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# SCIENTIFIC INTELLIGENCE RESEARCH AID

# THE SOVIET BW PROGRAM


OSI-RA/61-3

24 April 1961

[redacted]

CENTRAL INTELLIGENCE AGENCY

OFFICE OF SCIENTIFIC INTELLIGENCE

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Scientific Intelligence Research Aid

# THE SOVIET BW PROGRAM

NOTICE

The collated data contained herein are primarily background information and do not represent an intelligence position. This report has been prepared as a reference aid for intelligence analysts and others concerned with the subject matter and may not be acceptable or usable for other purposes.

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24 April 1961

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PREFACE

This study was undertaken as an exhaustive review of all intelligence information bearing on Soviet biological warfare capabilities as well as an appraisal of new information collated since 1956. [redacted]

1. There is insufficient direct evidence on which to base a firm assessment of Soviet BW offensive activities. Nevertheless, on the basis of considerable indirect evidence, including Soviet microbiological and other research possibly related to BW, and knowledge of what we believe to be a field testing site, we estimate that a BW research and development program is under way in the USSR which probably encompasses both offensive and defensive aspects.

2. The current tempo of testing activity is undertain. There is [redacted] evidence that offensive BW field tests have been carried out for many years, probably using a variety of dissemination devices and delivery systems, including aircraft and possibly artillery. Some offensive BW research probably is carried out at three military medical institutes, and studies related to offensive BW are conducted at various other institutes. [redacted]

3. Available evidence does not permit us to determine with certainty which BW agents are under investigation or which agents, if any, have been standardized for employment by the Soviets. There are indications that as many as 16 candidate agents are being studied, [redacted] No BW production facilities have been identified in the USSR, but known biological facilities are adequate to produce bacterial BW agents if desired.

4. We estimate that a variety of organisms probably will have been thoroughly tested, and some may be standardized for delivery systems, by 1965. Possible agents for standardization by the Soviets in this time period include those of anthrax, plague, tuleremia, foot-and-mouth disease, rinderpest, the encephalitides viruses, and botulinum toxin. The development of anticrop agents is unlikely.

5. By 1965, the Soviets could undertake large-scale virus production and mass-rearing of infected arthropods. Munitions for delivery by high-performance aircraft also could be perfected and, although unlikely, the Soviets probably could have BW warheads for missiles.

6. BW defense training by the military is conducted as part of CBR defense training. Apparently, however, it is not emphasized. Research and development on immunization, rapid detection of airborne microbes, and decontamination methods are well along, and military medical defense measures are well organized. Civil defense is well organized and has emphasized BW defensive measures as part of the program since 1956. Nevertheless, civil defense against BW is not well developed. By 1965, the Soviet defense capability should be strengthened markedly through improved medical measures and preparations, efficient aerosol sampling systems, more rapid identification procedures, and more effective training in BW defense.

The extensivly detailed information presented herein is being published to provide the U.S. intelligence community with as much backgrcund guidance as can be feasibly published to assist interested persons in understanding and resolving the serious problem of Soviet biological warfare. The intelligence research effort was completed 1 January 1961. The basic study findings were endorsed by the Scientific Intelligence Committee of the USIB on 22 June 1960.

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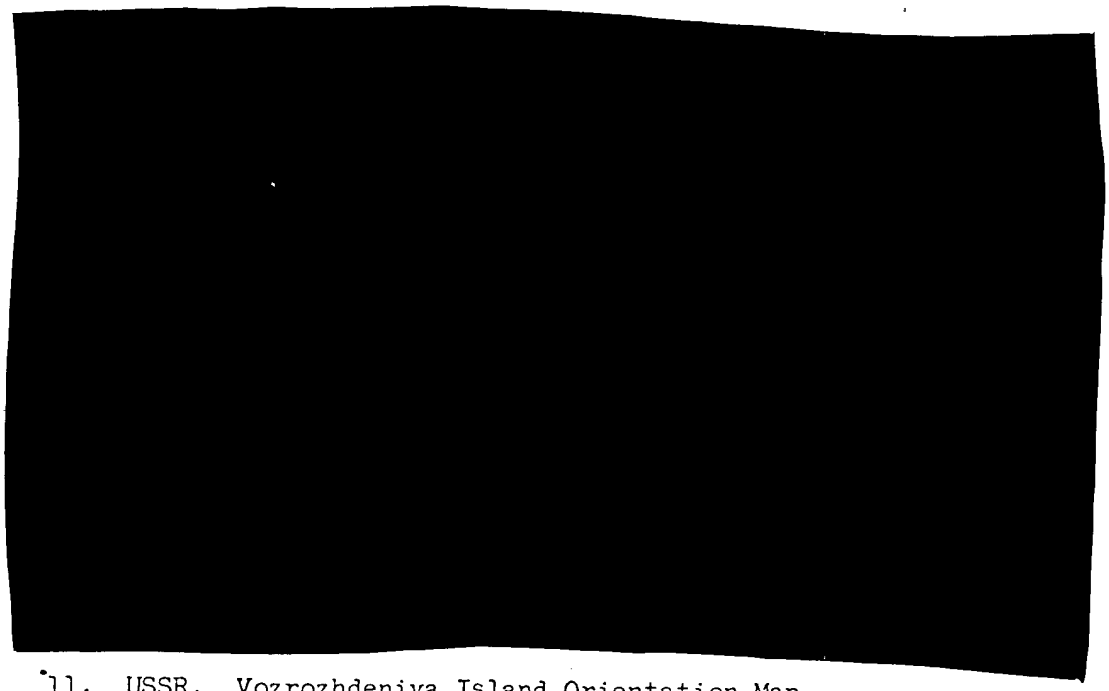

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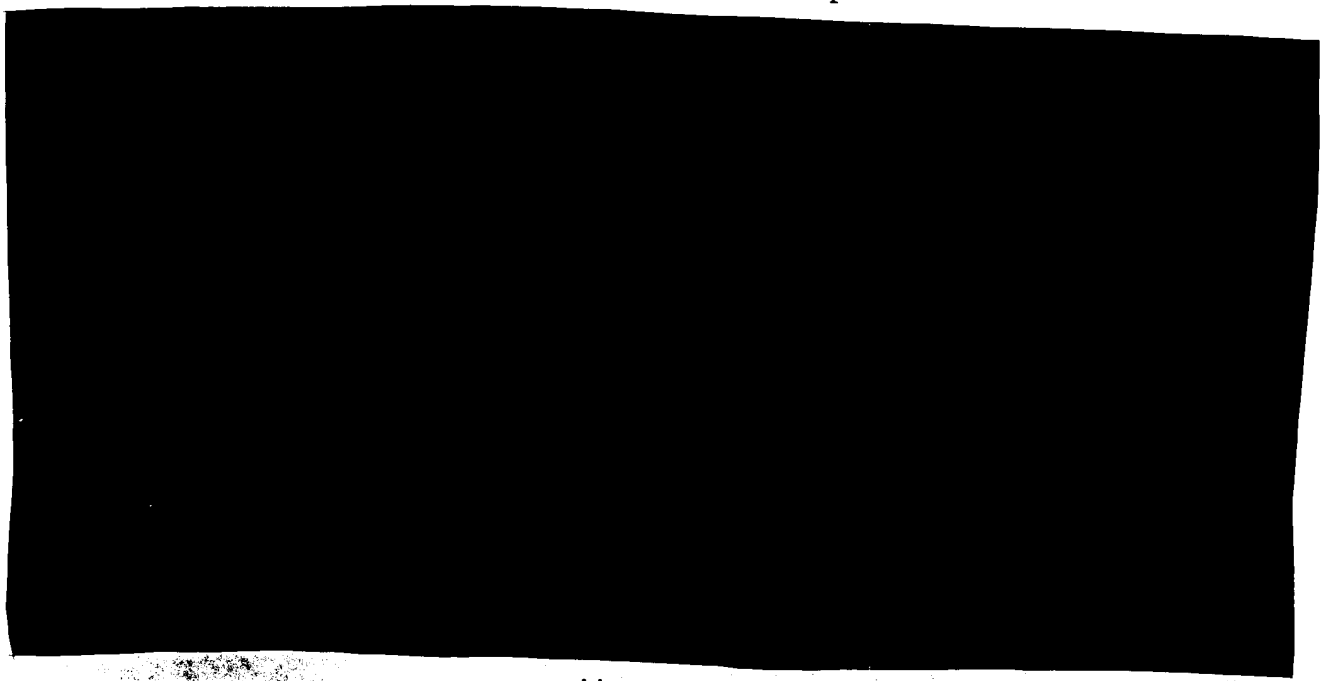

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# THE SOVIET BW PROGRAM

## General Aspects of the Soviet BW Program

### Existence of a Program

Background.--Soviet interest in biological warfare dates at least from 1932. 1/ 16/ Publications spanning the decade prior to the outbreak of World War II, for the most part, are unavailable for study in their original form; although Soviet scientists and military writers appear to have been no more prolific on the subject of biological warfare than authors of other nations during the same period. It is apparent that accumulated evidence on the alleged military use of infectious microorganisms in World War I was reviewed as early as 1935 by Soviet military figures and that by 1939 a rather thorough survey of the world's BW literature had been undertaken. 3/ 4/ 15/ Representatives of the Soviet armed forces were among the first to point out the potential usefulness of biological agents in time of war and to call for work by the nation's scientists on defensive measures. 3/ 4/ 16/ 24/ 28/ Rumors of BW research in the USSR are said to have been circulating among Soviet scientists as long ago as 1927, and there are indications that a mounting awareness of the subject was felt within the scientific community by 1940-41. 5/ 6/ 29/ French, Polish, and Japanese intelligence organizations are credited with having defined an active Soviet interest in both the offensive and defensive aspects of BW prior to World War II, 2/ but a belief that the USSR has devoted much attention to the study of biological agents is also found among Yugoslav military documents. 27/ German Intelligence of the Nazi regime amassed voluminous records of reported Soviet development and testing of biological agents and a means for disseminating them. These records formed a vast collection of unevaluated information covering an era from the 1930's to the early days of the second World War and were consolidated after the war into the so-called Hirsch report. 17/ Despite many shortcomings, that report constitutes one of the pillars upon which the still incompletely known historical development of Soviet BW activities has been partially reconstructed.

Unclassified Soviet literature on BW from the World War II period are few in number, and it is not clear whether the limited distribution of those papers or the suppression of publication is the underlying cause. Little reliable information on BW from any source was forthcoming during the years of World War II, although a continued interest is inferred from intensive Soviet interrogation of prisoners of war on this subject during the period of hostilities and from intelligence information generated in the postwar era. 18/ 19/

Since 1950, some 30-odd articles dealing specifically with BW have been gleaned from Russian sources, by far the greatest number of them having been noted in unclassified military or scientific publications and civil defense training manuals appearing during 1956, 1957, and 1958. It now appears likely that the notoriety following the Khabarovsk investigation in 1949 of alleged Japanese BW activities and the widespread charges of U.S. employment of BW during the Korean hostilities provided the stimulus for much of this writing, which ranges in scope from material of a purely inflammatory nature to searching inquiries on the subject of agents, weapons, and defensive measures. 7-12/ 25/ 347/ There is little doubt that in recent years the concept of BW and the problems inherent in its employment have been brought to the attention of a wide audience in the Soviet Union through military periodicals; professional medical textbooks; training manuals issued to civil defense groups; reading material placed in bookstores for sale to the general public; indoctrination of the Armed Services; and radio broadcasts. 12/ 20-23/

In addition to the mass dissemination of articles whose content pertains expressly to BW, the Soviet scientific microbiological literature offers an occasional instance of stated applicability of the research topic to biological warfare but almost invariably to its defensive aspects alone; examples of implied application are more numerous. 13/ 14/ 26/ 77/ 78/ For the most part, Soviet authors are prone to limit the scope of their discussions, particularly on those phases related to the actual employment of biological agents, to topics that originate in the world press or which can be traced to Western scientific periodicals. Thus, a study of unclassified writings yields no clear insight into the paths of BW development that the USSR may have pursued historically. The limitation of the subject matter itself reveals that Soviet microbiologists follow closely the progress in development of biological weapons as portrayed by Western scientific publications. In view of the extreme secrecy surrounding present day Soviet weapons development, it would be overly optimistic to anticipate publication of experimental work performed in support of unconventional warfare activities. The extent to which this aura of secrecy has pervaded the Soviet scientific community is exemplified by a recent statement on BW research in the SovBloc nations:

> There tends to be a taboo on the subject of BW in Soviet or Satellite scientific circles, especially in those fields most immediately concerned with related matters. The subject never arises spontaneously, and if it is brought up, the atmosphere indicates this is imprudent. 30/

The BW entities mentioned most frequently in classified documents representing a complex mixture of valid observations, half-truths, rumors, and outright fabrication are the bacterial diseases. These

diseases include certain of those which Western microbiologists recognize as possessing valuable agent characteristics, that is, plague, anthrax, brucellosis, and tularemia. The older documents cite the development of still other bacteria, among them typhoid fever, the dysenteries, and cholera, which are not generally looked upon today as favored agent candidates for modern mass dissemination weapons systems. Bacterial toxins, viruses, and the rickettsial diseases have been mentioned far less often than the bacterial infections, and no one disease of these groups has been given broad emphasis. No specific instance has been found of alleged Soviet interest in pathogenic fungi for use against human and animal targets or of the development of plant pathogens as agents of warfare against food crops and economically important plants. For the most part, the agents which have been reported under study in the USSR are those which give rise to a significantly high proportion of fatalities among infected hosts; for example, "lethal" agents, as opposed to the so-called "debilitating" agents which engender disease with relatively low mortality.

Many different methods for disseminating these infectious materials reportedly were considered by Soviet scientists over the years. Experimental development of biological weapons suitable for both strategic and tactical employment has been noted in many of the older reports, for example, serial bombs, aircraft spray systems, artillery munitions, and even rockets and missiles. References are made frequently to agent preparations or harmless-appearing devices for spreading disease covertly by means of food and water supplies and to procedures for infecting populated localities by birds, arthropods, rodents, or direct human efforts. A quick tabulation of representative data from the older information reports shows that some 20-odd test-sites or other experimental installations, lying over widely scattered areas of the USSR, were purportedly engaged in support of the earlier Soviet developmental programs. The size and complexity of these installations ranged from primitive laboratories with makeshift equipment to elaborate research centers and field test areas covering hundreds of square miles. There is little solid evidence, however, to substantiate early Soviet BW interests of such broad scope, and modern intelligence methods have not provided confirmation of even the existence of the great majority of these previously reported programs and facilities. Aside from the probability that some of the source materials were based on nothing more substantial than rumor or fiction, it seems likely that a significant portion of the earlier activities ascribed to BW may have arisen from the close similarity between BW research and conventional public health work. Certainly, the activities of field stations and survey teams of the widely-dispersed anti-plague organization and the frequent epidemiological expeditions sponsored by various other

public health establishments between 1937-44, and later, could have been construed in the minds of untrained observers as having a more sinister purpose. 2/ 34/ 50/ 120/ 121/

From an historical standpoint, distillation of classified intelligence information and its correlation with pertinent materials from more recently available open sources, focuses attention on the years 1934 and 1935, respectively, as the probable beginning of active participation by Soviet military figures in antipersonnel and antilivestock BW research and weaponery, although primitive efforts may have occurred some 5 or 6 years prior to those dates. 2/ 17/ 29/ German intelligence officers believed that Soviet attempts in 1930 to develop biological bombs were supplemented by animal experiments at Ft. Alexander on Leningrad's Kronstadt Island. 2/ Two former Russian residents also mentioned the island as the site of possible BW work. 343/ 359/ It is known that Kronstadt housed a plague laboratory from 1899 until 1918-19, and that this installation was the forerunner of today's Scientific Research Institute of Microbiology and Epidemiology of the Southeast USSR (Mikrob) in Saratov. 455/ 629/ A history of Ft. Alexander's work indicates that it was the primary training center for plague specialists in the USSR until the 1918-19 transfer to Saratov. Aerogenic infection of laboratory animals with plague was studied as one phase of research. 455/ No record exists of the period between 1919 and the alleged BW experimentation of 1930, and evidence to substantiate a BW mission at Ft. Alexander in more recent years has not been forthcoming. Despite the obscurity of early accomplishments in BW, there are strong indications that development of the program had progressed to a point that by 1935-36 geographically isolated areas were required for testing biological agents, dissemination methods, and defensive measures. 17/ 18/ 28/

As far as can be determined, this expansion began in 1935 with the establishment by the Commissariat of Defense of a center for BW research on Gorodomlya Island in Lake Seliger, Kalinin Oblast, RSFSR, utilizing preexisting facilities of the Foot and Mouth Disease Institute. 28/ Little has been learned of the work carried out by the Gorodomlya Institute, beyond the probability that diseases of both humans and animals were studied before its abandonment and partial destruction during World War II, but it is believed to have furnished a pattern for construction of a branch installation of the All-Union Institute of Experimental Veterinary Medicine (VIEV) on Lisiy Island, Kalinin Oblast, approximately 65 miles to the east. The Lisiy Island facility, thought to have been in operation from 1938 to 1941 and again during the period 1944 until at least 1957, is adjudged to have been almost certainly engaged in both defensive and offensive aspects of antilivestock BW research.

Significant development of antipersonnel biological weapons probably dates from 1936, the year in which Vozrozhdeniya Island in the Aral Sea is believed to have been established as a field test area. 17/ 35/ This island is considered to be the site most likely to be involved in current Soviet BW agent and weapons testing. 69/ 70/ While information compiled by German Intelligence in World War II first pointed to Vozrozhdeniya Island as a major Soviet BW test area, little information of real value on the guiding organization for such activities, or on the scientific establishments and research personnel which supported the test program, was available prior to 1948. 17/ [redacted] linked a group of military officers with BW research in Kuibyshev at an installation which [redacted] designated as the Sanitary-Hygienic Research Institute of the Soviet Army. 36/ These military scientists, who had been working as a group as early as 1936, were subsequently identified as staff members of the Scientific Research Institute of Epidemiology and Hygiene of the Armed Forces (NIIEG-VS), 18/ 37/ an institute later determined to be located in Kirov, Kirov Oblast, RSFSR. 51/ 69/ 73/ 74/ 165/ In recent years, evidence has indicated that the NIIEG-VS may be the principal antipersonnel BW research center in the USSR, and this center is now believed to have used the isolated test facilities provided by Vozrozhdeniya Island as one phase of its research programs. 18/

Soviet scientists were exploring measures for defense against BW during the 1930's, at a time when concern was felt in the USSR that Germany and Italy, rapidly rearming, might resort to biological warfare. The establishment of the Lisiy Island laboratories in 1938 probably was a direct result of this concern. 28/ Actual field testing of methods for rapid detection and disinfection of BW agents at an early date, was reported by German Intelligence, 17/ but the scientific literature and unclassified military writings of the period prior to World War II are largely devoid of any indication that original research devoted specifically to BW defense was under way at that time. Only after the war did Soviet publications begin to reflect work clearly suggestive of BW defense, which apparently had been in progress for some years. 37/ 38/ 52/ 53/

The foundation for the present-day Soviet defense mechanism may be considered in one sense to have been laid down in 1918-23 when the new Communist regime established a number of Central Research Institutes and a system of sanitary and epidemiological control laboratories under auspices of the Commissariat for Public Health to combat epidemic disease. 39/

Through the years, the civil public health structure evolved gradually and is recognizable today as a closely knit organization

of Scientific Research Institutes of Epidemiology and Microbiology, Institutes of Vaccines and Sera, Anti-plague Research Institutes, Sanitary-Epidemiological Stations, and various other specialized facilities. 39-41/ From its inception in 1918 until late 1929, the Chief Military-Sanitary Administration, the organization most intimately concerned with medical problems of the Armed Forces, was an integral part of the Commissariat of Public Health. 42/ When in the period 1928-30 the military medical services began to exhibit a more independent interest in sanitation, disease prophylaxis, and epidemiology, divergent paths of development were pursued and this Administration became the nucleus for a separate medical agency under jurisdiction of the Commissariat for Army and Navy Affairs. Concurrently, a group of purely military research institutes was created to study problems of armed forces sanitation, prophylaxis, and related matters. 42/ Little is known of the possible role of these institutes in BW research, but the secrecy surrounding their existence and the nature of some of their activities suggest that the role may have been a prominent one.

With the advent of World War II, additional strengthening of the military medical forces took place, and separate high-echelon administrative components were established to direct hygiene and antiepidemic control of disease. At the same time, greater responsibility for teaching and research in these fields was bestowed on the military medical academies. 42/ This period of expansion in 1941-43 probably marked the beginning of an era of research and development on problems of BW defense, and possibly offense, within the Military Medical Academy system, and particularly at the Military Medical Academy imeni Kirov in Leningrad. 42/ 43/ 45/ 46/ World War II provided a strenuous test of the epidemic-prevention system which had been devised in the years preceding the war, and close mutual support between civilian health agencies and the military medical services was quickly found to be necessary. 47/ 48/ The concept of a united defense effort has been retained and enlarged upon in the years since the war, so that today the framework of defense embraces not only the civil and military health agencies and units of the armed forces, but certain semiofficial associations such as the Red Cross and Red Crescent Societies. 42/ 49/

While integration of medical defense programs is a function of the Ministry of Health, other agencies also appear to have a coordinating role, so that, in effect, research on matters of BW defense could logically be found in biological research institutes of many different types in the USSR. 39/ 48/ 49/ This is very probably the case today according to pertinent BW information emanating from public health laboratories, Academy of Sciences research centers, medical institutes, the military medical academy, and specialized

laboratories of the Armed Services. Aside from conventional civil defense planning and preparations, only recently have Soviet figures deemed it appropriate to announce the existence of research programs designed for BW defense. 75/ 76/ 222/ 355/ Attempts have been made to incriminate Soviet forces in the intentional contamination of medical dressings with anthrax and tetanus spores, the appearance of typhus and typhoid fever among German military personnel in World War II and in an outbreak of foot and mouth disease in Finland during the 1939 Russo-Finnish War, but, again, complete documentation has not been established. 29/ 114/ 115/ 630/ Thus, the question of whether the USSR has ever resorted to BW remains largely unanswered.

As information on Soviet BW interests became available over the years, periodic studies were undertaken by intelligence organizations to evaluate certain critical factors, such as the capability of Russian science to support an active BW program, possible choice of agents, capacity for defense, and others. While the intelligence positions which were established in this manner from time to time did not take into account all of the elements essential to a BW program, they do reflect, in large measure, historical advances in the state of our knowledge on the existence of a BW program in the Soviet Union. For example, results of a study conducted in 1952 "suggested strongly" that the USSR has a BW research and development program; this was substantially the same position which had been held since 1948. 55/ The study also acknowledged a Soviet capability to employ biological agents covertly and recognized at least a limited capability for defense against BW attack. By 1954, there was general agreement that the USSR possessed the resources for sustained supporting research and a capacity to produce agents and devices for large-scale clandestine attack, or possibly even limited overt operations. At the same time, it was concluded that the Soviets probably have an active program encompassing antipersonnel, antilivestock and possibly anticrop aspects. 56-58/ Estimates prepared in 1956 established a position that the USSR almost certainly had an active BW program. Beyond this, an indication of the relationship between NIIEG-VS and Vozrozhdeniya Island in research and development on human diseases was obtained, and Lisiy Island was pointed out as almost certainly having been involved in both the offensive and defensive phases of antianimal BW research. 18/ 28/ Recent status reports have not materially altered the 1956 position with respect to estimated Soviet capabilities in science and technology, defensive stature, offensive developments, or other major facets of the problem.

Recent Progress.--Several critical gaps in Soviet BW intelligence were identified in the course of the recent studies, and the lack of progress in determining the scope and magnitude of the Soviet program, especially its offensive features, was pointed out. Since

publication of the last comprehensive status report in 1956, much valuable information on Soviet BW efforts has become available, both from classified sources and from study in depth of the scientific literature and other open publications. From analysis of this information significant conclusions can be advanced to supplement the meager knowledge in several of those substantive areas of BW intelligence for which major deficiencies were defined.

Perhaps the most notable progress was made in the collection of vital information on Vozrozhdeniya Island, long considered because of its ideal location to be the most probable site of Soviet field test activities. 18/ [redacted] In addition, substantiating evidence has been obtained that the port of Aralsk, approximately 130 miles northeast of the island, serves as the mainland supply base for Vozrozhdeniya. 62-66/ 69/ 70/ [redacted]

In 1956, a sudden outpouring of Russian scientific publications revealed a wealth of data on research programs of unusual significance to BW intelligence, which, in some cases, probably had been under way for several years. This flow of information has continued with little apparent interruption to the present time. Intense Soviet activity is apparent in certain broad fields of applied research which have a direct bearing on both public health improvement and protection against biological weapons, while other work is manifestly in support of BW defensive, and quite possibly offensive, planning. As an example, considerable emphasis has been noted recently in the field of Soviet aerosol research on development of chambers and allied equipment for the study of pathogenic bacteria, viruses, and microbial toxins dispersed as clouds; determination of the degree to which immunity can be established against respiratory infection and, conversely, the immunogenic properties of airborne microorganisms; and design of various sampling devices for detection of airborne disease agents. 13/ 45/ 46/ 77-88/ An active program to devise laboratory and field procedures for early detection and rapid identification of pathogenic agents has been defined, and much additional information which denotes widespread research activity on such fundamental needs as multiple, combined vaccines and polyvalent antisera, more effective

vaccine strains, improved disinfection methods, and others have been studied. 89-92/ Thus, within the period which has elapsed since the last critical evaluation of Soviet BW posture, a greater volume of more reliable information has been placed at the disposal of the analyst than was evident in the past affording the Intelligence Community the opportunity to establish a stronger and more confident position on BW in the USSR than was previously possible.

Organization of Biological Warfare

[redacted]

Although lacking finite data on Soviet procedures for developing biological weapons, from examination of the structure and functions of agencies expected to be active in one or more phases of the program, one can nonetheless establish organizational relationships which appear plausible. This approach presumes that steps found necessary by Western scientists to perfect an efficient weapons system, particularly for overt employment, that is, agent research, munition design, testing, procurement, maintenance, and training, would also be under way in the USSR. That the presumption is valid in part, at least, is shown by recent information that indicates not only the existence of a BW proving ground but that weapons suitable for overt employment have undergone extensive field testing. 62-66/ Many of the aforementioned steps in development are applicable to biological devices for covert delivery, although the scope and magnitude of effort might be substantially less, involving smaller numbers of workers and permitting the greater part of the program to be confined to one or a few agencies.

The Ministry of Defense is suspected of exercising general supervision over BW matters in the Soviet Union. 354/ An armed forces establishment; 18/ biological aerosol experimentation at the Military Medical Academy; 78/ 83/ and the existence of troop units with BW defense functions; 407/ 408/ and probable military jurisdiction over the Vozrozhdeniya Island proving ground are among the many factors which point in this direction. 62/ 63/ 65/ 66/ Each of these factors can be said to derive from the authority and control over all military forces vested in the Defense Minister and his responsibility for developing the means of combat. 405/ 407/

The direction offensive BW planning should take and the parameters of the program are policy decisions apt to be determined at a still higher executive level. During World War II, a State Committee for Defense headed by Stalin is said to have performed functions of this general nature, relinquishing them to the Council of Ministers at the end of the war. 407/ In subsequent years, the Council formulated policy and provided guidance to the Defense Minister on matters affecting the armed services. 336/ 354/ 407/ Various consultant groups, commissions, and administrative agencies subordinate to the Council of Ministers have been identified as possibly active in a BW advisory capacity to the Minister of Defense because of their support mission to research and development in general. Among the more important of these are the State Committee for Defense Technology, the State Scientific Technical Committee, and the State Planning Commission. 354/ 407/ [redacted] Staff advisory groups are also found within the Ministry of Defense proper, notably the Military Soviet and the College of the Defense Ministry; and it is entirely logical that the consultant services of these bodies should embrace BW planning problems. 407/

The bulk of experimental work on the newer weapons systems is reportedly still carried out in the military academies and in specialized institutes under the armed forces technical services. This suggests that the trend toward realignment of industrial establishments and institutes of the Academy of Sciences under the State Planning Commission pertains more to research on industrial problems and mass production of items of military equipment than to biological research. 117/ 405/ It is apparent that microbiological work related to BW is still conducted primarily outside the Academy of Sciences system, and publications from institutes affiliated with the Academy more nearly reflect fundamental research or industrial applications.

Because studies on the Soviet military research structure have implicated so many different elements of the scientific community, the Defense Ministry's role has been pictured as largely one of coordination.

[redacted]

117/ 354/ 407/ With respect to BW agent development [redacted] that supporting research would be diffused throughout various ministries, that is, Health, Agriculture, Defense, and would be administered through so-called secret sections of these agencies. 346/ The diffusion of BW-oriented experimentation on defensive matters is apparent today, particularly in military medical forces and among installations of the Academy of Medical Sciences, Ministry of Health, and the Agricultural Ministry. The extent to which offensive work follows this pattern is less obvious. [redacted] that the larger institutes serve as assembly points for projects delegated to smaller laboratories, the Scientific Research Institute of Epidemiology and Microbiology (Mikrob) at Saratov being a specific example of a larger institute serving in this fashion. 349/ [redacted] that the security services handled research assignments, consolidated experimental data, and provided the means of transmitting results. [redacted] that the MVD or KGB controlled BW research. 346/ That KGB elements perfuse every echelon of the military structure is documented; their existence in present-day civilian establishments has also been inferred. 348/ 399/ 405/ Other means are undoubtedly available for exerting control of research; however, it is reported that each civilian medical school and many research institutes have military departments, or faculties, which could be utilized for this purpose. 627/ Even if the presence of secret administrative sections is discounted, coordination and direction of effort could almost certainly be accomplished through organizational mechanisms and liaison groups already openly identified. The military medical establishment maintains contact with health agencies by liaison between its Main Military Medical Administration and the Minister of Health, USSR; this arrangement is extended to successively lower levels, involving military districts, republic, and oblast health services. 627/ The commander of each military district, in addition, reports directly to the Minister of Defense on all activities involving military personnel in his area. 407/ The Academy of Medical Sciences has within its structure the presidium, a group which develops broad research programs in biological sciences, which may be applicable to BW, and a Scientific Planning Committee, which works through so-called "problem" subcommittees composed of institute directors. Many military microbiologists participate in planning sessions of subcommittees in the Academy's Department of Hygiene, Epidemiology, and Microbiology. 116/ 355/ 654/ The Academy of Sciences, USSR, assumes a major role in research planning for the Central Committee and the Council of Ministers. 117/ Its subsidiary organizations, notably the Department of Biological Sciences and various councils and commissions set up to assign tasks and solve individual problems, afford to some degree an additional possible mechanism for coordinating BW research. 118/ Only one administrative body of the variety of types mentioned has actually been identified in offensive BW work. The Scientific Medical Council of the Main Military



[redacted]

Medical Administration, Ministry of Defense, almost certainly directed some phases of NIIEG's research in the 1940's. 42/ 396/ Closely related groups in the same ministry may likewise be involved, although no evidence can be brought to bear on this point; the Medical Technical Committee serves as a coordinating agency between the Military Medical Administration and industry for production of medical equipment, and the Medical Training Council, a group of specialists from various medical fields, reportedly plans military medical investigations, studies problems of sanitation and epidemiological control, and evaluates items of supply and equipment. 626/

Most of the known research shows only defensive interest on the part of scientific establishments of the various civilian agencies; but in selected instances, possible involvement in offensively oriented experimentation can been seen. The Rostov and Irkutsk antiplague institutes of the Ministry of Health conducted live vaccine work on plague and tularemia in conjunction with NIIEG in the 1940's. 53/ 173/ 265/ In the course of these explorations, pulmonary plague and tularemic pneumonia were studied in animals. A group at "Mikrob" in Saratov carried out plague aerosol research during the same period. 37/ 50/ 171/ The information so gained was undoubtedly of great value to NIIEG's program. Examples of work similarly important to offensive BW from other institutes of civilian agencies are: computations on aerosol dispersion in turbulent air from the Institute of Applied Geophysics, Academy of Sciences, USSR; 472/ ornithosis aerosol studies at the Institute of Virology, Academy of Medical Sciences; 503-506/ properties of biological aerosols and development of chambers for their use, Kiev Institute for Advanced Training of Physicians, Ministry of Health; 199/ 213/ radiation effects on experimental anthrax, Minsk Medical Institute; 331/ physiologic action of combined bacterial toxins, Odessa Medical Institute; 138/ 566/ and membrane feeding methods for artifically infecting lice, Institute of Vaccines and Sera imeni Molotov in Perm. 326/ Whether these varied pieces of research, among others over the years, were initiated by some executive body for direct utilization in BW cannot be stated with certainty, but they are consistent with a purposeful weapons development support program in the Soviet scientific community.

Agent development during the 1940's was conducted by NIIEG, showing that the Main Military Medical Administration, to which NIIEG was subordinate, performed at least part of that function for the BW program. 18/ 346/ 358/ 396/ Formerly known as the Sanitary Administration, and redesignated the Chief Military Sanitary Administration early in World War II, the executive organ for medical problems in the Defense Ministry now is usually referred to as the Main Military Medical Administration, or Directorate. 42/ 656/ Since 1953, this administrative organization has supervised medical activities for the

air force, navy, and ground forces, suggesting that if current BW agent experimentation is still within the province of military medicine it would be applicable to the needs of each of these services. 361/ 655/ [redacted] A prominent role in agent development for the Main Military Veterinary Administration is also possible [redacted]

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While some evidence is available on the probable mechanism of agent research in the USSR, the location of BW munitions development is more difficult to define. There are no indications that NIIEG's program went beyond experimentation on agents. If biological weapons follow the Soviet pattern of development for conventional armament, disseminating devices and delivery systems would logically become the responsibility of the Air Force, Navy, and Ground Force Directorates, under the Ministry of Defense. 405/ The Main Directorate of the Rear, a service rather than combat organization, supervises research and development of items for common use; specialized ordnance development, which would almost certainly include BW hardware, is either carried out right within the Ministry of Defense or by the force component directorates. The latter may actually draw up design specifications and work directly with the appropriate state committee in further developing an item; usually, however, these directorates call on their respective service academies or specialized institutes for assistence in prototype design. 405/ Each branch of the armed forces maintains an academy for officer education, testing of new weapons, the study of military tactics, and related functions. 117/ 405/ Some academies are reported to have subsidiary scientific research institutes, other such institutes are found directly subordinate to the force component directorates. 117/ Some of these establishments are the Central Scientific Research Experimental Institute of the Air Force, Military Artillery Engineering Academy imeni Dzerzhinskiy, Military Academy of Armored Troops imeni Stalin, and Scientific Research Institute of the Military Air Forces. 117/ 405/ 431/ 657/ It seems clear, however, that certain force component directorates, or subordinate troop directorates, carry out weapons development for the other service branches as well as their own. For example, the Main Artillery Directorate is said to handle design, development, and initial procurement not only of artillery, but naval guns, aircraft armaments, infantry weapons, and munitions. 405/ On the other hand, the Air Force's Military Air Engineering Academy imeni Zhukovskiy was reported in the 1940's to have a Chemical Weapons Department, indicating that each arm of the combat services probably conducts a certain amount of developmental work on the munitions or appliances which its forces will employ. 658/ It is conceivable, then, that BW devices under study in laboratories of the Air Force, Navy, and some elements of the combat ground forces; but because of the secrecy surrounding this form of warfare, BW

weapons development is more apt to be considered "specialized ordnance" and, hence, located within the headquarters of the Defense Ministry. 405/

Although Vozrozhdeniya Island's probable operational test sites may be used for an extensive weapons testing program, including the use of delivery aircraft, the military organization which administers the proving ground remain unidentified. 65/ It appears probable that units have been organized for manning test equipment on the ground, providing the aircraft, and evaluating the military characteristics and performance of weapons under development.

Researve officer trainees among the biology students of Moscow State University, formerly assigned to infantry duty, were purportedly trained after 1954 in the "Bacteriological Warfare Branch" of the service during summer encampments. 659/

Reportedly, the Soviet-trained personnel of an Albanian chemical unit indoctrinated artillery and infantry troops in the use of biological and chemical agents and protective measures against them. 662/ In all probability, such reports pertain to defensive training alone. Chemical units operating under a Chief of Chemical Troops, which is subordinate to the Main Directorate of Ground Forces, are organic to all Soviet tactical regiments and divisions. 405/ In addition to an ABC defensive mission, these units employ smokes and toxic chemicals offensively. 405/ 408/ 409/ that BW weapons are part of their equipment. German Intelligence indicated that the test force on Vozrozhdeniya Island in 1936 was working under the guise of chemical troops. 17/

It is highly unlikely that BW military units, per se, will be found as distinct entities among the conventional Soviet armed forces. Specialists in agent control, weapons maintenance, aircraft aerosol dispersion, and related phases can be integrated into present organizational structures should the need for employment of biological agents arise. Personnel with this special training logically would be assigned to separate, closely controlled groups to which knowledge of sensitive information could be restricted. A possible analogy lies in the special air elements for nuclear weapons delivery, or the security forces of the MVD and KGB. 405/

Because no organization with clear cut responsibility for BW weapons development and employment has been recognized so far within the conventional combat forces of the USSR or their supporting technical services, the possibility exists that the all-important offensive

investigative phases have been delegated in the main to some agency whose activities are less susceptible to detection, both by foreign powers and by the Soviet populace, itself. The position taken over the years by the USSR and re-emphasized recently by Khrushchev would appear to make it imperative that any offensive BW research be withheld from public view. 335/ An environment which affords the requisite degree of secrecy is apt to be found in the quasi-military organizations of the Ministry of Internal Affairs (MVD) or the Committee of State Security (KGB). While these elements are not subordinate to the Defense Ministry, being under Council of Ministers control, they actually comprise an important segment of the total military resources of the USSR. 336/ 361/

That personnel of the Interior Ministry security forces, and possibly the KGB as well, have the necessary facilities at their disposal for some degree of microbiological research is shown by diverse source materials. For example, the Main Administration of Local Anti-Air Defense (GUMPVO), said to be an arm of the MVD, purportedly maintains a central scientific laboratory and a medical experimental installation, ostensibly for development of civil defense equipment. 339/ 406/ The MPVO, a staff corps of defense specialists supervised by the MVD, apparently has established an extensive organization of epidemiological facilities outfitted to conduct bacteriological surveys and analyses of soil, air, and contaminated objects in the wake of a BW attack. 339/ 340/ 347/ 406/ In this regard, reference has been made in the scientific literature to microbial research carried out at a "District Sanitary-Epidemiological Laboratory of the MVD Troops Protecting the Frontier." 341/ Thus, there are strong indications of an existent framework of epidemiological and diagnostic laboratories within the MVD resembling that of the health and military medical services. [redacted] that MPVO groups of the MVD are physically located at sanitary-epidemiological sites of the Ministry of Health and that a close working relationship exists between the two organizations in carrying out the passive defense mission common to both. 48/ 347/ There is evidence, also, that the MVD provides its own veterinary services to installations within the parent organization, [redacted] Still less has been reported on veterinary resources in the KGB. 357/ 403/ [redacted] described the assignment of a brucellosis authority, [redacted] to an MVD laboratory from 1935-45; he also identified a strongly guarded MVD chemical laboratory for pharmacology and toxicological work in the Moscow area. 36/ 342/ 345/ [redacted] attributed BW research to MVD institutes near Tiflis and Baku, without divulging their exact location or function. 343/ Additional information in this vein, however incomplete, was provided by a geneticist whose experience in the USSR before World War II

led him to believe that the MVD has its own BW research projects. 344/ According to this native Russian, young scientists were recruited for work in MVD installations under severe security restrictions permitting little contact with the scientific community.

