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MEDVEDEV CITES USSR DATA CONFIRMING URALS NUCLEAR DISASTER

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[Article by Dr Zhores Medvedev, a "biochemist working at the National Institute for Medical Research, London": "Facts Behind the Soviet Nuclear Disaster." First paragraph is introduction. This material is copyrighted.]

[Text] When the story first came to light last year, Western nuclear experts were sceptical that a large accident, involving nuclear waste materials, could have occurred in the South Urals in late 1957 or early 1958. However, published Soviet research into the effect of radioactivity on plants and animals confirms that a nuclear disaster did contaminate hundreds of square miles of the region.

In my article "Two Decades of Dissidence" (NEW SCIENTIST, Vol 72, p 264), I mentioned the occurrence at the end of 1957 or beginning of 1958 of a nuclear disaster in the Southern Urals. I described how the disaster had resulted from a sudden explosion involving nuclear waste stored in underground shelters, not far from where the first Soviet military reactors had been built; how strong winds carried a mixture of radioactive products and soil over a large area, probably more than a thousand square miles in size; and how many villages and small towns were not evacuated on time, probably causing the deaths later of several hundred people from radiation sickness.

I was unaware at the time that this nuclear disaster was absolutely unknown to Western experts, and my NEW SCIENTIST article created an unexpected sensation. Reports about this 20-year-old nuclear disaster appeared in almost all the major newspapers. At the same time, some Western nuclear experts, including the chairman of the United Kingdom Atomic Energy Authority, Sir John Hill, tried to dismiss my story as "science-fiction", "rubbish" or a "figment of the imagination".

However, about a month later my story was confirmed by Professor Lev Tumerman, former head of the biophysics laboratory at the Institute of Molecular Biology in Moscow, who had emigrated to Israel in 1972. Tumerman visited the area between the two Ural cities--Chelyabinsk and Sverdlovsk--in 1960. He was able to see that hundreds of squre miles of land there had been so heavily contaminated by radioactive wastes that the area was forbidden territory. All the villages and small towns had been destroyed so as to make the dangerous zone uninhabitable and to prevent the evacuated people from returning. Tumerman's eye-witness evidence did not, however, convince all the experts, including John Hill, of the truth of this disaster. Doubts remained that the story was exaggerated. These doubts convinced me of the need to collect more information that would throw light on the real scale of this nuclear disaster.

Different kinds of nuclear accidents release different kinds of radioactive products into the environment. If reactor nuclear waste is scattered from a storage area the result will be quite specific. The numerous short-lived radioactive isotopes, with very intensive gamma and beta radiation, will already have disappeared during the storage period. Only long-lived isotopes, which constitute about 5 to 6 per cent of the initial radioactivity, remain dangerous after the first two to three months. Radioactive Strontium-90 and Caesium-137 are the most important of these. Both have half-lives of about 30 years. [paragraph continues]

Caesium-137, as an isotope with gamma radiation, is more dangerous for external irradiation. However, it is less cumulative and, because it is more soluble and is not fixed permanently in biological structures, it disappears more rapidly from animals and the soil. Strontium-90 is a close analogue of calcium and is able to substitute for calcium in both bones and soil. Since calcium forms part of permanent body structure, this means that Strontium-90 can be fixed in animals for many years, while it may remain for hundreds of years in the soil. This is why Strontium-90, which emits beta radiation, is considered the most dangerous product from nuclear bomb tests and the nuclear industry.

If the nuclear disaster in the Urals really caused the contamination of hundreds or thousands of square miles of territory, this area must still be polluted today--heavily by Strontium-90, and partly by Caesium-137. The soil, soil animals, plants, insects, mammals, lakes, fish and all other forms of life in this area would still contain significant amounts of Strontium-90 and Caesium-137. The random distribution of radioactive isotopes during an accident of this type would cause the isotope concentration level to vary enormously from place to place. In many areas the external and internal radiation would seriously threaten the life of many species--increasing their mutation load and mortality, and inducing many other changes. The extremely large contaminated area would also create a unique community of animals and plants, where genetic, population, botanical, zoological and limnological research into the influence of radioactive contamination could be studied in its natural conditions.

Critics of Tumerman's and my story can obviously ask: Why then did Soviet scientists miss this chance to study the unique radiobiological and genetic problems, which this enormous (certainly the largest in the world) radio-active environment provided for long-term study?

