Ecological Consequences of the Chernobyl Nuclear Accident

On the occasion of the first session of the Senior Advisers to the Economic Commission for Europe (ECE) Governments on Environmental and Water Problems, the Deputy Chairman of the USSR State Committee for Hydrometeorology, V.G. Sokolovsky, presented a report on the ecological consequences following the nuclear accident at Chernobyl on 26 April 1986. The situation had been characterized by complicated dynamics of emissions from the source, the formation of radioactive traces, and water pollution. He also explained the results of the studies that had been conducted during 1986–87 on the radiation impact on flora and fauna in the region of the accident.

According to the Soviet expert, one of the main problems in liquidating the consequences of the accident during the early weeks and months had been to protect the population from external radiation and consumption of contaminated local foodstuffs. During the first days after the accident, both the population and cattle were evacuated from the 30-km zone around the site. Later, priority was given to the assessment and projection of the contamination of agricultural produce in adjacent areas, and, in a more generalized form, the assessment and projection of ecological consequences of environmental pollution in natural and agricultural ecosystems.

Main Studies

To such ends, studies were undertaken to measure radiation parameters on contaminated surfaces, including surface waters; on migration into the soil layer of the most dangerous (long-lived) radionuclides, their solubility and accessibility for root consumption under different soil and geographical conditions; on the initial airborne contamination of natural and agricultural vegetation, in order to decide on the possible use of local crops; and on dangerous radionuclides' accumulation in milk and the organs of domestic animals, in order to decide on the possible use of their meat. An assessment was also made of any direct and long-term (genetic) impact of radioactive contamination on the functional and structural parameters of natural ecosystems (mainly forests) and fauna.

The studies could partly lean on experience of contamination of the environment with radioactive products emitted into the atmosphere as a result of nuclear tests in the 1940s–1960s, and also as a result of earlier accidents at nuclear-power installations. Large-scale and systematic surveys of ecological consequences of radioactive contamination of the environment were carried out during the first weeks after the Chernobyl accident in the areas adjacent to the power-plant site.

—and Conclusions

The broad scientific analysis of the accident and its consequences led to the following main conclusions: effects of direct radiation impact on plant and animal communities in the form of radiation damage to coniferous forests, and noticeable changes in the number of soil meso- and microfauna, were manifested in a limited zone of high radioactive contamination at a distance of several kilometres from the site of the accident.

Ecological effects of radioactive contamination itself have not been observed in the rest of the territory that was exposed to radioactive emission resulting from the accident. The consequences, for natural and agricultural ecosystems, of radioactive contamination of the terrain and ground-waters, are mainly caused by the transfer of radionuclides along the trophic 'soil–plant–animal' chain.

Countermeasures Implemented

The regularities of redistribution of radionuclides in natural and agro-systems, derived as a result of implementing a large-scale programme of radioecological surveys, made possible the development of basic principles of agricultural production in the contaminated territory. The following measures have been implemented:

- reorientation of farms in keeping up with the levels of land contamination; withdrawal of foodstuffs from direct consumption by humans; raising of crops for seeds and fodder;
- long-term fixation of radionuclides in a form inaccessible to plants by incorporating large doses of mineral fertilizers, lime, and sorbents (clay suspension, zeolites) into the upper contaminated soil-layer, with subsequent ploughing-in;
- radical improvement of natural meadows and expansion of territories sown with perennial grasses, which provides for a radical reduction of the content of radionuclides in fodder and beef; and
- pre-slaughter feeding of animals (45–60 days) with fodder free from radionuclides, so that beef could be used for consumption.

This complex of measures has allowed a stable functioning of agricultural production in the contaminated territory and, in this way, for minimizing the level of dose-loadings caused by feedstuffs.

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The World's Largest Flowers and Their Future*

Two of the 13 known species of *Rafflesia* grow in Kinabalu Park in Sabah, Malaysia—*R. pricei* (Fig. 1) and *R. keithii* (Willem Meijer, pers. comm.). Their buds take up to nine months to mature and, upon blossoming, they smell faintly like carrion. This attracts flies and beetles, which may pollinate the flowers. *Rafflesia arnoldii*, a species incorrectly reported in Kinabalu Park in an earlier article (Conservation Education Programmes: Evaluate and Improve Them, *Environmental Conservation*, **14**(3), pp. 201–6, 1987), is perhaps the showiest of the species, but grows only in Sumatra. It was first described by its European discoverers as 'the greatest prodigy of the vegetable world.' Upon finding a blossom weighing 7 kg, Sir Stamford Raffles, explorer and founder of Singapore, declared it to be 'the most magnificent flower in the world.' With a diameter of about one metre (Botanist Dr Willem Meijer recently measured a blossom 91 cm in diameter and noted an unofficial record of 1.07 m), *Rafflesia arnoldii* is the world's largest flower.

