

Atmospheric Conditions Surrounding the Anthrax Outbreak of Sverdlovsk, Russia, 1979

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April 2nd, 1979 in Sverdlovsk, Russia (now Ekaterinburg) anthrax was released from a military facility resulting in the death of 64 people and affecting many more. The purpose of this essay is to examine the atmospheric conditions during the time of this anthrax release to understand the relationship between the effects of the local atmosphere and the severity of this epidemic. Please note at the time of this outbreak Russia did not allow anyone other than Russian government employees to investigate the incident and in fact went as far as having the KGB indefinitely remove hospital files. It was not until 1992 that Russian president Boris Yeltsin admitted to the leak, and allowed the first group of Western scientists to visit Sverdlovsk (1).

Bacillus Anthracis is a spore-forming bacillus and in this case is \approx 1-5 microns in diameter, with an average dry density of one million spores per microgram. *B. anthracis* is typically responsible for acute disease in herbivores such as livestock, and occasionally spreading to humans who have excessive contact with animal product (2). Other cases in humans have been the result of eating the meat of a contaminated animal, and in the case of Sverdlovsk, exposure as a direct result of inhalation (3). Although there has not been any formal report published investigating the direct events leading up to the leak within the facility, in Yeltsin's statement he said an estimated one gram (1g) of anthrax was instantaneously released through the buildings exhaust system into the atmosphere (4).

Anthrax is most dangerous to people when inhaled and has an 80% mortality rate amongst those who are affected by aerosol anthrax (5). Recorded onset times in Sverdlovsk spanned two days to six weeks (April 4th-May 15th) after the leak, with an average of three days between onsets and time of death (3). Due to the size of the spore, less than five microns, it exhibits aerosol-like transport and inhalation properties similar to 2.5micron particulate matter. Thus wind speed, aerosol release height, and conditions within the atmospheric boundary layer (ABL) dictate where, how fast, and for how long this plume will travel (2).

Previous near surface (10m) weather reports were obtained from archived data supplied by the National Center for Atmospheric Research (NCAR), for the Koltsovo airport 10km east of Sverdlovsk on the day of the event. On April 2nd, winds were from the northwest between 320° and 350° during 0400 and 1900hrs local time. If winds had been from the south on this day, spores could have traveled towards more densely populated city (6). Additional meteorological data of the following two days, April 3rd & 4th, was examined to compare wind speed and direction, however only wind components of April 2nd correspond to the location of those who were exposed. For the remainder of the month of April, only 2% of all winds were reported from the above-mentioned northern sector (1).

A cold front had just passed through Sverdlovsk and followed with the cloudless day of April 2nd, 1979. On this day temperatures ranged from -10°C and -3°C, relative humidity between 50-66%, the midday sun reached 39° above the horizon, and wind speeds of 4-6 m/sec from the north. Further, temperatures between 500-1000m altitude indicate slight stability during the period of 0400-1000hrs, becoming neutral near 1600hrs. With these parameters and based on data from NCAR, the near surface atmosphere was of neutral stability. Assuming this event occurred during the day there is strong reason to conclude turbulence was occurring within the ABL. Given the size of spores with aerosol transport abilities, turbulence and constant wind speed within the ABL provide a likely explanation not only for the infected people along the northern bearing of 330° ending at the facility, but explains cases of dead cattle 50km from the facility on the same bearing (1).

Although it took 13 years of negation to allow for Western investigators to visit Sverdlovsk, sufficient data was collected to determine meteorological conditions during the time of the leak. Although the exact time at which the anthrax was released has yet to be determined, archived data from the Koltsovo airport suggests the release occurred during the period between 0400 and 1900 hours local time, and that typical characteristics of the daytime atmospheric boundary layer in combination with aerosol anthrax acted as a major contributor to this epidemic. However, averaged monthly data from surrounding meteorological reporting stations suggests the severity of the situation could have been much worse, and with many more casualties if southern winds were present during the release (2).

References

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