted from the records would result in an unwarranted invasion of the privacy rights of another individual concerned. This information is exempt from public disclosure provisions of the FOIA pursuant to Title 5 U.S. Code 552 (b)(6).

Information have been sanitized and withheld from the records that would reveal sensitive intelligence methods, techniques and sources. This information is exempt from public disclosure pursuant to Title 5 U.S. Code 552 (b)(7)(E) of the FOIA. The significant and legitimate governmental purpose to be served by withholding is that a viable and effective intelligence investigative capability is dependent upon protection of sensitive investigative methodologies.

The withholding of the information described above is a partial denial of your request. This denial is made on behalf of Major General Stephen G. Fogarty, Commanding, U.S. Army Intelligence and Security Command, who is the Initial Denial Authority for Army intelligence investigative and security records under the FOIA. You have the right to appeal this decision to the Secretary of the Army. Your appeal must be postmarked no later than 60 calendar days from the date of this letter. After the 60-day period, the case may be considered closed; however, such closure does not preclude you from filing litigation in the courts. You should state the basis of your disagreement with the response and provide justification for a reconsideration of the denial. An appeal may not serve as a request for additional or new information. An appeal may only address information denied in this response. Your appeal is to be made to this office, for forwarding, as appropriate to the Secretary of the Army, Office of the General Counsel.

In addition, during the processing of your request, a record was disclosed which is under the purview of another government agency. This office has no authority to release this record to you; therefore, the record is being referred, along with your request, and this letter, for appropriate action under FOIA, and direct response to you.

We are coordinating with another government agency concerning the releasability of their information contained in the record. We will inform you as to the releasability of this information upon completion of our coordination.

We apologize for any inconvenience this delay may have caused you.

There are no assessable FOIA fees for processing this request.

If you have any questions regarding this action, contact this office at 1-866-548-5651, or email the INSCOM FOIA office at usarmy.meade.902-mi-grp-mbx.inscom-foia-service-center@mail.mil and refer to case #2581F-12.

Sincerely,

Brad S. Dorris
Director
Freedom of Information/Privacy Office
Investigative Records Repository

Enclosure

U. S. ARMY MATERIEL COMMAND

FSTC 381-T65-391

TRANSLATION

POSSIBILITIES OF CHEMICAL WARFARE AGENTS

COUNTRY: FRANCE

U S ARMY
FOREIGN SCIENCE
AND
TECHNOLOGY
CENTER

November 1965

(b)(7)(E)

FSTC 381-T65- 391

This translation is a rendition of the original foreign text without any analytical or editorial comment. Statements or theories advocated or implied are those of the source and do not necessarily reflect the position or opinion of the U. S. Army Foreign Science and Technology Center.

Requests for additional copies of this document should be addressed to the Defense Documentation Center, Cameron Station, Alexandria, Virginia, DDC-OSR.

U. S. ARMY FOREIGN SCIENCE AND TECHNOLOGY CENTER
Munitions Building
Washington, D. C. 20315

FSTC 381-T65-391

(b)(7)(E)

POSSIBILITIES OF CHEMICAL WARFARE AGENTS

by Gye-Jacquot

English Pages: 15

SOURCE: L'ARMEE, No 49, June-July 1965

COUNTRY: FRANCE

There is little talk of chemical and biological weapons in the trilogy of modern arms. We generally have two opposing attitudes here. Some people, often try to hide their ignorance by maintaining that these weapons are negligible compared to the all-powerful atom, the dispenser of all future progress or disaster. Others, in contrast, imply that the possibilities of gases or microbes are so terrible -- both for the attacker and the defender -- that the responsible decision-makers tacitly refuse even to contemplate their use.

Classical military documentation deals only with general principles. It might therefore be a good idea to look at some recent American concepts to give us perhaps even a rough idea of the possibilities of chemical warfare.

Employment of Gases

Before 1939, the French did considerable work in this field and in 1945 the Germans were quite busy here; since then, however, only the Americans and the Russians have had the time and the resources for important tests, although they of course do benefit here from prior European experiences, particularly technical experts and materiel; as we remember they dismantled these factories and took them, along with their personnel, out of Germany.

To perfect a war gas, we need not only laboratories but also factories where the gas can be produced and also bottled in unlimited quantities; then we of course also need proving grounds that will have to be vast enough and diversified enough for life-size, realistic gas attack tests, in areas other than the Arctic or desert zones.

Use of Gas Simple -- at Least in Principle

Chemists and biologists have determined the lethal concentration of a toxic agent, in other words, 100 mg/m^3 for one minute (if we take, for example, a recent gas by the name of sarin). Given a target covering an area of 1 km^2 and figuring roughly on the saturation of a layer of 5 m of air at ground level, we can logically predict a consumption of 100 mg x 1,000,000 m^2 x 5 m = 500,000,000 mg, or 500 kg of sarin.

An 155-mm shell, weighing 43 kg, can contain 3 kg of toxic agent; this means that we would have to fire 170 rounds; a 6-gun battery, firing 25 rounds each, in 10 minutes will thus be able to cover the area here in less than 15 minutes.

Keeping in mind the surface area of the targets to be hit, the only thing we have to do is figure out the number of batteries we need; the city of Strasbourg, for example, which covers an area of 10 km^2, could be covered by 10 batteries, firing the load carried by about 50 GMC [trucks] (one

round weighs a total of about 70 kg); the greater Strasbourg area (40 km^2) could be covered with 40 batteries or about 10 artillery regiments (brigade-type [brigaded] artillery regiments).

The requirements which we have just calculated roughly are quite modest compared to those of the conventional artillery. We know that a regiment consisting of sixteen 155-mm pieces can neutralize 4 ha in 2 minutes and 15 ha in 10 minutes; we would thus have to have about 250 regiments -- instead of the 10 we mentioned earlier -- in order to neutralize the 40 km^2 of the Strasbourg area. The ammunition tonnage required would have to be carried by 2,800 GMC instead of the 200 we had earlier.

If the 20 tons of toxic agent were dispersed by means of modern artillery, using Honest-John rockets, with which the regiments are gradually being equipped and whose 600-kg warheads can contain 200 kg of sarin, then we would only need 100 projectiles.

(We realize that, to the expert in this field, the figures given here might be debatable as to some of their details, both from the tactical and the technical viewpoint. But we are looking here only for approximate figures. Besides, as we shall see, chemical weapons, like nuclear weapons, are distinguished by the fact that they are rather inaccurate.)

From Logic to Reality

It might now be a good idea to compare this apparently flawless reasoning with American operational concepts. If we take the same target surface (40 km^2), we will see that we will have to anticipate the consumption of a tonnage ranging from 750 all the way to 50,000 GMC as well as the employment of a corresponding number of artillery regiments, depending on the temperature, the wind, the precipitation, and enemy defenses.

The use of gas will therefore appear either more economical or much more costly than the use of conventional shells, depending on the situation and the circumstances. This variable from 1 to 200 is certainly worth taking another look at and tells us that we cannot, a priori, decide whether or not we are going to use a weapon as capricious as this one.

The conventional manuals sufficiently emphasize the characteristics and effects of gases so that we need not go into this in detail here; we merely want to recall their properties in connection with their large-scale use (which is something that differs tremendously from laboratory tests or from tests on proving grounds involving a limited area). But we do have to analyze the two groups of natural and tactical factors which considerably influence the effective concentrations. A few examples here will give us the order of magnitude of the requirements in specific tactical cases.

Summary of Characteristics of Chemical Warfare Agents

Chemical warfare agents are chemical substances -- gaseous, liquid, or solid -- which can be used for military purposes in order to neutralize,

put out of action, or kill enemy personnel with choking or blister gases or as the result of toxic action upon the entire organism.

Gases or Aerosols

Most of the war "gases" are really liquids at normal, ordinary temperatures; but, like solids, they can be made to act like gases if they are dispersed in the air in the form of aerosols, in other words, particles in suspension; the finer these particles are (a few microns), the more durable they are. The laws of viscosity in liquids bring out the importance of the temperature factor in the stability of the suspension; it is therefore not astonishing that in the field, a temperature that is too low will cause liquid toxic agents (mustard gas, trilons), to precipitate to the ground, whereas a mixture of real gases would remain homogeneous.

Thus the classical distinction between volatile gases (that is, those which remain in place less than 10 minutes) and the persistent gases (those which remain in position more than 10 hours) is very theoretical because a gas can be successively persistent and volatile, depending on the temperature.

Chemistry and Toxicity

Every chemical substance -- even water -- is a toxic substance, depending upon its dose, the mode of introduction, and its persistence in the organism before being eliminated. The chemistry of war gases is a fascinating study -- for the chemist who keeps discovering new synthesis products all the time. For the layman, it suffices to remember that most of the old toxic agents (arsines, phosgene, mustard gas, and lewisites) have a chlorine base and sometimes also an arsenic or hydrocyanic radical base; the recent toxic agents (trilons or "G" agents) or the very recent ones (American V agents) are organic compounds involving sulfur and phosphorus.

Toxicity, that is to say, the effective concentration, is expressed in terms of "ct" [tc -- toxic concentration]; this is the concentration in terms of mg/m^3 of air for an exposure time of 1 minute. The 50% lethal tc [Ltc] is the concentration which statistically leads to the death of 50% of the personnel subjected to this action; this is the basic characteristic for the use of a toxic agent, just like 50% tc -- out of action (here we write: Ltc 50 or tc-ooa [toxic concentration -- out of action] 50 in terms of $mg/m^3/min.$).

Gases are generally classified according to their physiological properties. The amount of the "tc" is shown in the following table.

Physiological Effects	Agent	tc-ooa 50	Ltc 50	Physical state
Irritants				
tear gases	chloraceto-phenone	80	10,000	solid
breathing gases	Arsines	1-60	10-30,000	solid
choking gases	Phosgene	1,500	3,000	gas
Blistering gases	Mustard gases			liquid
	Lewisites			
	skin	2,000	10,000	oily
	pulmonary tract	100	1,500	
General toxic agents	Sarin (trilon)			liquid
	skin		100	
	pulmonary tract		1,000	
	V agents		40 (?) & less	liquid
Non-fatal toxic agents	Neutralizers	?	?	
	Hallucinogens			
	Laughing, etc.			

The irritants (tear gases and sneezing gases) have tc-ooa 50 and Ltc 50 which are in a ratio of 1:100 and even more; this explains why they are mostly used in crowd control; here the so-called "hot points" (the areas that are more heavily saturated with gas than the surrounding areas) do not involve the risk of serious consequences; the concentration required for putting personnel out of action even if increased tenfold, is still less than the lethal concentration.

The more recent the toxic agent is, the weaker will be the tc; the volume to be dispersed (or, to use the jargon term "to be delivered") thus is smaller and smaller and this is, in turn, expressed by a reduction in the number of launching devices and the ammunition tonnage.

Some gases only have one effective means of entry: the respiratory tract. Others (mustard gases, lewisites, G agents and V agents) may penetrate through the skin and through the lungs, depending on whether they are deposited on the surface of the ground or on objects or whether they are suspended in air, and thus in contact both with the skin and the lungs. In the first case, we need a considerably greater concentration than in the second case because the epidermis is naturally less permeable than the mucosa. Mustard gas is at the same time also a blister gas acting upon the skin and a toxic agent in general; this means that any classification would have to be quite arbitrary.

Three Toxic Agents To Be Remembered

Today there are only three gases that should be remembered and retained for military use: mustard gas, sarin, and V agents.

Yperite or "mustard gas" was used for the first time in World War I in the region of Ypres. This is still a useful CW agent because it is a persistent liquid which can last for several weeks without evaporating, and permanently contaminate the terrain, even in very cold regions. In a temperate or hot climate, yperite evaporates in a few days and burns personnel through its vapors, provided the men have not already been attacked by the aerosols before they settle. It has a delayed-action effect: it is invisible and painless for several hours which means that no decontamination and treatment can be undertaken during that period. It is, in other words, definitely not an "assault" CW agent because it does not rapidly knock out personnel.

Sarin is one of the trilons or "nerve gases" perfected in Germany around 1944. It involves roughly the same technical employment conditions as mustard gas but the tactical conditions are the exact opposite because this gas has an immediate effect and leads to generalized twitching of the muscles, producing death in a few minutes. On the other hand, it can be very quickly eliminated from the organism and has almost no aftereffects if a lethal dose was not received.

The V agents have physiological characteristics and effects that are similar to those of sarin. It has been discovered rather recently and this explains why we do not have much in the way of accurate information on this subject.

Natural Conditions -- Essential Factors in CW Attack

We must have an over-all knowledge of the physical and physiological properties of gases in order to be able to select the gas best suited for the achievement of the desired tactical results. More important is a computation of the consumption figures because this will give us an opportunity to compare the requirements to the realistic possibilities for launching these agents and for supplying them to the launching units.

Let us therefore take up the five factors of weather and terrain which tests enable us to combine in an equation; of course, once again, we must keep in mind that the margin of error in this kind of approximation can be quite broad.

Wind Speed and Direction

Wind direction is very important when the target is in or near the front lines. If the target is located in depth, then our own units will be exposed to very little risk; first of all, they can be warned and they

will be able to put on their masks; second, the mere movement of a toxic layer diminishes its concentration through dispersion in height and along a surface.

To obtain a given concentration, and assuming the wind speed is 20 km/hr, we would have to expend 10 times more CW agent than if the wind speed were only 5 km/hr.

A moderate wind is thus a big handicap in any CW mission and a strong wind makes it impossible.

The Temperature Gradient

This is defined as the difference between the temperature at 2 m above the ground and at 0.50 m above the ground. Warm air rises: if the gradient is negative (conditions of "instability"), then the warmer and hence lighter air on the ground will be replaced by the higher-situated cold layers. We will have a mixture and, consequently, an accentuated dispersion of the CW agent. These unfavorable conditions can be encountered during warm and clear days.

On the other hand, we have "stability" (or temperature inversion) when the gradient is positive; this involves a minimum of turbulence hence the cold air remains on the ground. These favorable conditions obtain during clear nights and at daybreak.

The "neutral state" -- which is between inversion and instability -- is a rather unfavorable condition.

When we use heavy gases (mustard gas) or when we want a heavy but short concentration, the temperature gradient has little effect (factor of 2-3); but if we want to lay down a rather durable layer of CW agents, we must use as much as 8 times the volume of CW agent when the gradient is unfavorable.

Temperature

The direct effect of heat upon fluids is well-known; heat keeps liquid aerosols in suspension much longer; it causes the CW agents already on the ground to release more vapor. A warm agent will get through the skin faster than a cold agent; indirectly, likewise, absorption is facilitated by perspiring skin which means that the pores are dilated (factor of 1.5-1.0 depending on the gas used).

Rain and Terrain

Precipitation brings dangerous clouds down to the ground; the vapors and aerosols are dissolved in the water droplets and with them penetrate into the ground. A moderate rainfall requires 5 times more CW agent than would be needed during dry weather.

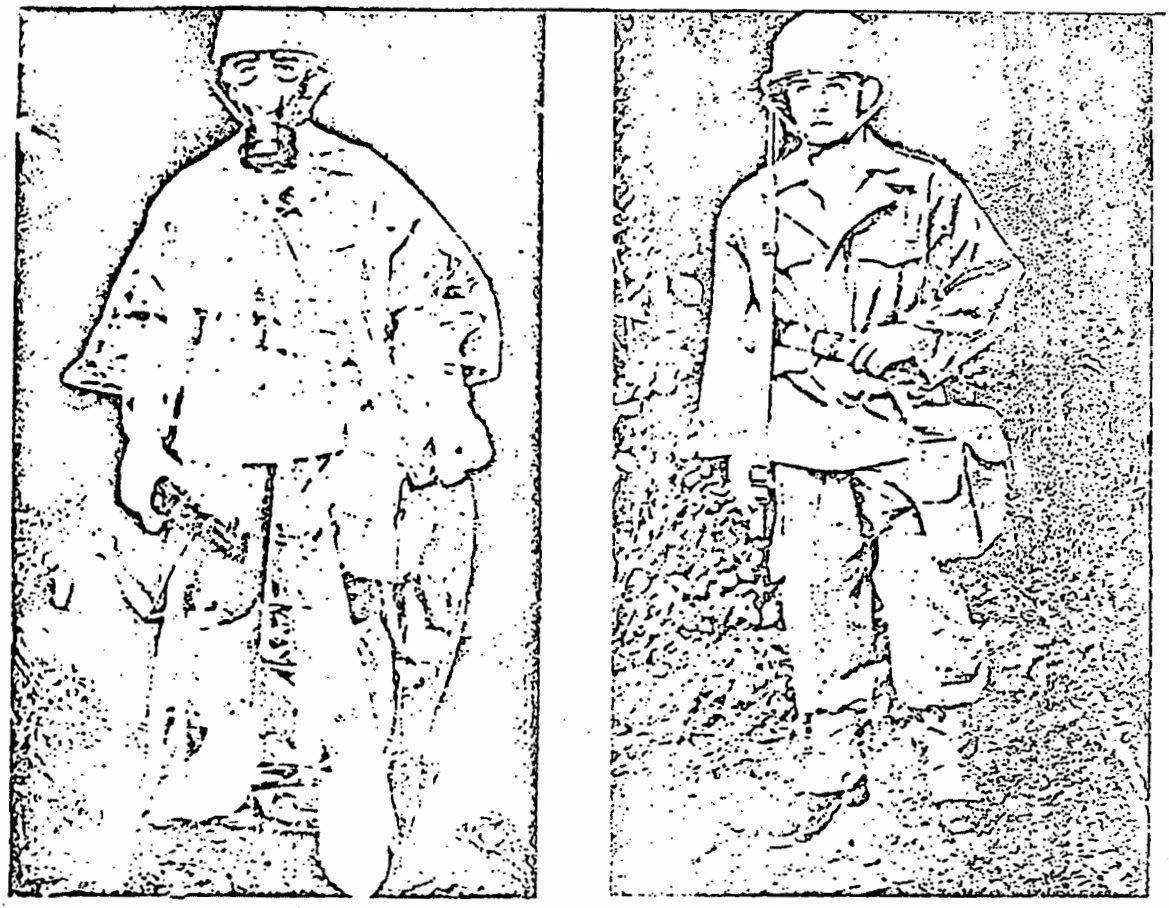
Uneven terrain does not permit even distribution of concentration as a result of the irregularity in the elevations and the corollary currents of air. The leaves of trees constitute a large surface for the deposit of these agents and a large surface for the absorption of the particles, a by no means negligible portion of which is thus neutralized. Uneven or covered terrain thus requires double the concentration required for flat and open terrain. On the other hand, we must note that the contamination of the skin and clothing will be facilitated through contact with contaminated high plants.

All of these natural factors add up (or, more specifically, multiply) and in many cases, in advance, rule out a decisive CW mission. The examples studied below in combination with tactical factors will easily show us why this is so.

Tactical and Logistics Factors

CW agents are thus at the mercy of the elements -- perhaps more so than the conventional arms. Their employment depends equally on tactical factors (position, enemy defenses, effects desired) and on the logistic possibilities (launching devices and ammunition supply).

Let us first of all analyse those factors that can be expressed in terms of figures: protection, percentage of casualties required, vectors, and ammunition; the others are circumstantial or are tied in with the concept of the particular tactical maneuver.



Left Photo: Soldier equipped with regulation protection gear -- model ANP 51 M 53 gas mask, model 63 uniform, cape, hood, gloves, and protective boots, emergency decontamination [selfaid] kit, first aid kit. All of this protection gear can be carried in the carrying pouch, model 63, shown in the photo on the right.

Enemy Equipment and Training

The 50% Ltc or the 50% tc-ooa have been determined statistically for "unprotected" personnel, that is to say, personnel not wearing masks. These figures go up if the personnel is:

Protected, carrying gas mask in carrying pouch;

Trained, to maintain, adjust, and wear the equipment in protective position;

Warned, place on mask at the moment of the attack.