While the majority of reports to date mention only the MVD's interest in BW research, the KGB is cited occasionally as having had an active role. It seems probable, however, that these citations actually pertain to the NKVD, the common ancestor of the present day MVD and KGB before 1941. 343/ 361/ 398/ Purported Soviet documents seized by the Germans at the beginning of World War II revealed the earlier formation of a medical investigative service within the KGB to explore, through operators especially trained in biological detection, outbreaks of infectious disease in the Soviet Union and to expose evidence of infiltration of combat teams or espionage groups employing BW methods. 2/ This alleged bestowal of a counter-BW mission on the KGB is compatible with its function as an internal security agency and with the history of arrests and sabotage charges of the 1930's involving prominent Soviet microbiologists. 343/ 345/ 361/ Information of more recent times suggests that the KGB still performs a security function in institutes conducting classified research. 348/ 399/

Perhaps the most comprehensive, albeit still scanty, information on supposed BW operations by the security forces [redacted] Material obtained from the former in 1948 was later corroborated in substance by the latter. The similarity of the two statements is so striking that the possibility of a common source cannot be excluded, although there is nothing to indicate that such was the case. That [redacted] revelations, in particular, should be given careful consideration follows from his professional relationship with political control elements of the USSR and his accurate identification of certain personnel working in the BW field, the group later verified as members of the NIIEG. 18/ 36/ 345/ Some of [redacted] information is believed to be accurate, too; [redacted] remarks pertaining to the transformation of Gorodomlya Island in the mid-1930's from a Foot and Mouth disease laboratory into a BW installation under the Defense Ministry are substantiated with only minor discrepancies by German Intelligence of the World War II period. 17/ 343/

Without admitting factual knowledge, [redacted] that BW research would fall under the auspices of the First Chief Directorate, Council of Ministers, [redacted] an organ directed in reality by the MVD. 36/ 346/ [redacted] contended that projects would be parceled out among conventional programs of the health, agriculture, and defense ministries, but that control would be retained by MVD personnel through "secret sections" of the various research installations.

[redacted] also described the existence in nonmilitary institutes of "special divisions" which supervised BW oriented research, reported through an MVD chain of command to the Council of Ministers level, and exercised censorship rights over experimental results, deciding what data should be published in the open literature. 343/ An MVD courier system of communication among such institutes was noted by another Soviet-born source, who revealed at the same time that projects presumably of the type mentioned by [redacted] as well as the installations which house them, are designated only by numbers. Research results from these widely dispersed projects were said to be assembled into a composite report by some of the larger institutes. 349/ The existence of a numbering system was confirmed by a former MVD officer in 1954. 348/ "V/2-1094" is the designation of the institute which supposedly established test facilities on Vozrozhdeniya Island in 1936, as recorded by German Intelligence. 17/ The validity of [redacted] concept of MVD control of BW research has not been fully substantiated. Their belief that phases of research would be widely dispersed rather than confined to a single installation or agency is consistent with the distribution pattern of BW defensive investigations in the USSR today. Biological aerosol research, aerogenic vaccine development, air sampler design and testing, disinfection studies, and similar projects recognizable as directly pertinent to BW defense are published on from a great many organizations, involving different ministries, without any semblence of unity or coordination.

So far, insufficient evidence is at hand to connect either the MVD or KGB with offensive BW research, testing, or employment, and information on this association is exceedingly scarce. Reportedly, agents of these groups used typhus-infected lice and typhoid fever bacilli as a water additive, presumably during World War II, against Ukrainian villages in retaliation for suspected subversive activities of the inhabitants. 31/ More recently, a Soviet refugee who claimed former status as an officer in the Red Army described the organization and training of MVD offensive or "aggressor" groups to carry out sabotage. 350/ These groups, said to have been employed in 1956 in the Suez Canal area, are purportedly maintained on such constant alert that operations against a foreign power could be undertaken within 10 hours. Among the members of each aggressor team is one agent well versed in methods of contaminating food supplies and water sources with chemicals and microorganisms. His skill is allegedly put into action only on specific order from an unidentified top agency of the MVD. [redacted] that Soviet BW efforts would be devoted to sabotage measures rather than large-scale strategic operation. 346/ The concept of sabotage elements is not foreign to Soviet military doctrine. Not only has the formation of small operational groups from MVD units for special missions been recorded, but the use of conventional troops by front-line commanders for covert destruction

of key installations in the enemy's rear areas and for collection of intelligence information has been established. 405/

Whether the MVD and its sister service, the KGB, have ever worked cooperatively with scientists known to be active in BW research is a matter of conjecture. It may be significant that mass testing of the newly developed STI anthrax vaccine on domestic animals was accomplished by [redacted] NIIEG personnel, in late 1941 and early 1942 at two MVD state farms in Saratov Oblast. 351/ The military status of scientists manning the Vozrozhdeniya Island proving ground has never been clarified, hence the possible part played there by MVD troops is unknown. It seems plausible that responsibility for security on the island should rest in the hands of one or the other of the two agencies. 65/ The existence of an MVD militia outpost during the 1950's on Barsa-Kelmea, an Aral Sea island north of Vozrozhdeniya, has been mentioned. 352/ Conclusive evidence that the secretive environment provided by the MVD and KGB has been exploited for BW offensive purposes is wholly lacking at this time, but the information discussed so far indicates that an examination of these agencies' activities for such evidence might prove fruitful to the intelligence community. The reported reorganization of Soviet forces (KGB) into a new unit during the past year to strengthen the security of atomic energy and missile projects suggests that safeguarding of BW offensive work might likewise fall within the purview of the new agency. 353/ 361/ 399/

Defensive Organization.--Several thorough studies have been made on the organization of Soviet defenses against mass destruction weapons. They show the existence of a complex system largely based on an administrative structure devised in World War II. 49/ 122/ 337/ 339/ 357/ 405/ 408/ 409/ 621/ 627/ 663-665/ Major elements are the military forces, public health agencies, the civil defense organization, and various para-military groups such as the Volunteer Society for Assistance to the Army, Air Force, and Navy (DOSAAF), the Red Cross, Red Crescent, and youth societies. Within the armed forces of the USSR, responsibility for BW defense is shared by medical, veterinary, and chemical troop units. 122/ 408/ 627/ 664/ In addition, among the main directorate of force components, an independent anti-air defense force has been identified, composed of personnel, weapons, and supporting equipment drawn from appropriate branches of the combat and technical support services, its mission is one of early warning and counteraction in the event of air attack. 405/ 407/

Over-all defense policy is probably established by the Council of Ministers, with the advice of representatives of the various component elements. 339/ The mainspring of the civil defense system is the Local Anti-Air Defense Organization (MPVO), a corps of specialists administered by the Main Administration of Local Anti-Air Defense

(GUMPVO) under the Ministry of Internal Affairs (MVD). 337/ 339/ Subordinate MPVO offices are located at oblast, rayon, and city level, and these form the basic operational units around which the citizenry, transportation, medical facilities, fire fighting units, and related resources are organized. At the local level, each potential target of importance is said to have its own MPVO unit to promote uninterrupted functioning in the event of attack. Self-defense groups in cities and towns and on collective farms carry out damage repair, fire fighting, medical aid, and similar duties, and conduct measures for chemical and bacterial agent control. 339/ 666/ 667/ The civil defense effort is predominatly a responsibility of civilian authorities in peacetime, working under directives formulated by MVD representatives in the MPVO offices. 337/ Training of the population is handled in large part by DOSAAF, an organization administered by the Ministry of Defense through a DOSAAF Central Committee, although the Red Cross and Red Crescent Society are said to participate in some phases of training. 339/ 405/ 621/ A description of BW agents, weapons, and countermeasures for protection against them is included in civil defense instruction. 663/ 666/ 667/

The medical service of the MPVO is superimposed on the Soviet public health system, utilizing personnel, sanitary-epidemiological stations, and medical institutions to sustain its self-defense teams and MPVO medical brigades, some of which are mobile. 613/ 663/ The chief of the local health department heads an MSSMPVO, or Medical Sanitary Service of the MPVO group. 49/ This medical organization for civil defense is coordinated within the MPVO section of the Ministry of Health, and at the ministry level with the Ministry of Defense through DOSAAF. 49/ 663/ An Institutes for the Advanced Training of Physicians, teaching and research establishments under the Health Ministry, a formal course of instruction on CBR defense is reportedly offered by MPVO medical service faculties. 674/ Veterinary services are organized in a fashion analagous to medical care of the human population, with the head veterinarian of a major city, agricultural center, or meat packing combine responsible to the MPVO for proper functioning of his unit. 403/ 663/ The local Veterinary Bacteriology Laboratory, disinfection detachments, and related elements of the peacetime work structure could provide facilities in case of an emergency; and mobile veterinary sampling teams also are available. 305/ 403/ 668/ Presumably the veterinary establishments in each military district can be called upon for further assistance. 357/ 627/ As in the case of other MPVO units, the veterinary groups routinely receive instruction in BW defense. 403/

Within the armed forces of the USSR, the military medical service probably holds primary responsibility for BW defense by virtue of its

[redacted]

mission to develop prophylactic and therapeutic measure against infectious diseases and to maintain sanitary and epidemiologic control of troop environment. 627/ 663/ In this regard, [redacted] Chief of the Main Military Medical Administration, was recently cited as participating in the development of countermeasures for BW weapons. 355/ 407/ 561/ Medical groups are an integral part of combat units down to battalion level, but the medical battalion attached to each line division is better manned and equipped for concerted BW defense. 336/ 627/ This battalion conducts sanitary-epidemiological surveys and initiates area control measures, tasks which are also accomplished by the Sanitary-Epidemiological Section of the field army medical service on a somewhat larger scale. 627/ The division epidemiologist, an assistant to the Division Surgeon, plays a key role in BW defense, as he carries out immunization programs on the basis of survey findings, checks food and water supplies for contamination, and performs related diagnostic procedures. 47/ At his disposal are a variety of trained units organic to the division of field army: portable decontamination and disinfestation apparatus, bath and laundry disinfection trains, and mobile laboratories for sampling and analysis of air, food, and water. 47/ 327/ 405/ 580/ 627/ Development of these facilities and techniques for their effective utilization was reportedly initiated prior to World War II and improved on the basis of wartime experience. 47/ Standards of equipment operation in some cases were devised by the Ministry of Health, showing the close association between public health agencies and the military forces in matters of biological research. 580/ This working relationship, particularly during the war years, is further exemplified by joint use of medical treatment facilities and integrated programs of disease control. 48/ There are indications that close cooperation between military units and civil defense organs is also in effect at the local level; MPVO medical groups apparently have the function of sampling for BW agents and reporting results to military medical establishments in the event of air attack. 11/ More training and better integration of these forces has been called for in Soviet writings. 48/

Activities relating to medical defense of troops against BW are logically centered in the Military Medical Administration of the Main Directorate of the Rear. The counterpart of that agency for veterinary protection is the Military Veterinary Administration, also immediately subordinate to the Main Directorate of the Rear. 627/ Veterinary personnel carry out prophylactic and epizootic measures in animals accompanying the troops, control the quality of meat products, and combat diseases transmissible from animals to man. 627/ Veterinary diagnostic laboratories are reportedly found at field army and army front levels, while dispensaries and assistance points are strategically dispersed throughout lower echelons. 627/ 639/ Larger facilities are available within each military district. 627/



[redacted]

[redacted]

Presumably the same relationship exists between military veterinary groups and MPVO veterinary teams of the civil defense organization as was noted in the case of medical units. Evidence of extensive defensive planning is available in the literature of World War II vintage, but little is known of current activities in military veterinary units. 669/

In addition to its medical and veterinary aspects, BW defense, along with chemical and radiological countermeasures, is apparently the responsibility of Soviet chemical troop units. 408/ This mission includes training of line elements in CBR protection; decontamination of personnel, equipment, and terrain; and, reportedly, detection of CW and BW agents. 409/ 586/ 670-673/ The detection of BW agents probably comprises sampling of suspicious materials in forward areas and marking of contaminated zones prior to final confirmation of BW attack by medical or veterinary laboratories. In certain instances, members of CBR reconnaissance or detection teams appear to be medically trained troops rather than chemical service personnel, suggesting a joint endeavor by combat and technical support units. 405/ 671/ 672/ Chemical troops are organic to all tactical regiments and divisions; at higher echelons, a chemical battalion or brigade may be allocated in time of war. In addition to reconnaissance, decontamination, and detection, some of these units employ smokes and toxic chemicals offensively and carry out weapons maintenance. 405/ 409/ There is no indication, however, that BW weapons are included in this offensive mission. CBR defensive groups are allotted a complete line of protective equipment, including impermeable clothing, decontamination devices, portable showering facilities, detector kits, and in some cases, mobile laboratories for CW agent identification. 405/ 409/ 670/ The use of mobile microbiological laboratories by chemical troops has not been documented.

Research on civil defense matters is conducted in all medical research institutes and public health centers of the USSR. 49/ A review of publications from representative establishments of the Academy of Medical Sciences, the sanitary-epidemiological service, and the military medical and veterinary forces amply illustrates the diffusion of BW-oriented experimentation throughout the scientific community. In appendix, A, typical investigations from the literature of recent years are listed with their sponsors and laboratories of origin. The coordinating mechanism behind these varied endeavors is not well known; in all probability, policy making, program planning, research scheduling, and related executive tasks follow a pattern similar to those previously discussed in connection with the organizations of offensive BW.



[redacted]

[redacted]

The Capability of Soviet Science to Support BW

General.--The USSR definitely possesses the scientific and technological capability to support a BW research and development program. 18/ 19/ 56/ 60/ It is necessary to examine recent Soviet advances in the fields of microbiology, aerobiology, the plant sciences, bioengineering, and other interrelated areas of scientific activity in order to identify any discernible trends or accomplishments which might have a bearing on the status of BW in the USSR

Soviet efforts in the biological sciences are not impressive by Western standards; with the exception of certain high-priority research areas, much the same conclusion can be reached with respect to basic work in the medical, veterinary, and agricultural fields. 54/ 93-97/ Several factors have been responsible for this relative backwardness of Soviet research, although not all fields of science are necessarily influenced by the same factors. In some instances, past adherence to unsound theoretical principles and the apparent restriction on freedom of scientific thought and action are believed to have played a part. 94/ 97/ A limitation in the basic knowledge of Soviet scientists as a group and a paucity of outstanding researchers, together with poor distribution of scientific information and a government policy which discouraged professional association with Western investigators, have also been suggested as causative factors. 93/ 96-98/101/ Perhaps of equal or greater significance is the seemingly lower priority of biological programs to those in the physical sciences. 94/ A strict priority system for manpower, facilities, equipment, and materials has apparently operated in the past to the detriment of biological research; and only those laboratories which are engaged in priority investigations, generally Institutes of the Moscow-Leningrad complex, are reported to be in any way adequately equipped and staffed for fundamental experimentation. 93/ 97/ 99/ 100/

Important changes can be anticipated, both in the Soviet basic research structure and in the orientation of theoretical investigations. Recent estimates predict that a marked improvement will be shown in the quality and quantity of research facilities, and this, together with the increase in number of competent scientists which is also foreseen, will provide the basis for broadened research frontiers in future years. 93/ A renewed acceptance of sound theoretical principles, greater freedom of scientific thought, and stronger official support for research programs, particularly in the biological and agricultural fields, have been noted since 1953; and there is an indication of intensified medical research effort as part of a new 7-year plan extending through 1965. 94/ 103/ Ample evidence is available of a attempts to raise the level of Soviet science through administrative action, examples of which are personnel changes, elevated standards of





[redacted]

graduate education, wider dissemination of experimental data, and more rapid utilization of foreign scientific information. 97/ 104-106/ In addition, a recent reorientation toward intercourse with Western scientists and the acceptance of Western scientific concepts has been detected. From this reorientation, several new and promising lines of research are expected to emerge. 96/ 109-111/ 113/

Among the significant changes which may be in the offing is a probable trend toward centralization of control and concentration of research planning in one government agency. 102/ Under the present research structure, responsibility for fundamental work is diffused throughout a number of government agencies, although over-all domination appears to be exercised by the Academy of Sciences, USSR. The complex organizational relationships in Soviet research have been reviewed in several recent publications. 93/ 94/ 116-119/ 125/ These reports suggest that basic investigations of interest to BW intelligence, as well as the more direct application of experimentation to military art, are likely to be under way in a variety of widely scattered medical institutes, public health installations, military laboratories, and specialized research organizations. Thus, for example, medical research is largely directed by the Academy of Medical Sciences of the Ministry of Health, but the Academy of Sciences, USSR, and the Main Medical Administration of the Defense Ministry also are believed to have active programs; 93/ 116/ basic biology, including microbiology, genetics, biochemistry and other important fields, is primarily the responsibility of the Academy of Sciences, USSR, and its Department of Biological Sciences; 94/ while veterinary research on infectious livestock diseases and studies on food crops and their infections fall within the purview of the Ministry of Agriculture, the All-Union Academy of Agricultural Science, the Academy of Sciences, USSR, and others. 93/ 125/ The bulk of the military research on weapons is considered to be centered in the academies of the armed forces; however, important segments of it are reportedly conducted throughout the entire scientific structure, from the Academy of Sciences level down to laboratories in individual plants. 117/ In view of the broad dispersal of research in the USSR, each increment of which could have a bearing on BW capabilities, it is desirable at outset to examine only the scope and direction of research in selected major sectors of Soviet science, and to reserve for subsequent close study the programs which appear to bear a more immediate relationship to actual development of BW.

Medical Microbiology.--The USSR has been confronted for many years with serious problems of endemic infectious disease. Because so much effort has of necessity been devoted to measures for solving immediate health problems which affect industrial development, agricultural expansion, and the welfare of the population, the developmental and applied aspects of microbiology have received relatively far greater

attention than has fundamental research. 93/ 95/ While success has been achieved in controlling major outbreaks of such diseases as typhus, cholera, plague and smallpox, basic knowledge of infectious diseases and the disciplines which relate to them is generally far behind that of Western science. 93/ 96/ 97/ 99/ 100/ In the past, progress in fundamental medical microbiology is believed to have been almost entirely dependent on information published in Western journals, 93/ but today there is apparently an increasing body of significant basic work in the biological sciences and medical fields, conducted by a small but competent group of scientists whose ideas, objectives, and methods are similar to those of U.S. investigators. 93/ 96/ 99/

In line with the trend toward concentration of pure research on medical problems in the Academy of Medical Sciences, there is evidence that medical research institutes of that organization will bear the brunt of future basic experimentation while other installations of the Ministry of Health will emphasize programs of applied microbiology. 116/ At the present time, however, separation of responsibility has not been accomplished entirely; investigations carried out by even the largest centers of research under the Academy, for example, the Institute of Epidemiology and Microbiology imeni Gamaleya, appear to relate in large measure to solution of immediate problems in microbiology, while studies on pathogenesis of disease and other fundamental aspects are still under way in the more elaborate public health laboratories at Saratov, Rostov, and Irkutsk, and other locations established originally as centers for anti-epidemic operations and field study of endemic diseases. 53/ 116/ 123/ 124/

Recent analyses of the status of Soviet medical microbiology indicate that few significant modifications in fundamental research patterns concerning infectious diseases of humans have occurred during the past 10 years. 93/ 96/ Although the USSR is actively studying almost every disease of worldwide interest and importance, the direction of emphasis lies in developing and applying more effective biological counter-measures such as vaccines, protective antisera and antibiotics; devising better diagnostic and disinfection procedures; compiling epidemiological information; and determining the means for combatting arthropod and rodent carriers of disease. 89-91/ 93/ 110/ 124/ 127-139/ 146/ Strong programs of applied research exist in each of these areas. Thus, the Soviet approach to solution of problems of endemic infections and inadequate hygiene and sanitation practices has been characterized as one of control, rather than eradication of disease; this concept has been applied to a wide range of serious human and animal ailments, with results that cannot yet be fully evaluated, but which appear questionable at this point. 93/ 100/ 128/ Theoretical research in microbiology has been focused largely on those problem areas which become most apparent when the concept is placed into

practice: controlled variation in microorganisms and stability of their properties under adverse environmental conditions; the nature of pathogenesis, with its many ramifications; host-parasite relationships among the arthropod-borne diseases; and the like. 96/ 123/ 126/ 133/

Within the parameters of the Soviet research effort in microbiology the bacterial diseases are still receiving much attention, particularly the dysenteries, brucellosis, tuberculosis, tularemia, plague, anthrax, and, to a lesser degree, glanders and melioidosis; recent estimates have indicated that more of the medical bacteriology in the future will be fundamental in nature, and that the volume of research on individual bacterial infections, except for refinements in vaccines, will decrease as correspondingly greater efforts are devoted to the virus and rickettsial diseases. 93/ Studies on bacterial toxins in the USSR are well advanced; investigations have been continuous since the early 1930's on the mode of action of these substances and on measures to overcome their effects in such diseases as diphtheria, tetanus, gas gangrene, and botulinum intoxication. 96/ 140/ 141/ On the other hand, little emphasis has been found in the Soviet Union on fundamental investigation of the human pathogenic fungi, and the limited information available suggests that work with these organisms pertains largely to screening of antibiotics and other compounds in a search for effective therapeutic agents.

Of greater significance from the standpoint of biological warfare, however, is the definite trend toward more Soviet research emphasis on infections of virus and rickettsial etiology. 93/ 96/ 97/ On the whole, Russian basic knowledge of these infections is adjudged to be several years behind that of Western scientists, but there are certain diseases of the so-called "exotic" group, notably atypical encephalitides and the hemorrhagic fever, with which Soviet investigators have had more actual experience than their counterparts in the free world. 93/ 100/ 120/ 121/ Consequently, marked differences exist in the quality of Soviet virus and rickettsial research, although the virus programs have perhaps been subjected to closer scrutiny. Some of them, as in the case of the neurotropic viruses and influenza, have been characterized as reliable and of good quality, while other experimentation, on infectious hepatitis, as an example, has been called unreliable by competent observers. 133/ 142/ In those fields in which substantial progress is dependent on the application of modern techniques, as in the use of tissue culture methods for fundamental study of viruses or for development of large-scale vaccine production processes, Soviet scientists have exhibited little proficiency. 100/ 133/ 143/ 144/

Many serious disorders caused by viruses and rickettsiae are endemic in the USSR, and sporadic studies of them have been under way

since the early 1930's. 100/ 120/ 121/ 146/ Today, however, Russian capability in the medical sciences is still considered to be insufficient to overcome completely the economic and public health problems posed by the existence of these diseases. 100/ 146/ For the most part, Soviet research has been concentrated in recent years on those infections whose high incidence and severity cause the greatest detriment to the nation's welfare; influenza, poliomyelitis, childhood diseases, the encephalitides, hemorrhagic fevers, and Q fever, for example, have received greatest attention. 93/ 100/ In recognition of the gravity of the problem of virus and rickettsial infections in the USSR, increased research efforts were apparently undertaken during the mid-1950's and, concurrently, the two disease groups were separated and given the status of independent fields of medical science. 121/ 145/ Recent observations of the importance which is now attached to research on virus and rickettsial diseases within the Soviet Union lend support to the current intelligence position that considerable improvement in the stature of Soviet research on these infections will be forthcoming. 97/ 132/

Veterinary Sciences.--Since World War II, a considerable advancement in scientific knowledge and expansion of over-all research effort have been noted in the various fields of Soviet veterinary science. As a result of this progress, levels of proficiency that are acceptable by Western standards have been achieved in veterinary microbiological research, immunology, and pathology. Good capabilities for experimental work also exist in related areas. 93/ Except for research in helminthology, the field of virology has shown the most rapid growth. While major animal viral diseases, with the possible exception of rinderpest, are not entirely under control, they are receiving much attention, and measures designed to overcome foot-and-mouth disease and hog cholera have reached a state of development essentially comparable to that of Western countries. 154-156/ 175/ The animal population of the USSR still suffers from many different infectious diseases; but current research emphasis appears to be concentrated largely on foot-and-mouth, brucellosis, hog cholera, Newcastle disease of fowl, anthrax, the encephalitides, and parasitic diseases. 93/ 125/

In keeping with the Soviet concept of gradually reducing the incidence of infection and parasitic infestation, rather than employing a more direct approach to eradication of animal disease, veterinary authorities in the USSR place a high priority on prophylaxis and disinfection measures in their control programs. There is little evidence of extensive original research in the development of new products for prophylaxis or disinfection, but those developed in Western countries are readily accepted by Soviet authorities. 93/ 161/ In the mechanization of disinfection equipment, however, and particularly in the employment of mobile units, Soviet researchers have demonstrated

considerable ingenuity in developing elaborate equipment and techniques. A great deal of importance is placed on the widespread use of such devices in sanitation of infected premises and animal transportation equipment. 161/ 305/

Perhaps as a reflection of the dependence of Soviet scientists on Western theoretical research and technology, development of veterinary vaccines, antisera, and other prophylactic and therapeutic preparations is less advanced than that of the United States and some European nations. Production techniques, as with product development, are usually adaptations of refined procedures arising in other countries, and despite the emphasis placed on providing adequate biological material for the ambitious animal disease control programs, there are occasional references in Soviet literature to shortages and ineffective products. There is an obvious need for more research to develop effective biologics that will retain their efficacy under the complex distribution and utilization system, particularly in remote areas of the Soviet Union. 154-156/ 158/ That work in this direction is under way is exemplified by attempts to isolate additional strains of brucella for live, dry vaccines of greater effectiveness and stability; experimental studies on the use of gamma globulin preparations from immune animals in treating such diseases as rabies and equine encephalitis; and exploration of improved methods of vaccination, as indicated by attempts to devise an aerosol vaccine for swine erysipelas or the dry lapinized vaccine for hog cholera. 154/ 162/ 163/ 177/ The impact of these experimental measures on the eventual control of animal diseases is not yet clear; and Soviet claims for early success, as in the large-scale brucellosis immunization program in sheep, have not been substantiated. 164/

As an adjunct to growth in Soviet virological research, veterinary scientists are displaying a deep interest in adaptation of tissue culture techniques to both the fundamental study of animal viruses and to production processes for improved biological preparations for the disease control program. Despite the relatively low order of proficiency exhibited by Russian researchers in applying the new methodology involved in cultivation of living tissue cells, some progress has already been reported in modification of foot-and-mouth virus culture methods to yield an intradermal vaccine. According to unverified Russian claims, the modified vaccine is superior to the presently used prophylactic preparation against this serious animal disease. Evidence that tissue culture methods are being introduced, to some extent, into basic explorations is furnished by current Soviet work on cytopathogenic effects of the encephalitis viruses in various tissue media. 154-160/

It is apparent that fundamental research in the veterinary sciences, as in the biological fields, is still given less emphasis than practical

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application; but this disparity may be more nearly a reflection of immediate politico-economic pressure to increase livestodk production than a valid measure of Soviet competency in veterinary matters. 93/ 154/ Recent intelligence estimates foresee both a qualitative and a quantitative increase in fundamental research during the years ahead, with no indication that applied aspects of veterinary medicine will be neglected. 93/ 97/ Discussions with Soviet veterinary scientists and review of the expanding volume of theoretical research material in current publications appear to substantiate this predicted trend. 154-156/ There is little doubt that a nucleus of basic research facilities, competently staffed, is already in existence and that as increased livestock production and other near-term goals are gradually attained, added emphasis will be given to veterinary investigations of a more basic nature. 125/ 154/

Plant Sciences.--Just as humans and animals are plagued by a wide variety of microorganisms which engender debilitating or fatal illness, economically important plants and food crops play host to specific microbial parasites, the plant pathogens. Among this broad group of bacterial, fungal, and virus forms, potentially effective agents can be found for anticrop or antifood warfare against nations dependent to any extent on agriculture for survival and growth. The well recognized diseases of cereal grains, potatoes, sugar beets, and cotton occur in the Soviet Union and conventional approaches to the study of these diseases are employed by Soviet scientists, thus, research is under way on fundamental problems common to plant infections in general: the influence of environment on the course of infection, host susceptibility, control measures, and development of plant varieties resistant to disease, but little significant work on the epidemiology of plant diseases is evident. 148-150/ The USSR has a predominantly cereal agriculture, and smut and rust diseases of wheat and other grains are prevalent in that country; but aside from limited investigations recently reported, or planned for the future, on identification and characterization of races of the leaf and stem rust fungi, relatively few significant studies on these important organisms, or on the other fungus, bacterial and virus diseases of cereals, are evident. Much the same situation prevails with respect to the pathogens of other food and commodity crops. 147/

As exemplified by the status of microbial experimentation on plant diseases, over-all Russian capabilities in the plant sciences are low, although an ever-increasing capability is expected in keeping with previously noted Soviet efforts to improve conditions for basic research and to enhance the stature of biological sciences in general. Despite the greater government support to programs in the plant sciences which is becoming evident today, theoretical research progress will be relatively slow because Michurinism, which characterizes Soviet ideological philosophy in biology, continues to be the official scientific


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position in the USSR. 94/ 113/ 148/ Significant increases in average per-acre yield of several major crops can be anticipated in future years, however, from progress in plant breeding, including development of better adapted and higher yielding varieties and pest and disease-resistant plants. 151/ Important advances probably will also result from research on pesticides, pest and disease forecasting, development of disease-free seed stock, plant physiology, plant nutrition, fertilizer development and application, and weed control. 148/

An analysis of Soviet scientific papers dealing with plant pathology indicates that more than 1300 Soviet scientists have appeared over the years as authors or co-authors of research papers in this field, but in spite of this rather considerable investigative effort, the quality of Soviet plant pathology research remains generally low, and few, if any, noteworthy scientific or technical advances have been made during the past two decades. 148/

Recent observations indicate clearly that crop losses are extensive in the USSR, and the problem posed by diseases and insects may be more severe than the Soviets themselves realize. Although in a somewhat better position than plant pathology, Soviet plant entomology research likewise is not considered adequate to meet the needs of the USSR. Greater emphasis is given to development and use of insecticides than to fungicides and the former are employed more widely and in greater quantities. 147/

Soviet basic research on herbicidal plant growth regulators is extremely limited in quantity and it is generally of low quality. Applied research with herbicides lags Western developments by about five years and generally has been limited to a few of the older compounds which were discovered and developed in the West. While herbicidal usage is increasing under official encouragement, only a small percentage of the cropped area of the USSR is treated; however, defoliants for cotton are used widely. 152/ Although the Soviets were aware of the U.S. and British investigations of herbicides as anticrop BW agents as early as 1947, there is no indication from available information that parallel research has been undertaken in the USSR. 153/ However, much of the technological and developmental experience gained from research and actual usage (some 2.5 million acres of crops were treated in 1957) is applicable to any anticrop BW program.

Technological advances in design of equipment for the application of chemicals have been slow, and present devices are comparatively inefficient and cumbersome, but aerial dissemination of control chemicals is becoming more widespread as supplies of high potency materials increase. Taken as a whole, Soviet experience in aerial application of





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agricultural chemicals (pesticides, herbicides, and fertilizers) has been rather extensive, even though the percentage of the total USSR crop land treated annually is low, thus, in spite of the rather unimpressive state of the supportive basic sciences, this wide experience with various chemicals under different conditions, affords the Soviets a considerable capability in technology, manpower, and machines, which is applicable to BW research and development of anticrop agents.

Genetics.--An assessment of research in genetics in the USSR over the years has shown that a gradual deterioration in the quality of Russian work took place after 1936 under the influence of officially sanctioned pseudo-scientific theories of heredity. As a result, from 1940 until 1953, adherence to modern theories in genetic experimentation was almost entirely lacking. 94/ Since 1953, Soviet genetics and biology have existed in a state of duality between the followers of Lysenko's theory of the predominance of environmental influence on inherited characteristics and the supporters of the classic genetical theory of transmission of characteristics through genes, but the current influence of Lysenko on Soviet genetics appears to be limited in comparison with his former domination of this science. 113/

Present conditions for improvement of Soviet genetic research are more favorable than at any time since the late 1930's. Major developments that have helped to create these favorable conditions are the removal of Lysenko as president of the All-Union Academy of Agricultural Sciences in 1956; the return of numerous classically oriented geneticists to research positions; the official acceptance of hybrid corn; the adoption of polyploidy and radiation as breeding and research tools; and the exploitation of biochemical and radiation methods in microbial genetics. 94/ 113/ 276/ In addition, biological and genetic research is being given increased government support. The Institute of Biophysics has been strengthened in its genetic and cytological aspects, an independent institute of cytology has been established, a new Institute of Radiational and Physico-Chemical Biology has been set up, and a new Institute of Cytology and Genetics is being constructed in Novosibirsk. 166/

Soviet research in the field of fundamental genetics is expected to become increasingly concerned with the structural basis of heredity and variation within the cell, the physical and chemical aspects of cellular organization and processes, and the effect of external mutation-inducing factors at the cellular level. However, most of the recent work in basic genetics and in the related fields of cytology and cytogenetics has been devoted to surveys of Western research in an effort to familiarize Soviet investigators with progress in development of modern concept. 94/ 113/



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Under Lysenko's influence, studies on microbial genetics received strong emphasis, but the considerable effort which was expended produced little scientifically sound research on genetic phenomena in microorganisms. 94/ 99/ For example, review of representative publications covering some 20-odd years in one of the most active Soviet research fields, and one in which genetics provides an invaluable tool; namely, the selection of strains of pathogenic organisms for use as live vaccines, suggests that selection methods were largely empirical, with the result that problems of low immunogenicity, instability of immunogenic properties, and occurrence of untoward post-vaccinal reactions have not been satisfactorily resolved in many prophylactic preparations which are in wide use today. 37/ 167-172/ Recent reorientation of Soviet approaches and acceptance of Western genetic concepts have raised the capability for research in the USSR, according to intelligence estimates; and newly initiated programs have been noted, particularly in the application of radiation genetics to selection of microbial mutants for improved antibiotics production and more effective live vaccines. 94/ 109-111/ 167/ 174/ 276/ Future investigations will probably follow genetic approaches similar to those employed in Western nations, and the result should be a marked improvement in Soviet genetics research. 113/

Entomology.--Research in medical entomology has made dramatic progress in the USSR since the time of the Russian revolution. During the Czarist regime, vector-borne epidemics ran largely uncontrolled through the population. Plague, typhus, relapsing fever, tularemia, encephalitis, and fly-borne enteric diseases took a heavy toll. Research in the field of arthropod-borne diseases was minimal, and it was reflected in only one or two publications each year in the world's scientific literature. Beginning in the early 1920's, the People's Commissariat of Health, flanked by the Academy of Sciences and the military medical services, initiated a long-term program for improvement in public health conditions. As part of the program, the number of trained investigators in medical entomology increased until at the present time more than 1800 Soviet specialists are believed to be actively engaged in research in the various fields of this science. Publications have swelled to the point that some 450 articles on arthropod-borne diseases now appear annually in the Russian literature; furthermore, the quality of the more recent Soviet work is adjudged to be equal in caliber to that published by Western nations. 142/ 146/ 247/

The serious problems of control and prevention of arthropod-borne diseases in the USSR have by no means been solved; and the vastness of the territory in which these infections are found, the diversity of climate in the Soviet Union, and the comparatively low level of sanitation have been suggested as factors which preclude their solution in the near future. On the other hand, a recent

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comprehensive evaluation of Soviet efforts in medical entomology, as portrayed by scientific publications, shows that the present large-scale investigative activity is not only being sustained but appears to be increasing at a rapid rate. 146/ A capability for arthropod vector research has been developed in the USSR which is second to no other nation's in regard to number of qualified personnel, research facilities, and training institutions involved. 132/ 133/ 142/ 146/

The rapid progress in development of Soviet medical entomology as a field of science has been ascribed, in part, to a high degree of central control and the consequent infrequent occurrence of duplication in research among military organizations, public health institutes and others of the 400-odd laboratories from which publications have originated. 146/ Aside from this, the sound work being carried out by groups of well-trained Soviet entomologists has been instrumental in the advance of basic knowledge in many different categories of research. 133/ 142/ 146/ Emphasis in the USSR has been placed on investigation of mosquitoes as carriers of infectious disease, followed in descending order of interest by ticks, fleas, the house fly, the sandfly, and others. While this relative emphasis is identical with that devoted to arthropod vector studies by most other countries with similar disease problems, the wide scope of Soviet effort is reflected in publications over the years on at least 11 groups of arthropods and their role in some 46 infectious diseases, all but a few of which are considered to occur in the USSR. 146/ In addition to the very considerable research on medical entomology, per se, Soviet scientists are reported to have strong programs in medical parasitology, ecology, and the study of life cycles among the arthropods. 133/

Over 400 laboratories in the USSR have contributed research on medical entomology during the past 35 years, but despite the large number of installations involved, only a few can be considered major centers on the basis of sustained research, the scope and type of experimentation and the caliber of the investigators: The Institute of Malaria, Medical Parasitology and Helminthology, Moscow; Zoological Institute, Academy of Sciences, USSR, Leningrad; All-Union Institute of Experimental Medicine imeni Gorky, Moscow; Institute of Epidemiology and Microbiology imeni Gamaleya, Moscow; Scientific Research Institute of Epidemiology and Microbiology for the SE USSR, Saratov; Military Medical Academy imeni Kirov, Leningrad; and the Institute of Zoology, Academy of Sciences of Kazakh SSR, Alma-Ata. 133/ 146/

The great emphasis given to entomological research in the USSR today is consistent with the nature and size of the public health problems to be solved; but experimentation on the mechanism of vector transmission of infection, retention of pathogenic organisms within the arthropod host, and related studies are equally applicable to BW





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research. There has been little evidence in the open scientific literature that programs more specifically tailored for BW purposes are under way at present, such as the mass rearing and infecting of arthropods, long-term storage, or dispersal patterns; there are indications that mass rearing and infection techniques are known to Soviet investigators, however. 146/ 307/ 318/ 325/ 326/ The basic knowledge of medical entomology which has been accumulated over the years in the USSR, the existing facilities for study of arthropods, and the valuable experience which Soviet scientists have gained in vector-borne diseases can be equated with an impressive capability to support a BW research and development program. 146/

Biochemistry and Biophysics.--Recent reviews of Soviet biochemical research indicate that the application of biochemistry to microbiological experimentation encompasses almost every area of interest and significance to BW. 93/ 95/ Work on microbial composition, nutrition and growth, intermediary metabolism, pathogenicity, and related problems is well represented in the scientific literature of the USSR, although the general quality and depth of research are considered to fall below that of Western investigators. Certain studies reveal imagination and the use of novel approaches; and this is especially apparent in (i) the characterization of bacterial toxins; (ii) investigations of new substances active against bacteria, viruses, and rickettsiae; and (iii) in protein chemistry. 95/ 96/ For all practical purposes, biochemical research in the Soviet Union has followed the lead of the West and is expected to continue to do so. Nevertheless, as in other biological sciences, a greater volume of higher caliber experimentation in this field has been predicted for future years. 93/ 95/ From the scope of current Soviet biochemical research, the anticipated expansion of effort, and the availability of research findings in Western publications, there is little reason to doubt the present and future capability of scientists in the USSR to render the necessary biochemical support to a BW program.

