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The 1971 Smallpox Epidemic in Aralsk, Kazakhstan, and the Soviet Biological Warfare Program

Edited by
Jonathan B. Tucker
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Chemical and Biological Weapons Nonproliferation Project

MONTEREY INSTITUTE OF INTERNATIONAL STUDIES

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Editing this occasional paper was a difficult undertaking because its subject combines issues related to public health, security, the natural sciences, and the physical sciences. The assistance of many persons made the task easier, and we take this opportunity to acknowledge their contributions. Had it not been for Dr. Bakyt B. Atshabar, this occasional paper would not have been possible. We thank him for having presented us with the original Soviet-era reports. The excellent translation provided by Ms. Rosa Kavenoki and Mr. Michael Gillen enabled us to understand what we were dealing with. Ms. Elena Bloomstein of Sandia National Laboratories served as interpreter in the extensive interviews that Dr. Zelicoff conducted with some of the victims of the smallpox outbreak, a difficult task given the unpleasant memories he asked his interviewees to share. Dr. Sonia Ben Ouagrham played a key role by acting as a liaison with Dr. Atshabar and by providing photographs of the Aral Sea region. Thanks to Mr. Milton Leitenberg who helped us by making available special information about the former Soviet biological warfare program. We are grateful to Dr. Richard Pilch and Ms. Kara Yermukan for their reviews of the official report and Dr. Zelicoff's analysis. We also appreciated the rapid publication of this occasional paper made possible by the work of Dr. Scott Parrish and Ms. Kimberly McCloud. CNS Director Dr. William Potter and Deputy Director Dr. Amy Sands provided consistent support of this project and our efforts.

Jonathan B. Tucker and Raymond A. Zilinskas
June 2002

FOREWORD

by Bakyt B. Atshabar

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The military-industrial complex of the former Soviet Union used the territory of Kazakhstan as a testing ground for various types of weapons of mass destruction, including nuclear weapons at Semipalatinsk. Soviet officials perpetuated the myth that the test sites were harmless and categorically denied any adverse effects on the Kazakhstani people, whose deteriorating health they sought to explain as a consequence of natural factors. In fact, the grave environmental and health effects of nuclear weapons testing at Semipalatinsk are now clear. Less well known are the consequences of biological weapons testing on the territory of Kazakhstan.

From 1936 to 1992, Vozrozhdeniye Island, an island in the western part of the Aral Sea whose territory is divided between Kazakhstan and Uzbekistan, was the major proving ground in the Soviet Union for the open-air testing of biological warfare (BW) agents. According to information provided by Z. A. Rakhmatulin, the former chief of staff at the test site during the 1980s, and by G. L. Lepyoshkin, the former general director of the National Center for Biotechnology in Stepnogorsk, a variety of BW agents were tested on Vozrozhdeniye Island, including the microbial pathogens that cause plague, anthrax, Q-fever, smallpox, tularemia, and Venezuelan equine encephalitis, as well as botulinum toxin. Some of the pathogens tested in aerosol form were genetically modified strains that produce atypical disease processes and are resistant to existing medications, potentially complicating diagnosis and treatment.

The environmental consequences of such tests were sometimes dramatic. In 1984 in the Volga-Ural steppe, and again in 1989 in the Torghai *oblast*, hundreds of thousands of *saiga* antelope died over a short time. These massive die-offs were officially attributed to outbreaks of pasteurellosis, a disease caused by the bacterium *Pasteurella haemolytica*. Yet they were almost certainly the result of open-air BW testing on Vozrozhdeniye Island. It is also known that during the late 1980s, large quantities of anthrax spores that had been mass-produced and stockpiled in Russia were transported to the island for decontamination and burial.

There are conflicting opinions on the dangers posed today by the legacy of BW testing on Vozrozhdeniye Island. Experts from the former Soviet military-industrial complex who worked on the island contend that the extermination of rodents from testing areas prior to the release of live BW agents, and subsequent clean-up operations, completely removed any danger that infectious agents would persist at the testing grounds. Soviet officials also counted on the intense solar radiation during the summer months to disinfect the testing grounds after they were closed down.

Other experts disagree. Ultraviolet radiation can kill only exposed, living microbes and viruses—not bacterial and fungal spores that persist beneath the surface of the soil. Moreover, because of the extensive downwind range of the tests, and the possibility that some of the microbes could have infected insect or animal hosts (such as fleas or rodents) that serve as persistent reservoirs of disease, infectious agents may have spread throughout the territory of Vozrozhdeniye Island.

Today it is impossible to guarantee with any certainty the absence of dangerous biological contamination at the former BW test site, which remains a potential health hazard not only to the population of Central Asia but to other peoples as well. Because of

several factors—the rapid shrinkage of the Aral Sea, which recently turned Vozrozhdeniye Island into a peninsula of the Uzbek mainland; the plans for oil and gas prospecting by international oil companies; and the largely unregulated visits to the island by local people scavenging for abandoned metal and equipment—there is an urgent need to decontaminate and rehabilitate the former BW testing ground. Solving this problem will require a comprehensive approach and the participation of specialists with a variety of expertise.

The world has no experience with cleaning up the contamination caused by biological weapons testing on such a large scale. Great Britain performed some remediation at its former BW test site on Gruinard Island, off the coast of Scotland, which was used for testing anthrax bombs during World War II. Nevertheless, the challenge of cleaning up Vozrozhdeniye Island is vastly greater. Gruinard Island has an area of only two square kilometers, anthrax was the only BW agent tested there, the duration of the testing was limited, and the soil contamination on the island was largely a surface phenomenon.

The Soviet medical report contained in this occasional paper describes an unusual outbreak of smallpox in the city of Aralsk, Kazakhstan, in 1971. From August to October, a total of ten cases of smallpox were recorded, three of them fatal. The undeniable fact is that people in Aralsk became infected with smallpox at this time. How could the virus have suddenly appeared out of nowhere in the middle of Kazakhstan, a thousand kilometers from the nearest border?

In their report, the Kazakhstani specialists who helped to contain the outbreak identified two possible routes by which the virus could have reached the city. The first scenario was that a scientist participating in an ichthyological expedition in the Aral Sea became infected with smallpox when she went ashore at one of three port cities. She then passed the virus on to her brother, who lived in Aralsk and became the first of the nine people infected. The second possible scenario was that the virus originated in Afghanistan, where smallpox was still endemic at the time, and reached Aralsk from the southern border regions of Kazakhstan by land or waterway. This hypothesis is less plausible, because the disease could only have been transported from Afghanistan to Aralsk through Tajikistan and Uzbekistan. If people had become ill with smallpox in those republics, they certainly would have been detected, yet no such cases were reported.

In view of what has been learned in recent years about the former Soviet BW program, it seems that the most likely source of the smallpox outbreak was the test site on Vozrozhdeniye Island. Simply put, the index case and the nine residents of Aralsk who became infected with smallpox in 1971 were in the wrong place at the wrong time. They all suffered, and three of them died, because they were unprotected and had not been informed about the secret testing of deadly pathogens that was taking place nearby without their consent.

No one has ever apologized to the citizens of Aralsk for those who died in the smallpox outbreak, or to their relatives. I hope that the publication of this report will serve as a memorial to them.

INTRODUCTION

by Jonathan B. Tucker and Raymond A. Zilinskas
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The heart of this occasional paper is a translation of an official Soviet-era document titled "Report on Measures Taken to Contain and Eradicate the Smallpox Outbreak Locale in the City of Aralsk, September/October 1971." This previously secret report describes and analyzes an outbreak of smallpox that occurred in autumn 1971 in Aralsk, a small city on the shore of the Aral Sea in what was then the Kazakhstan Soviet Socialist Republic. Ten persons became infected with smallpox, and three died, before the outbreak was successfully contained by means of quarantine, mass vaccination in Aralsk, and other public health measures. A contagious disease that killed about a third of its victims, smallpox was characterized by high fever, prostration, and a painful pustular rash on the face and body that left survivors with disfiguring facial scars.

The 1971 smallpox outbreak in Aralsk was unusual because the Soviet Union had eradicated endemic smallpox from its territory in 1936. Moreover, the last previous outbreak of "imported" smallpox on Soviet soil had occurred a decade earlier, in 1961. Soviet health authorities kept the Aralsk outbreak secret and did not report it to the World Health Organization (WHO), as required under international agreement. Epidemics in the Union of Soviet Socialist Republics (USSR) often went unreported, because they undermined the propaganda image of the "socialist workers' paradise." In this case, however, there may have been another reason for keeping the smallpox outbreak under wraps—the Aralsk outbreak could have originated in a field test of weaponized smallpox virus at the nearby Soviet biological warfare (BW) testing grounds on Vozrozhdeniye Island in the Aral Sea.

In 1980, a global vaccination campaign coordinated by the WHO ended with the eradication of smallpox from the planet, the first and so far only infectious disease to have been so vanquished. Nevertheless, stocks of variola virus, the causative agent of smallpox, still exist in a few laboratories. In addition to two WHO-authorized repositories of variola virus in the United States and Russia, it is believed that some states of proliferation concern, such as North Korea and Iraq, may retain illicit stocks of the virus. Since the terrorist attacks of September 11, 2001, and the subsequent campaign in which letters containing *Bacillus anthracis* spores were sent to public figures, the U.S. government has been increasingly concerned about the possibility that terrorists could gain access to laboratory stocks of variola virus and use it as a mass-casualty weapon. As a result, learning more about the Soviet offensive BW program, especially its efforts to weaponize the smallpox virus, has acquired new urgency.

The official Soviet report on the 1971 Aralsk outbreak, written in Russian, was made available to the Center for Nonproliferation Studies (CNS) of the Monterey Institute of International Studies in late 2001 by Professor Bakyt B. Atshabar, director of the Mosgut Aikimbaev Kazakh Scientific Center of Quarantine and Zoonotic Infections in Almaty, Kazakhstan. Members of the CNS staff reviewed the document and concluded that the original text of the report would be of great interest to infectious disease clinicians, microbiologists, public health practitioners, historians of the Soviet Union, and international security specialists. Accordingly, CNS arranged to have the document translated into English by Rosa Kavenoki and Michael Gillen of the Monterey Institute of International Studies.

The text of the translated report and its two annexes are published here for the first time.[1] Because the official outbreak report was written by a medical doctor for a technical audience,

[1] A small part of the report containing personal data on the smallpox victims, such as names, home addresses, places of work, etc., has been excluded from this publication for reasons of privacy.

Figure 1: Aral Sea, 1977

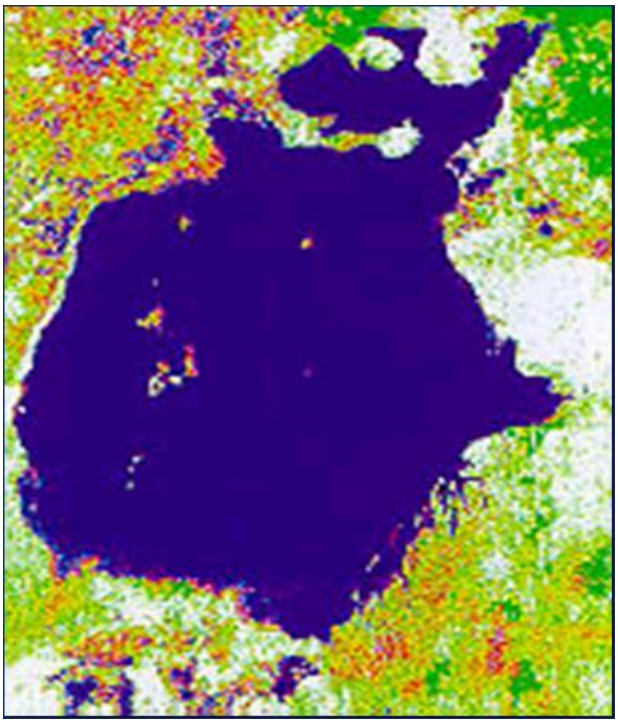

Figure 2: Aral Sea, 1995

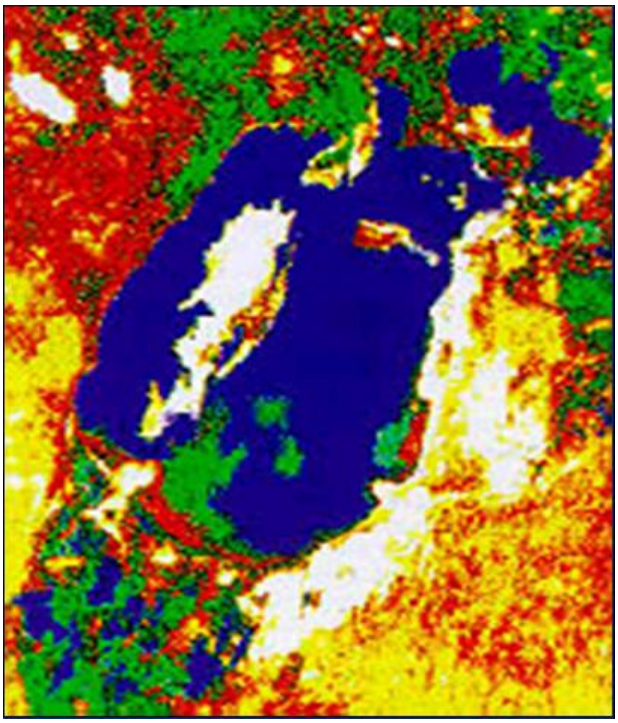

Figure 3: Aral Sea, December 2001

laypersons may find it rather dry and difficult to understand. New information has also come to light over the past 30 years that is vital for assessing how and why the 1971 smallpox epidemic occurred. For these reasons, the editors have supplemented the official report with two additional papers: this introduction and an epidemiological analysis of the outbreak by Alan P. Zelicoff, M.D., a physician and BW expert at Sandia National Laboratories in Albuquerque, New Mexico. The following sections of this introduction describe certain aspects of the Aral Sea region's environment and public health status; the history of the Soviet BW program; the level of awareness in the United States about that program; and some implications of the Aralsk outbreak and the Soviet BW program for international biological arms control.

THE ENVIRONMENTAL AND PUBLIC HEALTH STATUS OF THE ARAL SEA REGION[2]

The brackish Aral Sea was once the fourth largest inland lake in the world, exceeded in size by only the Caspian Sea, Lake Victoria, and Lake Superior. Until the 1960s, approximately 60 square

[2] The information in this section has largely been abstracted from presentations made at two conferences organized by the CNS Almaty Office. The first was "Biotechnological Development in Kazakhstan: Nonproliferation, Conversion, and Investment," held July 24-26, 2000, in Stepnogorsk, Kazakhstan; and the second was "Preventing Health and Proliferation Problems Stemming from the Soviet BW legacy in Central Asia," held April 19-20, 2001, in Almaty, Kazakhstan, <http://cns.miis.edu/cns/projects/nisnp-/nisro/cnsro.htm>. Additional information was gleaned from "The Aral Sea Homepage," developed by the German Aerospace Center, <http://www.dfd.dlr.de-/app/land/aralsee/index.html>.

kilometers of water flowed into the sea in an average year, carried mostly by two feeder rivers, the Amu and the Syr Darya. In the mid-1950s, Soviet planners decided that Central Asia should become the hub of cotton production for the entire Soviet Union. To this end, they launched massive public works projects to divert the waters of the feeder rivers away from the Aral Sea and into irrigation systems. Although these projects can be said to have achieved their objective—Uzbekistan today produces more than five million tons of cotton per year, accounting for about a third of the country's gross national product—the diversion of the rivers has had catastrophic effects on the environment and public health of the entire region.

Today the Aral Sea receives just 10 percent of the volume of water that flowed into it during the 1950s. Specifically, the current inflow is between one and five square kilometers of water per year, although the sea requires an inflow of about 35 square kilometers of water per year just to maintain a constant volume. Over the years, the drastically reduced inflow has caused the surface area of the lake to shrink to less than half its original size: from 26,000 square kilometers in the early 1960s to 11,000 square kilometers in 2000. As the sea has receded, the islands within it have increased dramatically in size.

Vozrozhdeniye Island ("Rebirth Island") was once located near the middle of the Aral Sea (see Figure 1). In 1960, the land area of the island was 216 square kilometers; but by 2000, because of the recession of the surrounding water, it had grown to 2,000 square kilometers. In late 2001, Vozrozhdeniye ceased to be an island and became a peninsula connected to the Uzbek mainland (see Figure 3). Although the border between Uzbekistan and Kazakhstan crosses the new peninsula, approximately 80 percent of its surface area belongs to Uzbekistan (the precise border is not defined).

The desiccation of the Aral Sea has had a profound environmental impact. The moderating effect of the lake on the local climate has nearly disappeared, causing the summers to become much hotter and drier, and the winters colder and windier. As the sea receded, a large expanse of silty lake bottom dried up and was transformed into fine dust. When strong winds blow, massive dust clouds are carried over thousands of square kilometers. Further, the indiscriminate use of pesticides and other agrochemicals has caused water polluted with toxic residues to drain from agricultural lands into the Aral Sea, where they have become concentrated. As a result, the blowing dust is heavily contaminated with toxic chemicals: over the years, approximately 75 million tons of dust, laden with salts and other toxic substances, have been carried on the winds from desiccated parts of the Aral Sea over the surrounding areas. The combined effects of the climatic changes, salination, and pollution have devastated the wildlife of the region. Of more than 20 species of fish that once thrived in the Aral Sea, two barely survive; of the 178 species of land animals once indigenous to the region, only 38 remain.

The severely degraded environment of the Aral Sea has had a grave impact on the public health of the local populations. The region's drinking water contains between seven and 16 times the maximum level of pollutants allowed by national law**.** In drainage ditches and irrigation canals, concentrations of toxic chemicals often exceed permitted levels by 900 percent. Almost every pregnant woman in the Aral Sea region is anemic, and the infant mortality rate is 110 per thousand live births.[3] Life expectancy for men living in some districts close to the sea is just 40 years, and approximately 70 percent of 10th grade boys have abnormalities in their sperm. The cancer rate of the population in the Aral Sea region is much higher than that of other populations in Kazakhstan and Uzbekistan, and increases by roughly three percent per year.

HISTORY OF THE SOVIET BIOLOGICAL WARFARE PROGRAM

Relatively little is known about the former Soviet Union's BW program, as it existed before the Aralsk smallpox outbreak of 1971. This introduction provides a brief overview of the history of the program; more extensive examinations can be found elsewhere.[4]

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[3] For comparison, the infant mortality rate for Kazakhstan generally is 59.17 deaths/1,000 live births (2001 est.) and 20.05 deaths/1,000 live births (2001 est.) for Russia. See *The World Fact Book*, 2001 (Washington, DC: Central Intelligence Agency, 2001), <http://www.bartleby.com/151/a28.html>.

[4] U.S. House of Representatives, Testimony of Dr. Kenneth Alibek to the House Armed Services Committee, 107th Congress, 1st Session, October 21,

During the Russo-Japanese war of 1904-1905, World War I, and the civil war of 1918-1921, infectious diseases inflicted far more casualties on the Russian armies than did battlefield wounds.[5] Of all diseases, military leaders feared typhus the most.[6] To improve military public health, the Worker-Peasant Red Army decided in 1926 to establish the Vaccine-Serum Laboratory in a village called Vlasikha, near the train station at Perkhushkovo (located approximately 20 kilometers from Moscow). In 1933, Professor Ivan M. Velikanov was appointed director of the laboratory, which developed vaccines and sera against common infectious diseases.[7] At the same time, however, the Vaccine-Serum Laboratory undertook secret research on offensive BW. Over the next decade, the laboratory changed its name and location repeatedly. In 1934, it was renamed the Biotechnical Institute.[8] In 1942, it became the Red Army Scientific Research Institute of Epidemiology and Hygiene and moved to the city of Kirov (located 800 kilometers east of Moscow), where it remains to this day. In 1985, the institute was renamed the Scientific Research Institute of Microbiology of the Ministry of Defense (MOD).

By the start of World War II, the military microbiological institute in Kirov was a component, albeit an important one, of a larger biological weapons acquisition system. Already in 1925, a small BW laboratory, which came to be called the Scientific Research Institute of Health, had been established in Moscow under the directorship of A.N. Ginsburg. In 1928, Ginsburg submitted a progress report to Kliment Y. Voroshilov (1881-1969), the commissar for defense, describing the work that had been done to demonstrate the feasibility of BW. He assessed the potential uses of bacteria for purposes of warfare and sabotage, presented a plan for the organization of military biology, and proposed another plan for organizing defenses against biological attacks.[9] It is likely that Ginsburg's report led the Revolutionary Military Council to issue a secret decree in 1928 ordering the launch of an offensive BW research and development program.[10] In response to this decree, the Military Chemical Agency, controlled by the Soviet People's Commissariat of Defense (which later became the MOD), was designated as the lead agency for managing both the offensive BW program and that for BW defenses. Also, a civilian agency, the People's Health Commissariat (which later became the Ministry of Health), was ordered to coordinate and execute military requests related to BW. At that time, the People's Health Commissariat operated a biomedical research network consisting of at least 35 institutions working in disciplines such as epidemiology, genetics, immunology, microbiology, and virology.[11]

As with many aspects of the history of the Soviet BW program, diverse opinions exist as to how the 1928 decree was implemented. Bojtzov and Geissler assert that the early phase of the BW program was headed by Ginsburg and focused initially on the weaponization of *Bacillus anthracis* (the causative agent of anthrax) and *Clostridium botulinum* (the source of botulinum toxin), as well as on developing efficient methods of disinfection and immunological research. Various types of animals were used as test subjects, including cats, rabbits,

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1999; Kenneth Alibek with Stephen Handelman, *Biohazard: The Chilling True Story of the Largest Covert Biological Weapons Program in the World—Told From Inside by the Man Who Ran It* (New York: Random House, 1999); G. Bozheyeva, Y. Kunakbayev, and D. Yeleukenov, *Former Soviet Biological Weapons Facilities in Kazakhstan: Past, Present and Future*, Occasional Paper 1 (Monterey, CA: Monterey Institute of International Studies, 1999); Milton Leitenberg, "The Possibilities and Limitations of Biological Weapons Conversion. Personnel and Facilities," in E. Geissler, L. Gazsó, and E. Buder, eds, *Conversion of Former BTW Facilities* (Amsterdam: Kluwer Academic Publishers, 1998), pp. 119-133; A. Rimmington, "Invisible Weapons of Mass Destruction: the Soviet Union's BW Programme and its Implications for Contemporary Arms Control," *Journal of Slavic Military Studies* 13 (2000), pp. 1-46; and Milton Leitenberg and Raymond A. Zilinskas, *Doing the Devil's Work: The Soviet Union's Biological Warfare Program and Its Legacy* (unpublished manuscript, 2002).

[5] V.L. Orlov, *We Defended Russia* (in Russian) (Moscow: Directorate of the Radiological, Chemical and Biological Defense Forces Command, Ministry of the Russian Federation, 2000).

[6] Alibek with Handelman, *Biohazard*.

[7] Orlov, *We Defended Russia*.

[8] Ibid.

[9] V. Bojtzov, and E. Geissler, "Military Biology in the USSR, 1920-45," in E. Geissler and J.E. van Courtland Moon, eds., *Biological and Toxin Weapons: Research, Development and Use from the Middle Ages to 1945* (New York: Oxford University Press, 1999), pp. 153-167.

[10] Alibek with Handelman, *Biohazard*.

[11] Bojtzov & Geissler, "Military Biology."

goats, and horses, and the BW agents were either injected or dispersed as aerosol in sealed chambers. The scope of work in Ginsburg's laboratory would later include studies on *Vibrio cholerae* (cholera) and *Yersinia pestis* (plague).

Ken Alibek's account of the response to the 1928 decree differs from Bojtzov and Geissler. Alibek—chief scientist and first deputy director of the Soviet BW complex, Biopreparat, who defected to the United States in October 1992—writes that the GPU (a predecessor to the KGB) was put in charge of efforts to weaponize the rickettsial species that causes typhus. During the 1930s, both "wet" and "dry" formulations of typhus rickettsia were developed for dissemination as airborne aerosols.[12] While it is impossible to determine who is correct without access to the archives of the former Soviet Union, one thing is clear: the Soviet Union initiated and supported the first organized BW program in the world.