In theory, the mask provides complete protection. However, we inevitably have slight leaks between the face-piece and the skin; these leaks grow bigger if the mask is not properly adjusted to the particular face, if it is not properly maintained, and if it is not supple enough, as well as if the personnel is not properly trained in mask adjustment or when the men move around in a tank or armored vehicle or when they move across difficult terrain.

A leak that might not be serious for a given concentration might become serious if this concentration were increased because the individual would then absorb more of the CW agent. Starting from a certain level it might be indirectly the cause of death if the smarting sensations around the eyes and the nostrils lead to uncontrollable scratching reactions which in turn lead to the instinctive removal of the mask. (It is interesting to note in passing the "chemical cocktail" which is a tear gas or a sneezing gas combined with another really toxic gas).

Statistically, the following "tc" multiplication factors have been established depending upon the degree of personnel protection:

Unprotected	1
Protected, poorly trained, not warned	4
Protected, trained, not warned	10
Protected, trained, warned	20

Of course, the schematic simplification of these figures might be somewhat debatable but the figures do show us the importance of instruction and training for the troops, the commander's function in the preparation of the men, in sounding the alert, and in the discipline that must be imposed in the field so that the men will always take good care of their masks and put them on if there is any danger and, particularly, not to discard them someplace.

Despite the perfection of new gases, conventional protective devices are still effective. They do not neutralize the agent through a chemical reaction; instead they keep it in the cartridge by means of the physical phenomenon of adsorption on filters and active carbon.

Percentage of Casualties Required

Here the analyst moves into an area apparently reserved only for the tactical requirements of the commander. The commander (whom the specialist has briefed on the possibilities of CW agent employment in the light of natural conditions and who has information available from his own intelligence section as to enemy preparations) will have to decide for himself which percentage of casualties he wants to inflict, as we said before, in terms of the artillery and ammunition he has available.

He should certainly be aware that the volume of CW agents required grows as fast as the percentage of casualties desired, roughly according

to the following progression:

Percentage of casualties:	10%	20%	30%	50%	90%
Quantity of CW agent:	1	2	4	7	10

It will therefore often be unreasonable to try to achieve 50% casualties when 10 or 20% would still be enough of a help in any given action.

Ammunition: Necessary and Feasible

The study of factors that can be expressed in terms of figures in the end gives us an ammunition tonnage figure. The table below, better than any long discussion, has been drawn up for European theaters of operation and will give us an idea of the quantities necessary to neutralize 1 km^2 of terrain for 1/4 hour with 25% casualties, using sarin.

For Languedoc [southern France]:

Moderate temperature gradient, wind velocity 25 km/hr; temperature 25° C; open terrain, fairly even, no rain.

For Alsace (summer):

Moderate temperature gradient, wind velocity 10 km/hr; temperature between 10 and 20° C, terrain covered and uneven, moderate rainfall.

For Alsace (winter):

Unfavorable temperature gradient, temperature below 0° C, wind velocity 30 km/hr, no precipitation.

The expenditure figures are expressed in terms of 155-mm shells containing about 3 kg of CW agent, with the round weighing a total of 70 kg; 1 GMC here is assumed to carry 2.5 t.

The requirements in terms of artillery firing chemical shells are based on a fire mission lasting 4 minutes or 192 rounds per regiment of 16 howitzers.

The requirements of conventional artillery have been calculated for the neutralization of personnel out in the open and have been found to require 20 rounds for the initial barrage and 15 rounds, per hectare, to maintain the effect, giving us a total of 3,500 rounds; a howitzer firing 40 rounds in 15 minutes would give us a requirement for 90 howitzers or approximately 6 regiments of four batteries with 4 howitzers each (Model 1959 brigade-regiments).

I am not trying to hide the fact that all of these estimates are rather arbitrary; let us only try to arrive at some general figures so that we can compare our requirements (keeping in mind also that casualties due to poisoning are hardly comparable to casualties due to fire involving

explosive shells). Nevertheless, we can come up with a few broad outlines here:

A CW attack will not have much of an effect on protected, trained, and warned personnel;

An attack conducted in the winter in a continental region, will require a prohibitive expenditure of ammunition;

In a hot climate, on the other hand, the ammunition required will be within acceptable limits if we are not dealing with specially trained personnel.

	Personnel (no mask)	Personnel (with mask) no warning, no training	not warned, trained	warned, trained
Languedoc				
155-mm shell	250	1,000	2,500	5,000
GMC loads	7	30	70	150
Regiments	1.3	5	13	25
Alsace (summer)				
155-mm shell	500	2,000	5,000	10,000
GMC loads	15	60	150	300
Regiments	2.5	10	25	50
Alsace (winter)				
155-mm shell	5,000	20,000	50,000	100,000
GMC loads	150	600	1,500	3,000
Regiments	25	100	250	500
Conventional Artillery				
155-mm shell	3,500			
GMC loads	100			
Regiments	6			

The Bothersome Problem of Launching Devices

Earlier we said that we would roughly confine ourselves to theaters of operation in which the problem of ammunition supply is not insuperable; we must now look into the reason for the considerable difference between the number of howitzers necessary for conventional artillery and the number required for artillery firing chemical shells. This is due to the need for saturating the target within a reduced period of time; if this is not the case, and if the element of surprise is no longer a factor here, the anticipated expenditure, according to the 2nd column, for example, should be somewhere between the 3rd and 4th, or 3-4 times more for trained, but warned personnel than for a unit that is not on CW alert.

Placing a major concentration of artillery fire on a particular sector of the front involves not only a problem of logistics but also a problem of protection and counterbattery fire.

If we have control of the air, we can use aircraft to drop these CW agents and this of course does away with the range limitations; it also eliminates the element of surprise since the fighting man's first reaction is to put on a mask as soon as the bombers are sighted.

The use of Honest-John warheads (each containing 200 kg of CW agent) is very tempting here because the range of this delivery vehicle is several tens of kilometers; this is hardly any more realistic because the means simply are unavailable; it would take 33 rockets to replace 2,100 155-mm shells and, likewise, 33 launching ramps, since the rate of fire is only 2 rockets per hour.

Finally, for rapid but short-range action, the least deceptive launching device is the M-55 Bolt rocket launcher which can fire a salvo of 45 projectiles, each containing 4.5 kg of CW agent, in 15 seconds. Thus we see that about 60 of these rocket launchers would instantaneously do the work of 25 regiments, firing the equivalent of 5,000 rounds of 155-mm ammunition.

The following table should enable us to make some rather instructive comparisons between the different types of ammunition and their modes of delivery.

Launching Devices and Ammunition

	155-mm Howitzer	Rocket Launcher	Honest-John	500-lb Bomb
Range (in km)	15	10	35	aircraft
Rate of fire	6/2 min	45/15 sec	2/hr	
Weight of round	70		5,000	
Weight of shell	45	26	570	222
Weight of CW agent	3	4.6	210	50
155-mm equivalent	1	1.6	70	17

Is a Chemical Barrage Possible?

We often visualize the employment of gas in the form of a chemical barrage intended to stop the enemy. Now, the saturation of a sector of the front only 50 km long, for a depth of 1 km, would, in Central Europe, require 25,000-2,500,000 155-mm shells and 125-12,500 regiments, depending on whether we are dealing with an unequipped enemy in the summer or with a trained enemy in the winter. We can see that these figures are quite unreasonable.

Using rocket launchers, we would only require 300-30,000 tubes, consuming, however, 150-15,000 CW loads -- which is a tremendous figure no matter which way we look at it.

But there is one important point which we must not lose sight of and that is: while conventional artillery neutralizes personnel and partly destroys the materiel, CW shells -- despite an explosive capacity which experts estimate at 10-50% of that of ordinary ammunition -- have relatively little effect on materiel.

The second fact which we must not forget is the temporary character of the CW effect. The quantities calculated above apply for a duration of 10-30 minutes; this means that we have to keep up the barrage afterwards. Regardless of the delivery method contemplated, we can see that this would be very difficult to keep up.

Besides, assuming that we can spread this layer of CW agent over an area of 50 km^2, the defenders will certainly have conventional means available to stop the enemy by means of artificial obstacles or by means of an artillery barrage. The units will be unable to advance on foot and they might even be entirely stopped. The motorized convoy, travelling at the rate of 20 km/hr would remain under the chemical cloud contemplated here for less than 2 minutes; after the alert has been sounded, personnel in vehicles would easily be able to put on their masks and loses would be small.

Local Operations, Position Warfare, and Harassment

Thus we see that an extended chemical barrage is rather unrealistic; the use of a CW agent for a highly localized operation (the reduction of a bridgehead, for example) is much more conceivable; the ammunition and the vector to be used in covering an area of several hectares involve a rather acceptable order of magnitude.

In position warfare, likewise, chemical action is justified, as in 1916, against an entrenched enemy who most frequently avoids the effects of conventional artillery fire, except of course for direct hits, but who could be dislodged from his position by means of gas -- always heavier than air -- which would penetrate and stagnate in the trenches and in the shelters which are less likely to have ventilation, the deeper they are.

But in all of these cases, where the CW agent is a supplement of conventional fire, the simple fact that we are forcing the enemy to put on his mask will cause him more trouble than the need for seeking protection against small-arms ammunition and shell fragments. Keeping the mask in the gas mask carrier during an exercise is one thing; but moving on foot, crawling, using small arms or handling weapons in a tank, with a mask on, is an entirely different thing. This is tough even for trained personnel; in this situation, the fighting man is rather restricted as to his movements, his precision, his morale, and hence also his effectiveness.

Fear

For the moment, at least, operational means and methods in the field of CW would preclude any total or global warfare. But our preceding analysis may be rather deceptive. We have not taken into consideration one factor -- perhaps the most important factor in all cold or hot wars, conventional or unconventional -- the factor of fear.

This eminently subjective factor cannot be expressed in terms of figures. We all know what an artillery barrage means or what it is like to be under fire from automatic weapons; but we do not know (except for some veterans of rather advanced age) what would happen to the morale of a unit under partial chemical attack, not to speak of a nuclear explosion. We can anticipate the physical effects; but the psychological effects are nothing more than conjectures. In 1916-1918, the use of mustard gas was limited both as to intensity and as to surface; it seems that, following the initial surprises, the French GI managed to get along. Modern CW agents, whose effects are insidious but brutal, would probably cause panic, perhaps unacknowledged, but certainly general, a state of permanent anxiety which would paralyze the reflexes of speed, aggressiveness, and coordination necessary in any effective military action as far as the combat troops are concerned.

If artillery barrages and aerial bombings are combined with chemical strikes -- without the latter causing major casualties -- in both the rear and forward areas, we have to fear mutinies and mass insubordination. If the cities are hit, there will probably be mass demonstrations calling for a suspension of hostilities, triggered by the unreasoned fear of total annihilation. Only the initiated know today that this annihilation is nothing more than an illusory threat; but we can be sure that a pacifist psychological preparation effort, combined with even very limited subversive action, would cause a population, which may be rather uninformed and rather unprepared to make sacrifices, to demand an end to the war, even through unconditional surrender.

At smaller costs, chemical strikes against civilians and fighting men might perhaps produce the same reactions as strategic or nuclear strikes.

Does this mean that CW could, in this fashion, become a decisive weapons system, a deterrent weapon?

Is there a reasonable conclusion for this analysis which may be somewhat disjointed to some people? In the opinion of the engineer and the man with the computer, CW is a deceptive, expensive, and uncertain weapons system; its possibilities of employment appear to be limited to harassing actions that are specifically spelled out in time and space. The strategists, however, who must keep in mind the unreasoning reactions of a mass of people with little warning and information, may well consider CW as a decisive weapon, approaching the nuclear weapons system in its efficiency.

Is the truth somewhere in between? At this time, we cannot foresee any possible compromise between these two aspects; instead it would seem that they should exist together, side by side. Due to the absence of gigantic delivery means and methods, a conventional conflict could not be physically affected by the massive employment of CW agents. These agents undoubtedly will decide the outcome of local actions; but, by themselves, they will not be able to win any major battle. On the other hand, the very fact that these agents have been used and the fear they inspire might indirectly decide the outcome not just of a battle but of the war.

This viewpoint might explain why the Americans are pumping considerable sums into the budget of the Chemical Corps amounting to something like 1/40 of the total French military budget. We do not know exacting what the Russians are cooking up here but we do know about the detailed preventive, protective, and decontamination measures which they are instituting even at the very lowest echelons of the nation, as if they were expecting a chemical war, rather than a nuclear war. The two camps furthermore appear to be setting up reserve stockpiles of CW ammunition on the order of 10% of their total stockpile.

But any opinion in this area is bound to be nothing more than speculative. As we look at the decrease of the Lct which moved from 1 gram/m^3 in 1914 to 100 mg/m^3 in 1944 and to several tens of mg/m^3 only 10 years later, then we are bound to think that, in the near future, the figure of the Lct will be on the order of unity for certain toxic agents. When that time comes, the logistic and artillery requirements will be tremendously reduced and will be quite a bit lower than those of the conventional weapons. CW will then have become not only a psychological deterrent but also an effective means of interdiction and blockage in battle.

If, moreover, non-lethal CW agents are perfected under the same conditions, then we might seriously envisage a war without dead and without material destruction. The use of incapacitants would provide an efficient and humanitarian solution for conflict.

Cyc-Jacquot, Major, Veterinary Corps

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FSTC 381-3082

AST-1600X-382-66

SINO-SOVIET BLOC
CHEMICAL AND BIOLOGICAL WARFARE
WEAPON SYSTEMS (U)

U S ARMY
FOREIGN SCIENCE
AND
TECHNOLOGY
CENTER

June 1965

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AN ARMY INTELLIGENCE DOCUMENT

U.S. ARMY MATERIEL COMMAND FSTC

JUL 6 1965

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U.S. Army Foreign Science and Technology Center
Munitions Building, Washington, D. C. 20315

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DESCRIPTORS

Chemical and biological warfare weapon systems, CW toxic-filled munitions, CW agents, nerve agents, antipersonnel BW agents, Sino-Soviet Bloc.

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January 1967

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Publication No. FSTC 381-3082
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U. S. ARMY MATERIEL COMMAND
FOREIGN SCIENCE AND TECHNOLOGY CENTER
Munitions Building, Washington, D. C. 20315

SINO-SOVIET BLOC CHEMICAL AND BIOLOGICAL WARFARE WEAPON SYSTEMS (U)

Publication No. FSTC 381-3082, June 1965, is changed as follows:

Make the following changes:

(U) Remove pages 9 and 15; insert new pages 9 and 15.

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FSTC 381-3082

SINO-SOVIET BLOC CHEMICAL AND BIOLOGICAL WARFARE WEAPON SYSTEMS (U)

June 1965

(Based on information available as of 31 December 1964)

ABSTRACT

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FSTC-CS-03-10-66

ARMY MATERIEL COMMAND

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FOREIGN SCIENCE AND TECHNOLOGY CENTER

FOREIGN CROP R&D ACTIVITIES RELATED TO ANTICROP WARFARE (U)

ARC 80-CBW

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Product Title: FOREIGN CROP R&D ACTIVITIES RELATED TO ANTICROP WARFARE (U).

Publication Date: September 1966.

Planned Revision: None.

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Topic Tags: Plant science, anticrop warfare, biologic agent, disseminating system, plant disease, insect vector, herbicide, defoliant, fungicide, plant breeding.

Abstract: This study presents foreign R&D activities in the plant sciences related to the development of anticrop warfare agents and disseminating systems, including research on plant and insect diseases, effects of chemicals, disseminating devices and techniques, protective measures, and assessment of overall anticrop biological warfare (BW) capabilities. Information from intelligence reports, intelligence studies, and open literature was used to assess the overall anticrop BW R&D capability and trend for each country covered in this study.

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FOREIGN CROP R&D ACTIVITIES RELATED TO ANTICROP WARFARE (U)

September 1966

(Based on information available as of April 1966)

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FOREIGN CROP R&D ACTIVITIES RELATED TO ANTICROP WARFARE (U)

Section I. (U) ANTICROP WARFARE RESEARCH

1. (U) PLANT PEST RESEARCH

a. Anticrop warfare research is indistinguishable, in many respects, from agricultural plant pest research, particularly among research descriptions in open scientific literature.

b. Certain phases of plant pest research are peculiar to anticrop warfare and others are preculiar to agricultural research. The table on page 2 points out the areas of commonality and the areas where the two types of research differ. This table is by no means complete, but it points out how the two types of research compare.

2. (U) HERBICIDES

Research on anticrop chemicals, a counterpart of agricultural herbicides, was omitted from the table. The object of most herbicide research is to develop sprays which destroy weeds, but are noninjurious to crop plants and leave no toxic residues. An ideal anticrop chemical is one that is liquid and relatively nonvolatile, and destroys all crop plants.

(C)

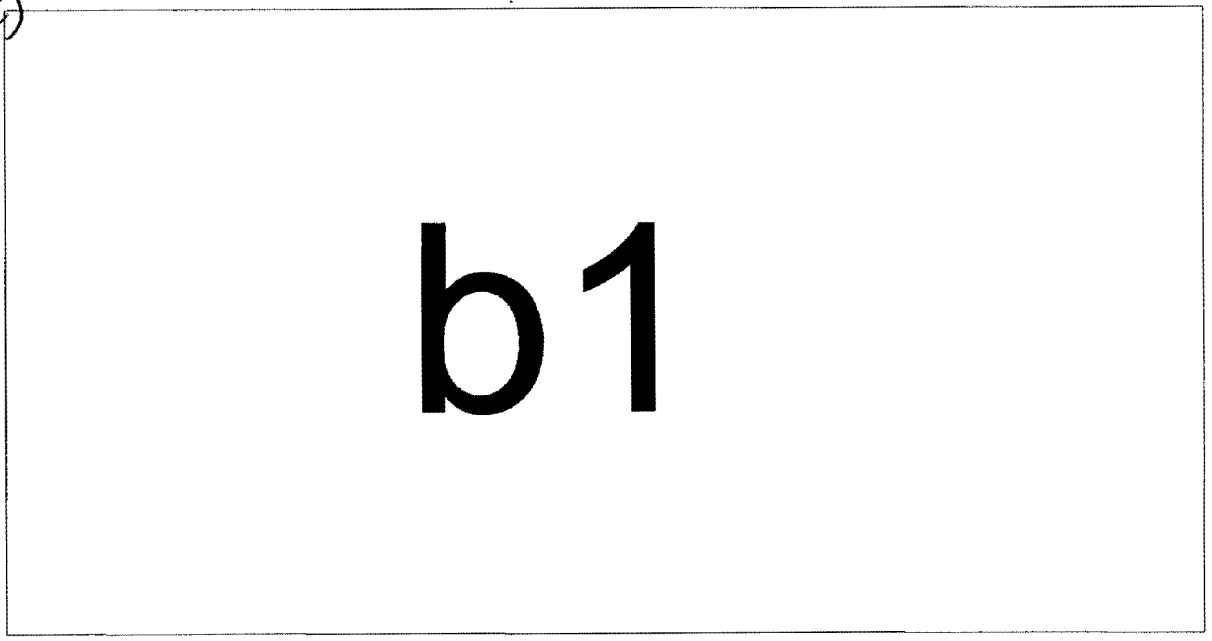

Table. (U). Similarities and Differences Between Anticrop Warfare Research and Agricultural Plant Pest Research (U)

	Applicable to	
Phases of plant pest research	BW research	Agricultural research
Study of life cycle of the pest	X	X
Morphology and physiology of the pest	X	X
Morphological and physiological effects of pest on host plant	X	X
Natural spread and buildup of plant pests and factors affecting them	X	X
Vector research	X	X
Yield reduction studies	X	X
Study of the natural biotypes of plant pest species	X	X
Morphological and physiological resistance of host plant to the pest	X	X
Studies on methods for large-scale production and storage of agent	X	
Studies on timing, equipment, and procedures for large-scale dissemination of plant pest	X	
Studies to increase infectivity, virulence, or destructiveness of plant pest	X	
Chemical and biological control of plant pests		X
Genetics and plant breeding research to develop resistant crop varieties		X

c. ~~(C)~~

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* The theory states that, by control of environments of plants, the life of the plant can be altered to create a variety with the innate hereditary factors that are required. This analysis is contrary to the classical Mendelian genetic theory of inheritance.

