The Political Determinants of Delayed Diagnosis: The 1979 Sverdlovsk Anthrax Outbreak and the 1972 Yugoslavian Smallpox Epidemic

Jeanne Guillemin
Senior Fellow, Security Studies Program, MIT, Cambridge MA, USA
Professor of Sociology, Boston College, Chestnut Hill, MA, USA

CONTENT

EARLY DIAGNOSIS IS CRUCIAL IN COMBATING ANY DISEASE

For the group as for the individual, belated identification of a life-threatening disease hinders effective medical intervention and can cause unnecessary illness and even death. The two cases presented here, the 1979 Sverdlovsk anthrax outbreak[1] and the 1972 Yugoslavia smallpox epidemic,[2] offer parallel instances of delayed diagnosis and its fatal consequences. Both events have been cited as models of how civilian communities, particularly industrialized ones, might be vulnerable to biological weapons attacks, that is, to intentional epidemics of anthrax or smallpox or other infectious diseases.[3] There remain questions about whether either event offers a useful model for the United States, where government concern about bioterrorism has increased following the terrorist attacks of September 11, 2001, and by subsequent postal anthrax attacks. For instance, the Sverdlovsk and Yugoslavian epidemics took place in socialist countries heavily invested in public health systems bearing little resemblance to the United States' decentralized commercialized health care system with a strong emphasis on curative medicine. The repercussions of a sudden, large-scale disease outbreak would probably be much different from these and other relatively small epidemics in non-American settings. Nonetheless, the Sverdlovsk and Yugoslavian outbreaks both demonstrated this important and often ignored lesson: government secrecy is directly opposed to public health goals. When a government withholds disease-related information, it misinforms the public and

health professionals alike about the hazards they confront. As we will see, secrecy (including but not only military secrecy) can directly cause delayed diagnosis in fatal epidemics.

ABOUT ANTHRAX

Biological weapons, difficult to produce, store, and target have almost no history of battlefield use, despite massive state programs starting in the 1930's with the Japanese Imperial Army, and continuing with British, Canadian, United States, and Soviet Programs.[4] Following the war, the United States maintained the most aggressive state program, until 1969, when President Nixon renounced offensive biological weapons. Despite the signing of the 1972 Biological Weapons Convention, the USSR maintained a secret biological weapons program that grew rapidly through the 1970s and 1980s and probably lasted until the Soviet demise in 1992. After the end of the Cold War, the vulnerability of cities in the United States to biological weapons attack became a major federal issue.[5] The immediate fear was that this "poor man's nuclear weapon" would be taken up by developing nations hostile to the United States. Following the Gulf War, revelations about the Iraqi arsenal of weapons of mass destruction led to increased concern about bioterrorism. Relative to nuclear and even chemical weapons, the materials and skills to produce known biological weapons are easily acquired. The fear of these invisible infective weapons, often exploited in the mass media, has become part of their power. The long-range jeopardy posed by biological weapons is that their development could be harnessed to the current biotechnology revolution, producing weapons of unimaginable danger to life.

In the latter half of the twentieth century, anthrax became the most researched and developed of the dozen or so pathogens tested in weapons programs. The dormant form (the spore) of the bacterium *B. anthracis*, hardy enough to withstand bomb detonation, was suited to munitions as well as sprays. Inhalation anthrax caused by breathing in the deadly spores is especially lethal. Macrophages in the lung, which ought to destroy the spores, instead convey them to the nearby mediastinal lymph nodes. There, if the spores germinate, the fast-proliferating bacteria enter the blood stream and release three deadly toxins, which in combination, cause death in a few days or less. Anthrax bacteria can enter the body through cuts or abrasions, causing cutaneous anthrax, or the consumption of contaminated meat can cause gastrointestinal anthrax.[6] Anthrax infection can be so massive that an autopsy might not immediately reveal by which "portal of entry" the bacteria entered the body.

In nature, anthrax afflicts grazing livestock, and probably has done so since ancient Greek and Roman times. The life cycle of the anthrax bacterium is especially well adapted to animal herds. When a cow or horse, for example, dies of anthrax in an open field, the bacteria escape from the corpse in the fluids emitted from the animal's orifices. The bacteria then form into spores, which wait in the soil until the next grazing animal comes along to be infected. In the outdoors, ultra-violet can kill spores, as can competing

organisms in the soil, but anthrax spores have been known to last for more than a century in arid conditions, unaffected by extreme hot or cold temperatures. Plagues of anthrax affecting humans were recorded with the rise of European cities in the late Middle Ages and in Russia and Asia as late as the seventeenth century. The handling and consumption of anthrax-contaminated animal products have been the principal causes of infection. Human cases of anthrax, though, have been rare in modern times. A remarkable outbreak occurred in Yaroslavl on July 6-17, 1927, when 22 men and 5 women died after eating infected sausages.[7]

Cases of inhalational anthrax have been rare and not well understood. In the nineteenth century, throughout Europe and America, they were long associated with episodic fatalities among workers in tanneries and woolen mills. The best known modern outbreak occurred in 1957 in a Manchester, New Hampshire textile factory, where spore-laden wool and hair from South Asia caused five cases, four of them fatal.[8] Data from Japanese scientists' anthrax experiments with 30 prisoners of war was obtained by the United States in 1947 through an agreement guaranteeing immunity from war crimes prosecution. Those records suggested that the inhalation of high doses led to death within two days after exposure.[9]

As with many infectious diseases, the early symptoms of anthrax are generally flu-like. The disease is known to progress quickly once infection takes hold. Faulty or limited laboratory technology might play a role in delaying anthrax diagnosis. Yet, laboratory testing was adequate in the USSR in 1979, as it was in Yugoslavia in 1972. The delay in the diagnoses of the early anthrax cases was due rather to overarching political forces that failed to alert physicians and the public to the source of infection. Political secrecy left the public (sick patients as well as the general population) ignorant and unable to take protective measures. It also led to misdiagnoses by physicians and to deaths that might have been prevented.

HUMAN AND ANIMAL ANTHRAX IN SVERDLOVSK

In early April 1979, the Sverdlovsk anthrax outbreak affected both people and animals. In 1980, after being challenged by the United States about the cause of the Sverdlovsk epidemic, the Soviet government claimed that 64 people had died from eating contaminated meat that, due to errors in inspection, was trucked to the city from the southeast countryside and sold. The United States, relying on CIA information, accused the Soviets of developing anthrax as a weapon in violation of the 1972 treaty. The United States asserted that lethal anthrax spores had been spread over the city by an explosion at the main Sverdlovsk military base and that hundreds of people had died as a result.