A broad spectrum of biophysical studies related to microbiology has been found in the USSR. 95/ 96/ The intense Soviet activity since World War II in research employing biological aerosols was noted previously. Investigations involving the application of ultraviolet and infrared microtechniques to the determination of microbial cell structure and composition have been under way for several years, and studies using electron microscopy, radioactive isotopes, chromatography, and ultra-high frequency or ultrasonic methods are in evidence from Soviet publications. 94-96/ 194/ 211/ 212/ The biophysical principles behind development of photoelectric counters, particle size scanners, infrared spectrophotometers, and continuous membrane filtration devices for detection of biological aerosols have been recognized in the writings of Soviet military authors, although there is no indication that alarm





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systems based on these principals have been perfected in the USSR. 205/ There is evidence, however, that experimental models of an aerosol collecting instrument founded on the electrostatic precipitation of particles have been fabricated. 213/ 214/ Much current research emphasis is being given to luminescent microscopy and fluorescent antibody reactions for identification of bacteria, viruses, and rickettsiae in biological speciments, procedures which have great potential value in both routine medical care and defense against BW attack. 215-218/ Results which have been published to date suggest that attempts to improve conventional laboratory diagnostic methods by the application of biophysical instruments and techniques are just getting under way. The diversified programs of aerosol research and the concurrent widespread development of aerosol chambers, generators, air samplers, and allied equipment indicate that biophysical assistance in these areas has been more generous. The fact that this experimentation has been carried out with some degree of success for a number of years substantiates the premise that Soviet biophysicists are capable of adequately supporting BW-related research. The quality and variety of support is expected to improve with an increased application of biophysics to the biological sciences in general. 93/ 96/

Aerobiology and Meteorology.--Basic to the development and testing of BW agents for airborne dissemination is knowledge of the behavior of liquids or powders dispensed into the air in the form of droplets or small particles; that is, aerosols. In the case of microbial aerosols, effectiveness of dissemination is influenced both by the form and manner in which organisms are released and by their reaction to environmental factors once the aerosol has been formed. The mechanics of dissemination and, to some extent, the aerobiological phenomena involved can be studied experimentally in chambers designed for that specific purpose, but for investigation of aerosol dispersal patterns, cloud travel, effects of solar radiation, and related problems of agent employment only an external environment provides suitable test conditions. Therefore, aerobiology, as it pertains to biological warfare, not only embraces the skills of microbiology and bioengineering, but also draws upon research in micrometeorology, turbulence and diffusion, and atmospheric pollution which fall within the province of the meteorologist and other specialists.

Although aerosol studies have been pursued actively by Soviet scientists only within the space of the last 20 years or so, today the USSR has an aerosol research program which is probably equal in stature to that of any other nation. Developments in this field over the years have been reviewed in two intelligence publications, the first covering the period from 1934 to 1953, and the second from 1953 to the present time. 178/ 179/ As reflected in scientific papers, on which these reviews were largely based, Soviet investigations are





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now primarily concerned with mathematical descriptions of the physical characteristics of aerosols, including cloud physics; the application of aerosols to agricultural pursuits; and the use of biological aerosols as an experimental tool in medicine, public health and immunological research. 178/ Extremes of quality have been noted in Soviet work; contributions to the formulation of mathematical theories on aerosol formation and behavior are considered outstanding while, on the other hand, the technology of aerosols, particularly in their application to agricultural needs, is often of rather poor quality. Basic studies have encompassed many of the problem areas which arise in aerosolization of microorganisms: particle size distribution, coagulation of particles, and the capture of aerosol particles by various surfaces. An increasing Soviet interest in theoretical treatment of particle motion, flow, and dispersion has become evident in the more recent writings. 178/ 208/ 209/ Much of the theoretical work on aerosols can be reconciled with research on cloud formation and other weather phenomena or with the extensive Soviet program of micrometeorological support to agriculture in defining the effects of climatic variables on plant growth and pollination and determining optimum conditions for the use of insecticides.

Because of the importance of variations in atmospheric conditions at or near ground level to the successful testing of BW agents under conditions simulating actual employment, Soviet activities in micrometeorology have been watched closely. In addition to aerosol investigations, highly competent research on wind flow, atmospheric stability, and temperature variation has been noted in publications for the USSR, and a few recent papers devoted specifically to the effects of micrometeorological conditions on aerosols have been found. 176/ 178/ Soviet scientists also have been active in theoretical work on atmospheric turbulence and diffusion. This is in keeping with a long desire to improve the general accuracy of their regular weather forecasts, although research on turbulence and diffusion at the ground surface is also directly applicable to the behavior of airborne microorganisms. Discussions of recent data between Western investigators and their Soviet counterparts suggest that while the latter are conducting a great amount of competent theoretical research little has been done on actual field measurements near ground levels to substantiate this research. There are indications from these discussions that large-scale field projects on atmospheric diffusion and pollution will be initiated in the USSR during 1959. 182-185/

Evaluation of Soviet work in micrometeorology, including related theoretical research on aerosols and turbulence and dissusion, has led to the conclusion that the proficiency of Soviet scientists in this general field is about equal to that of investigators in leading Western countries and that the USSR is capable of giving adequate micrometeorological support to both the research and operational phases of biological

warfare. 176/ 178/ Much the same position has been taken with respect to Soviet meteorology in its broadest sense; the capability of the Soviet system to provide adequate reporting and forecasting services for agriculture, flight operations and other activities which require up-to-date weather information over wide areas is believed to be good. 180/ 181/ [redacted]

As in other facets of aerobiology, Soviet scientists have been extremely active in atmospheric pollution research. While some work on air pollution, especially the theoretical phases, is conducted by investigators who are first and foremost meteorologists, most of the Soviet literature on this subject has been contributed by physicians, engineers, and biological scientists. Whereas fundamental aerosol research, micrometeorological studies, and experimentation on basic turbulence and diffusion problems are carried out principally at Academy of Sciences centers, as in the Institute of Physics of the Atmosphere, Institute of Physical Chemistry, and the Main Geophysical Observatory and Central Aerological Observatory of the Institute of Applied Geophysics, air pollution research is apparently a major responsibility of the Ministry of Health. 178/ 186/ 187/ Development of equipment and procedures for air sampling is under way at various sanitary-epidemiological stations, research institutes of hygiene and sanitation, and within the departments of communal hygiene at medical institutes of the Academy of Medical Sciences under the Ministry of Health. 187/ Guidance in air pollution investigations is furnished by a recently formed Committee for Sanitary Protection of Atmospheric Air at the Institute of General and Communal Hygiene. The Institute of General and Communal Hygiene and the Central Institute for Advanced Training of Physicians appear to be the two organizations most intimately concerned with current Soviet research on pollution of air by industrial wastes, the spread of airborne infectious microorganisms in the atmosphere, and formulation of sensitive methods and devices for detecting small quantities of noxious substances in the air. 186-190/

Air pollution studies apparently are still in an early stage with respect to the microflora of the atmosphere. While much research effort is being expended on methods of sampling, centralized planning and direction is a recent innovation, and standards for atmospheric purity and performance of equipment have yet to be established. 186/ 188/ 190/ That progress is being made is evidenced by reports that microbial air sampling programs have begun in an undetermined number of the larger cities in the USSR. 191/ 193/ 248/ Intensified Soviet attention to air purification along with the establishment of control

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stations for systematic atmospheric observations have been noted in recent years. 192/

The specialized study of aerosols of microorganisms has greatly increased in scope and volume in the USSR since World War II. This increase is much more obvious in the application of biological aerosols to the solution of medical and air sanitation problems than to basic studies of the organisms themselves; but published works reveal that fundamental investigations on the kinetic properties of aerosols; infectivity as a function of particle size; and the effects of temperature, humidity, and other factors on representative virus, bacterial, and microbial toxin aerosols have taken place. 45/ 77/ 80/ 83/ 189/ Experimentation of this nature appears from scientific periodicals to be confined largely to the Institute of Virology imeni Ivanovsky in Moscow, the Military Medical Academy imeni Kirov in Leningrad, and the Kiev Institute for Advanced Training of Physicians. 45/ 77/ 82/

In the medical field, Soviet work in past years was centered on the aerobiology of contagious diseases, principally respiratory diseases of virus etiology. While studies on the mechanism of infection or intoxication, through inhalation of bacteria, viruses, and toxins are still receiving attention, the trend as evidenced by current publications is toward experimentation with therapeutic aerosols, development of aerogenic vaccines, and research on immunity against airborne infections. 45/ 46/ 78/ 83/ 84/ 179/ 194/ 195/ 206/ 207/ At the same time, scientific journals from the USSR in recent years have contained numerous articles relating to design and construction of simplified chambers which are essential for laboratory study of pathogenic aerosols, filtration systems for purifying hospital and laboratory air, aerosol generating devices, and methods and reagents for disinfecting aerosols under a variety of conditions. 13/ 77/ 79-82/ 85/ 196-198/ 210/ Containers for studying clouds of microorganisms range in size and complexity from simple glass flasks, into which a suspension of organisms is sprayed, to fully instrumented, compartmentalized, stainless steel chambers designed for generation of multiple aerosols or simultaneous animal exposure to diverse, controlled conditions. 199/ 200/ In certain experiments, tents or isolated rooms have been employed for dissemination of aerosols. 46/ 201/ Chambers described in the Soviet literature have apparently been locally fabricated instruments produced in insufficient volume for general distribution and use; however, a newly designed aerosol chamber reportedly in production at the Medical Instrument Plant "Teknolog" is expected to become available to more research institutes in the future and thus broaden their capabilities in the aerobiology of microorganisms and infectious diseases. 82/

Soviet scientists have devoted much effort to the design and testing of aerosol samplers for laboratory and field use. Many of





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these samplers are simple devices, crude by Western standards but generally adequate for qualitative work. There is no evidence that an all-purpose sampler has been developed, and Soviet investigators have expressed the need for an apparatus which will effectively collect virus and rickettsial organisms and bacterial toxins. 13/ 85/ 87/ 88/ 190/ Principles of aerosol collection utilized by Western workers have been adopted for study in the USSR; namely, impingement on solid culture media, aspiration through liquids, sedimentation, suction through filters, and electrostatic precipitation. Much of the current research on air sampling is limited to comparative performance testing of the many different samplers, and inadequacies have been found in each type developed to date, whether from the standpoint of economy, portability, or efficiency. 188/ 193/ 201-204/ Portable collecting devices and air samplers mounted on automobiles, boats, and aircraft have received considerable emphasis. 187/ 203/ Little evidence of actual experimentation with electronic aerosol counters or alarm systems is available in published Soviet research, but the principles upon which such equipment is based are fully understood in the USSR. 187/ 203/ 205/

Too little direct reporting of basic research on biological aerosols has been found in Soviet publications to permit valid assessment of progress in the fundamental aspects of this field of aerobiology. In the use of microbial aerosols to investigate infectious diseases and to develop prophylactic and therapeutic measures against them, the experimentation is generally less sophisticated than that conducted by competent Western scientists and results are often poorly controlled. However, the volume and variety of aerosol research presently under way in the USSR, the number of different scientific establishments engaged in this work, and the extensive efforts which are being made to develop appropriate equipment and techniques for the study of airborne microorganisms suggest that Soviet scientists are quite capable of and are carrying out aerosol research in support of BW.

Industrial Fermentation.--The fermentation industry of the USSR lags considerably behind that of the West in almost every respect; in some phases of industrial fermentation this lag has been estimated to be some 10 to 15 years in terms of time. Whatever progress has been made is generally attributable to the exploitation of research and development from other countries and to the adoption of Western technology, but the Soviets are gradually building up a native capability in this field. 94/113/ 219/ Industrial fermentation research and development most likely to serve as a measure of the capacity of Soviet science to support a BW program involves those processes which employ the submerged culture method, such as the production of antibiotics, organics, certain vitamins, commercial microbial enzymes, and fungi for livestock feed purposes. Of these five, fermentation production of antibiotics is of greatest importance because submerged cultivation

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methods in the remainder are either in early research and development stages or have only recently been adopted by Soviet industry. 94/ 219/

Considerable progress has been made in production of antibiotics in the USSR within recent years. Yield efficiency is low which is an indication that production techniques are less advanced than those used by Western nations. 94/ 224/ The total supply of representative antibiotics is reportedly well below current Soviet needs, and certain of them are apparently still being imported. 225/ 226/ The progress that has been made by the Soviets themselves is to a great extent the outgrowth of an integrated system of research organized in various institutes and pilot plant establishments within the industry. Four scientific centers are devoted primarily to antibiotic research and process development, and numerous other institutes conduct research in this field. The existence in many of the institutes and most of the antibiotic plants of experimental fermentors for pilot research on new strains of organisms and new types of culture media is a very significant and important feature of this system. Many of the antibiotic plants in the western part of the USSR have grown through the expansion of older existing units. The layout in some of these plants is not modern and equipment is often improvised; however, in the more recently established antibiotic facilities in the Soviet Union and in countries to which Soviet assistance has been rendered, planning and design have been carried out according to modern standards and with more adequate equipment in mind. One of the objectives of the Sixth Five-Year Plan, in addition to greatly increased output and the production of newer antibiotics, is the installation of automatic or semi-automatic equipment for greater unit productivity. At present, there are reportedly 14 antibiotic plants in the entire USSR, two-thirds of them in the RSFSR. In general, these facilities are of about the same size, employing an average of 1,000 to 2,000 workers each. 219-221/ 226-228/

The contribution and support that Soviet industrial fermentation, as exemplified by the antibiotics industry, might conceivably make to a BW program encompasses through principal areas: equipment and instrumentation, the possibility of plant conversion from antibiotics to agent production, and trained scientific and technical personnel. Stainless steel fermentors in which antibiotic-producing organisms are grown, and their control mechanisms, could be modified for large-scale cultivation of bacterial and fungal agents, although fermentors specifically designed for vaccine production would appear to be basically more suitable for this purpose. At the present time, there is no evidence that Soviet scientists are capable of propagating viruses and rickettsiae in tissue culture on a scale which would require fermentation equipment, hence, the type of agent which could be produced is somewhat limited. Filtration, extraction, and purification and crystallization equipment and technology would be readily adaptable to the concentration of bacterial toxins. Thus, while conversion of antibiotic producing facilities to BW agent production is possible, the probability of such conversion is considered extremely unlikely. Many factors including





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time, cost of modification, the availability of vaccine and toxoid producing installations, reduction of national antibiotic production, and serious safety and security problems favor construction of new facilities or conversion of existing plants more closely related in their activities to production of pathogenic microorganisms. 219/ 220/ 222/ 223/

The biological and engineering technology developed for fermentation processes and the experience gained by personnel working in the antibiotic production field would be of value in BW research, even though there are major differences in procedures for growth of antibiotic-yielding organisms and the more fastidious pathogens. A sizeable group of Soviet microbiologists, mycologists, biochemists, and engineers are engaged in antibiotics development and production; and efforts are being made to train additional specialists in these categories. Many of these personnel are highly competent and have had extensive experience in various aspects of fermentation. 219/ 220/ 222/ At the present time, except for the technical knowledge which this group of experienced workers could impart, the fermentation industry in the USSR offers little in the way of facilities, equipment and processes for growth of microorganisms that is not more readily available in those segments of the scientific community which produce biologics for medical and public health agencies. The relative backwardness of industrial fermentation as a whole and the attention which must be given by scientists in this field to problems inherent in the planned expansion for future years indicates that the capabilities of the industry to influence or support BW research is meager.

Antibiotics Research.--Studies of Soviet basic research in the antibiotics field have shown it to be relatively well advanced, largely because of exploitation of Western progress. 95/ Some fundamental problems, such as the mechanism of antibiotic action, have not been stressed; but, in other areas, particularly in the biosynthesis of these compounds, research programs have been intensified and expanded in scope during recent years. 94/ 96/ The latter efforts are in consonance with Soviet objectives of increased production and better quality of presently available antibiotics. 93/ 226/ 228/ Attempts to develop higher yielding mutant strains of antibiotic-producing organisms also form an important part of the Soviet work. 109/ 110/ 131/ Much attention is being given to screening of new compounds effective against virus infections, tuberculosis, intoxication by bacterial poisons, cancer, and other diseases refractory to conventional antibiotics. 93/ 229/ 230/ In related medical investigations, some work is still evident on drug resistance in pathogenic microorganisms, but relatively more emphasis has been noted on the evaluation of antibiotic aerosols in the therapy of respiratory infections and other lung disorders. 194/ 195/ 206/ 207/ 231/ 237/ Because antibiotic research in





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the USSR includes exploitation of substances which are not generally considered in the antibiotics category by Western sciences; namely, tissue extracts, serum derivatives, enzymes, and proteins. Soviet literature also reflects work on protozoa and plant and animal tissues as well as on the more conventional bacteria, yeasts, and fungi. 93/

The developmental aspects of antibiotic investigations are less advanced in the Soviet Union than in the Western nations. 95/ While Soviet versions of most of the commonly recognized antibiotics are available, the quality of the preparations is open to question in many instances and scarcities still exist. 93/ 95/ 224/ 225/ 232/ Production processes for certain of the more recently discovered compounds are still under study, and actual production of others has just begun, according to Soviet announcements. 226/ 228/ Recognizing that the often inferior quality of antibiotic preparations in the USSR is related to imperfect fermentation technology and laxity in production control, steps are under way to correct these deficiencies by reevaluation of culture processes and quality control mechanisms. 112/ 226/ Expansion production capacity through construction of new facilities, modernization of older installations, and integration of research were mentioned previously as part of the present ambitious Soviet effort to become self-sufficient in fulfilling the need for antibiotics. 219-221/

Intelligence estimates have foreseen a trend toward more original research, especially in the isolation and development of new antibiotics in the USSR, although the liklihood is not considered great that significant scientific advances will result, and continued Soviet emphasis on exploitation of Western experimentation is expected. 93/ 95/ 96/ However, this exploitation, coupled with the volume of work which is reportedly under way now within the Soviet Union on isolation of new antibiotics and improvement of present products, suggests that the Soviet capability for supportive BW research in the antibiotics field is good.

Immunology.--Attempts to cope with the many prevalent infectious diseases in the USSR have stimulated vigorous research programs in immunology. Specific immunoprophylaxis and the establishment of immune contingents in the population have been extolled by Soviet scientists as the principal means of interrupting the epidemiological process of infection. Hence, Soviet immunology is largely oriented toward development, refinement, and application of vaccines and protective antisera, although fundamental research has not been entirely neglected. 95/ 233/ 234/ 271/ In the latter field, strong emphasis on proof of theories of immunity mechanisms is a characteristic of past Soviet studies, and valuable information has been compiled on the relation of immunity to functions of the central nervous system, allergic manifestations, antibody formation, the immune state in parasitic infestations, and similar problems. The application of immunological procedures to the zoonoses and neurotropic virus diseases has yielded data not readily available in other countries, but few major contributions to fundamental knowledge of immunology have emerged from the Soviet Union in recent years. 95/ 96/ 238/





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Protective inoculations for many diseases of BW importance have been developed and given broad application in the USSR; among them are tularemia, brucellosis, plague, anthrax, botulism, equine encephalomyelitis, tick-borne encephalitis, smallpox, Q fever, and typhus. Foot-and-mouth, rinderpest, hog cholera, and other specifically animal diseases which occur there have their respective vaccines. The effectiveness of some Soviet preparations, notably the vaccines for psittacosis and Japanese B encephalitis, is questionable, and no measures for bestowing active immunity are known to be available for glanders, melioidosis, infectious hepatitis, and some types of hemorrhagic fever. 96/ 100/ 270/ The great emphasis in the USSR on development of vaccines of viable organisms has yielded useful, live attenuated antigens for tularemia, brucellosis, anthrax, plague, tuberculosis, poliomyelitis, Pappataci fever, influenza, smallpox, and rabies, while live vaccines against measles and mumps are in experimental stages. 95/ 100/ 235/ 236/

Most Soviet vaccines against natural infection with diseases of BW significance appear to give only moderate protection. Adverse side reactions are common, and none is known to be fully effective under respiratory challenge or to afford protection against mutant and heterologous strains. 100/ 399/ As evidenced by the scientific literature, however, a long-term program is in progress to improve the protective qualities and stability of present vaccines, reduce post-vaccinal reactions, and obtain attenuated immunizing strains of low virulence and greater immunogenicity. 172/ 233/ 234/ 236/ 241/ 242/ 244/ This effort pertains not only to immunizing agents of recent development, but also applies to preparations which have been widely used for many years, as in smallpox, plague, tularemia, and anthrax. Even the basic enteric vaccines--the NIISI polyvalent vaccine, consisting of typhoid, paratyphoid A and B, Shiga and Flexner dysentery, and cholera organisms along with tetanus toxoid--is being reevaluated. 127/ 129/ 134/ 168/ 172/ 240/ 242/ 243/ 245/ 246/

In April 1958, a conference led by A. N. Meshalova, Chief of the Main Administration of the Institutes of Vaccine and Sera, Ministry of Health, pointed up a broad and significant research program on multiple vaccines which clearly had been in progress for several years at a number of public health institutes and the Kirov Military Medical Academy in Leningrad. 134/ 135/ 240/ 249/ 251-253/ 278/ 298/ Coincident with this first recorded symposium on multipurpose vaccines, the Soviet scientific literature began to reveal that a great variety of new immunoprophylactic preparations were undergoing experimental testing, and in a few instances, process development preliminary to production. 134/ 250/ In some of this work, the NIISI vaccine provided the basic preparation into which additional components, such as combined live smallpox and brucellosis antigens and Q fever, typhus, or tularemia



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organisms, were introduced. 135/ 240/ 251-253/ It is also apparent that much attention has been given to various combinations of living vaccines of the causative agents of brucellosis, tularemia, plague, and anthrax. 134/ 254-257/ In a relatively few reported investigations, one or another of these has been employed simultaneously with such antigens as killed Vibrio cholera cells, tetanus toxoid, or smallpox vaccine. 249/ 258/ 278/ Results published so far suggest that studies on combined bacterial antigens are still preliminary in that research objectives relate largely to determination of compatibility, that is, suppression of antigenicity or potentiating effects, when multiple immunizing substances are administered by different routes and in varying quantities. 249/ 251-256/ 258/ The lag period between this research and its publication date is not known with certainty, but there are no indications that production stages have been reached in any combined bacterial vaccines for BW important diseases other than the modified NIISI preparation. 129/ 134/

In addition to complex mixtures of bacterial cell antigens, considerable effort has been expended in development of combined toxoids; these substances have been studied both as homogeneous toxoid mixtures and in association with bacterial vaccines. 135/ 140/ 250/ As many as seven toxoids have been incorporated into a single preparation, [redacted] 135/ 140/ Diphtheria toxoid and Staphylococcus enterotoxoid are represented in some of the combinations in addition to the more commonly found gangrene, botulinum, and tetanus antigens. 135/ Despite this volume of work, it is significant that only a single study has been noted on multiple viral antigens; in this one investigation the compatibility of live yellow fever, p'appataci fever, and smallpox viruses was explored although detailed findings were not reported. 134/ The next task in devising multipurpose vaccines, by Soviet pronouncements, is development of combined virus, virus-rickettsial, and virus-bacterial antigens, and among those for which a specific need has been expressed are tick-borne and Japanese B encephalitis, poliomyelitis, yellow fever, and influenza. 134/ 135/ In the meantime, multiple-antigen bacterial vaccines and toxoids have in certain instances reached the stage which permits their testing on human subjects; the modified NIISI vaccine, brucellosis-tularemia mixtures, and various combinations of enteric bacteria and toxoids fall within this category. 129/ 134/ 263/

Paralleling research on multiple antigens and improvement of present vaccines are Soviet attempts to develop more effective antisera, or derivatives of them; as with the combined vaccine work, these attempts are regarded as still largely preliminary in nature. Two





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separate but related phases of this expanding effort are apparent from published studies; the first is concerned with incorporating additional immune substances into conventional preparations, usually antitoxins, such as those available for prophylaxis and therapy of botulinus poisoning, gas gangrene, and tetanus. 140/ 177/ 260/ The other includes purification and frationation of antisera as a means of concentrating protective factors in a more stable, preferably dry, form of reduced bulk. Examples of diseases to which this research has been applied so far as plague, anthrax, and leptospirosis among the bacterial infections; the toxic states found in tetanus, diphtheria, and gangrene; and the virus diseases of rabies, tick-borne encephalitis, and smallpox. 177/ 261/ 262/ It is significant that a search is under way in the USSR to find substitute animal donors for the preparation of immune serum and globulin to supplement human and equine sources of these products economically. 177/ Noteworthy is the recent finding that cattle destined for beef production can provide high-titered botulinum antiserum if immunized and then bled prior to slaughter. 262/ 264/

There is ample evidence that the questionable effectiveness of conventional vaccination procedures in preventing infection through the respiratory tract has been a matter of concern to Soviet investigators for many years. Early claims that plague and tularemia vaccines provide a high order of protection against inhalation infection are contradicted by other information from Soviet sources. 37/ 170/ 171/ 236/ 265/ Recent publications by scientists of the Military Medical Academy imeni Kirov reveal that the problem of immunity against airborne infection is still under serious study, and the results of aerosol challenge of immunized animals by selected animal pathogens and botulinum toxins further substantiate the deficiency of present-day vaccination methods in affording the necessary degree of protection. 45/ 78/ 83/ 84/ Vaccine administration through the lungs as a means of enhancing immunity to plague was explored at the NIIEG during World War II; and since 1953 or earlier, this approach has been investigated at the Military Medical Academy in Leningrad as an adjunct to the aerosol challenge experimentation. 46/ 266-268/ In research at the Academy, the immunizing properties of live, dry aerogenic vaccines of plague, tularemia, brucellosis, and anthrax were studied, along with tetanus toxoid; several hundred animals and over 400 human subjects were employed in these investigations, as an indication of the depth in which the work was pursued. Aerosol challenge of the animals and assessment of immunity in the humans by routine laboratory procedures prompted a claim for great effectiveness for the aerogenic vaccine method with live dry antigens. 268/ There are indications that inhalation immunization has also been explored by other workers in the case of experimental tularemia, tuberculosis, typhoid, dysentery, and diphtheria and that an extension of this research in the USSR to smallpox and yellow fever in humans and rinderpest, foot-and-mouth disease, and swine plague

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in animals is planned. 162/ 266/ 267/ 278/ Recent published work shows that a specialized aerosol device for mass aerogenic immunization of the human population against influenza and possibly other infections has been designed and mass tested in the Soviet Union. 269/

Another significant phase of immunological research under way on an increasing scale in various Ministry of Health laboratories, the Sukhumi Medico-Biological Station, and the Kirov Military Medical Academy in Leningrad is the effect of ionizing radiation on the immune state and susceptibility to infection. 271/ 272/ 297/ Several important facets of this research are reflected in recent Soviet publications. One publication pertains to the course of disease in experimental animals suffering from induced radiation sickness and discusses attempts to define adequate therapeutic measures, particularly against the bacterial pneumonias. 273/ In related studies, in which therapy was clearly not the sole objective, the increased susceptibility of irradiated animals to Leptospira, Staphylococci, Salmonellae, the anthrax bacillus, and other representative bacterial species has been explored, along with the toxins produced by Staphylococci and the gangrene and tetanus bacilli; viruses of rabies, poliomyelitis, influenza, yellow fever, lymphocytic choriomeningitis; and possibility other neurotropic agents. 270/ 273/ 274/ 297/ 306/ 331/ 439/ 440/ Still another segment of this research has dealt with the influence of radiation in lowering protective levels resulting from active immunization against bacteria and viruses; in that regard, concern has been voiced by Soviet writers for the possible inefficacy of immunoprophylactic defense against BW important diseases in the presence of sublethal amounts of radiation. 272-274/ There are apparent misgivings about the invasiveness of live vaccine strains when active immunization is superimposed on subclinical radiation sickness, as suggested by studies on the propagation of live antigen of the tularemia vaccine in irradiated host animals. 273/ 275/

Refinement of live vaccines and development of attenuated prophylactic preparations against those diseases for which none is now available are expected to characterize Soviet research for the next several years; on the other hand, relatively few advances in fundamental immunology, other than those derived from Western research, are foreseen in current estimates. 93/ The partial success which has reportedly been met in reducing the incidence of serious infectious diseases by mass application of immunoprophylaxic measures further suggests that the applied aspects of immunology will continue to receive major emphasis, particularly in the development of multiantigen vaccines, polyvalent antiserum derivatives, and new preparations for aerogenic immunization. 100/ 277/ The extent to which investigations in these areas and in the



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field of radiobiology are already under way and the direct relationship which they bear to BW research, clearly indicate that a Soviet capability to conduct immunological experimentation in support of a BW program is now existant.

Sanitation and Hygiene.--Because of the diversity of ethnic groups in the population and the relatively primitive conditions under which some of these peoples live, the expansion of agriculture and industry to underdeveloped areas, and other factors, the application of modern environmental sanitation measures in the USSR has lacked uniformity, with the result that inadequate sanitation practices prevail today in large areas of that country. 93/ 279/ Attempts are being made to extend and strengthen the control of sewage disposal, water purification, and milk and food processing, but Soviet statements show that amoebiasis, typhoid fever, helminthic infestations, and other enteric diseases whose incidence serves as an indicator of the sanitation level are still major public health problems in both urban and rural communities. 279/ 285/ Although faced with shortages of trained personnel, equipment and facilities, Soviet workers are reported by qualified observers to be making rapid strides in suppressing these diseases and other common communicable infections under an expanding preventive medicine program. 100/ 280/

In the USSR, sanitation research, hygiene, and epidemiology are closely integrated. The framework for the present day structure of the Ministry of Health was erected in 1923 with the formation of a far-flung system of sanitary-epidemiological stations. Subsequent reorganizations in 1935, 1948, 1953, and 1956 were designed to centralize control of research and administrative functions and to consolidate the programs of isolated laboratories, medical dispensaries, and detachments within this system. 39/ 247/ 279/ 281/ 282/ In general, a parallel development and expansion of military sanitary institutes, research programs, and supervisory organs was characteristic of this period, but diverging lines of growth were noticeable after a separation of military and civilian sanitation-epidemiological responsibilities in 1929. 42/ Nevertheless, the following years, and especially the period of World War II, saw cooperative interaction between the two forces in attacking problems common to both. 42/ 48/

Soviet writers point out that the expansion of public health organizations in recent years and the greater emphasis on sanitation and hygiene research have provided a degree of uniformity in health services and have led to stringent and more effective sanitation codes and standards. 279/ 283/ Future plans set forth at the 20th Congress in 1957 called for additional trained specialists in





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sanitation and epidemiology for schools, industry, and farming communities and included provision for opening, by 1965, sanitary bacteriological laboratories in 848 sanitary-epidemiological stations and hospitals which now lack such facilities. 284/

The field of sanitation and hygiene in the USSR embraces problems of disinfection of microorganisms, disinfestation of external parasites, and extermination of rodents. The development of appropriate measures for control of each of these contributors to the epidemiology of disease is under way. 138/ 270/ Microbiological research has centered around means of chemical and physical decontamination in industrial and agricultural pursuits for which infectious diseases are an occupational hazard or pursuits which form a link in communicable disease transmission. Since 1949, biological air pollution has also fallen within the purview of sanitation research, and considerable effort has been devoted to development of air sampling devices, aerosol disinfectants, and related specialized materials. 39/ 186/ 187/ 191/

Soviet disinfection practice utilizes the conventional decontaminants for laboratory and field work, but some attention is still being given to screening of chemical compounds, particularly halogen derivatives in mixture with other reagents, in a search for general purpose germicides of greater effectiveness and wider application. 196/ 286-289/ New ways of applying physical sterilization measures, such as filtration, ultraviolet radiation, heat, and electric current have been under study for several years; but the scanty published results of these investigations yield no clear impression of significant progress. 198/ 212/ 290-292/ There is little evidence of development and widespread use of gaseous disinfectants [redacted] 293/ 294/ Despite earlier claims that reagents and disinfection techniques have been worked out for air sterilization with the glycols, organic acids, and certain of the more common germicides, the literature of the USSR still reflects screening experiments on representative chemical substances from these and other categories, and indication that procedures for aerosol disinfection have not yet been perfected. 196/ 197/ 290/ 295/ 296/

A review of the critical problem areas in disinfection outlined periodically by Soviet investigators during the 1950's suggests that no adequate solution has been found for certain persistent problems of significance to BW defense. Foremost among them are the lack of suitable decontaminants for soil, air, and the interior of large





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buildings; while vertical surfaces, and structural materials such as brick, plaster, wallpaper and metals still present a challenge to thorough disinfection. With respect to specific microorganisms, aside from the dysentery group, poliomyelitis, and infectious hepatitis viruses and the tubercle and anthrax bacilli are the pathogens for which effective decontamination methods are most urgently needed at present. 136/ 138/ 286/ 290/ 295/ 296/ Measures for reducing the hazards of brucellosis, Q fever, tularemia, psittacosis, and other dangerous diseases to farmers, livestock handlers, and workers in animal products industries have not proven fully satisfactory, as judged by the quantity and type of research still under way on eliminating disease foci by disinfection procedures. 288/ 289/ 291/ 292/ 299-304/ 308/

Public health research intended to solve sanitation and hygiene problems affecting the general welfare of a nation is inherently much the same in scope and direction as research required to safeguard the investigators of infectious agents of BW or to devise protective measures against agent attack in wartime. In this sense, much of the Soviet work on disinfestation, rodent and arthropod control, and disinfection fulfills a dual role, regardless of intent or design. The fact that research programs bearing a direct relationship to BW defense have been under way in these fields for many years in Ministry of Health laboratories, two specialized centers, the Institute of General and Communal Hygiene, and the Central Scientific Research Institute of Disinfection, Moscow, and various installations under veterinary or military medical auspices leaves little doubt that a capability to carry out BW supportive experimentation on decontamination and its applied aspects is present in the USSR.

Epidemiology.--Epidemiological studies followed close in the wake of the previously mentioned, revitalized sanitation and public health programs of the early 1920's. With the establishment of a network of sanitary-epidemiological stations and socialized institutes for research on specific endemic diseases, a base was provided for long-term investigation of host-parasite relationships among the human population, rodents, and arthropods in natural foci of transmissable infection in the USSR. 39/ 50/ 53/ 124/ 247/ Much of the early work on BW-important infections was devoted to plague, tularemia, and other bacterial diseases; but the mid-thirties found Soviet investigators beginning detailed studies on the rickettsial disorders, and shortly thereafter, on those of virus etiology. 50/ 53/ 120/ 121/ 145/ 307/

The many epidemiological surveys conducted over the years, the assignment of prominent scientists to direct this survey work, and the emphasis on centralized reporting and evaluation of data have

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engendered an adequate knowledge of the occurrence and incidence of the important human and animal diseases in the Soviet Union. 93/ 96/ The application of this knowledge to prediction and control of epidemics and to analysis of the effectiveness of immunization and therapeutic programs has been a practical necessity, although theoretical research on the epidemiological process; that is, transmission, preservation of pathogenic microorganisms in nature, the role of ecological, and other factors, has been encouraged in recent years. 95/ 96/ The rapid advances made in the field of medical entomology and the expanding interest and activity in exploring the arthropod-borne diseases were noted previously. 146/ Efforts to formulate effective control measures for arthropods and rodents to break the chain of disease transmission have been accompanied by research on the nature of host-parasite associations and the compilation of epidemiological data. Thus, census-taking on the rodent population and determination of the extent of parasitic infestation is a continuous process, and insecticide dusting and poisoning of small animals is receiving broader application as methods and equipment are developed and improved. 146/ 279/ 310/ 311/

Soviet scientific literature shows that the mechanism of the spread of the bacterial infections is still under investigation, most notably in the case of brucellosis and tularemia; two diseases for which completely effective control measures have been difficult to define. The role of various vectors in preserving microorganisms in nature and the part played by wind, water, and other elements in their distribution are typical research undertakings. 137/ 313-316/ With the viruses and rickettisiae, experimental infection and transmission routes are being reexplored in certain of the long-experienced diseases, such as rabies, typhus, and Q-fever; but relatively more current emphasis appears to fall on less understood entities of the hemorrhagic fever, tick-borne rickettsiosis, and neurotropic virus groups. 120/ 121/ 239/ 307/ 317/ 318/ 320-324/ Along with work on specific diseases, a search for more efficient epidemiological tools of general applicability is noted in Soviet publications. Among those under consideration are quicker and more refined diagnostic tests and the use of radioactive tracers for delineating pathways of infection, insect transmission, and distribution of microbes in natural environments. 137/ 167/ 191/

Intelligence studies predict a future trend away from centrally-controlled antiepidemic measures, with stronger and more independent functions placed in regional research and support installations; these same studies indicate, however, that a nationwide antiepidemic network will be retained for emergency situations. 93/ 96/





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Increasing emphasis on experimental epidemiology and theoretical analysis of epidemiological data are also anticipated as an expansion of present programs of practical observation and assessment of disease outbreaks. 96/

The long history of serious endemic disease in the USSR has forced attention to epidemiological problems, many of them involving a complex relationship among humans, rodents, parasitic arthropods, and infectious microorganisms. In attempting to solute these problems, a wealth of knowledge has been gained on the epidemiology of diseases most likely to be candidates for BW employment; unique experience with exotic infections; for example, the atypical encephalitides and hemorrhagic fevers, has also accrued to Soviet scientists. 93/ 100/ Of necessity, a rather elaborate or anizational structure has been created to supply the needed resources; and the research installations within this structure, along with military and civilian research expeditions, survey teams, and mobile detachments, through years of activity, can be presumed to have provided a considerable number of trained specialists in epidemiological matters. 42/ 47/ 320/ 327/ Consideration of these factors leads to the conclusion that the sanitary-epidemiological service in the USSR is entirely capable of carrying out research in support of BW.