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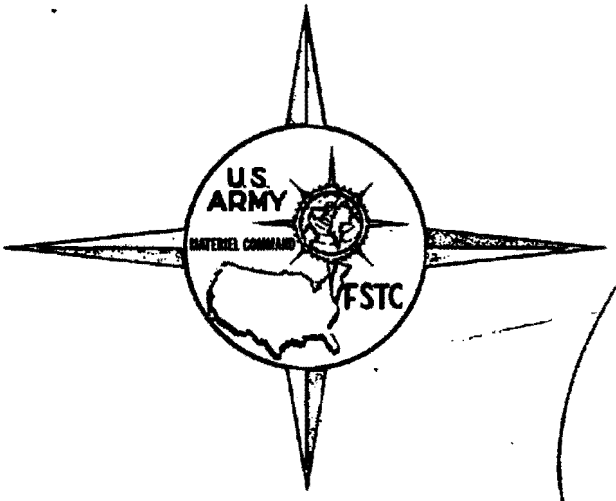

NATURAL PLANT AND ANIMAL TOXINS
(R&D FOR MILITARY TOXIC AGENTS)-FOREIGN (U)

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Munitions Building, Washington, D.C. 20315

NATURAL PLANT AND ANIMAL TOXINS
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1. Make the following pen-and-ink changes to publication No. FSTC-CS-03-02-66, dated September 1967:

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2. Insert new page 50.1 after page 50.

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FSTC-CS-03-02-67

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(U) Production Identification: FSTC-CS-03-02-67

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(U) Publication Date: September 1967

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(U)

(U) Topic Tags: Poison, natural; poison, plant; poison, marine; poison, insect; poison, bacterium; poison, fungus; poison, snake; poison, toad; venom; toxin; research and development, natural poison; natural poison, lethal; natural poison, incapacitating; toxin, animal; immunization; toxicity; antitoxin; antivenin.

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Pages: 70

Tables: 0

Illustrations: 0

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FSTC-CS-03-02-67

NATURAL PLANT AND ANIMAL TOXINS

(R&D FOR MILITARY TOXIC AGENTS)-FOREIGN (U)

September 1967

(Based on information available as of February 1966)

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PREFACE

(U) The toxic components of plants and animals are presently being examined in various countries and attempts have been made to isolate and characterize the active principles. Thousands of natural products have already been collected from many parts of the world; undoubtedly, thousands more are yet to be found. This huge source of physiologically active substances can become a ready supply of potentially useful chemical warfare (CW) agents, or they may serve as models for the syntheses of such agents.

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(U) The importance of the natural poisons to a CW research and development program lies in the fact that among them there is a wide range of properties which could satisfy a multitude of logistic requirements. Some may be classified as lethal-type agents; others as incapacitating types. Lethal-type agents cause death or inflict various degrees of physical destruction. In the latter case, problems of medical care and rehabilitation of survivors usually become the burden of the victors. The incapacitating agents form a new concept of chemical warfare; they debilitate the civilian or military personnel temporarily with few, if any, fatalities.

(U) Experimental animals are used in an initial screening of plant and animal extracts to evaluate the toxic nature and degree of toxicity of the crude extracts. A promising material is subjected to various procedures to isolate the active component, determine its physical and chemical properties, and if possible, determine its molecular structure. Components with simple chemical structures can probably be synthesized and even modified to enhance a desired pharmacological effect or to reduce undesirable side reactions.. The high-molecular-weight compound may be fragmented into smaller molecules that are simpler to synthesize, providing there is no loss of biological activity. Unfortunately, many of these large molecules are protein in nature and the state-of-the-art in the synthesis of polypeptides, the building blocks of protein, is not well developed. When the toxic substance cannot be synthesized economically, availability would then depend on the supply of the natural sources. In the event the processing of the crude extract uncovers a potential CW agent and appropriate means of its dissemination have been determined, steps are finally taken to devise a suitable detection system for identifying and quantifying the poison.

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1 Sep 93

FSTC-CS-03-02-67

NATURAL PLANT AND ANIMAL TOXINS

(R&D FOR MILITARY TOXIC AGENTS)-FOREIGN (U)

SUMMARY

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APPENDIX III. (U)

GLOSSARY OF TERMS (U)

Active immunization	Production of antibodies by individual's own body cells under stimulus of antigens introduced into body.
Aerosol	Colloidal system in which air is the continuous phase; maximum size of particles in 50 μ.
Anatoxin	See "toxoid."
Antibiotic	Chemical substance antagonistic to a form of life, such as bacteria.
Antibody	Specific substance produced in the body as a reaction to the presence of an antigen; it reacts with the producing antigen in some observable way, such as flocculation, lysis, and inactivation.
Anticholinesterase	Substance which inhibits action of the enzyme cholinesterase.
Antidote	Remedy for counteracting a poison.
Antigen	Any substance, which when introduced into the blood or tissues, incites, to a greater or less degree, the formation of antibody. When mixed with the antibody, reacts with it in some observable way, such as flocculation, lysis, and inactivation.
Antiserum	Serum that contains antibody or antibodies. Obtained from animal subjected to the action of antigen, either by injection into the tissues or blood, or by infection.
Antitoxin	Antibody found in antiserum or other body fluid which is specifically antagonistic to some particular toxin.
Antivenin	Antitoxic serum against snake venom.
Antivenom	Substances, other than antivenin, antitoxic against snake venom.
Alkaloid	One of a large group of organic, basic, physiologically active substances derived from plants.

APPENDIX III. (U) (Continued)

Biosynthesis	Building up of a chemical compound in a living organism.
Biotoxin	Toxin from a biological organism.
Cardioinhibitory	Restraining or inhibiting the movements of the heart.
Dialysis	Process of separating crystalloids from colloidal substances in solution by diffusion of the former through a semipermeable membrane.
Ecology	Branch of bioscience of living organisms as affected by the factors of their environment.
Extractive	Any substance present in an organized tissue and requiring extraction by some special method.
Fibrinolytic	Hydrolyzing or liquefying fibrin (clotting substance in blood).
Fluorescence antibody staining	Binding of a substance, exhibiting fluorescence, to an antibody protein for specific detection of an antigen-antibody reaction.
Fungus	Any one of a class in the plant kingdom of a low order of development, including ergot, mushroom, and toadstool.
Ganglion-blocking	Substance that blocks the nerve impulses passing through the ganglion. The latter is a mass of nerve cells serving as a center of nervous influence.
Hallucinogen	Substance that produces a sense perception not founded on objective reality, i.e., hallucination.
Helebore	Violent gastrointestinal poison.
Hemolytic	Causing destruction of the red blood corpuscles with the liberation of hemoglobin.
Histotoxic	Poisonous to tissue.
Hypotensive	Characterized by low blood pressure.
Hypoxic	Producing a deficiency of oxygen in inspired air or low oxygen tension.

APPENDIX III. (U) (Continued)

Ichthyotoxin	Poisonous principle found in some types of fish.
Immunity	Power which the body of an individual acquires to resist an infection or toxin intoxication.
Inactivate	Destroy the activity of.
Indirect (passive) hemagglutination	Serological test for detection of antigen (e.g. toxin). Red blood corpuscles, on which specific antibody was previously adsorbed, agglutinates in the presence of antigen as the result of an antigen-antibody reaction.
Intoxication	State of being poisoned.
LD_{50}	Amount (dose) which kills 50% of a group of test animals.
Lymphedemapathy	Disease of subcutaneous tissues due to presence of excessive lymph fluid.
Lysis	Destruction of cells by specific substance.
Mass immunization	Immunization of a group of animals or humans simultaneously.
MLD	Minimum lethal dose.
Necrosis	Death of a cell or group of cells in contact with living tissue, e.g., destruction of epidermal cells.
Neurotoxin	Toxin that affects nerve tissue.
Neurotropic	Having an affinity or predilection for nervous tissue.
Passive hemagglutination	See indirect hemagglutination.
Passive immunization	Introduction into body of an antiserum (containing antibodies) formed in the body of another individual or animal.
Phagocytic	Pertaining to cells that ingest microorganisms or other cells and substances.
Pharmacodynamics	Study of the action of drugs on living organisms.

APPENDIX III. (U) (Continued)

Pharmacological	Pertaining to the effects of drugs on living things.
Phospholipase	Enzyme that splits the phospholipids to phosphoric acid and free lipid.
Phospholipid	Substances that are highly active intermediates in lipid biosynthesis.
Physiological saline	Solution approximately isotonic to body fluids, usually an 0.85 to 0.90% NaCl solution.
Phytochemistry	Study of the chemical processes in plants.
Polyvalent	Heterogeneous mixture containing more than one type of toxin, toxoid, or antitoxin.
Potentiate	Render more active physiologically.
Ppm	Parts per million (μg/gm)
Protease	Enzyme that digests proteins.
Proteinase	Any enzyme which splits native proteins.
Protoxin	Inactive precursor of a toxin, formed by certain bacteria in the course of producing the toxin.
Psychochemical	Chemical substances affecting psychological functions.
Psychopharmacology	Study of action drugs on psychological functions.
Psychosis	Mental disorder; specifically, the deeper, more far-reaching and prolonged behavior disorders.
Psychotropic	Causing a change in the mental processes in response to a stimulus.
Spasmolytic	Checking spasms; antispasmodic.
Sublethal	Not fatal, i.e., below lethal levels.
Tincture	Alcoholic solution of a substance.

APPENDIX III. (U) (Continued)

Toxin	Poison formed as a specific secretion product in the metabolism of a plant or animal organism. Toxins are colloidal and chemically related to proteins.
Toxoid	Toxin treated in order to destroy its toxicity but still capable of inducing the formation of antibodies on injection.
Toxophoric	Chemical group or site in the molecule of toxin responsible for its toxicity.
Tracer (radioactive)	Radioactive isotope of a chemical element which can be introduced into the body and followed in its metabolism and distribution.

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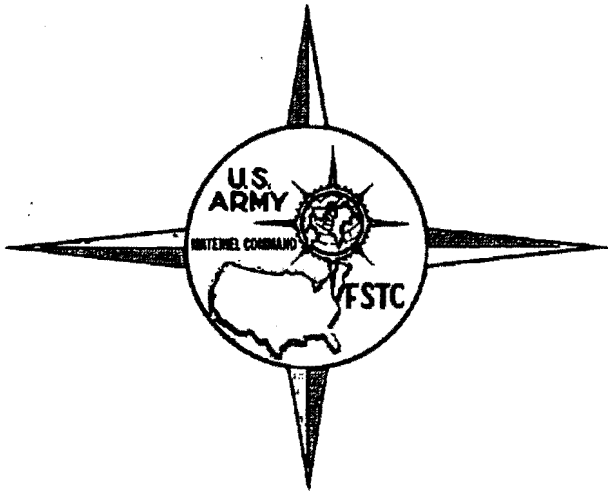

CW MATERIEL--NORTH VIETNAM (U)

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CW MATERIEL--NORTH VIETNAM (U)

October 1967

(Based on information available as of February 1967)

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APPENDIX (C)

TECHNICAL CHARACTERISTICS OF CW EQUIPMENT AVAILABLE TO NVA/VC FORCES (U)

A. CW MATERIEL IDENTIFIED IN NORTH VIETNAM (U)

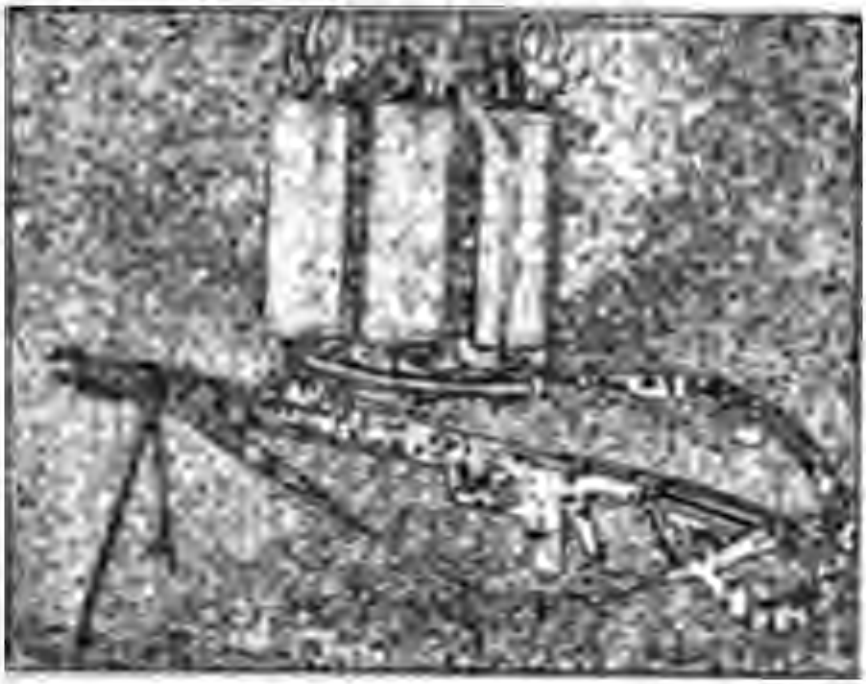
Page

(b)(7)(E)

* Presence probable but unconfirmed.

** Presence unconfirmed. (See Par. 2c, p. 2.)

NOMENCLATURE: Flamethrower, Model LPO-50 (North Vietnamese designations L-5 Gun and AT-64 Rifle)



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(U) According to Soviet specifications, the effective range of fire is 40 to 50 meters (45 to 55 yards); the maximum high trajectory range is 70 meters (75 yards); all three tanks can be fired in 5 to 7 seconds, and the flame fuel is composed of gasoline and a Soviet-type OP-2 thickening agent. The operating instructions state that the flamethrower's performance will be influenced by the properties of the fuel mixture, especially the viscosity of the mixture and the ambient temperature at time of use.

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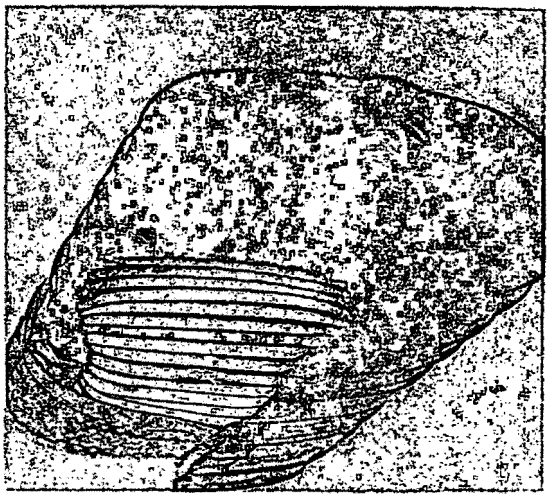
NOMENCLATURE: Canister, Model MO-4U



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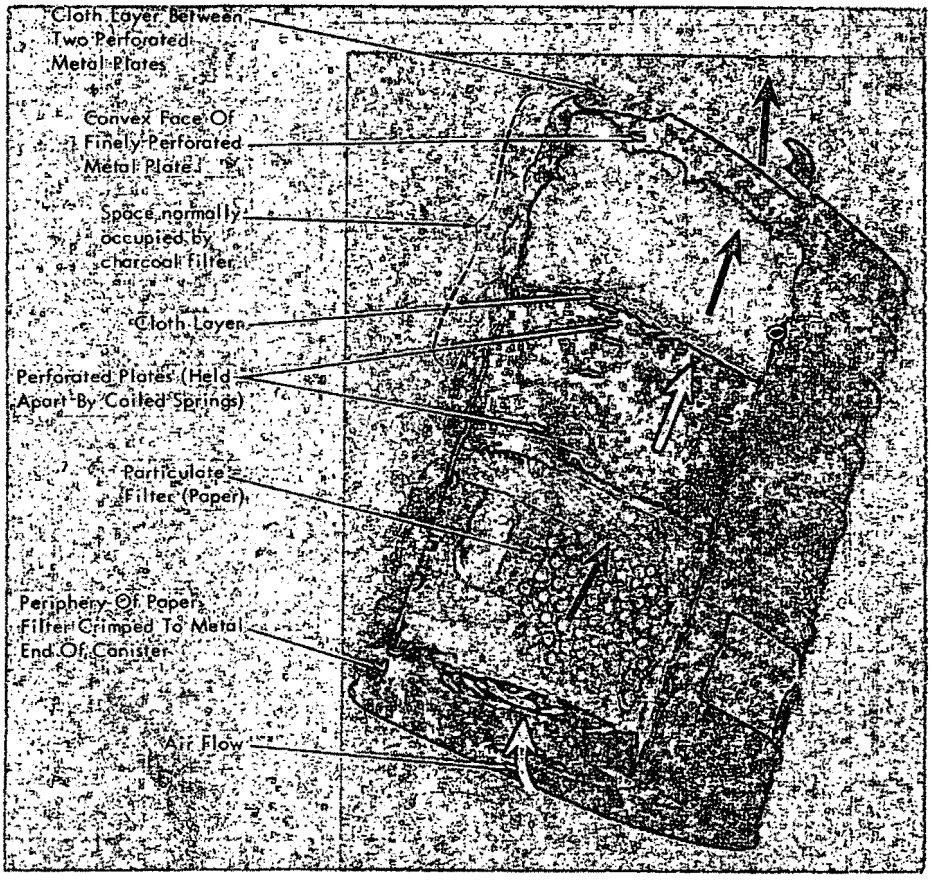

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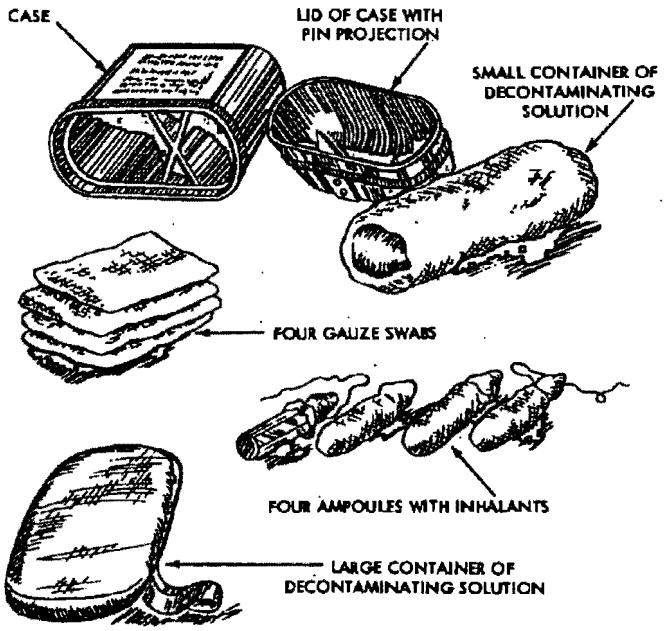
NOMENCLATURE: Decontamination Kit, Individual, Model IPP COUNTRY: U.S.S.R.*

NATIVE DESIGNATION: ИНДИВИДУАЛЬНЫЙ ПРОТИВОХИМИЧЕСКИЙ ПАКЕТ, ИПП ADOPTED: 1960 ?