Did the Soviets have a plausible explanation? Sverdlovsk, a Soviet closed city, 900 miles east of Moscow, is in a region historically known for endemic anthrax. Kazhakstan, still

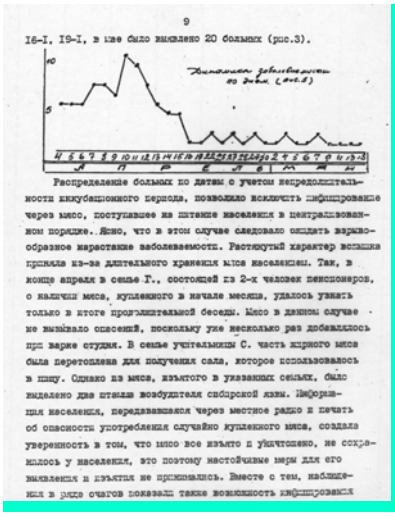
notorious for anthrax epizootics, is only a few hours south by automobile. Veterinarians working southeast of the city were familiar with anthrax in sheep and cattle. Still, the disease was unusual. For decades, the USSR ran an aggressive anthrax animal and human vaccination program, especially in its more rural soviets. All livestock were supposed to be vaccinated against the disease, but private owners, with just a few animals, might disregard that rule. Starting April 5, 1979, veterinary laboratory results confirmed anthrax as the cause of the first animal deaths in the area.

On April 7 and 8, city hospital clinicians became alarmed about a cluster of sudden deaths among workers in the southeastern district. In early discussions, they drew no connection to the animal deaths, apparently not having heard about them. What the hospital physicians and administrators knew was that apparently healthy people were dying. Everyone's initial fear was that this fatal disease was contagious. At the local hospitals, some staff, including physicians and nurses, refused to come to work. A few decided to stay at their hospitals, so as not to spread the disease to their families.

On April 10, during an autopsy, the lead pathologist, Dr. Faina Abramova, recognized the distinctive "Cardinal's cap" of anthrax, caused by cerebral bleeding. On April 11, anthrax infection was confirmed by laboratory tests on tissues from one of the first autopsied victims. Laboratory confirmation took about 24 hours, routine for technology at that time. Even before this result, the regional, city, and district public health officials had mapped out how they would organize the public health response. First, they organized the screening of potential patients at local clinics and hospitals and arranged for emergency ambulance transport to a central infectious disease unit in a large hospital. Clinical care was supervised by an eminent Moscow infectious disease expert, Dr. Vladimir Nikiforov and a team of physicians he brought with him from the Botkin Hospital. The USSR Deputy Minister of Health, Dr. Pyotr Burgasov, was in charge of the general public health response, which included warning about infected meat and broadcasting instructions on how to disinfect patients' sickrooms.

In 1988, these two physicians (Nikiforov and Burgasov) came to the United States to present the substance of their public health report on the 1979 anthrax epidemic, which was shortly after submitted in written form to the U. S. State Department. The trajectory of the epidemic showed that cases peaked on April 11-12, just when the Moscow physicians arrived in Sverdlovsk. One of the first things Dr. Nikiforov did was to assemble the medical staff and let them know that anthrax was not contagious. Aggressive clinical management of patients with anthrax was begun and continued through mid-May. The Soviets claimed that 15 patients (including four with cutaneous anthrax) survived, of a total of 79 victims. Would an early diagnosis have made a difference in this survival rate?

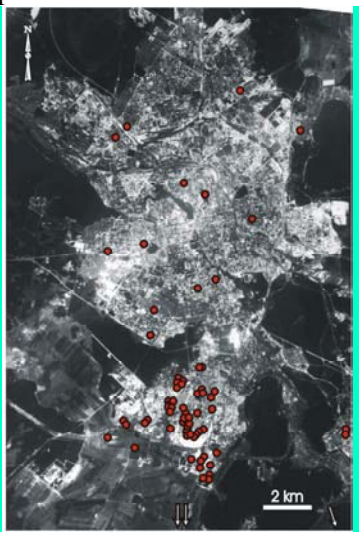
One peculiarity of the Sverdlovsk anthrax outbreak was its long duration. It was believed at the time that an anthrax aerosol would cause death in two or three days post exposure, but the Sverdlovsk epidemic apparently lasted for seven weeks. Figure 1 shows the rough graph that was part of the 1988 report on the epidemic that Dr. Burgasov presented to the U.S. State Department. He argued that the contaminated meat was stored in refrigerators and eaten over a period of weeks, hence the late cases. By this reasoning, the population at risk ignored the government's warnings about contaminated meat.



Page from Soviet report, 1988, submitted to US State Department. April 4-May 16,1979 cases reported as due to eating infected meat over weeks. Fatalities 64, survivors 15.

The CIA, though, had satellite photographs of the Sverdlovsk military base, which suggested a laboratory facility there. Soviet dissidents and emigrants had heard about people dying in the southern part of the city and attributed the deaths to dangerous clouds coming from the base.

In June 1992, a team organized by Harvard professor Matthew Meselson began to investigate the 1979 Sverdlovsk epidemic. As the anthropologist on that team, I was in charge of interviewing the families of victims to find out about both meat consumption and also about where the victims were just prior to the April outbreak. From a local source, I obtained the names and addresses of the sixty-four people who had died, recorded by the KGB in 1979. These addresses allowed the victims' location *at night* to be plotted on a map of the city (Figure 2). As the Soviet physicians had noted in 1988, a third of those who died came from outside the southeastern district, where ostensibly the contaminated meat had been sold and then carried home by the victims.



Sverdlovsk, c.1985
Red dots=Nighttime Locations of victims.
Addresses obtained from KGB and other lists.
Southern cluster is in Chkalovsky rayon.
Arrows=homes off map.

Chkalovsky District Only.
(note inset of entire city)

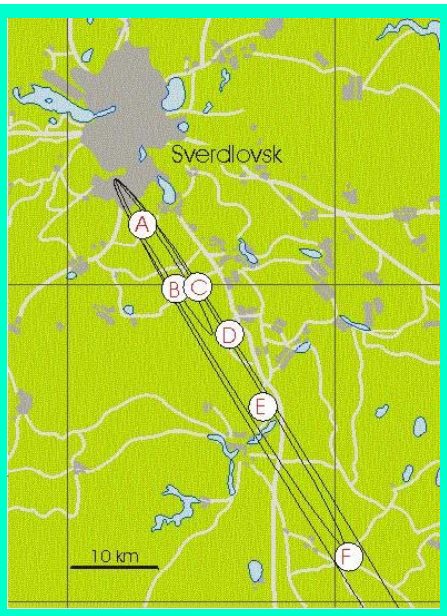
Irregular white lines show Compounds 19 and 32.

White rectangle indicates Ceramics factory.

Red dots=daytime locations of 66 victims and 11 survivors.