The answer is very simple--the Soviet scientists did not miss this chance. More than 100 works on the effect of Strontium-90 and Caesium-137 in natural plant and animal populations have been published since 1958. In most of these publications, neither the cause nor the geographical location of the contaminated area are indicated. This is the unavoidable price of censorship. However, the specific composition of the plants and animals, the climate, soil types and many other indicators leads to the inevitable conclusion that it lies in the South Urals. (In one publication, the Chelyabinsk region is actually mentioned--a censorship slip. The terms of observation--10 years in 1968, 11 in 1969, 14 in 1971, and so on--reveal the approximate date of the original accident. Finally, the scale of the research (especially with mammals, birds and fish) indicates clearly that rather heavy radioactive contamination covered hundreds of square miles of an area containing several large lakes.

I had known about the nuclear water explosion in the Urals area since 1958. My professor at that time, Vsevolod Klechkovskiy, who was a leading expert in the use of radioactive isotopes and radiation in agricultural research, was given the job of setting up an experimental station within the contaminated territory. The station was to study the effect of radioactive isotopes on plant and animal life and to monitor the so-called "secondary distribution" of the contamination. Radioactive pollution of this type cannot be confined within the initial area, since soil erosion and biological distribution constantly widen the radioactive region. The specific activity of the contamination declines with time both in the orignal area and the new neighbouring ones. [paragraph continues]

Klechkovskiy offered me a job at this station, but I did not accept it as the work was classified. A number of junior researchers from his department of agrochemistry and biochemistry at the Timiryazev Agricultural Academy, however, did go to work there, and still do today.

At the beginning all work associated with this nuclear disaster was considered as highly classified. There was no chance of publishing any research results. The situation changed slightly after Khrushchev's demise, because blame could be laid on the nuclear authorities appointed by him. The chairman of the State Committee for Atomic Energy of the USSR, Professor Vasiliy Yemelyanov, was dismissed from his post in 1965; some other high officials in both the peaceful and military branches of the atomic energy industry went as well.

It was too late in 1965/1966, and it was considered unnecessary, to acknowledge the catastrophe that had taken place years before. But at least the high level of secrecy which had surrounded the disaster was lifted. Many experts from the Soviet Academy of Sciences and other research establishments were allowed to start comprehensive research in the contaminated area and to publish their results in Soviet academic journals. The ending of Lysenko's domination in biology and genetics also helped this change in attitude. Several new research institutes and units specialising in genetics, radiobiology and ecology, set up in 1965 and 1966, pressed hard for access to this unique radioactive environment.

These studies started, unfortunately, several years after the initial impact of the radioactive hazard on the community which comprised all levels of life--from soil bacteria through to large animals, plants and trees. Farm animals and plants, as well as the human population, were included in places of "secondary distribution" where the radioactivity level had not been so high as to force evacuation.

One of the first works that pointed to a possible serious industrial nuclear disaster was published in 1966 (see ATOMNAYA ENERGIYA, Vol 18, p 379). At first glance the paper appeared to be purely mathematical. Its title--"The Calculation Method for the Distribution of Radioactive Contamination in Water and Bottom Deposits of Non-Running Water Lakes"--was rather theoretical, and the whole text was saturated with mathematical equations. This study was based on measurements that had been taken in two lakes contaminated by industrial radioactive waste five years previously. (Since the paper had been submitted for publication in May, 1964, the work must have been completed some time in 1963.) The author, F. Rovinskiy, found that the isotope composition was complex at first, but after the first few months Strontium-90 became dominant. The water radioactivity (the level in absolute figures was not given) fell quickly during the first two years because of absorption by the silt. Then some kind of equilibrium was established between the bottom silt deposits and the water. The theoretical calculations and the experimental picture were almost identical. One can find hardly anything wrong with the whole work or the "experimental contamination", except for the size of the two lakes referred to. "The experimental lakes were," wrote Rovinsky, "eutrophic types, the first was 11.3 sq. km in size and the second was 4.5 sq. km both almost round in shape." It is rather hard to believe that anyone in his right mind would contaminate two such large lakes just to confirm some mathematical calculations. However, I did not find any other research on these two particular lakes.

A third contaminated lake appeared in two papers by A.I. Ilyenko, published at the beginning of the 1970's (see VOPROSY IKHTIOLOGII, Vol 10, p 1127; Vol 12, p 174). [paragraph continues]

(Annex continues on back pages of report)

Ilyenko had studied the distribution of Caesium-137 and Strontium-90 in water plankton, water plants, and different species of fish between 1968 and 1970, but the lake had been contaminated many years before. He gave the actual isotope concentration of both isotopes in this lake. It varied every month depending very much on seasonal conditions, and with maximum peaks during October and July. Such variations could only be typical of a running water lake with a contaminated basin. During the summer of 1969, the concentration of Strontium-90 in the water was 0.2 microcurie per litre, and that of Caesium-137 was 0.025 microcurie per litre. Both figures are 100 times higher than contamination levels in ponds created specifically for research purposes, both in the USSR and other countries.