The Model IPP CW kit has two plastic vials of chemicals intended for skin and clothing decontamination. The smaller vial contains a liquid decontaminant ready for use against nerve agents. The larger vial, filled with a solvent and a glass ampoule of powder, must be squeezed until the ampoule is crushed and the powder is released into the surrounding solvent to produce a solution for neutralizing mustard and lewisite.

Other components of the kit are four antismoke ampoules and gauze pads. One antismoke ampoule is inserted into the protective mask facepiece, crushed, and inhaled to nullify the effects of irritant smoke.

The IPP, possibly also referred to as the IPP-51, differs from an earlier and probably obsolete model, the IPP-3, which did not contain a nerve agent decontaminant.

* Captured in Vietnam in 1966.

NOMENCLATURE: Decontamination Kit, Individual, Model IPP

1 CURRENT STATUS: ---------- Standard	3 WEIGHT OF KIT: ---------- 8.8 oz
2 CARRYING CASE: a Material ---------- Plastic b Dimensions ---------- 8.5 x 3.5 x 1.5 in	4 DECONTAMINANTS: a Type ---------- See remarks b Quantity ---------- See remarks

REMARKS:

	CW agents	Decontaminants
Items 4a and 4b.	Nerve	42.0 ml water-ammonia solution
	Vesicant	17.0 gm chloramine-B in 57.0 ml aqueous alcohol
	Irritant smoke (i.e., adamsite)	Inhalant compounded of 40 ml ethanol, 40 ml chloroform, 20 ml ethyl ether, and 10 drops strong ammonia water (each ampoule contains 1 ml of the compound)

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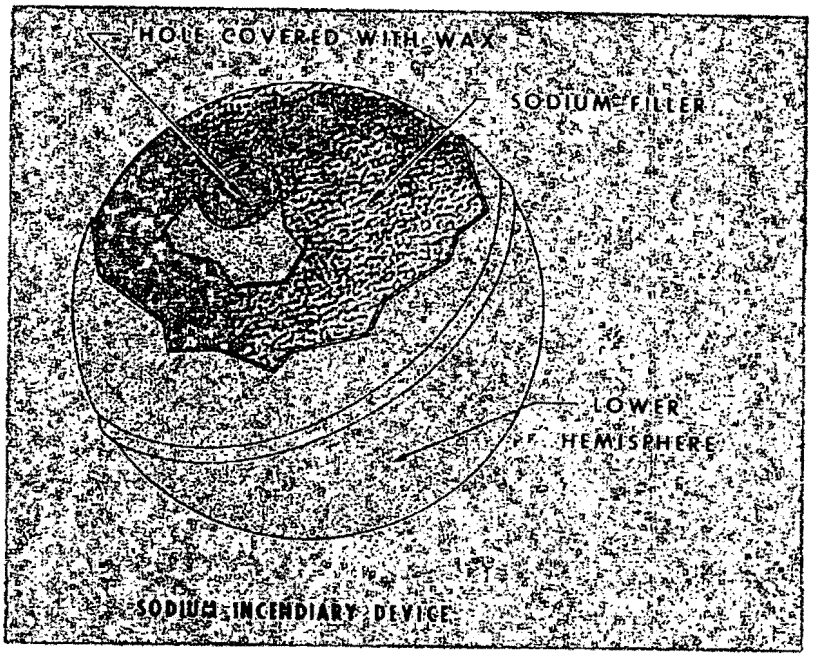
NOMENCLATURE: Sodium Incendiary Device



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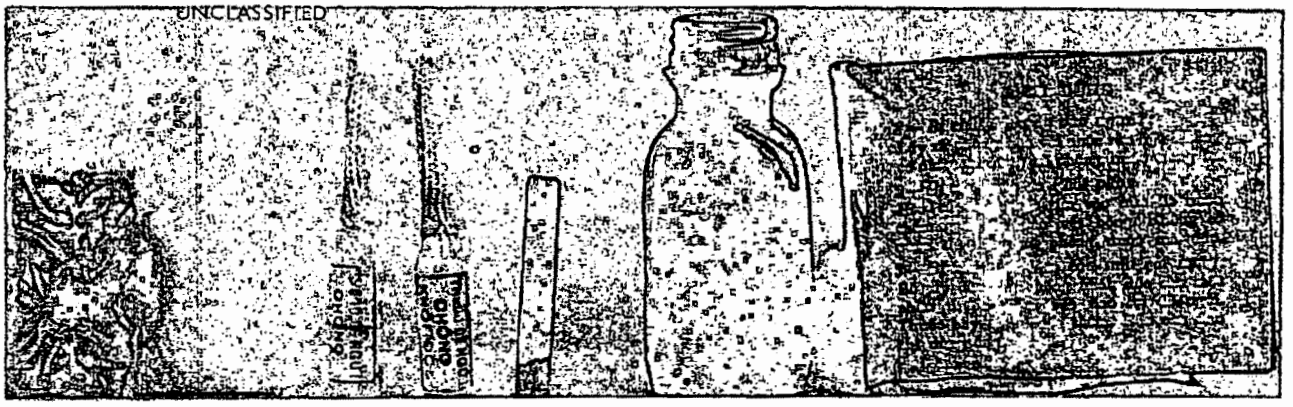
NOMENCLATURE: Decontamination Kit (with Antismoke Mixture)



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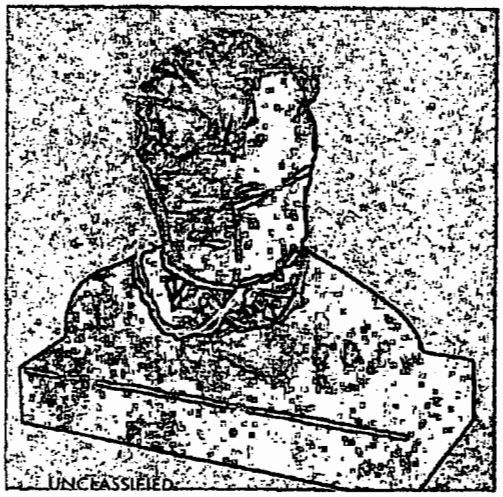
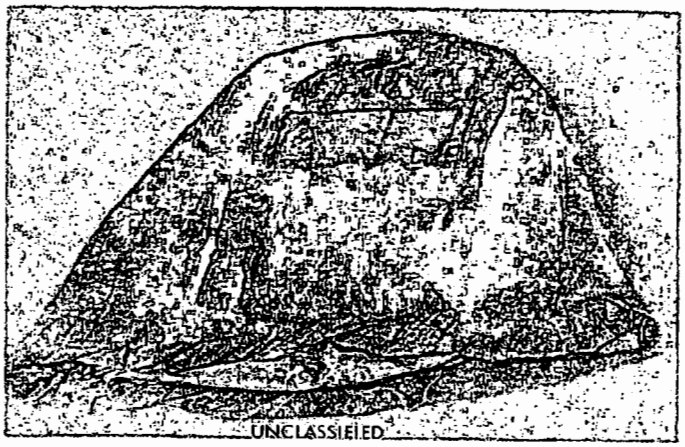
NOMENCLATURE: Protective Masks (Improvised Types)





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7 APR 1980

BW PROGRAMS (PROFILE OF PERSONALITIES, INSTITUTIONS, AND ACTIVITIES) — — ASIAN COMMUNIST COUNTRIES (U)

ARC 80-CB44

AN ARMY INTELLIGENCE DOCUMENT

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FSTC-CS-03-06-68

BW PROGRAMS (PROFILE OF PERSONALITIES, INSTITUTIONS, AND ACTIVITIES) — ASIAN COMMUNIST COUNTRIES (U)

March 1968

(Based on information available as of April 1967)

This product contains agreed Department of the Army Intelligence.

This product was prepared by the Foreign Science and Technology Center of the US Army Materiel Command, with contributions from the US Air Force Foreign Technology Division and the US Naval Scientific and Technical Intelligence Center. It has been reviewed and approved by the Office of the Assistant Chief of Staff for Intelligence, Department of the Army, but does not necessarily represent an approved Department of Defense position and is not to be considered a Department of Defense Intelligence Product.

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LIST OF ILLUSTRATIONS (Continued)

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Section II. (U) ~~(S/NFD)~~ FACILITIES ASSOCIATED WITH BW-RELATED RESEARCH

4. (U) COMMUNIST CHINA

The following list of Chinese Communist facilities performing work with BW-related applications is based on microbiological research and development information on public health facilities, universities, and military institutes. Wherever possible, facilities have been categorized as to major field of interest. The reference number indicates the bibliographic source found in the reference list (see appendix).

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b. (U) Agricultural Research. In addition to their increased research intended to improve public health conditions, the Chinese Communists have advanced their agricultural research in plant disease control for increased output of food and fiber plants. Important plant pathogens that might be of interest to an anticrop warfare program include bacterial blight of cotton, rusts of wheat and corn, and rice blast. (See table I.)

c. (S/NFE)

8. (C/NFE)

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APPENDIX (U)

REFERENCES

*1.

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* This and all other similarly marked references are contained in a separate list of classified references on file at FSTC; this list is available on request.

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3. REPORT TITLE

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4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Planned Revision: FY 1969. Study.

5. AUTHOR(S) (First name, middle initial, last name)

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13. ABSTRACT

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
BW agent BW-related research and development BW facility BW agent dissemination BW agent detection BW weapon /munition BW defense BW protective equipment Immunization Vaccine and sera Decontamination Aerosol Insect vector Germ warfare Biological warfare						

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DEFENSE INTELLIGENCE AGENCY

CROP VULNERABILITY (R&D): WARSAW PACT AND ASIAN COMMUNIST COUNTRIES (U)

ST-S-8-8304

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CROP VULNERABILITY (R&D): WARSAW PACT AND ASIAN COMMUNIST COUNTRIES (U)

FSTC-CS-03-12-68-INT

(b)(7)(E)

October 1968

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PREFACE

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(U) (b)(7)(E)

(U) This study updates a portion of study FSTC-CS-03-10-66, Foreign Crop R&D Activities Related to Anticrop Warfare (U), September 1966. (Secret) Some plant-protection information in the original study is still applicable, but has not been repeated because no updating information has been obtained.

(U) The cutoff date for information in this report is 15 April 1968.

(U) This document was prepared with the editorial assistance b6 b6

(U) Comments concerning this study should be forwarded to the Commanding Officer, US Army Foreign Science and Technology Center (Attn: ABC Division), Munitions Building, Washington, D.C. 20315.

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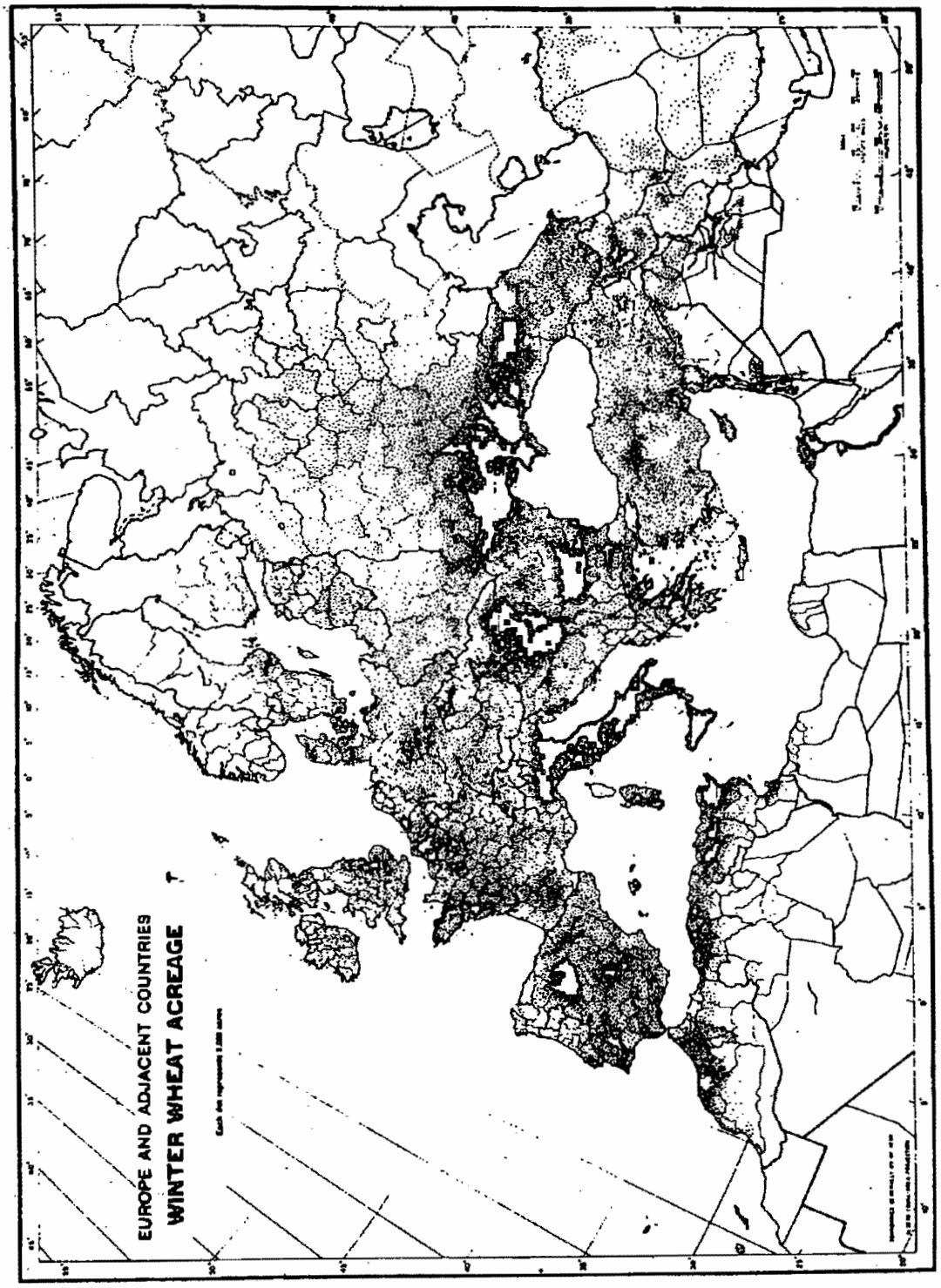

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Figure 1. Distribution of winter wheat in Europe and Western Asia (U).

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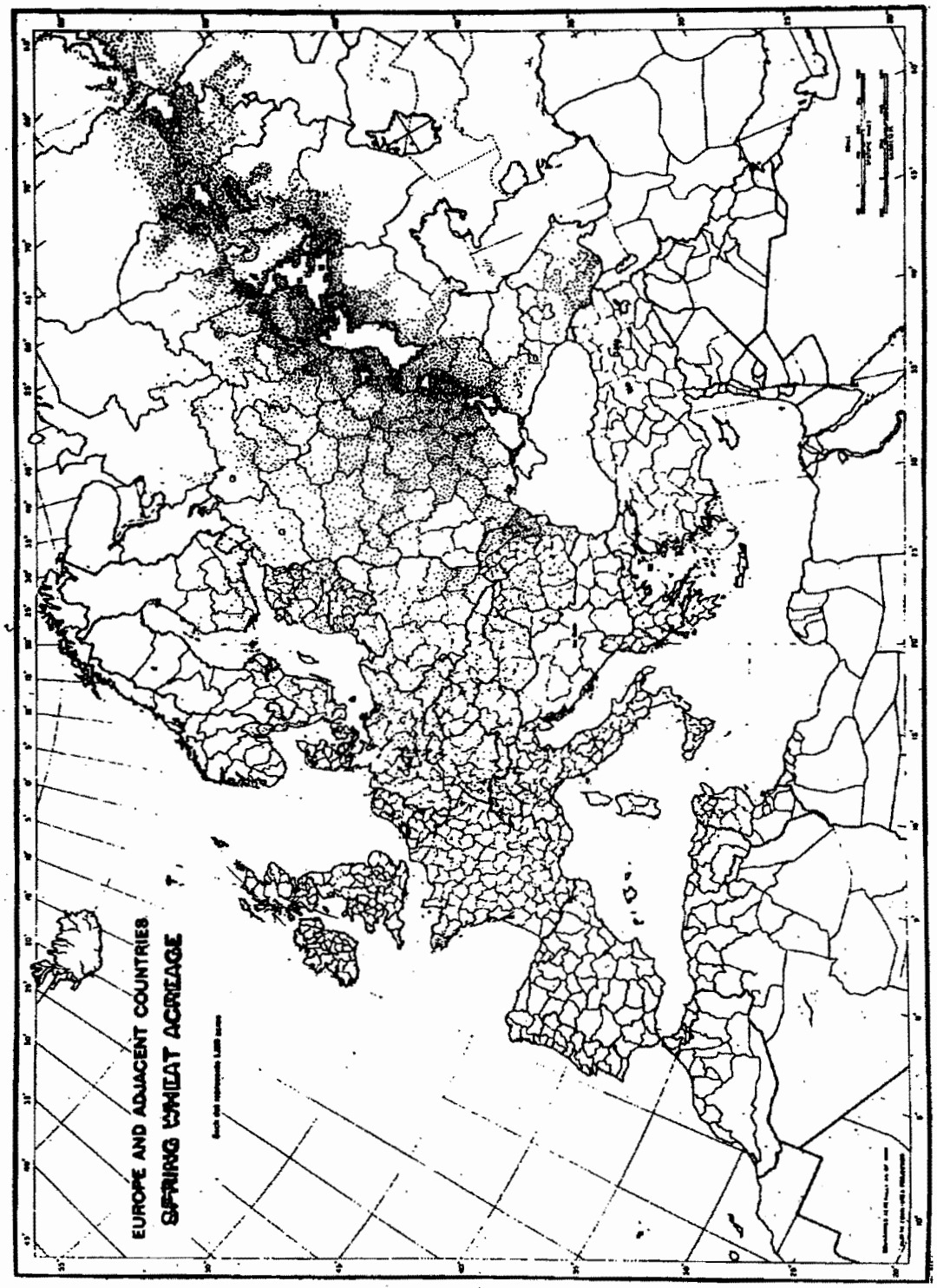

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Figure 2. Distribution of spring wheat in Europe and Western Asia (U).