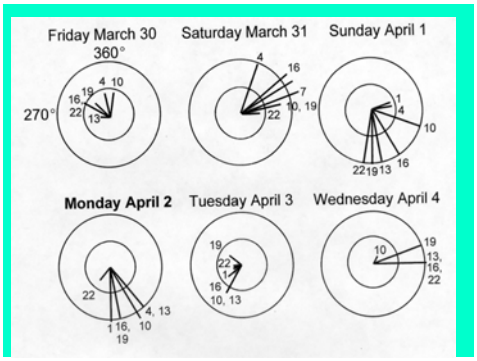
Another epidemiological map was needed. In the family interviews, I focused on where the victims had been *during the day* in early April 1979. Where did each work? Were they retirees at home or were they traveling? Did they work the night shift? The answers to these and other interview questions were cross-checked with every possible source of information: cemetery markers, autopsy data, hospital and clinical lists, veterinary documents, remnants of hospital records (most had been confiscated in 1979 by the KGB), interviews with public health officials. The goal was to map only valid cases, people whose death from anthrax was confirmed by more than one source. At times, this important epidemiological information remained out of my grasp and that of the Russians who assisted the team. The families could not be found. The workplace information was missing. My second map (Figure 3) shows the concentration of the victims (62, including 11 survivors) in a small area around five kilometers southeast of the military base, which is known as Compound 19. The isopleths (curved lines) on the map represent a projected plume of anthrax spores, starting from Compound 19 and flowing south over the ceramics factory (the rectangle in the center of the map).

Six villages southeast of Sverdlovsk where 1979 epizootic occurred. Public health measures April through May. Interviews conducted at F, Abramovo, confirmed Veterinary documents.



Around five thousand people were exposed to the aerosol. In the ceramics factory, around three thousand workers were present on April 2, and 18 of these died. The attack rate for this event has been estimated at 2 percent.[10] Men were two-thirds of the victims, and the median age was 45. No young people or children were affected, although they were certainly exposed. The youngest victim was a 24-year old kindergarten teacher who had suffered from tuberculosis. A third map (Figure 4) shows the distribution of villages where animals had died of anthrax. Again, these appeared in a straight line running southeast from Compound 19.

Airport records for early April 1979 (Figure 5) showed that at that time, April 2 was characterized by continual brisk winds from the northwest. Further, on April 2, five victims who neither lived nor worked in the southeastern district of the city were taking classes at Compound 32, adjacent to Compound 19's southern boundary. These "outliers" confirmed what the daytime locations of the other victims showed: that an anthrax aerosol had been emitted from Compound 19 and caused around 80 cases, of which some 66 were fatal.

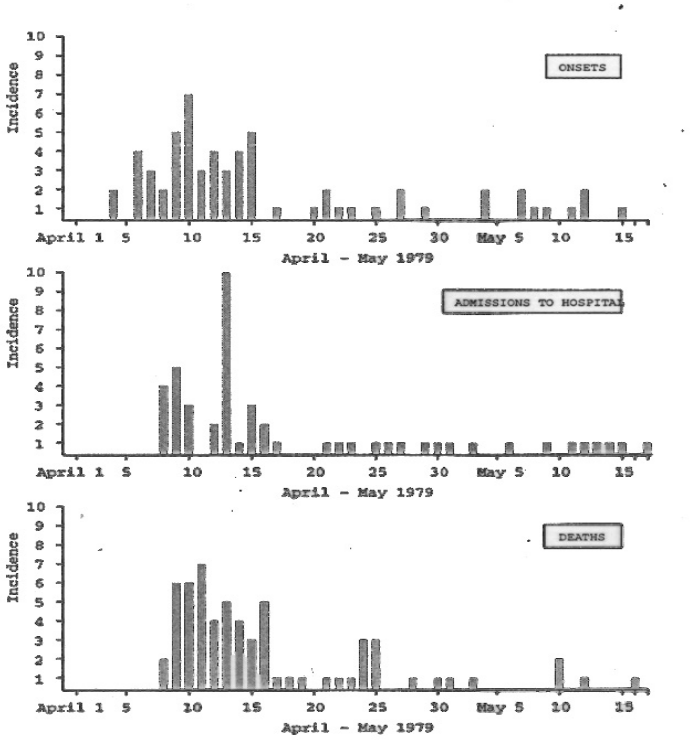


The Soviet public health response to the Sverdlovsk epidemic was thorough and well organized, but too late to help most victims. In mid-April, four thousand volunteers went door-to-door in the affected district to inquire about additional cases, to disinfect victims' bedrooms, and to distribute antibiotics, just to the households of victims. Perhaps among

families just southeast of the military compound, this effort prevented some late cases of anthrax.

Starting mid-April, a massive anthrax vaccination campaign for 50,000 local residents and workers began. The people who actually received the first vaccination (of three required shots) numbered around 30,000. My interviews with residents suggested that adverse reactions to the vaccinations were a factor in noncompliance. The Soviets used a "live" cell vaccine (as opposed to the United States, a-cellular one), which can cause a large ulcer at the point of vaccination, as well as flu-like symptoms lasting several days. The protective effect of any anthrax vaccination after aerosol exposure is unclear. At least two victims who died had also been vaccinated during this campaign. General suspicion of the government was apparently rampant and this attitude as well affected the community's lack of compliance with the vaccine program. For public health reasons, people were not allowed to follow the custom of washing and dressing the bodies of relatives before burial. The burials of victims in a segregated area of a local cemetery, were supervised by police with families excluded or kept at a distance, and some relatives frightened that the victims had been taken away for political crimes. With no explanation, the exteriors of some large buildings, including the ceramics factory, were washed down with chlorine solution. In the villages, some animal owners were forcibly vaccinated and all villagers were required to obey a quarantine that lasted several weeks.

Could there have been, as CIA sources alleged, hundreds of anthrax deaths in 1979? More cases would have been recorded by the pathologist in charge, Dr. Abramova, who hid her notes and complete tissue samples from the KGB but they were not. Nor were there more than 60 or so victims buried in the cemetery area designated by the public health service. In 1992, President Yeltsin decreed that the anthrax victims' families would receive special pensions, creating an incentive for relatives to step forward. By 1993, four new families had done this and four new names were added to the KGB list. My own research, assisted by colleagues from the Ural State University, included repeated canvassing of the southeastern district in search of unrecorded cases. This inquiry extended to Compound 32, where I discussed possible missing cases with local postal workers and with residents. Those unfamiliar with Sverdlovsk, or Ekaterinburg as it is now called, might underestimate how much the military bases were integrated into the community. Soldiers' family members worked off the bases and civilians worked at the bases. Even during our research, morning and evening were marked by the flow of workers through the gates. Two cases of deceased soldiers were added to the official list in 1992-1993 by their families. Interviews in 1992 and 1993 with military officials (one of whom was at Compound 19 in 1979) accounted for the total of six cases there and added details about their treatment and, for the fatal cases, about their burial by the city. In addition, the fact that scientists and technicians working with anthrax at Compound 19 were vaccinated against infection would have reduced the numbers of victims there, had they been exposed.