By the time World War II broke out, German intelligence sources had identified three Soviet institutes in the Moscow region that were involved in offensive BW activities: Ginsburg's institute, the Moscow Chemical-Pharmaceutical Institute, and the Saratov Institute for Microbiology and Epidemiology (called Mikrob for short).[13] Four more BW institutes were believed to exist in the Leningrad region: the Zlatogrov-Maslokovich Laboratory at the Leningrad Veterinary and Zoological Technical Institute, the Bacteriological Institute of Leningrad, an unnamed facility at the Kronstadt naval base, and an unnamed research station on the shore of Lake Ladoga. Reportedly, all of these institutions focused their efforts on the weaponization of anthrax and plague.[14] Again, Alibek's opinion differs from that of the Germans. He claims that there were two major Soviet BW facilities during World War II: the Lenin Military Academy, which focused on typhus, and a laboratory on Solovetsky Island, which performed research on the pathogens that cause Q-fever, glanders, and melioidosis. In 1941, the BW programs at the Lenin Military Academy and Solovetsky Island were moved to Kirov and incorporated into the work program of the Red Army Scientific Research Institute of Epidemiology and Hygiene.[15]

Two field test sites for biological weapons were established before World War II, both on islands. The first was Gorodomlya Island in Lake Seliger, north of Moscow. Here, a 10 square kilometer test site was laid out in the early 1930s. Starting in about 1935, Gorodomlya Island was allegedly used to field-test pathogens that cause foot-and-mouth disease, leprosy, plague, and tularemia.[16] The second island proving ground, which later became the favored location for large-scale testing of biological agents and weapons, was Vozrozhdeniye Island in the Aral Sea.

During the summer of 1936, the first military/scientific expedition, led by Biotechnical Institute director Velikanov, arrived on Vozrozhdeniye Island to conduct field-testing of pathogens being developed for weapons use.[17] The main pathogen tested at this time was *Francisella tularensis*, the causative agent of tularemia, an incapacitating bacterial disease of moderate lethality. Testing continued throughout the summer of 1937 and included dropping containers filled with the bacterial agent from aircraft.[18] Although the offensive development of *Francisella tularensis* remained the major focus of the testing program, field tests were also carried out with other anti-personnel agents, such as the pathogens that cause cholera, dysentery, leprosy, paratyphus, plague, tetanus, and typhus, as well as an anti-livestock agent, foot-and-mouth disease.[19] With the end of the 1937 testing season, no more field tests were performed on the island for 17 years.[20]

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[12] Alibek with Handelman, *Biohazard*.

[13] J.W. Barnes, C. Henze, W.J. Cromartie, and J.W. Hofer, *ALSOS Mission, Intelligence Report* B-C-H-H/305 (Washington, DC: War Department, 1945); and W. Hirsch, *Soviet BW and CW Preparations and Capabilities* (also known as the Hirsch Report) (Edgewood, MD: United States Army Chemical Warfare Service, 1951).

[14] Barnes, et al., *ALSOS Mission, Intelligence Report*.

[15] Alibek with Handelman, *Biohazard.*

[16] Orlov, *We Defended Russia*.

[17] Bozheyeva, et al., *Former Soviet Biological Weapons Facilities in Kazakhstan.*

[18] Hirsch, *Soviet BW and CW Preparations.*

[19] Ibid.

[20] Bozheyeva, et al., *Former Soviet Biological Weapons Facilities in Kazakhstan.*

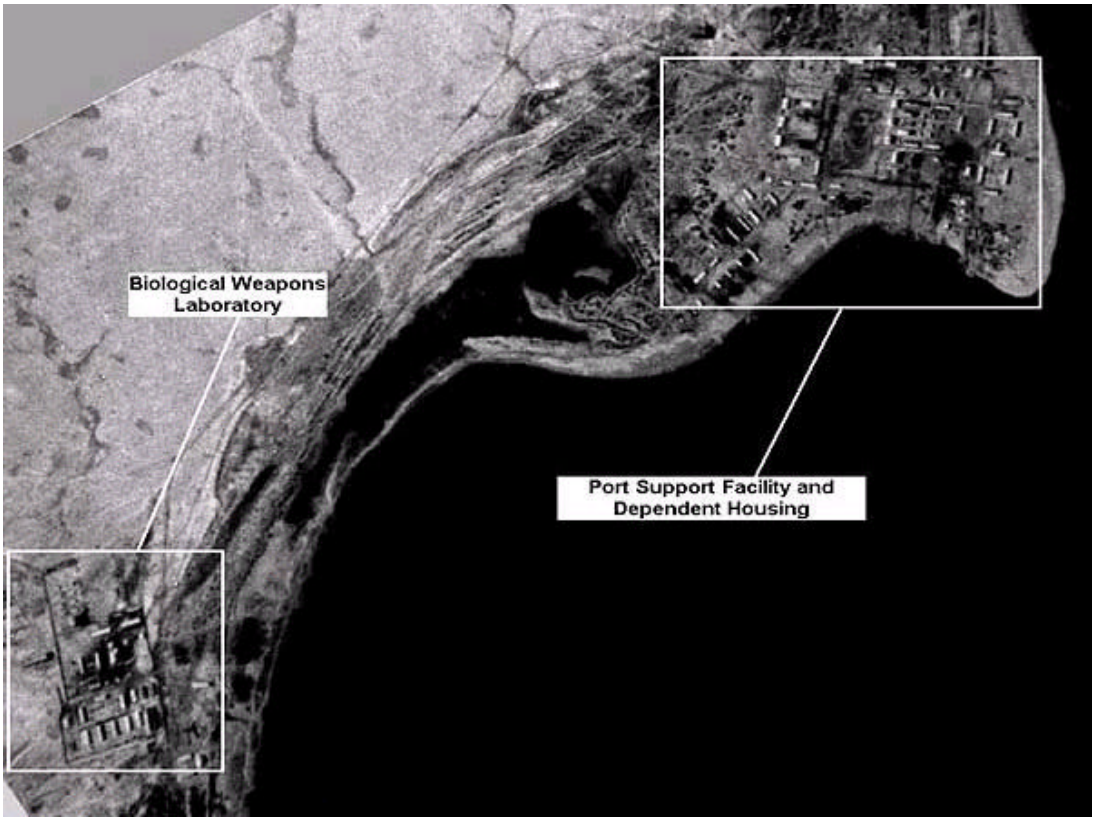
Figure 4: Vozrozhdeniye Island, 1970

In 1939, Stalin placed his Minister of Internal Affairs, Lavrentii P. Beria (1899-1954), in overall command of the Soviet BW program. Responsible for day-to-day operations was the Main Military Directorate of the Red Army, headed by Yuri I. Smirnov. Smirnov, who was to be appointed Minister of Health in 1947, has been described as "one of the main Soviet ideologues, if not the main ideologue, in the development of biological weapons and strategies of biological warfare."[21] In late 1946, the Main Military Directorate of the Red Army's name was changed slightly, to the Main Military Medical Directorate of the Red Army, and in 1953 the Council of the Ministers of the USSR transferred the BW-related responsibilities of this directorate to the Seventh Directorate of the General Staff, which operated the program for the next 20 years.

The history of the Soviet BW program from the 1950s to the modern era is largely unknown territory. No defectors have emerged who are familiar with the program as it operated in those early days. The Russian scientific literature makes few if any references to that period, and journalists have generally not found it worthy of investigation. What is known is that the Red Army Scientific Research Institute of Epidemiology and Hygiene in Kirov became the most important BW institute in the Soviet military. In 1948, as its workload expanded, the MOD decided to establish an additional research institute in Sverdlovsk (now Yekaterinburg). This new facility was at first a branch of the Red Army Scientific Research Institute of Epidemiology and Hygiene, but in 1960 became independent and was named the Military

[21] Soviet weapons scientist (name withheld by request), interview with Raymond A. Zilinskas, 1999.

Figure 5: BW Test Facilities on Vozrozhdeniye Island



Technical Scientific Research Institute.[22] The new institute initially focused its efforts on developing defenses against toxins and methods to treat anthrax infection. In the late 1950s, one of its research groups developed models for use by the Soviet military to predict the effects of enemy biological attacks.[23]

Beginning in the early 1950s, the Soviet government became increasingly concerned about biological weapons then being developed by the United States. It was decided, therefore, to establish an institute to carry out research on the problem of BW and how to defend against it.[24] Accordingly, in 1954 an existing institute in the town of Zagorsk (now Sergiyev Posad) was taken over by the MOD and named the Scientific Research Institute of Medicine.[25] At first, researchers at this institute concentrated their efforts on developing improved methods for immunization against smallpox. During the 1960s, however, institute researchers were tasked with developing biological weapons based on viruses, including variola virus, the causative agent of smallpox.[26] Apparently, the successor to the Scientific Research Institute of Medicine, the Virology Center of the Scientific Research Institute of Microbiology, is still the Russian military's premier virology research institute.

Meanwhile, in 1952, the Soviet government reactivated the BW testing site on Vozrozhdeniye Island. By 1954, a large and complex facility for testing biological weapons and defensive equipment, officially named Aralsk-7, had been built on Vozrozhdeniye Island and the nearby Komsomol Island. Experiments and field tests were

[22] The Military Technical Scientific Research Institute was renamed three times: in 1974 it became the Scientific Research Institute of Microbiology of the MOD; in 1986 the Russian Federation Ministry of Defense Department of Military Epidemiology under the Scientific Research Institute of Microbiology; and in 1995 the Center for Military-Technical Problems of Biological Defense of the Scientific Research Institute of Microbiology.

[23] Orlov, *We Defended Russia*.

[24] Ibid.

[25] In 1986, the Scientific Research Institute of Medicine was renamed the Institute of Virology under the Scientific Research Institute of Microbiology, and in 1995 it became the Virology Center of the Scientific Research Institute of Microbiology.

[26] Alibek with Handelman, *Biohazard*.

conducted by the staff of the MOD Field Scientific Research Laboratory, who were stationed on the island along with Military Unit 25485, which numbered several hundred personnel. Reportedly, Aralsk-7 tested the pathogens that cause anthrax, tularemia, brucellosis, plague, typhus, Q-fever, smallpox, Venezuelan equine encephalitis, and botulinum toxin. At the open-air test site, various BW agents were dispersed by aerosol sprayer and exploding bombs, and the resulting dispersion patterns were detected by arrays of detectors placed on and above the ground. A wide variety of animals were used as test subjects, including mice, guinea pigs, hamsters, sheep, donkeys, horses, and monkeys.[27]

By the time the 1971 smallpox outbreak in Aralsk occurred, the Soviet Union was supporting a large, sophisticated BW program, in which Vozrozhdeniye Island played a vital role. It appears that biological weapons developed at the three military microbiological institutes were field-tested on the island, including weapons based on the smallpox virus developed by the MOD institute in Zagorsk. At that time, the Soviet Union was legally bound by the 1925 Geneva Protocol banning the use in warfare—but not the development, production, or stockpiling—of chemical and biological weapons (CBW).[28] Thus, the Soviet Union did not violate international law at that time by operating an offensive BW program.

On April 10, 1972, however, the Soviet Union, along with 77 other nations (including the United States), signed the Biological and Toxin Weapons Convention (BWC).[29] In 1975, Moscow ratified the treaty and became a full-fledged state party. In doing so, it agreed to observe a complete ban on "microbial or other biological agents, or toxins whatever their origin or method of production, of types and in quantities that have no justification for prophylactic, protective or other peaceful purposes; [and on] weapons, equipment or means of delivery designed to use such agents or toxins for hostile purposes or in armed conflict" (Article 1 of the BWC). Shortly after it agreed to sign the BWC in 1972, the Politburo cynically ordered the Soviet offensive BW program to be substantially expanded and diversified.

Simultaneously with making the decision to substantially expand the BW program, the Council of Ministers of the USSR and the Central Committee of the Communist Party established a new directorate for biological defense and offense: the 15th Main Directorate of the Soviet MOD (for reasons of secrecy designated Post Office Box A-1968). General Smirnov directed the 15th Main Directorate until 1985 (he died in 1989). In parallel to the MOD program, a second top-secret BW program was established under the civilian cover of a vast pharmaceutical research and production complex known as Biopreparat, which encompassed some 40 facilities in various parts of the Soviet Union as well as other elements reporting to the Soviet Ministries of Health and Agriculture. By the late 1980s, a total of some 60,000 scientists, technicians, and support staff were working in various components of the Soviet BW program.

After 1972, the 15th Main Directorate operated the BW test site on Vozrozhdeniye Island and a year-round command post in Aralsk, on the mainland of Kazakhstan, to support it. At the height of the Soviet BW program in the mid- and late-1980s, up to 800 scientists and troops were deployed in the barracks and headquarters area of the island, called Kontubek, during the peak testing period from April to August.[30] One kilometer south of Kontubek was a laboratory complex, which included high-containment facilities for work with dangerous pathogens. A few kilometers south of the laboratory complex was an open-air test range, covering more than 100 square kilometers, where the BW agents were tested. Since the prevalent winds during the testing period blew from north to south, and because the distance from Vozrozhdeniye Island to the mainland along a north-south axis was approximately 125 kilometers during the 1970s, the risk that the aerosolized pathogens used in field tests would reach populated areas was extremely low.

[27] Bozheyeva, et al., *Former Soviet Biological Weapons Facilities in Kazakhstan*.

[28] League of Nations, Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous of Other Gases, and of Bacterial Methods of Warfare, *Treaty Series*, vol. 94 (2138), 1929.

[29] United States Arms Control and Disarmament Agency, *Arms Control and Disarmament Agreements: Texts and Histories of the Negotiations* (Washington, DC: U.S. Arms Control and Disarmament Agency, 1996), pp. 95-104.

[30] N. Moskvina, "Where Anthrax is Buried" (in Russian), Stringer-Agency (Almaty), April 9, 2002.

If the 1971 Aralsk smallpox outbreak was indeed caused by the Soviet BW program, which is likely, it should be noted that this program was over the years responsible for other civilian casualties. In 1937, the deputy director of the Biotechnical Institute, A.L. Berlin, was infected by *Yersinia pestis* during an experiment involving the testing of a newly developed anti-plague vaccine. After having been unknowingly exposed to virulent bacteria, he was called to Moscow to report on progress on the new vaccine. In that city, Berlin infected two other persons; all three died of plague. According to Dr. Igor Domaradski, the disease did not spread among Moscow's population because of quick preventive actions by local public health authorities.[31]

In addition, the 1979 anthrax epidemic, which took the lives of at least 85 persons and injured at least an additional 150 in Sverdlovsk, was the result of an accident at the Scientific Research Institute of Microbiology of the MOD (also called Compound 19), which was weaponizing *Bacillus anthracis* and producing massive quantities of its spores for weapons use. This event has been written about in many publications (there are 54 in our files), so it is not necessary for it to be described here.[32]

The last accidents of which we are aware occurred in 1988 and 1991 and involved researchers at Biopreparat's All-Union Center for Applied Virology (Vector). The first victim was the head of the Virus Culture Division, Dr. Nikolay Ustinov, who stuck himself with a needle attached to a syringe containing the Marburg hemorrhagic fever virus. After exhibiting horrible symptoms, he died on April 30, 1988.[33] Another person, whose name has not been released, was infected by same strain of Marburg virus that killed Ustinov in 1990, but he survived and still works at Vector.[34]

The Soviet BW program reached its apogee during 1985-1988, after which it was gradually scaled back by a secret decree of General Secretary Mikhail S. Gorbachev. In late 1988, slurries containing *Bacillus anthracis* spores and other deadly pathogens were buried on Vozrozhdeniye Island. The anthrax spores had been produced at the military microbiology facility in Sverdlovsk and stockpiled at Zima, near Irkutsk.[35] Because the volume of the slurries was too large to autoclave, they were shipped to Vozrozhdeniye Island for decontamination and burial. The anthrax spores were mixed with bleach in 250-liter stainless steel containers and then buried in 13 pits within a total area of less than a football field. Since *Bacillus anthracis* spores tend to clump when in solution, however, some were shielded from the disinfecting action of the bleach and remained viable in the burial pits. (In early 2002, the U.S. government entered into an agreement with the government of Uzbekistan to decontaminate the pits and destroy the remaining structures of the Field Scientific Research Laboratory.[36])

On April 19, 1992, Russian President Boris Yeltsin, who had replaced Gorbachev after the break-up of the Soviet Union in December 1991, acknowledged that the Soviet BW program had continued for some 20 years in violation of the BWC and ordered it to be closed down. That year, the biological laboratories on Vozrozhdeniye Island were partially dismantled, the equipment was removed to the mainland, and the military units stationed at Aralsk and Kontubek were deployed elsewhere. Over the next several years, the various Biopreparat facilities were dismantled or converted to peaceful research and pharmaceutical production. Nevertheless, the Russian military biological

[31] I. V. Domaradski, The *History of BW Development in the Soviet Union* (in Russian) (unpublished manuscript, 1998).

[32] See Matthew S. Meselson, Jeanne Guillemin, M. Hugh-Jones, A. Langmuir, I. Popova, A. Shelokov, O. Yampolskaya, "The Sverdlovsk Anthrax Outbreak of 1979," *Science* 266 (1994), pp. 1202-1208; Jeanne Guillemin, *Anthrax: The Investigation of a Deadly Outbreak* (Berkeley, CA: University of California Press, 1999); and Victor Israelyan, "Fighting Anthrax: a Cold Warrior's Confession," *Washington Quarterly* 25 (2002), pp. 17-29.

[33] Soviet weapons scientist (name withheld by request), interview with Raymond A. Zilinskas, 1999.

[34] V.V. Nikiforov, et al., "A Laboratory Case of Marburg Hemorrhagic Fever" (in Russian), *Zurnal Mikrobiologii i Immunologii* No. 3 (1994), pp. 104-106.

[35] Judith Miller, Stephen Engelberg, and William Broad, *Germs: Biological Weapons and America's Secret War* (New York: Simon & Schuster, 2001).

[36] J.B. Tucker, S. Khamrakulov, and A. Karimova, "Briefing Series: Biological Decontamination of Vozrozhdeniye Island: The U.S.-Uzbek Agreement," Center for Nonproliferation Studies, Monterey Institute of International Studies, March 2002, <http://cns.miis.edu/cns/dc/011802.htm>.

institutes remain shrouded in secrecy, so it is unknown whether or not illegal offensive work continues at these facilities, or if they are engaged in strictly defensive work, as permitted under the BWC.

It is of more than historic interest to determine what the U.S. intelligence community knew about the Soviet BW program at the time of the 1971 smallpox outbreak in Aralsk. Based on our review of relevant U.S. intelligence assessments of the Soviet BW program from the 1950s, 1960s, and 1970s, it appears that the U.S. intelligence community had no firm evidence during this time that the Soviet Union possessed an offensive BW program. This lack of information is remarkable considering that the Soviet program had been active since approximately 1928 and had conducted a sizeable open-air testing program since the early 1950s, apparently including the field test that led to the 1971 Aralsk smallpox outbreak. There is no evidence that U.S. intelligence detected this outbreak.

More disturbing still is that the U.S. intelligence community appears not to have known for an surpisingly long time that Soviet military scientists were developing variola virus as a biological weapon. The Soviet military may have begun offensive research on smallpox in the 1950s, and was definitely conducting such work in the 1960s. From the testimony of senior defectors such as Vladimir Pasechnik and Ken Alibek, it appears that the first time the U.S. intelligence community became aware of Soviet work with smallpox was in 1989, when Pasechnik was debriefed by British intelligence. This debriefing took place 18 years after the Aralsk smallpox outbreak. It may not have been until Alibek was debriefed in 1992 that the U.S. intelligence community grasped the full extent of Soviet work on weaponizing smallpox virus. As a result, Soviet military scientists may have been able to develop the variola virus for weapons use over a period of 20 to 40 years without being detected. That the U.S. intelligence community overlooked such a major threat to national security appears to have been a major failure.

IMPLICATIONS OF THE SOVIET BIOLOGICAL WARFARE PROGRAM FOR INTERNATIONAL ARMS CONTROL

The successful concealment by the Soviet Union of decades of work on the weaponization of smallpox, including the 1971 smallpox outbreak in Aralsk, as well as the 1979 anthrax outbreak in Sverdlovsk, points to a systemic weakness in the current biological disarmament regime. The BWC lacks effective measures for checking and assuring that countries are in compliance with its provisions. Moreover, even after the Soviet BW program was exposed, the international community failed to apply sanctions on Moscow, and none of the persons responsible for developing, producing, and stockpiling biological weapons faced international opprobrium of any kind.[37] This situation, which is largely defined by an inadequate and increasingly impotent BWC,[38] must be corrected in order to prevent the proliferation and use of these heinous weapons in the future. The BWC also lacks measures to prevent terrorist acquisition and use of biological weapons. In view of the growing threat of biological warfare and terrorism, urgent steps must be taken to bolster the international biological disarmament regime.

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[37] Michael Moodie, "The Soviet Union, Russia, and the Biological and Toxin Weapons Convention," *Nonproliferation Review* 8 (Spring 2001), pp. 59-69.

[38] Jonathan B. Tucker and Raymond A. Zilinskas, "Assessing U.S. Proposals to Strengthen the Biological Weapons Convention," *Arms Control Today* 32 (2002), pp. 10-14.

AN EPIDEMIOLOGICAL ANALYSIS OF THE 1971 SMALLPOX OUTBREAK IN ARALSK, KAZAKHSTAN

by Alan P. Zelicoff, M.D.
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During the summer of 1971, a previously unreported outbreak of smallpox occurred in Aralsk, a city of approximately 50,000 people on the northern shore of the Aral Sea in the Soviet republic of Kazakhstan. It is now clear that senior Soviet leaders, starting with KGB chief Yuri Andropov, suppressed the reporting of this outbreak, possibly to protect the top-secret Soviet biological warfare (BW) program. In so doing, they put the population of Central Asia at risk of a potentially catastrophic epidemic.[1]

Professor Bakyt B. Atshabar, Director of the Mosgut Aikimbaev Kazakh Scientific Center of Quarantine and Zoonotic Infections in Almaty, Kazakhstan, generously made available to the Center for Nonproliferation Studies of the Monterey Institute of International Studies a previously secret Soviet medical report describing the 1971 smallpox outbreak, which is published for the first time in this occasional paper in English translation. The document was addressed to Dr. M. A. Akimbayev, then the director of the Central Asian Anti-Plague Research Institute, the forerunner of the institute that Dr. Atshabar now heads. The outbreak report includes descriptions of clinical illness, pathology data, and a detailed review of quarantine and prophylaxis measures taken during and after the outbreak, including primary vaccination and the disinfection of homes of smallpox victims.

In addition to the initial (index) case of smallpox in Aralsk, nine more people contracted the disease, and three of them died. Evidence presented in this analysis suggests that the outbreak was probably not of "natural" origin. Although endemic smallpox was still present in Afghanistan in 1971, smallpox had not been reported anywhere in the Soviet Union since 1961. No smallpox cases of any kind on Soviet soil were reported after that year to the World Health Organization (WHO), as required by international agreement. In and of itself, the failure of the Soviet Union to notify the WHO of the 1971 outbreak suggests a sinister source for the epidemic. This paper reviews the data in the official report, evaluates the purported mechanism of introduction of smallpox into Aralsk, and offers an alternative hypothesis for the source of the outbreak.

SUMMARY OF OFFICIAL REPORT

The facts of the outbreak as stated in the official report are as follows. On or about July 15, 1971, a biological research vessel called the *Lev Berg* (named after a famous Russian biologist and geologist) set sail from Aralsk on an extended voyage. The ship was scheduled to stop at two dozen research stations scattered around the Aral Sea, and planned to return to its homeport on August 8, 1971.

The course of the ship took it to Uyaly on the eastern shore of the Aral Sea on July 29, then some 200 kilometers west across the southern expanse of the sea to the city of Komsomolsk-on-Ustyurt (now in Uzbekistan) on July 31 (see Map 1). The ship berthed for a day before heading to the southeast city of Muynak (also now in Uzbekistan) on August 4. The final portion of its journey took the ship and crew back to Aralsk on August 11, having traveled some 450 kilometers in roughly a week.

