PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES

# General Discussion

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# General discussion

D. Purves (*Edinburgh School of Agriculture, West Mains Road, Edinburgh, U.K.*). Mrs Cannon referred to the work of the U.S. Environmental Protection Agency. Unfortunately, in the U.K. we do not have an independent agency dedicated to the protection of the environment. We do have a Department of the Environment, but this is a Government Ministry which sometimes gives the impression of being on the side of the polluters. To illustrate what I mean, last year the Department of the Environment published a Working Party Report which 'permitted' the addition in sewage sludge of 1 t of Pb, 1 t of Cr and 5 kg of Cd per hectare of agricultural land. Admittedly, these additions were to be phased over a 30 year period, but they represent something like a 15-fold increase in Pb, and five-fold increases in Cr and Cd over natural background levels in the soil.

We have heard quite a lot at this symposium of the hazards presented by the presence of enhanced levels of Pb and Cd in the environment and I wonder if Mrs Cannon or any of the other speakers would care to comment on the possible long-term consequences of virtually irreversible enhancement of these metals to this extent in the soils on which we depend for the production of our food.

B. G. Wixson (*Civil Engineering Department, University of Missouri-Rolla, Rolla, Missouri, U.S.A.*). We have historical evidence of such contamination in soils surrounding old abandoned smelter areas that lacked modern pollution controls. These areas contain only limited growth of tolerant plants (which are usually quite toxic to grazing by animals). Since the past is often the key to the future, one must analyse for metals under natural background conditions, characterize the waste (such as sewage sludge) and determine the species of plant to be grown so as to limit the bioavailability of metals such as Cd and Pb. If potential environmental or human health problems are indicated, then the metal-rich material should not be used for land spreading but rather disposed of in such a manner as to not cause future hazards through metal enrichment.

B. E. Davies (*Geography Department, University College of Wales, Aberystwyth, Dyfed, U.K.*). I should like to associate myself with Dr Purves's strong misgivings concerning the use of sewage sludge, which is often rich in heavy metals, as a manure for agricultural and horticultural soils.

Although certain heavy metals are essential for metabolic processes, all of them are toxic at higher concentrations and excessive amounts in soil can injure growing plants and poison grazing stock. Unfortunately, toxicity symptoms such as leaf chlorosis are not good guides to the metal content of plants, and apparently healthy plants can grow on severely contaminated soils as is seen in productive pastures in the Rheidol and Ystwyth valleys of west Wales where alluvial soils can contain Pb up to 3000 mg/kg. On a number of occasions I have observed that apparently edible radishes growing in polluted soils have accumulated enough Pb to exceed the present British limit of 2 mg/kg fresh mass. Thus, it is very difficult to evaluate the significance of any particular soil metal content.

The loss by leaching of heavy metals from soils appears to be small. The analysis of samples taken from soil profiles excavated in land which was polluted a century or more ago suggests that little downward movement of Cu and Pb has occurred and only soil erosion, which is


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normally a very slow process, will cause a decrease in metal levels. Chemical fractionation of such samples leads me to believe that much of the added Pb and other metals is present either complexed by the humus or absorbed by the clay–humus complex and I have seen no convincing evidence that there is any significant reversion to forms not available to plants.

Consequently, in view of what we know about the toxicity of heavy metals and their fate in soils, I believe simple prudence to demand that we do not deliberately apply metal-enriched materials such as sewage sludge to our land.

Finally, Professor Webb's geochemical maps have revealed that we already have substantial areas of contaminated land in Great Britain. Although agricultural practices such as liming may help to control the absorption of metals by crop and food plants, there is another approach. Several recent reports in the literature have shown that different cultivars of a single species can take up greatly differing quantities of heavy metals from soils or solutions. Perhaps the plant breeder can help by selecting varieties with a low ability to absorb metals.



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