Diagnosis 9 days post
April 2 exposure
Total 21 deaths

Moscow doctors
April 12 arrival.
Total 25 deaths

17 victims die with no hospital care

City clean-up begun.
30,000 vaccinated.
April 16,
Total 42 deaths

Last recorded death
May 16.
Total 66 valid cases
11 survivors

The duration of the Sverdlovsk epidemic proved to be long. Based on interviews, autopsy notes, and other sources, the onset of cases (Figure 6) lasted into May, just as documented by the Soviet physicians in 1988. Although in 1979 there were rumors in the city of a second exposure and wave of fatalities, the onset curve showed no rise. Instead, the slight April 24-25 increase in deaths might have caused local alarm. Clearly, the once-accepted idea that death from inhalational anthrax occurred several days after exposure was wrong. Our 1992 investigation offered the first evidence that human inhalational anthrax could occur as long as 43 days after exposure. As far as we understand now, the anthrax spore can remain dormant in the lung for weeks, if not longer, and then cause infection. Earlier experiments by the United States Army with monkeys had suggested this effect, with germination as long as 100 days after exposure. Following the anthrax postal attacks of 2001, this discovery informed the prescription of antibiotics for as long as three months to those who had been exposed to the dangerous letters.

As Figure 6 also shows, 17 people died without being hospitalized, this after the Sverdlovsk public health response had been mobilized. These victims most likely dismissed early symptoms of anthrax infection. One wonders what they might have done had their risk of exposure to the anthrax aerosol — not to infected meat — been made patently clear, but in April 1979, those who lived and worked just southeast of Compound 19 and their physicians had no information about this hazard.

We know now that the source of the 1979 epidemic was Compound 19 and its dangerous anthrax program, the full dimensions of which remain unknown. It was a secret venture

of minor military importance, too dangerous to conduct near a populous area, and hardly worth the deaths, illness, and fear it caused. The accidental nature of the aerosol release may initially have left the Soviet military unaware it had caused a catastrophe. One likely theory is that, through carelessness, a filter was not replaced.[11] Another is that the filtration system was old fashioned and inadequate. In retrospect, the military should have been anticipating disaster or at least on the watch for problems. Once the animal cases south of Sverdlovsk were confirmed, around April 6, there should have been a general alert to the city and to the military. While endemic to the region, animal anthrax is by no means a chronic problem. The April 7 and 8 alarm about human cases in the city should have made the military part of the public health response. One of Compound 19's own employees was a sentinel case who fell ill on April 7 and died on April 9, the day when panicked Sverdlovsk officials called Moscow for help.

It is difficult not to speculate what might have happened if the Soviet military had opted for openness. Even belatedly, its cooperation could have prevented illness, death, and fear. Residents would have known that infected meat was not the source of the disease, vaccinations were unnecessary, and more general distribution of antibiotics to those exposed to the plume was necessary. The city government, which even then enjoyed a certain autonomy from Moscow, might have insisted on a shut-down of the anthrax experiments, instead continued jeopardy to the public. Boris Yeltsin, then in charge of the Sverdlovsk regional government, might have made an early stand for democracy. Instead, to protect its secrets, the Soviet military let the public health officials and the community, proceed as if the anthrax epidemic had its origins in mistakes by meat inspectors.

ABOUT SMALLPOX

Smallpox differs from anthrax in several important ways. Anthrax is rare, while smallpox was officially eradicated from the world by 1980 and absent from most of it since 1972. Smallpox is a highly contagious virus, infecting enough people in the twentieth century to be scientifically studied in its various forms, such as variola major, variola minor, and the smallpox caused by primitive inoculation methods and by vaccination (Figure 7). Unlike inhalation anthrax, smallpox could be visually diagnosed (for example, in its early contagious stage, by a rash on the face and extremities) but not always distinguished by inexperienced health professionals from chicken pox or allergic rashes. While no cure exists for the disease, vaccination produces immunity in as short a period as nine days. If administered in the first several days after exposure, the vaccination is a known effective preventive measure.

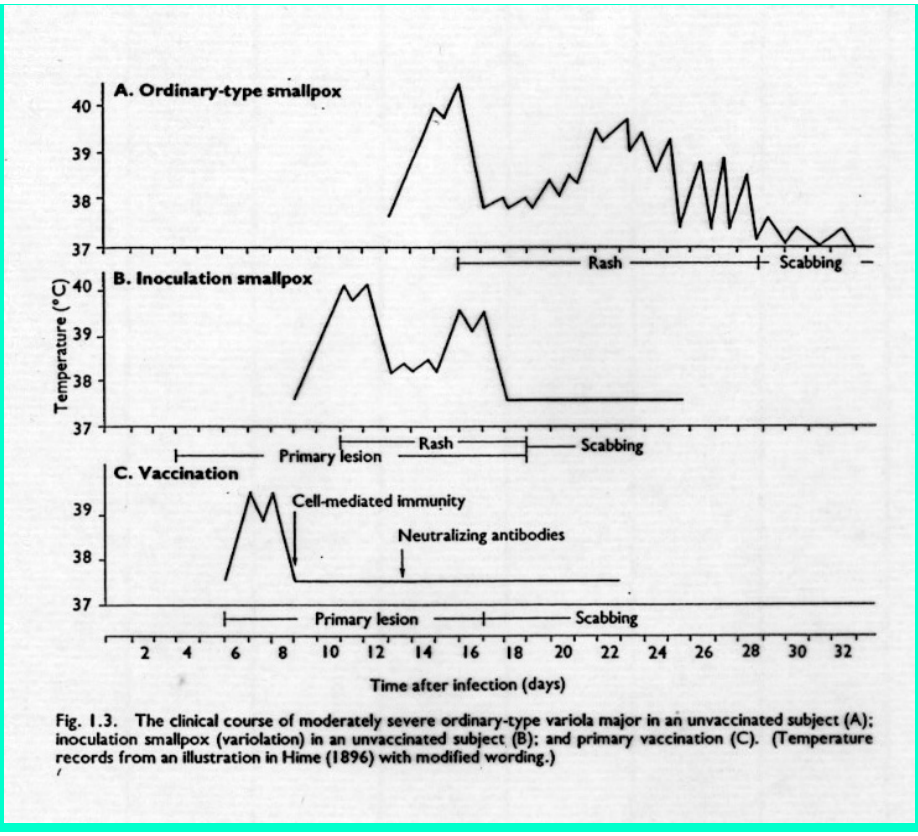


Fig. 1.3. The clinical course of moderately severe ordinary-type variola major in an unvaccinated subject (A); inoculation smallpox (variolation) in an unvaccinated subject (B); and primary vaccination (C). (Temperature records from an illustration in Hime (1896) with modified wording.)