Rafflesia flowers are rare as well as enormous, the entire genus and family being restricted to the tropical forests of Southeast Asia. Their tiny seeds infect the trailing stems of wild grape-vines (such as *Tetrastigma* spp.). *Rafflesia*

* *See also* Pollination of *Rafflesia* (Rafflesiaceae), in *American Journal of Botany*, **75**(8), pp. 1148–67, 10 figs, 1988, by Reed S. Beaman, Pamela J. Decker & John H. Beaman.—Ed.

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FIG. 1. *Flower of* Rafflesia pricei *in Kinabalu Park, Sabah. It was 30 cm in diameter, brick-red in colour but splotched with yellow, and smelled faintly of carrion. Photo: Susan K. Jacobson.*

plants are parasites and produce no photosynthetic leaves, instead deriving all their nourishment from these forest vines. The rapid destruction of tropical rain-forests within their range, including those in Indonesia, Malaysia, Brunei, Thailand, and the Philippines, makes their future uncertain. Two species have not been seen since World War II, and may be extinct (Willem Meijer, pers. comm.). Although Kinabalu Park is 754 sq. km in area, many of the other ten nature reserves that protect these flowers are small.

In 1854, the Bogor Botanical Garden successfully cultivated *R. arnoldii*. Recent cultivation attempts at the Singapore Botanical Garden, however, have so far failed. Protection of these unique flowers in the wild should remain a conservation priority.

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IIED-North America Join WRI

The World Resources Institute (WRI) and the International Institute for Environment and Development-North America (IIED-NA) are joining forces to strengthen their ability to promote improved policies and practices for environment and resource management world-wide. IIED-NA will become a major centre within WRI, fully integrated with the overall WRI programme.

As separate organizations, both groups have been committed to the principles of environmentally sustainable development, pursuing this common objective in different but complementary ways. WRI specializes in policy studies and research on environmental and natural resource issues affecting the industrialized as well as the developing world. These studies are followed by intensive engagement in pertinent policy-making processes in the United States, in international bodies and, to a lesser extent, in other countries. IIED-NA's programmes concentrate on developing countries, emphasizing technical programme support, institutional strengthening, and policy advice for Third World governments and non-governmental organizations.

Together, WRI and IIED-NA are committed to transforming the insights of the past decade into effective policies, programmes, and on-the-ground actions, that link natural resource management with progress in economic development.

The new Director of the IIED-NA centre within WRI is Thomas H. Fox, former Vice-President for International and Public Affairs of the Council on Foundations. He also has been the Director of the Office of Private and Voluntary Cooperation at the United States Agency for International Development (USAID) and the Executive Director of Volunteers in Technical Assistance (VITA). Mr Fox served in the Peace Corps in Africa for seven years, as Deputy Director of the Program in Togo, Director of the Program in Burkina Faso, and finally as Chief of Programs and Training and Deputy Director of the Africa region in Washington. At WRI he will report to WRI's Vice-President for Research and Policy Affairs, Mohamed T. El-Ashry.

'Bringing IIED-North America within WRI adds an important new capability for WRI. For the first time, we have the ability to pursue issues in a sustained, cooperative way with leaders and groups in the Third World, where many of the most difficult challenges are today', said James Gustave Speth, President of WRI. He continued 'We are committed to maintaining the special character of IIED that has made it uniquely effective in working with environment and development issues in developing countries. IIED-NA's field-based expertise combined with WRI's strengths in research, publishing, and policy affairs, will strengthen our common ability to help define and implement the concept of sustainable development. We will be able to address natural resource and environmental issues on a broader front, joining policy analysis with implementation to reach the full range of actors who can influence change throughout the developing world, as well as in the United States, Europe, and elsewhere.'

Speth also announced that two members of the IIED Board of Directors, Robert O. Anderson and Maurice F. Strong, have joined the WRI Board. In concrete terms, WRI will assume overall management responsibility for IIED-NA. IIED-NA will be an operational centre within WRI, focusing on providing programme support, applied research, and policy and technical advice to public and private institutions in developing countries.

The International Institute for Environment and Development, based in London, England, UK, will continue its independent programme as a separate entity. WRI and IIED in London will continue their close relationship, and plan to collaborate on such matters of mutual interest as sustainable agriculture. WRI and IIED have jointly published *World Resources 1986* and *World Resources 1987*—annual reports on environmental conditions and trends—and are working on *World Resources 1988–89.*

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