Bioengineering.--Prior to obtaining Western assistance in establishing antibiotic production facilities during World War II, the USSR had not progressed far in the general application of engineering principles to fields of biological science. Since 1945, significant strides have been made in some areas, notably in production of vacuum-freeze dried vaccines and allied preparations; advances also are detectable on certain other fronts. 126/ Some of the newer Soviet antibiotic plants are designed and equipped in accordance with modern standards, and the expansion of these facilities envisioned under the Sixth Five-Year-Plan will include installation of automatic and semi-automatic processing equipment in an effort to improve yield efficiency and quality of product. 220/ 228/ At the opposite end of the scale, industrial fermentation in the USSR lags several years behind the West, although a native capability, independent of Western technology, is gradually building up. 94/ 219/ The lack of Soviet proficiency at present in adapting tissue culture methods to production of human and veterinary virus vaccines was also mentioned as evidence of questionable bioengineering know-how in one specific area. 143/ 144/ 154/ In research giving a direct measure of one other facet of BW-related bioengineering capability, previous discussion took cognizance of the greatly increased scope and volume of microbial aerosol work since World War II and of the introduction during the past three or four years of more

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sophisticated techniques in design and construction of test chambers, air samplers and aerosol generators. 45/ 77/ 78/ 80-82/ 88/ 179/

Evaluation of Soviet bioengineering skills would be incomplete without reference to two other specialized biological problems; namely, "continuous culture" of microorganisms and germ-free animal research. Continuous cultivation techniques and equipment provide a useful tool for studying the effects of genetic and environmental factors on microbial properties; they also offer considerable potential for the efficient, controlled, large-scale production of organisms. Development of effective continuous cultivation processes, as with other more elaborate biological techniques, places unique demands on bioengineering skills. Two recent symposiums permitted a brief insight into current Soviet efforts, but little is known of the actual scope and depth of Russian research in this field. 328/ 329/ Not much emphasis has been found on continuous culture devices as a means of fundamental problems or by way of practical application, for microbial strain selection and vaccine production in the realm of medical research. On the other hand, adaptation of continuous fermentation processes to the yeast industry, alcohol production, and paper manufacturing is apparently being attempted. So far, Soviet investigations appear to relate primarily to early stages of process development in which culture equipment for industrial fermentation and the effect of design characteristics and environmental factors on growth efficiency are worked out. 328-330/

The rearing of germ-free animals, a research technology that also requires a high degree of bioengineering skill, is a comparatively recent innovation in Soviet science. The isolated biological system provided by a germ-free animal host affords almost ideal conditions, upon introduction of selected microorganisms, for investigation of immunity mechanisms, the nature of pathogenesis and other fundamental problems of immediate significance to offensive and defensive BW. The reported trends of Soviet interests in germ-free research and the affiliations of microbiologists believed to be associated with the program indicate that laboratories for such purposes may be operational in Moscow at the Ivanovskiy Institute of Virology and/or the Institute of Epidemiology and Microbiology, Academy of Medical Sciences, and at the Institute of Experimental Medicine in Leningrad. Several prominent Soviet virologists follow closely Western research on germ-free techniques; their areas of apparent interest include possible infectious disease problems encountered during space travel, "super-clean" assembly of equipment for space vehicles, and medical situations posed by sealed cabin conditions. The few available reports suggest that germ-free facilities in the USSR are on a smaller scale than those in Western countries and that Soviet scientists are still preoccupied with





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technological refinements of equipment and methodology. They appear to be well aware of current concepts and applications of germ-free research, however, and are steadily planning program expansion. 384/ 385/

Soviet bioengineering capability is perhaps subject to more thorough analysis in the field of production of biologics, that is, live vaccines, antisera, toxoids, and related preparations, because the nature, volume, and diversity of products and duration of effort permits a broader over-all view than could be gained from study of specialized research areas alone. By 1921, there were reportedly some 15 scattered sanitation and bacteriological institutes in the USSR producing these preparations. In the 1940's, the institutes of epidemiology and microbiology functioned both as developers and producers of biologics. In recent years, a system of serum and vaccine institutes has been established to conduct research and process development; and to turn out, through its bioplants, the more than 40 different biological products used in diagnosis, prophylaxis, and therapy of infectious diseases. Under the current 5-year plan, quality control and production will be centered exclusively in these institutes for sera and vaccines and in their monitor, the State Control Institute, while explorations leading to new products will be carried out by research laboratories of the Health Ministry and other elements. 41/ 233/ 235/

The groundwork for efficient production of biologics in one vital area, the bacterial vaccines, was laid during the early years of World War II by military scientists of the Scientific Research Institute of Epidemiology and Hygiene of the Armed Forces (NIIEG-VS), who developed methods and equipment for mass growth, harvesting, and dry storage of live bacterial antigens for brucellosis, tularemia, plague, and possibly others. 18/ In the post-war period, conventional laboratory equipment which formerly had been used at various production sites was replaced to some extent by metallic fermentors, high-speed centrifuges, large-volume freeze dry apparatuses, and supporting devices of the NIIEG type which are better suited to industrial methods. 41/ Current Soviet standard operating procedures for vaccine production yield little direct evidence of widespread use of large volume equipment; however, a suggestion that an important segment of the total vaccine supply is prepared in bioplants still encumbered with outmoded processes and equipment. 332/ 333/ Large reactors are not unknown in the USSR; [redacted] but the probability exists that first priority use is enjoyed by the antibiotics industry and that a shortage of the latest and most efficient equipment is felt in some vaccine producing plants. 227/ 332/



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Among other isolated indications of weakness in certain aspects of bioengineering in the USSR is the inconsistency of quality in biological products, that is, instability, loss of potency, impurities, in vaccines, diagnostic aids, and antibiotics and the relative inferiority of quality control mechanisms. 126/ 219/ 226/ This situation may be alleviated eventually by steps now under way to prescribe and enforce uniform standards of quality, reevaluate and improve processes, and exert more stringent control of steps in production. 112/ 233/ 235/ A wealth of experience has been gained over the years in the biologics production field, and Soviet scientists are considered to possess the competency to expand and extend these accumulated skills to other areas of bioengineering. There are many significant gaps in intelligence on Soviet strengths and weaknesses, particularly in regard to virus and rickettsial vaccine production, large-scale toxin fermentation and purification procedures, and development of multiple or combined immunizing agents and protective antisera beyond the laboratory stage. Future emphasis on mass production methods in these gap areas can be expected from indications in current Soviet writings.

Trends in Research.--Although the predominant view of recent years is that Soviet research in the biological and allied fields, with some few exceptions, has been qualitatively unimpressive by Western standards, the USSR possesses an over-all scientific and technical capability to carry out BW research and development. The degree of capability has been difficult to establish accurately from past information, because finite knowledge of the direction in which Soviet BW programs are moving is exceedingly scanty. It is still not possible to give absolute values to the relative effectiveness of research support to agent development, production, testing, weapons design, and the many other distinctly different facets of BW; but it is important that the trend is toward more emphasis on basic research in the USSR without a concurrent lessening of the applied aspects. The various factors leading to improvement of the atmosphere for biological investigations have been identified in terms of a broader research base, more adequate facilities, better trained scientists, stronger official support and coordination of research, acceptance of sound theories, freer exchange of information with the West, and others. This strengthening of the biological sciences can be equated with a steady improvement in support capability over a period of the next several years in major scientific areas applicable to BW.

In medical microbiology and epidemiology, the pronounced emphasis on endemic virus and rickettsial diseases should bring into focus several candidates for consideration in antipersonnel BW agent development. Among the many possibilities are the Soviet-designated Omsk, Crimean, and hemorrhagic nephroso-nephritis types of the little understood viral hemorrhagic fevers; infectious hepatitis, and the



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arthropod-borne dengue-like virus infections; tick-disseminated rickettsioses of the antigenically related spotted fever group, that is, North Asian tick typhus and Boutonneuse fever and the incompletely studied mite-borne "vesicular" and tick-carried "paroxysmal" rickettsioses. Arthropod-transmitted encephalitides, such as spring-summer encephalitis, lymphocytic choriomeningitis, and the still largely unknown rabies-related "Dikovanie" disease of the Arctic offer additional interesting possibilities. A background of information applicable to BW agent development can be expected from efforts to characterize the pathology of these various diseases, define routes of transmission, develop immunological, disinfection and therapeutic measures, and design processes for production of microbes in the laboratory or vaccine plant. Concurrent with investigation of etiologic agents, considerable data should be forthcoming on their arthropod vectors regarding retention and viability of pathogens in the respective vectors, duration of infectivity, frequency of disease transmission, and other information essential to use of arthropods in the dissemination of BW agents. The marked Soviet progress of recent years in exploring medically important vectors and the stature of entomological research as a whole are compatible with this trend.

Much the same position can be taken with respect to animal disease research in the USSR. The relatively greater emphasis expected on virus diseases, as opposed to bacterial infections and the rapid growth already seen in veterinary microbiology suggest that further opportunities for development of suitable anti-animal BW agents will arise; this can be said not only for the major infections, such as hog cholera, foot-and-mouth, rinderpest, but with certain low incidence maladies of important animals, such as sheep and fowl pox, Newcastle disease of chickens, vesicular exanthema of swine, and a host of others.

There are no indications that progress in research on the plant pathogens of cereals and other food crops is sufficient to stimulate development of these potential agents for BW use. This is in keeping with the generally low Soviet capability in the plant sciences and the absence of past evidence of more than marginal interest in anticrop warfare. The limited and qualitatively poor work on new herbicides portends no significant effort toward development of these compounds as agents, although the rather extensive and expanding application of pesticides and herbicides in the USSR may contribute to a growing capability with the older, mass-produced chemicals.

There is nothing in currently available material to suggest a broadening of agent research to include additional candidates from among the bacteria. The years of work already expended on plague, anthrax, brucellosis, and tularemia have in all probability provided

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enough basic data to sustain full-blown agent development with these diseases. Studies on glanders, melioidosis, and certain of the other less frequently occurring infections, if under way at all on a continuing basis, are seldom reported. Along with the latter disorders, cholera, listerellosis, the spirochetal fevers, and the more commonly found tuberculosis, typhoid, and dysenteries, all of which have potentiality for BW employment, are under investigation to one degree or another; but little evidence exists of research directly pertinent to their development as offensive tools.

The great volume of work in the USSR on bacterial toxins, not only on formulation of immunoprophylactic preparations, but also in physiological studies on toxin action, may reflect to some extent the low standard of sanitation and lack of uniformly adequate medical care; however, the resulting wealth of information gained on botulinum, tetanus, diphtheria, and staphylococcus toxins could exert a marked influence on selection of candidates for BW explorations. Recorded Soviet interest in wound botulism, respiratory challenge of immunity with this toxin, and aerogenic immunization with tetanus and possibly other toxoids is a case in point.

As with the fungal parasites of food and commodity crops, the pathogenic fungi of humans and animals offer certain unique properties which have prompted their examination by the West for possible BW use. There is an almost complete absence of any evidence of similar research in the Soviet Union; but the rather limited scope of public health investigations and the low order of fundamental work on medically important fungi do not justify suspicion that these potential agents will play a significant role in Soviet BW agent development of the near future.

Without necessarily affecting the scope of agent research, several noticeable current trends may well shape the direction of such programs in the USSR. Among them are research on dry microbial products, especially live, dry vaccines administered aerogenically; development of multiple-antigen vaccines of bacterial, toxoids, and viruses; and studies on susceptibility to infection or intoxication following radiation damage. Soviet experience in the application of drying technology to vaccine production has extended over a period of several years; the improvement and increasingly prevalent use of live, dry vaccines affords an excellent background for similar development of fully virulent BW agents and warrants a tentative conclusion that in refinement of dissemination methods, emphasis might well rest on use of bacteria and toxins and possibly viruses and rickettsiae in the dry form. From present lines of research on incorporation of various living antigens into a single immunoprophylactic product, and



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subsequent analysis of the effect of one ingredient on another in generating a protective response, it is a short step to the study of infectivity of combinations of virulent organisms when employed simultaneously in BW. In this regard, the intensive Soviet effort in multiple vaccine experimentation could conceivably foretell a move toward agent fills comprising mixtures of toxins, bacteria, and other forms, with greatly enhanced invasiveness or potentiating properties. Recent findings of the increased susceptibility to a variety of pathogenic microbes when ionizing radiation damage has been incurred by animals also point up an obvious and possibly fruitful area of research in weapons development; namely, the concurrent challenge of body defenses with radioactive materials and biological agents, either by consecutive exposure or by virtue of the induced radioactivity of the agents. There are indications of Soviet interest in this dual weapon concept and further explorations would be a logical sequence to radiation injury studies now under way in the USSR.

The postwar trend toward more thorough study of biological aerosols and the development of suitable chambers, samplers, and ancillary equipment and techniques for facilitating aerosol and aerogenic vaccine investigations, indicates strongly that BW dissemination of airborne infectious particles has already received serious consideration and probably will be studied with increasing vigor from both offensive and defensive viewpoints. The reported periodic air sampling in some of the larger cities of the USSR, together with the newly promulgated responsibility for systematic air pollution sampling by sanitary-epidemiological stations not only demonstrates concern with defense against BW attack, but could provide a base line for collecting data of value in offensive large-area coverage (LAC) calculations on aerosols.

There is little question but that experience with large-scale processing of bacterial vaccines, and probably toxoids as well, and the extensive facilities for their production in the USSR are commensurate with a capability for turning out almost any desired quantity of BW agents by one or more of the various methods required. With regard to virus and rickettsial agents, apparent Soviet dependence at this time on egg or animal production techniques could prove severely restrictive of the amount of available infectious material. Cultivation of microbes in selected tissues offers a potential means of overcoming this limitation, but the previously noted lack of Soviet competency so far in fully exploiting these methods suggests that any impetus to mass reproduction of viruses and rickettsiae in the immediate future will not be drawn from tissue-culture processes.

Among Soviet research trends having a possible impact on BW defense programs is the increasing utilization of biochemical and

biophysical methods to improve microbial detection and identification techniques and diagnostic procedures. Published data reflect rather preliminary explorations in this broad field, but refinement of presently available methods for luminescent microscopy, fluorescent antibody reactions, rapid fermentation testing, and particle-size analysis could provide the foundation for future biological alarm systems or automatic detection equipment.

Perhaps foremost in defensive significance is the very considerable investigative effort in immunology, particularly the aforementioned trend toward development of new vaccines and antisera containing multiple immunizing or protective substances, respectively, against a variety of virus and rickettsial forms, bacteria, and toxins. While such undertakings are extremely long-range research projects, formulation of effective combined immunoprophylactic preparations would lend support to Soviet objectives of improving public health and strengthening BW defense by building up immunity to prevalent diseases in large segments of the population. Experimental vaccination via the respiratory route, while not yet extensive in the USSR, is also worthy of special attention from the standpoint of the possibly greater immunity which aerogenic vaccines may bestow and the ease with which mass immunization could be accomplished.

[redacted]

## The Offensive Program

### Resources for BW Weapons Development

The Scientific Research Institute of Epidemiology and Hygiene.-- Attention has long been focused on the Scientific Research Institute of Epidemiology and Hygiene (NIIEG) as the center of antipersonnel agent development and probable directing agency for the field-test installation on Vozrozhdeniya Island in the Aral Sea. 18/19/74/466/ Because of the possible roles of NIIEG and the island proving ground in offensive BW experimentation, it is important to present prevailing views of circumstances surrounding the inception of this association, to record and evaluate any new data bearing on these two facilities, and to assess their status as mainstays of the Soviet BW program.

The sequence of events which eventually led to recognition of the NIIEG--Vozrozhdeniya Island complex as the primary BW intelligence target actually began, according to present thinking, on Gorodomlya Island in Lake Seliger, Kalinin Oblast, in the mid-1930's. Gorodomlya's importance lies not so much in the work carried out there as in the link which this Island established between a succession of Soviet research institutes on the one hand, and Vozrozhdeniya Island on the other. All collateral information of value pointing to an association between Gorodomlya and Vozrozhdeniya Islands comes from German intelligence of the World War II period; [redacted] provided the clearest and, until 1957, the strongest evidence of Vozrozhdeniya's involvement as a BW field-test site. 17/ Two other reports from past years mentioned Vozrozhdeniya, or an island in the Aral Sea, in this regard without giving further details. 35/359/. The location of an institute for foot-and-mouth disease studies in 1932, Gorodomlya Island was taken over by the Ministry of Defense in 1935, an event which has been well documented. 17/28/36/343/ The institute was abandoned and partially destroyed early in World War II; on cessation of hostilities, the Island was converted into a missile research installation, and it reportedly operated as such between 1946 and 1952. 28/360/ During its approximately 6 prewar years under Ministry of Defense occupancy, Gorodomlya housed an investigative center for BW agent development and served as a base for expeditions in 1936-37 to Vozrozhdeniya for testing of agent dissemination methods. A description of facilities on Gorodomlya after the war adds little to our knowledge of the size of the former research institute or the scope of its programs in BW. By 1946, the only indicators of earlier experimentations were said to be old animal cages scattered over various parts of the island. 360/

Known variously as V/2-1094 or the Biotechnical Instiute of the Soviet Army and referred to at times as a branch of the Biochemical Institute of the Soviet Army, the Gorodomlya installation reportedly had its origin in the transfer of [redacted] BW activities from the Red Army's Scientific Medical Institute in Moscow, an organization



[redacted]

[redacted]

alleged to have begun BW work in 1934. 17/ The existence of an institute by this name [redacted] is confirmed in the literature of 1936. 392/ In the only known report of Gorodomlya's program, V/2-1094 was said to be studying animal infectivity, the effect of environmental factors on biological agents, rapid detection methods, and disinfection measures for buildings and terrain, using a number of human and animal diseases. BW simulants were stated to have been employed at Volsk polygon on the Volga river [redacted] during 1935. 17/ The mystery of Gorodomlya's activities and the difficulty in identifying personnel stationed at the institute may be in part attributable to the reported arrest and disappearance of [redacted] and some of his staff in 1937 at the peak of the field trials on Vozrozhdeniya Island. 17/ It is not known how many of the early BW researchers perished in the widespread purge of scientists characteristic of that era. 345/361/ German reports have it that [redacted] an authority on tularemia [redacted] replaced [redacted] as director of the Gorodomlya Island institute and continued the tests on Vozrozhdeniya Island for only a few months in the spring and fall of 1937 [redacted] 17/ [redacted] The scientific literature of a later date reveals that during this period [redacted] investigated the spread of tularemia in natural foci of infection in the course of an epidemic of the disease in humans; he also studied the various clinical forms of tularemia, including upper respiratory infections, and explored chemotherapeutic measures. 173/402/ [redacted] indicate that this work was conducted at the Scientific Control Institute imeni Tarasevich and the Institute of Experimental Medicine imeni Gorkiy, [redacted] 17/ 173/ [redacted]

The status of Gorodomlya Island during the interval between the [redacted] episode of 1937 and its abandonment in 1941 in the face of the German invasion remains a challenge. Hirsch's data from prisoners of war spoke of continued use of the island for BW research right up to the outbreak of war in that year. 17/28/ From an historical standpoint, it is entirely plausible that Gorodomlya Island housed the Sanitary Technical Institute (STI) during this period. STI was the site of preliminary research in 1940-41 on the anthrax vaccine, a product which still bears the STI designation, [redacted] later identified on the staff of NIIEG. 52/169/172/362/436/441/ Soviet statements show that some members of NIIEG actually began working together in 1936, even though formal publications from these early years have not been



[redacted]

[redacted]

found. 37/ It is considered likely that [redacted] institute was renamed the Sanitary Technical Institute about 1936-37 and that BW agent research, including experimentation on Vozrozhdeniya Island, was pursued by [redacted] and others, at the Gorodomlya Island laboratories until the forced move in 1941. [redacted] placed STI "near Leningrad". 397/ Gorodomlya Island lies some 100 miles from that city.

The terms STI and NIIEG are employed synonymously in Soviet microbiological literature, and such statements as ". . . the vaccine STI, developed by the Scientific Research Institute of Epidemiology and Hygiene, of the Soviet Army . . ." leave little doubt that the Sanitary Technical Institute was the immediate predecessor of NIIEG. 169/172/362/363/442/443/

The exact date on which the Sanitary Technical Institute was redesignated NIIEG is not known with certainty, but it appears to have occurred shortly after the evacuation of Gorodomlya Island. In the 1941-42 vaccine trials, [redacted] were referred to as "STI representatives", whereas in 1942-43, [redacted] represented "NIIEG" on a commission to explore the potential of the STI anthrax vaccine for general use. 52/443/ [redacted] 467/ Subsequent work on other bacterial vaccines of the later 1940's is uniformly referenced as NIIEG in origin. 37/169/170/432/434/

There are conflicting views on the probable course of events which led to NIIEG's relocation in Kirov. Possibly the institute on Gorodomlya Island was evacuated to pre-existing military research facilities in Kuibyshev in 1941. Three scientific establishments have been associated with Kuibyshev through post-World War II reports. These are the State Medical Institute; the Institute of Epidemiology and Microbiology (NIIEM), in existence as early as 1940; and a Military Medical Faculty. 446-448/ The Military Medical Faculty, as of 1953-55, was apparently separated physically from the others, but affiliated itself with the State Medical Institute for teaching purposes. 448/ A branch of the Military Medical Academy imeni Kirov in Leningrad had been transferred to Kuibyshev in 1939 to accelerate research and training of medical personnel for the expanding Soviet army. 43/ The actual location of this Academy branch within the city is not known with certainty, but presumably it shared quarters with one of the aforementioned establishments. The Military Medical Faculty of the 1950's may well be a later title for the Academy branch of 1939. 448/ The latter is believed to have existed in its own right for a relatively short period, since published research originating at the Kuibyshev Military Medical Academy is limited to 1941 journals. 393/394/428/ The short-lived existence of the Medical Academy as a research center suggests that it merged with, or was absorbed by, the Sanitary Technical Institute at the time of the evacuation of Gorodomlya Island's personnel to Kuibyshev. The consolidated

[redacted]

organization then, according to this view, was redesignated NIIEG and pursued for a number of years the broad programs of vaccine development and agent research exemplified by the literature of the mid-1940's.

A merger of STI and the Kuibyshev Military Medical Academy as envisioned has not been substantiated, but it provides a rational explanation for a statement made in 1948 [redacted] that NIIEG was located in Kuibyshev. [redacted] went on to say that NIIEG's existence in that city was common knowledge among Soviet scientists. 36/346/ Two Soviet publications of 1951 and 1955 pointed to NIIEG's actual location in Kirov, ". . . the Kirov Scientific Research Institute of Epidemiology and Hygiene (NIIEG) prepares a dry vaccine . . .", and ". . . vaccinations with strain 19 in the USSR have been carried out by the Kirov Research Institute of Epidemiology and Hygiene since 1944 . . ." 73/165/ [redacted] 51/

It is possible, too, that [redacted] did not want to reveal the true location of the NIIEG. Supporting evidence is found in the consistent failure of Soviet works over the years, with the three important exceptions noted previously, to show geographic origin of NIIEG research or to print city of residency of NIIEG personnel, as is commonly done for others in attendance at scientific gatherings. 51/165/ In this regard, NIIEG is omitted from a recent Soviet survey of historical and present-day establishments in Kirov. 417/

[redacted]

This type of endeavor is seen in the extended vaccine tests by NIIEG scientists at the Saratov Veterinary Station in 1942; the assistance rendered the Moscow meat combine by an NIIEG team in 1944-45 in setting up antibiotic production facilities; and in the organization of vaccine processes for suppliers of these materials. 358/432/443/ The Kuibyshev NIIEM, for example, is reported to have been turning out vaccines in the 1950's as part of the mission of such institutes announced in 1939. 40/41/

If it is conceded that [redacted] the location of NIIEG was inaccurate for whatever cause, it is conceivable that STI was shifted from Gorodomlya Island directly to the city of Kirov without an interim period of activity in Kuibyshev, or with only a short stay, at best. [redacted] 51/





[redacted]

[redacted]

The site of operation within the city of Kirov and the duration of NIIEG's activities present other critical problems which have not been completely resolved. With respect to the first, every indication points to NIIEG's occupancy of research facilities of the Scientific Research Institute of Epidemiology and Microbiology (NIIEM). A NIIEM was organized in Kirov in 1939-40 to supersede the Sanitary-Bacteriology Institute which had existed there since 1917. 41/447/ The NIIEM is a typical laboratory for infectious disease research, epidemiology, vaccine development, limited biologics production, sanitation and allied matters, which emerged during the extensive 1939 reorganization of the Ministry of Health. 40/41/ Thus NIIEM programs are closely related to certain of those carried out by NIIEG in the 1940's. This similarity in research would permit joint use of laboratory space at a time when the destruction of World War II placed a high premium on research facilities. For instance, work on improved vaccines, production methods, and biological drying technology, all openly described in the scientific literature from NIIEG, might readily have been conducted on the premises of the NIIEM, with the more hazardous or security-cloaked experimentation taking place on Vozrozhdeniya Island. This arrangement would provide a plausible explanation for NIIEG's existence, in terms of military interest in disease control, and would concurrently afford the necessary cover for BW-oriented research.

The exact Kirov address of NIIEM as in the case of NIIEG, has not been released in publications emanating from the institute nor in a historical description of the city's scientific establishments. 417/ It is clear from the literature, however, that NIIEM's programs were underway during much of the same period that NIIEG was known to be functioning in Kirov. Work on measles prophylaxis was discussed in 1941 during a symposium held at the NIIEM; 419/ serological studies on glanders were openly reported in 1947 under auspices of NIIEM and the Kirov Agricultural Institute; 421/ and further research on measles and diphtheria immunization appeared in papers from 1950 to 1951. 418/420/ The glanders experimentation shows the possibility of cooperative use of facilities by NIIEM, NIIEG and the Agricultural Institute. In this regard, [redacted] of NIIEG completed drying research on reagents for a serological test for glanders in 1945, a study begun in 1941. 422/ In 1951, [redacted] also published a summary of developments in diagnosis of glanders; 423/ and, in 1947, [redacted] wrote from NIIEG on his observations of allergic phenomena in animals infected with the glanders organism, among other bacteria. 424/ The Agricultural Institute is located at No. 73 Oktyabr'skaya Ulitsa, adjoining an unidentified establishment at No. 53 Oktyabr'skaya which probably housed the NIIEM and in all likelihood afforded joint tenancy for NIIEG. 417/425/

[redacted]



[redacted]

Pages: 63

Exemptions: (b)(1), (b)(3)

[redacted]

It is not known whether NIIEG still exists as an organizational entity, and, if still active, whether it currently is located in Kirov. NIIEG was functioning until at least 1948, [redacted] 1951 marks the last known specific date of operation for this military research organization. 469/ [redacted] 441/

After 1948, openly published scientific articles ceased to emerge from NIIEG, and there is strong evidence that the researchers once prominent in the institute programs have since departed. [redacted]



[redacted]

[redacted]

A gradual curtailment of NIIEG's activities probably took place in the late 1940's and early 1950's. A reorganization of health services in the Soviet Union also occurred during the same period. Much of NIIEG's published work was oriented, either directly or indirectly, toward public health improvement and the welfare of military personnel, and this work was well known to the Soviet scientific community as a whole. NIIEG's undertakings in bacterial vaccine development were cited, reviewed or criticized on many occasions between 1947 and 1958 by writers not connected with the institute. 165/172/250/362/363/402/436/ [redacted] 169/ In addition, NIIEG's endeavors became known through proceedings of various administrative groups during the 1940's. [redacted] a public health commission which convened in 1942-43 to consider the possible uses of the STI anthrax vaccine; and, in 1946, a vaccine-serum commission adopted NIIEG's instructions for manufacture of the tularemia vaccine. 52/623/ During the same year, the Academy of Medical Sciences reviewed NIIEG reports on vaccine technology; [redacted] 624/626/ Discussions of the Scientific Council of NIIEG were even disclosed, in part, in a journal of 1948. 411/ Beyond this, there is a wealth of evidence of cooperative experimentation between NIIEG and institutes of the Health and Agriculature Ministries and industry. An excerpt from a Russian periodical illustrates this very clearly, " . . . During the past five years (1941-46), the Irkutsk and Rostov antiplague institutes and the NIIEG-Soviet Army have joined in the study of tularemia, particularly vaccine prophylaxis with live tularemia vaccine. [redacted] Gayskiy, B. Ya. Elbert, M. M. Faybich, and their coworkers are especially [redacted] 53/173/ [redacted] also received assistance from the "Mikrob" research institute in Saratov in procuring tularemia strains and antiplague serum. 170/625/ As early as 1941-42, STI vaccine studies were conducted on animal farms of the Saratov Veterinary Station. 443/ Data on the effectiveness of this antianthrax preparation were compiled



[redacted]

[redacted]

over the years [redacted] and the Veterinary Administration of the Ministry of Agriculture and subsequently analyzed at a joint session in 1949. 626/ Some of the other experimental products of NIIEG, notably the tularemia vaccine, were undergoing evaluation by scientists of civilian public health agencies in 1948. 413/ Aid given by a team of NIIEG specialists in microbial fermentation and drying technology to the Moscow meat combine in 1944-45 in setting up facilities for penicillin production is another example of cooperative work in which this institute was involved. 358/ [redacted] personnel were associated simultaneously with the NIIEG and some other scientific establishments. [redacted] 412/

Thus, there are indications that NIIEG, despite its military affiliation fulfilled certain functions which placed it in the same general category as the Institutes of Epidemiology and Microbiology (NIIEM) of the Ministry of Health. Biological establishments of the armed forces were sometimes considered the equivalent of NIIEM's. 41/ Changes in program objectives and revamping of the organizational structure which affected the NIIEM's could be expected, then, to modify NIIEG's status in some respects. The close association existing between military medical and civil public health institutes in the World War II period is demonstrated by the fact that all sanitation and epidemiological matters were placed under the jurisdiction of a single State Defense Office at the onset of hostilities. 39/48/627/

After the war, a drastic reorganization of public health services took place, beginning with a five-year plan drawn up in 1947 by the Minister of Health. 628/ In 1948, the Sanitary-Epidemiological Stations were given primary responsibility for hygiene, public sanitation, and related research in an effort to reduce duplication of work and to unify administration of assorted laboratories, dispensaries, and medical detachments. 39/281/282/ During the same period, the Academy of Medical Sciences, founded in 1944, was consolidating fundamental research by incorporating many of the major biological and medical institutes into its organization. 247/ The first phase of modification of public health systems is claimed to have been completed by 1951, although from 1953-55, certain specialized institutions, which had temporarily retained independent status, were finally absorbed into the sanitary-epidemiological framework. 39/281/282/ About 1952, the NIIEM's were also revamped, and those with the greatest capacity for biological production became Institutes of Vaccines and Sera. The remainder were stated to have retained the NIIEM title, specializing in such functions as live vaccine development. 40/ According to 1957 Soviet planning, NIIEM's eventually will revert completely to a purely research mission, leaving process development, production, and quality control of biologics to the Institutes of Vaccines and Sera. 41/ There are indications that the military medical service also underwent a reorganization in the post-war

[redacted]

period, but little is known of the specific changes which occurred among its research institutes. 627/

The realignment of functions which affected the NIIEM's in 1952 probably had its impact on NIIEG as well. The design of production processes for new vaccines, development of equipment for the scale-up from laboratory to large volume production of biologics, and drying technology, all engaged in by NIIEG, are typical problems reportedly taken over by the Institutes for Vaccines and Sera. 432/434/442/491/624/ In subsequent years, additional changes appear to have altered the status of NIIEM's in some localities. That the Kirov NIIEM may have been similarly affected is suggested by a Soviet summary of activities of the All-Union Association of Epidemiologists, Microbiologists, and Infectionists published in 1956, ". . . No branch was organized in the Karelia-Finnish SSR and the branches of Ulianovsk, Kirov, and Dzaudzhikan have discontinued their work." That Kirov NIIEM scientists were former members of the association seems likely, since no other biological institute of its kind, except NIIEG, has been associated with the city.

From 1947 until some time in the early 1950's, NIIEG and NIIEM possibly shared facilities at 53 Oktyabr'skaya Ulitsa in Kirov. Despite the absence of unclassified publications to attest their work, NIIEG's scientists probably continued conventional research on the prophylaxis and therapy of militarily important infectious diseases, a program which supplemented and provided cover for agent development on Vozrozhdeniya Island. The absence of publications on the bacterial forms after 1948, and the familiarity of [redacted] with virus diseases as shown by their administrative and professional positions of later years, suggests that viruses may have replaced bacteria and toxins as the primary research tools of NIIEG during this period. The technology of biologic production which had occupied much of NIIEG's time in the 1940's was probably assigned to other institutes during the reorganization of public health services in 1949-55. With this change in program emphasis and the closing down or consolidation of certain NIIEM's, the installation at 53 Oktyabr'skaya could have been relinquished by NIIEM and NIIEG to other users, and prominent NIIEG researchers transferred. This move cannot be pinpointed by date, but the 1952 reorganization of NIIEM's in the USSR probably marks the beginning of the transition. The reappearance of [redacted] in the middle and late 1950's and the absence in 1957 at 53 Oktyabr'skaya of security measures characteristic of sensitive Soviet establishments strongly imply that the premises were vacated after 1952 and before 1957. [redacted]

631/

The present occupants of the installation at 53 Oktyabr'skaya are still unidentified. There is a strong possibility that expansion of the





[redacted]

[redacted]

Agricultural Institute at 73 Oktyabr'skaya either partially prompted, or followed, the move by NIIEM and NIIEG, as the Agricultural Institute began to expand its curriculum in 1948, and student enrollment reportedly increased from 900 students per year in 1951 to over 1600 in 1957. 417/

The fate of NIIEG after its probable move and the location of the organization which now conceivably directs agent research on Vozrozhdeniya Island are unknown. From detailed information on Vozrozhdeniya received in 1957, 1958, and 1959, the possibility cannot be excluded that BW agent development now takes place solely in the island's extensive laboratory facilities. [redacted] 62-66/69/70/

Military Medical Academy imeni Kirov.-- The Military Medical Academy imeni Kirov in Leningrad is the primary Soviet educational center for military physicians. It offers advanced specialty courses and refresher training and provides extensive research facilities for members of the 50-odd departments, or chairs, of medicine. Doctrine for troop care and employment of medical forces under wartime conditions is formulated at the Academy, and the development and testing of military medical equipment constitute an important part of the program. 43/645/646/ The Academy is said to exercise jurisdiction over military faculties and their research units in various civil institutions of the USSR, these faculties being considered extensions of the Academy. The Academy also serves as a planning and coordinating agency for military organs of the entire Soviet Bloc in matters of defense against biological, chemical, and atomic weapons. 43/647/648/

Much of the Academy's work in the past has dealt with the epidemiology of militarily important diseases: cholera, dysentery and typhoid, brucellosis, and anthrax. 649/ Expeditions from Leningrad were among the first to investigate the newly recognized tick-borne encephalitis viruses in the 1937-41 period. 43/628/650/ While no direct evidence of BW-oriented work was found in 1954, the general applicability of its microbial research to BW led to classification of the Academy as a suspect installation. 649/ The Academy is now the leading Soviet institution for BW defensive explorations and may be involved in certain offensive problems. 45/46/78/83/84/92/651-653/ The lack of a detectable association between the Military Medical Academy and NIIEG long suggested a clear separation of their respective programs. Since publication of vaccine research from NIIEG ceased in 1948, military programs in this field, particularly in aerogenic immunization, appear to have been emphasized by the Military Medical Academy, and the Academy may have taken over certain responsibilities formerly held by NIIEG. Aerogenic vaccine research is a logical sequence to the development of live dry parenteral preparations completed by NIIEG. There are no indications that the Academy is directing test programs on Vozrozhdeniya Island. In 1956, a series of field experiments on controlling fleas by hexachlorane aerosols was carried out by Academy personnel at Tyup-Bogetskiy in the Aral Sea region. The fact that a





[redacted]

[redacted]

"polygon" or a test grid, a field laboratory, and other supporting equipment were established in this desolate area so near to Vozrozhdeniya Island facilities is an indication that the scientists from Leningrad may not have free access to the island proving ground. 410/ On the other hand, the extreme isolation of the field camp may have been dictated by the desire to employ plague infected fleas. 653/ Program scheduling or various other factors also may have precluded the use of Vozrozhdeniya.

Some of the researchers identified in recent years with work of BW interest at the Kirov Military Medical Academy are: [redacted] There are strong indications that U.S. vulnerability to BW has been studied by [redacted] 205/535/537/ Published research from the Academy falls into certain easily recognized categories directly related to BW: aerogenic immunization, combined vaccines, rapid detection of pathogens, biological aerosols, disinfection, and epidemiology of selected infectious diseases. These programs reveal an extensive BW oriented effort to be underway at the Kirov Military Medical Academy and possibly the Academy's resources are already being utilized fully in development of a biological weapons system.

Lisiy Island Branch, All-Union Institute of Experimental Veterinary Medicine (VIEV). -- A branch laboratory of the All-Union Institute of Experimental Veterinary Medicine (VIEV) was established in 1938 on Lisiy Island, Kalinin Oblast, shortly after an official warning to Soviet veterinary organizations to develop countermeasures against antilivestock BW agents. Circumstances surrounding the origin of the Lisiy Island installation, its abandonment in 1941 during the German invasion, and its reactivation in 1944 for foot-and-mouth disease experimentation led to a conclusion in 1956 that the VIEV branch had almost certainly been involved in both offensive and defensive antilivestock BW research. 28/ Lisiy Island's operations apparently included the acquisition of foreign strains of the foot-and-mouth disease virus and possibly included studies on the experimental transmission of the infection in domestic animals. 28/ These operations constitute early steps in the screening of candidate agents; but they are also necessary phases in development of effective vaccines, a vital part of defensive BW. Such effort can actually be construed as either offensive or defensive, depending upon the nature of ancillary information.

Considerable publicity in professional veterinary journals attended the 1938 activation of the branch laboratory and its reestablishment in 1944. Its mission of foot-and-mouth disease research was made known through the same medium. 28/ This action is not consistent with Soviet behavior in withholding any reference to activities on Vozrozhdeniya Island, the Aral Sea test site, and to NIIEG's location and true function. An institute for foot-and-mouth disease studies had been opened in 1932





[redacted]

on Gorodomlya Island, Lake Seliger, some 65 miles from the Lisiy site. 28/35/36/343/ The Gorodomlya institute was taken over by the Ministry of Defense in 1935, reportedly for BW research on foot-and-mouth virus disease among others, from the Scientific Medical Institute of the Red Army in the Moscow area. 17/36/343/

There is no evidence, however, of a professional association between personnel of Lisiy and Gorodomlya Islands during the three-year period of their coexistence. 28/ Nor can a relationship be established between scientists of the Lisiy branch and the NIIEG or Vozrozhdeniya. If Velikanov's microbiological work on Gorodomlya Island after 1935 included foot-and-mouth disease as one phase of Soviet offensive BW studies, there is strong indication that antilivestock experimentation was actually underway by the Ministry of Defense some 3 years prior to Lisiy Island's activation by the Ministry of Agriculture. 17/28/ The lack of known coordination or cooperative research between laboratories only 65 miles apart suggests that programs of two installations, presumably involving some of the same diseases, were deliberately maintained as separate entities. The explanation of Ministry of Defense research on Gorodomlya as offensive in nature and that of the Agricultural Ministry on Lisiy as mainly defensive in scope is plausible.

that foot-and-mouth disease studies have been underway intermittently for years on Lisiy Island. Hog cholera research also has been included in the program. 28/154/401/ The foot-and-mouth vaccine in widest use today in the Soviet Union was developed in 1948

work on Lisiy Island was directed primarily toward immunoprophylaxis of this serious disease rather than to its offensive potential. 28/

German aerial photography of World War II vintage revealed that the VIEV branch laboratory is neither extensive nor impressive.