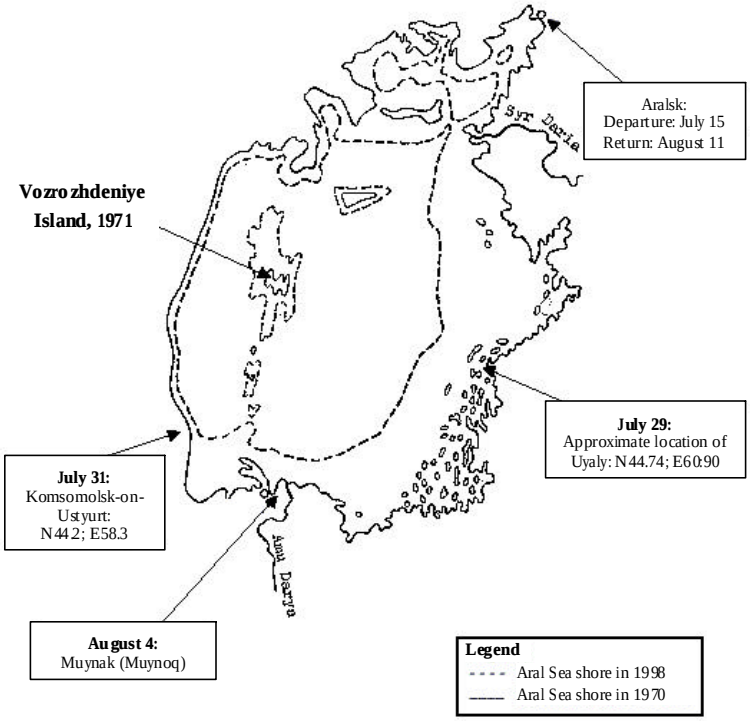
On board the *Lev Berg* was a young fisheries expert, Patient 1,[2] who was responsible for, among other things, casting nets and collecting various species of fish and plants for archiving. The Aral Sea, then the fourth largest freshwater

[1] The views presented here are the author's own personal opinions, and do not necessarily reflect those of Sandia National Laboratories or the U.S. Government.

[2] The name of the index case, her current city of residence, and other patient-specific information for the index case and other victims of the Aralsk smallpox outbreak have been intentionally obscured in the interest of protecting their privacy.

lake in the world, was in the early throes of its slow death as a result of a Soviet government decision to divert its feeder rivers into massive irrigation projects, with the goal of making the Soviet Union self-sufficient in the production of cotton, a water-intensive crop. After two decades of cotton farming, the shoreline had begun to recede, threatening vast numbers of birds, fish, and small mammals with extinction. Accelerating the shrinkage and deterioration of the sea was the evaporation from its surface in the hot, desert-like environment, and the use of huge quantities of organophosphate pesticides, which turned the sea into a drainage pool of salts and toxic chemicals.

Map 1: Voyage of the* Lev Berg, *July-August, 1971



The main purpose of the *Lev Berg* expedition was to assess the ecological damage to the sea, which was already apparent in 1971. Today, the Aral Sea has shrunk in surface area more than 60 percent, and the seaside towns that hosted the *Lev Berg* are now located tens to hundreds of kilometers from the shoreline.

The official report states that on August 6, as the research vessel headed back to Aralsk at the northern end of the Aral Sea, Patient 1 became ill with fever, headache, and muscle aches. For the last five days of the voyage, she stayed in her bunk on the ship and, on reaching Aralsk, headed immediately to her family home. There, she was nursed by her mother and visited by the local general practitioner, who noted that she had a fever of 39 degrees Centigrade (102.2 degrees Fahrenheit) and a cough. The doctor prescribed antibiotics and aspirin but did not make a definitive diagnosis. Shortly thereafter, a rash appeared on her back, face, and scalp—more or less at the same time—and her fever broke. She recovered quickly, feeling well enough to leave for the Kazakhstani capital of Alma-Ata[3] on or about August 15, to be married.[4]

Patient 1 had been vaccinated against smallpox, as had the other members of her family. Doubtless because of this fact, her skin rash—which the official report describes as rather mild (but which she recalls as being fairly extensive)—

[3] In Soviet times, the capital of Kazakhstan was called Alma-Ata. The city is now named Almaty and is no longer the capital of Kazakhstan.

[4] Patient 1, telephone interview with author, May 25, 2002 (not part of the official report). Patient 1 disputes some of the important details of the official report (see below).

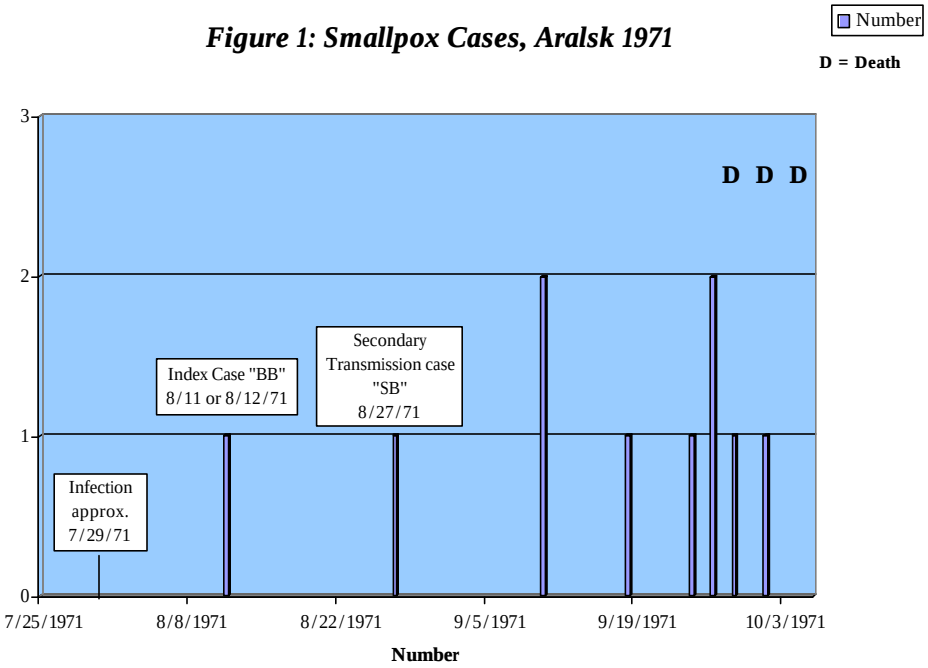
disappeared without much permanent scarring. On August 27, however, Patient 1's nine-year-old brother, Patient 2, came down with a fever and a skin rash. A pediatrician (not the same physician who had treated his older sister) made a house call to see the boy on August 30. He diagnosed "urticaria" (hives), a skin eruption often considered to be an allergic reaction, although in approximately 70 percent of cases no specific cause can be identified. Patient 2 was treated with tetracycline and aspirin, and recovered completely over the next two weeks.[5]

The pediatrician did not see Patient 2 again, and the boy returned to school on or about September 13. He was later quarantined after the medical authorities realized that they were dealing with a smallpox outbreak. In late August and early September, however, the medical records suggest that no consideration was given to a diagnosis of smallpox. This oversight is hardly unreasonable, given that the Soviet Union had been free of the disease for a decade and that the nearest country with endemic smallpox was Afghanistan, hundreds of kilometers away.

Over the next three weeks, physicians in Aralsk saw eight additional cases of fever and skin rash. Six adults (ages 24 to 60, median age 34.5 years) and two children (ages four and nine months) were diagnosed with smallpox, based on clinical appearance and the confirmatory growth of viral plaques on the chorioallantoic membrane of a fertilized egg, resulting in characteristic glossy white "pocks." A rise in the level of antibodies to variola virus—the causative agent of smallpox—was also reported in the medical records. The antibody assays were done at an unnamed facility in Moscow. (Although the name of the laboratory is not mentioned in the report, it was probably the Institute for Viral Preparations in Moscow, the leading center for smallpox research in the Soviet Union in 1971.)

The clinical manifestations of smallpox in the 10 patients varied across the known spectrum of the disease. The two children, both of whom were reportedly unvaccinated, developed the rare and highly lethal hemorrhagic form of smallpox and died. Patient 2 survived a case of classical "discrete" smallpox, meaning that he had diffuse lesions separated by areas of normal skin (in contrast to the more severe "confluent" form of smallpox, in which the lesions coalesced and frequently became secondarily infected with bacteria). One adult, 23 years old and unvaccinated according to her medical records, also died from the hemorrhagic variant of the

Figure 1: Smallpox Cases, Aralsk 1971



[5] The administration of aspirin is an odd choice, as aspirin can exacerbate urticaria.

disease. The other four infected adults (ages 24, 36, 38, and 60) contracted smallpox despite having been vaccinated. Three were described as having "varioloid smallpox" with only a few scattered lesions evident on physical examination, and one with a classical "discrete" rash. In short, three people, all unvaccinated, developed the hemorrhagic form of the disease and died. Six others also contracted smallpox in either a modified or typical discrete form. The epidemic curve for this outbreak is shown in Figure 1. Table 1 lists the ten cases with patients numbered in the order of the date of onset of their illness.

The official report also describes the massive effort made by public health officials to contain the outbreak. Nearly 50,000 residents of Aralsk were vaccinated in less than two weeks, and many hundreds were placed in isolation in a makeshift facility on the outskirts of town. Transportation into and out of Aralsk was almost completely halted, and more than 5,000 square meters (54,000 square feet) of living space in the homes of local residents were disinfected, along with 18 metric tons of household goods.

Table 1: Summary of Smallpox Cases, Aralsk, 1971

Patient	Age (years)	Sex	Date of Onset of Illness	Type of Rash	Previously Vaccinated	Outcome (Dead vs. Recovered)
1	24	F	8/12/71	Discrete/classical	Y	R
2	9	M	8/27/71	Discrete/classical	Y	R
3	23	F	9/10/71	Hemorrhagic	N	D
4	36	F	9/10/71	Discrete/classical	Y	R
5	5.5	M	9/18/91	Discrete/classical	Y	R
6	38	M	9/24/71	Varioloid/mild	Y	R
7	0.8	M	9/26/71	Hemorrhagic	N	D
8	60	F	9/26/71	Varioloid/mild	Y	R
9	33	M	9/28/71	Varioloid/mild	Y (x3)	R
10	0.33	F	10/2/71	Hemorrhagic	N	D

EPIDEMIOLOGICAL ANALYSIS OF THE ARALSK OUTBREAK

Although the number of cases in the Aralsk smallpox outbreak was small, it is instructive to compare it with another "imported" epidemic for which clinical and environmental parallels exist. In Yugoslavia in 1972, a Muslim from Kosovo province went on pilgrimage to Mecca, Saudi Arabia, and returned through Baghdad, Iraq, where he was infected with smallpox. He then "imported" the disease into Kosovo, resulting in the first smallpox outbreak in Yugoslavia since 1930.[6] Only about 65 to 70 percent of the adult population of Kosovo province had received a primary vaccination, and children were not being vaccinated at that time.[7] The official report suggests that the extent of vaccination among adults in Aralsk was similarly poor. In both outbreaks, smallpox remained undiagnosed until approximately six weeks into the epidemic. Thus, in most key epidemiological aspects, including the importation of the virus into a previously smallpox-free environment and the limited "herd immunity" of the affected population, the two outbreaks were quite similar.

Taking only the Kosovo cases from the published epidemiological curve for the Yugoslav outbreak and ignoring later cases that resulted from the movement of infected individuals to other parts of the country, it is possible to perform a survival curve analysis to characterize the two outbreaks (see Figure 2).[8] The limited

[6] S. Litvinjenko, B. Arsic, and S. Borjanovic, *Epidemiological Aspects of Smallpox in Yugoslavia in 1972*, Document WHO/SE/73.57 (Geneva: World Health Organization, 1973).

[7] F. Fenner, D. A. Henderson, I. Arita, Z. Jezek, and I.D. Ladnyi, *Smallpox and Its Eradication* (Geneva: World Health Organization, 1988), p. 1019.

[8] Ibid., p. 1020.

number of cases makes it difficult to perform a robust statistical analysis because small changes in the Aralsk data could change the results. Nevertheless, using three different statistical tests (Log-Rank, Wilcoxon, and Weibull proportional hazards modeling), the Aralsk and Kosovo smallpox outbreaks are indistinguishable in their time course ($p>.34$, .43, and .24, respectively). Because these statistical tests apply different weightings to early versus late cases and use different regression techniques, the uniformly high p-values suggest very similar dynamics in the two outbreaks. This finding probably reflects the strong correlation between the respective incubation periods, the delays in recognition and intervention, and the consequent epidemic peaks.

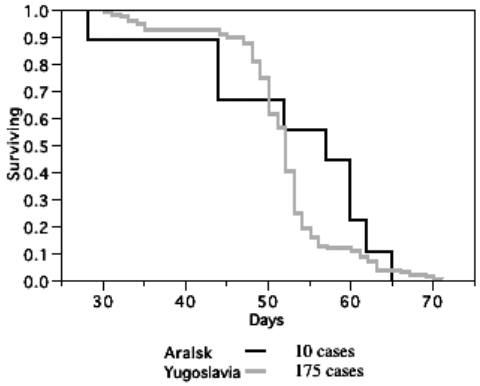
Although the overall mortality in the two outbreaks was similar (three out of ten cases in Aralsk, 35 out of 175 cases in Kosovo, $p>.43$ by Fisher's exact test), critical differences between the two outbreaks are also evident. There were three patients with hemorrhagic smallpox (all fatal) in Aralsk, but five such cases in Kosovo, where the total number of smallpox cases was much larger ($p<.005$ by Fisher's exact test). This observation suggests that the clinical manifestations were somewhat more severe in the Aralsk epidemic.[9]

Hemorrhagic smallpox was rare in most outbreaks and was almost universally fatal. Its manifestations were believed to be related mainly to host factors rather than to the specific strain of variola virus involved.[10] In Rao's large series of over 10,857 smallpox patients in Madras, India, there were only 240 cases of hemorrhagic smallpox, an incidence of about 2.2 percent (confidence interval 2.0–2.5 percent).[11] The most striking aspect of Rao's data is the almost complete absence of hemorrhagic smallpox in infants; only three cases were reported in children under one year of age (fewer than .03 percent of cases). Yet in the Aralsk outbreak, two of the three cases of hemorrhagic disease occurred in infants.

Although the Aralsk outbreak data are insufficient to support a firm conclusion, the seemingly high percentage of hemorrhagic cases and the skewing of the distribution to very young children suggest that either unusual "host factors" (e.g., nutritional status, genetic resistance), or an unusual strain of the virus, were responsible for this distinctive feature of the Aralsk outbreak. It seems unlikely, however, that the host factors were somehow more adverse in Aralsk than in Madras.

Further, of the six adults with confirmed smallpox in Aralsk, five had been vaccinated. Because it is not known how many of the later-quarantined "contacts" of Patients 1, 2, and 3

Figure 2: Kaplan-Meier Curves (time to event = onset of illness) for the Aralsk (1971) and Yugoslavia (1972) Outbreaks



[9] Binomial 95 percent confidence intervals are as follows: 30 percent of the cases in Aralsk were fatal (6.7 percent—65.2 percent) and 2.8 percent in Kosovo (0.9 percent—6.5 percent).

[10] A. R. Rao, *A Study of 240 Cases of Haemorrhagic Smallpox*, Document No. Smallpox/WP/22 (Geneva: World Health Organization, January 6, 1964).

[11] There are no confidence intervals published in Rao's study. This interval was calculated based on a binomial assumption.

were vaccinated, nor how many years had passed since their last vaccination, it is impossible to calculate vaccine effectiveness in the Aralsk outbreak. However, the efficacy of the smallpox vaccine (sometimes also called "rate of protection") is usually described as being in excess of 90 percent. The official report states that there were approximately 30 direct contacts of Patients 3 and 4 (including Patients 7–9); those contacts that developed clinical disease had all been vaccinated. In addition, the index case (Patient 1) had been vaccinated, but not Patient 3. These data suggest that the variola virus strain involved in the epidemic may have been somewhat vaccine-resistant. This hypothesis is strengthened by a statistical comparison of the transmissivity of smallpox in the Aralsk outbreak with that in other well-documented outbreaks.

Data from Pakistan suggest that if the index case is unvaccinated but household contacts are vaccinated, the frequency of smallpox transmission is approximately 5.5 percent.[12] If the index case is vaccinated, then vaccinated family members contract smallpox at a rate of approximately 2.1 percent. In the Aralsk outbreak (allowing for a wide confidence interval), one would expect that in the households of Patients 3 and 4, consisting in total of roughly 30 people, all of whom were presumably vaccinated, two household contacts (or less) should have become ill. In fact, at least four household contacts became ill.

Patient 3 (who died of hemorrhagic smallpox) had two household contacts before being admitted to the hospital and diagnosed with smallpox, but neither of her contacts became ill. Patient 4 had at most 25 contacts, three of whom became ill. Table 2 compares smallpox transmissibility during the Pakistan and Aralsk outbreaks. Chi-square analysis shows a moderate statistical likelihood that smallpox transmission was more likely in vaccinated household contacts in Aralsk than in Pakistan (p=.11 by Fisher's exact test).

These observations suggest, but do not prove, that either vaccine efficacy in the Soviet Union was less than in Pakistan, or that the viral strain in Aralsk was somehow more infectious than traditional strains. When one considers that hemorrhagic index cases have a *lower* efficiency of virus transmission (probably because they are completely bedridden and die quickly), the possibility that an unusual strain of smallpox was involved in the Aralsk outbreak cannot be dismissed. Although the outbreak was successfully contained, doing so required heroic efforts. Moreover, the non-vaccine component of the response—household quarantining, the halting of all transportation into and out of the city, and the isolation of infected or exposed individuals in a separate observation hospital for as long as three to four weeks—may have been as important as mass vaccination in preventing the further spread of the disease.

Table 2: Smallpox Transmissibility in Two Outbreaks

Outbreak Location	Vaccination Status of Index Case	Number	Number Contracting smallpox	Percent
Pakistan	Unvaccinated	271	15	5.5
	Vaccinated	48	1	2.1
Aralsk	Unvaccinated	2	0	0
	Vaccinated	25	3	12.0

CONCLUSIONS OF OFFICIAL REPORT

How did the index case in the 1971 Aralsk outbreak become infected with smallpox? The official report does not offer a conclusive explanation but presents three hypotheses. According to the first of these:

> Members of the crew and of the research team went ashore on July 29 in the town of Uyaly in the Kzyl-Orda region, on July 31 in the town of Komsomolsk-on-

[12] G.G. Heiner, N. Fatima, and F. R. McCrumb, "A Study of Intrafamilial Transmission of Smallpox," *American Journal of Epidemiology* 94 (1971), pp. 252-268.

> Ustyurt, and on August 4 in the town of Muynak in the Karakalpak Autonomous Soviet Socialist Republic. Patient 1 was in all three towns, and in Muynak she bought a towel, some fabric, and a dress. Patient 1 became ill on August 6, while on her way from Muynak to Aralsk. She first had a headache and a fever. On August 11 upon her arrival in Aralsk, where her family resided at No. 7 Shkolnaya Street, M. B. Buyraev, the physician responsible for that district, was called to the house, and he noted that the patient complained of the following: head-ache, cough, and a fever up to 39° [Centigrade].

The reader is again referred to Map 1, illustrating the approximate geographic location of the ports of call made by the *Lev Berg*. The authors of the official report conclude:

> According to this scenario, Patient 1 was the source of the disease's outbreak in the city of Aralsk. She contracted smallpox at the end of July, 1971, either in Uyaly or in Komsomolsk-on-Ustyurt. This is confirmed by the absence of the illness among the other crew members of the vessel and among the researchers.

This interpretation of the epidemiological data is problematic, however. The median incubation time for smallpox is approximately 13 days, with a range of 11 to 15 days encompassing the 95 percent confidence interval. Thus, if Patient 1 became ill on August 6, she would have likely been exposed to smallpox between July 23 and July 27. Although exposure during the port visit in in Uyaly on July 29 is possible, it seems unlikely. More important, Patient 1 stated in an interview (see below) that at no time was she permitted to leave the ship throughout the voyage.

The second hypothesis put forward in the official report is that the infection was introduced directly into the city of Aralsk from the southern borders of the Soviet Union via land or water transportation. The last previous cases of smallpox in the Soviet Union had resulted from an importation of the disease from Afghanistan in 1961,[13] and such an importation certainly could have happened again. According to World Health Organization reports, there were 1,030 cases of smallpox in Afghanistan in 1970, and 482 cases during the first eight months of 1971. The disease could have reached the territory of the Tajik and Uzbek Soviet Socialist Republics, which were economically linked to the city of Aralsk. Large quantities of cotton, melons, and other agricultural products from the Uzbek and Tajik republics were shipped north to Aralsk via the Amu-Darya River and the Aral Sea, whereas grain, coal, and other items were shipped south.

The Uch-Say transshipping facility was serviced by workers from Aralsk and other cities and towns in the region. Periodically, teams from the Aralsk shipping company were sent to the port of Termez, where they transferred cargo from Afghanistan from ships to trains. Such a team arrived in Aralsk from Termez on August 29-30. Nevertheless, its members could not have been the source of infection for Patient 1 because of the time discrepancy. According to the third hypothesis presented in the official report:

> A scenario of infection via the open-air market has also been thoroughly checked. As a matter of fact, individuals bring to the city of Aralsk large quantities of produce from the Uzbek and Tajik republics. However, no evidence was established that people with smallpox arrived from those regions and visited the home of [the father of Patients 1 and 2] or the market's director, or that goods such as rugs and other wool artifacts were bought or sold there.

INTERVIEW WITH PATIENT 1 AND COMPARISON TO OFFICIAL REPORT

On May 25, 2002, the author (Zelicoff) contacted the index case, Patient 1, by telephone and conducted an extensive interview of about two hours (approximately half of this time was taken up by Russian-English interpretation). Patient 1 is currently living in Kazakhstan, is married, and consistent with the official report, is now 54 years of age. She is currently disabled by a neurological disease that makes it difficult for her to engage in strenuous physical activity. But her mind remains clear, and she spends most of her time reading, including biology journals, her scientific specialty.

[13] Fenner, et al., *Smallpox and Its Eradication*, pp. 1073-1074.

Patient 1 confirms that, as a recent graduate of the Fisheries Institute in Aralsk, she sailed on the *Lev Berg* in 1971. She disputes, however, several key aspects of the official report. Most significantly:

- Patient 1 insists that she did not disembark from the *Lev Berg* at any of the ports of call along its route, though she does remember that the ship stopped at Muynak (Muynoq) near the delta of the Amu Darya at the southern end of the Aral Sea. In particular, she did not, as officially stated, visit the market in Muynak (now located in Uzbekistan), nor did she purchase any items of any kind from vendors. Patient 1 noted that official policy allowed only the male members of the crew to leave the ship, and that this rule was strictly enforced.
- The official report states that Patient 1 became ill en route to Aralsk. Yet Patient 1 recalls feeling well on the ship and only becoming ill shortly after arriving home in Aralsk, on August 11 or 12, 1971.
- Patient 1 describes a diffuse rash that "covered [her] entire body," and contends that a similar rash occurred in her brother, Patient 2, about two weeks later.
- She states that no one on board the *Lev Berg* developed illness or fever through August 11, when the ship returned to Aralsk.

Patient 1 does not remember the precise dates of the *Lev Berg*'s voyage on the Aral Sea. She noted in the interview that, as the youngest member of the crew, she was the one working most frequently on deck. She spent most of her time casting nets to catch fish, which she then took to the small laboratory below deck to archive samples, perform simple analyses, and make notations in the laboratory journal. Unfortunately, she did not retain ownership of the journal, which might confirm the dates and locations of the ship.

Patient 1 recalls that when she became ill after her return to Aralsk, she was visited by a physician. She was living with her mother, father, and three brothers at the time. As noted in the official report, the doctor did not provide her or her family with a specific diagnosis, nor did he show particular concern about the nature of Patient 1's rash or illness. The rash was sparse and did not leave permanent scars on her body. Nevertheless, it appears to have been more severe than the "mild variety" of smallpox ascribed to her case in the official report.

If Patient 1's recollections are accurate, it is unlikely that she was exposed to smallpox at any of the ship's ports of call on the Aral Sea. It is also unlikely that she was secondarily infected by any of the male crew members who went ashore, because no one on board became feverish or otherwise sick during the voyage.

INTERVIEW WITH PATIENT 2, THE BROTHER OF PATIENT 1

On May 26, 2002, the author spoke with Patient 2, the younger brother of Patient 1.[14] (The two did not communicate between my interviews.) Patient 2 is now 40 years old, consistent with the official report. He works as a manual laborer, but attended university for some time. He is in good health, married, and has several children. Patient 2 stated that he became ill in late August 1971, shortly before school began (September 1 was the traditional first day of school in the Soviet Union), again consistent with the official report. He recalled his illness vividly, describing it in his own words as follows:

> About two weeks after my sister came home, I became ill. It was in late August, maybe the 27th or 28th. At first I had a very high temperature for three days, and then the rash appeared. My whole body was covered with lesions about 2 to 3 millimeters in diameter. The rash lasted two weeks, and then the lesions crusted over. After the rash disappeared, I had white spots on my skin that disappeared after about one to two years.

This description leaves little doubt that the disease was classical (discrete) smallpox. Patient 2's recollection is also consistent with the official report, which places the date of onset of his illness as August 28, 1971. He also recalls that his schoolteacher came to visit, and that she later died. She was probably the third case of smallpox, one of two cases with onset of illness on September 10. The official report lists this individual as a teacher at School No. 13, and the date of her death as September 29. Patient 2

[14] Patient 2, telephone interview with author, May 26, 2002.

specifically recalled that he was a student at School No. 13.