A Lake with 50,000,000 Curies

The purpose of Ilyenko's work was to study food chains among different forms of life in the lake. Pike were the largest and final link in the chain. Ilyenko had measured the isotope concentration in the bones and muscle of more than 100 pike, some weighing as much as 25 to 30 lbs. The lake was not a rich one, since only four species of fish were found there. And as it is important for food chain studies that the population balance is not seriously affected, the number of pike in the lake must have been at least 10 to 20 times the number studied. A lake containing this number of large pike must be between 10 to 20 square kilometres in size. One would need at least 50,000,000 curies to contaminate such a lake with Strontium-90 up to the level of 0.2 microcurie per litre, that is if it were non-running and not too deep. For a running water lake the amount would have to be much greater. But in either case such a level of radioactivity is far too high to handle for experimental purposes.

The lakes in the Urals region usually have very thick bottom silt deposits. The total amount of Strontium-90 in the bottom silt of the two lakes which Rovinskiy studied was at least 10 times higher than in the water, once equilibrium was reached. However, these were non-running-water type lakes. The lake studied by Ilyenko had an intensive turnover of its water supply--the Strontium-90 concentration could vary up or down by more than 400 percent within one month. These conditions meant that the bottom silt and the water plants became the main accumulators of radioactive materials--a process which had started many years before Ilyenko's experiments. Ilyenko calculated that the total amount of Caesium-137 and Strontium-90 in the water plants, plankton and silt was about 1000 times higher than in the water. For example, the concentration of Caesium-137 in water plants varied from 10 to 38 microcuries per kilogram.

This means that the total minimum amount of Strontium-90 and Caesium-137 in the whole lake must be around 50 million curies. And this enormous amount of radioactivity filtered into the lake from the lake's basin! It is well known that soil fixes strontium very strongly, so only a small fraction could have filtered through with the soil water--probably some five to six percent over several years.

It is, of course, impossible to know precisely how many hundreds of millions of curies of Strontium-90 and Caesium-137 would have to be fixed in its basin for such an enormous amount of radioactivity to accumulate in a running water lake. There are no precedents for such research. This radioactivity is equivalent to thousands of tons of radium. Could anyone imagine that this amount of radioactive material would be distributed over the area surrounding the lake, just for "experimental" purposes?

Many papers have been published on the different species living in the contaminated area. The levels of soil contamination were usually the same with the different experiments--from 0.2 to 1.0, from 1.0 to 1.5 and from 1.8 to 3.4 mci[millicuries]of Strontium-90, and 4.0 to 7.0 microcuries of Caesium-137 per square metre between 1965 and 1969. Ilyenko and his collaborators also carried out several studies of mammals at the same time as they were doing their work on the lake's population, between 1968 and 1970. Since the samples of fish and animals were taken continuously, the whole research was certainly carried out in the same environment. In two studies of mammals, where food chains were also the main research aim, about 2000 individual animals from 15 different species were killed (see ZOOLOGICHESKIY ZHURNAL, Vol 49, p 1370; ZHURNAL OBSHCHEY BIOLOGII, Vol 31, p 6989). Small animals, such as mice, rats and rabbits, are poor indicators of the size of a research area. However, these two papers reported killing 21 deer from the contaminated area. This final link of the food chain is indeed rather revealing. Since the shooting had to be done without causing any serious depletion in the natural population or species ratios, at least 100 deer must have been available. Deer migrate normally over large distances, especially during winter, so the area covered should have been at least 100 square miles.

The level of soil contamination by Strontium-90, between 1.8 and 3.4 microcuries per square metre, is also much much higher than any possible "experimental" contamination. About one million curies of Strontium-90 would be necessary to obtain such an "experimental" field.

Works by other authors, in which the plants, soils and soil animals were studied, also indicated an area on a geographical scale, not just a fenced-off field. Their identical levels of radioactivity and cross references to Ilyenko's work indicate that it was in fact the same "experimental" area these authors were studying. The contaminated territory had many different soil types, consisting as it did of meadows, hills, plains and various kinds of forests. In general, within any contamination area there were at least six or seven ecological groups.