Even though the laboratory is situated on a wooded island encompassing some 1500 acres, its location near Vyshniy Volochek does not provide the degree of seclusion ideal for offensive BW activities, such as that afforded by Vozrozhdeniya Island in the Aral Sea.

[redacted] 72/154/ [redacted] 65/ This information also demonstrates that adequate facilities for the study of diseases of large animals are almost certainly available on the island and suggests that research of purely offensive design is more apt to be carried out in the isolated Aral Sea laboratories than on Lisiy Island. These various factors leave a clear impression that the VIEV branch installation on Lisiy Island, under direction of the Ministry of Agriculture, is engaged primarily in conventional animal disease control work applicable to BW defense although its contribution to offensive developments, if any, is minimal.

Central Scientific Research Testing Institute of Military Medicine.-- A study of Soviet resources would be incomplete without reference to NIISI-KA, the Scientific Research Testing Sanitation Institute of the Red Army, or, as it is currently designated, the Central Scientific Research Testing Institute of Military Medicine (TsNIIIVM). 42/368/ Although much remains to be learned about this institute, the similarity of its earlier programs to those of the Military Medical Academy imeni Kirov, a recognized center for present day BW defensive research, and the movement of scientists between the two organizations in past years, suggests a close association during the formative stages of BW defense research in the USSR. NIISI's origin can be traced with some confidence as far back as 1927. The Experimental Scientific Research Sanitary Institute of that era became the Military Sanitary Institute (VSI-RKKA) in 1930, with a program devoted to chemical defense, toxicology, and military sanitation. 42/365/366/372/ Another change in nomenclature in 1932 brought forth NIISI-RKKA, the Scientific Research Testing Sanitation Institute of the Workers and Peasants Red Army, the title by which it was known, with minor variations (NIISI-KA) as late as 1943. This was the last year for which publications with the NIISI designation are available. 367/370/371/ In 1932, the results of a 1930 expansion of research to embrace a wide range of military problems became apparent. 42/ Early work (1932) still was concerned with such diverse matters as aircraft cabin illumination, sanitation methods in army units, development of footwear and first-aid kits, and packing of medical supplies. 367/373-375/ By 1935, publications reflected greater effort in microbiology, such as, research on bacteriophage therapy of infectious diseases, improved identification of bacteria in diagnostic procedures, steam sterilization and water purification methods, and development of sanitation equipment. 376-380/632/ During the next several years, much attention was given to the so-called NIISI vaccine for enteric diseases, as well as to practical measures for disinfection, delousing, and control of rodents. 370/371/381-384/ There is also indication that during this period process development for a dry smallpox vaccine was worked out at NIISI [redacted] 250/ The NIISI epidemiologist [redacted]





[redacted]

[redacted] conducted research prior to 1934 on the transmission of foot-and-mouth disease to humans. 761/

A close working relationship evidently existed between NIISI and the Military Medical Academy imeni Kirov in Leningrad. This association probably dates from 1929-30 when, following the redelegation of military medical responsibilities from the Commissariat of Health to the Commissariat of Army and Navy affairs, departments of military sanitation were established at the Academy, and the Military Sanitary Institute (later NIISI) was created. 42/ Research on tetanus toxoid initiated at the Medical Academy [redacted] was completed [redacted] in 1936 at NIISI. 384/386/ This suggests an iterim transfer of programs and scientific personnel to the latter institute and implies that NIISI was not physically a part of the Academy. Vaccine work was apparently discontinued during NIISI's reorganization of 1937 and [redacted] extensive human trials of the new enteric vaccine in 1937-38 from the All-Union Institute of Experimental Medicine (VIEM). 355/386/

No details are available on the post-1936 research at NIISI, although vaccine experimentation appears to have been de-emphasized. The relatively few published papers denote primary interest in improving sanitation and medical facilities for troops in the field. 371/382/387-389/ The most recent references to TaNIIIVM's activities imply that current programs are much the same, with the important addition of studies on radiation sickness. 368/461/760/ Sanitation and epidemiological matters were also under way at the Kirov Military Medical Academy in Leningrad during the 1930's, perhaps accounting in part for the apparent association, and in some cases cooperation, between NIISI and the Academy. 384/390/ Still other organized groups, even less well known than NIISI, conducted similar undertakings in military sanitation and medical fields during the same period, denoting that problems of this general type were attacked on a broad front by a multiplicity of laboratories under Military Sanitary Administration auspices. 42/368/396/ Among such institutes were the Scientific Research Laboratory of Sanitary-Chemical Defense, the Medical Institute [redacted] and the Aviation Scientific Research Sanitary Institute. 42/391/392/

Intelligence interest in NIISI and the other sanitary institutes, aside from the early association with the Military Medical Academy, hinges mainly on the supposition that these institutes comprised an organizational complex in which the Sanitary Technical Institute (STI), the predecessor of NIIEG, was an integral part. [redacted] 342/ Previous discussion

[redacted]

of the transition of NIIEG from STI pointed to the latter's probable origin in Gorodomlya Island in 1936-37. Although substantiating data are lacking, it has been postulated that STI may have been formed first at NIISI in 1936, the year in which STI scientists began working together, and that separation from the parent agency occurred during the NIISI reorganization of 1937 to provide a nucleus for the group on Gorodomlya Island [redacted] Evidence linking the scientists of STI (NIIEG) or their specific research projects with personnel or programs of NIISI and other institutes of the Military Sanitary Administration organizational complex has not been uncovered to date, although it is explicit in Soviet writings that both NIISI and STI were subject to some degree of control by the Sanitary Administration. 368/ 396/

The location of the present day TaNIIIVM is unknown; the specific date on which NIISI became TaNIIIVM has not been determined either, but it apparently antedated 1953. 641/ Even the exact site of NIISI's early work has not been determined specifically, although the little available evidence suggests that it may have been the Leningrad area. [redacted] The implication of these events is, first, that NIISI evolved from the State Institute of Medical Education; this is at odds with the earlier discussion which showed from Soviet statements NIISI's immediate predecessor to be the Military Sanitary Institute. The latter may be synonymous, however, with the Sanitary Hygiene Institute by which GIMZ was eventually designated. Secondly, NIISI is very likely to have been located in the vicinity of Leningrad, [redacted]

The redesignation of NIISI as the Central Scientific Research Testing Institute of Military Medicine (TaNIIIVM) parallels a change which began some five years ago in nomenclature of certain Ministry of Health installations. Within major medical institutes so-called Central Scientific Research Laboratories reportedly are being organized as investigative centers, each having a staff of specialists in medical and biological fields for coordinated attack on difficult research problems. Eventually a supporting system of branches located in hospitals and other scientific facilities will follow, if current Soviet planning is fulfilled. 404/ The implication is clear that a similar attempt to concentrate scientific effort may be underway among the military agencies, suggesting that NIISI, now considered a "Central" institute, might be vested with an increasingly varied and more important part in military research relating to biological, chemical, and radiological warfare. [redacted]



[redacted]

[redacted]

[redacted] 42/

Military Veterinary Scientific Research Institute (VVNII-RKKA).--The Military Veterinary Scientific Research Institute, also referred to in Soviet publications as the Military Veterinary Microbiological Institute, was founded about 1925. It originated from what was probably the first organized military veterinary research group in the USSR, the Central Military Bacteriological Laboratory. The latter, known synonymously as the Central Microbiological Laboratory, was established in 1918 to combat the widespread outbreak of glanders among horses of the Russian cavalry. 395/560/637/ Glanders control at that time was the responsibility of the Veterinary Administration of the Ministry of Internal Affairs (MVD), although the Military Veterinary Service of the conventional armed forces joined the MVD in undertaking control measures. These measures consisted of establishing army laboratories; training workers in glanders eradication at the Central Microbiological Laboratory, and later at its successor institute, VVNII; and preparing diagnostic reagents. The VVNII supervised research programs of the district laboratories and served as an advisory organ to the Military Veterinary Administration. 395/637/ Cooperative field work was carried out with veterinary agencies of the Agricultural Ministry in later years, 1934-37, during an investigation of infectious equine anemia. 28/ Few papers are available from VVNII to chart the course of its existence, and none reveals its location. An article on poison wormwood was published in 1942, and a [redacted] published in 1946 on the stability of glanders diagnostic preparations. 558/638/ The last known research appeared in 1949 on standards for tetanus toxoid. 557/ The professional fields of interest of VVNII's [redacted] reveal other areas of probable research activity: equine infectious anemia, bovine pleuropneumonia, equine encephalomyelitis, rinderpest, anthrax, and tuberculosis. 356/559/560/

A veterinary encyclopedia of 1950 refers to the Central Veterinary Scientific Research Laboratory in a manner to suggest that VVNII had undergone a title change prior to that year. 639/ An article on the immunization of horses against hemosporidiosis in 1954 carried the new designation as its institute of origin, but this is the only known publication to date from the Central Laboratory. 640/ It is likely that the move toward "Central" institutes noted in the Ministry of Health and the Defense Ministry's Military Medical administration was extended to the Military Veterinary Administration as well. 404/

[redacted] evidence of large animal



[redacted]

[redacted]

experimentation in the BW field test program and suggest that some aspects of Soviet agent development involve the infectious animal diseases and, thus, require the services of military veterinarians. If a relationship exists between Vozrozhdeniya Island and VVNII it has escaped detection so far. While nothing is known specifically of VVNII's facilities for BW supportive research they probably offered the military seclusion and experienced scientists needed for such work.

Moscow Veterinary Academy.-- The Moscow Veterinary Academy is closely associated with the military veterinary service historically, although its present subordination has not been clearly defined. This Academy was reportedly founded in 1948 from union of the Moscow Military Veterinary Academy of the Armed Forces and the Moscow Veterinary Institute. 560/627/ A Chair of Military-Veterinary Medicine was retained to instruct veterinary students from troop units, and [redacted] 356/560/ It is apparent that the Military Veterinary Academy even prior to union with the Moscow Veterinary Institute, was separate from VVNII, because the two institutions simultaneously published in the open literature. 557/558/562/ From 1949 to the late 1950's, papers describing interests of the Moscow Veterinary Academy appeared infrequently, but the subject matter is pertinent to antianimal BW. [redacted] articles on rinderpest, botulinum intoxication, and methods for rapid diagnosis of hog cholera exemplify this point. 140/562/563/ [redacted] professional fields, that is, animal viruses, glanders, anthrax, also may be reflected in current work at the Academy. 559/560/ [redacted] veterinarian who reportedly lectured on BW to his military students for several years after World War II and who claims to follow the Soviet picture closely stated recently that military academies for veterinary medicine are conducting most of the BW and CW research. 643/ The accuracy of his statement remains to be verified for there are no indications that the Moscow Veterinary Academy is affiliated with the test program on Vozrozhdeniya Island. The Academy presumably possesses resources which could be called upon in advancing antianimal BW.

Military Academy of Chemical Defense.-- The Academy of Chemical Defense, formerly called the Military Chemical Defense Academy imeni Voroshilov, was founded in 1931 as a center of study for officers of the chemical service. 635/ Said to be housed in 20 to 30 buildings on Baumanskaya Street in Moscow, the Academy reportedly offered in the 1940's a variety of courses dealing with chemistry and the technology of chemical weapons and directed a training camp for practical experience with these weapons. 634/ According to a recent intelligence study, the Academy's curriculum now includes all aspects of CBR warfare. 409/ Bacteriology was among the subjects studied in 1941, and BW defensive research was conducted both at the Voroshilov Academy and the Scientific Research Institute of Chemical Defense. 634/635/ The Voroshilov Academy probably





[redacted]

[redacted]

also was among those having facilities devoted to BW experimentation during the same period. 359/636/ There are implications that the Academy was associated with early steps in setting up a BW program in the USSR. Academy graduates probably staffed [redacted] newly designated Biochemical Institute of the Red Army at the time the first BW research assignments were received in 1934. The Biochemical Institute subsequently carried out bacteriological work of undetermined nature and provided a cadre for the Gorodomlya Island laboratories from which [redacted] reportedly directed field testing on Vozrozhdeniya Island in 1936. 17/

No published microbiological work has been found from the Chemical Defense Academy or the Scientific Research Institute of Chemical Defense; however, two references are available to a Scientific Research Laboratory of Sanitary Chemical Defense. [redacted] 391/438/ Whether an affiliation exists among this Laboratory, the Institute, and the Academy is uncertain. There is no evidence of present involvement of the Chemical Defense Academy in BW experimentation, although concepts of biological weapons employment and defense against them are probably considered by its students. 636/ The Academy is one of the military resources that could be utilized in developing a BW weapons system.

The All-Union Institute of Plant Protection.-- Some of the research and agricultural practices being carried on in the USSR are plainly applicable to BW and could be exploited to further a developmental program. The All-Union Institute of Plant Protection (VIZR), Leningrad, was created in 1929 to provide an agricultural insect and plant disease registration service. 682/ It was commissioned in 1935 as the main institute for study of cereal rusts; and in 1949, a herbicide laboratory was added to foster research on chemical methods of crop protection, a move which led to the present day work on two 4-D-type compounds of interest to BW. VIZR's Laboratory of Mechanization of Plant Protection has developed and introduced into production an assortment of sprinklers, dusters, aerosol generators, and similar devices for the mass application of insecticides and fungicides to croplands. VIZR is the most important plant protection institute in the Soviet Union, having primary responsibility for the investigation of crop diseases, herbicides, and aerosols for agricultural employment. 94/682/ Its research on the environmental aspects of plant infection and disease spread is significant from the standpoint of selection and evaluation of anticrop agents. VIZR's chemical control work has been done in association with the Scientific Research Institute of Fertilizers and Insectofungicides (NIIFIF) in Moscow; it has also joined forces with the All-Union Institute of Plant Industry (VIR), Leningrad, for the study of disease resistance in crops. The VIR is in a good position to contribute to an anticrop BW program because of its special function within the USSR as a collector and supplier of foreign

and native crops. 94/ The work which VIR has conducted on disease-resistance is important, because the innoculants used in routine disease-testing are often identical with anticrop agents. Assessment of the vulnerability of foreign and native crops to BW agents could be carried out at VIR with little need for overt security measures. The wide geographic distribution of experimental stations of both VIR and VIZR provides the varied conditions necessary for extensive BW experimentation. In addition, VIR's highly specialized staff of scientists includes agro-meteorologists who could provide the micrometeorological support necessary for such testing.

Vozrozhdeniya Island.-- Vozrozhdeniya Island (45°03'N, 59°12'E) in Aral Sea is believed to have been established as a BW weapons test site in 1936. Although the German World War II intelligence service reported the use of this island for agent dissemination in 1936-37, no satisfactory description of the installations and its facilities was obtained until 1957. [redacted] that a BW field test site probably is in operation on Vozrozhdeniya Island.

Vozrozhdeniya is almost ideally located for BW test purposes. Second largest of a group of over 300 islands, it lies in semi-isolation some 300 miles from the nearest shore of the Aral Sea (Figure 11). 352/496/740/741/ Only two islands, both small, are found in the immediate vicinity of Vozrozhdeniya: Konstantin Island, some 3 miles to the south, and Komsomol'skiy to the northwest, which is a narrow spit of land believed to be uninhabited. Konstantin, on the other hand, probably is associated with the probable test program on Vozrozhdeniya, although the role it plays has not been determined. 65/ [redacted] Barsa-Kelmes Island lies northeast of the proving ground in the direction of the city of Aralsk, probable supply point for Vozrozhdeniya Island. 63/ Barsa-Kelmes reportedly became a wildlife sanctuary in the early 1950's, and a militia post of the MVD is also said to be housed on this island. 352/ The Aral Sea is situated in the midst of a sparsely populated semidesert region, but its waters sustain a vigorous fishing industry, among other enterprises. 352/ 495/740/ Processing plants, canneries, and fish hatcheries found along the shores of the Sea support this industry. Small shoreline and island settlements provide villagers for the fishing fleet, reported to number about 80 commercial vessels of 10 to 80 ton displacement. 66/352/ A steamship line offers scheduled transportation between Muynak Peninsula at the extreme southern end of the Aral Sea and Aralsk (46°48'N, 61°40'E) on the northeastern shore. Assorted smaller boats and barges also ply the waters between Aralsk and the delta area around Muynak (43°44'N, 59° 00'E) where hydrological projects have been under way for several years. 66/352/ Air travel is made available by civil airfleet bases at Muynak, Aralsk, and Nukus (42°29'N, 59°38'E). 66/352/ Meteorological assistance to the fishing industry is reportedly supplied by island weather stations in communication with a center at Alma-Ata. 352/ In view of these varied

[redacted]

activities, it is not surprising that a restricted travel zone has been established around Vozrozhdeniya Island. The island has long been known by the local populace as a prohibited area. 62/64/66/ Inadvertent trespassers, usually storm-wrecked fishermen, have allegedly received rough treatment and lengthy interrogation. 64/66/ The island is shown as a port of call for water transport in 1958 maps, although actual schedules are not known. There are indications that aircraft overflights are banned. 495/ [redacted] 66/494/

The installation on Vozrozhdeniya Island is clearly under armed forces jurisdiction [redacted] Identity of the military forces in charge has not been established. There are barracks on the island which could accommodate up to approximately 1,500 civilian or military personnel.

Earlier intelligence reports indicated that the Soviets were conducting BW tests there. [redacted]



[redacted]

Pages: 79

Exemptions: (b)(1), (b)(3)

[redacted]

[redacted]

For some years, speculation and minor evidence pointed to the city of Aralsk as a probable supply base for operations on Vozrozhdeniya Island.

[redacted]

Irregularly shaped Vozrozhdeniya Island measures some 17 miles long at its longest point and 10 miles wide at its widest point. Approximately 60 square miles are useable. Several observations can be made on the adequacy of this island installation for testing BW weapons; on geographical and environmental limitations imposed on various types of testing; and on the probable categories of weapons which might have been employed in tests.

[redacted]

65/ Vozrozhdeniya's comparative isolation in the Aral Sea, the extensive expanse of water downwind from the island, and the surrounding desert regions provide considerable latitude in the type of weapons which can be studied. Local climatic conditions are influenced by both the desert and the sea, leading to extremes of temperature, humidity, and cloud cover, each a factor which affects BW agent viability. 63/496/ This situation is fortuitous in the sense that agent effectiveness and munition performance can be evaluated under a wide range of environmental conditions. The extremes encountered on Vozrozhdeniya do not preclude the testing of biological materials on a year-round basis, although summer dust storms and winter blizzards may halt operations for limited periods. 63/496/ Thus, no natural restriction on employment of agents against man and animals is imposed; bacteria, toxins, viruses, and rickettsiae, or their orthropod carriers can all be studied. However, the island is not suitable for the study of anticrop biological agents. The clay soil, which supports only sparse growth of native flora,





[redacted]

[redacted]

and the scanty annual rainfall, only 4 to 6 inches, make cultivation of host plants virtually impossible without extensive irrigation. 63/496/ Although fresh water wells are probably found on Vozrozhdeniya, the supply of sufficient water for irrigation of other than small garden plots would pose a formidable logistics problem. There is no evidence that anti-crop agents or weapons have ever been used on the island.

Other than its various effects on the test program, the climatic and geographic environment of Vozrozhdeniya presents other logistic burdens if a complement of 1500 persons and large numbers of experimental animals are to be supplied adequately. Housing for troops and animals, supply warehouses, maintenance shops, fuel dumps, and vehicle storage sheds would have to be furnished. The animal pens and fenced enclosures suggest that large domestic animals are utilized in the program, adding a requirement for considerable quantities of hay and fodder which the island cannot produce. Aralsk, 130 miles away, has been mentioned as the mainland depot for Vozrozhdeniya, furnishing materials, equipment, and animals for the test program. 63/65/ The Aralsk airport may conceivably be used to receive supplies destined for Vozrozhdeniya, although no evidence to that effect is available. That the island, itself, does not have an airport means either helicopter or light aircraft and/or water transportation is employed. Almost any spot on Vozrozhdeniya would permit the landing of supplies and personnel from light planes and helicopters. 63/65/

[redacted]





[redacted]

Pages: 82

Exemptions: (b)(1), (b)(3)

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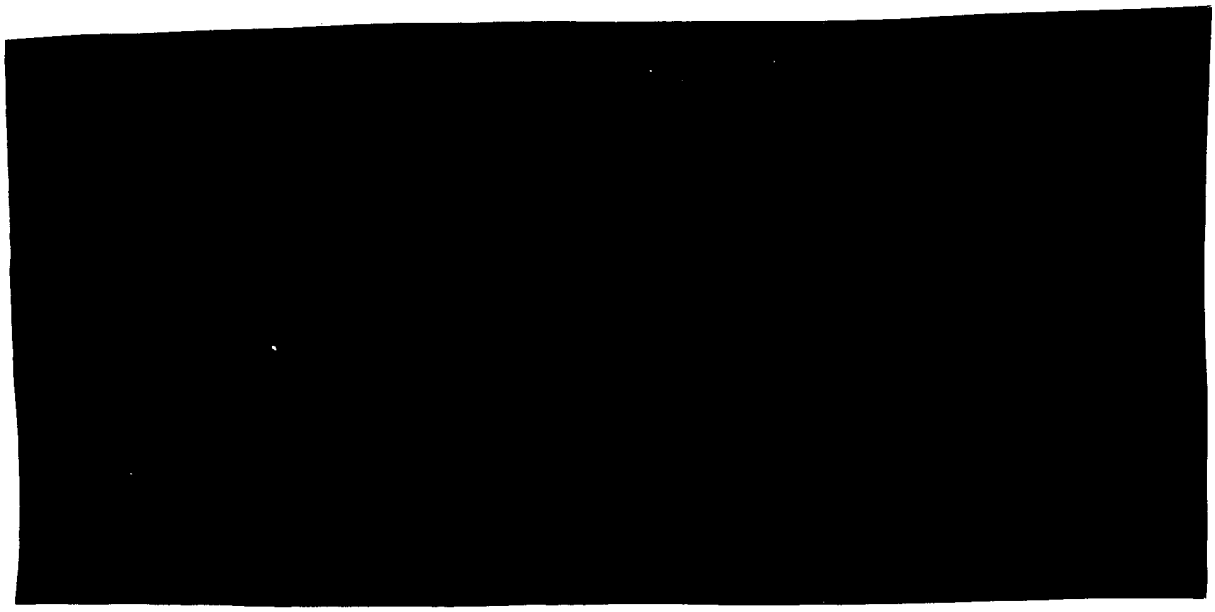

Vozrozhdeniya Island has a potential for self-sufficiency as regards BW research, development, and testing. The necessary physical plant is present: administrative offices, animal facilities, laboratories, proving ground, and the personnel and materials to conduct the various programs. It seems likely that agent production in the relatively small quantities needed for experimental purposes is accomplished on Vozrozhdeniya itself. BW agents in amounts required to arm clandestine dissemination devices could be propagated in such fashion, but the island is not a major production site.

[redacted] 65/ Meteorological support for field tests could come from routine broadcasts of weather stations in the area, supplementing atmospheric observations made on the island. It is conceivable that most current Soviet BW activities are accommodated on Vozrozhdeniya and Konstantin Islands. Large-scale agent and weapons production are important exceptions. Fifteen hundred personnel would appear to be excessive for field testing alone. It may be that screening of BW candidate agents, laboratory development of those selected, design of prototype weapons to disseminate them, and related phases of the program are conducted exclusively on these Aral Sea islands.

Vozrozhdeniya has been mentioned [redacted] as sheltering chemical laboratories [redacted] 62/64/66/ In no case did the statements include specific evidence; rather, they appeared to be based solely on rumor or fleeting impressions. [redacted] Chemical



[redacted]

[redacted]

procedures and equipment are often a part of microbiological research. There is no reason to question the suitability of Vozrozhdeniya for other types of testing, chemical warfare (CW) testing in particular, because many similarities are found in field experimentation with airborne biological and chemical agents. Nonetheless, the island has never been connected with other than BW activities. Fishing villages were abandoned and their activities discontinued before the island was taken over for BW purposes.

Biological Warfare Agent Production Facilities.--No Soviet facility specifically designed for mass production of BW agents is known today. A single plant for propagation of several different infectious microorganisms would not be easily managed from the standpoint of safety; hence, it is considered likely that the USSR, rather than invest in one large installation, would employ smaller separate establishments, each to produce a specific agent. Because of security considerations, production for BW purposes is also apt to be superimposed on pre-existing plants known to be turning out conventional biologics or antibiotics. Because the cost of converting antibiotic plants to production of infectious material is generally high, bioplants and other facilities under the Ministries of Health and Agriculture probably offer the greatest potential in this regard. 223/ The Soviet military forces are not known to maintain any installations suitable for agent production in quantity.

NIIEG was not believed to be equipped for large-scale production, but the methods which it devised were utilized for live vaccine production by other agencies. 432/623/ During the mid-1940's, over 40,000 liters of NIIEG's anthrax preparation were reportedly produced within a 2-year period by the Kashin bioplant and others, demonstrating the capacity available if such facilities are exploited. 52/442/ In fact, Soviet live-vaccine achievements show that little difficulty would be experienced in producing pathogenic bacteria in quanitities sufficient for overt BW employment on almost any scale desired, but the capability for virus and rickettsial mass propagation is believed to be limited by reliance on egg-embryo methods. 116/143/ Fermentors of 15,000-gallon capacity have been introduced into industry in the USSR, but there are indications that standard biologics, even the live bacterial vaccines, are still produced by a series of small-scale operations in the bioplants. 227/ 332/333/ This suggests that heavy equipment necessary for efficient production is in short supply.

Live vaccines, whose manufacture differs in only minor respects from that of virulent BW agents, are currently prepared in Ministry of Agriculture establishments under auspices of the Veterinary Administration's Central Scientific Control Institute of Veterinary Preparations; 332/631/ the Ministry of Health also possesses an extensive system of production sites, including 15 or more Institutes of Vaccines and Sera supervised





[redacted]

[redacted]

by the State Control Institute of Medical Biological Preparations in Moscow. In 50 Institutes of Epidemiology and Microbiology, production is still carried out to varying degrees. 40/41/235/250/631/ Whether one or more of these sites has been earmarked for current military use is not known. [redacted]

Personnel Implicated in BW.--Among its resources for biological weapons developments, the USSR can count on an impressive number of military physicians, microbiologists, and veterinarians whose published works reveal the requisite proficiency for BW experimentation. Civilian scientists from various fields provide additional support, a fact illustrated by representative research compiled in appendix A. Relatively few individuals have been directly implicated in the BW program. Some 70 scientists, technicians, and administrators are linked to offensive phases through association with the Scientific Research Institute of Epidemiology and Hygiene in Kirov. In many cases the technical specialty of these persons is obscure because their affiliation with NIIEG is known only through group awards and prizes given during the 1940's. 430/431/438/ The list of NIIEG members probably reflects a developmental team comprising specialists in microbial laboratory research; the technology of production; agent field testing; instrumentation; and administrative chores, such as finance, logistics, and personnel matters. Whether this team is still largely intact is not known because certain key researchers are no longer identifiable with NIIEG, among them, [redacted] 175/397/

Research on defense against BW, and possibly on certain facets of the offensive program, is the province of a large staff of the Military Medical Academy imeni Kirov in Leningrad. Some 50 microbiologists are engaged in important studies on biological aerosols, equipment and techniques for detection of pathogens, combined vaccines, aerogenic immunization methods, and the epidemiology of little known infectious diseases. Some of the most significant work is led by scientists [redacted] associated in past years with the military institute, NIISI, now designated the Central Scientific Research Experimental Institute of Military Medicine. [redacted] former NIIEG members, are now affiliated with Medical Academy programs. 532/570/ Several figures on the faculty of the academy have authored articles on BW, [redacted] have recently



[redacted]

written a series of papers on vaccination procedures, the civil defense structure, and rapid detection methods in the United States and appear to have analyzed Western publications relating to BW. 9/205/535/537/ This suggests that a study of U.S. vulnerability to biological attack is under way at the Military Academy in Leningrad.

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[redacted]

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[redacted]

[redacted]

[redacted] 815/

Status of Agent Research

Role of NIIEG (Bacterial BW Agents).-- The Scientific Research Institute of Epidemiology and Hygiene (NIIEG) is best known in the Soviet literature for its contribution to the development of live, dry vaccines against anthrax, plague, tularemia, and brucellosis. 624/ This emphasis led to a belief in intelligence circles that microbes of the four diseases have been given primary consideration as antipersonnel BW agents in the USSR. 18/ All information bearing on this subject today attests to the soundness of the 1956 position as it relates to those specific pathogens. It seems probable, however, that NIIEG's program was more diversified than previously realized; with additional information now available for study, the scope of the institute's activities can be seen in sharper perspective.

Vaccine development would afford a plausible explanation for NIIEG's existence and, at the same time, serve as a cover operation for agent testing on Vozrozheniya Island. The major steps in perfecting a live vaccine are very similar to those involved in tailoring a microorganism for BW employment, that is, selecting strains, determining optimum growth conditions, devising the equipment and culture media for large-scale propagation, and defining methods of harvest and storage. Simultaneous programs of agent and vaccine development are entirely feasible, and data acquired from one are generally applicable to the other; therefore, the published vaccine work from NIIEG serves as a rough measure of progress in agent research, particularly with regard to bacterial pathogens. Preliminary screening of plague cultures by NIIEG began in 1936, [redacted] initial selection of anthrax strains in 1940. 37/436/441/ By late 1941, the STI anthrax vaccine was undergoing animal trials in the field; reference Soviet literature to "manufacture" and storage of a plague vaccine by NIIEG in the same year has been noted. 37/443/ These actions suggest that plague and anthrax were probably the first bacterial diseases selected for full-scale development. The introduction of Pasteurella tularensis apparently came shortly thereafter, for progress in drying the organism was reported as early as 1942. 432/ An experimental tularemia vaccine was placed in storage for quality control tests in 1944; by 1946, process technology had been worked out and evaluation of the product was under way in human volunteers. 170/623/





[redacted]

[redacted] began studies prior to 1940 on the pathology of Brucella strains, but only three additional articles on brucellosis have been found in NIIEG's literature: [redacted] 678-681/683/ That fewer articles on this disease reached the open literature suggests either that brucellosis was not as thoroughly studied by NIIEG's scientists as plague, anthrax, and tularemia, or else more difficult problems were encountered in its development, yielding less finished research to report before all publication stopped in 1948. [redacted] 169/ From other Soviet sources, it is clear that a live, dry vaccine was eventually formulated for use in animals, if not humans. 624/ Official Ministry of Health instructions for the manufacture and control of this product have been distributed. 333/ By 1946-47, the four bacterial vaccines and, by analogy, the agents of anthrax, tularemia, brucellosis, and plague had successfully undergone phases of screening, laboratory evaluation and process development preparatory to mass production of viable, dried preparations. That this work was largely completed within a decade is an impressive accomplishment. When the other programs which were under-way simultaneously at NIIEG are considered, there is every reason to suspect that the institute's complement of workers was substantially larger than the 70 so far identified. Only 20 of these are known from their publications to be leading researchers; yet, in addition to vaccine technology, several other diverse problem areas were dealt with. Among them were epidemiology; 414/ penicillin fermentation; 358/491/aerogenic immunization; 37/ chemotherapy of infectious diseases; 625/ pathology of the infection process and bacterial intoxication; 415/679/ and techniques for rapid detection of pathogens. 38/412/ Little of the actual agent research is spelled out in NIIEG's papers, even though the BW characteristics of plague anthrax, brucellosis, and tularemia presumably were under study concurrently with the development of vaccines against them. [redacted] in 1947 that NIIEG's research had application beyond production of vaccines and that this secondary application had military implications. 346/ There is sufficient evidence to denote probable emphasis on properties of the bacterial pathogens in the dry aerosol form. NIIEG is known to have developed by 1947 a freeze-drying unit which bears the institute designation. 434/ Tularemia and plague organisms were reportedly among the first to be tested on Vozrozhdeniya Island. Infection of animals with plague via the lungs in [redacted] was recorded [redacted] although this aerosol chamber has never been described. 625/ On other occasions the protective power of the plague and tularemia vaccines was noted against exposure through the lungs to "pulverized suspensions of virulent culture." 37/170/ The joint effort of NIIEG and the Rostov and Irkutsk Antiplague Stations during the 1940's also involved pathological studies of pneumonic plague and "primary tularemia pneumonia," almost certainly yielding data important to NIIEG's program. 53/171/236/265/

Research of the 1950's was still concerned to some extent with respiratory infections caused by plague and tularemia, as exemplified by immunological, pathological, and therapeutic studies in Ministry of Health laboratories. 207/573/578/597/ The four diseases emphasized in NIIEG's experimentation, are among those regarded by Soviet scientists as most probable BW agents; 9/347/ they are also the illnesses against which current aerogenic immunization and polyvalent vaccine development programs are primarily directed. 254/267/573/ Thus, many indications point to intensive Soviet development of their BW potential at NIIEG, a program which probably culminated in a well-defined technology for large-scale production by the middle or late 1940's. The degree of success attained in capturing within the finished product essential BW agent properties of virulence and stability under conditions of dissemination is not known.

There is ample evidence of attention by the Kirov scientists to microorganisms other than those described so far. Work on unrelated bacteria, bacterial toxins, and viruses is reflected in the literature from NIIEG and in the publications of investigators associated at one time or another with the institute. [redacted] proposed in 1946 that NIIEG's dessication methods be applied to development of a live, dry tuberculosis (t.b.) vaccine. 411/ Reports, which reached print in 1948-49, show that a vaccine carrying the NIIEG designation was subsequently prepared from the BCG strain, an avirulent form, and that its immunological effectiveness was being evaluated. 411/434/684/ Nothing is known of NIIEG's work on the organism itself beyond [redacted] on bacterial allergies that animal infectivity studies had been conducted with t.b.; this suggests screening of its possibilities as an agent. 424/ The apparently successful application of drying techniques to t.b. microbes in quantities sufficient for live vaccine use indicates that the method is probably also adequate for preserving living virulent cells; but whether t.b. underwent the full-fledged development visualized for plague, anthrax, tularemia, and brucellosis is still equivocal.

Malleomyces mallei, the etiologic agent of glanders, was studied by the NIIEG group; M. pseudomallei, a related organism which causes melioidosis, possibly also was investigated. [redacted] 421/424/ At the time of the Communist Party's rise to power, epizootics of glanders

ravaged the equine population, and an extensive eradication program was undertaken by the military veterinary service; 395/639/ this move led to establishment of the Military Veterinary Scientific Research Institute of the Armed Forces. Its staff investigated glanders, among other animal infections, at least until 1946, despite Soviet claims that the disease had been eradicated at a much earlier date. 343/395/558-560/ Melioidosis is said not to occur in the USSR, although there is substantial evidence that its epidemiology has been explored. 343/ Considerable information on glanders and melioidosis useful to BW has been gained by Soviet scientists. The viability period of the organisms in soil, water, body exudates and excretions, and cadavers is known; transmission routes of M. pseudomallei to humans from rodents and arthropods have been studied; and statements to the effect that infection can occur through the respiratory passages suggests investigation of that aspect. 347/613/724/ In addition, the two diseases are included in Soviet listings of probable BW agents whose use by aerosol can be expected. 9/347/716/ There is no evidence that NIIEG undertook a vaccine program on either microorganism; [redacted] stated in 1947 that nothing new on glanders prophylaxis had been forthcoming in 15 years. 169/ It is a matter of conjecture to what degree mass propagation and preservation techniques worked out for the other bacterial pathogens at NIIEG were applied to glanders or melioidosis, but [redacted] animal infectivity studies on M. mallei are consistent with agent screening and, possibly, the laboratory evaluation stage. 424/ A recent Soviet review of melioidosis took cognizance of BW-related research on this disease in the United States and set forth problems to be solved in establishing a defense against its employment as a weapon. 724/ Among the tasks enumerated were the application of fluorescent serological techniques to rapid diagnosis, development of an aerogenic vaccine, therapeutic provisions for respiratory and radiation-complicated infections, and deep-vat cultivation methods for volume production of the organism. If this review furnishes a valid picture of the state of knowledge of melioidosis in the USSR, the development of M. pseudomallei as an agent has not advanced far. It is unlikely that a public health writer, as was the reviewer in this case, would be fully aware or progress in offensively oriented work; but his recognition of the serious gaps in defensive information possibly indicates a low order of research in general, because the intensity of effort in offensive and defensive BW investigations is often parallel.

NIIEG's staff apparently maintained a nominal interest in two other bacterial species, the diphtheria and typhoid fever microbes. While diphtheria may have been investigated more in connection with studies of its toxin, [redacted] implies that the organism was examined in its own right. 685/ [redacted] published from NIIEG on the properties of a polysaccharide-lipoid antigen fractionated from the typhoid bacillus, ostensibly related to the search for an improved immunizing agent. 424/ His findings were later exploited in attempts to devise a technique for

[redacted]

rapidly identifying the typhoid and related enteric organisms [redacted] 38/412/686-688/ This research not only demonstrates Soviet concern with enteric infections as BW agents to be used against the USSR, but raises the possibility that typhoid may have been among the diseases whose offensive potential was evaluated. [redacted]

The typhoid organism does not produce a toxin in the accepted sense; but the marked emphasis in NIIEG's publications on the mechanism of allergic reactions to typhoid antigens, as well as to the true bacterial toxins, suggests the possibility that interest lay in isolating from Salmonella typhosa a toxic fraction, or endotoxin, analogous in systemic effects to the well-known exotoxins elaborated by certain other bacteria. 415/424/691-693/ The enteric group has not been considered by Western scientists to be useful for BW purposes, but typhoid and dysentery are two diseases, among others, against which the USSR believes defensive measures should be developed. 9/347/ They and the paratyphoids are also among the infections allegedly disseminated during the Vozrozhdeniya Island field trials of 1937. 17/ With a few exceptions, work on these diseases reported in Soviet journals is not strongly suggestive of either an offensive or defensive support program. An article submitted for publication in 1948 described one of the earliest recorded investigations of an aerogenic vaccine. It pertained to immunization by administering typhoid vaccine and dysenteric toxin through the lungs. 694/ In 1959, Soviet veterinarians employed aerosols of representative paratyphoid species to infect sheep, calves, mice and rabbits, establishing in some instances an enhanced susceptibility of animals to these organisms by the respiratory route. 589/ 591/ In parallel experiments by members of the same group, fluorescent antibody techniques were used to detect typhoid and paratyphoid contamination of meat products from artificially infected animals. 218/ Typhoid microorganisms have also been utilized in exploring tagged antibody procedures for identifying pathogens in military surroundings. 581/ Other serological tests, carbohydrate fermentation, and physical separation methods have been adopted experimentally in recent years, particularly by armed forces workers, for quickly detecting typhoid, dysentery, and the paratyphoid microbes. 14/483/531/ The effects of radiation on immunity to paratyphoid diseases is another matter of recent concern. 273/ Despite this flurry of activity, there is no firm evidence to date that the enteric bacteria have been chosen for offensive BW development in the USSR; but it appears likely that they have undergone some form of agent screening.