AN ALTERNATIVE HYPOTHESIS

It is clear that Patient 2 became ill as a result of contact with his sister, Patient 1, the index case. Because it is certain that Patient 2's illness began during the last week of August 1971, it is most likely that his sister, Patient 1, became ill on or about August 11, roughly thirteen days earlier. This is precisely in line with her oral history and at variance with the official report, where the date of onset of her illness is given as August 6. It is extremely unusual for patients with smallpox to transmit the disease after the first week of clinical illness, further discrediting the official report. It is therefore most likely that she became infected with smallpox during the last days of July 1971.

Until at least 1990, the Soviet Ministry of Defense maintained an offensive BW program in violation of the 1972 Biological and Toxin Weapons Convention, which entered into force in 1975. It is now known that beginning in 1936, the Soviet Ministry of Defense used Vozrozhdeniye Island in the Aral Sea as a site for BW field testing.[15] The island offered a number of advantages: it was isolated and surrounded by water, making security relatively easy. The wind blew predictably from north to south,[16] providing an upwind "safe haven" on the northern end of the island that was used for housing troops, their families, and even a children's playground. Finally, the blistering hot temperatures and intense solar radiation insured that microbial pathogens tested in the open environment would die quickly and hence would not inadvertently escape from the island.

No definitive documentation has been released from the Soviet archives describing the activities at the Vozrozhdeniye Island test site. Reportedly, it was used for the offensive and defensive testing of aerosols of various biological agents, including the pathogens that cause anthrax, tularemia, and Q-fever. Some sources have also claimed that smallpox virus strains were stored and tested on the island.[17] In the early 1970s, it was well known among those living in the region that Vozrozhdeniye Island was a "biological laboratory testing military equipment and weapons."[18] Thus, the local inhabitants knew enough to avoid it.

Referring to the map, the *Lev Berg* was probably south of Vozrozhdeniye Island on or about July 30. Could an open-air test or a laboratory accident involving a virulent strain of variola virus have resulted in the inadvertent contamination of the research vessel? Dr. Pyotr Burgasov, a former chief sanitary physician of the Soviet Union who is notorious for his now-discredited claim that the Sverdlovsk anthrax outbreak of 1979 resulted from "contaminated meat,"[19] was interviewed in the Russian press in November 2001. He is quoted as having said:

> On Vozrozhdeniye Island in the Aral Sea, the strongest formulations of smallpox were tested. Suddenly I was informed that there were mysterious cases of disease in Aralsk. A research ship of the Aral fleet came 15 kilometers away from the island (it was forbidden to come any closer than 40 kilometers). The laboratory technician of this ship took samples of plankton twice a day from the top deck. The smallpox formulation—400 grams of which was exploded on the island—"got her" and she became infected. After returning home to Aralsk, she infected several people, including children. All of them died. I suspected the reason for this

[15] See Kenneth Alibek with Stephen Handelman, *Biohazard: The Chilling True Story of the Largest Covert Biological Weapons Program in the World—Told From Inside by the Man Who Ran It* (New York: Random House, 1999); G. Bozheyeva, Y. Kunakbayev, and D. Yeleukenov, *Former Soviet Biological Weapons Facilities in Kazakhstan: Past, Present and Future*, Occasional Paper 1 (Monterey, CA: Monterey Institute of International Studies, 1999).

[16] E.E. Small, F. Giorgi, L.C. Sloan, and S. Hostetler, "The Effects of Desiccation and Climatic Change on the Hydrology of the Aral Sea," *Journal of Climate* 14 (2001), pp. 300-322.

[17] Ken Alibek, Testimony before the Committee on International Relations, U.S. House of Representatives, 107th Congress, First Session, December 21, 2001.

[18] Patient 1, telephone interview with author, May 25, 2002.

[19] V. Israelyan, "Fighting Anthrax: A Cold Warrior's Confession," *Washington Quarterly* 25 (Spring 2002), pp. 17-19.

> and called the Chief of the General Staff of the Ministry of Defense and requested that the train from Alma-Ata to Moscow be forbidden to stop at Aralsk. As a result, an epidemic around the country was prevented. I called Andropov, who at that time was chief of the KGB, and informed him of the exclusive recipe of smallpox in use on Vozrozhdeniye Island. He ordered that not another word be said about it. This is a real biological weapon! The minimum radius of contamination was 15 kilometers. One could imagine what would have happened if instead of one laboratory technician, there had been 100 to 200 people.[20]

Burgasov's statement is unclear on some points and inaccurate on others. For example, the claim that "all of them died" is certainly not correct. Nevertheless, Burgasov, who was highly placed in the Soviet government at that time, must have known which pathogens were tested on Vozrozhdeniye Island and if major mishaps had occurred. Thus, although some of the details of his admission are false, the general thrust seems credible: Patient 1 was exposed to smallpox virus released as part of a BW field test on Vozrozhdeniye Island on or about July 30. An infection contracted on that date would have resulted in the onset of fever approximately 13 days later—on August 11, 1971, precisely when Patient 1 states her illness began. The localized epidemic then followed her arrival in Aralsk.

UNANSWERED QUESTIONS

This preliminary and admittedly incomplete analysis of the Aralsk smallpox epidemic raises a number of unanswered questions. For the first time, there is clear circumstantial evidence that the Soviets not only "weaponized" smallpox but succeeded in aerosolizing it and, it appears, "hardening" the virus so that it maintained its infectivity as it traveled downwind over a distance of at least 15 kilometers. What strain of variola virus was tested on Vozrozhdeniye Island? Does the apparently high prevalence in the Aralsk smallpox outbreak of hemorrhagic manifestations and, perhaps, of vaccine resistance indicate that Soviet military scientists chose an especially virulent strain of variola as a candidate biological weapon? A few scientific papers suggest, but do not necessarily prove, that "hemorrhagic" strains of smallpox exist.[21] Are clinical or laboratory samples of the weaponized strain still stored in one or more Russian laboratories? Were there other incidents in which civilians were accidentally exposed to Soviet BW agents from the Vozrozhdeniye test site?

The answers to these and many other questions will almost certainly have a profound effect on civilian and military biodefense efforts in the United States and elsewhere. In the immediate term, our complete reliance on a single vaccine (unmodified vaccinia) represents a serious potential vulnerability. Only a detailed analysis of the Aralsk strain with the most modern tools of molecular biology can guide public health officials and defense planners in formulating appropriate policies and prophylaxis, which may include a concerted effort to produce new vaccines based on entirely novel approaches, along with testing of anti-viral drugs in animal models.

With the Cold War over and Russia eager to be accepted by the West as a newly emerging democracy and a member of major international organizations, such as the North Atlantic Treaty Organization and the World Trade Organization, it is long past time for Moscow to reveal the detailed history of the Soviet BW program. Helping to resolve the numerous uncertainties about the 1971 smallpox outbreak in Aralsk would be an important first step in that direction. That smallpox is still with us is obvious, perhaps in forms we never encountered throughout its long history as a natural disease. The problem is, we do not know where it is and when it will emerge—yet again.

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[20] Evgeniya Kvitko, "Smallpox: As Bad a Weapon.: An Interview with General Pyotr Burgasov" (in Russian), *Moskovskie Novosti*, November 13, 2001.

[21] J. Sakar and A. Mitra, "Virulence of Variola Virus Isolated from Smallpox Cases of Varying Severity," *Indian Journal of Medical Research* 55 (1967), pp. 13-20; R. Shafikova and S. Marennikova, "Comparative Studies on the Properties of Variola Virus Strains. II. Pathogenicity for Suckling Mice and Gamma-Irradiated White Mice," *Acta Virologica* 15 (1971), pp. 321-323.

[in Kazakh]
Ministry of Health of the USSR
Aralomorsk Anti-Plague Station
40 Kirov St., Aralsk

[*in Russian*]
Ministry of Health of the USSR
Aralomorsk Anti-Plague Station
40 Kirov St., Aralsk

No. 53 October 18, 1971

[*handwritten text in upper left quadrant*] Show to Comrade Yermilov (initialed by unknown person), dated October 26, 1971

TO: Professor M. A. Aykimbaev, Director
Central Asian Anti-Plague Research Institute
City of Alma-Ata

Enclosed herewith: "Report on Measures Taken to Contain and Eradicate the Smallpox Outbreak Locale in the City of Aralsk (September/October, 1971)

Attachments: This report, consisting of
I. The main body of the report, 63 pp.
II. Appendices, 33 pp.
III. A map, 1 p.

Signed O. Misaleva, Director
Aralomorsk Anti-Plague Station

On September 21, 1971, doctors were summoned to the infectious disease department of the district hospital to examine Patient 3. Dr. Tulepbergenova, who was on duty at the time, suspected that the patient had smallpox, and Dr. Alishev, an internist with whom she consulted, concurred.[1]

Infectious disease specialists Chun-Sun and Zholdaspaev, who arrived on September 22 from the city of Kzyl-Orda, confirmed the diagnosis of smallpox from clinical data. They also examined Patient 5, who was being treated at the inpatient unit of the skin and venereal disease clinic for the same clinical symptoms. She was also diagnosed with smallpox.

The discovery of these two cases was immediately reported to the district's chief physician, the regional health department, and regional Soviet and CPSU [Communist Party of the Soviet Union] officials. That same day, Patients 3 and 5 were transferred to the isolation unit of the Aralomorsk Anti-Plague Station, and individuals who had come in contact with these patients were identified.

In compliance with a directive issued by the district emergency counter-epidemic commission [ChPK], effective as of 1400 hours on September 22, 1971, the surgical and infectious disease departments and the inpatient unit of the skin and venereal disease clinic were placed under quarantine, and the entire facility was disinfected. The residences of Patients 3 and 5 were also disinfected.

On September 23, as per a ChPK directive, an isolation unit for people who had come into contact with the patients was established on the premises of the Young Pioneer summer camp, with Dr. B. Zhumakhmetov appointed as its director. House-to-house calls and smallpox vaccinations began.

The chief physician of the outpatient clinic, N. Makhanova, was charged with supervising the house-to-house visits, while Dr. V.A. Khodorich, an epidemiologist with the district epidemiological monitoring station, was put in charge of the vaccination team.

On September 23, an epidemiological investigation was undertaken to determine exactly how smallpox had been introduced into Aralsk. B. A. Aytkaliev, the deputy director of the Aralomorsk Anti-Plague Station, was designated as head of the epidemiological investigation team.

Beginning September 23, individuals without vaccination certificates were not allowed to purchase tickets for travel beyond the limits of Aralsk. Vaccination centers were set up at the Aralsk Sea train station and at the airport.

On September 24, 1971, as per another district ChPK directive, the city of Aralsk was declared a smallpox outbreak containment locale, and, at 1200 hours, police placed the city under quarantine. Additional funds and personnel were requested through the offices of the regional ChPK.

On September 23, after consultants confirmed the diagnosis, medical specialists (epidemiologists, a virologist, and a disinfection technician) and mid-level medical personnel arrived from Alma-Ata, Kzyl-Orda, and Aktyubinsk, in order to help contain and eradicate the infection. On the same day, Dr. N. N. Maltseva, a virologist, arrived from Moscow.

The same day, a smallpox laboratory diagnostic capability was organized, and by September 23, 25 medical personnel had arrived, including 10 physicians.

[1] Translators' note: there is considerable variation in the report as to the spelling of names, ages of patients, and dates of various events.

On September 25 (after the smallpox cases had been confirmed by the laboratory), additional medical personnel began arriving from Alma-Ata, Aktyubinsk, Moscow, and Leningrad. By October 1, 1971, in addition to the local medical personnel, 143 medical personnel, including 53 physicians, had arrived from other locations to help out with these efforts.

Also on September 25, a medical headquarters was organized, the director of the outbreak containment locale was appointed, and all necessary services were staffed (see chart on pages 4 and 5).

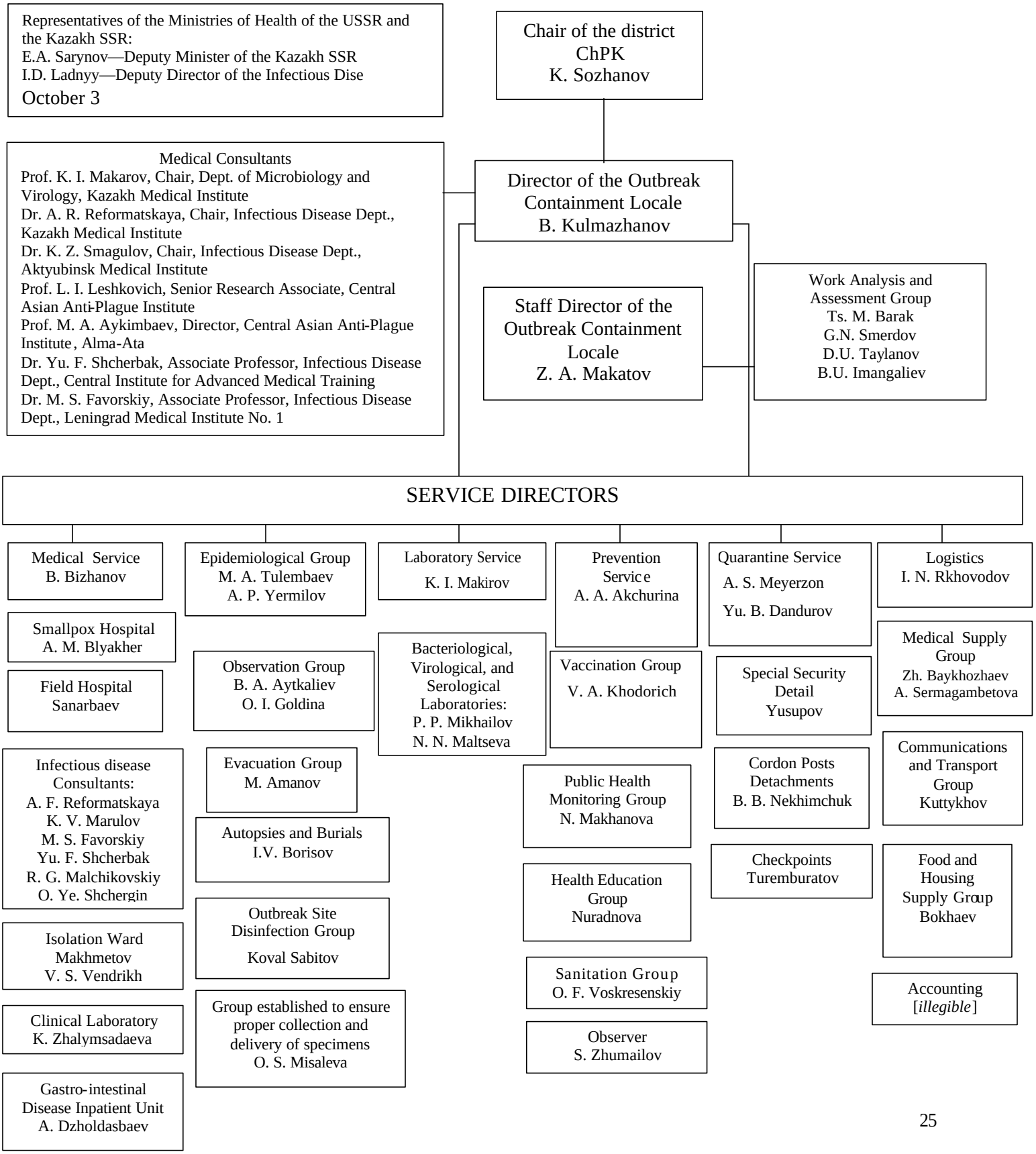
On September 26, a 150-bed isolation ward was set up at the Young Pioneer summer camp location; an 8-bed hospital for smallpox patients and a 25-bed field unit were also arranged.

By October 1, an observation ward was filled to capacity with 68 patients, who were being kept under observation.

Information on the work performed by these services in the containment area is presented below.

The work of the services was run by the headquarters, and team supervisors presented reports at daily meetings, at which work was assigned for the next day. During operations in the containment locale, the ChPK held 14 meetings where decisions of an administrative and logistical nature were made.

Organizational Chart for the Epidemiological, Medical, Preventive, and Sanitary Measures Taken in the Outbreak Containment Locale of the City of Aralsk



Epidemiological Service

The epidemiological service of the smallpox outbreak containment locale in the city of Aralsk consisted of the following teams:

a) epidemiological investigation
b) evacuation of patients and contacts
c) disinfection of the outbreak containment locale
d) autopsy and burial

General supervision was provided by Dr. M. A. Tulembaev, a junior research associate at the Central Asian Research Anti-Plague Institute. The director of the institute, Professor M. A. Aykimbaev, and the head of the institute's epidemiology department, A. P. Yermilov, served as consultants to the epidemiological investigations. The epidemiological investigation group also consisted of Drs. B. A. Aytkaliev, O. I. Goldina, and assistant epidemiologist I. I. Baskakov. The team was provided with adequate transportation (three GAZ-69 passenger cars). According to a comprehensive investigation of how people became infected, the smallpox outbreak seems to have originated in the following manner:

Patient 1, a 24 year old female, was working as part of an ichthyological research expedition on the vessel *Lev Berg*. The expedition was conducting research at 20 stations in the Aral Sea from June 15 to August 8, 1971. Members of the crew and of the research team went ashore on July 29 in the town of Uyaly in the Kzyl-Orda region, on July 31 in the town of Komsomolsk-on-Ustyurt, and on August 4 in the town of Muynak in the Karakalpak ASSR. Patient 1 was in all three towns, and in Muynak she bought a towel, some fabric, and a dress. Patient 1 became ill on August 6, while on her way from Muynak to Aralsk. She first had a headache and a fever. On August 11 upon her arrival in Aralsk, where her family resided at No. 7 Shkolnaya Street, M. B. Buyraev, the physician responsible for that district, was called to the house, and he noted that the patient complained of the following: headache, cough, and a fever up to 39°.[2] He completed a form releasing her from work from August 11 to August 17. The following course of treatment was prescribed: monomycin intramuscularly, sulfathiazole, and aspirin. According to her mother, on the 4th or 5th day of the illness, Patient 1 noticed the appearance of individual skin eruptions on her back, face, and scalp. After these eruptions appeared, her temperature returned to normal. On August 20, she left for the city of Alma-Ata.

It should be noted that, in order to celebrate Patient 1's recovery and departure, [her family] hosted a party (*sodokha* in Kazakh) on August 25 that was attended by 23 people. It is possible that Patient 1 had contracted varioloid, the mild form of smallpox.

On August 15 (the date supplied by her parents), Patient 1's younger brother, Patient 2, who was born in 1962 and was a second grade student at Kazakh City School #19, fell ill. The outpatient clinic's house-call log recorded that a pediatrician was called out to the boy's home on August 30th, and that his temperature was 37°. Patient 2 was diagnosed with urticaria, and tetracycline, aspirin, and calcium chloride were prescribed for him. He stayed home from August 27 to September 12. The doctor did not see him again. The boy had been vaccinated against smallpox on January 29, 1963, but was never revaccinated. He went to school on September 13, and on September 23 was placed in isolation at the infectious disease hospital as a former smallpox patient. On September 26, this diagnosis was confirmed in the laboratory by fluorescent anti-body testing, gel precipitation, and isolation of the smallpox virus in chick embryo and tissue cultures.

Before and after his illness, the boy visited the family [of Patients 8 and 9], who lived at No. 3 Shkolnaya Street.

[2] Translators' note: all temperatures are rendered in degrees Celsius.

Including those already named, Patient 1's family has a total of six members: the father, who was born in 1902 and works as the director of a new open-air market; a housewife, who was born in 1924; and two other sons, one a student at the Alma-Ata Veterinary Institute and the other a high school student. In addition, two other residents of the town had been staying with the family until August 30.

[The veterinary student] was home on vacation from July 23 to August 25, when he left for the rice harvest in the Chiiliyskiy district.

On September 10, Patient 5, a 36 year old female building maintenance worker residing at No. 3 Shkolnaya Street, fell ill. She first came down with a headache and fever. On the 4th day of her illness, a rash appeared over her whole body. On September 17, the patient was hospitalized at the skin and venereal disease clinic with a diagnosis of Durante's disease. On September 22, she was seen by an infectious disease expert, who diagnosed her with smallpox. She was transferred to the infectious disease ward of the city hospital, and then to the smallpox hospital.

Her husband, Patient 8, who was born in 1933 and works as a building maintenance worker, his four children, and his mother, who all reside at No. 9 Kuibyshev Street, were placed in the isolation ward. The family of Patient 5's brother, who was born in 1938, including his wife, their parents, and their five children, were also placed in isolation. In addition, 30 people who had come into contact with them either at home or at work were identified. The skin and venereal disease clinic was closed and converted into an isolation ward with 64 patients, and its personnel were confined to the premises.

According to Patient 5, she had been vaccinated against smallpox in early childhood only. Patient 2 was a possible source of the infection.

The smallpox diagnosis was confirmed by fluorescent anti-body testing, gel-precipitation reaction, and isolating the virus in chick embryo and tissue culture.

Patient 3, a 24 year old female who resided at No. 39 Zhansugurov Street and was a teacher at School No. 13, began to feel ill on September 10, 1971. On September 14, an ambulance was called, because she had hit her head. She was diagnosed with a concussion and placed in the surgical ward of the district hospital. Following are the circumstances surrounding her injury. On September 14, Patient 3 and a person by the name of S., who had arrived from the city of Chimkent, were visiting friends together on the outskirts of Aralsk. While returning to the city in the back of an open-bed truck, her head forcefully hit the side of the truck bed.

On September 20, a rash appeared, after which she was diagnosed with measles and transferred to the infectious disease ward of the district hospital. She had never been vaccinated against smallpox.

G. T. Tulepbergenova, the duty physician in the ward, suspected smallpox and requested Dr. B. M. Alishev to consult with her about the patient. The latter concurred with her diagnosis and made an entry to this effect in the patient's case history. The manner in which the skin eruptions developed and the order in which they appeared—first on her face, then on the trunk of her body and extremities—further corroborated their suspicions. B. A. Aytkaliev and O. Ye. Alekseeva from the anti-plague station and P. A. Khodorich, the epidemiologist from the district SES [epidemiological monitoring station], were called in for a consultation. They concurred with the hospital's doctors. The individual rash elements tested positive for multiloculation.

On September 22, 1971, Dr. Chun-Sun, a physician from the infectious disease department of the Kzyl-Orda regional hospital, clinically confirmed the smallpox diagnosis, and, on the same day, the patient was transferred to the infectious disease hospital. On September 26, the same diagnosis was confirmed in the laboratory using the same tests that were run on previous patients.

This [Patient 3] was the patient from whom the smallpox outbreak originated.[3] She resided in the city of Aralsk during August. She never left the city, and no one visited her family.

On September 28, Patient 3 died. The results of the autopsy were consistent with the clinical and laboratory results. The deceased was a friend of Patient 1 and had visited her while Patient 1 was ill. She also visited [Patient 1's] home when Patient 2 was ill.

Contacts of Patient 3 were her mother, a 49 year old housewife; her brother, 29 years old; a city financial department driver; and her sister-in-law, 23 years of age. In addition, 338 people at school, 8 people at her residence, and 109 people at the surgical and infectious disease departments of the hospital were also considered possible contacts.

During house-to-house calls on September 27, Patient 4, five and a half years old and residing at No. 7 Shevchenko Street, was identified. He fell ill on September 18, complaining of a severe headache and fever. Four days later, on September 22, 1971, a rash developed on his face, scalp, and trunk. On September 27, he was hospitalized for smallpox at the infectious disease hospital. The diagnosis was confirmed in the laboratory.

The family [of Patients 4, 6, and 7] are relatives of the family of [Patients 1 and 2] and visit them often. They went to the party held on August 15.[4] In Patient 4's medical record, there is the annotation "positive smallpox." Also, there is no date of vaccination, nor a series or control number for medication. Due to the presence of profuse eruptions, a vaccination scar could not be found.

Patient 2 can be considered a source of infection. There were five people who were in contact with him at home—his parents and three siblings. His mother is a housewife, and his father is a carpenter employed by a building maintenance service. They never left Aralsk.

Patient 4's sister, Patient 7, 4 months old, was transferred on October 1 from the isolation ward to the hospital in serious condition. A rash had developed on her body. She had never been vaccinated against smallpox. The smallpox diagnosis was confirmed in the laboratory. On October 5, her condition deteriorated. Hemorrhages appeared in the cavities of the rash elements. The patient died during the night of October 6. On October 9, a diagnosis of smallpox (varioloid) was virologically confirmed in the child's father, Patient 6, 31 years of age.