In the 1970s, a successful World Health Organization (WHO) campaign was led by industrialized nations already free of smallpox but increasingly aware of the costly jeopardy generated by poorer nations, especially those in Africa and South Asia. The average annual preventive cost to the United States alone was approximately 150 million dollars, leaving aside the problems of medical complications associated with the vaccination and revaccination programs.[12] The WHO basic strategy was to concentrate on endemic foci (epidemic locales, usually villages) and vaccinate 80 percent of the inhabitants. At present, the last two known reserves of smallpox virus are kept in secure facilities by the United States and by Russia. These last reserves were scheduled to be destroyed in 2001, but that action was delayed by the WHO. Its rationale was that more scientific work of value in some future outbreak might possibly be done on the virus. Suspicions that terrorists have access to other secret reserves turn on two ideas. One is that the Russians (or the prior Soviet government) failed to keep its reserve secure. The other is that an unreported reserve still exists, possibly in one of the Third World nations targeted during the WHO campaign. The danger the virus presents to laboratory researchers, such as in the 1978 outbreak at the University of Birmingham, UK, would be a disincentive to this kind of preservation.[13]

In modern times, smallpox occurred as variola major, the severe form of the disease, or variola minor, the milder yet still potentially lethal form, or other modified forms. In an unvaccinated subject, the incubation period for variola major was about two weeks, followed by a high fever. The early symptoms often included severe backache and vomiting. A rash would emerge in the face around day 16 and increase in intensity over the arms and legs for another two weeks, followed by the formation of scabs. When the rash was apparent, the patient could communicate the disease by coughing or spitting. At that point, caretakers (including hospital employees) were most at risk. Of those infected, around 20 percent might die, depending on the general state of health of the population and its previous vaccination history. In the United States, from 1900 to 1929, when smallpox essentially disappeared, case fatality rates from variola major averaged 17 percent (the fatality rate for variola minor was less than one percent). Worldwide, in instances where attack rates (the percent of those exposed who contract the disease) were calculated, these rates varied widely. Comparatively rare, hemorrhagic-type smallpox produced more severe symptoms and higher death rates. It was associated not with any especially virulent strain but with individual response and perhaps problems with the immune system.[14]

Hospitals were universally recognized as environments, which amplified the spread of smallpox. From 1958 to 1973, hospital contagion accounted for nearly half of all cases of imported smallpox (253/573) in Western industrialized nations.[15] Schools, crowded public events, and community rituals also played their part in contagion. The isolation of the patient and simple precautions, such as masking the mouth and nose, were important in preventing and limiting epidemics. While attack rates (the percent of people infected of all those exposed) varied widely from one epidemic to another, the general rule was that crowding and face-to-face contact, particularly in households, increased the spread of the disease. An interval of two to three weeks usually marked each generation of transmission, with the index case infecting at most, five other people.[16]

Smallpox was apparently rejected as a biological weapon by the United States early in World War II.[17] Its enemies, Germany, Italy, and the Soviet Union, had vaccine programs to defend their troops and civilians. United States interest in the disease rekindled during the Cold War,[18] perhaps because China and Korea loomed as potential foes. As a biological weapon, though, smallpox added the uncontrollable dimension of contagion. This contagious property was likely one reason the disease was abandoned by most biological weapons programs during the twentieth century, although it was apparently no impediment to Soviet experimentation in the 1980's.[19] Anthrax posed the problem of contaminating the landscape with spores. Smallpox posed the hazard of random waves of disease that might infect one's own soldiers or civilians. Today smallpox would appear only as a biological weapon, a threat to civilians anywhere in the world, although new vaccination programs would offer protection.

THE 1972 YUGOSLAVIAN SMALLPOX OUTBREAK

The 1972 Yugoslavian outbreak illustrates that, even in so-called natural outbreaks, political forces have the most important influence on detection, and therefore on the health and lives of civilians. As with many infectious disease outbreaks, travel played a crucial part in its spread. Still, government secrecy was at the core of the outbreak. Between February 3 and 7, 1972, a 38 year-old Yugoslavian pilgrim returning by bus from Mecca was infected with smallpox in Baghdad. The Iraqi government had not reported the outbreak there. In 1970-1972, smallpox traveled from Afghanistan into Iran and from Iran into Iraq, and from Iraq into the Syrian Republic and, via this pilgrim, into Yugoslavia.

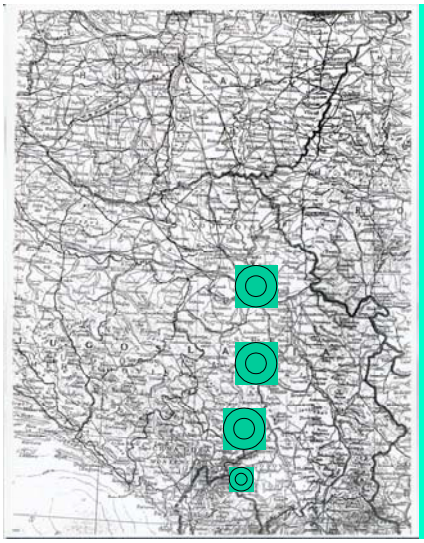
The last large smallpox outbreak in Yugoslavia occurred in 1923; the last reported endemic cases (14) were in 1925. In 1942-45, no statistics were reported for Yugoslavia, although epidemics took place in Greece and Italy in those war years. In 1946, when reporting began again, endemic cases had disappeared. Presumably, vaccination programs in Yugoslavia and surrounding countries led to the elimination of smallpox. The 1972 outbreak was clearly a case of importation from Asia, where smallpox still raged. From where and by who was not known until the epidemic had done its worst.

After returning home, the pilgrim fell ill on February 15-16 at his home in Danjani, Kosovo. Visited at his home by dozens of relatives, friends, and acquaintances eager to hear about his pilgrimage, he infected eleven others. One of these, a 30-year-old teacher returned to his home in nearby Serbia and fell sick there. His brother brought him to the local clinic, where his disease was misdiagnosed. From there, he and his brother traveled by bus to a hospital in a ak. From there he was transported to a larger hospital in Belgrade, where he was diagnosed as having an allergy to penicillin. On March 10, he was transferred to another hospital in Belgrade, and that night he died. This patient infected 38 others, of whom eight died. In Belgrade alone, 27 people (20 patients and seven hospital staff, including two physicians and a nurse) contracted smallpox.

On the evening of March 14, a physician in a hospital near the pilgrim's village correctly diagnosed four new patients with smallpox and sounded the alarm to the national public health administration. On March 17, the Yugoslavian government notified the WHO, which sent an expert to advise on the public health response. A Belgrade laboratory confirmed the smallpox diagnosis on March 20. Before that, on March 15, the government had begun mobilizing its response. On March 17, state containment efforts began, including quarantining, roadblocks, and a massive vaccination program, plus newspaper, radio, and television alerts to the nation. In three weeks, 18 million of 20.8 citizens in the country were vaccinated, but between March 15 and 31, 100 more cases appeared in Kosovo. By May 9, when Yugoslavia was declared free of smallpox, the case total was 175, with 35 dead. Thirty-seven percent of the cases were among those previously vaccinated; the effects of those vaccinations had worn off or the vaccine had

been ineffective to start. All ages were represented in the patient population. Fifty-seven percent of the victims were males, 43 percent were females. The case fatality rate in general was 20 percent; among the unvaccinated, it was 10 percent. The case transmission level was high, with 12.8 new infections per case. Two people traveling on the bus with the Serbian teacher became ill. Ten percent of the cases were hemorrhagic, which was unusual.