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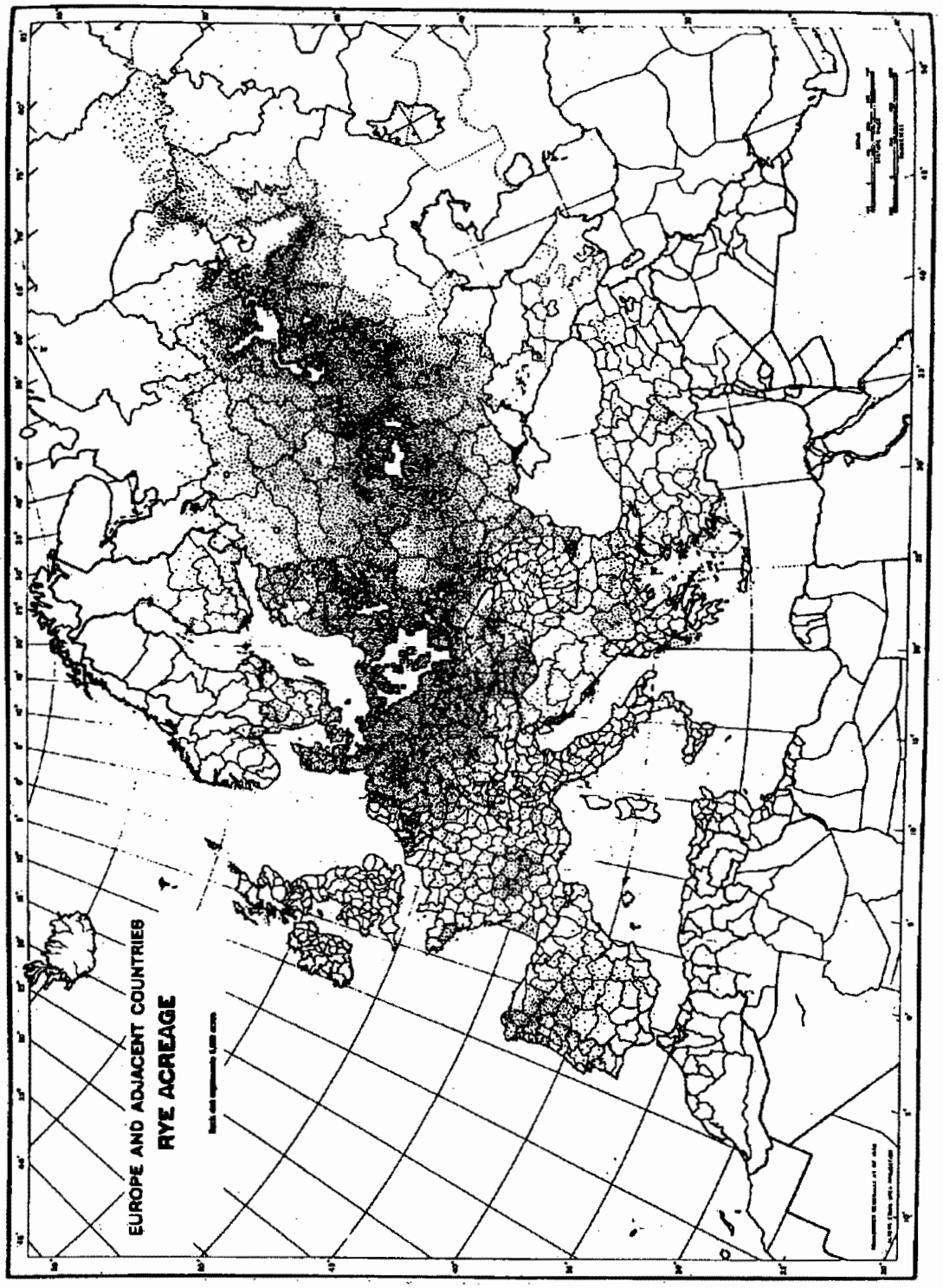

Figure 3. Distribution of rye in Europe and Western Asia (U).

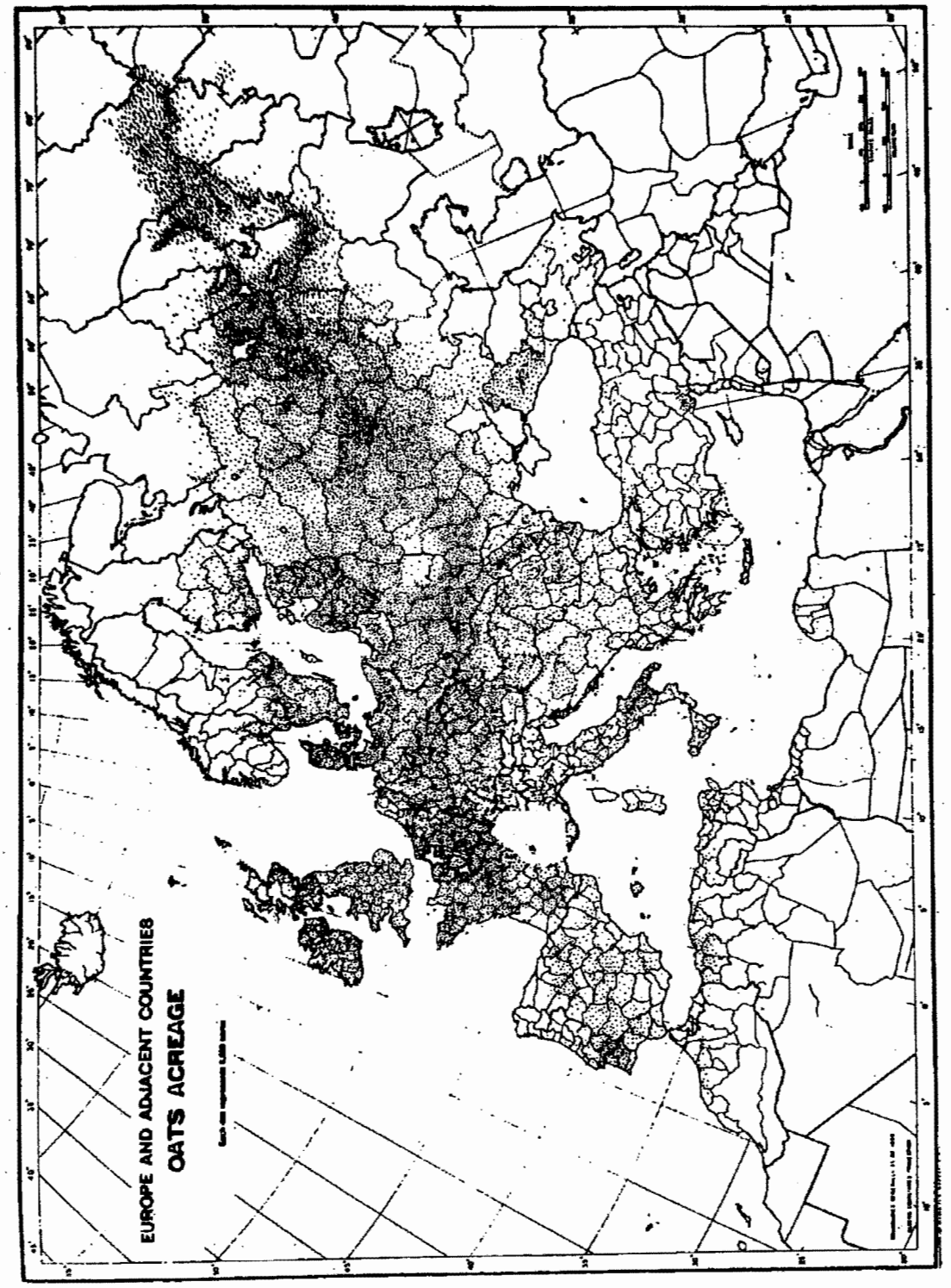

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Figure 4. Distribution of oats in Europe and Western Asia (U).

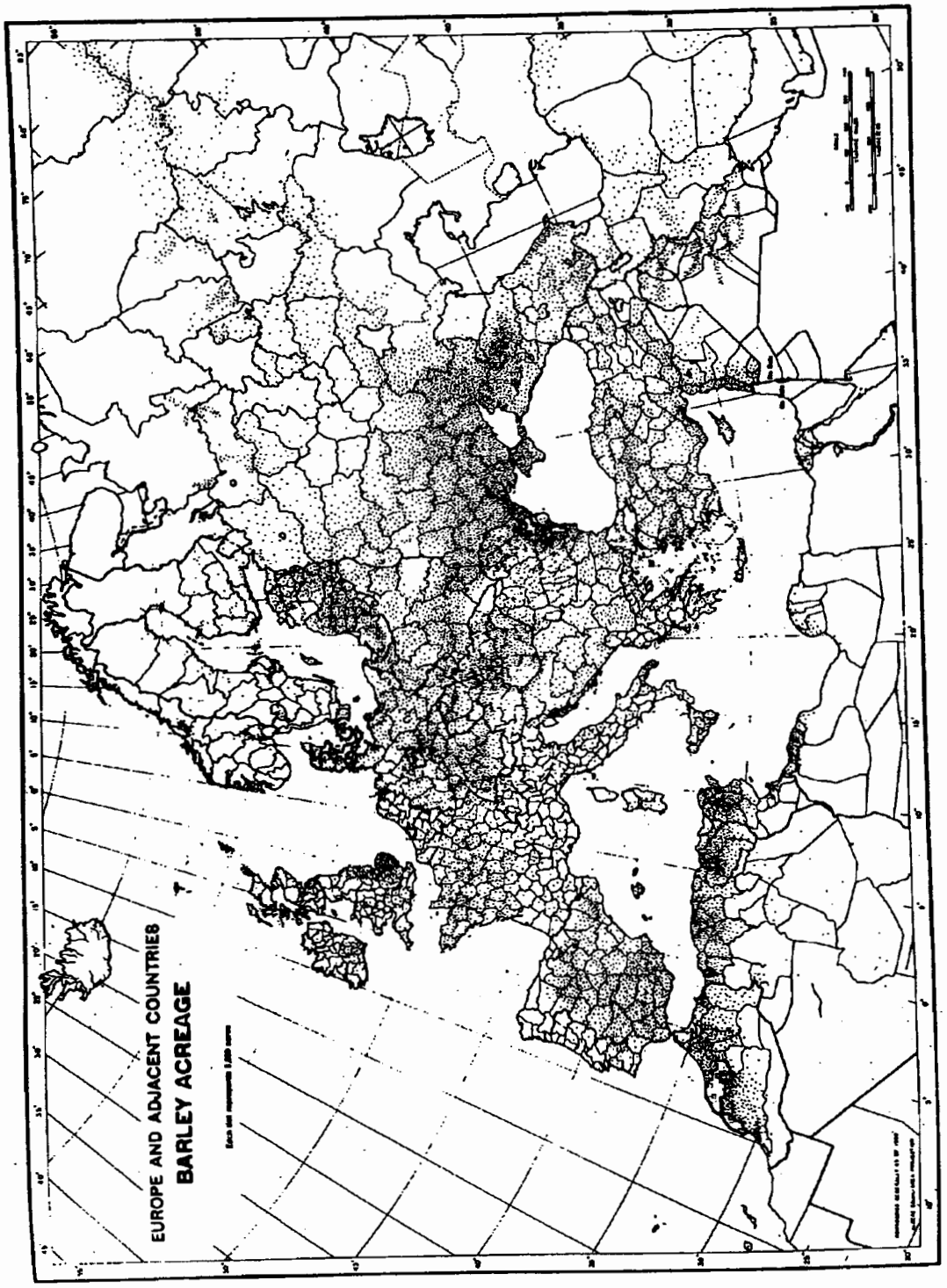

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Figure 5. Distribution of barley in Europe and Western Asia (U)

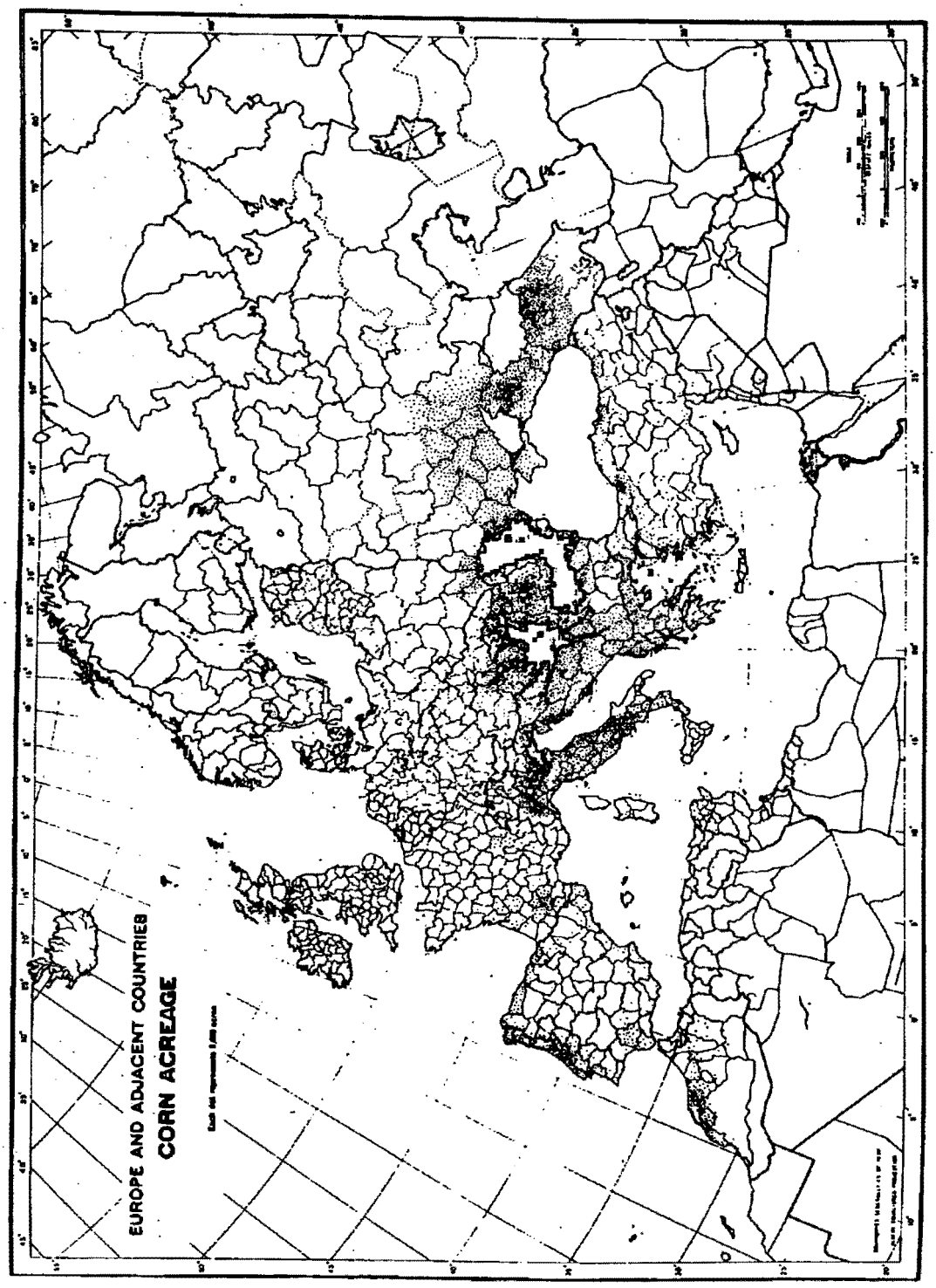

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Figure 6. Distribution of corn in Europe and Western Asia (U).

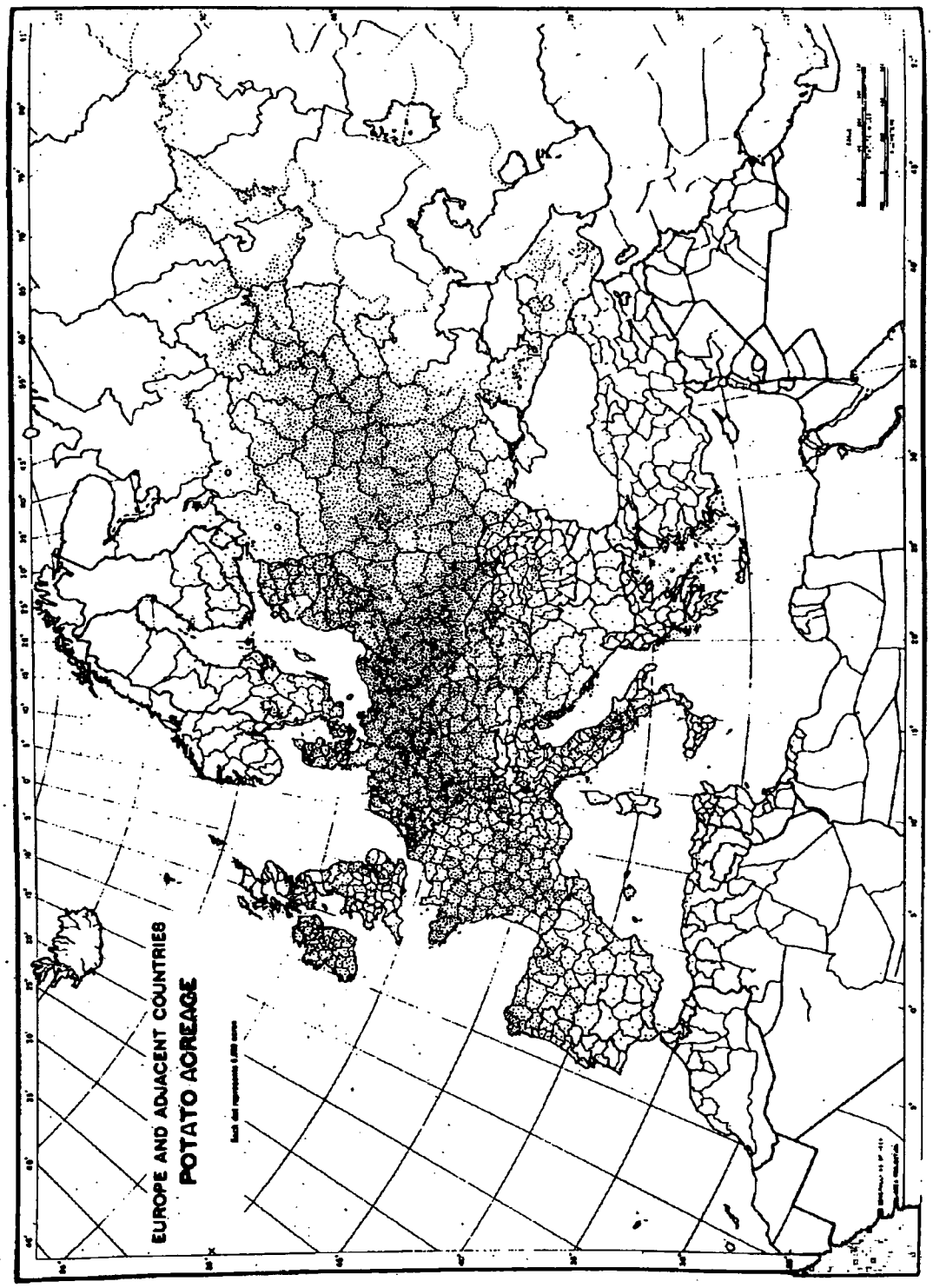

Figure 7. Distribution of potatoes in Europe and Western Asia (U).

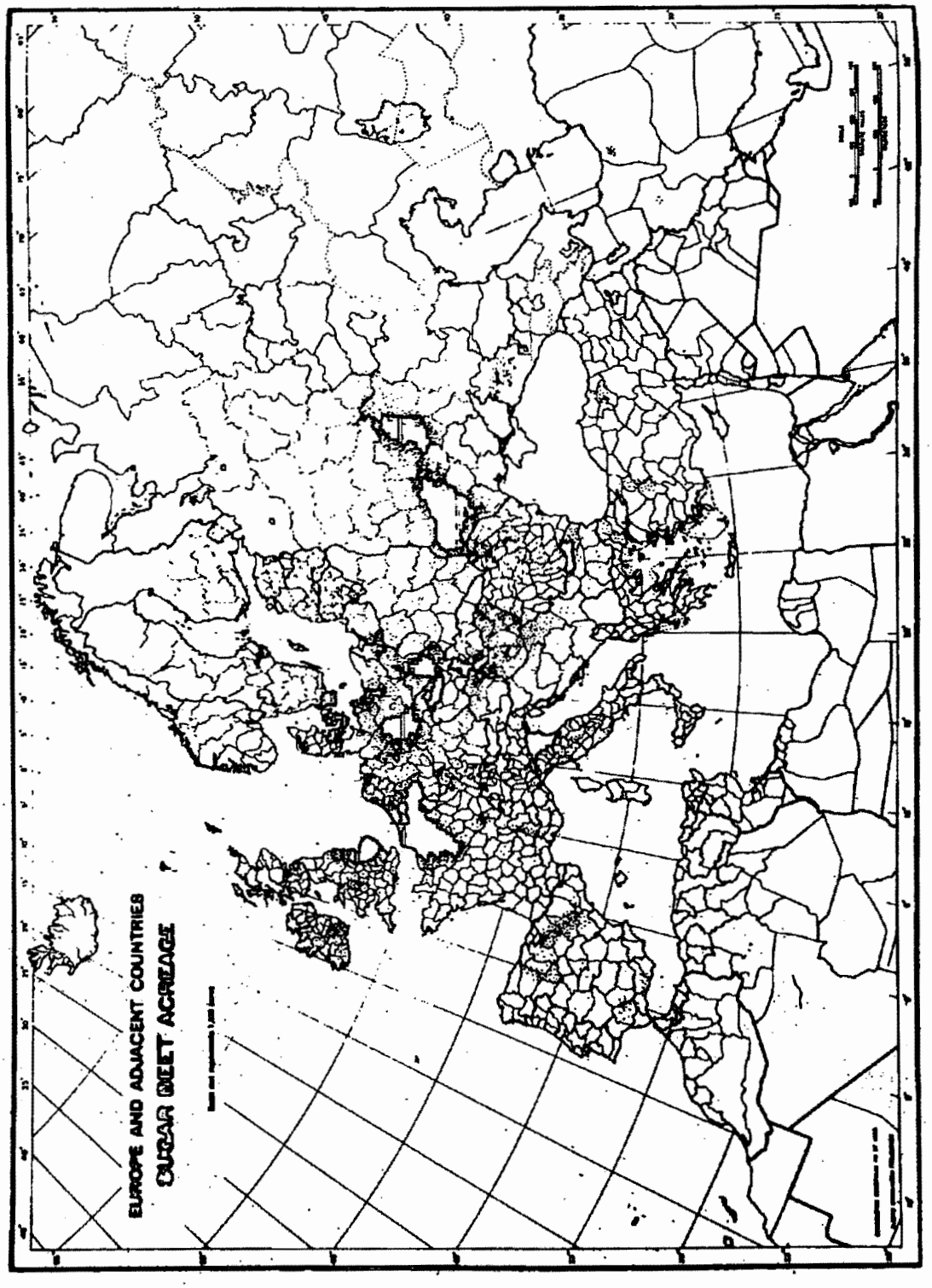

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Figure 8. Distribution of sugar beets in Europe and Western Asia (U).