On September 25 in the isolation ward, symptoms of the disease were identified in Patient 9, the 9 month old son of Patient 8. He had never been vaccinated against smallpox.

Since his mother's condition remained serious, he was hospitalized along with his father, Patient 8. Later, the boy's condition sharply deteriorated, and, on October 2, he died.

On September 28, several rash elements were found on the father's body. His general condition was good. The laboratory confirmed that both Patient 8 and his son [Patient 9] had smallpox. It was presumed that Patient 8 had the mild form of smallpox—varioloid.

On September 30, two rash elements were identified on the forearm skin and right side of the back of [Patient 8's mother], 60 years of age. At the time, she was staying at the field hospital. Specimens from the rash elements were taken to the virological laboratory. On October 3, by isolating the virus and using other tests, the smallpox nature of the elements was confirmed. Patient 10 also had the mild form of smallpox—

[3] Editor's note: This statement is unclear, since Patient 1 obviously was the index case.
[4] Translators' note: Conflicting dates are given for when the going-away party for Patient 1 was held.

varioloid. The source of infection for these three patients was Patient 5. Their contacts, of course, had been previously isolated; i.e., on September 23 and 24, Patient 8 and Patient 10 were vaccinated.

Thus, in the second half of August, 1971, an outbreak of smallpox occurred in the city of Aralsk. The infection was further transmitted through relatives and friends of [Patients 1 and 2] and affected four families (see chart on page 13). A total of 9 people were infected, among whom three came down with varioloid, the mild form of the disease.[5]

The age distribution among patients is as follows: less than 5 years old—2; 5 to 9 years old—2; 23 years old—1; 30 to 37 years old—3; 60 years old—1. Because of the low number of cases and nearly even distribution among age groups, no age-related differences were identified. No occupational pattern could be discerned among the cases.

It was of specific concern how much more severely the disease progressed in those who had not been vaccinated in time. All three such cases ended in death—Patient 3, 23 years of age, Patient 9, 9 months, and Patient 7, 4 months.

Smallpox is known to emerge in the Soviet Union only when the illness is brought to regions known to have an immuno-compromised populace; in other words, in those regions where timely vaccination and revaccination are not performed. In this context, there is almost no doubt that the disease was brought into the city of Aralsk from outside.

In order to understand how this occurred, the most important issues are the timeframe of the first illness, who could have been the source of the first case, and how the smallpox virus found its way to the susceptible community of Aralsk. There is no doubt that the outbreak first originated in the home of [Patients 1 and 2]. It was proved clinically, in the laboratory and epidemiologically, that the first case of the disease was Patient 2, who fell ill on August 27.

Thus, consistent with the average incubation period, it is presumed that he contracted the disease sometime between August 10 and August 20, 1971, when his older sister came home from her trip. This is why it is necessary to carefully investigate and analyze the nature and conditions of Patient 1's illness. As has been mentioned before, she was sailing the Aral Sea from July 18 to August 8 and went ashore on July 29 and 31, 1971, and August 4, 1971. She became ill on August 6. It can be presumed that she became infected with smallpox in one of the two locations [where she went ashore]. Judging by the incubation period, these locations were Uyaly and Komsomolsk[-on Ustyurt]. Patient 1 and her friend P., who fell ill a day earlier, associated their illness with the fact that they had felt very cold a few days prior, when they were casting nets from the boat.[6] According to a September 29 report from Guryev and Alma-Ata, neither woman had any traces of smallpox on their skin. They were completely healthy. Both had vaccination scars. However, blood-serum tests on Patient 1, conducted in Moscow, showed high antibody levels, indicating recent exposure to the smallpox virus. Obviously, she had been sick with the mild form of the disease—varioloid.

Currently, an epidemiological investigation is being carried out where the vessel went ashore, the health of the local populaces is being monitored, and individuals who had smallpox are being traced.

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[5] Editors' note: although it is stated here that nine persons were afflicted with smallpox, this report actually describes ten cases. See Figure 1.

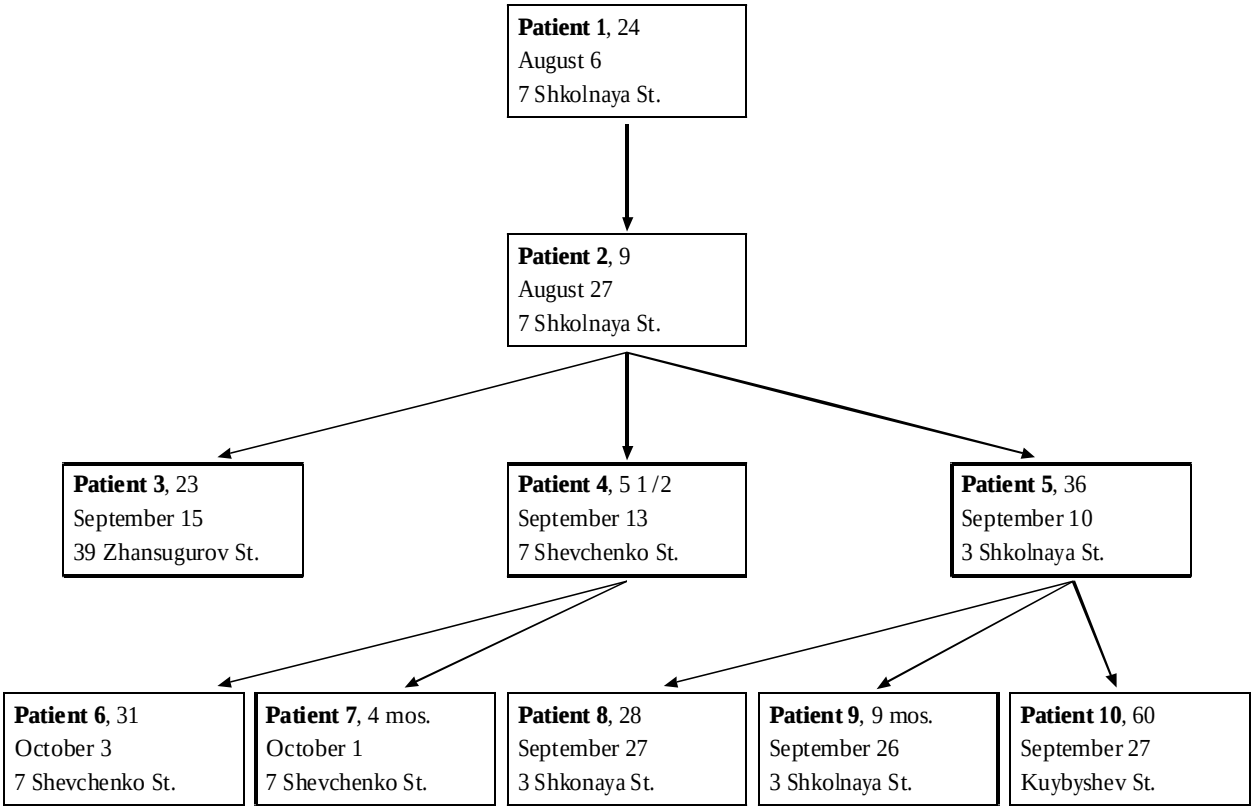
[6] Editors' note: P. is mentioned one more time after this reference, but then no further reference is given to this person. P. was not listed in this report as a smallpox patient. Therefore, it is assumed that this person did not contract smallpox.

According to this scenario, Patient 1 was the source of the disease's outbreak in the city of Aralsk. She contracted smallpox at the end of July, 1971, either in Uyaly or in Komsomolsk-on-Ustyurt. This is confirmed by the absence of the illness among the other crew members of the vessel and among the researchers, with the exception of P. P. is now in the city of Alma-Ata, where her blood is being analyzed in a virological laboratory. Less probable, but still possible, is that the infection was introduced directly into the city of Aralsk from the southern borders of the Soviet Union via land or water transportation.

According to WHO [World Health Organization] updates, smallpox is known to be recorded in Afghanistan every year; there were 1,030 cases in 1970 and 482 cases during the first 8 months of 1971. It would be entirely possible that the disease could reach the territory of the Tajik and Uzbek SSRs [Soviet Socialist Republics]. These regions are connected to the city of Aralsk economically, as large quantities of cargo are conveyed via the Amu-Darya River and the Aral Sea. Cotton, melons, etc. are shipped to the north, while grain, coal, and other items are shipped to the south. The Uch-Say transshipping facility is served by workers from Aralsk and other cities and towns in the region. Periodically, teams from the Aralsk shipping company are sent to the port of Termez, where they transfer cargo coming from Afghanistan by ship to trains. Such a team arrived from Termez on August 29-30, so its members could not have been a source of infection for Patient 1 because of the timeframe.

A scenario of infection via the open-air market has also been thoroughly checked. As a matter of fact, individuals bring to the city of Aralsk large quantities of produce from the Uzbek and Tajik republics. However, no evidence was established that people with smallpox arrived from those regions and visited the home of [the father of Patients 1 and 2] or the market's director, or that goods such as rugs and other wool artifacts were bought or sold there.

Figure 1: The Spread of Smallpox in the City of Aralsk
(August-September, 1971)



Evacuation Group

The evacuation group, which began its work on September 24, 1971, consisted of: M. Amanov, group leader and chief physician of the Aralsk TB clinic; V. Chekalin, senior research associate of the Central Asian Anti-Plague Institute [PChI]; S. Seksenbaev, assistant epidemiologist of the Aralsk District SES; S. Nuraliev, a driver from the service center; and G. Krasyukov, a driver from the Aral Sea Anti-Plague Station. They had two UAZ-452 cars. The group was involved in the evacuation and transfer of smallpox patients, febrile patients suspected of having smallpox, and people who had been in close contact with them to the field hospital and the isolation ward. They also transported the contacts and field hospital patients to their homes after their release. In addition, the group assisted the infectious disease consultants by transporting suspected cases identified during house-to-house calls to the field hospital. They were called out for this purpose a total of 57 times. The group also helped organize burials of those who died from smallpox.

Between September 25 and October 10, 1971, the group transported 274 people, including 7 to the special hospital, 20 to the field hospital, and 108 to the isolation ward. All transfers were made according to directives issued by ChPK headquarters and were carried out either immediately or within 3 hours, depending on how urgent the case was. Most of the patients and contacts were evacuated to the hospitals and isolation ward within the first 3 days—September 24-27, 1971. When the close contacts were being released from the isolation ward after the completion of the isolation period, at the request…[7]

[7] Translators' note: the sentence is not finished in the source text.

The group's work became more difficult because of a multiple relocation of both the special and the field hospitals. Another obstacle that slowed their work was not having a map of the city showing street names and numbers.

Medical Service

In order to provide medical and consulting assistance in the outbreak containment locale, a hospital for smallpox patients, a field hospital for suspected cases, and an isolation ward for contacts were set up. A group of consultants was constituted.

The consulting group consisted of:

1. K. Z. Smagulov, associate professor, chair of the Infectious Disease Department at the Aktyubinsk Medical Institute—group leader;
2. A. F. Reformatskaya, associate professor, chair of the Infectious Disease Department of the Alma-Ata Medical Institute;
3. Yu. F. Shcherbak, associate professor, Infectious Disease Department, Central Institute of Advanced Medical Training, Moscow;
4. M. S. Favorskiy, associate professor, Infectious Disease Department, Leningrad Medical Institute No.1;
5. R. G. Malchikovskiy, physician, Municipal Infectious Disease Hospital No. 2, Moscow;
6. V. S. Vendrikh, physician, Municipal Infectious Disease Hospital No. 2, Moscow;
7. O. Ye. Sherchik, physician, Alma-Ata Skin and Venereal Disease Clinic.

During the period from September 23 to October 7, 1971, the group made 270 calls (see Table 1).

From this table, one can see that in addition to the medical work, most of the attention was given to quickly identifying those people suspected to have been in contact with the patients and those who had fevers. Later, in conjunction with the mass vaccinations on the 4th and 5th days, a large number of febrile patients emerged. A total of 270 children and adults suspected of having smallpox were examined.

The station would be alerted to a new patient, and a duty physician would be dispatched immediately. Notification of a potential smallpox case in a private home could come from a physician making house-to-house calls, from epidemiologists, from vaccination technicians, and, in some cases, from private parties and the police.

As previously indicated (in Table 2), out of 270 calls, post-vaccination reactions were diagnosed in 170 patients. In the other 100 cases, [the following medical problems were also discovered:] respiratory disease—13; digestive tract illness—5; liver—4; cardiovascular—2; skin—22; allergies—7; surgical—3; mental cases—1. In 24 cases, the people examined were healthy.

In addition to examining people at home or at school, physicians examined and treated patients in various local workplaces.

Diseases Identified in 270 Patients Suspected of Having Form 60[8]

Disease	No. of Cases	Disease	No. of Cases
1. Smallpox	10	7. Skin diseases	22
incl. Varioloid:	3	t*odermia [*2nd letter illegible*]	9
		neurodermatitis	1
2. Post-vaccinal reaction (total):	170	scabies	5
(secondary)	10	[*left blank*]_____	3
		urticaria rashes	2
3. Respiratory illnesses	13	acne	1
pneumonia	6	birthmarks	1
acute respiratory disease	5		
acute bronchitis	1	8. Surgical illnesses	3
tuberculosis	2	spinal cord injuries	1
tonsillitis	9	infected forehead wound	1
		phlegmon in the right arm	1
4. Digestive tract disorders	5		
dysentery	1	9. Allergic reactions	7
gastritis	3	to measles vaccine	3
enteritis	1	exudative diathesis (metabolic allergic reaction)	4
5. Liver disease, incl.	4		
cirrhosis	1	10. Mental disorders	
infectious hepatitis	1	epilepsy	1
hepatargia	2		
		11. Healthy	24
6. Cardiovascular disease			
hypertension	2		

Inpatient Clinics

The following hospitals were organized:
1. hospital for smallpox patients;
2. field hospital for suspected cases;
3. isolation ward for contacts;
4. epidemiological inpatient unit for those with acute digestive-tract disorders.

[8] Editors' note: in the anti-plague system, code terms were used for infectious diseases. For example, Form 100 denoted plague, and Form 20 denoted cholera. As far as we have been able to determine, Form 60 stands for anthrax, even though that usage seems inconsistent in the context of this report.

Smallpox Hospital

Initially, the hospital was established in the isolation ward of the anti-plague station, which could accommodate 3 patients in 2 rooms. There was a physician's lounge, an examination room, and a room for sterilizing equipment.

Later, when new cases emerged, part of the dormitory at the GPTU (State Professional and Vocational School) was converted into a hospital.

By October 11, a total of 9 patients had been hospitalized.

Smallpox distribution and type:
1. Discrete smallpox (*variola vera discreta*)—3;
2. Hemorrhagic smallpox (*variola vera haemorrogica*)—3;
3. Modified smallpox—varioloid (*variola vera modifical)*—3

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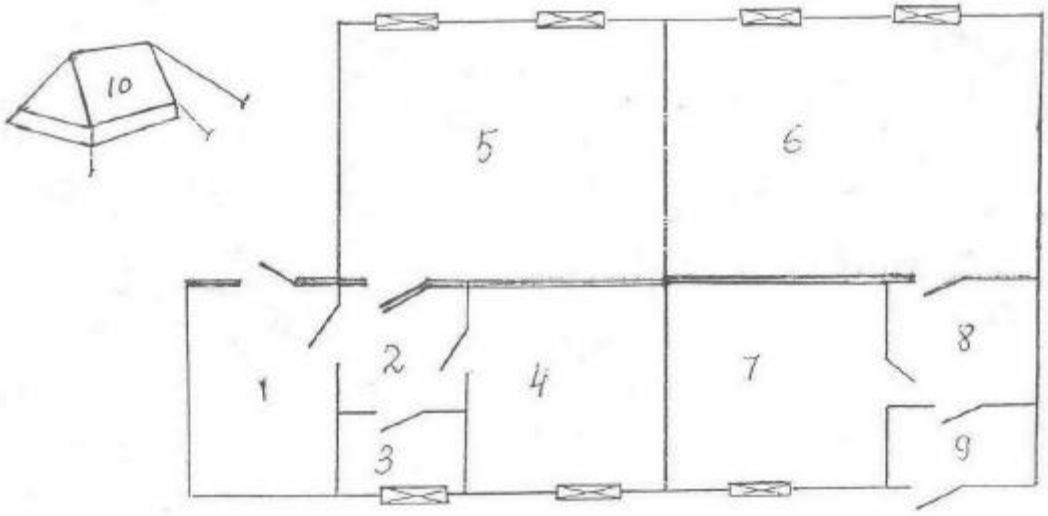

Layout of the hospital set up at GPTU

1 – Room for putting on anti-plague suits
2 – Passageway
3 – Room for removing suits and for disinfecting procedures
4 – Room for duty personnel, examination room
5,6,7 – Patient rooms
8 – Passageway
9 – Room for removing and disinfecting anti-plague suits
10 – Tent for clean suit storage

All hospital personnel worked in Class-I anti-plague suits.

A dorm for hospital personnel was set up in a separate part of the hospital, and a third area was used as a hospital for [patient] contacts.

The entire area was surrounded by a high fence, with police stationed outside the fence 24 hours a day.

All personnel at both the smallpox hospital and the hospital for contacts were confined to quarters.

In order to limit the number of people working in close contact with the patients, hospital personnel (nurses and orderlies) had very heavy workloads (24 hours on, 24 hours off). [There were] a total of 3 nurses (2 ward nurses and 1 who worked both as the supervisory nurse and as the supply nurse), 2 orderlies, and 1 instructor/ exterminator/ disinfection technician.

What follows is a detailed clinical discussion of the case history for each one of the hospital's patients, including those who stayed at the hospital as well as those who are in the hospital as this report is being written.

1. Patient 3, 23, female. Admitted to the smallpox hospital on September 22, 1971, having been diagnosed with smallpox. Fell ill on September 10, experiencing general discomfort, weakness, and headache; but continued to work until September 13. Fever, severe headache, dizziness, nausea, and vomiting began on the 14th. On September 15, she was admitted to the surgical ward having been diagnosed with a "concussion" (she had hit her head against the side of a truck bed, but it was never determined when); she had a nosebleed the same day.

When admitted, her condition was serious; she had a fever, her blood pressure was 120/80, her pulse was 86, and her lungs were normal. Her condition steadily worsened, with severe headache and repeated vomiting. On September 20, a bright red rash appeared on her face and chest. At the same time, profuse eruptions appeared on her buccal mucosa; these were initially diagnosed as Belski-Filatov spots. After examination by an infectious disease specialist, the patient was diagnosed with measles and transferred to the infectious disease ward on September 20. At the time of her admission to this ward, the patient was in grave condition. Abundant papular eruptions had spread to her extremities, including her palms and soles. The papules were firm to the touch. Her tongue was dry with a brown coating. Her heartbeat grew muffled and she experienced sustained tachycardia. Because of the pain, she swallowed and breathed with difficulty.

On September 21, vesicles were noticed forming in the center of some of the papules, and this is when the duty physician began to suspect smallpox.

The diagnosis was made on September 22 by the regional infectious disease specialist, Dr. Chun-Sun, and confirmed by Drs. K. Z. Smagulov and A. F. Reformatskaya.

The patient suffered from an extremely severe form of smallpox. The rash was confluent, and many of the rash elements subsequently became hemorrhagic. Profuse eruptive lesions were noticed on the nasal and buccal mucosa. Symptoms of toxemia and vascular insufficiency became much more severe. Later, a moderation of the rash elements was observed on the skin of her face, while on her lower back and buttocks a continuous ulcerated surface formed. The patient was agitated and restless. She refused to eat or drink. Symptoms of cardiovascular insufficiency persisted: her heart sounded muffled, her pulse was 120, her blood pressure was 90/60, then 80/50. Anuria set in. The patient was periodically delirious. Her temperature remained very elevated until the 16th day of the illness. On the last 2 days of the patient's life, her temperature dropped to subnormal levels (collapse!). Death occurred on the 19th day of the illness in conjunction with increasing intoxication and a sharp decrease in cardiovascular activity.

Course of treatment: anti-smallpox gamma-globulin, 1*0 [*numeral illegible*] ml [milliliters]; intravenous and subcutaneous administration of saline solution with 5% glucose, polyglucin, heart medications (corglucin, caffeine), corticosteroids (prednisolone, hydrocortisone), irrigation of the mouth cavity.

Blood tests, September 17: erythrocytes – 4,350,000; Hb – 11.8%; L – 9,100; differential blood count: eosinophils – 2; stab/band neutrophils – [*numeral illegible*]; segmented neutrophils – 68; lymphocytes – 18; monocytes – 3; ESR – 28 mm [millimeters] /hr.

September 21: erythrocytes – 3,230,000; Hb – 8.8%; L – 11,650; differential blood count: eosinophils – 6; stab/band neutrophils – 7; segmented neutrophils – 49; lymphocytes – 33; monocytes – 5; ESR – 35 mm/hr.

September 27: L – 12,500; differential blood count: eosinophils – 7; stab/band neutrophils – 4; segmented neutrophils – 37; lymphocytes – 50; monocytes – 2.

Diagnosis: smallpox, hemorrhagic form.

2. Patient 5, 36 year old female. Admitted to the smallpox hospital on September 22 with a diagnosis of smallpox. Became acutely ill on September 10 with a fever, general weakness, chest pains, shortness of breath, and general bodily discomfort. On September 13, the 4th day of illness, she went to the outpatient clinic where, during the examination the following was discovered: dry and moist rales in conjunction with vesicular respiration from underneath the lower lobes of the lungs. She was diagnosed with bilateral pneumonia and antibiotics were prescribed for her.

During a second examination on September 17, profuse pustular eruptions were found on the skin of her face, trunk, and extremities. She was hospitalized in the dermatological ward with a diagnosis of Duhring dermatitis.

At the time she was admitted, she was in moderately grave condition, with a temperature of 38.3°. A mass of vesicular monomorphic elements appeared on the skin of her trunk and extremities. Some of the elements had indented centers. Individual vesicular elements were found on the buccal mucosa. Later, she had a subfebrile temperature, complained of itching skin, and pain in her armpits. Some rash elements began to dry out, but new eruptions appeared on the palms of her hands and soles of her feet.

On September 20, she was examined by an infectious disease specialist, who ruled out the possibility of an infectious disease. The rash elements eventually dried out.

On September 22, she was examined by the regional infectious disease specialist, Dr. Chun-Sun, who diagnosed smallpox. During subsequent examinations on September 23-25 by Drs. K. Z. Smagulov and A. F. Reformatskaya, the diagnosis was confirmed.

The smallpox illness followed a typically clinical course for a moderately severe case: acute onset of the illness, rash onset on the 4th day of the illness, starting with the face and then spreading within 3 days to the trunk and extremities. The rash was at first papular, then vesicular with multilocular vesicles that had indented centers sitting on a thick base.

Pustulization and drying out of the elements were later observed. After the scabs separated, multiple patches of the skin remained discolored. Starting with the 10th day of the illness, her temperature was subfebrile; from the 16th day—normal. No abnormalities were observed in the cardiovascular system. Dry and moist rales persisted in the lungs for some time.

Course of Treatment: antibiotics and vitamins.

Blood tests, September 6: erythrocytes – 4,000,000; Hb – 11.6%; L – 9,000; differential blood count: eosinophils – 2; stab/band neutrophils – 1; segmented neutrophils – 41; lymphocytes – 52; monocytes – 4; ESR – 8 mm/hr.

Diagnosis: smallpox (discrete form).

3. Patient 4, 5 years, 6 months. Admitted to the smallpox hospital on September 27, 1971, having been diagnosed with smallpox. On the 5th day of the illness, his condition was serious. He became sick on September 19, 1971. He had a fever, but did not feel particularly unwell. On September 22, rash onset began, but no doctor was called. He was identified as a potential smallpox patient during the house-to-house calls on September 27, 1971.

He was first vaccinated against smallpox when he was 3 years old.

At the time the child was admitted, his condition was serious. He complained of a headache. A profuse vesicular rash was observed on the skin of his face, chest, stomach, and extremities. The vesicles were dimpled. Hard scabs formed in some places on his face, scalp, and ears. On the 10th day of illness, the facial scabs separated in some places, forming spots of presquamosal epidermis. A pustular rash appeared on the skin of his trunk and extremities. No abnormalities were observed in his lungs or heart, his abdomen was soft, his liver was firm, and, when palpated, extended 4.5-5 cm [centimeters] below the bottom of his ribcage (the child had suffered from Botkin's disease when he was 18 months old). On the 10th-12th days of illness, stage-by-stage drying of the rash elements was observed, with scabs forming and separating. Some of the rash elements on his ankles and on the tops of his feet burst, forming bleeding surfaces. On the 13th and 14th days of illness, numerous patches of discolored skin formed on his face, upper trunk, and upper extremities, where the scabs had separated. Epithelization began on the eroded surfaces of his ankles and soles. Within the next several days, the scabs on his face, trunk, extremities, and scalp eventually separated. By the 22nd day of illness, some scabs remained on his scalp, back, and extremities. He was in satisfactory condition.