Most of the cases (123) occurred in Kosovo. Forty-eight occurred in Serbia, due to the Serbian teacher. Vojvodina and Montenegro had one case each, of travelers. A migrant Yugoslavian worker came down with smallpox in Hanover, Federal Republic of Germany, but no further cases resulted.



Feb. 3-7 idex case infected in Baghdad.
Feb.15-16 falls ill at home Danjani (Kosovo)

Mar.5 one of 11 infected by index case falls ill in Serbia
Mar.10 Serbian dies after infecting 42 in hospital
Mar.11, Serbia case total 10, Kosovo 12
Mar.13 physician in Kosovo sounds alert

Mar.17 diagnosis and state containment initiative
Mar.25 case total is 137
April 15 case total is 173 (123 Kosovo, 48 Serbia, 1 Vojvodina, 1 Montenegro

As in Sverdlovsk, the public health response was well organized but too late to prevent deaths. By March 14, the second wave of victims was already infected. The epidemic would peak on March 23-25, as indicated in the above chart. The centralized state system allowed public health, government, and army officials complete authority to quarantine families, take over hotels and apartment buildings, commandeer villages, set up roadblocks, shut down the country's borders, and administer an enormous vaccination program.

By failing to report its smallpox epidemic, the Iraqi government contributed the dangerous component of secrecy to the 1972 Yugoslav outbreak.[20] Ideally, the Yugoslav pilgrim should have known about the epidemic in Baghdad and avoided the city, or he should have felt free enough to report his illness at the local clinic in Danjani. Had he been diagnosed accurately in mid-February, public health intervention might have prevented, if not the 11 first generation cases, at least the 163 cases that followed.

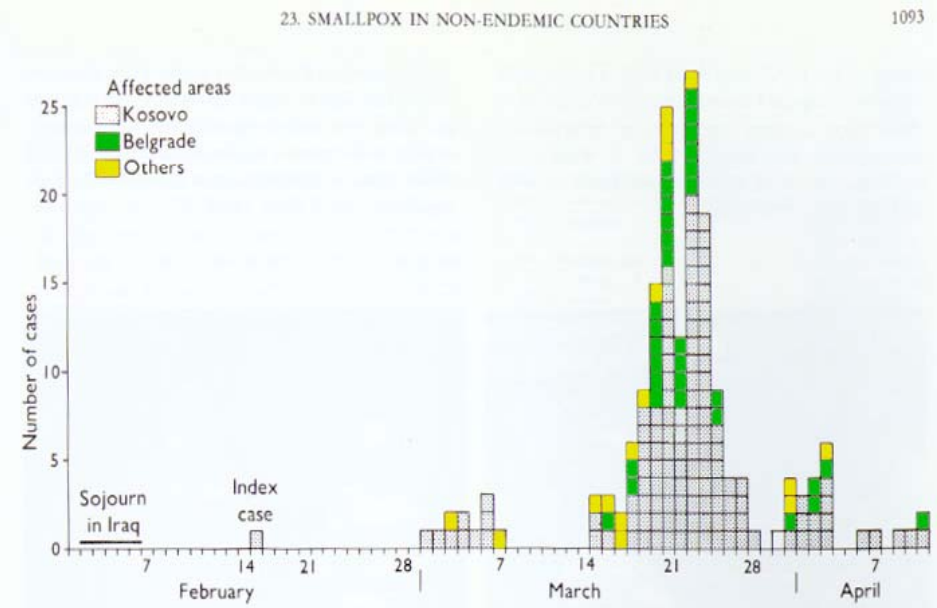


Fig. 23.7 Yugoslavia: number of cases of smallpox, by date of onset and locality, 1972. The first generation of cases occurred in Kosovo province and adjacent areas; the large second generation in Kosovo, Belgrade and some other places.

As a second political factor, the pilgrim who was the index case was reluctant to reveal himself. He belonged to the semi-secret Bektaki Moslem sect that, like all religion, was forbidden by the Yugoslav government. Apparently, he feared discrediting his religion and being responsible for the epidemic, which had killed several of his village neighbors. He never admitted to having a rash and was traced only after March 20, when the brother of the Serbian teacher fell ill with smallpox, and it was realized that the teacher himself had died of the disease.

As a third political factor delaying diagnosis, relations between the Belgrade government and Kosovo communities were strained. The majority of the cases (124, with 26 fatalities) occurred in rural Kosovar villages near the Albanian border among a relatively uneducated population. Albanian was the dominant language and suspicion of Serbs was rampant. When public health officials arrived from Belgrade, they had to use translators to identify foci and persuade villagers, who lived in large, extended families, to cooperate. During the campaign, the discovery that some vaccine batches were faulty did little to encourage trust in the Albanian villages. To this day, rumors persist that even prior to 1972 the Serbs had never vaccinated the Kosovars, but left them vulnerable to the outbreak. The centralized Yugoslav government had considerably more control in Serbia and especially in Belgrade, where cases were few and communication to the public much easier. By April 11, with the diagnosis of the last two cases, the epidemic was effectively over. The national vaccination campaign continued until the end of the month.

CONCLUSION

How do these two outbreaks, one of anthrax, the other of smallpox, inform us about the hazards of a biological weapons attack on US civilians? As we already knew, reactions to sudden, potentially massive outbreaks require rationally coordinated medical response. In Sverdlovsk, screening at the local level, canvassing neighborhoods for potential victims, and transport to central facilities were already in place as features of the public health system that could be readily activated. The entire social context made mobilization relatively easy. The medical personnel and the affected community were extremely stable and they all spoke the same language. Soviet citizens, especially factory workers, often spent their entire lives in the same house in the same neighbor hood, going to the same schools, and involved in the same local communist party and factory organizations. Physicians and patients sometimes knew each other their entire lives, from childhood. United States health care, with its myriad hospital types, most of them large, its choice of market rather than government control, and its mobile, linguistically diverse populations would have to undergo massive change in order to mount an effective response to a biological weapons attack.

By an effective response, I mean that the risks of an intentional epidemic would be minimized for all targeted groups, without discrimination. Historically, epidemics most affect those who are already disadvantaged — the malnourished, the poorly educated, the elderly, children, those who are already sick. The great majority of the Sverdlovsk victims were working class people who, in a sense, lived in the wrong neighborhood. Similarly, the Yugoslavian smallpox outbreak demonstrated the role of social divisions in determining the outcome of epidemics. The common reference to smallpox vaccinations in Yugoslavia as "routine" at that time[21] does not explain how rural Kosovar Albanians took the brunt of the outbreak. More likely, they resisted or were not included in earlier vaccination programs. With a biological weapons attack, the same risks would fall heavily on poorer or marginal members of society, unless effective public health efforts were in place to level those risks.