[redacted]

Bacterial Toxin BW Agents.-- At least one of the bacterial exotoxins was studied by NIIEG, but whether other substances in the same category were investigated is not yet clear. [redacted]

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Political refugees from the Soviet Union contend that botulinum toxin was one of the earliest candidates for agent development, chosen primarily because of its potential effectiveness by ground, air, or water dispersion. 29/343/ Unconfirmed reports state that a purification process and suitable disseminating media were two major problems encountered in the preliminary investigations; by 1940-41, studies on agent properties were allegedly in progress and the toxin was purportedly being stockpiled. 5/29/ [redacted] director of Soviet BW research in the mid-1930's, established an extensive program of botulinum



[redacted]

[redacted]

prophylaxis and therapy between 1929-33. 17/343/ His work is still cited by present-day Soviet authors. 140/260/ [redacted] is said to have seen 227 cases of botulinum intoxication in humans, and his computations on comparative fatality rates among treated cases and untreated controls are one of the few hints of suspected human experimentation related to BW in the USSR. 343/

Botulinum toxin and the other exotoxins produced in tetanus, diphtheria, gangrene, Staphylococcus food poisoning, Stachybotrys intoxication, and some forms of dysentery offer hypothetical advantages as BW agents. Because they are not communicable, their employment can be visualized in tactical military situations for which the infectious diseases are ill-suited because of the hazard from the natural spread to the armed forces which use them. Within certain time limits, the duration of toxicity can be controlled by readily available decontamination equipment or environmental degradation processes. The most serious drawback to BW application of the toxins, as a group, is their unknown degree of effectiveness when introduced into the body by other than a natural portal of entry, e.g., toxicity when inhaled as an aerosol. There are many indications, however, of Soviet concern over the possible use of these substances, especially botulinum toxin. 9/ The latter is almost invariably discussed in BW defense training literature on agents. Military researchers have instituted an aerosol program for the avowed purpose of evaluating ". . . immunity in humans against respiratory infections with botulinum and other less effective bacterial poisons." 542/556/ Among the factors which suggest a strong Soviet defensive, and possibly offensive, interest in botulinum toxin as a BW agent are the search for rapid diagnostic techniques and polyvalent botulinum toxoids and antisera; 140/260/264/527/ the reported plans for immunizing contingents of the population against botulism; 233/259/ and the aerosol work. 78/83/ 91/262/

Soviet authorities on botulinum poisoning state that the toxin produces illness following administration under the skin, orally, and via the respiratory system. 140/ Reference has been made in Soviet literature to a human patient with pulmonary botulism. 696/ Studies on active and passive immunity to airborne toxins at the Military Medical Academy imeni Kirov show that inhaled botulinum toxins type A and B cause fatal intoxication in mice and guinea pigs; in these investigations the possibility of death from orally induced disease cannot be completely ruled out. A higher level of active or passive immunity was found to be needed for protection against respiratory exposure than for parenteral routes of entry. 542/556/ In nature, the oral intake of toxin is responsible for most cases of botulinum poisoning, but Soviet writers note that experiments have demonstrated "wound botulism" in man. 140/ [redacted] 697/ It has been claimed that toxicity



[redacted]

is several thousandfold more pronounced by the respiratory route than by mouth. 762/ The possibility of initiating disease by combining toxin producers such as the tetanus and gangrene microbes with fragmentation munitions, that is, bombs and artillery shells, has also been described in Soviet writings. 347/ It is considered most likely, however, that toxins would be selected for BW development on the basis of their relative degree of absorption through the lungs in keeping with modern concepts of mass dispersion of toxic or infectious material by air; ingestion, in the case of botulinus or Staphylococcus toxin, would provide a bonus effect. By this criterion, botulinum poisoning would probably be the agent of choice. The effectiveness of airborne diphtheria, tetanus, gangrene, and other toxins is unknown; and little evidence is available of Soviet attempts to determine this factor. Programs comparable to the botulinum aerosol work in Leningrad have not been detected. [redacted] 725/

Hirsch included tetanus among the diseases tested for BW properties by the Gorodomlya Island group in 1937, but he did not specify whether toxin or the intact organisms were used. 17/ [redacted] from the Military Medical Academy in Leningrad revealed in 1958 that for some 5 years they had been evaluating a dry tetanus preparation and other undisclosed toxoids for immunizing animals aerogenically. These workers expressed a belief that aerogenic immunization will eventually be applied to diphtheria, among other human and animal diseases mentioned. 267/ An attempt was made to protect against Shiga dysentery by administering toxin through the respiratory tract. 694/ Combined toxoids under development in the USSR for parenteral use generally include, but are not limited to, components for tetanus, diphtheria, and botulinum; [redacted] 140/259/ The claim is made that production methods were successfully completed in 1958 for unidentified tri- and tetravalent anaerobic toxoids. 250/ Several references pertaining to aerogenic immunization point up the probability that emphasis will be placed on the dry toxoid forms as is the case with the bacterial vaccines. 267/ 480/542/ No data are available on which to judge corresponding Soviet progress in obtaining active, stable toxins. Because the technology of producing toxins and toxoids is similar, partially purified products almost certainly have been prepared as one step in toxoid manufacture, but there is no evidence that the bacterial toxins have been crystallized in the USSR. 211/ [redacted] 693/

[redacted]

The pathogenicity of bacterial toxins as a group has received considerable attention in the Soviet literature; for example, there are signs that botulism pathology came under serious study as early as 1933, with continued present-day emphasis [redacted] 230/480/564/575/696/ In selected instances, the action of toxin mixtures is seen to be under investigation, although details of the work are still lacking. 138/566/ Current experimentation in the USSR on radiation effects on immunity mechanisms and microbial infectivity has been extended in limited fashion to bacterial intoxications. An increased sensitivity to toxins reportedly exists in tetanus, some forms of gangrene, and Staphylococcus poisoning following irradiation. 274/ No comparable data are available on botulinus toxin.

An outbreak of a newly recognized disease occurred in the Ukraine in 1930, resulting in the reported death of some 30,000 horses before control measures were devised. The causative factor, a hemmorrhagic toxin produced on decaying straw used for animal fodder, was finally attributed to the fungus, Stachybotrys alternans (Stachybotrys atra). 343/ Intensive study of conditions for toxin formation and alleged success in extracting and crystallizing the active principle suggested the possibility of Soviet exploitation of the material for BW purposes, particularly since reference to the toxin in scientific publications from the USSR declined markedly after 1948. 56/699/700/ Soviet sources state that the disease is common in humans as well as horses. 488/ Figures on its prevalence are lacking and the manner in which this ailment is transmitted to humans, and its effects, have not been well studied in the West. Ingestion of contaminated cereal grains and the handling of moldy hay are believed to produce human symptoms similar to those seen in horses. 702/ There is no real evidence of development of Stachybotrys toxin as an instrument of BW, although "forage poisoning" was included in a 1940 Soviet text of defense of domestic animals against chemical warfare. 669/

Whereas attempts to cause illness in cattle with the toxin were previously unrewarding, according to Soviet writings, an epidemic affecting 4,000 animals was recorded in the Ukraine during 1958-59. 701/ This extension of the disease, or a variant of it, to cattle under natural circumstances could conceivably prompt an evaluation of Stachybotrys toxin as an antilivestock BW agent; that exploratory research may already have been conducted is suggested by the earlier use of cattle in defining the spectrum of animal susceptibility. The recent literature reveals that work is underway at the Moscow Veterinary Academy on the influence of nutritional factors in toxin elaboration by this fungus. 730/

One other type of intoxication has been described by Soviet military scientists in such a way as to raise the possibility of BW interest. The disease results from infection with Toxoplasma gondii, an intracellular protozoan parasite of animals. In the USSR, the illness is reportedly communicated to humans through contact with the domestic animals or by





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consuming raw animal products; the systemic infection is said to be accompanied by excretion of a toxin which affects the central nervous system. According to Soviet studies since World War II, the causative agent can be transmitted experimentally by ticks or by contact with "all mucous membranes and slightly injured skin." 735/ Whether the organism has been propagated successfully in vitro is not known, but the transmission studies suggest that sufficiently purified cultures are available to carry out extensive laboratory investigations.

Viral and Rickettsial BW Agents.-- Publications originating at NIIEG give no hint of virus or rickettsial research at the institute; yet, certain of its investigators were well grounded in virology, as other articles demonstrate. [redacted] 710/ The transition from bacteriological experimentation to virology is not accomplished quickly; [redacted] Thus, there is indirect evidence that the institute in Kirov was active to some extent in the field of virology. No indications are found of the type of viral or rickettsial organisms with which the NIIEG workers were familiar, other than encephalitis, foot-and-mouth disease and





[redacted]

[redacted]

influenza. It is a reasonable conclusion that such research would progress slowly until after the technology of mass-propagating the bacteria of plague, anthrax, brucellosis, and tularemia was firmly established. It follows that any real emphasis on viral diseases probably came in the late 1940's, and early 1950's, before NIIEG's leading investigators were reassigned elsewhere. Thus, over a span of several years, conditions at the institute were presumably favorable for obtaining data on viral and/or rickettsial agents for use in BW. On the basis of Western experience, the screening of a number of potential agents can be accomplished in the course of a very few years, but development of mass production processes generally take longer than the time apparently available to NIIEG before its postulated reorganization about 1952.

Military elements in the USSR today openly acknowledge little effort in laboratory research which would add measurably to development of viruses and rickettsiae as BW agents. By and large, this work is carried out in institutes of the Health Ministry. 100/ Clinical and epidemiological aspects have aroused military interest for many years, and medical service teams have been in the forefront of programs to combat newly recognized virus and rickettsial infections. The discovery of boutonneuse fever foci in the Crimea in 1936 set off a nationwide survey of certain endemic diseases which to that time had received scant attention. [redacted] from the Military Medical Academy explored the tick-borne neurotropic virus infections and spotted feverlike rickettsioses on expeditions beginning in 1937-38; 34/43/121/628/ during the same period [redacted] studied the epidemiology of viral hemorrhagic fevers; 120/512/ and military veterinarians were investigating the equine encephalomyelitis viruses. 560/ In more recent years, the medical service has given some attention to lymphocytic choriomeningitis, Japanese B encephalitis, and clinically related but ill-defined encephalitides. 323/538/550/713/ The various arthropod-spread virus and rickettsial diseases are still serious problems in the USSR, but much of the actual research on them has been taken over by the health agencies. 250/307/364/521/ In the course of epidemological studies, data have been compiled on possible routes of agent transmission to humans and animals, other than the usual arthropod vector involvement, which could have a bearing on BW planning. "Artificial peripheral infection" of sheep and goats with tick-borne encephalitis has been successfully tried, and the inhalation of contaminated dust or airborne droplets in hemorrhagic fevers, Q fever, Venezuelan equine encephalomyelitis, and allied diseases has been tentatively incriminated in cases of human illness. 341/120/320/322/509/513/520/538/ [redacted] 142/ Attempts are under way to devise reliable diagnostic and prophylactic procedures, to clarify means by which organisms of the tick-borne encephalitis group are distributed in nature, and to understand their biological characteristics and differences in an isolated environment, that is, by tissue culture. 160/215/246/718-721/





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723/ These efforts apparently are not far advanced, notwithstanding the passage of some 20-odd years. Soviet investigations on the less common rickettsioses, viral encephalitides and hemorrhagic fevers, as a whole, are generally felt to be in relatively early stages as regards one or more important aspects of epidemiology, prophylaxis, or therapy. 100/120/133/239/270/ Soviet knowledge of these infections has not apparently progressed to the point that the etiologic agents could be employed effectively in BW.

The possible significance of viral and rickettsial diseases to warfare is recognized in Soviet writings. 100/512/ The viral encephalitides, including Russian spring-summer, Japanese B, and the equine varieties; typhus and Q fever rickettsiae; and psittacosis and yellow fever viruses are classed as likely agents. Influenza, Rift Valley fever, mumps, and dengue are said to be doubtful candidates. 9/347/403/ The incompletely understood hemorrhagic fevers are not often mentioned with regard to BW. Typhus rickettsiae were probably the earliest members of this group to be studied in the USSR. 121/ With the advent of an adequate vaccine and measures for protection of troops against louse infestation, research on this disease had been at a relatively low intensity; recent work apparently relates largely to a search for improved vaccine strains, limited effort to incorporate a typhus antigen into combined immunizing preparations, and evaluation of radiation effects on the experimentally induced disease. 240/473/477/ There is no solid evidence that characteristics of the causative microorganism have been assessed under laboratory or field conditions simulating BW employment.

Q fever is still a public health problem in the Soviet Union, and considerable research was conducted in the 1950's on its epidemiology, notably transmission routes and preservation under natural conditions, and on environmental disinfection procedures. 300/308/317/320/478/481/ The Military Medical Academy has shown a mild interest in combining a Q fever antigen with the NIISI polyvaccine, but nothing suggestive of agent development, or even undue concern with defensive measures, has been found in the case of Coxiella burneti. 253/

The ornithosis viruses supposedly became endemic in the USSR only in recent years, but their study goes back at least to 1948. 507/514/ A center for research on psittacosis and allied diseases has been organized at the Institute of Virology in Moscow, and intensive work on psittacosis virus aerosols is now under way. With the IVK-1 chamber, information on the behavior of infective clouds has been collected, but the extent to which results are exploited for BW experimental purposes is still unknown. Using liquid mouse-lung suspensions and white mice as the test animal, preliminary studies determined such factors as LD50, temperature and humidity effects, particle size range, and optimum exposure time. 503/504/ Techniques and equipment for aerosol sampling were devised concurrently. 503/ Supplemental investigations have been

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conducted on infectivity and growth of the virus in various animal tissues and in tissue cultures; 511/722/ therapy with antibiotics on animals exposed via the respiratory tract; 507/ the relative pathogenicity of different virus strains; 490/ psittacosis epidemiology; 508/514/ and resistance of the microbe to diverse physical and chemical disinfection techniques. 292/ The most recently recorded work purportedly showed that psittacosis virus is released through the respiratory tract during systemic infection in monkeys inoculated intratracheally. 712/ Human infection with psittacosis virus arises most often from close contact with diseased birds, and transmission by air is well established. From this standpoint the aerosol research under way in the USSR goes beyond the practical needs of epidemiology While still consistent with public health interests, the program supplies data obviously pertinent to BW agent development. 82/717/ Because standardization of experimental variables appears to be the prime objective of the aerosol investigations reported to date, the over-all effort is judged to be preliminary, and not yet capable of yielding information translatable to employment of psittacosis virus under field conditions.

Yellow fever virus is a potentially good antipersonnel BW agent which does not occur naturally in the Soviet Union, and evidence is scarce of any extensive research on the disease. Only review articles on yellow fever are found in Soviet scientific literature, although foreign journal data are examined closely by Soviet workers. 347/502/536/ From studies of Western documents, the conclusion has been reached in the USSR that yellow fever virus should be regarded as a probably BW agent whose employment in aerosol form, in addition to transmission by mosquitoes, can be expected. 9/347/403/ Nothing is known of research on the offensive aspects of this virus, and few instances can be cited of defensively oriented work. Only recently have attempts been made to incorporate live yellow fever virus into experimental combined vaccines, and these studies are apparently still concerned with compatability of antigen mixtures. 134/135/ As far as is known today, aerogenic immunization trials have not included this particular virus, although yellow fever is among the diseases for which a successful respiratory vaccine is predicted. 267/ Preliminary investigations of radiation effects on virus infections reported in 1957 included yellow fever, but no follow-up research has been noted. 274/306/ The experimental application of rapid detection techniques, disinfection procedures, and related defensive measures seen in the USSR for other potential agents has not been extended openly to yellow fever; but the recent review articles by military scientists and indications of future research suggest a mounting Soviet interest in this virus as a BW agent. 711/

There is little cause to suspect that agent research is in progress on other representative virus and rickettsial diseases, even though some of the viral forms are receiving a disproportionate amount of investigative effort. Poliomyelitis and influenza fall within this category, probably because of the widespread immunization programs prompted by the appearance



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of Asian influenza and discovery of more effective polio vaccines. The influenza organism probably also serves as a simulant for the more dangerous human viruses in working out techniques and equipment for aerosol experimentation and mass human aerogenic vaccination. 269/ There are several recent instances in which this virus has been utilized by the health agencies to evaluate chamber design, aerosol dispensers, collectors, and detection or disinfection procedures. 200/296/486/506/523/524/ No evidence is at hand that military scientists are similarly engaged in the virus aerosol field, even with influenza, and the work reported so far from public health institutes primarily concerns methodology.

Smallpox virus is considered a logical candidate agent for airborne delivery, but Soviet exploration of the BW potential of this entity is not freely exhibited. Along with some other diseases, smallpox has been singled out for future aerogenic vaccine investigations, implying at least a defensive interest. 46/267/ Little current research is evident with the virus aside from re-examination of conventional vaccine strains and limited efforts by military workers to combine the live antigen with other prophylactic preparations. 245/ 552/

Rabies and the rabies-like diseases are being studied from the standpoint of epidemiology and improved prophylaxis, yielding from time to time information of possible BW value. Strains of viruses serologically related to rabies have been collected in Arctic regions, such as, the "Dikovanie" or "polar madness" viruses. These, along with other little known encephalitides of animals in the far north, offer a reservoir of potentially new agents for exploitation. 324/714/ With respect to rabies, itself, a recent paper described virus penetration of uninjured mucous membranes of the nose and eye in animals exposed to droplets of infected brain tissue. 319/ Research of this type is not known to have a BW objective, although the data could be so utilized. There are no indications at this time that the rabies virus and related organisms have been subjected to evaluation as agents in the USSR.

Unique BW Agents.-- There is no indication of Soviet development of unique biological agents, such as, microorganisms differing markedly, as a result of laboratory treatments, from those of the same species found in nature. Research on live vaccine strains has been directed toward selection of avirulent forms rather than organisms of enhanced virulence. The manipulation of genetic mechanisms to produce a pathogen refractory to the immunity bestowed by conventional vaccines probably does not lie within present Soviet capabilities. Intentional development of microbial tolerance for physical and chemical disinfectant measures is not described in any available Soviet work, although an example of increased antibiotic resistance in plague cultures has been recorded. 231/237/ The simultaneous use of several biological agents to facilitate infection and confuse diagnosis is visualized in Soviet writings; 12/403/612/ in only one instance, however, does the literature reveal an investigation of deliberate mixed





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infection, namely, superimposed brucellosis and Q fever. 715/ Limited research on the physiological action of toxin mixtures was noted previously. 138/566/ While the exposure of animals to combined type A and B botulinum toxin was a feature of [redacted] aerosol challenge work at the Military Medical Academy, the aerogenic vaccinations carried out at that establishment so far have not included mixtures of living bacteria. 268/542/556/ Contemporary research on polyvalent live vaccine is expected to provide information of some value on concurrent infection, particularly with respect to either suppression or potentiation of one disease type by the others; but the absence of the virulence factor in these living antigens is prejudicial to experimental results as far as development of BW agent combinations is concerned.

BW Agents and Ionizing Radiation.-- Considerable emphasis in Soviet writings is placed on ionizing radiation as an adjunct to biological agent dissemination, a factor interpreted in intelligence circles as possibly indicative of research on combined RW-BW weapons. 12/275/612/726-727/ Novel thinking is apparent in the Soviet concept of incorporating isotopes of low radiation levels into living, infectious microbes, [redacted] The combination of biological agents with radioactive substances is no less probable. Radioactive radiation, as recent investigations have shown, does not affect the growth, proliferation, or pathogenic characteristics of the pathogens of various infections. The microorganisms are cultured just as easily on media containing radioactive substances as on ordinary media. It has been proved that radioactive isotopes of chemical elements are assimilated by the microbial cells and enter into the composition of the substances from which the microbial body is built, while not curtailing or altering its vital activity. At the same time, radioactive radiation vitally affects human and animal organisms. Independent of the method by which the organism is subjected to the action of radioactive substances, as a result of external irradiation or the ingestion of them, a sharp reduction in the activity of the natural defense mechanisms, and evidently their barrier functions above all, was noted . . . It is possible that a comparatively small degree of contamination by effect radiation will be sufficient to allow pathogenic microorganisms to penetrate the organism more easily . . ." 612/

Within the past year, the preparation of radioactive anthrax bacilli and influenza virus has been claimed by Soviet scientists. 579/728/ Whether the intensity of radiation in these instances ($S^{35}$,$P^{32}$) is sufficient to depress body defense mechanisms is uncertain. Almost all Soviet work on (i) proliferation of live vaccine strains, 273/ (ii) susceptibility to infection by representative bacteria and viruses 270/ 273/297/306/331/473/ and (iii) the lowering of immunity levels after exposure to radiation has been conducted with total irradiation at or near the lethal dose. 272-274/592/729/ Hence, there is no assurance that the problem has been overcome of combining candidate BW agents with isotopes

which will decrease host susceptibility without impairing microbial pathogenicity. Evidence is totally lacking of any success in combining biological agents with radiological or other injurious materials, such as, chemical agents, as components of a finished weapons system; recognition of the value of such mixtures in warfare is clearly shown in Soviet documents, however.

Fungal BW Agents.-- The potential employment of pathogenic fungi is mentioned infrequently in Soviet BW literature, although on one occasion a writer surmised from his study of the literature that the Western powers maintain an agent development interest in two members of the group, Coccidioides immitis and Histoplasma capsulatum. 9/ Military scientists at NIIEG and the medical academy in Leningrad have not openly exhibited concern with either offensive or defensive problems involving the fungus diseases. There are no indications that specialists in mycology were assigned to NIIEG; moreover, published research from both that institute and the medical academy, although broad in scope, does not disclose any evidence of experimental programs over the years on the medically important fungi. Much the same can be said for the military veterinary agencies, with the previously noted exception of Stachybotrys alternans intoxication. The effectiveness of ccccidioidomycosis, histoplasmosis, and related diseases as BW implements has never been fully established. Because of the low-grade chronic illness usually resulting from such infections, the causative organisms are not considered ideally suited to present-day warfare. There is nothing to suggest that these microbes have been given BW agent status in the USSR.

Arthropod-Vector BW Agents.-- The use of arthropods to disseminate biological agents to humans and animals is well understood in the Soviet Union; measures to combat disease vectors released on the populace, food crops, and livestock occupy a prominent place in BW defense instructional material. 9/11/347/403/609/611/ From the offensive standpoint, unverified reports allege that encephalitis-infected ticks and plague-contaminated fleas were airdropped during field tests in the USSR just prior to World War II. 17/35/ [redacted] Vozrozhdeniya's 1937 BW trials, is known to have been exploring the transmission of tularemia by ticks, mosquitoes, horseflies, and fleas during the same period. 17/146/173/ Confirmation is lacking that this and similar research of the late 1930's was actually sponsored for BW purposes; nevertheless, the accelerated post-1936 public health programs on arthropod-borne diseases by [redacted] undoubtedly provided much background data which could be utilized in selecting candidate vector agent combinations. 121/733/ Methods of mass-rearing representative arthropods and techniques for artificially infecting the larval forms by membrane feeding were perfected in 1942-43. 121/307/326/ This accomplishment permitted controlled studies on flight range and dispersion, viability, and the fate of microorganisms introduced into either

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natural or unnatural vectors. It paved the way for data on the following unusual host-parasite relationships, among others: for the louse, Q fever, tularemia, poliomyelitis, and spring-summer encephalitis; 146/307/326/ for the horsefly, anthrax and tularemia; 733/ for the mosquito, tularemia and spring-summer encephalitis; 146/733/ for the bedbug, plague and typhus; 146/ for the tick, plague and brucellosis; 146/347/ and for the mite, Q fever and tularemia. 146/ Experimental transmission is still under way in the USSR, but current work appears to be directed more toward the role of ticks as carriers of encephalitis, brucellosis, and Q fever. 312/317/ 481/594/719/734/

A compilation of Soviet research of the type equally applicable to public health and BW arthropod problems was included in a recent intelligence report. 146/

Although propagation of various arthropods in the laboratory was a major research objective of the 1930's, little has been learned of Soviet establishments for mass rearing. 326/733/ Visiting U.S. entomologists have had only limited access to these facilities. 732/ From the standpoint of published work, the outstanding organization in this field is the Institute of Malaria, Medical Parasitology, and Helminthology, Ministry of Health, Moscow. 146/ The armed forces are not known to maintain an installation for furnishing arthropods, but the apparent need for considerable numbers of vectors in experimentation at the Military Medical Academy suggests the existence of an internal supply source. 133/410/547/ One phase of the Academy's program provides the only clearly discernible instance of present-day military research possibly relating to the BW use of disease carriers. A series of field trials on flea eradication with hexachlorane smoke was carried out on a "polygon" at Tyup-Bogetskiy near the Aral Sea in 1956. 410/ This work is consistent with the Academy's mission of BW defense, since portable aerosol smoke pots with the limited effective range of those utilized in the tests appear well suited for decontaminating the immediate vicinity of a suspected biological munition. The extreme isolation of the site chosen for these trials also points up the possibility that infected fleas or other arthropods were used, conceivably in conjunction with a delivery device. 653/

There is little evidence on which to predict a Soviet choice of arthropod carriers for BW purposes. Relative research emphasis over the years follows the pattern seen in other nations, that is, mosquitoes, ticks, fleas, horseflies, and sandflies in descending order. 146/ Final selection would probably be dictated by the microbial agents to be employed, but the versatility of mosquitoes and certain ticks in spreading disease suggests that these two would receive strong consideration. Pronounced concern in the Soviet Union with biological aerosols is indicative of primary interest in airborne dissemination; presumably arthropod release of agent would play a secondary role in development of BW weapons. A thorough evaluation of the





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state of Soviet entomological knowledge warranted the conclusion in 1959 that a capability does exist in the USSR for solving the many technical problems involved in such development; 146/ to date, however, there is no firm evidence that vectors of disease comprise a significant part of the BW effort.

Antilivestock BW Agents.-- Estimates written in recent years reflect the intelligence view that BW research in the USSR includes biological agents against livestock. 18/28/ Two animal infections are singled out as those most likely to have been considered, foot-and-mouth disease (FMD) and rinderpest. 18/737/ Several factors were apparently influential in shaping this position: FMD was studied intensely at the Lisiy Island Branch laboratory of the All-Union Institute of Experimental Veterinary Medicine, an establishment whose activities are believed to have been oriented at one time toward BW; 28/ FMD virus was among the first candidate agents investigated on Gorodomlya Island, the directing installation for Vozrozhdeniya's field trials, according to the Hirsch report; 17/ an appraisal of Soviet research on rinderpest concluded in 1954 that much of the effort could be applied directly to development of the causative virus for warfare; 737/ and, lastly, the extreme vulnerability of livestock on the North American continent to FMD and rinderpest was felt to argue persuasively for selection of these diseases. 18/737/ A more recent examination of FMD research in the USSR reaffirmed the earlier position that the Soviet antianimal program probably gives high priority to development of this virus for agent purposes. 738/

NIIEG's agent development program is not known to have considered animal targets, although some of the institute's researchers were officers of the veterinary service, [redacted] 676/ Certain infections which NIIEG explored, presumably from the standpoint of antipersonnel BW, also fall within the antilivestock category, such as, anthrax and brucellosis. The technology of producing microorganisms in a suitable state for use against humans does not vary markedly from that concerned with animal populations, even though the mode of delivery and agent dispersion may differ widely. Hence, some aspects of NIIEG's work conceivably could have supported an antilivestock program. The part in BW, if any, played by veterinarians of the Military Veterinary Scientific Research Institute (VVNII-KA) and the Military Veterinary Academy has not been resolved. [redacted] and other authorities on livestock diseases affiliated with the armed forces veterinary establishment provide a reservoir of knowledge and experience on hog cholera, rinderpest, botulism, glanders, and the equine encephalitides. There is no information to date linking either VVNII-KA or the Veterinary Academy with NIIEG and Vozrozhdeniya Island. It seems probable, however, that any field testing of animal agents on the island would involve veterinarians of the armed services, because the Aral Sea installation is under military jurisdiction. 62/63/65/66/

The expenditure of manpower and resources for veterinary research in the civilian agencies, centered largely in institutes of the Ministry of Agriculture and the All-Union Academy of Agricultural Sciences, appears to be compatible with the disease problems which exist in the USSR today. Major effort is directed toward control of the economically important FMD, hog cholera, anthrax, brucellosis, and Newcastle disease; 175/ a high degree of research capability has been displayed with these infections. 18/ Openly exhibited activity on rinderpest, claimed to have been eradicated in 1927, is now largely limited in the health agencies to production of enough vaccine to maintain a buffer zone of immune animals along the border of countries in which the infection is still endemic. 731/ Exchange delegates from the United States, having toured most of the civilian veterinary research centers of recognized importance in the USSR, found no indication in 1958 of other than legitimate animal disease investigations. 125/154/175/ The current Soviet scientific literature, however, reveals a deepening interest in measures for defense of livestock against airborne microorganisms; a group of veterinarians whose institute affiliation has not been disclosed, [redacted] reported in 1959 a series of experiments on aerosol exposure of small laboratory animals, sheep, and calves to Salmonella organisms in a newly developed plexiglass chamber. 589/591/ This work apparently is designed to check out equipment and techniques preliminary to more extensive studies, probably on highly pathogenic microbes; the paratyphoids employed so far may be considered as simulants for these pathogens. 736/ Some of the same investigators are also applying the latest innovation in bacterial detection methods, fluorescent antibodies, to rapid diagnosis of anthrax and the Salmonella's. 218/590/ This technique is under examination concurrently at the Moscow Veterinary Academy for identification of hog cholera virus. 563/ It is felt to be indicative of Soviet thinking in terms of effective livestock agents that the present experimental aerogenic vaccines for humans will be extended, according to a Soviet prediction, ". . . for defense against other infections of man . . . and of animals, rinderpest, hog cholera, foot-and-mouth disease, tuberculosis . . ." 267/

The existence of animal pens and fenced enclosures on Vozrozhdeniya Island strongly suggests that large domestic animals are utilized in one or more phases of the BW test program. 65/ Swine, sheep, goats, cattle, or horses, for which pens, rather than wire cages, would be required, might serve several useful purposes, even though specific identity of types cannot be made on the basis of presently available information. These purposes include agent infectivity studies; evaluation of effectiveness of munitions or other disseminators; production of small quantities of agent; and production of immune sera, gamma globulin, blood for culture media, and other biologics used in research. Conventional Soviet work on highly contagious zoonotic diseases is conducted without the strict geographic isolation imposed in Western nations; because of the logistics

problems inherent in Vozrozhdeniya's location, the presence of large animals on the island is almost certainly indicative of sensitive experimentation, in all probability related to BW. With the exception of a few diseases, such as, hog cholera and rinderpest, small laboratory animals or mechanical devices are generally satisfactory for aerosol viability and cloud-travel calculations, determining agent dispersion patterns from experimental disseminators, and similar phases of development. Economy of operation would probably dictate use of livestock only in a critical phase, such as final testing of agent infectivity on intended target animals under field conditions simulating actual employment. Accordingly, the presence of large domestic animals might well be indicative that a late stage has been attained in development of one or more zoonotic agents in the USSR.

A firm conclusion regarding the diseases undergoing field trial cannot be reached without knowledge of the kind of animals used, but certain general observations may serve to focus attention on the more likely candidates. Natural host-parasite relationships make certain animals better suited than others for studies on specific diseases; in a few infections only one type of host animal is susceptible. In most cases, however, considerable lattitude is permitted in substituting test animals, since goats, sheep, cattle, horses and swine are susceptible in varying degrees to a multiplicity of potentially good BW agents. Anthrax, hemorrhagic septicemia, brucellosis, Q fever and pseudorabies (Aujeszky's disease), for example, could be studied in either cattle or sheep, and in some instances goats and pigs; sheep and goats are readily infected with the glanders bacillus, even though the organism is ordinarily a pathogen of horses only. Aside from the possibilities inherent in a situation such as this, the presence of swine would point to vesicular exanthema, hog cholera, or African swine fever, since these diseases are not reproducible in typical form in other domestic animals. Likewise, the occurrence of sheep might indicate interest in blue-tongue virus or Rift Valley fever. Cattle would undoubtedly be chosen for experimentation on rinderpest and malignant catarrhal fever for the same reason. The cow is also ideal for experimentation with FMD, although swine, and to a lesser extent sheep and goats, are mildly susceptible. The equine encephalitides in nature are predominantly spread by arthropods to horses. The relative affinity of these viruses for large animals by respiratory exposure, or some other BW-related mode of transmission, is obscure; the susceptibility of various small laboratory animals would probably preclude the use of horses, which, in any event, do not constitute a prime target for antilivestock warfare against the West. Thus, it is obvious that a rather wide range of infectious diseases could be investigated on Vozrozhdeniya Island through proper selection of livestock for agent development, and no clear insight is had into Soviet preferences solely on the basis of agent studies which might possibly be under way.

Animals can be exposed to biological agents by routes other than airborne. Inoculation of fodder, for example, is an effective means of

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spreading disease, especially in clandestine employment. Tissue products from infected livestock are admirably suited to this purpose, since fully virulent microbes, not always obtainable by artificial propagation, are harvested from the natural host animal. Hog cholera, FMD, and rinderpest exemplify the disease states in which infective blood, exudates, and minced organ tissues can be collected in satisfactory yield to provide either material for dissemination or microorganisms for further experimentation. It is interesting that the Hirsch report on Soviet BW noted that blood drained from anthrax-inoculated cattle was dried to furnish an agent fill for biological bombs in the World War II period. 17/ Anthrax spores now can be mass produced for BW purposes without using animal products, but FMD, rinderpest, and hog cholera viruses still require animal tissue for reproduction in virulent form. Artificial tissue culture suffices for propagating some strains of FMD and hog cholera microbes, but rinderpest is not successfully handled by this technique. Egg inoculation is not generally satisfactory for harvesting viruses of any of these diseases. Tissue culture competency in the USSR at present is of a low order, as previously discussed; it seems likely, therefore, that large animals on Vozrozhdeniya would be utilized not only for assessing the virulence of selected agents, but also for production of experimental quantities of the viruses of one or more of the three aforementioned diseases. Existence of livestock facilities on Vozrozhdeniya tend to support the intelligence position that rinderpest and FMD have been given consideration as BW agents in the USSR. These facilities are also consistent with an active interest in the hog cholera virus.

Anticrop BW Agents.-- It was pointed out previously that no evidence exists of Soviet interest in developing anticrop BW agents, even though Western intelligence regards it as "possible" that an anticrop program is under way. 18/60/ Lacking specific information, one must resort to vulnerability concepts in order to predict the course of action which the USSR would probably pursue in agent research. The rationale for this approach is that developmental work would almost certainly entail the planned exploitation of vulnerability of the most important of U.S. crops. In the continental U.S., for example, wheat is considered to be most susceptible to attack from black stem rust and potatoes to late blight. Elsewhere in the Free World there are notable examples of vulnerable strategic crops, such as rubber in the Far East and coffee in Central and South America. In some instances small-scale clandestine attacks are considered to have a highly destructive potential, not only to the crop, but to the entire economy of areas so threatened. In contrast to anti-personnel agents, anticrop agents rely to a significant extent on secondary and tertiary infections for their real destructive effects. This means that exceedingly small quantities may have a far-reaching impact. For purposes of this discussion, consideration is given only to agents which could cause severe crop losses in a relatively short time, usually within a single growing season.





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The biologic nature of the cereal rust pathogens, such as fungi infecting wheat, oats, rye, and barley, is such that they lend themselves ideally to use as agents of biological warfare. Cereal rusts can be obtained readily by growing the pathogens on susceptible cereal plants under ordinary field conditions and collecting the infectious spores with vacuum-type harvesting equipment. Therefore, agent production is limited only by the acreage devoted to it. Further, cereal rust spores are sufficiently stable under ordinary environmental conditions to make storage, delivery, and dissemination feasible. A BW attack employing cereal rusts could be highly damaging to U.S. grain crops if carried out on an extensive scale under optimum conditions. It must be recognized, too, that even a small-scale attack might cause appreciable damage during a period conducive to a rapid build-up of the spore population.

On the basis of the established epiphytotic potential in the United States, several other fungus pathogens are also possible choices for agent development in the USSR. Potato late blight affords a good example; but present control measures available to the farmer and several critical inadequacies of the pathogen as a BW agent make it a far less likely selection than the cereal rusts for operation against the United States. Soviet writings on potato late blight are extensive, indicating that their own problems in control of this disease have not been solved. Work with potato late blight appears less well developed in the Soviet Union than in the United States and the United Kingdom, and Soviet knowledge of its epidemiology is appreciably less exact. An anticrop agent research program probably would include fungus rusts against maize (corn) and cotton, and anthracnose and bacterial blight against cotton. Soviet experience with maize diseases, however, is rather limited. Such pathogens as tobacco blue mold and sugar beet leaf spot are possible but unlikely choices for use against the United States. The very extensive publication in the USSR on cereal smuts is probably a measure of the backwardness of plant protection, and illustrative of continuing trouble with these diseases, rather than an indication of interest in smuts as anticrop agents. Viruses are not considered feasible for attack against crops, at least in terms of their use for quick, decisive operational effects. Much the same is true of insect pests and noxious weeds.

For several years, the USSR has produced highly potent herbicidal chemicals of the 2, 4-D type and utilized them to control weeds in cereal plantings. 152/ Small aircraft are commonly used to disseminate herbicides as small-droplet sprays at low-volume rates comparable to those adopted in the United States for weed control purposes. Although Soviet use of herbicides has been on a much smaller scale than in the United States, there are current indications that considerable effort is being devoted to research on synthesis of new herbicides and to the production and utilization of greater quantities of these compounds. Chemical agents are known to the Soviets which could effectively destroy either broad or narrow-leaved crops.

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While it is doubtful that such materials currently pose a threat to free world crops because of logistical considerations, they could assume real importance in limited war operations. Furthermore, the Soviets are known to have a significant number of agricultural aircraft equipped for the effective dissemination of such chemical materials.

