The Incident in Chelyabinsk

Nuclear Disaster in the Urals. ZHORES A. MEDVEDEV. Translated from the Russian by George Saunders. Norton, New York, 1979. viii, 214 pp. $12.95.

Sometime in 1958, in the Chelyabinsk region of the Soviet Union, an occurrence of unknown scale and lethality occurred that resulted in the contamination of large areas with radioactive waste from fission processes. Bits and pieces of information about this incident have been leaking to the West through comments of refugees and second-hand interviews. In addition, it appears that the U.S. Central Intelligence Agency has accumulated a large amount of information from its own sources, some of which has been made public through the Freedom of Information Act.

Because of the obvious and varied implications of such an occurrence, there has been a great deal of interest in the West in this incident, and attempts have been made to obtain information from individuals, government agencies, and the open scientific literature. The unwillingness of the U.S. government to release pertinent information, which is no doubt obtained routinely through its thousands of independent sources, has fed speculation about the extent of the affected zone and the causes of the accident and, on the part of some groups, feelings of paranoia about the government's motives.

Nuclear Disaster in the Urals by the Russian dissident Zhores A. Medvedev is a serious and intelligent attempt to deduce the scale and the cause of the Chelyabinsk incident. Medvedev's arguments are based on an extensive survey of Soviet radioecology literature, the available CIA documents, interviews, various public sources of scientific and technical data, and expert opinions obtained from people outside his field. The book is extensively referenced and contains an appendix in which the heavily "sanitized" (and confused) CIA documents are reproduced for the reader to inspect. The result is, at a minimum, an astonishing, interesting, and potentially useful source of references. The book is, however, far more than just a source document, since Medvedev is also familiar with some of the dark corners in Soviet society. He uses his social and scientific background to assess, sometimes convincingly, sometimes not, the vast array of incomplete, inconsistent, and varied information he has collected.

Medvedev contends that a careful survey of the biological literature leads to the conclusion that an area of no less than 1500 square kilometers was contaminated with millions or tens of millions of curies of strontium-90 and cesium-137 and smaller quantities of other isotopes from fission reactions.

Medvedev's conclusions about the extent of the affected area and the level of contamination are derived from an examination of articles that discuss radioecological studies of deer, mice, fish, and birds as well as varieties of field plants and trees. He also reviews articles on the movement of radionuclides through soil, lakes, and rivers. These examinations add weight to many of his arguments.

Most of Medvedev's attention is focused on a set of radioecological studies that appear to have been designed to investigate large inadvertently contaminated areas. A striking feature of these studies is that they appear to have been conducted in land areas and lakes considerably larger than might be expected in controlled environmental studies. In addition, the studies seem to indicate a lack of either environmental control or careful planning that would not normally be considered desirable or acceptable for experiments in planned environments. For example, Medvedev discusses two contaminated lakes of 4.5 and 11.3 square kilometers and convincingly argues that a third lake tens of square kilometers in area is also contaminated. He further examines the studies involving fish, deer, and mice in an attempt to deduce the area of contamination from known information on migration patterns of these various animals. Important assumptions must be made in order to arrive at his estimates, but they are not entirely unwarranted in view of some other disturbing features of the studies. For instance, he cites published studies of how radionuclides pass through the food chain as animals feed on plants and on each other, but it appears that the studies used such a high level of contamination that poisoning due to radiation affected the natural distribution of predator and prey. If one assumes that the researchers are competent, one reaches the inescapable conclusion that many of these studies were taking advantage of an area in which contamination was not controlled by the research team.

Medvedev's speculations on the causes of the Chelyabinsk accident, while plausible, seem far too unlikely. After arguing that the absence of certain shorter-lived fission products rules out a large-scale reactor accident or an accidental nuclear weapon detonation, he discusses an unlikely but possible nuclear mud-volcano type of accident. In this scenario, residual amounts of plutonium left behind during chemical processing operations accumulate through selective absorption in the soil, filtering through concrete or precipitating in tanks. Once the residual plutonium has been accumulated, groundwater or some other source of water results in a local criticality, with venting of radiotoxic materials. Medvedev documents a situation at the Hanford reservation that had this potential. As reported in the April 1972 WASH-1520 report, about 100 kilograms of plutonium had been retained in a narrow band of subsurface soil at Hanford, and the possibility of a nuclear chain reaction was present. In addition to large amounts of plutonium, such a scenario might require groundwater finding its way into the mass of plutonium, the buildup of high temperatures and pressures, aerosol generation, and rather severe weather conditions, all occurring simultaneously. While such a set of conditions should not be ruled out by engineers working at such facilities, an accident on a scale consistent with Medvedev's deductions is more likely to come about through a much less exotic set of circumstances.

Chelyabinsk 40, the apparent source of the accident, seems to have been a large military facility where plutonium was produced in fission reactors and chemically separated for use in the Soviet weapons program. There is little doubt that such a facility would have to handle large amounts of wastes from the chemical processing operations. These wastes are chemically quite active, since the first part of the process involves the dissolving of irradiated fuel elements in nitric acid. They are also very radioactive and can boil violently as a result of self-generated internal heating. Some stages of the process involve the handling of potentially explosive organic nitrates. If these materials are handled without care and in large quantities, it is not hard to imagine scenarios involving chemical explosions, fires, steam explosions, dis-

rupted or breached storage tanks, and the like.