The extraordinarily high transmission rate of 1:12 for the Yugoslavian smallpox outbreak is an unreliable basis for an imagined United States attack scenario, although the extrapolation is commonly made. Critical of such generalizations, analysts at the U. S. Centers for Disease Control have estimated on the basis of past recorded smallpox outbreaks that predictable rates of transmission range from 1-1 to 1-5.[22] The outbreaks used in their reckoning included many which took place in developing nations, where neither the health status of the population nor medical care in general resembles the average US situation, although they do reflect conditions in American communities of extreme poverty, both urban and rural.

Two factors increased transmission rates in the Yugoslavian outbreak. One was the frequent, intimate contact of large extended families in a rural setting, a demographic feature not typical in the United States, where many people live alone, but common

among immigrants, minorities, and the poor. The second factor was the successive hospitalizations of the undiagnosed Serbian teacher. By increasing exposure to other patients, this factor may have also contributed to the relatively high rate of especially virulent hemorrhagic smallpox (10 percent instead of a predictable 1 percent or less). Such multiple referrals could conceivably take place in the United States, although hospital care tends to be centralized, especially in urban areas. The problem would be whether the primary physician could accurately decipher a patient's symptoms and intervene immediately. Unlike Yugoslavia in 1972, today's United States medical system has been developing new techniques for detecting suspicious diseases. Due to the AIDS epidemic, the growing incidence of drug-resistant tuberculosis, and also the steady incursion of West Nile virus, the growing area of emerging infectious diseases has led to numerous surveillance and educational programs. Nearly a decade of emphasis on bioterrorism also generated hundreds of educational programs for medical professionals. Not just symptom recognition but learning to think in epidemiological terms makes the difference in diagnosis. During the anthrax postal attacks, for example, all but one of the 11 inhalational anthrax cases were initially misdiagnosed by clinicians.[23] Six of these cases were postal workers from facilities where anthrax-filled letters were known to have been processed. Although the media had broadcast this information, the physicians failed to see the significance of their patients' workplaces. Two of these postal workers died.

Yet, even physicians who can connect the epidemiological dots cannot overcome the obstacle of government secrecy. In the Sverdlovsk and Yugoslavian outbreaks, governments obscured information about the specific causes of epidemic disease and therefore left clinicians struggling with ignorance. The Sverdlovsk outbreak, caused by a biological weapon, is most clearly marked by military secrecy. Without knowing about the biological weapons program at Compound 19, Sverdlovsk residents could not gauge the risks of anthrax escaping from it. The Yugoslav smallpox epidemic has the features of what is called a natural epidemic, although the social influences on infectious disease are well known. Without knowing about the smallpox epidemic in Iraq, the Muslim pilgrim could not understand the danger he posed to others. If communication is politicized to the point where silence reigns, the risks of dangerous epidemics only rise. Physicians must have full information to make accurate diagnoses. In the same way, the public must have full information to estimate risks to its health, including education about preventing disease and about what therapies do and do not exist to cure sickness.

Can these rules apply to modern biological weapons programs, where military secrecy is the norm? I realize that the idea of military officials at Compound 19 breaking their silence in 1979 is completely unrealistic, and not just because the local population would have been angered. Secrecy is expected in weapons development. The question is, how much and for what ends? The Soviets created an extensive offensive program which was illegal and had to be kept deeply secret. A defensive program, the kind the United States, the United Kingdom, and other countries legally maintain, should be more open, but the line between offensive and defensive investigations is not always sharp. For the last

seven years, following federal directives, United States cities and states have prepared a wide diversity of local responses to potential biological weapons attacks. Simultaneously, the United States intelligence agencies became engaged in secret biological weapons projects that blurred the distinction between offensive and defensive goals. These projects included the genetic manipulation of anthrax and the building of a small weapons production plant.[24] Following the 2001 terrorist and anthrax attacks in the United States, government secrecy expanded to include public health. The CDC was given the right to classify its documents, more government Level 4 laboratories were planned, and reserves of smallpox vaccines were designated for secret storage locations. Furthermore, the United States maintained its stance that its government and commercial biological facilities should be exempt from inspection regimes, although all other states parties to the Biological Weapons Convention agreed that international transparency is the only way to reduce the risks of biological weapons.

All we know about epidemics indicates that a universal protective rule of openness must apply or entire societies are at mortal risk. Can we think of any instance of an epidemic in which secrecy reduced the jeopardy to the public? To the contrary, history is full of counter examples in which ignorance led the unsuspecting into danger. Even recent history illustrates this point. In 1994, the Indian government tried to cover up a bubonic plague epidemic, which led to increased spread of the disease and tremendous public panic.[25] In any number of countries, including the United States, government suppression of information regarding AIDS led to increased contagion and death.

By reason, the same rule against secrecy should apply to the threat of biological weapons, which can increase in scope from twentieth-century technology to the futuristic biotechnologies of this century. The rule of openness should be a preemptive weapon, to head off predictable catastrophes and the nightmare of a new generation of biological weapons. We are fast reaching the point where any offensive biological weapons program in any nation poses a general threat to humanity. Small measures are insufficient to the problem. Instead, our focus should be on aggressively enforcing universal sanctions to prevent the secret development of biological weapons. Every available legal means should be used to uncover and eliminate all offensive biological programs, in the name of national and international security.

JEANNE GUILLEMIN

Jeanne Guillemin is a Senior Fellow at the MIT Security Studies Program and a Professor of Sociology at Boston College. She has twenty years of active experience in the investigation of biological weapons controversies and has published broadly on them in Science, Scientific American, The Journal of the American Philosophical Society, and The New England Journal of Medicine. She did her undergraduate work in social psychology at Harvard University and received her graduate degree in sociology and anthropology from Brandeis University in 1973. She has been a Congressional Fellow, sponsored by the American Anthropological Association, and a National Endowment for the Humanities Fellow at the Hastings Center for the Study of Society, Ethics, and the Life Sciences in New York. She is an associate of

the Harvard-Sussex Program, a major institute for the study of biological and chemical weapons non-proliferation.

Her latest book is Anthrax: The Investigation of a Deadly Outbreak (University of California Press, 1999, pb 2001). It is the definitive account of the 1992 team research of the largest inhalational anthrax epidemic in recorded history, which in 1979 killed sixty-six people in the Soviet city of Sverdlovsk. Guillemin's interviews with the families of victims were the basis for the epidemiological map that proved an anthrax aerosol from a nearby military facility caused the outbreak. The Sverdlovsk data is also the only proof that the incubation period for human inhalational anthrax can be as long as six weeks.

Figure Legends

Note: Intellectual Property Rights to graphics remain with J. Guillemin

Figure 1. Page from the 1988 Soviet Response to U. S. Regarding Information on Sverdlovsk" *by I. S. Bezdenezhnikh, P. N. Burgosov, and V. I. Nikiforov. The graph indicates that the outbreak began April 4, 1979, and ended April 14.*

Figure 2. Sverdlovsk (1985) in a Star satellite photo. The dots indicate the night time locations of victims, based on addresses from the KGB list and other sources. The southern cluster is in Chkalovskiy district. Arrows indicate residences off the map.