Trends in BW Agent Development.-- Steady improvement, both qualitatively and quantitatively, can be anticipated in most biological fields supporting the BW effort. The implications of this situation are threefold: a more rapid rate of over-all progress in agent and hardware development; refinement of infectious materials already under consideration; and greater variety in the type of biological weapons available for experimental purposes. The pronounced emphasis on virus and rickettsial diseases now displayed in the USSR, both in human medicine and in the veterinary sciences, could bring forth additional candidate antipersonnel and antilivestock agents. The clear intention expressed in the Soviet literature to proceed from bacteria to viruses and rickettsiae in developing aerogenic vaccines, combined immunizing preparations, disinfectants, air sampling devices, and rapid detection and diagnostic methods marks an apparent broadening of interest with respect to the feasibility of employing representative agents from these two pathogen groups. The adoption of modern technology for propagating viruses and rickettsiae was seen to have lagged in the Soviet Union; however, success in the use of tissue culture for the contemporary poliomyelitis vaccine program, and for FMD among the animal vaccines, should intensify, the application of this method to other microorganisms of BW importance, particularly with regard to production in volume.

A broad conjectural view of agent development in the USSR, beginning with the activities of Velikanov's Institute in the mid-1930's, suggests a sequence of steps, or phases, which culminated in the elaborate test program probably undertaken on Vozrozhdeniya Island. During the early years, in the thirties, a preliminary, and perhaps haphazard, screening of potential agents was conducted. Botulinum toxin, one or more of the animal viruses, and several bacterial pathogens of humans were investigated in the laboratory and disseminated in primitive field trials at the Aral Sea installation. With the establishment of NIIEG serious efforts were made to assess the BW properties of selected candidate agents. In what may be categorized as phase I, a variety of infectious bacteria and their toxins were screened for effectiveness in aerosol form against experimental animals. In phase II, a technology was devised for processing large quantities of at least four of these to a state suitable for agent purposes: anthrax, plague, tularemia, and brucellosis. Presumably some, or all of them, were investigated on Vozrozhdeniya Island during this period. In the late 1940's and early 1950's NIIEG's attention was diverted, in a third phase, to screening of potentially good virus agents for use against man; and in this era the institute's scientists gained the experience in virology which enabled certain of them to move subsequently into supervisory positions in virological research establishments. Little significant





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progress was made in development of viral agents before NIIEG was supplanted by a still-unidentified agency whose current program places emphasis on viral and rickettsial forms for use against humans and animals.

At some point in this speculative but plausible series of events, the union of candidate biological agents to dispersing devices was apparently made on Vozrozhdeniya Island. [redacted]

Continued attention to aerosol technology and the properties of airborne pathogens, the recently established programs of systematic sampling of natural air microflora, and the high order of competency in theoretical aspects of the movement of air masses indicate no lessening of emphasis on the respiratory exposure as the primary means of employing BW agents. At the same time, resources for exploiting the arthropod vectors of disease are such that an alternate weapons system utilizing these carriers seems a likely possibility for the future, if not already in being. In keeping with the poor capability of the plant sciences and the low level of medical research interest in fungus pathogens, there is no discernible trend in the USSR toward development of the fungi as agents of human, animal, or plant disease.

## Status of Weapons Development

According to information collected by German World War II intelligence, an investigation of delivery and dissemination methods was begun at about the same time that Soviet research on biological agents got under way. 17/ 35/ These early studies reportedly began with BW agent simulant field trials at Volsk polygon in 1935 and were extended to Vozrozhdeniya Island in 1936-37. Among the several means of releasing infectious material purportedly explored during the period were "fog generators"; aircraft spray equipment for medium and low-altitude attack; contaminated metallic darts for airdrop against troops; arthropod-carrying bombs; and various devices for covert distribution of microbes. Reasonably detailed descriptions are available for certain of these items, but in no case has the actual existence of any of them been substantiated. Pear-shaped aluminum vessels for use on aircraft were designed to hold either 25 liters of bacterial suspension, yielding 10 square miles of aerosol coverage (type BR-1), or 50 liters of dried anthrax spores (type BR-2), area coverage not specified.

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Soviet planning for externally mounted 500-1000 liter containers of the plague bacterium was also mentioned. Beyond this, experimental glass aerial bombs designed either to shatter on impact or to explode above the surface were reported, as were ampoules of dry agent for inclusion in artillery shrapnel munitions. For contaminating water sources with typhoid and cholera, gelatin capsules, ice cylinders, and the so-called TZV-1 tube with an automatic release mechanism were supposedly developed. With the possible exception of a 250-liter BW aircraft belly tank said to have been captured by the Germans and employed in their own tests with simulant agents, apparently none of these weapons was ever observed or examined outside the USSR.

In keeping with Soviet policy of complete silence on matters pertaining to offensive BW research in the Soviet Union, no outright admission of interest in biological weapons has been found in official statements. Tacit admission can be inferred, [redacted] 42/ ". . . The specialists in bacteriological war strive to sow despair and horror and to plunge the peoples of the earth into the Dark Ages with their terrible epidemics . . . they forget that biological war, like atomic war, is suicide for the country that begins it, since the means of bacteriological attack are well known and can in short order be directed against the aggressor who has taken up this terrible sword." [redacted] 739/ In an authoritative book published in 1958 on protection of the civil population in modern warfare, the following assertion was made: ". . . The existence of atomic, chemical, and bacteriological weapons in the hands of imperialists and the threat of their use are causing us to prepare actively for defense against air attack. One of the forms of this preparation is the study by the population of the battle properties of mass attack weapons and of the existing methods of defense . . . at the present time, not only have the military properties of mass attack weapons been well studied, but methods of defense against all modern means of attack have also been worked out." 613/ [redacted] 743/

Soviet writers are thoroughly familiar with the classes of weapons to which BW agents theoretically can be adapted for delivery: aerial bombs and spray systems, balloons, missiles and rockets, portable aerosol generators, mines and artillery, and "diversionary," or covert, equipment. 11/12/347/403/590/607-609/611/744/ In addition, references to large-area-coverage (LAC) techniques have been noted in terms which probably reflect





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Soviet thinking rather than the usual quotations from Western articles: ". . . Up to one ton of infectious material can be sprayed during a single airplane flight;" 347/ ". . . Considering the large volumes of material dispersed at one time (they amount to ten and more tons per operational flight) it will be necessary to prepare quantities in the range of thousands of tons . . . the bacterial or viral suspensions containing millions of active particles per milliliter will be pumped like beer from huge tanks through cooled pipes into the 'camp cellars of death.' From there the selected combination of bacteria and viruses (in the form of a turbid liquid) will flow to the tanks of aircraft that will be equipped with an apparatus to maintain constant temperature while the suspensions are delivered to the site of their aerosol pulverization. This will be effected late in the night . . . so that by sunrise the disease carrying particles will have reached the ground, enveloped the streets and seeped into the homes . . ." 739/ It is notable that agent dispersion with each of the aforementioned delivery vehicles, aside from certain covert devices and arthropod weapons, is dependent on the generation of an aerosol. From other Soviet articles it seems clear that the performance of airborne biological agents in the field has been investigated experimentally. . . . A bacterial cloud retains its effectiveness for long periods in narrow streets, and cul-de-sacs, ravines, forests, orchards, thick grass, underbrush. . . . It penetrates into houses, buildings, animal and commercial buildings . . . and settles on the ground . . . these particles can be raised by the wind and contaminate the air again"; 403/ ". . . In favorable weather (the absence of rising air currents and slight wind, the speed of which does not exceed four meters per second). . . in localities where the movement of air is slight (yards, narrow streets, blind alleys, gullies) the bacterial cloud can maintain its injurious properties for several hours and sometimes longer . . . the injurious properties are preserved for the longest period of time by sections of the locality contaminated by spore or toxins." 613/

In those phases of the BW program where the confines of the Aral Sea obviously are limiting, the USSR has resorted to open water for aerosol testing. In one instance, announced in 1958, a simulant agent cloud was allowed to penetrate the interior of a ship, presumably a naval vessel, in order to evaluate decontamination measures. 196/ In November of the same year tracer aerosols of an undetermined nature were purportedly sprayed over the Baltic Sea, 300 miles off the Swedish coast; ship-borne sampling devices are said to have been distributed over a wide area during the early morning exercises of some 2-3 hours duration. 748/

The dispersion of BW agents by munitions having powerful explosive charges, that is, land mines, mortar and artillery projectiles, has not been thoroughly explored in Western countries. There is sufficient information, however, to suggest that the tactical employment of micro-organisms or toxins with certain of these weapons has been attempted in

the USSR. Several statements found in Soviet publications imply that aerosol coverage from short-range air or ground bursts has been investigated. ". . . Between World Wars I and II it was shown experimentally that even microbes which do not form resistant spores readily tolerate conditions created in the use of firearms. Microbes have survived in an artillery shell, particularly of the shrapnel type, and even on the surface of a bullet. This has given us the expectation that biological agents can also be carried by artillery shells . . . At a comparatively short distance, the ejection of microbes is possible by means of mortars. Recently long-range rockets have also been designed for this purpose . . . The use of special artillery shells . . . very much complicates the rapid recognition of the fact of an attack because these shells can constitute only a certain small portion of the shells ordinarily used which would mask the use of the biological weapon." 347/ It is interesting with regard to the detection factor that a firing plan for Soviet artillery described in 1954 included BW rounds interspersed with atomic and CW projectiles. 499/ A treatise on biological weapons written in 1957 by [redacted] of the Military Medical Academy, and a subsequent review of the article by [redacted] brought out the following points which are strongly suggestive of actual experience: ". . . Many microbes possess high stability to temperature, even such high temperatures as arise in the explosion of artillery shells and mines . . . it is known that a temperature of over 3000 degrees is created by the explosion of artillery shells and the effect on microbes of such a temperature would be destructive; nevertheless, with the short thermal reaction due to the explosion (0.00001 of a second), biological agents are apparently protected by the medium in which the microbes are suspended." 12/ Morgunov wrote that the slurry form of an agent fill is more infective than a dried product, although the dry agent is preserved better and can be used in artillery weapons whereas the liquid culture cannot. The disparity in infectivity can be overcome by fine grinding of the dry mass, according to him. 347/ The previously mentioned revelations of a former Soviet officer with respect to biological artillery munitions in 1954 was the first indication of the possible existence of such weapons since the German World War II reports. 499/ [redacted] 745/ [redacted] 662/ These various pieces of information were interpreted in 1957 as demonstrative of a definite Soviet interest in BW agent delivery by artillery fire. 746/ The range of artillery types to which the Soviets might adapt experimental biological munitions is wide. Among the improved models emerging since World War II are 100, 122, and 130 mm. field guns; 152 and 203 mm. howitzers; and 160 and 240 mm. mortars. Field rocket launchers of 140, 200, and 240 mm. have also been described. 747/ No data are available on which to predict the probable choice of these weapons to disperse BW agents in tactical situations.

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From Colonel Hirsch's documentation of BW weapons development in the USSR, it seems likely that early efforts were concentrated on relatively small-volume containers, such as, the 25 and 50-liter "BR" tanks for aircraft dissemination. Plans called for 500-1000 liter vessels eventually, according to his sources. 17/ Recent DOSAAF training material states that ". . . the airplane spray tanks consist of thin-walled metal reservoirs with a capacity of 500 and 1000 liters or more." 403/ The author may well have had in mind a modified version of the VAP, ZAP or HKHAP aircraft tanks of 500-1000 liter capacity developed for chemical agents. 336/ The containers of this series are not aerodynamically suited to delivery by modern high-performance aircraft, a fact recognized by Soviet writers: ". . . The high speed and altitude of modern jet planes and the powerful antiaircraft defense combine to restrict the use of airplane spray tanks." 403/ Whether a more suitable externally mounted apparatus has been developed is unknown. It is entirely plausible that aerodynamic problems may have dictated a shift in emphasis either to (a) internal containers of exceedingly large capacity for LAC employment by jet aircraft, or (b) cluster munitions for bomb bay release. No evidence is available to date that LAC disseminators have been designed in the USSR, such as, equipment capable of indiscriminately dispersing more than one ton of infectious or toxic material.

Soviet rotating cluster bombs and their component bomblets, although intended primarily for CW agents, are probably adaptable to delivery of microorganisms. 178/336/ Several types and sizes of these munitions have been identified, including spherical metal or glass bomblets generally comparable to experimental models developed in the West for BW purposes. 749/ In speaking of biological weapons one Soviet author stated, " . . . As regards the design, bacterial aerial bombs should obviously be similar to that of chemical bombs . . . consequently it can be assumed that the basic components of a bacterial bomb are the body with a reservoir for the bacterial formulation, explosive charge, stabilizer and fuze (impact or time type)." 611/ [redacted]

Other means of aerosol dissemination are known to the Soviets in addition to bombs, artillery, and spray tanks for conventional aircraft. The possibility of using compressed air and piston driven devices has been mentioned in their publications. 611/ Portable and vehicular spray equipment for toxic agents is believed to be available to the armed forces, while various biological aerosol generators yielding particles in the appropriate size range have been described. 80/195/336/565/ The health and agricultural agencies have also developed dusters and sprayers for dispersion of liquid and dry insecticides from helicopters. Military usage of light planes for releasing insecticides has been mentioned, as well.





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310/ 750-752/ A recent intelligence study pointed out the probability that certain similar items of equipment have been modified for employment of BW and CW aerosols. 178/ Perhaps the greatest utility of these items would be found in portable generators or harmless-appearing devices for disseminating biological aerosols covertly. It must be assumed that progress has been made in devising efficient methods and equipment for clandestine attack, and that nothing as primitive as the ice cylinders reported by Hirsch is still under consideration in the USSR. [redacted] 12/

The current intensity of BW weapons activity in the Soviet Union is unknown. The existence of the probable proving ground on Vozrozhdeniya Island is, in itself, the strongest evidence that biological weapons have been developed, at least as far as experimental stages. Analysis of the facilities on the island suggests aswell balanced program encompassing munitions for both tactical and strategic employment, deliverable by either ground or airborne equipment. The relative status of the various possible types has not been learned; and there are still no firm indications that biological weapons have been standardized, produced, and distributed to units capable of using them. [redacted] 753/ Reserve officer students in the biological sciences in 1954 were reportedly assigned to a "BW branch" of the military services for training. 659/

Current Research Identifiable with Offensive BW

Little research known to be under way in the USSR today can be construed as oriented solely toward offensive BW. On the other hand, a great deal of reported work, in addition to its value in problems of public sanitation, medical science, and defense of the nation against possible attack, could have offensive applications. Many investigations of this nature have already been cited as pertinent to agent and weapons development because of their historical identification with personnel and institutes believed to be involved in one or another phase of BW. In this section, selected information will be pinpointed in order to focus attention on recent activities having an easily recognized bearing on the offensive aspects of the Soviet program. These are found almost exclusively in the field of aerobiology.

According to the 1957 edition of the authoritative Soviet Great Medical Encyclopedia, the primary objective of medically related aerobiological studies in the USSR is knowledge of immunological mechanisms involved in



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aerogenic infections arising from enemy action. 11/ New developments in aerobiological equipment since 1955 have materially improved Soviet capability for this type of research; at the same time, conditions for compiling data of offensive value have been established. Military scientists of the Central Institute for Advanced Training of Physicians, Moscow, reported initial studies on aerosol chamber methodology in 1956, using an intestinal microorganism as a model. 190/ [redacted] conducted an investigation of the influenza viruses at the Kishinev Medical Institute from the same standpoint. 524/ From a design worked out in 1954, the IVK-1 chamber was fabricated and put into operation at the Institute of Virology in Moscow by 1956. 505/506/ Created specifically for virus aerosols, the IVK-1 has been employed extensively for studying airborne psittacosis, influenza, and possibly Venezuelan equine encephalitis. 486/503-506/509/ Researchers of the Institute of General and Communal Hygiene imeni Sysin apparently are sharing the chamber facilities of the Virology Institute. 486/ In 1956, [redacted] developed an elaborate multichambered apparatus for exploring the kinetics of bacterial aerosols powdered and droplet form at the Kiev Institute for Advanced Training Physicians. 199/ [redacted] adapted certain [redacted] techniques influenza virus experiments in a smaller chamber improvised at the Kiev Institute of Infectious Diseases. 200/ Some of the most significant Soviet aerosol work has been recorded by scientists of the Military Medical Academy imeni Kirov in Leningrad. [redacted] devised a chamber ostensibly for immunizing animals via the respiratory route as a means of protection against airborne pathogens and bacterial toxins. Pasteurella avia and Salmonella typhi-murium probably served as simulants for more dangerous microorganisms in the published version of [redacted] investigations; P. avis is closely related to P. tularensis and P. pestis, the causative agents of tularemia and plague, respectively. 293/543/ [redacted] followed up with an assessment in mice and guinea pigs of active and passive immunizing procedures for counteracting aerosols of botulinum toxins A and B. The ultimate objective is to "evaluate immunity in humans against respiratory affections with botulinum and other less effective bacterial poisons." 542/556/ Since botulism does not occur in nature in the pulmonary form, this experimentation is one of the clearest examples of purely BW-sponsored work. The generation of toxin aerosols, even to challenge immunity, cannot be completely divorced from the offensive side, because background information must of necessity be gained first on biological decay, effective dosage range, optimum particle size, appropriate exposure periods, and related variables. In a like manner, the current aerogenic vaccine program of the Military Medical Academy [redacted] is meant to overcome deficiencies in conventional immunization procedures by developing protective antigens to be introduced through the lungs; in challenging immunity bestowed on animals by this means data are obtained concurrently on aerosolizing virulent plague, brucellosis, tularemia, and anthrax organisms. 268/ The documented employment of aerosolized vaccine strains of these four microbes in human volunteer trials is similarly motivated,



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although the information being collected has less value for offensive purposes because the subjects have not, as far as is known, been exposed to virulent cells. 268/532/ This rather ambitious program has been under way at the Academy since 1953, or earlier, according to Soviet writings; extension of aerogenic vaccine methods to virus diseases of man and animals has been visualized. 267/ In the meantime, attention is apparently being devoted to refinement of the bacterial aerogenic preparations, particularly with regard to penetration and retention of antigens in the lungs as a function of aerosol particle size. 522/540/754/

Veterinary scientists are also active in the field of respiratory vaccines, and the information gathered in these programs almost certainly adds to the fund of knowledge of offensive BW. [redacted] have designed a plexiglass chamber for studying immunity in domestic animals. 589/591/ First exposing mice and rabbits, and later sheep and calves to aerosols of Salmonella species, comparative susceptibility and infective-dose levels were established. Presumably the investigation will be extended to microbes causing the more serious animal diseases. Further evidence of a trend toward aerogenic vaccination as a practical expedient is the recently reported dissemination of fowl plague virus and swine erysipelas vaccines by aerosol. 162/755/ In two other instances the literature of the 1950's refers to aerosol studies which can be expected to produce data of offensive significance. Without giving details, the notes of a 1957 conference in Saratov mentioned an account [redacted] Sivolobov] of characteristics of pneumonic plague arising from aerosol infection. 597/ In 1956 [redacted] from the Tomsk Scientific Research Institute of Vaccines and Sera on the minimum infective dose of tularemia organisms for guinea pigs via the lungs and other portals. 578/

Current work of the Military Medical Academy on penetration and retention of aerosols in the lungs points up the critical importance of particle size to development of microbes as BW agents. The Soviets have available a variety of generators for laboratory-scale aerosols, including the Chicago atomizer developed in the West for creating biological clouds of uniformly small particle size. 200/ The IVK-1 chamber is said to contain a compressed air sprayer yielding 60 percent of the particles one micron in size. 503/506/ [redacted] of the Medical Academy stated that his vaccine aerosols in some experiments consisted of particles in the 3 to 7 micron range. 754/ [redacted] employed an AI-1 disseminator for infecting small animals and livestock with Salmonella aerosols; the particle size range obtained within his chamber was not specified, however. 589/591/ An "0-45 pistol atomizer" and an "0-29 pulverizer" were used [redacted] to disseminate his fowl plague virus vaccine, but specific data on the aerosols so generated were not given. 755/ The aerosol chamber equipment developed recently [redacted] at Kiev, the Institute of Virology's IVK-1 chamber, and [redacted] instrument at the Military Medical Academy are probably equivalent to similar pieces of apparatus designed in the West as

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regards precision and versatility. In general, the Soviet literature shows that prior to 1950 comparatively little microbial aerosol work was accomplished; from 1950-55 studies dealt mostly with the mechanics of air-sampling and techniques for isolating and identifying airborne organisms. 179/ In later years, emphasis on aerogenic infections, biological aerosol properties, and environmental effects suggests that technology and methodology have been improved to the point that collection of experimental data should proceed at a faster rate. While [redacted] among others, compiled encyclopedic documents on the fundamentals of aerosol formation and behavior some time ago, it is paradoxical that certain of the current Soviet microbial aerosol research is still concerned with the effects of major variables on biological decay. 756/757/ For example, [redacted] of the Institute of General and Communal Hygiene imeni Sysin, who has published widely on aerosol sampling methods and principles of the spread of airborne disease, reported in 1960 on chamber studies with dry and droplet aerosols of the relatively innocuous Micrococcus albicans for the purpose of eliciting humidity and temperature effects. 188/189/201/485/486/758/ [redacted] botulinum aerosol work demonstrated a lack of sophistication in that a low-potency toxin was employed and little apparent attention was paid to particle-size measurements and other controls. 542/556/698/ It was noted previously, too, that the psittacosis aerosol research under way at the Institute of Virology is still largely preliminary since the main objective at this point is probably stabilization of experimental variables. 503/504/ Superficially, this indicates that Soviet knowledge of biological aerosols which could be applied to weapons is relatively retarded. At the same time, conditions for effective aerosol dissemination are a matter of individual concern for each candidate microbial agent, and generalities on this subject are usually invalid. It is also conceivable that Soviet scientists are satisfied with fewer refinements in biological weapons, and, hence less concerned with high percentage viability, exact particle size, and related properties in their aerosolized agents.

Whereas laboratory investigations pertinent to offensive BW can sometimes be recognized from the published biological literature, similar screening of source material for evidence of aerobiological activity in the external environment is far less rewarding. Indications of large-area coverage (LAC) testing in the USSR are practically nonexistent. The 1958 Baltic Sea exercises in which aerosol tracer clouds were reportedly released and then studied by ship-borne samplers may be significant, but the nature of the aerosol cloud, that is, whether simulated chemical, biological, or atomic, and the distance involved have not been ascertained. 748/ Theoretical research which also appears applicable to CBR warfare was described by [redacted] of the Institute of Applied Geophysics in 1959; they computed characteristics of the distribution of nonspecific aerosols at long distances downwind from a release point. 472/ As early as 1954, sampling of the atmosphere was begun over Moscow to establish normal background counts of airborne microorganisms, information useful in detecting BW attack. At

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altitudes of 500 feet and under, some 2800 bacteriological analyses were conducted and the results apparently correlated with prevailing atmospheric conditions. 588/ During 1957-58, the Lvov Scientific Research Institute of Epidemiology, Microbiology, and Hygiene developed its own techniques for aircraft sampling of the atmosphere, and in a preliminary publication described 37 flights performed to obtain vertical bacterial profile counts. 526/ A second article advised that 12 additional flights had been made in March 1958, and 530 samples taken at various altitudes between 300 and 19,500 feet. 759/ The authors' rationale for undertaking the latter study, and the manner in which it was organized, suggest the possibility that a LAC test on a somewhat reduced scale was actually under way in that month: ". . . Questions concerning the dissemination of microbes in the atmosphere are not yet sufficiently studied, especially not under meteorological conditions of the seasons. These questions are of special interest in regard to the transmission of microbes at long distances. . . In order to study the microflora of the high altitudes during the winter period, and to investigate the character of air masses, we undertook a special research." Microbial counts were correlated with recorded meteorological observations and with the movement of air masses taken from charts of a weather station, apparently located in the vicinity of Lvov. The statement, ". . . Our observations have also revealed the effect of meteorological factors on the resistance of the bacterial plankton," infers that an easily recognized microbe, perhaps a BW simulant, was released as a control on which to judge the deleterious effects of humidity, solar radiation, and other variables. Without a base line figure for comparison, i.e., total number of organisms present initially, the data on such effects would be meaningless. In speaking of a correlation between bacterial numbers and moisture content of the atmosphere at various altitudes, this explanation was given,". . .Apparently, due to increased gravity, sedimentation of bacterial aerosols of condensed water vapor occurs faster in a vacuum." From the fact that" . ..the period of investigation conducted at the latitude of Lvov was characterized by predominant arctic air masses," and considering that sampling was done specifically at the junction of two different air masses near that city, the implication is plain that one objective of the research was to trace the movement of airborne organisms with a frontal system, a critical feature of the LAC concept.





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## The Defensive Program

### Status of Military Defense

Soviet countermeasures against biological and other mass destruction weapons are based on a complex organizational structure. The major elements are the armed forces, including medical, veterinary, and chemical troop units; the public health agencies; the civil defense system; and certain paramilitary groups of which DOSAAF is representative. Local anti-air defense units (MPVO) form the backbone of the civil defense organization, drawing on the resources of the medical, epidemiological, and sanitary-hygiene services of the Ministries of Health and Defense. DOSAAF is primarily concerned with indoctrination and training of the populace. Sanitary and epidemic control of the military environment is a joint function of medical units and chemical troops within the armed forces, the former having responsibility for prophylaxis, diagnosis, and therapy of disease and for providing the necessary sanitation equipment. Chemical troops carry out decontamination and protective procedures, participate in CBR defensive training of personnel, and assist the medical units in detecting attack with biological weapons. The veterinary staff is concerned with animal diseases transmissable to humans and with protection of food supplies. The research foundation for development of defensive tools employed by the civil and military components is furnished by the scientific community as a whole, a prominent part being taken by the service academies and military research institutes. The Military Medical Academy imeni Kirov and the Central Scientific Research Testing Institute of Military Medicine probably play leading roles in this respect. At one time NIIEG was similarly involved, although its current status is unknown.

The administrative mechanism for coordinating BW defense of the USSR dates from World War II days; continuity of effort was ensured to some degree by the founders because, in the words of the Great Medical Encyclopedia, ". . .This defense is based on the existing peacetime system of sanitary hygienic and antiepidemic measures." 11/ It was not until 1953, however, that CBR training in the military forces was formulated in its present scope, with greater emphasis on atomic and biological weapons than in the past. 66/ In like manner, the public of the USSR was given little significant information in ABC warfare prior to 1954. 767/ Now, instruction in principles of detection, protection, and decontamination is said to be an integral part of the annual military training cycle, and unit commanders have been made responsible for its effectiveness. 122/664/768/769/ In some cases the program is actually supervised by the commanding officer of the CW troop component. 60/662/672/673/ This arrangement is to be expected because under Soviet concepts individual and collective methods and equipment for CW protection also serve for BW and radiation defense. 11/409/598/600/ The gas alarm reportedly is used to signal a BW attack, and detection kits apparently contain dual-purpose sampling devices. 11/336/586/610/





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According to intelligence studies, the Soviet army is thoroughly trained and well prepared to defend against mass destruction weapons. 59/ 122/ 409/ Recruit training has been described in which the use of protective clothing, masks, and decontamination equipment is solidly instilled during the first three months of service. Practice alerts and lectures supplement the indoctrination. 770/ The extension of this type of training to army field maneuvers and naval sea exercises has been reported. 122/ 670/ BW defense forms part of the 3-year curriculum of officer candidates for the CW branch, [redacted] Soviet officer stated in 1959 that he had received periodic orientation in CBR [redacted] 122/ 753/ There are no indications, however, that BW defensive training for the mass of Soviet troop units has gone much beyond the mechanics of safeguarding the individual soldier. Demonstration of biological agent effects, the employment of simulants, and similar elements of realistic training are not known to have been introduced. On the whole, the quality of instruction and practical application is considered sufficient to degrade the impact of biological attack if advance warning were available. The degree of effectiveness of countermeasures, however, is dependent on certain other factors, among them the status of immunity; the type of BW agent used; the efficiency of detection, identification, and decontamination procedures; the availability of protective garments and shelters; and the timeliness of therapy.

Soviet troops are not known to have administered uniformly prophylactic antigens for microorganisms deemed to be the most promising candidate biological agents. The basic formulations against typhoid, the paratyphoids, bacillary dysentery, tetanus, smallpox, and cholera are given routinely. 240/ It seems likely that units deployed in regions of endemic disease receive vaccines for tick-borne and Japanese B encephalitis, and possibly tularemia, brucellosis, and Q fever, as is reportedly practiced with civilian workers. 100/ 238/ 277/ 279/ Presumably, the large-scale immunization programs for influenza and poliomyelitis have been extended to the military forces. Soviet statements show clear recognition of the value of immunization as a BW defensive factor: ". . . the essential role belongs to specific prophylaxis in the system of anti-epidemic measures for troops;" 234/". . . the establishment of immune contingents among the population assumes great significance in considering such diseases as brucellosis, tularemia, anthrax, and botulism;" 233/ ". . . the necessity may arise in a specific epidemic situation of simultaneously immunizing people with numerous antigens in various combinations. . . against a large number of infectious diseases." 135/ Such thinking has almost certainly provided the impetus for current research on multiple, or combined, antigens, polyvalent antisera, and aerogenic vaccines. Combined vaccines, except for the trivaccine and the NIISI preparation against enteric diseases and tetanus, probably have not yet reached the stage of general usefulness. 238/ 631/ As regards the status of respiratory immunization, [redacted] commended, ". . . despite general acceptance of the high degree of effectiveness and evident promise of the method of inhalation immunization, it has not to date obtained extensive practical application." 266/ The lack of tailored vaccine strains, production techniques, and equipment uniquely suited to mass application of the antigens demonstrate the still-experimental nature of this approach. A test-model aerosol apparatus for dispensing influenza antigen to large groups of people was developed recently by the Health Ministry. 269/ There is little





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question but that the widespread use in the USSR of conventional vaccines against tularemia, brucellosis, anthrax, and plague has generated a production capability over the years such that prophylaxis as available for the armed forces should the demand be felt. A recent Soviet statement indicated, however, that plague vaccine production may have been curtailed because of the low incidence, or absence, of the disease. 631/ The extent to which botulinum toxoids of various types and effective antigens for most of the virus and rickettsial diseases could be supplied is obscure.

Much work is conducted on improvement of existing preparations, even among the bacterial antigens, with respect to antigenicity, duration of immunity, and reduction of the incidence of adverse physiological reactions to immunization. A search is under way for new tularemia cultures for immunity against highly virulent strains; 236/ a better antigen is sought for the present plague vaccine as regards respiratory protection and side reactions; 168/771/ and the STI anthrax vaccine is being re-examined with a view toward fewer reactions. 127/172/595/ Tularemia and brucellar live antigens, although used on a mass scale, also yield undesirable side effects, and several full-blown cases of brucellosis arising from immunization have been reported. 238/309/ Antigens for glanders and melioidosis have not been successfully prepared. In the virus and rickettsial field, adequate vaccines are not yet available for infectious hepatitis and the hemorrhagic fevers; and little effort to provide prophylaxis against Coxsackie, echo, and adeno viruses is apparent. 100/ Even though mass vaccination has taken place in endemic areas with the mouse-brain tick encephalitis antigen and the Japanese B encephalitis vaccine, the results are questionable. The latter preparation is considered unsatisfactory, and the morbidity from use of the tick-borne spring-summer encephalitis antigen has prompted a search for an improved egg-grown vaccine and the withholding of some production lots from distribution. 100/238/279/772-773/ While the egg-propagated antigen for Q fever gives adverse reactions, too, it is felt to be generally effective; such is not the case with the experimental psittacosis vaccine. 100/238/ Little is known of the yellow fever antigen prepared in the USSR, but a visiting Soviet scientist claimed in 1959 that manufacture had been stopped because of unsatisfactory production processes. 631/ The Soviet program of immunization against infectious diseases and the biologics program in general is far from adequate. A lack of confidence in the quality of products and skepticism of the efficacy have been noted. 309/334/ It is said, for example, that BCG tuberculosis vaccination was discontinued in Poland because of the hazard of the Soviet antigen. 309/ Recognizing that improvement is badly needed, Soviet administrators now are re-evaluating the entire production effort. 112/ Dissatisfaction over the purity of bacterial toxoids has been expressed; the Shigella dysentery antigen was reportedly deleted from vaccines in 1959; and the stockpiling of several antisera, in addition to the experimental Omsk hemorrhagic fever antigen, is to be stopped. 631/774/ Other drawbacks within the health agencies were described recently as poor record-keeping, lack of space for conducting immunization, unfamiliarity with procedures and reagents on





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the part of medical technicians, and insufficient storage facilities, for biologics. 775/ There is nothing to suggest that immune contingents exist within the armed forces of the USSR with respect to the more likely BW microbes. Coupled with the absence of immunogenic materials against certain of the serious bacterial, viral, and rickettsial diseases, Soviet military personnel are considered to lack at present the immunological basis for any significant degree of protection against biological agents, particularly if exposure occurs by the respiratory route.

This adjudged low order of physiological preparedenss places a premiun on the availability of protective clothing and collective shelters to allay the effects of BW attack. The Soviet soldier's garments are designed for defense against all types of CBR weapons, and his routine training includes use of the mask, gloves, cape, boots, and various other specialized items of equipment. 11/60/336/409/597/600/670/770/ The Great Medical Encyclopedia mentions three sets of clothing whose function depends on the degree of potential exposure of the wearer: the standard set for MPVO workers, a more elaborate attire for persons active in contaminated areas, and impermeable decontamination garb for teams cleaning up after an attack. 11/ Each member of the ground forces is said to have a complete line of protective clothing; 122/336/ this is substantiated in general by information from representative land units and naval forces. 122/672/ Thus, there are strong indications that adequate supplies of clothing are available for physical protection of the individual soldier, and, further, that these items have been distributed to the units which may have to use them. The scarcity of comparable information on collective shelters for Soviet troops suggests that little emphasis has been given to procurement and distribution of portable or quickly assembled shelters. It appears, rather, that reliance is still placed to a great extent on a combination of protective clothing, covered trenches or other conventional defensive positions, and decontamination procedures to degrade a BW attack. 768/ Only recently has mention been made of hermetically sealed, lightweight shelters, complete with air filter and ventilation system, for housing each platoon in an infantry company. 769/ Such items are not yet believed available to the military forces as a whole, and this recent description may only reflect prototype development and service testing of experimental models.

For decontaminating the locale of suspected BW munitions, and for disinfecting clothing, weapons, and equipment subjected to airborne agents, Chemical troops of the ground forces reportedly possess a variety of multi-purpose mobile and portable devices. 59/336/409/ Naval vessels presumably also have wash-down equipment. 122/ Decontamination teams are supplied with a portable spray apparatus, and are supported by larger, truck-mounted units. Machinery has been developed for dispensing chloride of lime as a means of terrain disinfection. 59/ Shower and laundry trailer and disinfection trains have been described in Soviet writings. 580/ Standards of operation and recommended capacities for the different types of equipment are known, and

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procedures for eliminating vegatative and spore forms of BW agents from various fabrics and materials have been prescribed by the Ministry of Defense. 580/ Detailed instructions for applying disinfectants in the proper concentration to terrain, vehicles, and buildings are also promulgated in training literature for general public consumption. 613/ Inasmuch as reagents for biological decontamination are relatively inexpensive, identical in some instances to CW agent decontaminants, available in large quantities, stable, and require only simple dispersing equipment, there is no reason to doubt that adequate supplies are on hand for use by Soviet troops. Chloride of lime, formalin, and calcium hypochlorite, the chemicals most commonly cited as biological disinfectants in the USSR are deemed satisfactory for mass application, BW defensive purposes. No indications have been noted of efforts to counteract agent clouds before the organisms have settled on environmental objects. Military scientists in Czechoslovakia have been experimenting with chlorosulphonic acid, a reagent used to generate smoke, as a means of disinfecting airborne microbes over open terrain. 777/ The work reported in 1958 was still highly preliminary, but Soviet investigators undoubtedly have access to any data acquired since that date.

The donning of protective clothing, the initiation of decontamination procedures, and selective therapy are dependent for effectiveness on timely warning of exposure. The warning function is purportedly performed for the military forces by observations teams, organic at company levels, comprising specialists in CBR detection. 671/769/ Portable kits containing soil, water, and food sampling equipment, therapeutic preparations, and diagnostic aids have been described for team use. 586/671/ Vehicle-mounted epidemiological laboratories manned by mobile detachments of the medical service probably carry out the required analyses for agent identification. 47/59/327/336/768/ The number of detachments operating in a given zone is unknown. It appears unlikely that such units would be formed below division level, and possibly they are attached only to field armies or fronts. 59/ In the event of disease outbreak, the division medical staff can establish isolation areas and commandeer field hospital facilities. 47/ A Soviet naval officer stated in 1959 that shore installations supporting the Baltic fleet maintain mobile hospitals in reserve solely for counteracting unconventional warfare. 753/

The methods employed routinely by the Soviet forces for identification of agents are still not known with certainty. [redacted] NIIEG published as early as 1947 on a technique, [redacted] for adsorbing a polysaccharide bacterial fraction onto erythrocytes; these cells, in the presence of a specific antiserum, show a positive reaction by agglutination. He claimed that antigens corresponding to 50 to 100 microbes can be identified within 7 to 10 minutes. 38/ Believing that such serological techniques offer the greatest promise for rapid detection, workers at the Military Medical Academy in Leningrad, [redacted] have extended [redacted] procedure to representative enteric bacteria;

plague, tularemia, brucellosis, and anthrax organisms; unspecified rickettsiae; and mixtures of these. 14/545/546/ By concentrating the pathogens from air, fluids, or soil with membrane filters, and by employing improved adsorbants, [redacted] that slide agglutinations can be performed in 40 minutes to 3½ hours. 14/545/ The sensitivity of the method, [redacted] is such that several missions of microbial cells must be collected to give a positive reading. Other experimental approaches utilized recently are selective adsorption of intact bacterial cell mixtures with chemical reagents, and flourescent antibody analysis. 531/563/581/ [redacted] wrote in 1959 of their attempts to identify typhoid, tularemia, brucellosis, and anthrax on contaminated military equipment, and from food, water, and various surfaces. 581/ The fluorescent antiserum slide-procedure was reportedly capable of detecting cell concentrations greater than 125 million per milliliter, although at least 250 millions cells were needed for absolute accuracy. Difficulty in positively identifying anthrax was encountered, according to their data. Again, membrane filters were employed for the concentration process. Aside from the aforementioned reference to unidentified rickettsial species in [redacted] investigation, and [redacted] experience with hog cholera, the viral and rickettsial agents, and bacterial toxins are not actually known to have been used in rapid detection explorations by military researchers. 545/563/ Scientists of the civilian health agencies have been active in recent years on these forms, as well as on the bacterial pathogens.

[redacted] Another experimental method tried by the Soviets is the injection of suspect organisms into animals, followed shortly by subculturing of infected body organs in nutrient media. Scientists at the Rostov Antiplague Institute reported in 1959 that

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positive tularemia cases can be found within "several hours," although best results came from a 2 to 3 day incubation. 568/ With regard to botulinum toxin detection, [redacted] Institute of Epidemiology, Microbiology, and Hygiene devised a procedure for measuring the "phagocytic index" of blood in animals injected with type A toxin. 527/ Variable results were obtained when toxic serum and eluates of contaminated food were employed to challenge the method, and the technique must be considered imperfect at this stage of development.

