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The radioecological consequences after explosion of the most powerful atomic bomb on Novaya Zemlya

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On the 30th of October 1961 an H-bomb of 50 MT TNT - equivalent was exploded at a height of 3.5 km over Novaya Zemlya. This explosion with other world tests had required the expert inspection of the most important regions of Russia Arctic to enforce the system of population radiation safety. It was necessary to inspect 10 000 km of coast and to assess the situation in towns and settlements of the main provinces, districts and autonomous republics.

The expedition consisted of two groups with different experts' views and attitudes to the problem. Now these groups would be referred to as a «greenpeace» group and a group of «hawks». The authors of the article were in different groups. The work of the expedition took place during March and April of 1962. An Arctic aviation airplane with special equipment was at the expedition's disposal.

Scientific tasks were given to the expedition members as follows: aerogamma survey and collection of air and snow samples, samples of local food, daily ration, soil, vegetables and autopsy material were collected. The radioactivity of samples was measured and extensive contamination material was obtained.

The following results were obtained.

The aerogamma survey showed that in spring 1962 the gammabackground was about 8-10 prem/h along the whole route of the expedition (see Fig.). As expected, in the Novaya Zemlya testground the gammabackground was substantially higher, especially in the hypocenter. In some places, where rocks contained higher levels of natural radionuclides, the gammabackground reached 20nrem/h. The data did not show higher level local fallouts in the Arctic in comparison with central regions of the country.

Air is the first environmental media in the radionuclides migration chain after the ground and atmospheric explosions, therefore air control was one of the main objects of our expedition. The measurements of summary beta-activity in Ci/l (10^{-15}) gave the following values: Murmansk - 1.0-1.2; Arkhangelsk - 1.8-1.9; Narjan-Mar - 0.8; Amderma - 4.5-6.1; Siktivkar - 4.3-4.8; Port Kamenni (Yamal) - 1.7-1.8; Dixon - 2.5-3.0; Norilsk - 3.9-4.0. Average levels for the Arctic were $2.8 \cdot 10^{-15}$ Ci/l. At the same time in Leningrad corresponding values were $(2.0-5.0) \cdot 10^{-15}$ Ci/l, in Moscow - $(3.0-6.0) \cdot 10^{-15}$ Ci/l; in Finland - $(1.0-3.0) \cdot 10^{-15}$ Ci/l; in USA - $4.8 \cdot 10^{-15}$ Ci/l. These values were 30-100 times lower than the accepted maximum permissible concentration for the population.

It was considered that in the north the soil role in the soil-fodder-animal products-man chain is different from the soil role in other climatic conditions. At that time there were 2.2 million reindeers in the northern regions of the country, and the basic feed for reindeers were lichens which have no root-system and concentrate radionuclides from fallout. At a latitude of 70°

North all along the Arctic Ocean coast northern soils had in 1969 radioactivity an average 1.5-2 times lower than soils at USSR and the northern hemisphere.

Lichens were contaminated with caesium-137; strontium-90; lead-210 and polonium-210 five to ten times more than tundra annual grasses. Analyses of lichens indicate caesium-137 separation against strontium-90 with isotopes ratio in fallout -1.6-1.7 changed to 4-10 in lichens. In 1962 in northern cities radioactive contamination of drinking water at large reservoirs was negligible - $(1.3) \cdot 10^{-12}$ Ci/l. Snow as well as water samples from small springs which are the main water-supply for the North population indicated that radionuclide levels in snow were the same as in other regions of the USSR. Particularly high levels of strontium-90 were observed in old melted snow samples concentrated by snow thawing. Radioactivity of drinking water in rivers and lakes of Northern regions did not differ from other country regions.

Radioactivity of local vegetables was studied in Arkhangelsk district and Komi Republic, where some quantity of vegetables had been cultivated. In general, Arctic regions have completely outside supply of vegetables from the central regions of Russia, but the local products were also not sources of caesium-137 contamination in the local population. Vegetables radioactivity for caesium-137 spectral range was less than $1 \cdot 10^{-10}$ Ci/kg. In cow milk in Murmansk province, Nenets region, Komi Republic and Taimir region strontium-90 concentration was about $5 \cdot 10^{-12}$ Ci/l, caesium-137 - $1.7 \cdot 10^{-11}$ Ci/l, with an average over Russia for Sr-90 23 and for Cs-137 $300 \cdot 10^{-12}$ Ci/l accordingly. Content in beef from northern regions of caesium-137 ($0.3-0.9 \cdot 10^{-9}$ Ci/kg) and strontium-90 ($7-8 \cdot 10^{-12}$ Ci/kg) did not differ from levels in central regions of Russia and did not effect the radiological situation due to low radionuclide concentration in beef and its virtual absence in ration of reindeer-breeders.