A large research team, headed by Academician N.P. Dubinin, has carried out work on the population genetics of the area--the frequency and pattern of chromosomal aberrations, comparative radio-sensitivity, selection of radio-resistant forms, and so on. It is clear that they were working in the same contaminated area as the one used for the other studies. The authors refer to Ilyenko's work when quoting the level of radioactivity as being 1.8 to 3.4 and 1.0 to 1.5 millicuries per square metre. They also acknowledge that the area was not contaminated on purpose for their experiments, and that they had only been able to start their radiobiological and genetical observations seven years after the organisms, selected for research purposes, had already been living in the radioactive environment. (See USPEKHI SOVREMENNOY GENETIKI, Vol 4, p 170.)

This lapse of time was a definite research disadvantage. The early adaptation stages had been missed and the initial level of irradiation by the mixture of short-lived and long-lived isotopes was unknown. Despite these methodical aberrations, the authors were able to find a selection of more resistant forms and some other genetical population changes in soil algae (chlorella), many plants (mostly perennial), and rodents, particularly species of mice.

The special aspect of the work, which I wish to emphasize here, is the size of the research area. For example, the research team started their work on rodents with a population that had already lived 30 generations in a radioactive environment. [paragraph continues]

One has to be certain for population genetics work that the individual animals being used for the different measurements are the true ancestors of those animals which lived in the area when the original radioactive contamination occurred. Rodents do not migrate very far during their adult life, perhaps about 1000 metres. However, with each new generation the migration from the ancestral environment will be even further. During 30 generations, migration could reach as much as 20 to 30 kilometres, which means 400 to 900 square kilometres of radioactive environment. Dubinin and his colleagues do not give the exact size of their research area, but they do admit that all the animals they studied had really lived in the radioactive zone over all these years.

Single-cell soil algae (chlorella) are extremely resistant to radioactive contamination, so their level of genetical damage should be much higher than for those species which just could not survive. Dubinin and his team took samples of chlorella some five years, or 200 generations, after the radioactive contamination had occurred. The work was clearly carried out in a different area, one perhaps where only the algae could have survived. The radioactivity of the soil was much higher, its maximum activity being 1.0 exponent 10 [as published] disintegrations per kilogramme of soil per minute. This activity calculated per metre is about five curies for a surface layer of 8 to 10 cm depth!

There was a very uneven distribution of radioactive contamination over the area used for this research. The work that has been published on plants and animals was carried out in places where these animals and plants could live for many generations. Other areas, where they were not able to survive, were certainly not explored so thoroughly. But the existence of such areas in this general geographical location has been acknowledged by Dubinin. In his autobiography, VECHNOYE DVIZHENIE, he describes how his group carried out long-term research in an area "contaminated by high doses of radioactive substances", where "some members of the species have died out, some are suffering and declining slowly, while others have evolved a higher resistance".

The nature of the plant and animal species referred to in these research papers--there are more than 200 species in all--can easily indicate the approximate geographical location of the area under study. The mixture of European and Siberian species points to the Urals. This conclusion is confirmed by the accidental acknowledgement in one of the recent works of Ilyenko and his collaborators that the animals for their work had been collected in the Chelyabinsk region. This particular research was done during the autumn of 1971 and the animals had been living in a radioactive environment for 14 years--in other words since the autumn of 1957.

The papers, that I have referred to, represent only a small fraction of the research data that has been published on this contaminated environment in different Soviet scientific journals. The nuclear authorities in Britain and the U.S. probably put more trust in the expensive information they receive from monitoring global fall-out or from space-satellite surveillance. They certainly do not read such Soviet journals as VOPROSY IKHTIOLOGII, GENETIKA or ZOOLOGICHESKIY ZHURNAL. There are probably very few foreign scientists who can understand the meaning of the many methodical omissions.

This is why so many experts were puzzled and doubtful about my article in NEW SCIENTIST last November. Science fiction or not, many millions of curies of Strontium-90, Caesium-137 and other radioactive isotopes did contaminate a very large area of the South Urals region, where the first Soviet military reactors were built in the late 1940's. The nature of the contamination certainly excludes the possibility that it was a reactor accident or a real atomic explosion. The facts in the published materials agree much better with an accident in a nuclear waste disposal site. How it happened, and what was the real human price of this accident, has not yet been revealed. Soviet secrets can often be extremely long-lived. But whether the sceptics, who felt that the burial of nuclear waste in the USSR or elsewhere could not have led to an accident remotely resembling the one I described in my previous NEW SCIENTIST article, believe it or not, there are no doubts that this nuclear disaster in the Urals did happen around 1957/58. And we must take this accident as a warning to ensure that such a tragedy does not happen again.