[redacted] Military Medical Academy evaluated the world literature on rapid detection of pathogens and published their views in a 1959 article. 205/ These are significant from the standpoint of the direction Soviet research may take in the future. As regards specific measures, they believe the fluorescent antibody technique offers the best prospect because it can be applied directly to contaminated materials without the necessity of pure culture isolation. Noting that time-consuming animal inoculation must presently be done to separate viruses, rickettsiae, and toxins, they predicted that tissue culture will be widely used eventually because of its simplicity and rapidity. This step has been attempted successfully with the poliomyelitis virus, according to the authors, [redacted] recognized the potential value of continuous cultivation, selective media, and infrared spectrophotometry for identifying specific microbes, but they agreed that nonspecific measures, such as, alarm systems, are of greater importance. The paper demonstrated that Soviet military scientists are fully aware of the latest experimental approaches explored in the West for developing instruments to indicate BW attack. Scanning for particle-size discrimination, photoelectric recording of an upsurge in the number of airborne particles, pyrolysis of protein in the air, and electrostatic precipitation, are among the methods cited. The Great Medical Encyclopedia of 1957 referred to electronic devices for calculating the number and distribution of particles or drops in a bacterial cloud; however, no evidence for the existence of automatic detection instruments in the USSR has been found. 203/ From emphasis seen on other aspects of BW defense in recent years, it seems highly probable that alarm systems are under active investigation as one phase of the over-all program. At a conference of the Academy of Medical Sciences in 1957, quick identification of specific organisms was pointed out as the chief problem in studying the microflora of the external environment. 483/ A need was expressed for direct isolation methods for the viruses, and beyond that, a technique universally applicable to all pathogens. Dependence on animal or egg inoculation to isolate viruses and rickettsiae, or to confirm the presence of bacterial toxins, is considered a major limitation of the present Soviet ability to counter a BW attack. From all indications, the accelerated identification techniques now under study for these potential agents, as well as for the bacteria, have not been perfected and are not yet applicable to use in the field. Reliance is probably placed on classical laboratory isolation methods and pure culture differentiation, a situation consistent with agent identification in terms of days rather than of a few hours.

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The sensitivity level of identification techniques devised thus far is so low that some form of concentration is required to provide enough organisms for a clear-cut positive reaction. Filtration, impingement of aerosol particles, and subculturing are among the manipulations employed for this purpose. The requirement for collection of cells from large volumes of water and air has engendered a broad field of development in filtration and sampling equipment.

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In searching for simple equipment, Soviet scientists have turned to inexpensive filters of nitrocellulose or gelatin for collecting pathogens from air and water by aspiration 86/87/ Bacteria can be impinged on the porous cellulose disk, stained for microscopic viewing, or cultured on the filter surface. 204/582/ Gelatin (gel-foam) filters are soluble in nutrient liquid media, ensuring that most of the trapped organisms will be recovered. These soluble products are reportedly used at the Institute of Virology for sampling psittacosis and influenze virus aerosols, and for influenza studies at the Kiev Institute of Infectious Diseases. 200/486/503/ Comparative data are being compiled on the advantages and disadvantages of membrane filters when tested against other types of samplers, as well as on differences among various kinds of membranes. 193/487/ Limitations are encountered with membranes, too. They tend to be fragile, often yield erratic counts, sometimes inactivate viruses during the dissolution process, and, in the case of gelatin, provide a source of nutrient which may not be desirable. 193/485-487/ Nevertheless, reliance has been placed on membrane filters since 1929, according to Soviet claims, first for water purification analysis, and later for virus research and air sampling. Mass production was reportedly under way as early as





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1932-33, and unspecified present-day equipment for collecting micro-organisms under field conditions by various agencies is said to utilize membrane filter components. 778/ Military medical researchers stated in 1956 that simple, reliable methods for sampling aerosols still do not exist, the inability to trap viruses, rickettsiae, and toxins constituting a significant drawback. 190/ Efforts are apparently under way to develop air samplers more nearly suited to military field laboratories. 85/88/

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Status of Civilian Defense

General--Surveys of Soviet civil defense in recent years are in essential agreement that an extensive, well-organized system has been formulated. Based on an administrative structure established during World War II, but actually dating back to the early 1930's as regards a policy of military education for Soviet civilians, the defensive program has reportedly indoctrinated over 85 percent of the adult population in one or more phses of CBR protection. 59-60/122/336/339/621/779/ A network of locally organized groups is said to



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span the entire territory of the USSR, each capable of rapid mobilization in the event of attack, and of carrying out the special tasks for which it is trained. 122/780/ Civil defense was oriented in earlier years toward conventional air attack and CW weapons, but atomic and biological defensive measures were introduced in 1954 and 1955, respectively. 337/339/ From 1955 onward it became apparent to close observers that civil defense activity as a whole was being intensified; by 1958 the highest peak since World War II was reached in training efforts. 59/621/767/781/ January of 1957 found a revised program under way to indoctrinate all persons over 16 years of age, its foundation being 22 hours of instruction in CBR defense. Completion date was set for July 1958 in large cities and December 1958 in smaller population centers and rural areas. 782/783/ The DOSAAF Congress in 1958 proposed an extension of the so-called 22-hour phase, a follow-up stage of practical application to encompass the 1959-60 period. 122/779/784/ The progress of this ambitious undertaking is difficult to assess since eyewitness accounts, which differ markedly from official pronouncements, indicate training to be spotty and unevenly applied. Many persons purportedly have received no instruction at all, while select industrial groups are given periodic lectures and demonstrations, interspersed with practice alerts. Protective clothing and masks are said to be stored at work sites for the use of key workers. 785/786/ Training is initiated through recruitment of members for DOSAAF, an organization estimated to have 25 million persons on its roster in 1959. From oblast to oblast, marked differences in enrollment and, hence, extent of training, are found. Variations ranging from 20 to 95 percent of the adults have been reported. 787/ Slow progress is criticized in the Soviet press, and student apathy and poor quality of teaching have been described. 122/783/788/789/ A partial basis for this lack of interest probably lies in the arbitrary methods employed for choosing instructors. In some instances work performance rather than background knowledge is the criterion for selection. After a brief period of orientation in CBR defense, newly designated instructors are expected to organize and indoctrinate fellow workers on this complex subject. 790/ It appears probable that the training program so far has not lived up to expectation, and that relatively few Soviet civilians have sufficient depth of knowledge to be considered thoroughly indoctrinated and effective in CBR defense.

The status of progress in providing collective shelters for the population is also a controversial matter. Officially, a program of construction was started in 1949, with the intent that air-raid shelters should be installed in all future public buildings, factories, schools, and apartment dwellings. 339/ Greek, Spanish, and German repatriates from the USSR report that basement shelters were being erected throughout the late 1950's in Soviet cities. 781/795-798/ The shelters consist of reinforced concrete or brick cubicles whose ceiling and walls are formed by the building foundation; utilities, ventilation systems, and sleeping facilities have supposedly been completed in some of them. 795/798/ These structures apparently conform to the first of the three basic types described in civil defense publications, the other two being earth shelters and permanent safety areas,





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such as subways. 337/ [redacted]

There is no confirmation of large-scale construction of heavy shelters in or near Soviet urban centers for protection of the population, or of any significant number of bunker-type structures. 339/768/783/786/792/ It appears likely that the collective shelter program is still largely in the planning stage, although a few well-protected areas probably have been equipped for the protection of high authorities in government. 768/ A parallel approach, the modification of underground rail systems to provide public safety apparently has been no more successful. 665/ A project was supposedly initiated in 1957 to revamp the Moscow subway for atomic defense purposes; 802/ the work is claimed to have been finished during 1959, but [redacted] during 1958-59 were unable to find any indications of the modification. 785/792/ Qualified observers report no evidence of crucial civil defense interest in the larger Soviet cities as exemplified by construction activity, overt training, posted evacuation plans, visible shelter signs, and mobilization of medical resources. 665/783/785/786/788/791-794/

While DOSAAF cadres apparently have sufficient protective clothing for instructional purposes, it is questionable whether the populace as a whole is adequately equipped. 122/785/ The civilian gas mask is probably available in quantity only for defense workers and key personnel of essential industries; 337/ cotton and gauze masks for protection of the respiratory tract are recommended for general civilian use. 803/ Firm data are lacking on the extent to which MPVO teams are outfitted with multipurpose garments, but members subject to immediate mobilization to carry out designated emergency tasks

probably have priority in the issue of such equipment. It seems likely that individual sets are maintained in ready storage for teams in critical areas. DOSAAF publications show that protective clothing has been developed specifically for active participants in defense, based on the relative degree of need. 11/611/803/804/ Set No. 1 consists of a disposable paper mantle, rubberized or plasticized stockings worn over ordinary footwear, and rubberized gloves. These items are intended for protection of exposed portions of the body against gross infection by bacterial agents in local antiaircraft defense groups working outdoors. No. 2 comprises a jacket with trousers or protective overalls of rubberized fabric, rubber boots, and cotton cap; it is designed for prolonged exposure in an infected area during reconnaissance or decontamination. Set No. 3 includes a protective apron of rubberized or plasticized fabric, rubberized stockings, and rubber gloves for teams handling disinfection equipment. Each outfit contains a gas mask, presumably the GP-4. Individual antichemical kits have also been described; disinfectant-soaked tampons supplied in the kits are used to wipe the fingers, face, or other parts of the body contaminated in a BW attack. 605/ There are no indications that equipment of this nature has been produced for the benefit of the general public, however, or that the government intends to make it available on a massive scale. 768/

There is no reason to believe that civil authorities are in a more favorable position than their military counterparts with respect to rapid detection of BW attack. The first indication that biological agents are present could come from civil defense teams though, depending on whether MPVO or military units are operating in a given locale at the time. The responsibility for BW sampling is apparently shared by armed forces medical units, mobile sanitary-epidemiological detachments of the MPVO medical service, and reconnaissance patrols of MPVO. 613/ Since the civil defense agencies lean heavily on the peacetime epidemiological service of the Health Ministry for support, Soviet planning calls for analytical procedures on suspected materials to be conducted by local sanitary-epidemiological stations. 803/ In 1957, a Soviet article on BW defense announced that ". . .mobile sanitary-epidemiological detachments and groups have been formed in sanitary-epidemiological stations whose duty will be to organize measures and eliminate bacterial foci when they arise." 605/ One such mobile detachment was reportedly instrumental in diagnosing an outbreak of influenza in a military garrison during 1957. 327/ Presumably these newly organized teams will function in time of emergency under the supervision of MPVO personnel. This move is apparently one of several designed to bolster the Soviet defensive capability, which concurrently raising the level of public health. For example, the 20th Congress of the Communist Party not only decreed an increase in the number of sanitation specialists, epidemiologists, and physicians within the health organs, but recommended that modern, fully equipped bacteriological laboratories be installed in 848 sanitary-epidemiological stations and hospitals which had none at that time. 284/ Certain of the sanitary-epidemiological stations have joined in the program of systematically sampling the atmosphere for background microbial counts. This participation is strong evidence that some sanitary-epidemiological installations, and probably their mobile

detachments as well, are proveded with aerosol samplers. These devices, [redacted] could be utilized for biological agent collection if attack were known to be impending or to have actually occurred. Just as in the case of military medical units, the MPVO groups and the sanitary-epidemiological establishments are not believed to have indicator systems or automatic alarms to warn of this contingency. The recent training literature for civilians still stresses detection of BW attack by observing characteristics of munitions and symptoms of illness in humans or animals. 59/ Leading institutes of the Ministry of Health are pursuing research on rapid identification of bacteria, toxins, and virus and rickettsial forms, but there is nothing to suggest that quick diagnostic procedures have reached the point of applicability to the detection problems of sanitary-epidemiological laboratories. At this stage of development, it is to be expected that a period of many hours, or even several days, would elapse before a BW instigated outbreak of airborne disease could by plainly recognized.

Epidemiological problems are investigated at the working level by sanitary-epidemiological stations which form a network across endemic disease areas of the USSR. These stations also provide the technical assistance and equipment for disinfection and insect or rodent control when outbreaks occur locally. Decontamination crews are supplied with a means of transportation and portable apparatus of various types to clean up the environment of patients with serious communicable illnesses. 807/ The reagents employed for disinfection, like those used by the armed forces, are available in quantity; presumably the mobile equipment is identical to, or a modification of, that furnished the military services. It is not clear to what extent the activities of these disinfection organs are integrated with the MPVO, but it seems likely that civil defense supervision of their functions takes place in emergency situations in a fashion analogous to the aforementioned epidemiological investigations. Despite the abundance of inexpensive reagents, the simplicity of equipment, and the availability of general medical knowledge on how these tools should be used, improvement in the disinfection services is cited as a critical need. 137/138/ The high incidence of diseases attributable to faulty sanitation demonstrates that education of the populace is an important first step. 279/280/ BW defense literature spells out the manner in which decontamination should be handled by civilian workers where limited foci of infection exist, but the massive contamination possible with modern delivery systems raises serious problems for which solutions are only now being sought. 613/ Disinfection of air, new chemical agents for inactivating resistant anthrax spores, and special methods for killing brucellosis, Q fever, and other candidate BW materials in external surroundings are important research subjects in recent programs of sanitary-epidemiological stations, veterinary institutes, and particularly, the Central Scientific Research Disinfection Institute in Moscow. 291/ 300-304/308/316/454/530/569/707/ The Military Medical Academy imeni Kirov is exploiting its aerogenic vaccine experiments to formulate hygiene procedures for disinfecting body surfaces of volunteers exposed to aerosols of living

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anthrax and brucellosis microbes. 534/ It is especially significant from the standpoint of rapid decontamination of building interiors and delicate equipment that little or no Soviet utilization of the very effective modern gaseous disinfectants has been reported, e.g., ethylene oxide mixtures with freon or carbon dioxide. Because MPVO and military units are probably trained sufficiently in the mechanics of decontamination and supplied with the requisite equipment, it appears likely that Soviet defenses could cope with isolated disinfection situations arising from BW attack, as in the case of a bomb crater or sickness in a few residences. Gross contamination of an extensive area, however, would almost certainly overtax present facilities, and prolonged exposure of the population to viable agents would result.

Large segments of the Soviet public, especially in urban centers, presumably have no history of contact with infectious organisms likely to be employed against them in warfare. There is no confirmation, and little direct evidence, that antigenic stimulation by wholesale vaccination has yet been carried out as a means of building up immune contingents in the populatio for BW defense. Previous discussion showed that Soviet planning envisions th approach in the future, however. For the present, the peoples of the USSR must be considered susceptible in varying degrees to a number of potential biological agents. Few figures are available on the prevalence of active immunization. Civilians reportedly receive smallpox, pertussis, diphtheria, tuberculosis (BCG), and tetanus antigens; but only smallpox is required, and there is some doubt that complete coverage results. 238/631/768/ [redacted] In 1922, for example, 10 million were vaccinated against cholera; by 1940, typhoid antigen had been dispensed to an estimated 10 percent of the populace, with additional millions coming under the program each year. Following introduction of the live brucellosis vaccine in 1952, over two million sheep and cattle attendants were supposedly immunized by 1955. Mass prophylaxis against tularemia was initiated in 1949, but total numbers involved are unknown. 277/ [redacted] More recent Soviet claims are on the order of several hundred thousand for spring-summer encephalitis. 238/ Influenza antigen was received by 155,000 in 1952, with other thousands vaccinated during 1953. Soviet figures on current use of live influenza vaccine are approximately 10 million persons each year. 100/ Some of the experimental products have been administered on a sizable scale, too. It is reported that the Pappataci fever egg-embryo vaccine was tried out on 69,000 people in 1950; a live mumps antigen of the same type was field-tested on 35,000 children 100/ As of early 1960, the administration of this parotitis vaccine and the newly developed measles antigen to large segments of the population is still





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in the planning stage. 775/ The poliomyelitis program is perhaps the outstanding example of mass immunization capability of the USSR when once the technology of live-vaccine production has been mastered. By late 1959, over 21 million polio inoculations were reportedly given. 808/ The oral antigen for this disease will be dispensed to 77 million persons in 1960, according to Soviet announcements. 809/ Data are not available on the prevalence of prophylaxis against plague, anthrax, botulism, Q fever, tularemia, and yellow fever, among the more promising candidates for BW. Q fever, tularemia, and brucellosis vaccines apparently are used widely in endemic areas; 238/ workers in the hide and textile industries are protected against anthrax by immunization when the nature of the job requires it. 768/ Yellow fever vaccine is almost certainly given to travelers leaving the USSR for countries where the disease is endemic, but actual figures are unknown. Plague immunization was probably carried out extensively during the mid-1940's when serious outbreaks occurred in the Volga River basin and the Kazakh Republic; it is possible that this practice has been continued in localities where plague is still present in the rodent population. Because of long-standing experience with the typhus fevers, effective protective antigens are believed to be available and in limited use. 768/ As in the case of psittacosis, no effective vaccine for the Venezuelan and Eastern equine encephalomyelitis viruses is known to be in Soviet possession, but efforts to develop these preparations seem to be under way now at the Institute of Virology. 100/509/513/ Active immunization against the pathogenic fungi is not successful, and no indications of substantial Soviet attempts to solve this problem are noted. While the need for toxoids and antisera for the bacterial intoxications, diphtheria, and tetanus has almost certainly resulted in a satisfactory technology for production and widespread use, the situation with respect to botulinum is obscure. Toxoids for Types A and B are available, at least in experimental quantities, but the extent to which prophylaxis is presently employed, in the absence of frank exposure, has not been noted. 768/

Vulnerability.--Even though the Soviet civil defense program lacks full effectiveness, the scope and intensity of training have contributed significantly to the BW defensive posture of the USSR, according to intelligence studies on the subject. 339/ Perhaps the greatest benefit from this training is awareness of the steps to be taken by the individual to safeguard his own health in the event of air attack. Despite periodic indoctrination and the assignment of specific tasks, MPVO teams probably have not rehearsed their functions sufficiently under realistic conditions to negate the impact of a strong BW onslaught. On the other hand, their existence, and the presumed operational readiness, in every element of industry, government offices, and residential areas of urban centers could possibly degrade the severity of limited local attack by shortening the period in which the inhabitants are exposed to infectious material. Thus, a combination of individual protective action and rapidly initiated quarantine and decontamination measures might

well reduce, without preventing entirely, the number of cases of disease arising from a readily recognized source, for example, a biological bomb casing. In view of the absence of adequate shelters, the probable lack of protective clothing and gas masks for the vast majority of civilians, and the almost certain inability to detect airborne biological agents before exposure has occurred, physical defense in the USSR is adjudged to be incapable of preventing contact between a biological agent and its intended civilian host. The armed forces are probably in a more favorable position with respect to the physical barriers which can be erected against infection; this follows primarily from their possession of individual protective garments and masks, and greater intensity of training. However, the probable unavailability of collective shelters, and, more important, the lack of a timely warning system, cast serious doubt that wholesale exposure to disease could be prevented in the foci of a vigorously pressed BW attack on military units.

If physical protection from infectious agents is not fully effective, biological protection assumes critical importance in minimizing the hazards to exposed civilian and military personnel. Biological safeguards may take the form of prophylaxis or therapy, and the incidence of disease will necessarily depend on the availability and timely use of vaccines, antisera, and antibiotics. An additional significant factor is the general status of sanitation within a nation and the degree of public knowledge about personal hygiene. These can be conducive to continuation of a contagious disease outbreak on the one hand, or a strong force to break the cycle of infection on the other. An evaluation of certain prophylactic preparations commonly employed in the USSR, specifically vaccines for brucellosis, tularemia, anthrax, plague, and Q fever, show them to afford fair, and in some instances good protection against the diseases as they are encountered in nature, despite the undesirable side reactions which are provoked. 768/ There are no firm data, however, to demonstrate that these same antigens, and others deemed to be less satisfactory, will protect humans challenged through the respiratory tract by airborne BW agents. Indeed, the trend toward aerogenic immunization in the USSR suggests that the Soviets lack confidence in their conventional vaccines to furnish this protection. It is reasonable to believe that some residual immunity to occupational diseases exists in rural communities where vaccination for spring-summer encephalitis, brucellosis, Q fever, anthrax, and tularemia have been carried out. 768/ Among the urban population, however, no evidence has been found that natural susceptibility to these and other BW candidate agent infections has been counteracted by active immunization programs. The same position apparently holds for the Soviet military services. For the great mass of the Soviet populace, it must be considered that a state of susceptibility to biological agents exists. The aerogenic immunization program, the development

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of combined antigens and polyvalent antisera, and the efforts to formulate satisfactory vaccines for diseases now lacking them are believed to be highly preliminary and thus incapable at present of altering the over-all status of biological protection.

The USSR is considered to have the same broad-spectrum antibiotics and sulfa drugs possessed by Western countries. There is no evidence that specific therapy with these products has been successfully applied to the virus diseases; as in the other nations, a search is under way to find and produce effective antiviral drugs. A recent evaluation of the Soviet situation with respect to quantities of antibiotics available for degrading BW attack led to the conclusion that current production is probably at peak capacity. 768/ Streptomycin, chloramphenicol, penicillin, and sulfas were said to be in adequate supply for normal civilian needs as of 1958, but stocks of the tetracyclines and neomycin were felt to be insufficient. Previously cited reports indicate that firm steps are being taken in the USSR to attain self-sufficiency and to overcome dependence on imports. 226/ 228/ Given certain working assumptions, the aforementioned evaluation found, however, that present supplies of therapeutic preparations would serve to treat less than 6 percent of the Soviet population. 768/ With the production volume of therapeutic drugs deemed to be marginal from the standpoint of fulfilling peacetime needs, there is no indication that stockpiles are being built up, beyond those required for normal military reserves, in anticipation of BW attack.

Studies of Soviet treatment facilities [redacted] have brought forth additional significant information bearing on the Soviet capability to cope with biological agents. [redacted] found in 1957 that, while a great expansion of medical programs is under way, equipment and installations are often antiquated, poor in quality, and much in need of replacement. Sacrificing quality of professional care to quantity of physicians has yielded medical workers of less competence than those trained in the West. The range of drugs for medical practice was also seen to be limited. 280/ Other [redacted] gained the impression that Soviet medicine is not organized to handle catastrophes or large-scale emergencies. Dispersal of facilities is not practiced, no blood collection program has been initiated or planned, and medical supplies are apparently not stockpiled. 793/ 794/ The sanitary-epidemiological stations, on which the brunt of BW countermeasures would fall, are frequently poorly equipped and understaffed, and diagnostic laboratory support for clinical medicine is generally of low quality. 100/ The integration of medical civil defense units and public health establishments has developed satisfactorily in theory, but there is considerable doubt that full cooperation, smooth teamwork, and realistic coordination have been reached. 768/ Depending as it does on a sprawling





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structure of peacetime sanitation and epidemiologic installations for a biological defense foundation, the Soviet public health system has made vigorous attempts to improve the capacity of the organization to function in defense. Programs referred to earlier fall within this category, for example, tightening of sanitation and hygiene regulations; identification of particularly susceptible population elements; delineation of potential routes of spread of infectious diseases; investigation of airborne microflora for background purposes; and locating and typing of rodent and arthropod vector reservoirs. Public education has been intensified in an endeavor to bring under control the so-called "filth diseases" which reflects the generally inadequate state of sanitation in the USSR. 279/ 280/ Realizing the shortcomings of their public health services, Soviet authorities have decried this unsatisfactory situation and have called for greater effort in devising procedures for improving sanitation, hygiene practices, and antiepidemic protection of the military and civilian population. 279/ 368/ Intelligence studies in the recent past are generally in accord that because of deficiencies in existing medical treatment and public health measures the Soviet Union cannot provide over-all protection against BW attack. 18/ 49/ 59/ 768/ Soviet military leaders are reported to have concluded after a symposium in 1956 at the Military Medical Academy that their nation could not cope with a coordinated attack from mass destruction weapons. 647/

Status of Veterinary Defense

In the Soviet organization for defense, veterinary specialists under the Military Veterinary Administration carry out prophylaxis and antiepizootic measures in animals accompanying armed forces units, conduct quality control of meat products, and counteract animal diseases communicable to man. 627/ They staff veterinary diagnostic laboratories reportedly assigned to field army and army front levels, and maintain dispensaries and local assistance points among the body of troops. 627/ 639/ Military districts have access to more extensive, permanent treatment facilities. 627/ Military veterinary personnel and MPVO civil defense veterinary teams probably enjoy the same working relationship as that found between medical units of the military forces and MPVO medical detachments. The civil defense elements were seen to be organized around veterinary administrators of each political echelon and the head veterinarian of packing plants and livestock farms. 403/ 663/ Much as the defensive structure in human public health is based on peacetime medical-care installations, the backbone of veterinary defense probably consists of bacteriology laboratories, disinfection detachments, and mobile diagnostic facilities of the civilian agencies. 305/ 357/ 403/ 627/ 668/ Around these nuclei, so-called self-defense groups are formed in rural areas. 666/

Veterinary affairs in the USSR are administered through an organization analogous in many respects to that found in the medical and public health fields. Supreme authority is vested in the chief of the Veterinary Administration under the Ministry of Agriculture. A staff known as the Veterinary Collegium, composed of the top veterinary officials in the Soviet Union, has the responsibility for all civil veterinary services in the USSR. Administrative responsibilities are passed down through similar bodies established by each of the constituent republics, and these in turn exercise responsibility for provincial, district and municipal services. All work is carried out in conformity with the government's Veterinary Regulation, which oblige the management of state and collective farms to take timely measures to ensure veterinary aid in all cases of sickness among animals. Livestock brought to a given veterinary organization must undergo 30-days quarantine. Veterinary surgeons and their assistants have access to the animals for purposes of inspection, diagnostic examinations, preventive inoculations, and other medical and prophylactic treatment. Animals that have not undergone the preliminary quarantine may not be housed in the common cattle sheds nor put in the general herds. In addition, under veterinary regulations promulgated by the Ministry of Agriculture, livestock owners and farm managers are required to inform immediately the veterinary surgeon or his assistant here serving that farm, as well as the local officials, of all cases of sudden death or simultaneous sickness in several animals. It is forbidden to use the meat of livestock or poultry condemned for slaughter, or to sell meat or raw animal products without special permission of a veterinary inspector. This rigid degree of control is possible because the chain of authority extends downward from the ministry to elements at the local community level without marked diffusion. Republics of the USSR are divided into autonomous geographic divisions, and then into districts and regional areas. Each district reportedly has at least one strategically located diagnostic laboratory, well-equipped and manned. From the district or regional laboratories, consultant veterinarians, disinfection teams, and diagnostic units can be dispatched to livestock holdings. Each state and collective farm specializing in animal production is said to maintain one or more resident veterinarians who have at their disposal the services of the regional animal hospital and diagnostic laboratory. 125/ 175/ In addition to the network of local veterinary establishments, the Ministry of Agriculture has organized a system of veterinary research institutes and experimental stations, industrial enterprises for producing biological preparations, and centers for veterinary supplies. The concentration of veterinary work under a central state service is of great importance in providing efficient animal husbandry. It makes it possible to carry out all veterinary measures in conformity with uniform plans and regulations. 155/ 810/

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The state of readiness of military veterinary units is not definitely known. Articles from the World War II period suggest a strong concern with defensive indoctrination, but few publications of that nature are available today. 669/ The possibility of attack is well recognized, for the Military Veterinary Administration has been directed to train special cadres to work closely with civil defense teams in counteracting biological agents employed against the animal population. It seems probable that the armed forces veterinary specialists would function under existing Ministry of Agriculture doctrine and regulations for disease control in the event of BW outbreaks. 811/ 812/ Aside from these regulations for reporting routinely on illnesses and deaths in animals, the defensive role of the veterinary service has been defined in training literature for MPVO units. The following responsibilities for defense against biological warfare are included: the veterinary service provides protection for livestock from air attack injury; carries out veterinary processes for livestock contaminated by pathogenic bacteria and toxins; conducts decontamination procedures; and determines the feasibility of utilizing contaminated material. All cases of livestock exposure or suspected contact with infectious disease agents must be reported immediately to the chief of the installation (city, rayon) MPVO veterinary service. In addition, there are instructions for collecting samples of contaminated soil, fodder, water, insects, and ticks for submission to a veterinary laboratory for determination of the type of agent used. Contaminated food and water, or food and water suspected of being contaminated, cannot be used without a laboratory check and without the permission of sanitation and veterinary inspection agencies. 666/ 813/ There are no indications that rehearsal for these functions in time of emergency has occurred on a significant scale, or that stockpiles of necessary equipment and reagents have been placed on livestock farms specifically for defensive purposes. The fact that disease outbreaks in peacetime are handled locally by the resident veterinarian, often with the assistance of regional diagnostic laboratories, suggests that considerable experience has been gained in combatting isolated cases. 175/ For the same reason, it can be anticipated that prophylactic and therapeutic drugs are available to some degree for immediate use. Because normal operating procedures and daily experience involve the timely dispatch of professional teams and mobile equipment from the regional or district treatment centers, it seems probable that the veterinary service could degrade substantially a biological attack of limited scale. In all probability, a mass attack covering large areas would quickly overwhelm the existing defensive structure and result in widespread and continued exposure of animals to infectious material; however, other factors affecting vulnerability must be taken into account.





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Effective vaccines against economically important animal diseases of BW potential are in the hands of Soviet veterinarians. Foot-and-mouth disease (FMD), hog cholera, and brucellosis are still major problems; however, anthrax and tuberculosis continue to take their toll of livestock. 175/ 238/ Rinderpest is reportedly in check, although a vaccinated buffer zone must be maintained in the Asiatic border areas. 810/ Because of the relatively great prevalence of these diseases in the past, eradication by slaughter was economically infeasible, and strict quarantine plus the building of a zone of immunized animals around the focus of infection became the practice in disease control. This philosophy is still paramount today; for example, a poster observed at the 1958 Agricultural Exposition in Moscow recommended a buffer zone 8 kilometers in radius for FMD. In carrying out this recommendation, figures were cited for vaccination in Kazakhstan of 105,000 cattle and 250,000 sheep. 814/ While islands of presumably solid immunity to some of these animal diseases undoubtedly exist as a result of the prophylaxis program, the over-all effectiveness of the policy is questionable. First, the diseases are still prevalent and, secondly, large segments of the livestock population in other geographic areas probably remain susceptible and in constant danger of infection by accident. For this same reason, there is no compelling indication that Soviet veterinarians could cope with biological agents against livestock if massive dissemination were involved. Since some of the most serious BW animal diseases are of viral etiology, for example, hog cholera, rinderpest, and FMD, present antibiotics and therapeutic drugs would have little effect on the course of disease.

Research in the USSR pertinant to BW defense centers on the animal disease control program. Emphasis is given to development and improvement of biologics for prophylaxis, diagnosis, and therapy, as shown by previously cited investigations. Only recently has the scientific literature reflected real concern for the possibility of airborne attack and measures to protect against it. [redacted]

Status of Anticrop Defense

Primary responsibility for the protection of crops from pests and diseases lies with the All-Union Institute of Plant Protection (VIZR), Leningrad, which is subordinate to the All-Union Academy of Agricultural Sciences in over-all policy and planning the VIZR





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coordinates and controls, to some extent, all plant protection research conducted at other institutes and establishments under the Ministry of Agriculture. 94/ No specific defensive measures against BW attack on crops, other than ordinary agricultural protection methods against disease and pest losses, are known to have been taken in the USSR. The problem posed by losses from disease is great. Research on fungicides lags behind Western development. A similar situation prevails in the development of effective apparatus for dissemination of these chemical compounds. While the USSR does possess some modern fungicides and dissemination equipment, including airplanes, it is believed that neither are in sufficient supply to mound an effective program to counteract any sizable disease outbreaks, either of natural or BW origin.

The USSR is thought to have reduced only slightly its vulnerability to anticrop attacks by normal improvement of the competence of its pathologists, increased knowledge on the part of the ordinary farmer, and the improvement of the disease-reporting services, quarantine, and quarantine enforcement. From a long-range viewpoint, the vulnerability of crops in any country to plant pathogens can be lessened in considerable measure by the development and widespread adoption of disease-resistant varieties. Reports indicate most Soviet wheats are susceptible to stripe, leaf, and stem rust; rye to black stem rust; and oats to crown rust. Evidence suggests strongly that Soviet plant breeders have made relatively little progress in developing rust-resistant varieties of wheat, rye, and oats. Recent observations [redacted] indicate that wheat-breeding programs of the conventional type are under way at a number of institutes. It is evident that considerable effort is being made to provide collective farms with clean and relatively pure seed.

There is no countermeasure known which can be used against herbicides employed as biological agents. The crops of the USSR are considered vulnerable to attack, but only at a certain season, during certain stages of growth, and under favorable meteorological conditions.

Of the many pathogens of cereals, the rust fungi seem by far the most promising for use as BW agents; of these, stem rust heads the list for use against wheat, rye, and barley, and crown rust for use against oats. Races of stem rust are known to which all available Soviet wheats appear susceptible. Because sweeping epidemics of stem rust are not at all common in the USSR, a massive inoculum would probably be required to initiate disease on a significant scale. Deposition of the inoculum early in the growing season is necessary for maximum exploitation of vulnerability. A recent comprehensive analysis of the biological vulnerability of Soviet wheat indicated that a properly timed attack with cereal rusts could cause extremely severe damage.





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Of the many pathogens of potato, only Phytophthora, the casual agent of late blight, gives rise to the sweeping epidemics needed for quick and decisive results. The area of greatest potato culture and yield in the USSR, the northwest European part, is also the region most favorable to the development of late blight and the area in which the disease now occurs most frequently. Early and massive inoculum might well be destructive, given favorable temperature, moisture, and wind conditions. The greatest weakness of this agent as a BW candidate, is the fragility of the vegetative forms. [redacted]

Both sugar beets and cotton are presently cultivated on relatively concentrated areas of southern European USSR; both are subject to a very large number of pathogenic diseases, which as yet have an undetermined anticrop BW potential. The most promising agents appear to be rust, anthracnose, and bacterial blight diseases of cotton. Because of their destructiveness and the lack of other promising pathogens, the virus diseases of sugar beets possibly have potential as BW agents.

Piricularia blast of rice and rust of maize have some potential as BW agents for these crops. Maize cultivation in the USSR is being expanded rapidly, with the development of hybrid varieties for both forage and grain. While rice is a relatively minor crop in the USSR, it is extremely important to the Sino-Soviet Bloc as a whole.

Soviet crops, in addition to being subject to the widely known bacterial and fungal diseases, are vulnerable to a large number of virus and nematode diseases, some of which are not present in the USSR but are to be found elsewhere in the world.

Pages: 143 - 181

Exemptions: (b)(3)

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## REFERENCES

The source references supporting this paper are identified in a list published separately. Copies of the list are available to authorized personnel and may be obtained from the originating office through regular channels. Requests for the list of references should include the publication number and date of this report.





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Pages: Figures 1 – 10

Exemptions: (b)(3)

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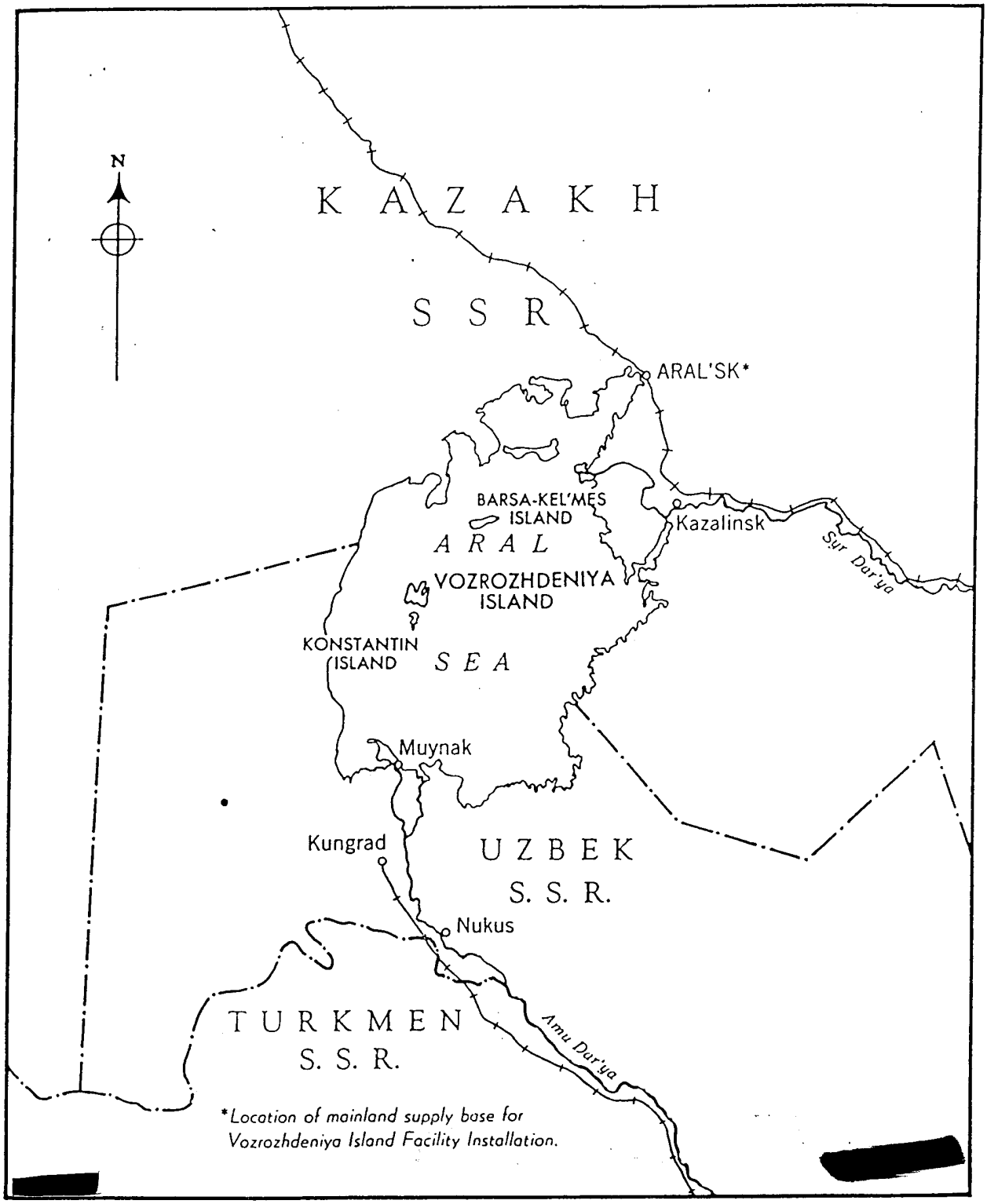
Figure 11

# USSR: VOZROZHDENIYA ISLAND ORIENTATION MAP

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Pages: Figures 12-27

Exemptions: (b)(3)