Blood tests, 5/-71 [*sic*][9]: erythrocytes – 4,180,000; Hb – 11.4%; CI – 0.83; L – 6,000; eosinophils – 2; stab/band neutrophils – 2; segmented neutrophils – 30; lymphocytes – 57; monocytes – 3; ESR – 37 mm/hr.

Virological testing, September 27: smallpox virus isolated from pustular fluid.

Diagnosis: smallpox (discrete form).

4. Patient 2, 9, male. Admitted to the smallpox hospital on September 28, 1971 in satisfactory condition, on the 32nd day of illness. He had been vaccinated on January 29, 1963, when he was 3 and a half months old (according to a note in his medical records). He has not been revaccinated. He became acutely ill on August 27, 1971, with a high fever and headache. He felt generally bad. On August 30, a doctor was called for the first time from the outpatient clinic (a rash had appeared on the child's skin that day). It was suggested that he had urticaria, and some powdered medication was prescribed (there is no indication to that effect in his medical records). No other physician saw the child. The child went to school on September 13. On September 24, he was examined by the head of the infectious disease department, K. Z. Smagulov, and infectious disease specialist Zholdasbaev. He was diagnosed with smallpox.

The child's condition was satisfactory at the time he was admitted. He did not complain of anything. A rather significant quantity of discolored rounded patches was observed on the skin of his face, trunk, and extremities. On his lower extremities (ankles and soles), some dark scabs were firmly attached. There were no heart or lung abnormalities. During subsequent days, the child's condition remained satisfactory. Some individual scabs remained on his ankles and soles. No irregularities were observed in his internal organs. His temperature was consistently normal.

[9] Translators' note: The blood tests were probably performed on October 5, 1971.

Blood tests, October 5, 1971: erythrocytes – 4,580,000; Hb – 13*%; CI – 0.86; L – 9,350; eosinophils – 2; stab/band neutrophils – 1; segmented neutrophils – 43; lymphocytes – 54; monocytes – 0; ESR – 34 mm/hr.

Virological testing, September 5/25 [*sic*]: smallpox virus isolated from the patient.

Diagnosis: smallpox, discrete form.

5. Patient 8, 38, male. Admitted to the smallpox hospital on September 29, 1971, on the 5th day of illness. He had been vaccinated as a child, but never revaccinated. He was revaccinated on September 22, 1971, and again on September 27, 1971, because he had no reaction to the first revaccination.

This patient was in close contact with his wife, Patient 5, a smallpox patient who, after getting sick, stayed at home from September 10 to September 22, 1971. He was hospitalized as a contact in the isolation ward on September 25, 1971. He became acutely ill on September 25, 1971, with a fever, headache, and a cough typical of a febrile patient. He was transferred to the field hospital, where he stayed from September 26 to September 29, 1971. During those 4 days (September 26, 27, 28, 29), his temperature ranged from 37.5 to 38.7º. Starting with the 5th day of illness, his temperature was normal. On September 28, the 4th day of illness, he was examined by A. F. Reformatskaya, the head of the infectious disease department of the Alma-Ata hospital.

It was noted that, despite an absence of obvious smallpox symptoms, it was recommended that atypical elements on his skin be cultured for virological testing (there were two pointed elements on the skin of his chest, but they were not firm.) Elements of a similar nature appeared on his neck, the left side of his chest, and one of the soles of his feet on September 30, 1971, his 6th day of illness.

On September 29, 1971, in conjunction with the illness of a child (Patient 9, 9 months old), Patient 8 was transferred to the smallpox hospital, where he was kept under observation and underwent further tests. The rash elements noted became firm and papular in 2-3 days; and in those places where the eruptions were cultured for virological testing, punctuated scabs formed.

From September 30 onward, his condition was satisfactory, and there were no irregularities in his internal organs.

Blood tests, October 6, 1971: erythrocytes – 4,4800,00; Hb – 13%; CI – 0.88; L – 9,500; stab/band neutrophils – 3; segmented neutrophils – 50; lymphocytes – 45; monocytes – 2; ESR – 32 mm/hr.

Virological testing, September 28-October 3, 1971: smallpox virus isolated from skin-lesion culture.

Diagnosis: modified smallpox—varioloid.

6. Patient 10, 60, female. Admitted to the smallpox hospital on October 3, 1971, on her 8th day of the illness. She was in close contact with Patient 5 (her daughter-in-law) between September 10 and 22, 1971. She was first vaccinated in 1922 and revaccinated on September 25, 1971. Because of this contact, she was hospitalized in the isolation ward on September 25, 1971.

On September 26, 1971, she was transferred to the field hospital together with her grandchildren.

On September 27, her second day at the hospital, her temperature rose to 37.7º, and within the next few days her temperature was subfebrile – 38.3-37.4º on September 30; later, it was consistently normal. On October 2, 1971, her 6th day of illness, two pinkish patches appeared on her right upper extremity; similar patches appeared on her back on the 8th day after the fever began, and papular elements appeared on her

extremities. The papular elements became pale, and traces of excoriation remained after the elements were cultured for virological testing. Her general condition was normal. The patient was also examined by Dr. A. F. Reformatskaya, head of the infectious disease department of the Alma-Ata Medical Institute and by Dr. U. F. Shcherbak from the Central Institute for Advanced Medical Training.

Blood tests, October 6, 1971: erythrocytes – 4,080,000; Hb – 11.4%; CI – 0.82; L – 5,000; eosinophils – 5; stab/band neutrophils – 3; segmented neutrophils – 53; lymphocytes – 38; monocytes – 1; ESR – 40 mm/hr.

Virological testing, September 28-October 3, 1971: smallpox virus isolated from skin-patch culture.

Diagnosis: modified smallpox—varioloid.

7. Patient 6, 33, male. Admitted to the smallpox hospital on October 9, 1971, presumably on the 12th day of illness.

He had been vaccinated in childhood, and then revaccinated when he was 10 or 11 years old and again between 18 and 20 years old, while serving in the Soviet Army.

The patient was in close contact with children who were smallpox patients: Patient 4 (5 yrs, 6 months), between September 19-27; and Patient 7 (4 months), on October 2, 1971.

From September 27, 1971, he stayed in the contact isolation ward. His condition was satisfactory, and he did not complain of anything.

On October 2, 1971, while his temperature was normal and his general condition was satisfactory, elements 0.3 and 0.5 cm in size, with a firm base, appeared on the skin of his right cheek, right shoulder blade, and on the internal surface of his left hip.

On October 3, 1971, vesicular rash elements appeared; on October 6, suberuptions that would lead one to suspect varioloid appeared.

On October 3, 1971, and again on October 6, 1971, the skin irregularities were cultured for virological testing, and the smallpox virus was isolated.

The patient was examined again by Dr. U. F. Shcherbak.

On October 9, 1971, the following entry appears in his case history: “Patient being actively monitored; clinical pattern to illness (limited to individual rash elements), epidemiological testing, as well as positive results from virological testing confirmed the diagnosis of modified smallpox – varioloid.”

On October 9, 1971, he was transferred to the smallpox hospital. At the time of admission, his condition was satisfactory. Only traces of excoriation, after culturing for virological testing, remained on his skin. From October 2-5, 1971, he was to take 0.6 units of methisazonum twice every 24 hours.

After analyzing his medical record and factoring in the time when the rash first appeared, the onset of the illness should be associated with September 28, 1971 (the rash onset occurred on the 5th day after the probable beginning of the illness).

Clinical diagnosis: modified smallpox—varioloid.

8. Patient 9, 9 months, male. The child was in close contact with his sick mother, Patient 5, between September 10-17, 1971 (on September 17, the mother was hospitalized at the skin and venereal disease clinic). On September 25, 1971, the child was admitted to the contact isolation ward.

The child was breast-fed and also eating solid food, and he had not been vaccinated (according to his father he had been vaccinated, but no traces of vaccination were visible). He got sick on September 25, 1971, with a fever, vomiting, and cough. On September 26, he was transferred to the field hospital for febrile patients.

At the time he was admitted, the child's condition was grave, his temperature was 38.7º, and he was coughing and vomiting. A micropunctuated rash appeared on his skin. His fauces and mucosa were clean. Dry and moist rales were detected in both lungs. His heartbeat was clear, his abdomen slightly distended, and his stool dyspeptic. On September 27, 1971, the 3rd day of the illness, he was in grave condition, refused to eat, was agitated, and the rash acquired a papular nature. The dry and moist rales remained in his lungs (microfocal bilateral pneumonia). His heartbeat was clear, and his stool remained dyspeptic.

On September 28, 1971, the 4th day of illness, the boy was examined by Professor A. F. Reformatskaya.

The entry in his case history says: "The child is in grave condition, agitated, restless, did not sleep well during the night. Profuse papular rash, firm to the touch, is present on the skin of his face, the lateral surfaces of his neck, his chest, and his abdomen. The elements range in size from pinpoint to 3-4 mm. Vesicles have formed in the center of some elements. Individual brown scabs are present on his forehead. His fauces is slightly hyperemic. Dispersed dry rales can be heard in his lungs. Tachycardia. Slight enlargement of the heart with deviation to the left. His abdomen is soft, not distended, his liver is not enlarged. The stool is normal. Muco-purulent nasal discharge. The diagnosis remains unclear, and virological testing is recommended."

On the 5th day of illness, the rash became typically vesicular and dimpled. Individual vesicles appeared on his palms. Hyperaemia of the fauces. Same irregularities in his lungs. His heartbeat were muffled, his liver slightly enlarged (up to 1.5 cm); fauces and mouth mucosa were hyperemic. The child was reexamined by Professor A. F. Reformatskaya, diagnosed with smallpox, and transferred to the smallpox hospital.

His condition continued to become more severe. By 1800 hours Moscow time on September 29, 1971, his condition was critical. He was restless, his temperature was 40º, and his face was puffy. Eruptions of a polymorphic nature were present on the skin of his face, neck, chest, abdomen, and extremities; individual rash elements were dimpled. His pulse was rhythmic and full. His heartbeat were slightly muffled. His tongue had a white coating and was moist. His abdomen was distended, and his liver palpated 2 cm below the edge of the rib. The stool was normal.

On the 6th day of illness, the child's condition remained critical. He was groaning, not eating well, and had continuous purulent discharges from the nose and conjunctiva of both eyes. The mucosa of the mouth not covered by the rash was hyperemic. There was a polymorphic rash on the skin, and individual vesicular elements began to suppurate. Vesicles remained on his soles and palms. Dry rales remained in his lungs, while moist rales were not detected. The heartbeat were significantly muffled. The abdomen was greatly distended, but could be palpated. The liver was firm, and there were palpates 3 cm below the edge of the rib. The stool was yellow. Urination was normal.

The child was examined by Dr. U. F. Shcherbak. On the 7th day of illness, hemorrhagic eruptions appeared on his skin, particularly at the injection sites. Bleeding was also noticed at the injection sites. The pustules had hemorrhagic saturations. The stool was dark and loose. The liver had enlarged to 4.5-5 cm and

was very firm. Against a background of increasingly regressive cardiac activity, the child died on October 2, 1971, at 1610 Moscow time.

From the moment the child was admitted to the field hospital, he was treated with antibiotics: at first with penicillin, administered twice every 24 hours, 50,000 units each time. Starting on the 5th day of illness, 100,000 units every 4 hours; streptomycin, 100,000 units twice every 24 hours; and sulfathiazole, 0.25 units 4 times every 24 hours. On the 5th and 6th days of the illness, he was intramuscularly administered anti-smallpox donor gamma globulin, 6 ml each day (he was also administered gamma globulin on the 1st and 2nd days of his stay at the smallpox hospital).

On September 26, 1971, clinical specimens were taken for virological testing. The smallpox virus was isolated from these specimens (nose-and-throat and skin-patch cultures).

Diagnosis: smallpox—hemorrhagic type.

9. Patient 7, 4 months, female (born May 20, 1971). Admitted to the smallpox hospital on October 2, 1971. Within the first 24 hours of illness, she was diagnosed with smallpox.

The child was normotrophic, breast-fed, and had never before been ill. The child had not previously been vaccinated against smallpox. Her first vaccination against smallpox was given on September 27, 1971.

Between September 19 and September 27, 1971, she was in close contact with her brother, Patient 4 (5 yrs, 6 mos).

On September 27, the girl was hospitalized in the contact isolation ward, where she stayed until October 2, 1971, the day the illness began.

She became ill during the night of October 1, 1971; she was sluggish and cranky. On October 2, 1971, while maintaining a normal temperature, she began vomiting, her stool was loose, she could not sleep during the night, and she did not eat well. According to her mother, during the evening of October 1, 1971, a rash appeared on the skin of her trunk and extremities. On October 2, the child was examined by a group of infectious disease specialists (M. S. Favorskiy, F. O. Vendrik, D. Zh. Zhumakhmetova, and Yu. F. Shcherbak). They noted that the child was in grave condition. A papular, bluish, dimpled rash with individual vesicular elements was noticed on the skin of her trunk, neck, and upper and lower extremities. A vaccination site in an early pustular stage appeared on her left shoulder. No irregularities were noted in her internal organs.

Conclusion: factoring in her extended contact with the smallpox patient and the clinical symptoms, smallpox was suspected.

When admitted to the hospital, the child's condition was grave. She was agitated, but alert. She was able to visually follow moving objects. An abundant, macropunctuated rash, spotted in some places, was detected on the skin of her face, scalp, neck, upper and lower extremities, palms, soles, and trunk. An individual vesicle was detected on the inner edge of her left palm. Post-vaccination pustules were noticed on her left shoulder. No abnormalities were detected in her heart or lungs. The liver palpated 20 cm below the bottom edge of the rib. No stool.

On the second day of the illness, her condition worsened; she did not sleep well and hardly ate. The rash became papular, firm, and confluent, especially on her back and buttocks. Dispersed dimpled vesicles were detected. The mouth mucosa was hyperemic, the tongue had a whitish coating, the lungs were clear, the heartbeat was rather strong, the abdomen was slightly distended, and the liver remained the same size.

By the end of the second 24-hour period, her condition further worsened. She began to moan while breathing, she refused to nurse, and tachycardia was noted (temperature 37.8º, pulse 160-164 per minute). On the third day of illness, the number of vesicular elements increased. Individual vesicular eruptions emerged in her fauces. There was slight bleeding at the injection sites. Breathing was harsh, no rales, 56-60 breaths per minute. Coughing began. A significant muffling of the heartbeat began, tachycardia continued. The liver enlarged to 4.5-5 cm, and became quite firm and sensitive during palpation. By the evening of the third day, her condition was critical. She refused to nurse, and she moaned while breathing. A scleral injection appeared. Her lips were dry and encrusted, she was vomiting, and her palms and soles were puffy. There was nearly continuous and abundant slight bleeding from the injection sites. The liver enlarged to 5.5-6 cm, extended below the bottom edge of the rib cage, and was firm. The stool was green and fluid. She continued to moan while breathing. Dyspnea (no clear auscultatory data) indicated that pneumonia was developing.

On the 4th day of illness, her condition was critical; her breathing was very short and required a great deal of exertion; her nostrils were flaring; and the intercostal spaces of the chest began to retract during inhalation. Multiple hemorrhages were detected on the skin of her trunk, extremities, and especially on the abdomen. Slight bleeding continued from all of the injection sites. All visible mucosal surfaces were extremely pale. Her tongue was thickly coated. Percutory sounds, with tympanic tones, were detected above her lungs, and fine, moist rales were detected everywhere against a background of harsh breathing. Her heart rate was 60-64 beats per minute. Her heartbeat was severely muffled. The number of heart contractions was 160-164 per minute. The abdomen was severely distended. The liver was firm, its edge palpated 5.5-6 cm below the bottom edge of the rib. The stool was green; consciousness was impaired. At 1220 hours (hrs) on October 5, the epidermis on her soles and palms began to slough off.

On October 5, as cardiac activity became increasingly compromised, the child died at 1500 hrs Moscow time.

From the first day of her stay at the hospital, the child received: penicillin, 200,000 units every 4 hours; streptomycin, 100,000 units twice every 24 hours; and methisazonum, 0.3 units twice every 24 hours. On October 2 and 3, she received intramuscular injections of anti-smallpox donor gamma-globulin, 3 ml each; and on October 5, 3 0.4-ml doses of hydrocortisone.

Blood tests, October 5, 1971: erythrocytes – 2,050,000; Hb – 6.4%; CI – 0.72; thrombocytes – 201,000; L – 21,000; eosinophils – 4; stab/band neutrophils – 1; segmented neutrophils – 10; lymphocytes – 83; monocytes – 2; ESR – 44 mm/hr; Mack-Magro blood coagulation – 5*.

Virological testing: nose-and-throat and papule culture swabs on October 2, 1971 – smallpox virus isolated.

Field Hospital

I. Director, physicians (2), nurses (5), orderlies (3), cook (1), driver (1), disinfection technician (1).

September 26—9 patients admitted; and by September 27—20.

September 28—8 [patients] released (see Tables 5, 6, and 7).

Smallpox patients identified among febrile patients at the field hospital: Patient 9 (9 months, son of Patient 5), Patient 8 (the child's father and Patient 5's husband), and Patient 10 (60, Patient 8's mother who cared for the child).

14 patients remained.

Regular shifts were instituted. Food and water were delivered to the hospital by vehicle.

Contact Isolation Ward

In order to isolate individuals who were in contact with the patients, a 150-bed isolation ward was set up on September 24, 1971, at the Young Pioneer summer camp, located 5 km from the city [of Aralsk].

The camp consisted of 4 structures surrounded by a fence. Food was cooked in the camp's dining facility. Water was brought in by car.

Personnel: 4 physicians, 4 nurses, 5 orderlies, 1 cook, 3 kitchen assistants, 1 supply nurse, 1 supply supervisor, 2 drivers, 1 disinfection technician, and 2 electrical technicians. External security was provided by 3 policemen.

As a result of their contact with patients, 104 people were placed in isolation. Patients suspected of having smallpox and subsequently transferred to the isolation ward [from the contact isolation ward]: September 26—Patient 8's family; October 2—Patient 7 and Patient 6. The contacts were examined daily by the physicians, and their temperatures were monitored. Relatives were allowed to bring food and other necessary items to the ward. Dishware was not returned.

Epidemiological Inpatient Facility

The infectious disease department of the city hospital was quarantined because of its contact with Patient 3, who was transferred there after having been diagnosed with measles. This is why the department could not admit patients with infectious diseases from among city residents.

The inpatient unit for patients with infectious diseases was not set up until October 2. According to incomplete data, by that time 25 patients with acute intestinal illnesses were staying at home. The 25-bed station was opened in the House of Culture. 10 patients were admitted. Food was cooked on the premises. Personnel: 1 director, 2 physicians, 4 nurses, 2 orderlies, 1 supply technician, 1 driver. The physicians' lounge and the procedure room shared the same space. A dining facility was set up. The total number of patient rooms was 4.

After the quarantine was lifted from the infectious disease department on October 8, the epidemiological facility was closed, and the patients were transferred to the infectious disease department.

[*Page 35 of original not supplied*]

…dryer, miscellaneous equipment (mortar, syringes, forceps, scissors, etc.) and soft inventory.

The following tests were used in laboratory research: microprecipitation reaction in agar, hemaglutination inhibition reaction, fluorescing antibody method, and viral isolation in chick embryo and tissue cultures.

Depending on the time between the onset of illness and the appearance of skin eruptions, specimens were gathered and tested as appropriate. The results of the patient tests are presented in Table 3.

The diagnoses of smallpox were confirmed by isolating viral strains of smallpox in 9 patients.

Table 3.[10]

Last, First, Patronymic	**Age**	**Date material collected**	**Clinical Diagnosis**	**Results of laboratory tests**
1. Patient 3	24	Sept. 23	Smallpox	Viral isolation
2. Patient 5	37	Sept. 23	Smallpox	Viral isolation
3. Patient 2	9	Sept. 25	Smallpox	Viral isolation
4. Patient 4	5	Sept. 27	Smallpox	Viral isolation
5. Patient 8	33	Sept. 26	Smallpox	Viral isolation
6. Patient 9	9 months	Sept. 27	Smallpox	Viral isolation
7. Patient 10	66	Sept. 30	Smallpox	Viral isolation
8. Patient 7	4 months	Oct. 2	Smallpox	Viral isolation
9. Patient 6	31	Oct. 2	Smallpox	Viral isolation

By October 8, 1971, material had been collected from a total of 41 people.

Table 4. Number of People Virologically Tested for the Smallpox Virus

Number of people tested, including:					
				Corpse Material	
Total number tested:	Patients diagnosed with smallpox:	Direct contacts:	Febrile contacts:	Died after diagnosed with smallpox:	Died of other causes:
41	9	12	13	3	4
Test Results:	Smallpox virus isolated in all 9 patients	Smallpox virus isolated from nose-and-throat cultures of 2 contacts	Negative	Smallpox virus isolated from material taken from all 3 corpses	Negative

As can be seen from the table, 9 people had virologically confirmed diagnoses.

Work of the Histopathological Group

A medical examination group was formed on September 24, 1971. It included:

1. Borisov, I. V.—senior researcher, group leader;
2. Kimshimbaev, T. K.—medical examiner, coroner of the city of Aralsk;
3. Kopotilov, P. A.—laboratory technician, Aralomorsk Anti-Plague Station;
4. Khisamutdinova, N.—materials technician, Aralomorsk Anti-Plague Station;
5. Nurymbetov, N.—extermination instructor;
6. Alimbaev, Sh.—extermination instructor;
7. Zhumataev, A.—driver;
8. Kalibaev, S.—driver.

[10] For unknown reasons the index patient, Patient 1, is not included in Table 3. In addition, the order in which patients are listed in Table 3 appears haphazard.

On the premises of the Aralomorsk Anti-Plague Station, the group was provided with specialized clothing and laboratory collection equipment for virological and bacteriological testing. In addition, the group was equipped with the requisite quantity of disinfectants, a hydraulic sprayer, stretchers, barrels, pails, and so forth.

During the period from September 24 to October 7, autopsies were performed on 10 corpses. In 7 cases, the cause of death was due to various diseases. 3 people (Patient 3, 23; Patient 9, 9 months; and Patient 7, 4 months) died of smallpox. Until they died, they remained in the infectious disease hospital. Autopsy results confirmed the clinical diagnoses. The pathoanatomical pattern was typical for smallpox. The most significant damage was noted on skin surfaces, in the upper respiratory tract, and in the lungs, stomach, large intestine, and parenchymal organs. (Autopsy reports are attached.)

Materials provided by the bureau of vital statistics, the hospital, and the outpatient clinic were used to analyze all the deaths in the city of Aralsk that occurred between June 1 and October 5, 1971. It was established that, within the period indicated, 89 deaths were recorded in the city of Aralsk. Of that number, 30 people died of cardiovascular pathologies; 12 of oncological disease; 4 of tuberculosis; 5 of toxic dyspepsia; 2 of diphtheria; 1 of tetanus; 12 of pneumonia; 3 of peritonitis; 1 of meningital encephalitis; 1 of Botkin's disease; and 1 of whooping cough.

While analyzing deaths in the city of Aralsk, no individuals died of smallpox or were suspected of having died from smallpox.

Members of the autopsy group went directly to where people had died, in order to determine the cause of death in each case. They spoke with relatives of the deceased, discussing with them symptoms of smallpox and the importance of getting vaccinated and promptly seeking medical personnel in the event of illness.

Disinfection Procedures

Starting September 24, 1971, the following [disinfection] measures were taken:

A disinfection group consisting of 29 people was formed, 6 from Alma-Ata and 4 from Kzyl-Orda.

Personnel: Physician—1; orderlies—2; extermination instructors—3; disinfection technicians—20; and driver with car and miscellaneous personnel—3.

A group was formed to decontaminate the smallpox outbreak locales. The group was led by a medical technician. The group included an extermination instructor and 4 disinfection technicians. The group was supplied with a DDA-66 disinfection chamber.

Within the time indicated, 5 smallpox locales were treated, as well as 17 contact locales. The treatment used was wet disinfection (a 3% solution of chloramine was used to clean the internal surfaces of structures, furniture, laundry, and dishes). The chamber method was used for soft objects. A total of 1,200 kilograms was treated in the disinfection chamber.