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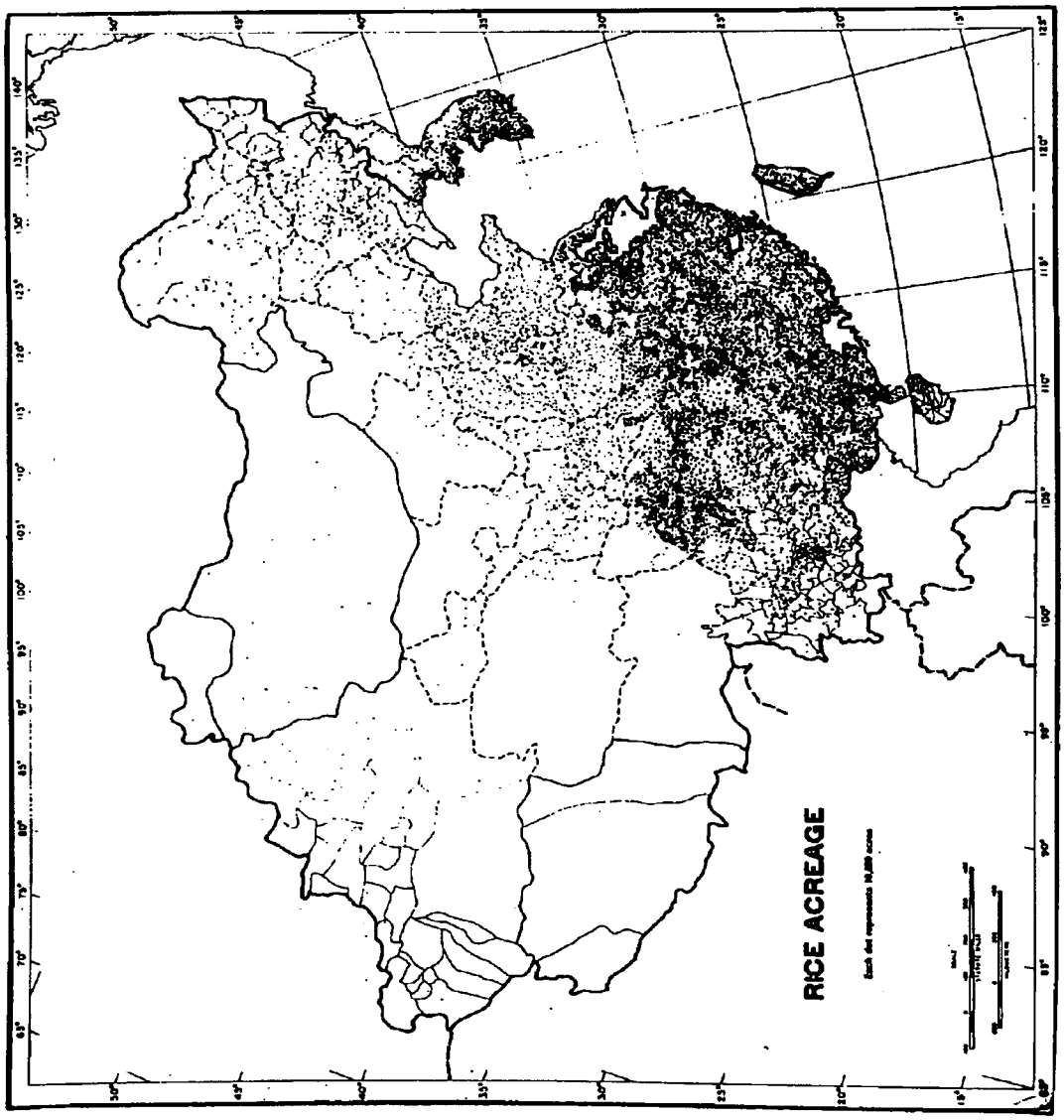

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Figure 12. Distribution of rice acreage in Communist China (U).

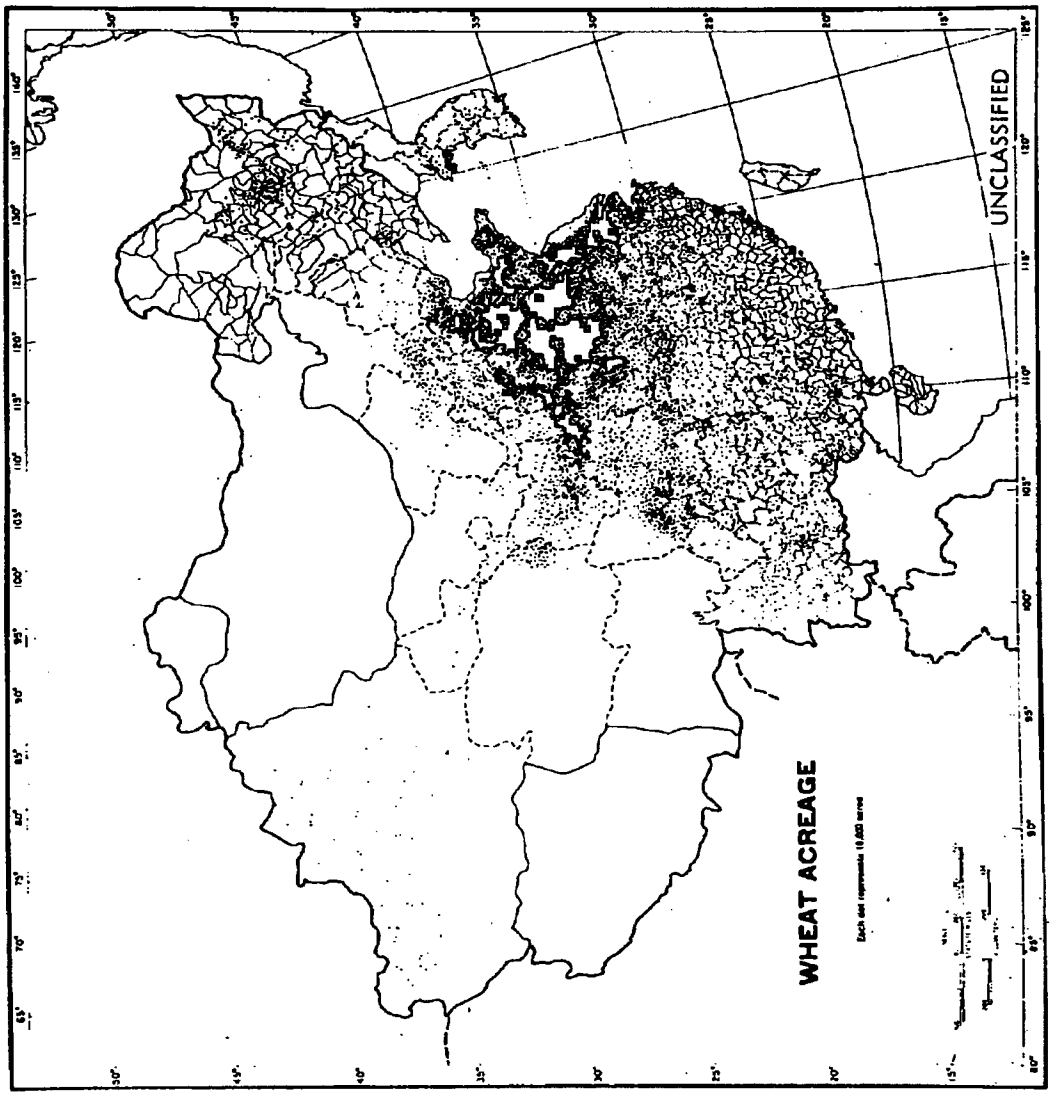

Figure 13. Distribution of wheat acreage in Communist China (U).

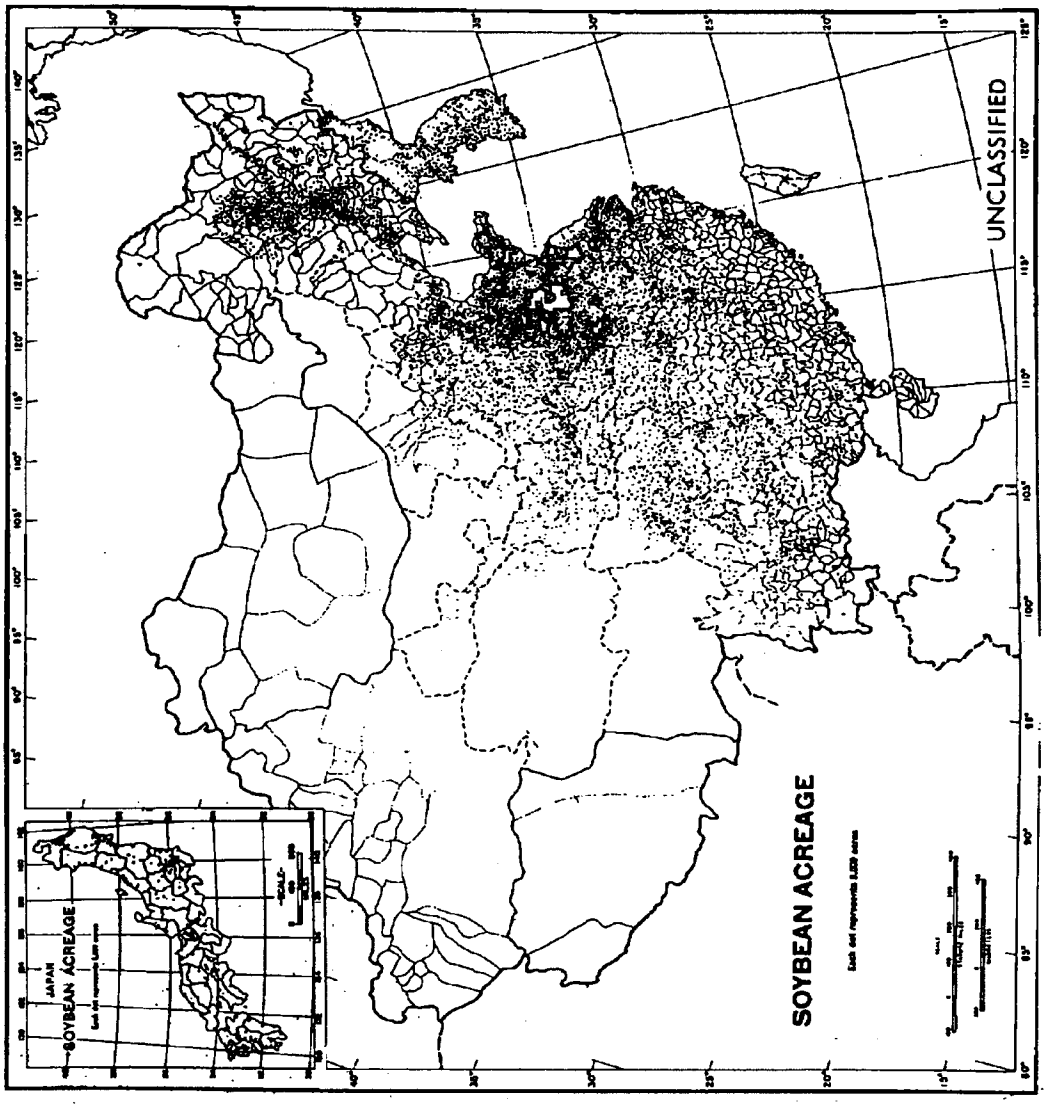

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Figure 14. Distribution of soybean acreage in Communist China (U).

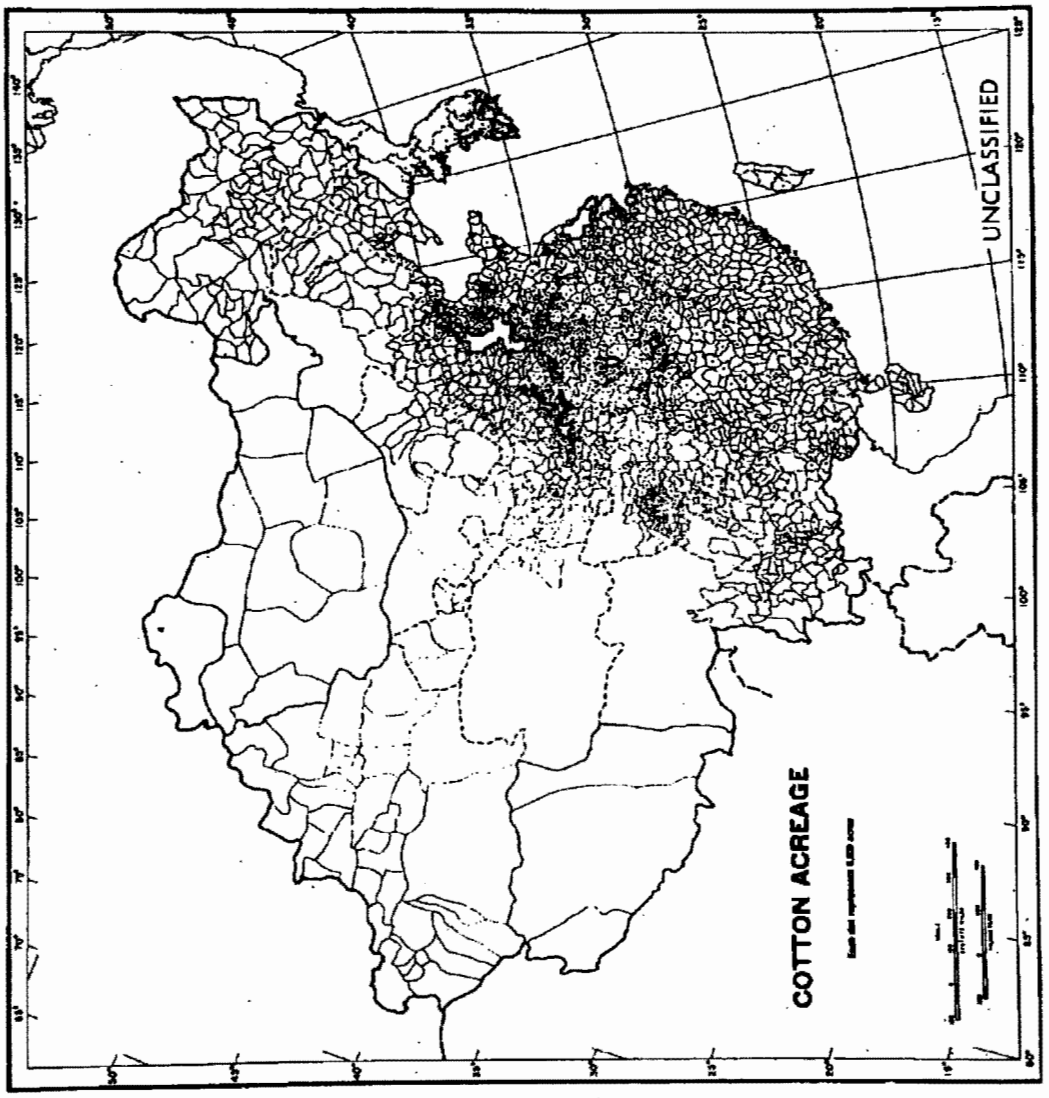

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Figure 15. Distribution of cotton acreage in Communist China (U).

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UNCLASSIFIED

Security Classification

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1. ORIGINATING ACTIVITY *(Corporate author)*
Foreign Science and Technology Center
US Army Materiel Command
Department of the Army

2a. REPORT SECURITY CLASSIFICATION
SECRET

2b. GROUP
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3. REPORT TITLE
Crop Vulnerability (R&D): Warsaw Pact and Asian Communist Countries (U)

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Planned revision: Biennial. Study.

5. AUTHOR(S) *(First name, middle initial, last name)*
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6. REPORT DATE
October 1968

7a. TOTAL NO. OF PAGES
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Department of the Army

13. ABSTRACT

(b)(7)(E)

DD FORM 1 NOV 65 1473 REPLACES DD FORM 1473, 1 JAN 64, WHICH IS OBSOLETE FOR ARMY USE.

UNCLASSIFIED

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Crop vulnerability						
Plant protection						
Plant disease						
Plant insect pest						
Defoliant						
Herbicide						
Fungicide						
Insecticide						
Anticrop biological warfare						

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IAGPA-CSF Form 6-R
1 Sep 93

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FSTC-CS-03-3-68-INT

DEFENSE INTELLIGENCE AGENCY

pdf

VIROLOGY (BW RELATED) U.S.S.R. (U)

Regraded CONFIDENTIAL per authority
FSTC-CS-03-3A-68-INT, Amend. B.

Cy

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May 1968

FSTC-CS-03-3A-68-INT

Publication No.
FSTC-CS-03-3-68-INT
Amendment A

US ARMY MATERIEL COMMAND
FOREIGN SCIENCE AND TECHNOLOGY CENTER
Munitions Building, Washington, D.C. 20315

VIROLOGY (BW-RELATED)--USSR (U)

Publication No. FSTC-CS-03-3-68-INT, April 1968, is amended as follows:

Make the following pen-and-ink changes:

Page 1, para 2, line 2: Change "improvement" to "improve".

Page 3, para 4b., line 2: Change "off" to "of".

Page 10, para 4f. (2), line 2: Change "thee" to "the".

(Reverse Blank)

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Page(s) 458-459

IAGPA-CSF Form 6-R
1 Sep 93

August 1969

FSTC-CS-03-3B-68-INT

Publication No.
FSTC-CS-03-3-68-INT
Amendment B

US ARMY MATERIEL COMMAND
FOREIGN SCIENCE AND TECHNOLOGY CENTER
Munitions Building, Washington, D.C. 20315

VIROLOGY (BW-RELATED)--USSR (U)

Publication No. FSTC-CS-03-3-68-INT, March 1968, is amended as follows:

1. (U) The overall classification of FSTC-CS-03-3-68-INT is changed from SECRET Group 3 to CONFIDENTIAL Group 3. Necessary pen-and-ink changes will be made to accomplish the downgrading.