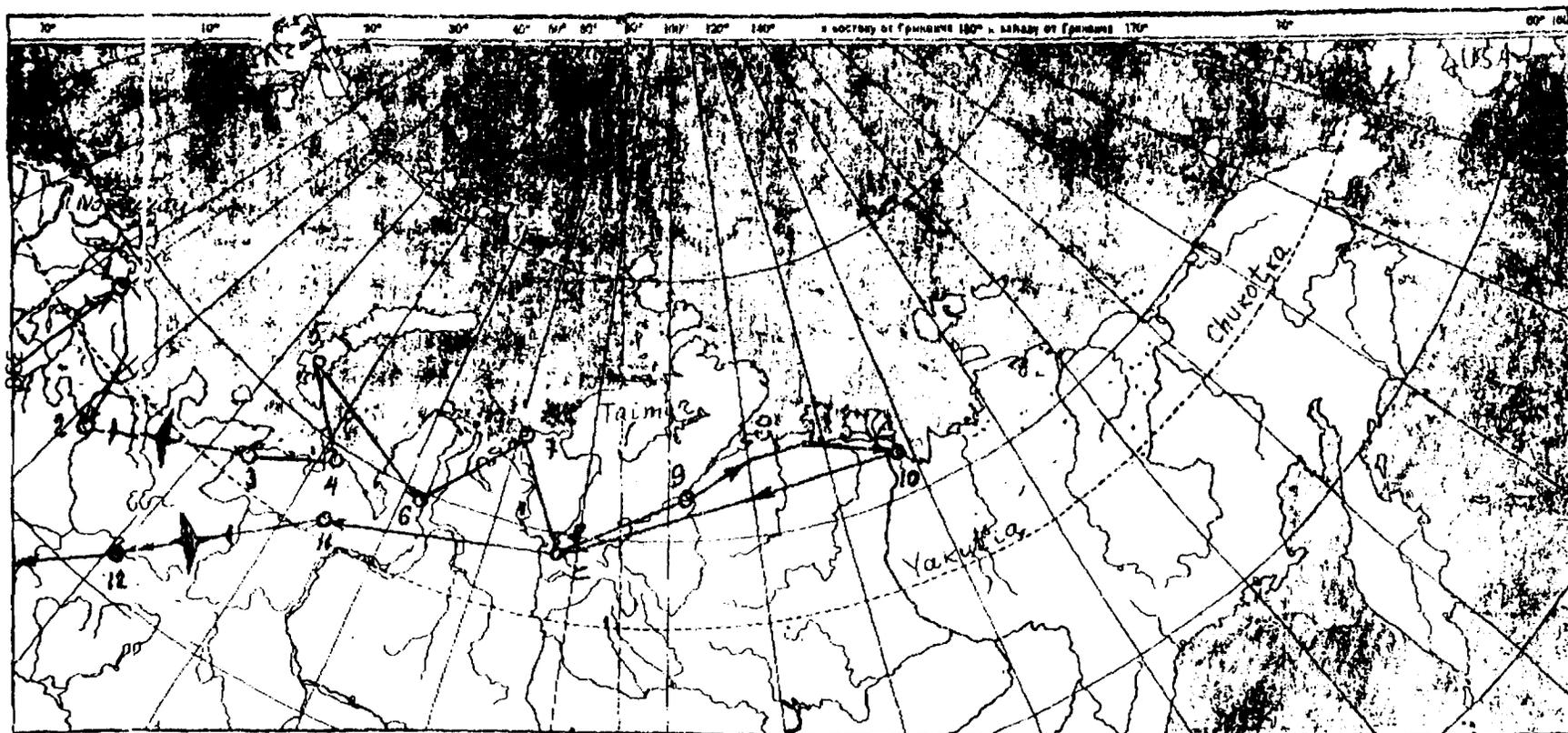
The high level of radioactivity in reindeer was first discovered by sanitary epidemic station inspectors Kupzova T.A. (Sakhalin) and Astafyeva G.A. (Kamchatka). Already at the end of 1958 they found that summary reindeer bones beta-activity reached $2 \cdot 10^9$ Ci/kg and other live-stock bones radioactivity was 100 times lower. During the inspection of Murmansk region, Nenets territory and Komi Republic in 1962 strontium-90 $30-55 \cdot 10^9$ Ci/kg and caesium-137 $5-14 \cdot 10^9$ Ci/kg concentration in reindeer bones were registered. Strontium level in reindeer bones was 5-80 times higher than in cow, sheep and pig bones. Lichens (reindeer main forage) were contaminated by caesium-137 and strontium-90 approximately by an order higher than annual grasses (cow and sheep main fodder). The data on levels of radioactivity of reindeer in different northern regions was confirmed later by other authors with values of $10-30 \cdot 10^9$ Ci/kg caesium and $20-40 \cdot 10^{12}$ Ci/kg strontium-90 in reindeer muscle.

Evaluation of daily rations in cantines showed that with little exception radioactivity content in northern cities and towns rations did not differ significantly from those in central Russia. But permanent reindeer meat consumption in Narjan-Mar in contrast to Murmansk, Arkhangelsk and Norilsk increased caesium-137 content in humans. In 1962 in Narjan-Mar residents whole-body content of caesium-137 was $1-1.3 \cdot 10^7$ Ci, exceeding by 3-5 times the levels in other northern or central cities of the country. The whole-body assessment of reindeer-breeders from Murmansk province showed 7.7 to $17.1 \cdot 10^7$ Ci of caesium-137 content or 32-85 times higher than in Leningrad residents. Measurement of reindeer breeders from Nenets and Taimir territories and from Komi Republic showed that this excess was 10-20 times higher. No significant peculiarities in strontium-90 accumulation were found. Only

later it was discovered that strontium-90 after «biological separation» in reindeers accumulated in reindeer-breeders bones by an order higher than in bones of central regions residents.

The results of the 1962 expedition for the first time showed the Arctic radioecological peculiarities due to the specific «lichen-reindeer-man» food chain. This study simulates investigation of chain quantity characteristics and assessment of health and environmental effects of global fallout. 1962 study shows that while some countries continue nuclear tests, radioactivity effects environment and all world population without distinction between nationalities or places of habitation.

RADIOLOGICAL SURVEY OF ARCTIC REGIONS IN 1962



1. MURMANSK
2. ARKHANGELSK
3. KARJAN-MAR
4. ARDERMA

5. NOVAYA ZEMLYA
6. YAMAL
7. DIXON
8. NORILSK

9. HATANGA
10. TIXI
11. VORKUTA
12. SIKTIVKAR