Second, constraints on the supply of some productive factors will cause increases in the use of other material inputs proportionately far greater than the increase in the total product. An important example of this influence is found in the production of food. Because arable land is in short supply in most nations, increases in chemical and capital inputs do not produce proportional gains in food production. During the period 1951–1966 world food production increased only 34 percent, far less than the 75–300 percent increases in the inputs of phosphate, nitrates, and pesticides mentioned (SCEP 1970, p. 118). These trends may continue, for Figure 6-5 illustrates the sixfold increase in pesticide use expected to be necessary to double the present global food production, an increase that must be achieved within thirty years to maintain even the current inadequate food standards.

Third, man-made materials are often longer-lived and potentially more harmful than the natural materials they replace. On the basis of research on the product substitutions that have occurred over the past twenty-five years, Commoner has concluded:

> Evidence leads to the general conclusion that in most of the technological displacements which have accompanied the growth of the United States economy since 1946, the new technology has an appreciably greater environmental impact than the technology which it has displaced.[Commoner 1972]

The substitution of radioisotopes for fossil fuels, synthetic fibers for wool and cotton, detergents for soap, and plastics for paper and wood are examples of this third factor

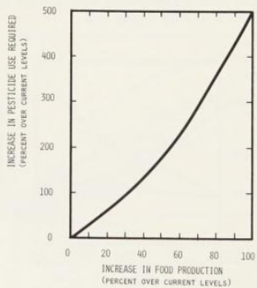

Figure 6-5 Pesticides required to increase food production on land now under cultivation in Africa, Latin America, and Asia (except mainland China and Japan)
Source: Data from SCEP 1970, p. 282.

contributing to an increase in the use of persistent materials proportionately far greater than the increase in population or economic activity.

An increase in the production and use of persistent materials is, in itself, not a sufficient cause for concern. Damage will result only if the materials are toxic, released to the environment, transported to a sensitive part of the biosystem, and sufficiently concentrated to interfere with natural biological processes. Thus any assessment of global pollution must also examine historical patterns associated with the transmission and the concentration of persistent materials.

Transmission Delays

The movement of materials through the global ecosystem is governed by the physics of particulate and molecular transportation in water and air streams and by the biological processes of absorption and degradation in living tissues. None of these processes act on the total quantity of any pollutant instantaneously. Often they act in sequence as the material is transported through the environment and within each food chain. Thus one would expect to observe a transmission delay between the time a persistent pollutant is released into the environment and the time it appears elsewhere in the ecosystem. The delay should depend both on the geographical distance and on the number of trophic levels involved.

When the geographical distances involved are large the transmission delays may be several years in length. One illustration of a persistent pollutant transmission delay is shown in Figure 6-6, where data on the annual level of strontium-90 (Sr-90) in New York City drinking water are compared with a tally of worldwide atmospheric nuclear tests. The figure suggests delay of about two years between the peak in the

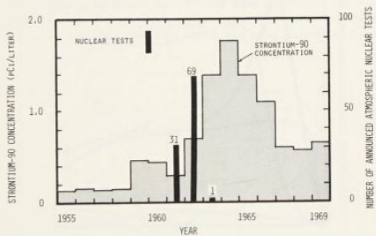

Figure 6-6 Yearly average strontium-90 concentrations in New York City drinking water, 1955–1970, versus number of announced atmospheric nuclear tests by the United States, the USSR, and France, 1961–1963
Sources: Data on number of tests from Facts 1964; water contamination data from EPA 1972.