2. (U) ~~(C)~~ Make the following pen-and-ink changes:

(U) Page v: Under LIST OF TABLES opposite the word, "Table:" Add the following title:

"0.1. Cultivation of Venezuelan Equine Encephalomyelitis Virus in Different Culture Systems ---------- 4"

~~(C)~~

b1

3. (U) Remove old pages and insert new pages as indicated below:

Remove pages 3, 4, 11, and 12 and insert new pages 3, 4, 4.1, 11, and 12.

4. (U) Insert new pages as follows:

Insert pages iv.1 and iv.3.

(Reverse Blank)

400

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Page(s) 461-462

IAGPA-CSF Form 6-R
1 Sep 93

August 1969 FSTC-CS-03-3B-68-INT

Publication No.
FSTC-CS-03-3-68-INT
Amendment B

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FOREIGN SCIENCE AND TECHNOLOGY CENTER
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VIROLOGY (BW-RELATED)--USSR (U)

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IAGPA-CSF Form 6-R
1 Sep 93

FSTC-CS-03-3B-68-INT
August 1969

LIST OF EFFECTIVE PAGES

SUBJECT MATTER	PAGE NUMBERS	DATE
Title Page	None	Original
Preface	iii (Reverse Blank)	Original
List of Effective Pages	iv.1 (Reverse Blank)	August 1969
Record of Changes	iv.3 (Reverse Blank)	August 1969
Table of Contents	v (Reverse Blank)	August 1969
List of Tables	v (Reverse Blank)	August 1969
List of Illustrations	v (Reverse Blank)	August 1969
Summary	vii (Reverse Blank)	Original
Section I, II, III	1 and 2	Original
	3 through 4.1	August 1969
	5 through 10	Original
	11	August 1969
	12 and 13	Original
Section IV	14	August 1969
DD Form 1473	15 and 16	Original
Distribution List	17 and 18	Original

FSTC-CS-03-3B-68-INT
August 1969

RECORD OF CHANGES

CHANGE NUMBER	DATE OF CHANGE	DATE ENTERED	SIGNATURE RANK/RATE AND ORGANIZATION OF INDIVIDUAL ENTERING CHANGE
A	May 1968		
B	August 1969		

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FSTC-CS-03-3-68-INT
Original

Virology (BW Related) U.S.S.R. (U)

FSTC-CS-03-3-68-INT

(b)(7)(E)

MARCH 1968

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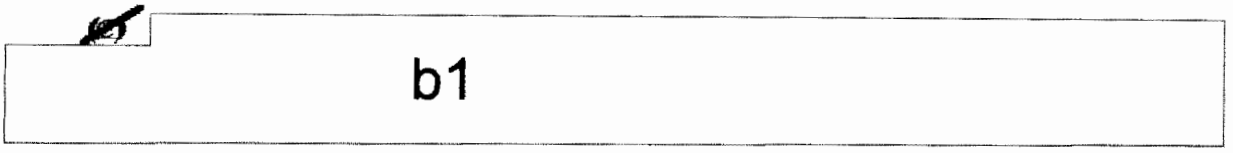
FSTC-CS-03-3-68-INT
Original

PREFACE



(U) Although the cutoff date from information in this document is October 1967, major updatings have been made up to the date of final approval for printing (February 1968).

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August 1969

LIST OF EFFECTIVE PAGES

SUBJECT MATTER	PAGE NUMBERS	DATE
Title Page	None	Original
Preface	iii (Reverse Blank)	Original
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Section IV	14	August 1969
DD Form 1473	15 and 16	Original
Distribution List	17 and 18	Original

FSTC-CS-03-3B-68-INT
August 1969

RECORD OF CHANGES

CHANGE NUMBER	DATE OF CHANGE	DATE ENTERED	SIGNATURE RANK/RATE AND ORGANIZATION OF INDIVIDUAL ENTERING CHANGE
A	May 1968	23 Oct 69	b6
B	August 1969	23 Oct 69	

(Reverse Blank)

FSTC-CS-03-3-68-INT
Original

TABLE OF CONTENTS

(b)(7)(E)

LIST OF ILLUSTRATIONS

Figure

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FSTC-CS-03-3-68-INT
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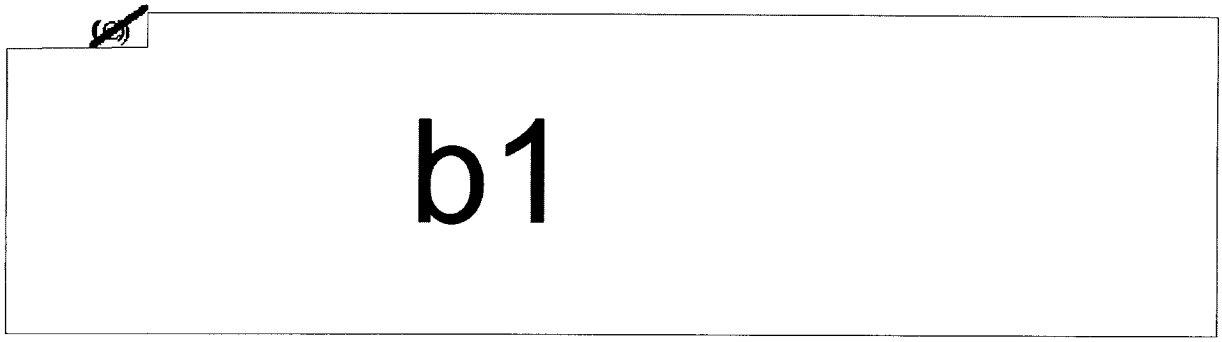
VIROLOGY (BW RELATED) U.S.S.R. (U)

SUMMARY

(C)



(U) The U.S.S.R. has expanded facilities, increased the number of trained personnel, and has improved the quality of research and development. A shortage of complex equipment, pure chemicals and reagents, and biological preparations still exists. Administrative politics and favoritism often tend to hinder research efforts.

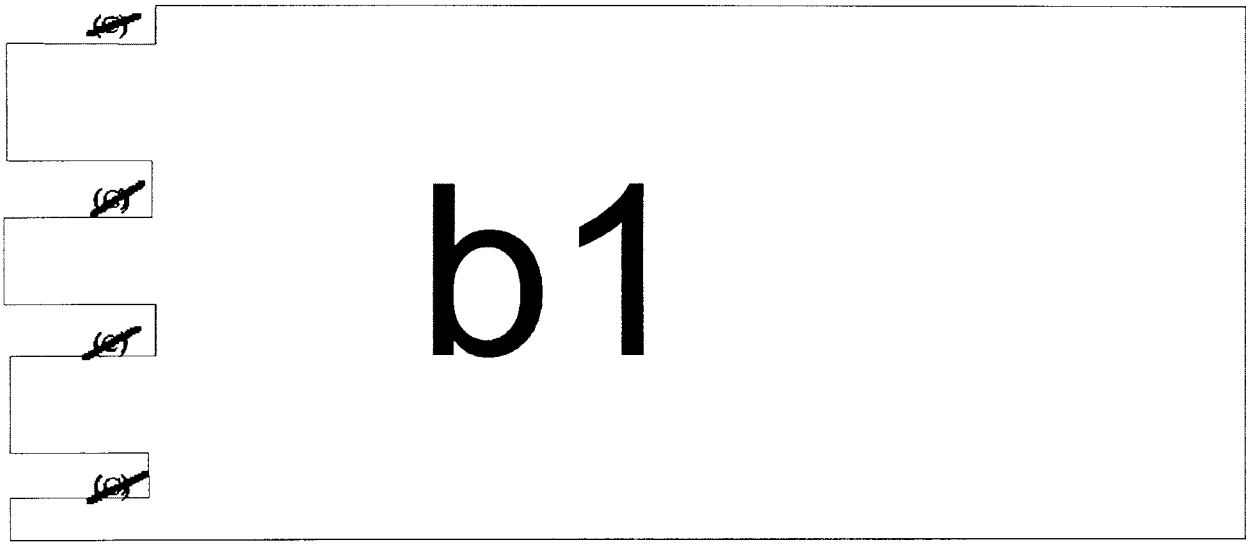
(U) The fluorescent antibody staining technique (FAST) has been incorporated as a research tool in the major institutions. It is used primarily for detection and diagnosis of viral diseases and related studies.

(C)

(C)

(C)

(C)



FSTC-CS-03-3-68-INT
Original

VIROLOGY (BW RELATED) U.S.S.R. (U)

Section I. (U) RELATION OF VIROLOGY TO BIOLOGICAL WARFARE

1. (U) GENERAL

Research and development of virology related to biological warfare (BW) is difficult to disassociate from the study of diseases of importance to men and animals. there are areas of work in Soviet virology, however, that seem to be receiving much greater attention than is necessary to satisfy public health needs. A number of publications presented each year on the means of defense against weapons of mass destruction confirm the existence of a BW defense program. Publications by the military on techniques of detection, diagnosis, decontamination, and therapeutic measures for viral diseases give additional evidence of a BW defense program. Since methods and techniques used in "open" virology so closely parallel those necessary for BW offensive measures, virological research and development can be related to BW programs.

Section II. (C) RESEARCH TRENDS

2. (C) GENERAL

b1

Section III. (U) INSTITUTES AND PERSONALITIES

3. (C) GENERAL

b1

4. (C) VIROLOGICAL INSTITUTES

a. (C)

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Page(s) 475-488

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Foreign Science and Technology Center
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Department of Army

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP
3

3. REPORT TITLE
Virology (BW Related) - U. S. S. R.

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Study; Planned revision: As appropriate

5. AUTHOR(S) (First name, middle initial, last name)
b6

6. REPORT DATE
April 1968

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Foreign Science and Technology Center
US Army Materiel Command
Department of Army

13. ABSTRACT
b1

DD FORM 1 NOV 65 1473 REPLACES DD FORM 1473, 1 JAN 64, WHICH IS OBSOLETE FOR ARMY USE.

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Virology						
Virus						
Viral disease						
Viral antigen						
Viral genetics						
Viral RNA						
Viral nucleic acid						
Virus cultivation						
Viral immunization						
Viral vaccine						
Tissue culture vaccine						
Phage						
Viral aerosol						
Virus-vector						
BW agent						
Fluorescent antibody staining technique (FAST)						

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IAGPA-CSF Form 6-R
1 Sep 93

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FOREIGN MATERIEL EXPLOITATION MEMO RPT.

FSTC CR-20-37-66
ARROW POISONS, CENTRAL AFRICAN REPUBLIC
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AST-1600X-37-65

SI-3-51 897

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1 Sep 93

b1

The data contained herein were derived by examination and testing of the physical specimen by Edgewood Arsenal under FSTC Project 6372-91.

(b)(7)(E)

SECRET

(b)(7)(E)

ICS-07-08-62 INT

DEFENSE INTELLIGENCE AGENCY

ELECTROMAGNETIC PROPAGATION THROUGH THE EARTH'S CRUST (U)

437

SECRET

~~SECRET~~

EE2020165

ELECTROMAGNETIC PROPAGATION THROUGH THE EARTH'S CRUST (U)

FSTC-CS-01-08-67-INT

(b)(7)(E)

April 1968

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(b)(7)(E)

GROUP-1
Excluded from automatic downgrading and declassification

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~~SECRET~~

PREFACE

(U) The purpose of this study is to provide information pertaining to the extent and nature of Soviet interest in the propagation of electromagnetic signals through the deep crust of the earth

b1

(U)

b1

Supporting research has included laboratory studies of the conductivity and dielectric coefficient of rocks as functions of structure, temperature, and pressure.

(U) Only a few open-source references have indicated Soviet interest in underground communications, and these cite primarily US research.

b1

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

FSTC-CS-01-08-67-INT
Original

ELECTROMAGNETIC PROPAGATION THROUGH THE EARTH'S CRUST

SUMMARY

(S) A review of b1 open literature indicates that the USSR is fully aware of each basic mode of underground electromagnetic propagation and is conducting many types of research b1

(S) The modes of propagation considered include antennas buried just beneath the surface, antennas located deep in the upper layer of the earth's crust, antennas placed in the resistive waveguide layer b1 and a nonradiative method of communication by ground conduction.

(S) b1

(S) b1

(S) b1

(S) Many individual Soviet researchers are using electrical and seismic procedures to study the earth's crust, and b1

501

FSTC-CS-01-08-67-INT
Original

SUMMARY (Continued)

b1 Other researchers have been studying the electrical properties of various types of rock at temperatures and pressures representative of the waveguide layer. These scientists do not appear to be organized into a formal development program for underground communications,

(S) b1

ELECTROMAGNETIC PROPAGATION THROUGH THE EARTH'S CRUST (U)

A. (U) TYPES OF UNDERGROUND COMMUNICATION AND DETECTION

1. (~~S~~) GENERAL CONSIDERATIONS

Although the upper layers of the earth are electrically conductive and therefore absorb radio waves, special cases exist in which electromagnetic signals may propagate for fairly long distances underground. In some instances, these signals cannot be detected from above the ground. Several basically different mechanisms may be used to describe the various modes of propagation.

b1

An excellent summary of the technical consideration for underground communication has been presented by J. R. Wait, who included many of the foreign publications in his review.[1*]

2. (~~S~~) SHALLOW ANTENNAS

a. The simplest form of underground radio terminal requires only a buried directional antenna array and electronics, perhaps a meter or two beneath the surface.[2] The layer of dirt surrounding the antenna imposes some minor changes in the sizes and spacing of the antenna parts, but not much difference in design. The layer should be well drained to minimize its radio absorption. Much of the signal may be lost at each terminal, but virtually the entire propagation path is actually above the surface. Depending upon transmitter power, antenna burial depth, antenna configuration, ionospheric absorption, and other design and technical parameters, the terminals may be separated by 1000 to 3000 km utilizing radio frequencies in the HF band.

b1

b.

There are three important types of signal loss: the attenuation because of antenna burial in a partially conducting medium, the coupling loss of the antenna, and the normal radio attenuation with range. The problem of antenna coupling has been investigated by A. P. Ivanov and others.[4] D. Staiman and T. Tamir, in the United States, have

*Superior numbers appearing throughout the study refer to references contained in the bibliography (Appendix I)

shown how the signal may be optimized under special conditions by tilting the buried antenna.[5] G. A. Lavrov and A. S. Knyazev have discussed the use of near-surface underground antennas and have made actual measurements of direction patterns and field strengths.[6]

c. (U) Because the technology needed to understand and construct a shallow-antenna communication system is practically identical to that required for conventional radio in the same frequency range, b1 Measurement of the electrical properties of the soil in each selected terminal site, optimization of the directivity patterns of buried antennas, and selection of the most efficient frequencies for propagation would have to be accomplished before installation of such an antenna system.

3. (U) THE WAVEGUIDE LAYER

a. If the antennas are buried progressively deeper, the absorption loss becomes severe; however, a substantial part of the signal travels entirely underground from one terminal to the other. The losses may be minimized by choosing favorable terrain and by using a low carrier frequency, with a corresponding decrease in information capacity. b1 Under good conditions, a range of several kilometers might be possible.

b. (U) b1 Radio absorption in rock depends upon the electrical conductivity of the rock; conductive rock absorbs radio waves. Near the earth's surface, the rock is interrupted by numerous fine cracks filled with water, and the water contains dissolved salts with high conductivity. Such rocks may exhibit an average bulk conductivity of 6×10^{-4} mho/meter or more. At greater depths, the rock is warm, dry, and nearly unbroken. Its conductivity may be as low as 2×10^{-6} mho/meter, a 300-fold decrease. But still deeper, the rocks are hot enough that ionic conductivity is important, and the rocks become even more conductive than those near the surface. b1 Knowledge of the electrical properties of the deep rocks has come from direct resistivity measurements (with widely separated electrodes in the surface of the earth) and from indirect resistivity measurements obtained through observations of telluric currents. Certain other

information, such as the frequency dependence of the electrical properties, has been found by laboratory studies of rocks at high pressures and temperatures.

c. (U) The waveguide layer will be selective in the frequency band that may propagate. Absorption losses are great at high frequencies since the attenuation of the signal is exponential, with the exponent roughly proportional to the square root of the frequency. At low frequencies there is another limit, for the waveguide will not pass wavelengths longer than about twice the electrical thickness of the layer.

b1

d. (U) This waveguide-layer mode has been discussed at length in a review paper by A. M. Ryazantsev and A. V. Shabel'nikov.[7] Although their bibliography contains 176 literature references, the Soviet papers cited discuss only geological considerations and laboratory measurements. Nearly all the technical discussion of underground electromagnetic propagation is represented by US sources--most of them from a single volume of an I. E. E. E. journal.[8]

b1

M. P. Dolukhanov has casually included underground radio waves in a general review article about radio wave propagation, but has not cited particular work.[9]

b1

4. (C) GROUND CONDUCTION

a. An entirely different mode of signal propagation, not truly a form of radio, may be practical for some purposes. When an electric current is applied to a pair of electrodes grounded some distance apart, a current distribution pattern is established in the earth, and the size of this pattern is much greater than the electrode separation. A second pair of grounded electrodes, distant from the first, will exhibit a very small voltage difference related to the current flow in the first pair. The strength of a signal received in this way diminishes much faster with distance than a radio signal would, but further losses from ground absorption may be made quite small by using a very low frequency, perhaps in the audio range or below. (Even a direct current could be used, although the received signal would be impractical to detect.)

b1

b.

b1

c.

d.

5. (S) DETECTING NUCLEAR EXPLOSIONS

a. A nuclear explosion generates an intense electrical impulse that may be detected with a radio receiver or by measurement of sudden voltage gradients set up in the earth's crust.

