Spectrum

What comes out of a power station chimney?

Sphagnum moss grown in the clean air near Mt Kosciusko has been used by CSIRO scientists to catch airborne material issuing from the Wallerawang power station in the Hunter Valley of New South Wales.

Dr Dal Swaine and colleagues at the Division of Fossil Fuels wanted to find out what concentrations of trace elements emitted by a black-coal-burning station ended up in its nearby environment. Trace elements are important in the environmental chemistry of soil, water, plants, and animals.

Black coal contains perhaps 20 elements that could be regarded as environmentally important. They include arsenic, cadmium, copper, manganese, lead, antimony, selenium, and zinc. In most cases, the concentrations are very low (lower, for many elements, than those in American coals) and, in general, similar to the concentrations in soil.

However, Dr Swaine, Mr Bill Godbeer, and Mr Noel Morgan wanted to check that the combustion process does not concentrate these elements to high levels. The 1%, or less, of fly ash that escapes electrostatic precipitators differs from the remainder in that it mostly comprises particles less than 10 μm in diameter, and these could be unusually rich in certain elements. A grant from the National Energy Research, Development, and Demonstration Program enabled them to conduct an experiment to find out.

Some *Sphagnum* moss.

They chose the *Sphagnum* moss technique, which had been used overseas to sample industrial atmospheres, because of its simplicity and cheapness. The moss was packaged in nylon-mesh envelopes and placed on poles (as many as 46) around the Wallerawang power station and up to 40 km away.

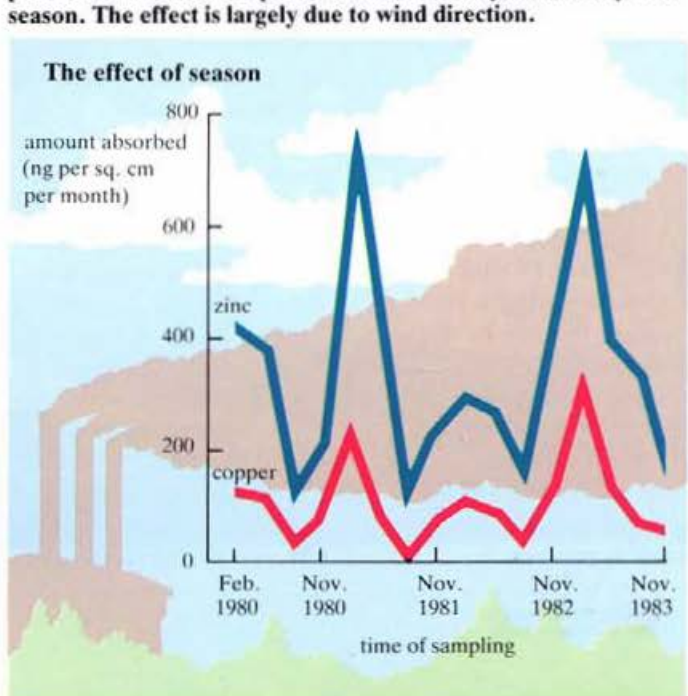
Unlike other methods, such as those involving volume samplers and particle impactors, the moss system requires no power supply and virtually no maintenance. Continuous collection for long periods is assured.

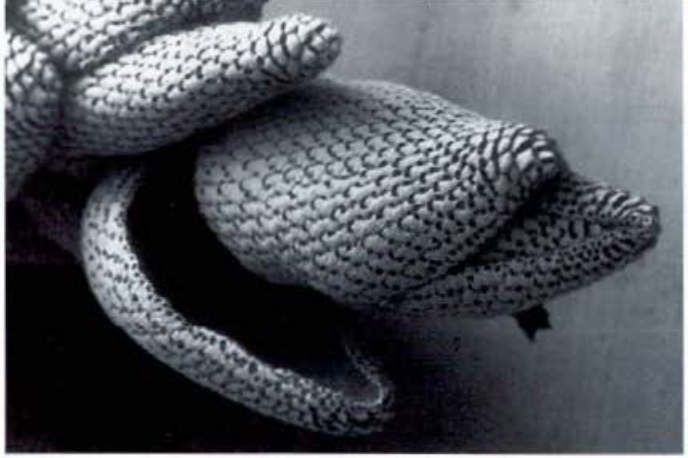
Sphagnum moss contains many very small pores, and even when dry it can selectively absorb and concentrate trace elements from the air (which it must do in its natural environment in order to gain essential elements).

After 3 years of sampling, during which time moss samples were analysed and replaced every 3 months, the scientists' main conclusion was that the amounts of trace elements discharged from power stations like Wallerawang should cause no

Interested onlookers watch the researchers putting moss-containing envelopes in place near the Wallerawang power station.

The amounts of trace elements absorbed onto *Sphagnum* moss placed 2 km west of the power station varied systematically with season. The effect is largely due to wind direction.





***Sphagnum* moss under the scanning electron microscope (above): and, at high magnification (right), the pores that trap spherical particles of fly ash.**

concern. The amounts were insignificant compared with the natural levels in the soil.

Even at the site closest to the power station (1·8 km distant), trace elements from airborne soil contributed as much as emissions from the power stations. (The scientists used germanium levels to distinguish contributions from soil and fly ash: fly ash is rich in this element but soil almost completely lacks it.)

The proportion of trace elements of power station origin declined with distance from the source, and beyond 10 km the power station's contribution was so small it was virtually impossible to measure.

The results showed the prime role of wind direction and strength in distributing material. As prevailing winds changed from one season to another, particular elements varied by a ratio of typically 4:1, demonstrating that long sampling periods are essential in studies of this kind.

Andrew Bell

Environmental consequences of coal combustion. Final NERDDP report. D.J. Swaine, W.C. Godbeer, and N.C. Morgan. (CSIRO Institute of Energy and Earth Resources: Sydney 1984.)