Figure 3. Chkalovskiy district only, indicating the daytime locations of 62 valid cases, including 11 survivors. The isopleths indicate decreasing intensity of the anthrax aerosol from Compound 19 to the city's southern line. Four additional outliers, including the two outside the large isopleth, are located off the map to the north and west. The irregular white lines indicate Compound 19 (north) and Compound 32. The rectangle indicates the ceramics factory. (Note: map version for presentation should have but does not show four outlier locations, hence this text change.)

Figure 4. Six villages southeast of Sverdlovsk where 1979 epizootic occurred.

Figure 5. Wind directions and speed from Sverdlovsk Koltsovo airport March 30-April 4, 1979. Numbers at the downwind end of each line are the local times on a standard 24 hour clock. Inner and outer concentric circles designate wind speeds of 2.5 and 5.0 meters per second, respectively. Date archived at the National Center for Atmospheric Research, Boulder, Colorado.

Figure 6. Onset, admissions, and death incidence in the 1979 Sverdlovsk anthrax epidemic.

Figure 7-(in presentation Fig. 23.7) Time after infection in days. The clinical course of moderately severe ordinary-type variola major in an unvaccinated subject (A); inoculation smallpox (variolation) in an unvaccinated subject (B); and primary vaccination (C). From Fenner et al. *1988: 41.*

Figure 8. Map of Yugoslavia and route of 1972 smallpox transmission from Danjani in Kosovo to Belgrade in Serbia.

Figure 9. (Figure 23.7 in presentation) Yugoslavia, 1972: number of cases of smallpox, by date of onset and locality. The first generation of cases occurred in Kosovo province and adjacent areas.; the large second generation in Kosovo, Belgrade and some other places. From Fenner et al. *1988: 1093*

Endnotes

---

[1] *Guillemin, J.* Anthrax: The Investigation of a Deadly Outbreak *(Berkeley CA: University of California Press, 1999) and "The 1979 Anthrax Epidemic in the USSR: Applied Science and Political Controversy"* Proceedings of the American Philosophical Society *2002, 146: 18-35.*

[2] *Fenner, F., Henderson, D.A., Arita, I , Je ek, Z., and I. D. Ladnyi, I. D. "Smallpox in Non-endemic Countries" in* Smallpox and Its Eradication *(Geneva: World Health Organization, 1988) 1091-1095.*

[3] *Inglesby, T. V., Henderson, D. A., and Bartlett, J. G. "Anthrax as Biological Weapon"* JAMA *281: 1735-1745*; *Henderson, D.A. "Smallpox: Clinical and Epidemiologic Features"* Emerg Infect Dis *1999, 5:537-39; O'Toole. T. "Smallpox: An Attack Scenario"* Emerg Infect Dis *1999, 5:540-46.*

[4] *For essays on the history of biological weapons, see Geissler, E. and van Courtland Moon, J.E.* Biological and Toxin Weapons: Research, Development and Use from the Middle Ages to 1945. *SIPRI Chemical and Biological Warfare Studies No.18 (New York: Oxford University Press, 1999). For coverage of the Japanese program, see Harris, S. H.* Factories of Death: Japanese Biological Warfare 1932-45 and the American Cover-up *(London: Routledge, 1994).*

[5] *Drell, S. D., Sofaer, A. D., and Wilson, G. D. (eds)* The New Terror: Facing the Threat of Biological and Chemical Weapons *(Stanford, CA: Hoover Institution Press).*

[6] *Dixon, T., Hanna, P., Guillemin, J., and Meselson, M. "Medical Progress: Anthrax"* N England J Med *1999, 341:815-826.*

[7] *V. Barykin. V., Vygodchikov, G. and Sazhina, Y. "Outbreak of Intestinal Anthrax in Yaroslavl"* Zhurnal Gigiyena I Epidemiologiya *[Journal of Hygiene and Epidemiology] 1929, I: 25-30. US State Department Translation.*

[8] *Albrink, W. S., Brooks. S. M., Biron, R. E., and Kopel, M. "Human Inhalation Anthrax: A report of Three Fatal Cases"* Am J Path *36: 457-71.*

[9] *"The Report of 'A'" Chemical Corps Research and Development Command, Biological Warfare Laboratories, Fort Detrick, Frederick, Maryland, 1950.*

[10] *Meselson, M. "Note Regarding Source Strength"* Applied Science and Analysis (ASA) Newsletter *21 Dec, 2001, 87: 1, 10-11.*

[11] *Alibek, K. with Handelman, S.* Biohazard: The Chilling True Story of the Largest Biological Weapons Program in the World, told from the Inside by the Man Who Ran It *(New York: Random House, 1999).*

[12] *Senser, J. D. and Aznick, N.W. "Cost Benefit Analysis" in* International Symposium on Vaccinations Against Communicable Diseases, Monaco, 14-17 March, 1973 *(Symposia Series on Immunobiological Standardization (Basel: Karger 1973) 22: 37-46.*

[13] *Fenner* et al. *1988, 1097-98.*

[14] *Fenner* et al.*, 1988, 32-38.*

[15] *Fenner* et al.*, 1988, 1077.*

[16] Ibid., *208.*

[17] *Rosebury, T. and Kabat. E.A. "Bacterial Warfare"* J Immunology *1947, 56, 1: 7-96, 33.*

[18] *Hahon, N. "Screening Studies with Variola Virus" US Army Chemical Corps, Biological Warfare Laboratories, Fort Detrick, Frederick, MD. 1958.*

[19] *Alibek, 1999: 111-115.*

[20] *Secrecy in Iraq also caused a parallel outbreak in Syria, after a school child became infected in Baghdad between February 28 and March 5, 1972, and then returned to Meyadin. Fifty-four cases and two deaths were reported for Syria, with the epidemic ending by April 27. Cases numbers may have been underestimated. Fenner* et al., *1090-91.*

[21] *Henderson, 1999. This article's reference to a transmission rate of 1:13 should be 1:12.*

[22] *Meltzer, M. I, Damon, I., LeDuc, J. W., and Millar, J. D. "Modeling Potential Responses to Smallpox as a Bioterrorist Weapon"* Emerg Infect Dis *2001, 7: 959-69.*

[23] *Guillemin, J. Biological and Chemical Weapons. "Appendix 3.1 (Geneva: WHO, 2003).*

[24] *Miller, J., Engelberg, S., and Broad, W.* Germs: Biological Weapons and America's Secret War *(New York: Simon & Schuster, 2001).*

[25] *John, T. J. "Learning from Plague in India"* Lancet *344: 972; Tysmans, J. B. "Plague in India--1994 Conditions, Containment, Goals"* Carolina Papers in International Health and Development *University of North Carolina-Chapel Hill, NC, 1998.*