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C. C. Bates has explained some of the limitations and possibilities.[11]

b1

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B. (U) RELATED RESEARCH

6. (C) DEEP DRILLING (6-12 km)

a.

b1

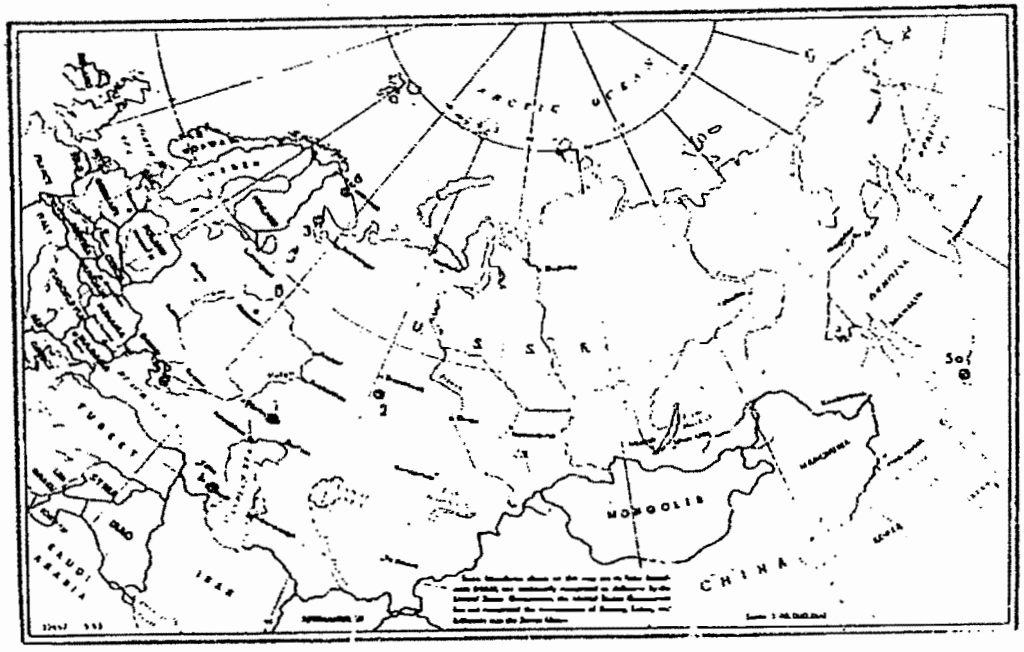
b. Since 1960, the Soviet Union has shown remarkable enthusiasm in drilling deep holes for "geological research" purposes. The economic value of such deep holes for petroleum or mining exploration is doubtful, and Soviet geologists who have been asked to explain the project have countered by asking why the United States wants to dig the Mohole. The planned deep holes actually would yield important basic geological information, and past Soviet geophysical projects, particularly in petroleum exploration, have never been affected noticeably by arguments that they were absurdly impractical.

c. Locations of the holes now planned, underlying geological structures, and status of the work are of more direct interest here. The Soviet Union has published many descriptions of the deep holes, both in professional journals and in the popular press.

d. N. A. Belyayevskiy has outlined the wishes of the geologists and discussed the types of location that might be selected for superdeep holes.[15] The earth's crust, extending from the surface downward to the Mohorovicic discontinuity level and the upper part of the earth's "mantle" layer, varies in thickness from 3 to 7 km under oceans, 60 to 75 km in the high mountain regions of the land masses. Seismic studies show that the crustal layer is composed of thinner layers with different physical properties. From the top, the three major layers are sedimentary, granitic, and basaltic rock. Depending on the location, the sedimentary layer may be absent or may be as much as 15 km thick. The granitic layer may be from 0 to 30 km deep, and the basaltic layer varies in depth from 5 to 40 km. Under a typical ocean the sedimentary and granitic layers are thin or absent, and the basaltic layer is no more than 5 km thick. Under the mountains of a continent, such as the Asiatic land mass, the sedimentary and granitic layers may total 45 km in thickness, and the basaltic layer may be 25 to 30 km thick. Although indirect geophysical techniques provide much information about the materials of the crust, Soviet geologists desire a series of superdeep holes drilled in various parts of the USSR to explore and sample the different types of layering.

e. Belyayevskiy believes that two of the holes should be drilled in the Caspian depression (platform structure) and in the Urals (geosyncline) to penetrate the full depth of sedimentary rock. Another should be drilled in Karelia to study the granitic layer, and a fourth in the Trans-Caucasus to study the basaltic layer. A fifth hole is suggested for the Kuriles island chain to penetrate the Mohorovicic discontinuity and reach the upper mantle, as the US "Mohole" was intended to do.

(1) The Caspian depression, in the region of the Aralsorsk and Khobdinsk gravitational maxima (site 1, figure 1), is of particular interest because of its steep subsurface temperature gradient and the large gas and petroleum deposits in the area. Belyayevskiy suggests that the lowest sedimentary rocks there may be undergoing metamorphosis and hopes that the lower limit of petroleum deposits can be learned. According to D. I. Mendeleyev, petroleum may originate inorganically by polymerization of gas at extreme pressures, and a deep hole in the Caspian depression could test this view. Such a hole would establish the stratigraphic sequence in the region and would clarify the physical properties of the lower rocks. The total depth required might be 13 to 15 km. A test hole planned for 7 km was in progress in 1961.



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1. epi-Caspian depression
2. Urals
3. Krelia
4. Trans-Caucasus
5a. Southern Kuriles
5b. Crimean Peninsula
6. Kola Peninsula

Figure 1. Proposed superdeep drilling sites in the USSR (U)

(2) The Ural geosyncline contains large concentrations of copper, iron, titanium, chromium, aluminum, and other ores and might provide an opportunity to study ore formation at great depths. The region of Karabash has the greatest quantity of these deposits, and superdeep drilling equipment can be constructed in the nearby industrial centers. In the Urals the temperature gradient is small, the temperature rising to about 300°C or less at 15 km deep. Bulashevich et al. believe that the most favorable site in the Urals is in the Tagil-Magnitogorsk synclineorium in the Verkhotur'ye-Krasnoural'sk region[16] (site 2).

(3) Northern Karelia, in the Kem' region (site 3), is one of the few places in the USSR where the granite-basalt boundary is only 8 to 10 km deep. The geologic formations are quite ancient and are related to the Baltic crystalline shield. Information learned by deep drilling will be easier to interpret at this because the geology of the region has been studied extensively. Uniform structure will facilitate drilling, and the hole should extend to 15 km.

(4) In Azerbaydzhan, near the settlement of Karadonia in the eastern part of the Kurina depression (site 4), seismic depth soundings have shown that the basaltic layer is only 5 to 8 km deep. There is probably no granitic layer in this part of the Trans-Caucasus. Little is known about the actual state of the rock in the basaltic layer, and a hole to investigate it would provide knowledge valuable for understanding the geology of seas and oceans as well. Other questions that might be answered pertain to the deep origins of ores, a study of water and aqueous solutions at high temperature and pressure, and also the vertical distribution of petroleum deposits common to the region.

(5) Kunashir, in the Kurile Islands (site 5a), offers the shortest route to the Mohorovicic discontinuity level in the entire Soviet Union. That level is only about 12 km deep there. Volcanic accumulations cover the surface to a depth of 3 to 4 km. A deep hole at Kunashir might also help to understand the unexplained origin of "island arcs," the strange groups of islands and mountain ranges that surround the Pacific Ocean. Belyayevskiy expects a steep temperature gradient and possibly some difficulty in drilling. (Presumably the USSR will select a substitute location before reaching the discontinuity.)

f. This brief outline has shown the geological purposes behind the Soviet deep-drilling program and the tentative selection of sites. b1 b1 The sites actually chosen, as listed more recently by Academician Shcherbakov, are the same as those suggested by Belyayevskiy except that the Crimean Peninsula (site 5b, figure 1) replaces the Kurile Islands as the location of the Soviet "Mohole."[17] A. Simirnov has listed a sixth drilling site, on the Kola Peninsula, where an attempt may be made to learn more about granite and basalt and the gradation from continent to ocean.[18]

g. The deepest hole yet drilled by the Soviets is near Lake Aral-Sor in the Zapadno-Kazakhstanskaya Oblast, in the Caspian Depression north of the Caspian

Sea. Drilling began late in 1961. This work has been conducted by the Ministry of Geology and Ore Conservation of the Kazakh SSR, aided by scientists from the Moscow Institute of the Petrochemical and Gas Industry imeni I. M. Gubkin.[19] Vast reserves of petroleum and natural gas are expected at great depths. Two wells were planned, the first situated between two salt domes 25 km north of Lake Aral-Sor. By 1964 the first hole was 5.43 km deep, and by late 1966 it had penetrated to 6.3 km. At this depth it was abandoned because of technical difficulties in drilling. Two professional papers have described the temperature profile and other early measurements in this hole.[20,21] Its depth was to be 7 km--a good beginning for the superdeep drilling program but still short of the 7.77-km depth reached in Texas during 1958. A. A. Ali-Zade and G. A. Akhmedov have discussed the geology of the nearby Apsheron Peninsula, where the second Caspian superdeep hole is being drilled.[22] This hole had reached a depth of 6.5 km in January 1967.

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h. In addition to the argument that the deep holes may reveal mineral wealth, various Soviet geologists have advocated tapping the high-temperature rocks at great depths as a source of heat for geothermal power generation. Although geothermal power is practical, the suggestion of drilling deep holes for it is not. The higher temperatures in deep layers offer both greater heat flow and higher conversion efficiency, but the advantages increase no faster than the square of the depth. Costs increase much faster with depth, so a given amount of power may be obtained more efficiently from several holes of moderate depth than from one superdeep hole.

i. In 1961, the program of superdeep drilling was reported to be part of the 7-year plan then in effect for developing the national economy of the USSR.[23] In 1966, a proposed 5-year plan for economic development also included superdeep drilling, with emphasis on the study of deep mineral deposits.[24] Evidently the USSR plans to pursue the drilling programs that have been publicized, and may eventually have antennas deep enough to communicate through the electromagnetic waveguide layer.

j. Participating organizations include the Institut Fizik, Zemli, ANSSSR; the Moskovskiy Institut Nefte-Khimicheskiy i Gazovy Promyshlennosti imeni I. M. Gubkina; the Vsesoyuznyy Nauchno-Issledovatel'skiy Institut Burovoy Tekhniki -- VNIIBT; the Gusudarstvennyy Nauchno-Issledova-tel'skiy i Proyektniy Institut Neftyanogo Mashinostroyeniya; and the Vesesoyuznyy Nauchno-Issledovatel'skiy Geologorazvedochnyy Institut.[18]

7. DEEP ELECTRICAL MEASUREMENTS

a. The electrical properties of the earth's mass may be measured by applying current to buried electrodes and observing the resulting voltage distribution. When the electrodes are all spaced far apart, the electrical effects

measured are influenced by properties of the rock at great depths. For practical reasons, four electrodes are generally used: two carry a standard current, and two are used to chart the distribution of voltage at the surface of the ground. Commonly, the four electrodes have been spaced along a straight line, with the voltage electrodes between the current electrodes.

b. The electrode spacing must be much greater than the depth investigated, and electrical measurements of a layer 10 km deep may require an electrode pattern 100 km long. Great practical difficulties exist in setting up the apparatus to provide high enough voltages and currents over such a distance. L. M. Al'pin and his students in the Soviet Union have demonstrated that deep measurements may be made much more simply if the two current electrodes are located within a few kilometers of each other at one end of the 100-km path and the voltage electrodes are similarly spaced at the other end.[26] No wires run the full distance.

b1

c. G. V. Keller and others have reviewed the results, methods, and problems of studying the electrical properties of the earth's crust and underlying rock.[25-29] Keller and L. A. Anderson have also described a typical experiment in which a signal was propagated 60 km from a 5-km sending-selectrode pair to a 1-km receiving pair.[27] Their frequency was only 0.017 Hz, but a somewhat higher frequency could have been used. D. B. Jackson[28] attained a range of 100 km with an 8-km sending pair, a 1-km receiving pair, and a 720-volt, high-current power supply delivering 10 to 100 kw. Signals as weak as 10 μv/km could be detected at the receiver.

d.

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e. Key Soviet research in this field through 1963 has been collected in one volume.[30] This publication contains a review bibliography, an extensive analysis of the complex interpretation of measured electrical quantities, and a comprehensive graphical atlas of computed theoretical properties of specific geological configurations.

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f. Aside from the use of electrical methods in geophysical prospecting, the conductivity of the earth's surface layers has an important influence upon the propagation of ordinary radio signals. Radio amateurs throughout the USSR were recently invited to make local measurements for compilation into a conductivity map of the USSR. Certain problems in making these measurements have been discussed by S. Ordzhonikidze of the Geological Survey Institute, Moscow.[31] Yu. K. Kalinin has also discussed the measurement of soil conductivity,[32] and V. S. Yampol'skiy has measured the frequency dependence of conductivity for surface rocks in Western Siberia, Kazakhstan, and Central Asia.[33]

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8. (C) MAGNETOTELLURIC STUDIES

a. In addition to electrical studies made with currents artificially applied to the earth's crust, much can be learned by careful measurements of natural electric and magnetic fields and by analysis of their fluctuations. Field variations are of several types, including the familiar slow drift of the magnetic poles. Irregular electrical pulses are generated by distant electrical storms, and disturbances of natural current in the ionosphere also appear as induced fields in the earth's crust. Other fluctuations may represent low-frequency electromagnetic radiation traveling through space and impinging upon the earth. These different types of fluctuation may be identified by characteristic patterns in a chart recording.

b. Cagniard has shown that measurement of fields associated with impinging radiation or ionospheric fluctuations can yield information on resistivity of the earth as a function of depth.[35] An effective resistivity can be found for each recorded frequency of fluctuation by taking the ratio of electric to magnetic field strength, squaring it, and multiplying by the period. The difference in phase between the electric and magnetic fields is also useful. The resistivity found for longer-period fluctuations is to some degree a measure of the average for rocks at great depths, and the variation of apparent resistivity with period is therefore a rough profile of resistivity at various depths, perhaps to a few hundred kilometers. Typical measurements in the United States and Canada have been reported by D. Plouff[36] and by K. Vozoff and R. M. Ellis.[37]

c. Soviet interest in the use of natural electric and magnetic fields for geological studies began during the International Geophysical Year activities.[38] A. N. Tikhonov and M. N. Berdichevskiy of the All-Union Scientific Research Institute of Geophysics, Moscow, recently reviewed the various forms of magnetotelluric exploration used in the USSR and outlined the advantages of these different techniques.[39]

d. The Soviet geophysical journals carry frequent reports of this research on natural electric and magnetic fields.

e.

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f.

g. Tikhonov, Deputy Director of the Mathematics Institute, ANSSSR, was awarded the 1966 Lenin Prize for an undisclosed series of experiments.[41] His active theoretical studies of telluric currents and wave propagation in an absorbing medium, in conjunction with the Institute of Physics of the Earth, probably have been followed by a successful experimental program of some practical interest, perhaps toward development of underground communication.

9. (C) SEISMIC STUDIES

a. Notice should be taken of the excellent seismic research conducted in the USSR. The top Soviet seismologists lead their field. Although the USSR lacks the most modern instrumentation for collecting and rapidly processing large quantities of seismic data, very competent research is being done, and the theoretical interpretations are generally more advanced than those in the West.

b1

Results of seismic measurements and theoretical research are published in great numbers in open literature.

b. b1 seismic methods have provided more detailed information about the layering of the earth s crust. This background understanding is essential for interpreting the electrical observations and is vital in selecting a site for a superdeep hole. Seismic studies, both with natural earthquakes and with explosive charges as acoustical sources, provide fairly detailed information about the character and depth of layers within the crust.

c. b1

10. (C) LOW FREQUENCY RADIO

Historically, the USSR has shown more interest than the rest of the world in the propagation of low frequency radio waves and has a broad competence in the theory and practice of electromagnetic propagation. S V. Borodina et al. have surveyed the study of very long electromagnetic waves (between 10 Hz and 50 kHz) and cite 109 references, 12 of them Soviet.[44] (The predominance of non-Soviet reference does not reflect upon Soviet technology, because this is a review paper apparently written to acquaint Soviet researchers with work done elsewhere.) P. Ye. Krasnushkin and N. A. Yablochkin have also reviewed this topic, with emphasis on relating theory to experiment.[45] Both of these works consider waves propagating through the space between the earth's surface and the ionosphere, which acts as a type of waveguide.

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11. (C) LABORATORY SUPPORT

a. Because measurements of the electrical properties of deep rocks have been subject to experimental uncertainties, supplementary work has been undertaken in laboratories to determine the conductivity and dielectric coefficient of many types of rocks as functions of temperature, pressure, dampness, and frequency. Ryazantsev and Shabel'nikov have cited more than 40 of the many publications describing this research.[7] S. G. Hibben has cited eight more publications in a review paper on underground electromagnetic wave propagation.[46] These measurements support the conclusion that electrical conductivity should increase with depth in the earth, mostly because of the higher temperatures.[47] Pressure has a minor influence.[48] Apparently the conductivity also increases with frequency, except at the very highest temperatures studied.[47] The dielectric coefficient of rock, which also influences wave attenuation, increases with increasing temperature and slightly decreases with increasing frequency. Damp rocks, similar to

those in the uppermost layers, exhibit the expected high conductivity.[49] These studies are entirely consistent with indirect measurements of conductivity in the earth's crust, b1

b. b1

C. (U) SOVIET INTERESTS AND CAPABILITIES

12. INSTITUTIONS AND PROGRAMS

a. Soviet authors b1 are scattered among more than 20 institutes, most of them already named. Only one to four scientists at any one institute have reported such work, with one important exception: more than a dozen of the authors are associated with the Institute of the Physics of the Earth imeni O. Yu. Shmidt, AN SSSR. Their interests include shallow antennas, electrical prospecting, deep drilling, magnetotelluric studies, and some laboratory support work- b1 These personnel are A. G. Ivanov, V. N. Nikitina, B. S. Eneshteyn, D. N. Shakhsuvarov, Ye. V. Rybakova, E. I. Parkhomenko, M. P. Volarovich, I. I. Rokityanskiy, Yu. I. Vasil'yev, B. P. D'yakonov, A. N. Tikhonov, V. A. Troitskaya, Yu. P. Bulashevich (Ural Affiliate), and A. G. Bondarenko.

b. Other institutions that have contributed very few known studies are the Sci. Res. Inst. of Geophysical Methods of Prospecting, the Math. Inst. imeni V. A. Steklova (AN SSSR), the Inst. of Mining and Geology (Ural Affiliate, AN SSSR), Moscow State U. imeni M. V. Lomonosov, Sci. Res. Inst. 88 (Podlipki), the Inst. for Geology of Useful Minerals (AN SSSR), the Leningrad State U. imeni A. A. Zhdanov, the Inst. of Radio Eng. and Electronics, the Inst of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, the All-Union Sci. Res. Inst. for Geology, the Ministry of Geology and Mineral Conservation, the Inst. of Geophysics (Ural Affiliate, AN SSSR), the Inst. of Geology (AN SSSR), the Far Eastern Affiliate imeni V. L. Komarov (AN SSSR), the Moscow Petroleum Inst. imeni I. M. Gubkin, the (AN AzSSR), the Inst. of Geophysics (AN TuSSR), the Geology Inst. imeni I. M. Gubkin (AN AzSSR), the Moscow Inst. of Geophysical Prospecting imeni S. Ordzhonikidze, the Molotov State U. imeni A. M. Gor'kiy, and the All-Union Sci. Res. Inst. of Geophysical Prospecting. These establishments may have only a sporadic interest in the relevant research topics reported by them, or one or more classified programs may actually be in progress. No confirming information is available, and the work reported could be fully justified for scientific or industrial purposes.

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Telluric communication						
Detection system						
Underground facility						
Magnetotelluric networks						

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U. S. ARMY MATERIEL COMMAND

AST-1610s-216-65

COMMUNIST BLOC FACILITIES FOR BW FIELD TESTING (U)

U S ARMY
FOREIGN SCIENCE
AND
TECHNOLOGY
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February 1965

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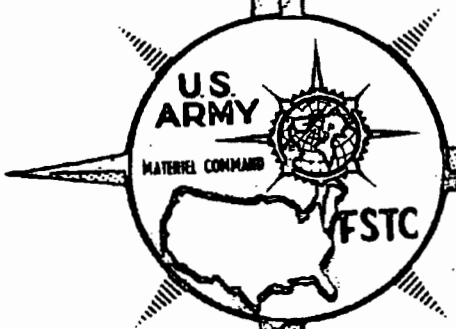

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DESCRIPTORS

Biological warfare; field testing centers; Soviet Bloc; proving grounds; microbiological research.

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COMMUNIST BLOC FACILITIES FOR BW FIELD TESTING (U)

February 1965

(Based on information available as of July 1964)

ABSTRACT

(U) This study presents a summary of published intelligence data on Communist Bloc facilities for BW field testing and proving ground activities.

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AST-1610S-217-65

U. S. ARMY MATERIEL COMMAND

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REFERENCE SET

BW-RELATED INSECT VECTOR RESEARCH IN THE SINO-SOVIET BLOC (U)

U S ARMY
FOREIGN SCIENCE
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CENTER

February 1965

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DESCRIPTORS

Entomological BW weapons system; insect vectors; Sino-Soviet entomological research; tick-borne encephalitis; biological warfare.

WARNING NOTICE

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BW-RELATED INSECT VECTOR RESEARCH IN THE SINO-SOVIET BLOC (U)

February 1965

(Based on information available as of July 1964)

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ABSTRACT

(U) This study discusses some significant Sino-Soviet Bloc entomological research and development. It compares entomological biological warfare (BW) with other weapons systems and lists activities which indicate or contribute to an entomological BW capability.

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(C) CONCLUSIONS

2. (C) SCOPE

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