The preventive disinfection service organized 3 mobile teams to thoroughly disinfect the city of Aralsk. Each team included:

1. a truck;
2. 2-3 containers for disinfecting solutions and water; and
3. 5 personnel (an extermination instructor, who served as the group leader, and 4 technicians).

During this period, 964 buildings were treated.

A scrub-down group was formed, which included a mobile bathhouse mounted on a ZIL-150 passenger car chassis. The processing capacity was 10 people per hour. The 2 disinfection technicians were responsible for washing down isolation wards and hospitals.

Within this period, the following disinfection materials and equipment were obtained and used:

1. Hydraulic sprayers—20
2. Disinfecting ***
3. Buckets—20
4. Scrubs—30
5. Medical gloves—60
6. Protective eyewear—50
7. Chloramine—250 kg
8. Bleaching powder—200 kg
9. Trichlorfon—145 kg
10. Hexachloran emulsion—100 kg
11. Polychloroprene—100 kg
12. DDT soap—50 bars
13. DDT powder—100 kg

A special team consisting of Alma-Ata disinfection workers was formed at the hospital. They were charged with organizing and maintaining disinfection procedures.

One disinfection technician was assigned to the isolation wards and field hospital. All the facilities where patients, contacts, and people under observation stayed were fully equipped with disinfection resources and supplies.

At the checkpoints where transshipment terminals (3) were set up, decontamination points were organized and fully supplied with disinfection equipment and resources (i.e., containers for water, sprayers, buckets, gloves, masks, and medical scrubs). Nurses working at the checkpoints were trained in disinfection procedures.

Quarantine Service

As was previously mentioned, in compliance with Directive No. 3 issued on September 24 by the district ChPK, the city of Aralsk was declared an active smallpox outbreak locale and placed under quarantine, starting at 1200 hours on September 24, 1971. Strict quarantine measures were the only way of stopping the further spread of the disease beyond the city, because of late hospitalization and isolation of patients, late diagnoses, and the inability to establish the source of infection. Up until September 26, the quarantine measures were enforced by the police, then beginning at 00 hours on September 26, by the military units of the local garrison and by a SAVO-64411 unit.[11]

The total length of the cordon around the city was 20-21 km, with soldiers placed at intervals of 700 to 800 meters; in other words, where they were directly visible to each other. The cordon was manned by 23 posts with a total of 200 soldiers.

According to Directive No. 4, issued by the district ChPK on September 26, procedures for leaving and arriving at the locale were established, as well as a procedure for tracking and registering outgoing economically vital shipments, whether by road, sea, or rail.

[11] Translators' note: SAVO = Central-Asian Military District.

The conditions of quarantine forbade city residents from leaving the city. A uniform identification system was introduced for certain categories of people whose work required them to be involved in emergency maintenance of the electrical and communication systems, etc. All these people were under constant medical observation at their place of residence; their temperatures were monitored, and their mucosa and skin surfaces were examined before they left and when they returned.

Entrance to the city was permitted to those who could show a local resident's registration, or a business travel certificate, after which they were vaccinated.

In order to monitor vaccinations and transshipments, a total of 5 checkpoints and medical control points were set up near roads leading to Aralsulfat, the Aralsk collective farm, railway junctions No. 86 and 87, and the seaport. Each checkpoint and medical control point was provided with 2 tents for a shift of 4 people and for the medical personnel (2 nurses). Each checkpoint shift was supplied with boiling water, fuel, disinfection equipment and supplies, and hot food. The cordon posts, each of which had 3 personnel, were similarly equipped. The medical control point personnel consisted of 14 nurses and 1 physician. The following work was done at the medical control point: examination and vaccination of 620 people arriving in the city and involved in shipping activities; examination of 82 vehicles with various types of cargo; and disinfection of 32 vehicles. Twelve ships and barges were also monitored.

Quarantine Service

Site guarded	**No. of posts**	**No. of personnel**	**Base unit of security personnel**
I. External perimeter			
a) land	23	100	Local military garrison
		100	SAVO military unit
including	4	8	District Interior Dept.
b) sea	1	3	District Interior Dept.
total:	24 [*sic*]	211	
II. Internal posts			9 from the regional Interior Dept.;
a) security for medical facilities	7	23	7 from the district Interior Dept.; 7 from elsewhere;
b) railway security	4	14	5 from the Aral Sea local Interior Department; 6 from the Alma-Ata Police Directorate; 3 from Kustanay

Medical Control Points

Location	**Number on map**	**Number of medical personnel**	**Length of shifts**
Railway junction No. 86	1	6	Round-the-clock
Road to collective farm	2	2	800 to 2100 hrs
Road to Aralsulfat	3	2	800 to 2100 hrs
Railway junction No. 87	4	2	800 to 2100 hrs
Seaport	5	2	Round-the-clock
Railroad	6, 7, 8	9	Round-the-clock

While the quarantine was in effect, several people were detained for violating the quarantine. Ten people were fined, while five were arraigned and had their drivers' licenses revoked.

Internal quarantines covered a zone of medical and preventive facilities, where smallpox patients were identified; i.e., departments of surgery and infectious diseases, skin and venereal disease clinics, as well as newly organized special facilities. The police were responsible for maintaining the quarantine over the hospital, the field hospital, the isolation ward, and the observation facility. A total of 7 posts with 23 personnel were set up. Round-the-clock security was provided for office buildings, with shifts 8 to 12 hours in length.

Organizing the Smallpox Vaccinations

An analysis of smallpox immunization conditions for the Aralsk district population within the last 5 years indicates serious deficiencies in this regard.

During the years 1966 to 1970, according to Report No. 86 of the epidemiological monitoring station (SES), a total of 69.7% of the district's population and 31.6% of the residents of the city of Aralsk were vaccinated (vaccination and re-vaccination), which is obviously insufficient. Vaccination plans were not always realized. For example, according to the plan for 1969, 9,800 children were to be vaccinated. Only 7,505 children (76%) were actually vaccinated.

As a result of an examination of 1,383 schoolchildren, carried out in order to determine their immunization status by randomly checking the nature of their skin reaction to revaccination, it was determined that 161 of these children (11.6%) did not have vaccination scars. Among the first and second grade students, 24% had not been vaccinated, while among the third to tenth grade students, 15%. Of 370 adults examined, 37 (10%) did not have vaccination scars; i.e., they had not been previously vaccinated. At the same time, a significant percentage (20.6%) had primary skin reactions, indicating an absence of immunity. A low-immunity segment was observed among first and second grade students, where the primary reaction percentage was 31.6%.

The following shows that immunization work among schoolchildren was unsatisfactory. While checking vaccination scars among schoolchildren that were in contact with smallpox Patient 2, it was discovered that 10 students of the 2B class of School No. 13 did not have vaccination scars, although in their preventive vaccination medical cards these children were registered as having been vaccinated.

Insufficient smallpox immunity was also discovered among non-affiliated adults, 64% of whom had accelerated and primary skin reactions.

An emergency mass vaccination was required in conjunction with the emergence of smallpox patients in the territory of Aralsk. On September 22, the chief physician of the district SES, Dr. Kulmakhanov, ordered smallpox vaccinations to be performed. As of September 22, the SES had 3.5 thousand doses of smallpox vaccine and 30 vaccination pens. Two primary groups of 9 station employees were formed, and they started the vaccinations at 1700 hrs on September 22. Within a short period of time on that day, 470 hospital personnel were vaccinated. The next day, September 23, vaccinations were performed in other medical facilities in the city.

On the morning of September 23, an epidemiologist, Dr. A. A. Akchurian, arrived from Kzyl-Orda with 5 mid-level medical personnel. They brought 2,000 vaccination pens and 13,000 doses of smallpox vaccine. Starting at 1000 hrs that morning, the group began vaccinating students at School No. 13. On September 23, 1,787 people, including schoolchildren, were vaccinated.

In order to improve vaccination measures, on September 24, 25 more medical personnel arrived from Kzyl-Orda, 5 of who were physicians. That same day, the chief physician of the district, Z. A. Makatov, ordered 7 more physicians and 14 mid-level medical personnel to join the group. By September 24, a total of 12 physicians and 49 nurses and orderlies were working for the vaccination group. Medical personnel continued to arrive: 4 people arrived from Aktyubinsk on September 27, and 6 arrived from Alma-Ata on September 30.

By the end of the vaccination campaign, the group of vaccination specialists consisted of 61 people, 15 of whom were physicians. In addition, a back-up group was formed from employees of the SES, who vaccinated people working in small companies and organizations. Several people from this group were assigned as additional support to the medical staffs at the shipyard, the seaport, the fish-processing plant, the mobile power-generating engine, and so forth.

The city was divided into 15 sectors. A group of vaccination specialists worked in each sector. The number of specialists would vary from day to day, because some of them were sent to vaccinate individuals that had not yet been vaccinated, discovered during house-to-house calls.

Special attention was given to the streets where patients resided and were being isolated. In particular, two vaccination groups conducted vaccinations on Shkolnaya, Zhansugurova, and Shevchenko Streets.

On September 24, 7,870 people had been vaccinated throughout the city. After vaccinations had been completed in organizations (i.e., schools, offices, and hospitals), vaccinations were then performed in the 15 sectors of the city among people who were not affiliated with any organization. By September 26, 6,859 of these people had been vaccinated as well. Vaccinations were continued on the next day, September 27. At the same time, the scope of the vaccinations was verified at schools and institutions. On this day, 6,391 people were vaccinated.

Table 1 shows that the greatest number of people were vaccinated immediately after the first cases were detected, September 22 and 23, and on September 26/26 [*sic*] and 27.

Starting on September 25, vaccination results were checked daily. By October 5, the number of positive results reached 98%, and by October 9, 99%.

The data show that by September 27, the vast majority of the population had been vaccinated against smallpox. Table 1 shows that after September 24, the number of people revaccinated would eventually decrease, while the number of vaccination reactions verified would dramatically increase. The largest number of positive reactions was detected on September 2, 3, and 4 [*sic*].

Between October 3 and 5, 6,475 children were examined for monitoring purposes, among which 5 children who had not been vaccinated were detected; 425 children were revaccinated. Of the 1,615 adults examined, 6 had not been vaccinated; 120 were revaccinated.

Table 1. [sic] Daily Smallpox Vaccination Patterns[12]

Date	No. vaccinated	Including revaccinations	Of those checked		Comments
			vaccinated	positive reaction	
Sept. 22	478	-	-	-	Dates indicate identification of patients
Sept. 23	1,787	-	-	-	
Sept. 24	7,870	-	-	-	
Sept. 25	9,372	68	412	237	
Sept. 26	6,859	1,534	975	473	
Sept. 27	6,396	2,145	9,314	4,845	
Sept. 28	3,744	683	8,725	5,545	
Sept. 29	2.140	1, 939	10,514	4,755	
Sept. 30	1,319	876	8,658	5,905	
Oct. 1	803	614	19,553	16,905	
Oct. 2	876	725	27,381	25,735	
Oct. 3	233	188	21,585	20,988	
Oct. 4	279	243	25,413	24,972	
Oct. 5	264	234	19,750	19,073	
	42,020 primary 32,849	9,239			

Date	No. of Patients	Number vaccinated in the city
Sept. 22-23	2	2,265
Sept. 25	1	19,607
Sept. 26	1	20,296
Sept. 27	1	26,602
Sept. 30	2	33,805

Conclusion [of the Organization of Smallpox Vaccinations]

Immediately after identifying smallpox patients, the city's medical network organized a vaccination campaign among contacts, medical personnel, and city residents. The arrival of an additional group of medical personnel made it possible to vaccinate almost the entire population of the city by September 27. By September 30, the entire population of the city had been completely vaccinated. Verification conducted among significant groups of children and adults detected only isolated cases of non-vaccinated people. It can be said that, as of this moment, the population of the city of Aralsk has been sufficiently immunized against smallpox.

[12] Translators' Note: There are two tables entitled "Table 1" in this report.

House-to-House Calls

In addition to performing smallpox vaccinations, a great deal of attention was given to the timely detection of febrile individuals with skin eruptions. In order to identify such people, a group of medical personnel was formed to conduct house-to-house calls.

By September 24, the group consisted of 20 medical personnel, including 5 physicians. Eventually, the group increased to a size of 171 people (after vaccination specialists joined those going house-to-house).

An average of 20,000 to 25,000 people were examined on a daily basis. 270 people with fevers and various types of skin eruptions were identified.

The health of the population continues to be monitored.

Measures Undertaken to Upgrade Public Health and Sanitation Conditions in the City of Aralsk

The organizations and enterprises located in the city of Aralsk are: the shipyard, the fish-processing plant, the vehicle yard, the dairy, the bread-baking plant, the consumer services center, the Aralsulfat plant, the mobile power-generating engine, the seaport, the airport, and the railway terminal.

The city has 9 schools with 9,232 schoolchildren; 18 preschools, kindergartens, and nurseries, with 1,378 children enrolled. The city's Vocational School No. 68 has 320 students. There are 8 cafeterias, 2 restaurants, and up to 90 shops and storage facilities.

During the work in the outbreak containment locale, all these facilities as well as the public water supply system and the general sanitary condition of the city were monitored.

Water for the city of Aralsk is provided by the city's own water service. The location of the water intake is 80 km from the city. The source of the water is the Syr-Darya River. The intake facilities do not have any water purification systems other than a horizontal sedimentation basin and a chlorinator (which are within city limits). There are two functioning reservoirs, each with a capacity of 5,000 cubic meters. The length of the water distribution network is 28 km. 70-75% of the city's residents draw their water directly from the water system. The rest of the population receives its water from water dispensing stations. The total number of individual connections to the public water system has never been counted. There are 70 such stations located throughout the city. Average per capita water consumption is 15-20 liters per 24 hours. During the time the emergency work was carried out in the outbreak containment locale, the water supply was regularly monitored.

According to data from 1971, the coli index for the water supplied by the municipal system fluctuated between 56 and 300. For this reason, the water was hyperchlorinated, with residual chlorine reaching a concentration of 2 mg/liter by the first primary distribution point. On October 3, the water quality noticeably worsened in the northwestern part of the city (organoleptic—salty taste), and there was a general decrease in residual chlorine concentration. The director of the water service, comrade Shigirshibaev; the laboratory manager, comrade Bayzhanov; and the laboratory technician, comrade Tleubergenov, were each fined for sanitary violations, as a result of ceasing to chlorinate the water and for not addressing a breakdown in the water distribution system in a timely manner. Other than that, the condition of the water system was satisfactory.

The city does not have a sewer system. For the most part, the city is cleaned and its sanitary condition maintained by its residents. In early 1971, a communal service complex was built in the city of Aralsk

(comrade Asanbaev, director). The complex is equipped with 2 sewage disposal machines, 4 garbage trucks, and 4 street cleaning machines. Half of the equipment is not in working order. The cleaning of the city is provided on a request basis, by using labor and vehicles from 5 communal departments of state enterprises. Meetings were held in order to decide how to keep the city clean: the directors of the agency enterprises met at the district CPSU committee headquarters; the directors of housing met at the SES, and the heads of the street committees met at the city executive committee headquarters. A total of 63 street committees were formed for 138 streets. During the outbreak containment period, 2 sewage disposal machines, 4 open and dump trucks, and 17 people took part in cleaning the city. 150 latrines were cleaned and repaired, 21 streets were cleaned, and 135 cubic meters of solid waste were disposed of.

At the same time, it should be noted that, because of the low capacity of the sanitation vehicles and insufficient attention to sanitation procedures by certain organizations, some territories were not kept clean, particularly in the so-called swampy areas of the city that were converted into illegal dumps and repositories of household and industrial waste (i.e., Pionerskaya, Kosumov, Budennyy, Mikoyan, Kievskiy, Chapayev Streets, etc.).

During the outbreak containment period, an administrative commission worked under the City Executive Committee. This commission reviewed 9 cases pertaining to the unsanitary conditions of some areas and to improper cleaning procedures. Certain officials and violators of sanitation procedures within the city were reprimanded.

During the period from September 22 to October 10, the following actions were taken:

Inspections of Organizations	**Food**	**Preschools and Schools**	**Communal**
[Total]	67	28	34
Fined for violating Sanitation procedures	14	4	2
Closed	14	--	--
Including for a sanitation day:	13	--	--

During the inspections of food, communal, school, and pre-school facilities, the main objectives were compliance with sanitation procedures established for those organizations, as well as the performance of counter-epidemiological and disinfection measures. As a result, the sanitation conditions of the city's facilities somewhat improved.

Measures Taken at the Aral Sea Train Station

Medical services for the outbreak containment period at the Aral Sea Station were organized and put into effect beginning for the most part on September 24, 1971. Responsibilities assigned to the railway services included: organization of comprehensive vaccination; house-to-house calls; sanitation inspections of railway transportation facilities; and organization of a railway checkpoint to monitor passengers and economically important shipments. The requisite number of medical personnel and transportation police were requested from the medical services of the Kazakh railway line.

As medical personnel and police arrived, their responsibilities were distributed as indicated on Lists 1-3.

The railway quarantine service was constituted of 3 quarantine checkpoints [VSKP] and police.

The VSKP at the Aral Sea station was located at the outpatient clinic of the Kazakh railway line. Three 24-hour police posts were formed at the railway station platform; all kiosks and shops were closed. Passenger access to the platform was closed. Procedures were established for monitoring train departures and arrivals as well as incoming and outgoing shipments. (There was a list of shipments that were allowed to leave the quarantine zone.)

Special procedures were established for the train and work crews, who came and went from the quarantine zone: all of them were constantly monitored by medical personnel before each shift and their temperatures taken. After each shift, the documentation that allowed them to travel in and out of the quarantine zone was seized until the next shift, their temperatures were taken, and the data was logged.

Individuals who violated epidemiological procedures and left the quarantine zone without permission were tracked down and isolated.

The VSKP in charge of monitoring train crews along the 15 km Soltrest line monitored train crews going to and from the quarantine zone. They also monitored the cargo weigher who was processing documents at Soltrest, as well as the manner in which the assembler assembled the train. This VSKP also monitored compliance with procedures to ensure that the cargo weigher and the train assembler avoided contact with people from Soltrest.

A VSKP was set up at railway junction No. 86, in order to examine people who were entering the outbreak containment zone, vaccinate the local populace, and monitor their health.

House-to-house calls and vaccinations were carried out in the area assigned to the railway, located in the southwest part of the city of Aralsk.

Regarding the Work Performed by the Disinfection Group at the Aral Sea Station

There are 10* [*second numeral illegible*] railway points with a total territory of 3,000 square meters located at the Aral Sea Station. There are 25 latrine openings, and 64 openings within the Aral Sea MGCh. All of them were disinfected twice with a 2% solution of Dipterex (Trichlorfon). The number of rodents at each facility was counted. No contaminated sites were found.

The facilities were inspected, official documents drawn up, and suggestions made to building management as to how to clean the area and maintain the outdoor facilities. The toilet at 2 Oktyabrskaya Street was out of order, and the waste pits had no covers. The building management has not removed sewage and waste from the area since September 30, because of a lack of transportation. The vehicle yard did

provide them with transportation despite a request to do so. A 0.25% solution of trichloromethyl parathion was used to process outdoor facilities to a radius of 20-30 cm.

Territory of the fire station: Latrines were not properly equipped, the cesspools did not have covers, the toilets were not cleaned, and all the waste pits were overflowing. Suggestions were made as to how to eliminate these problems.

Conclusion

On September 22, smallpox patients were clinically identified in the city of Aralsk. On September 24-25, the diagnoses were confirmed by the following virological methods: fluorescing antibody, gel microprecipitation, and isolation of the virus in chick embryo and tissue cultures.

A total of 9 smallpox patients were identified, 3 of whom had the mild form—varioloid. Three patients had not been vaccinated against smallpox (ages 23, 9 months, and 4 months). The source of the infection was [Patients 1 and 2's] family, from which the infectious agent spread to four households. By September 27 (i.e., within 5 days), the outbreak was contained.

This containment was achieved by taking the following steps: timely identification and isolation of patients and contacts. A total of 638 individuals who had any kind of contact with the smallpox patients were identified, 282 of whom were placed in the isolation ward or isolated at outpatient units of the district hospital, while the rest (schoolchildren and teachers at School No. 13) were monitored at school and at home.

During house-to-house calls, physicians and mid-level medical personnel examined up to 30,000 people. Those suspected of having smallpox were examined by medical specialists and then sent to the field hospital. After September 27, 4 patients were discovered among the family contacts at the isolation ward and the field hospital.

In order to create a collective immunity against smallpox, beginning on September 23, vaccinations were organized in the city of Aralsk. A total of 42,899 vaccinations were performed, of which 6,623 were revaccinations (36,276 people were vaccinated). Positive reactions to the vaccinations were noted in 99% of those vaccinated.

A timely final disinfection was performed in the outbreak containment locale. Preventive disinfection and insect abatement measures were carried out in 2,672 households. 10,400 kg of household items were chamber-processed.

Quarantine measures prevented the infection from spreading beyond the city.

The quarantine was lifted in the city of city of Aralsk on October 11 at 1400 hrs. Further work to eliminate the outbreak continues according to a plan approved by the district Emergency Counter-Epidemic Commission.

[Signatures:]

Deputy Minister of Health of the Kazakh SSR (E. Sarynov)

Director of the Outbreak Containment Locale (B. Kulmakhanov)

Chief of Staff (Z. Makatov)

[*in Kazakh*]
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40 Kirov St., Aralsk

[*in Russian*]
Ministry of Health of the USSR
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40 Kirov St., Aralsk

No. 56 October 25, 1971

[*handwritten text in upper left quadrant*] Comrade Petrenko; Show to Comrade Yermilov (initialed by unknown person),[1] dated October 29, 1971

TO: Professor M. A. Aykimbaev, Director
Central Asian Anti-Plague Research Institute
City of Alma-Ata

The Aralomorsk Anti-Plague Station is sending an additional report to supplement the previously dispatched report. This report covers operations in the smallpox containment locale in the city of Aralsk from October 12-25, 1971.

The report, which consists of 7 pages, is attached hereto.

Signed O. Misaleva, Director
Aralomorsk Anti-Plague Station

[1] Translators' note: this is the same person who initialed the main report, requesting that it be shown to Yermilov.

REPORT

on the work performed from October 12-25, 1971, in the smallpox outbreak containment locale in the city of Aralsk, after the quarantine was lifted.

Epidemiological Service

After the quarantine was lifted, the task of the epidemiological service was to:

1. carry out an epidemiological investigation of those containment areas where there were illnesses suspected to be smallpox;
2. monitor the health status of people living in micro-containment areas where smallpox patients were identified;
3. verify all deaths from unknown causes and perform autopsies; and
4. organize and carry out disinfection measures in infected areas and in all medical and disease prevention institutions (i.e., the hospital, the isolation ward, and the field hospital).

In view of these objectives, the epidemiological group:

Conducted a continuous daily surveillance of the health status of the populace, including registering temperatures and examining skin and mucosa surfaces in previous smallpox micro-containment areas.

Gave special attention to School No. 13, where all the students were under constant medical surveillance.

Established that throughout this entire surveillance period, no patients suspected of having smallpox were identified.

The disinfection service of the outbreak containment locale carried out the final disinfection of 13 containment areas where acute infectious diseases had been present.

Within the same period, the disease prevention service eradicated fly larvae in 3,654 households.

After they were dismantled, the isolation ward located in the anti-plague station, the field hospital, the observation ward, and the isolation ward at the summer camp were all twice subjected to wet disinfection with a 3% solution of chloramine. A total of 5,000 square meters were disinfected. Soft objects were processed in a disinfection chamber. A total of 18 [metric] tons of soft objects were disinfected. Individuals who had been discharged from the isolation ward, the field hospital, and the observation ward were scrubbed down in a mobile bathhouse. A total of 236 people were processed.

Medical Service

After the quarantine was lifted, the smallpox hospital continued to care for 6 smallpox patients. The field hospital also remained in operation with 19 patients, as did the isolation ward at the anti-plague station with 2 individuals. A group of consultants continued to work. It consisted of physicians M. S. Favorsky, R. G. Malchikovksiy, F. S. Vendrikh, and S. B. Shirgin. Nature and location of work performed included:

1. infectious disease hospital for smallpox patients;
2. field hospital;
3. isolation unit of the anti-plague station;
4. medical control points at the railway station and at the airport;
5. health of contacts was monitored;

6. the group consulted with all those suspected of having smallpox, and identified and treated those with post-vaccination complications.
7. consultations to verify vaccination reactions in the city and district.