To contaminate an area of 100 square miles (that is to say, an area no larger than that covered by a circle of 6 miles' radius) with a million curies of strontium-90 would require only a mechanism that could disperse 8 kilograms of freshly separated strontium-90. A chemical explosion in a liquid storage tank could disperse many droplets of material that could quickly become dust as, warmed by the radioactivity, they evaporated. An explosion involving chemicals that could boil through self-generated heating could therefore be a very effective means of generating an aerosol of highly activated fission products.

If a fire were to accompany or follow such an occurrence, the rising hot air could carry fine particles of these materials to appreciable altitudes. Although many particles might be large enough to fall out at short distances from the fire zone, fine particles such as those in the 1-to-10-micron range could stay in the air for days. It would not require severe winds to carry these particles tens of kilometers from the area of the disaster. In addition, such a facility would almost certainly be situated on a large river or other body of water. The contamination of the surface waters near the facility might even result in the spread of contaminants to bodies of water outside the range of airborne contaminants through connected lakes and streams. As wind, rain, or melting snow leached surface contamination from the soil, additional contamination of the surface water could then be expected periodically. Medvedev discusses scientific studies of water-carried radioisotopes that suggest just such periodic and uncontrolled additions of contaminants to lakes and streams.

Such an accident would require only physical mechanisms that have already been seen on an industrial scale. One can easily conjure up horrifying images of people attempting to fight fires or reach victims while extraordinarily radiotoxic materials settled around them. The circumstance, however, would more likely be the result of negligent handling of dangerous materials than of some exotic feature of nuclear waste.

There are a number of criticisms that should be noted. The book was written in Russian and translated into English, and it contains a number of glaring errors that the author clearly did not make. There are many typographical errors, some of which will be confusing to the layperson. The book comes with a jacket that makes some mystifying references to Three Mile Island, which is likely to make many technically sophisticated readers hostile and to mislead many less sophisticated readers. Unfortunately, the publisher's sloppy and inappropriate handling of such details gives the book a less credible appearance than it might have had and could be quite embarrassing to the author.

Medvedev's book is a substantial contribution toward informing the technical and lay public about the incident in Chelyabinsk. It would be interesting to see what an exhaustive and critical examination of "laundered" Soviet scientific publications on nuclear safety and engineering might reveal. Medvedev's story is far from complete and unambiguous, but it is honest and well referenced and provides a starting point for those who wish to dig further.

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The Dioxin Issue

The Pendulum and the Toxic Cloud. The Course of Dioxin Contamination. THOMAS WHITESIDE. Yale University Press, New Haven, Conn., 1979. x, 206 pp. Cloth, $15; paper, $4.95.

This book deals with the environmental and human exposure problems of one of the most toxic and teratogenic substances known—2,3,7,8-tetrachlorodibenzo-*p*-dioxin, or simply TCDD or dioxin. This material is a by-product in the manufacture of 2,4,5-trichlorophenol and consequently ends up in the herbicides 2,4,5-T and silvex and in the antiseptic hexachlorophene. The continued use of these products has been the subject of a great deal of scientific and public interest stemming from the defoliation operations in Vietnam, continuing through the tragic explosion in 1976 of a trichlorophenol plant outside Seveso, Italy (the main subject of the book), and culminating earlier this year in the emergency ban of 2,4,5-T by the Environmental Protection Agency (EPA). The basis for the ban is the alleged high spontaneous abortion rate in parts of Oregon subjected to frequent sprayings of 2,4,5-T for forest management.

In the first part of the book, Whiteside discusses the events that led to the confrontation between Dow Chemical, the major producer of 2,4,5-T, and the EPA. The author leaves no doubt about his position in this controversy. As he puts it in the conclusion, the issue of TCDD "symbolizes the encroachments of heedless technology upon the fundamental liberties of the individual, and, above all, touches upon our guardianship of the physical integrity of those yet unborn" (referring to the teratogenic nature of 2,3,7,8-TCDD).

These are strong words, and Whiteside has devoted his book to building an argument in support of them. Using the Seveso accident as the principal vehicle, his approach is to couple a discussion of the social, political, and scientific aspects of the accident with a summary of selected scientific and anecdotal evidence on the dangers of TCDD.

The account of the Seveso accident and its aftermath is a story of error, apathy, and neglect on the part of the manufacturer and the Italian government. Five thousand people were initially exposed to the "toxic cloud," and yet no mention was ever made that the fallout contained TCDD until the manufacturer was specifically asked by an Italian health authority nine days after the accident. Fourteen days passed before a physician representing Hoffman-La-Roche, the parent company that owned the plant, stated that contamination was serious enough to warrant evacuation. Finally, 16 days after the explosion, the first of the evacuees left.

On the evidence of Whiteside's account, the blame for Seveso must be shared by many. The manufacturer was guilty of poor practices; no holding tank was provided to capture the debris of an explosion and none of the plant workers knew about TCDD, its dangers, or even its presence in the reactor. The government attitude led to frustration and cynicism among the residents. Seven months were required to fence in the contaminated area. Schools were declared safe and then discovered to be contaminated. The cleanup of the area was done casually and included incidents leading to the additional spread of toxic wastes by spilling from trucks, dumping into sewers, or incinerating contaminated animal carcasses at low temperature, which only revolatilized the TCDD. Some cleanup workers assigned to wear protective suits were seen playing soccer in T-shirts and shorts in areas of high contamination. Accompanying all this were acts of terrorism, payoffs, and political maneuvering. The situation was well summarized by a local pharmacist who stated "everything finishes in politics. This tragedy has turned into a farce. A farce of cash considerations."

The Seveso disaster, according to Whiteside, underlines the hazards of the use of 2,4,5-T in the United States. Is there a scientific message for the United