Patients with Form No. 60 staying in the infectious disease hospital did not show any complications within the reporting period. On October 23, 1971, only 2 patients, Patient 2 and Patient 3, were discharged in satisfactory condition on the 57th and 43rd day, respectively, of their illnesses, after all scabs had separated (after being fully disinfected). Four patients, Patient 4, Patient 5, Patient 6, and Patient 10, remained in the infectious disease hospital until full recovery.

2.[*sic*] In the field hospital, where 19 people were being monitored, all those who had been in contact with the patients were examined, and courses of treatment were determined. Special attention was given to the 3 people from the family [of Patients 4, 6, and 7], 3 from the family [of Patients 8 and 9], and Patient 3, S., and U.K. Form 60 was not suspected. Some assistance was also provided to better organize hospital operations, including:

a. support of epidemiological procedures; and
b. improvement in patient services.

On October 9, at 1100 hours, the last contacts were admitted to the field hospital: the children [of the family of Patients 4, 6, and 7], who were 2 and 8 years old. On October 23, after the 14-day quarantine was lifted, and without any clinical symptoms of Form 60 or of any other illness, all 19 people were discharged at 1100 hours with negative results of virological testing.

U.M., 23 years, and K.A., 49 years, who were contacts of the family of Patient 3, remained under observation in the isolation ward of the anti-plague station. On October 19th, 14 days after they were quarantined on October 5 and the day of the first negative virological result, their quarantine was lifted. They were discharged and showed no clinical symptoms of Form 60 after completing disinfection out-processing.

After the quarantine was lifted, the group performed additional work at the railway station and airport medical control points.

Special attention was given to the house-to-house calls at the households of the primary contacts—31 people. The group monitored the number of households and carried out multiple examinations of the schoolchildren at School No. 13, class 2”b” [contacts of Patient 2], the family [of Patients 1 and 2] at No. 7 Shkolnaya St., and the family [of Patient 5] at No. 9 Kubyshev St.

During the surveillance period, no suspected cases of Form 60 were identified. The consultants worked around the clock. The number of house calls dramatically decreased within the reporting period, but there were still a few calls every day. None of the calls turned up any suspected cases of Form 60. One sick child, M.M., 9 months old, was identified with autoinoculation and a mild form of generalized vaccinia. B.A., 1 year, 6 months, was also identified with a serious form of autoinoculation. Both patients were treated with methisazonum and anti-smallpox donor gamma-globulin. The treatment was effective.

Assistance was also provided to the infectious disease department, the skin and venereal disease clinic, the children’s outpatient clinic, and at private residences. All the specialists in the consulting group were involved in verifying efforts to revaccinate the populace, registering those who had been revaccinated, monitoring their level of immunity, and providing specific treatment in the following rural areas: Kara-Toron, Bugun, Sazdy, and Ay-Besty.

Six patients stayed at the smallpox hospital from the 10th to the [*left blank*]. The hospital director is Dr. I. M. Blyakher. All patients are in satisfactory condition.

1. Patient 4, 5 and a half years old—by the 30th day of illness, October 18, his skin had no scabs, while multiple discolored patches remained. Stayed at the hospital up until his isolation period expired—October 28, 1971.
2. Patient 2, 9 years—detained at the hospital, because his scab separation period was longer. Discharged on October 23, 1971, on his 57th day of illness.
3. Patient 5, 36 years—satisfactory condition. Scabs had separated by the 40th day of illness. Discharged on October 23, 1971, on her 43rd day of illness.
4. Patient 8, 38 years—suffered from the modified form of smallpox. Scabs separated on the 22nd day of illness. Stayed at the hospital until his isolation period expired – November 3, 1971.
5. Patient 10, 60 years—suffered from the modified form of smallpox. Individual scabs separated by the 18th day of illness on October 14, 1971. Remained at the hospital until the quarantine was lifted—November 5, 1971.
6. Patient 6, 33 years—suffered from the modified form of smallpox. Scabs separated by the 21st day of illness on November 3, 1971. Remained at the hospital until his 40th day of illness, until his isolation period expired—November 6, 1971.

Hospital personnel worked in Class-I anti-plague suits. The hospital was provided with round-the-clock protection by a squadron of police.

Laboratory Tests

After the quarantine was lifted, the laboratory group continued to test specimens isolated from individuals staying at the hospital and at the isolation unit of the anti-plague station, as well as specimens collected from patients diagnosed with generalized vaccinia.

Table 1. Number of People Tested and Number of Tests

No. of people examined	including:			Total no. of tests
	patients	contacts	generalized vaccinia	
9	6	2	1	18

Six patients diagnosed with smallpox, who stayed at the infectious disease hospital, were tested twice. The smallpox virus was not isolated from their nose-and-throat cultures.

Two individuals who were in contact with Patient 3, and who stayed in the isolation ward of the anti-plague station, were also tested twice—the smallpox virus was not isolated from their nose-and-throat cultures.

Patient M.M. (9 months old), who was diagnosed with generalized vaccinia, was tested twice. The vaccination virus was isolated from his vesicular fluid and scabs.

Medical Control Point Activities

The medical control points were formed at the railway station, the airport, and the seaport. They monitored the passengers arriving in and departing from the city of Aralsk. All those who arrived were examined, and if they did not have recent indications of smallpox, they were vaccinated; after which they were given a certificate allowing them to receive travel documents.

Within the period of the medical control point activities, 2,100 people were examined, and 189 were vaccinated.

House-to-House Calls

Significant attention continued to be paid to the timely identification of febrile patients and individuals with various types of skin eruptions.

After the quarantine was lifted, 74 mid-level medical personal and 15 physicians participated in house-to-house calls. From 28,000 to 29,000 people were examined on a daily basis. 24 febrile patients and individuals with various types of skin eruptions were identified. Information on the patients identified was immediately sent to district physicians and to the specialists in the consulting group, so that they could take any necessary measures.

No one suspected of having smallpox was identified.

By October 25, the smallpox outbreak in the city of Aralsk was eradicated. A localized containment area remained in effect at the hospital, where 4 patients were still being treated.

Signatures: Deputy Minister of Health of the Kazakh SSR, E. Saryanov,
Director of the Outbreak Containment Locale, B. Kulmakhanov

[*in Kazakh*]
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[*in Russian*]
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40 Kirov St., Aralsk

No. 54 October 18, 1971

[*handwritten text in upper left quadrant*] Show to Comrades Yermilov and Koburg (initialed by unknown person)[1], dated October 26, 1971

TO: Professor M. A. Aykimbaev, Director
Central Asian Anti-Plague Research Institute
City of Alma-Ata

The Aralomorsk Anti-Plague Station sends autopsy report Nos. 1, 2, and 3.

1. Autopsy Report No. 1 on Patient 3, 23 years old, female, 4 pp.

2. Autopsy Report No. 2 on Patient 9, 9 months old, male child, 4 pp.

3. Autopsy Report No. 3 on Patient 7, 4 months old, female child, 3 pp.

Total of 11 pp.

Signed O. Misaleva, Director
Aralomorsk Anti-Plague Station

[1] Translators' note: this is the same person who initialed the main report, requesting that it be shown to Yermilov.

AUTOPSY REPORT NO. 1

September 28, 1971

City of Aralsk
Infectious disease hospital
Infectious disease department
Deceased's surname, first name, and patronymic – [Patient 3]
Age – 23 years old, female, teacher
Medical Examiner – Borisov
Present at the autopsy: Kinshymbaev, Misaleva, Maltsev, Leshkovich, Alekseeva, Kopotilov

Date of hospitalization – September 15, 1971
Date of death – September 28, 1971
Date of autopsy – September 28, 1971, 1100 hrs local time

Clinical diagnosis: September 21, 1971, smallpox, confluent form

Brief clinical post-mortem accompanied by data from laboratory tests and x-ray examination:

The patient became ill on September 13, 1971. She developed a headache, dizziness, nausea, and vomiting. On September 20, eruptions of a papular nature appeared on her face and chest, and then spread to her extremities and to the rest of her body. From the onset of the illness, she had a high temperature. Intoxication and cardiovascular insufficiency rapidly increased, and on September 28, at 0815 hours, the patient expired.

Autopsy results:

Basic diagnosis: smallpox

Complications: Dystrophic changes in parenchymatous organs.
Small foci of hypostatic pneumonia.

Report text:
Corpse is that of a female adult of normal physique and adequate nourishment. The hair on her scalp is short. Dry scabs and discolored spots indented in the center are located on various parts of her face. The skin of her trunk, extremities, palms, and soles is almost completely covered with pustules. Around the edges of the pustules is a hyperemic zone 1-2 mm [millimeters] wide. The center of each pustule has an indentation, and most are covered with a dry, black crust. The pustules have a multilocular structure and, in most cases, are filled with pus. On the sides of her thorax and in the area of her pelvis and thighs, large sections of epidermis have peeled away. Dermis with individual and confluent hemorrhages can be seen in these areas. Similar hemorrhages, mostly micropunctuated, can be seen on the skin of her shins and soles. In addition, on many parts of her body, large and small vesicles full of transparent, light-yellowish, opalescent fluid can be seen.

Circulatory organs: A small quantity of transparent, light-colored fluid is seen in the cavity of the pericardium. The layers of the pericardium are smooth and shiny. No irregularities are noted in the pericardium, endocardium, or cardiac valves. The intima of the coronary vessels is smooth and shiny. The myocardium is flaccid throughout, of a grayish-red color, and is dull in appearance. The intima of the aorta and of the large blood vessels is light yellow, smooth, and shiny. Only individual, slightly protruding, atheromatous plaques are visible in the initial part of the aorta.

Hematopoietic organs: The spleen is slightly enlarged, firm, and dark red in color. The capsule is somewhat taut, smooth, and shiny. When sectioned, the pulp is dark cherry in color, juicy, with [hyperplastic?] follicles. The pulp swab is moderate and sanguineous.

Peripheral and visceral lymph nodes are slightly enlarged, firm, grayish in color in section.

Respiratory organs: Both sides of the lungs in the upper and back sections adhere to the chest cavity with soft, whitish adhesions that are easily separated by a blunt instrument. Throughout the rest of the lungs, the pleural layers are smooth and shiny. Beneath the pleura and when sectioned, small (1.5 x 1.5 cm

[centimeters]), firm, dark red spots can be seen in the upper and lower lobes. The section surface is smooth. Elsewhere, the lung tissue on the surface and in each section is light pink in color and soft. Under pressure, a foamy, pink fluid appears on the section surface. The mucosa of the pharynx, trachea, and large bronchi are edematous and hyperemic along nearly their entire length. Small, necrotic spots, not well defined, and micropunctutated hemorrhages, in some places confluent, can be seen on the mucosa. These changes are most pronounced in the pharynx and in the upper sections of the trachea. In the lumen of the trachea, there is a small quantity of thick, viscous mucus, slightly pink in color.

Digestive organs: The buccal mucosa is severely edematous and hyperemic. The tongue is edematous, covered with a viscous dirty-gray coating that is difficult to remove. When the coating is removed, a few small, necrotic spots and ulcerations can be seen. The pustules are similar to those found on the skin. The tonsils are enlarged, edematous, covered with a dirty-grayish coating. The pharynx mucosa is edematous, covered with a small quantity of viscous mucus. The esophageal mucosa is edematous throughout its length. Its upper third is severely hyperemic with small, necrotic spots and ulcerations and micropunctuated hemorrhages. The esophageal lumen contains solid [pterygium?], light yellow in color, and a small quantity of mucus. The stomach is of normal shape and size. Its mucosa is edematous; the mucosal rugosity is not well defined. In the areas at the bottom of the stomach and the large curvature, there are small ulcerations and micropunctuated hemorrhages. In the stomach lumen, some thick, viscous mucus can be seen. The duodenum mucosa is edematous. On the remaining length of the small intestines and colon, the mucosa is normal. In the small intestinal lumen, a small quantity of mucus that is of a slightly light-yellowish color can be seen. The colon lumen is filled with black, fecal masses. The liver is enlarged, light brown in color, and flaccid. Its capsule is smooth, shiny, and somewhat taut. When sectioned, the pattern of its lobules is not defined, the tissue is light yellow in color. Some quantity of dark red liquid blood flows from the section surface. The gallbladder is of normal size, and its lumen contains some quantity of liquid bile. The mucosa is velvety and of normal color.

The pancreas is lobular in nature, firm, edematous, and severely hyperemic. Its section tissue appears edematous and sanguineous.

Urogenital system: The kidneys are of normal size, firm, dark red in color. The capsule is smooth, shiny, and easily removed. The section pattern is well defined; the cortex is substantially thinned and pale yellow in color. The pelvic mucosa is unchanged. The adrenal glands are flat, firm, and their section pattern is well defined. The bladder is not large, and in its lumen, about 150 ml of light, transparent urine can be seen. The mucosa is pale pink in color. The uterus is of normal size, firm, and its mucosa is slightly edematous. The

ovaries are whitish gray in color and firm. Under the middle part [*word illegible*] of the left ovary, there is a hemorrhagic spot 2 mm by 2 mm in size.

The brain was not autopsied.

The mucosa of the trachea, esophagus, and stomach were sampled for virological testing.

Pieces of the internal organs were sampled for histological testing. The patient expired as a result of smallpox, development of severe general intoxication, and associated severely dystrophic changes in the parenchymal organs.

While the patient was still alive, a smallpox culture was isolated from her.

Signed I. Borisov
Last name and title of person performing autopsy

AUTOPSY REPORT NO. 2

October 3, 1971

City of Aralsk
Infectious disease hospital
Infectious disease department
Deceased's surname, first name, patronymic – [Patient 9]
Age – 9 months, male child
Medical examiner – Borisov
Present at the autopsy: Kinshymbaev, Kopotilov, Chekalin

Date of hospitalization – September 21, 1971
Date of death – October 2, 1971, 1810 hrs
Date of autopsy – October 3, 1971, 1030 hrs

Clinical diagnosis: September 21, 1971, smallpox with hemorrhagic syndrome.

Brief clinical post-mortem accompanied by laboratory test and x-ray examination data: The boy had face-to-face contact with a smallpox patient in his family. On September 21, 1971, the first skin eruptions appeared on his body, and his temperature increased. The eruptions quickly multiplied, the child started to cry more, and lost his appetite. These symptoms intensified, and, on October 2, 1971, the patient expired.

Autopsy results:

Basic diagnosis: Smallpox.

Complications: Severely defined dystrophic changes in the parenchymal organs. Bilateral lobar pneumonia, multiple hemorrhages in the skin and internal organs.

Report text: Corpse is that of a boy of ordinary physique and adequate nourishment. External genital characteristics are well defined. On the skin of the scalp, face, trunk, and extremities, including the soles and palms, there are multiple pustules, grayish-white in color. They range from 2-5 mm in diameter. Some of them are clearly prominent on the skin surfaces, while others are of a solid nature. The center of most of the pustules has a naval-like indentation and is covered with a dry, black crust. The skin around the pustules is encircled by a hyperemic wall 2 to 3 mm wide. On some parts of the skin, the pustules are confluent, forming small fields that are grayish-white in color. The pustules are multilocular and filled with thick pus. On many parts of the face, where pustules used to be, dermis with multiple, micropunctuated hemorrhages, some of which are confluent, can be seen. In addition, on many parts of the skin (i.e., face, neck, ankles, etc.), multiple minute hemorrhagic spots, some of which are confluent, can be seen.

Circulatory organs:
Heart: The pericardium layers are smooth and shiny. In the pericardium cavity, a small quantity of light, transparent fluid can be seen. In the heart cavities, a small quantity of dark, red blood clots and liquid blood can be seen. No irregularities are observed in the endocardium, pericardium, or valves. The intima of the coronary vessels is smooth and shiny. The myocardium is of a slightly flaccid nature; in section, it is dark brown and dull. The intima of the aorta and of the large blood vessels is smooth and shiny.

Hematopoietic organs: The spleen is enlarged, firm, and dark red in color. The capsule is smooth and shiny. In section, the pulp is juicy and dark cherry in color. The follicles are not well defined. The pulp swab is moderate and sanguineous.

The bone marrow of the sternum is somewhat dry and dark red in color.

The peripheral and visceral lymph nodes are slightly enlarged, firm; in section they are grayish in color.

Respiratory organs: The mucosa of the larynx, trachea, and large bronchi is severely hyperemic, edematous, with multiple micropunctuated hemorrhages. In the lumen of the trachea and bronchi, a small quantity of viscous mucus can be seen.

Lungs: Paristal and visceral pleura are smooth and shiny. Under the visceral pleura, particularly in the bottom lobes, are multiple hemorrhages, bright red in color, ranging in size from micropunctuated to 2 to 3 mm in diameter. Dense, dark red, and somewhat prominent foci are located in the bottom lobes of both lungs and in the core zone. They range in size from 2 x 3 to 6 x 9 cm. The section surface of these areas is granular. When pressure is applied, some quantity of dark red liquid blood emerges. In the remaining areas, the lungs are light pink in color; when sectioned, a foamy pink fluid emerges when pressure is applied.

Digestive organs: The tongue is edematous and covered with a grayish-brown coating. On its lateral surfaces, some ulcerations, 2 and 3 mm in diameter, are seen. The edges of these ulcerations are uneven. The tonsils are enlarged and dark red in color. All the mucosa of the pharynx and the esophagus is edematous, hyperemic, with multiple micropunctuated hemorrhages. The stomach is of normal shape and size. Its serous capsule is smooth and shiny. In the stomach lumen, there is some quantity of food residue and some thick mucus. The mucosa of the stomach is of a matte color, edematous; the rugosity is not well defined. In all segments of the stomach, particularly the pyloric, multiple, mostly minute, hemorrhages, some of which are confluent, can be seen in the mucosa. The serous integument of the small intestines and colon are smooth and shiny. The small intestinal loops are distended. The small intestinal mucosa is pale, moderately edematous; its rugosity is well defined, and, in the lumen, some mucus can be seen. The colon mucosa, particularly in the transverse and upper segments of its descending parts, is severely hyperemic, edematous, with multiple punctuated hemorrhages. Small erosions and ulcerations are observed on some parts. In the lumen, an insignificant amount of liquid fecal matter, yellowish in color, can be seen.

The liver is enlarged, flaccid, and light yellow in color. The capsule is smooth, shiny, and slightly taut. When sectioned, the pattern of the lobules is not well defined, and some dark red liquid blood flows from the surface.

The gallbladder is somewhat elongated. In its lumen, the bile is thick and dark brown in color. The mucosa is velvety and colored by bile pigment. The pancreas is white-gray in color, firm, and lobular in nature.

Urogenital system: The kidneys preserve elements of their lobular structure, are firm, and light yellow in color. Their capsules are smooth, shiny, and easily removed. When sectioned, the pattern is not well defined,

and some swelling of the medulla can be seen. The pelvic mucosa is pale. The adrenal glands are flat and have a well defined pattern. The cortex is pale yellow in color. The bladder is not large, and, in the lumen, a small quantity of light, transparent urine can be seen. The mucosa is pale pink in color, the rugosity is well defined.

The brain was not autopsied.

The mucosa of the esophagus, trachea, stomach, and colon was sampled for virological testing. Some skin and pieces of internal organs were sampled for histological testing.

The results of specific tests: While the patient was still alive, the smallpox virus was isolated from him.

Anatomical post-mortem: The death of [Patient 9], 9 months old, occurred as a result of smallpox, critical dystrophic changes in the parenchymal organs, and as a consequence of severe general intoxication and the development of bilateral, bottom-lobar pneumonia.

Signed I. Borisov
Last name and title of person performing autopsy

AUTOPSY REPORT NO. 3

October 6, 1971

City of Aralsk
Infectious disease hospital
Infectious disease department
Deceased's surname, last name, and patronymic – [Patient 7]
Age – 4 months, female child
Coroner – Borisov
Present at the autopsy: Yung, Shcherbak, Blyakher, Alekseeva, Kolesnik

Date of hospitalization – October 2, 1971
Date of death – October 5, 1971, 1700 hrs
Date of autopsy – October 6, 1971, 1030 hrs

Clinical diagnosis: October 2, 1971, hemorrhagic smallpox. Bilateral confluent pneumonia.

Brief clinical post-mortem accompanied by laboratory and x-ray test data: Admitted to the hospital from the isolation ward with a diagnosis of smallpox. While admitted, experienced skin eruptions, a temperature of 38°, drowsiness, and poor appetite. At the hospital, the patient's temperature continued to be elevated; some hemorrhages appeared on her skin and at the injection sites. On October 5, 1971, at 1700 hrs, the patient expired in the context of steadily deteriorating general condition.

Autopsy results:

Basic diagnosis: Smallpox
Complications: Bilateral bottom-lobe confluent pneumonia. Multiple hemorrhages in the skin and internal organs. Dystrophic changes in the parenchymal organs.

Report text: The corpse is that of a girl of ordinary physique and adequate nourishment. External genital characteristics are well defined. On the skin integument and on the right knee pan, on the internal thigh surfaces, and on the palms, there are individual papular vesicular elements prominent above the skin surface. Upon separation, the dermis, with micropunctuated and confluent hemorrhages, can be seen. In addition, multiple punctuated hemorrhages are observed on the skin integument, particularly near the naval and the lower part of the abdomen. Their size ranges from micropunctuate to 1.5-2 mm in diameter. Recent hemorrhages, which can be seen alongside old hemorrhages, can be differentiated by their bright, light red color.

Circulatory organs: Heart: The layers of the pericardium and smooth and shiny. In the pericardium cavity, a small quantity of light, transparent fluid can be seen. In the heart cavities, a small amount of dark red liquid blood and smooth, shiny blood clots can be seen. No irregularities are observed in the valves, endocardium, or pericardium. The myocardium is dense; in section, it is somewhat dull, grayish-red in color. The intima of the coronary vessels is smooth and shiny. The intima of the aorta and the large vessels is also smooth and shiny.

Hematopoietic organs: The spleen is slightly enlarged and dark cherry in color. The follicles are hyperplasic, and their pattern is not well defined. The pulp swab is sparse and sanguineous. The sternum bone marrow is somewhat dry and dark red in color. The visceral and peripheral nodes are somewhat enlarged, dense, and, in section, gray-red in color. The section surface is moist and swollen.

Respiratory organs: The mucosa of the larynx and the upper segments of the trachea is moderately edematous and hyperemic. The mucosa of the lower segments of the trachea and of the large bronchi is moist and shiny. In the trachea lumen, a small amount of mucus can be seen.

Lungs: Pneumonic foci dark red in color and confluent in nature can be seen in the bottom lobes of both lungs. They occupy the major part of the lobe tissue. In section, they are of the same color, and the surface is slightly granular. Under pressure, a dark red fluid emerges. The remaining external and section surfaces of the lungs are light pink in color. Under pressure, a foamy, light pink fluid flows from the section surface.

Digestive organs: The tongue is slightly covered by a white coating. The tonsils are dark red. The mucosa of the pharynx and of the esophagus is moist and somewhat matte in appearance. The stomach is of normal shape and size. The serosa is smooth and shiny. All the stomach mucosa is matte in appearance, edematous, and has a large number of dispersed minute hemorrhages. In the stomach lumen, a small amount of viscous mucus is observed. The serous integument of the small intestine and colon are smooth and shiny. Under the serous integument of the small intestine, two foci of hemorrhages, 3 and 4 mm in diameter, were detected. The mucosa of the small intestine is moist and shiny; the rugosity is well defined. All the colon mucosa is severely edematous, matte in appearance, and has a large number of minute recent and old hemorrhages, some of which are confluent.

The liver is enlarged, flaccid, and light yellow in color. The capsule is slightly taut, smooth, and shiny. When sectioned, the liver tissue is of the same color; the pattern of the lobules is not well defined. The gallbladder is of normal size; its mucosa is velvety and colored with bile pigment. In the lumen, there is small amount of liquid bile.

Urogenital system: The kidneys have a lobular structure, are dense, and light brown in color. Their capsules are smooth, shiny, and easily separated. When sectioned, the pattern is not well defined. The marrow layer is somewhat prominent above the section surface. The cortex is slightly thin and light yellow in color. The pelvic mucosa is pale. The adrenal glands are flat; their pattern is well defined when sectioned. The cortex is light yellow in color.

The bladder is of normal size. Its mucosa is pale with 2 punctuated hemorrhages. Its rugosity is well defined.

The brain was not autopsied.

The mucosa of the esophagus, trachea, stomach, and colon was sampled for virological testing.

Pieces of all the internal organs were sampled for histological testing.

The smallpox virus was isolated from the patient while she was alive.

[Patient 7] contracted smallpox due to close contact with another smallpox patient. The illness was complicated by the development of bilateral bottom-lobe pneumonia and dystrophic changes in the parenchymal organs; as a result, the patient expired.

Signed I. Borisov

Last name and title of person performing autopsy

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