Toxic metals by the roadside

The lead in petrol makes cars bigger lead-emitters than diesel-powered trucks. But trucks have more and bigger tyres, so they may leave behind more cadmium.

As well as putting unpleasant gases such as carbon monoxide and nitrogen oxides into the air, cars and other motor vehicles leave in their wake small amounts of the toxic metals lead and cadmium. The metals can accumulate in roadside soil and are taken up by plants growing there. If these plants are crops or pastures, the possibility arises that people or stock could be poisoned. Dr John David and Dr Colin Williams, of the CSIRO Division of Plant Industry, recently examined soil and plants from beside one of Australia's busiest highways and assessed the risk.

Both lead and cadmium are very poisonous in quite small quantities, and they accumulate in the body. The National Health and Medical Research Council recommends that, to be safe, vegetables should contain no more than 4 parts of lead per million. The standard for cadmium is 5·5 p.p.m., but is under review and seems likely to be significantly reduced. The limit for this metal in seafoods was lowered recently from 5·5 to 2 p.p.m.

Most of the roadside lead comes, via car exhausts, from the lead additive in petrol. The main source of the cadmium is rubber worn from tyres. The metal finds its way into the rubber as an impurity in zinc oxide added to accelerate vulcanization, the process that gives the rubber the strength and elasticity that tyres need.

Dr David and Dr Williams chose for their tests a site beside the main Sydney–Melbourne link, the Hume Highway—on the side that the prevailing north-west winds would blow contaminants towards. The area, about 18 miles north-east of Marulan, N.S.W., had not been cultivated or fertilized, so it was free of metal contamination from fertilizers. They took soil samples 7·5, 15, 25, and 50 m from the road and samples of bracken at the nearest and furthest of those distances. They also grew rye corn in a glasshouse in soil taken from the top 5 cm at the same two distances from the highway.

The scientists found that the metals had contaminated the soil 7·5 and 15 m from the road, but not measurably 25 and 50 m away.

The highest lead concentration measured was 12·4 p.p.m., in the top 5 cm of soil at the sampling point nearest the road. By contrast, the lead concentration at the furthest point was only 4·2 p.p.m. in this top soil layer.

The corresponding cadmium concentrations were 0·057 p.p.m. and a much smaller 0·009 p.p.m.

The scientists also found contamination by zinc, nickel, and copper at the points nearest the road, but these metals are much less toxic than lead and cadmium and should not cause problems.

When they analysed the bracken, they again found much higher concentrations of lead and cadmium 7·5 m from the road than 50 m away. In the glasshouse experiment, cadmium concentrations followed a similar pattern. With lead, however, the picture was not so clear-cut. A higher concentration was measured in the rye corn grown in soil from the point nearer the road, but the difference was not great enough to be statistically significant. (See the table on the left.)

The scientists suggest three explanations for the

Concentrations of toxic metals		
	7·5 m from road	50 m from road
in bracken (p.p.m.)		
lead	19·1	5·3
cadmium	0·036	0·017
in rye corn (p.p.m.)		
lead	2·22	1·65
cadmium	0·065	0·030

much greater lead contamination of the bracken grown near the road than of the rye corn grown in soil taken from the same area. One is that some plant species are more inclined to take up lead from the soil than others. The second is that, unlike the soil the bracken grew in, which had more lead near the surface than lower down, the rye corn's soil was thoroughly mixed; this made the lead less available. The third explanation is that the bracken probably collected lead from the air as well as the soil.

Dr David and Dr Williams compared their findings with measurements of roadside soil contamination made in the United States, and found that, per thousand vehicles per day, the Australian lead and cadmium readings were considerably lower. They say the reasons for the lower lead measurements are not clear, but possibilities are lower lead contents in fuel in Australia, lower fuel consumption per vehicle, and a high proportion of diesel-powered vehicles. (Diesel fuel does not contain a lead additive.)

The unusually low cadmium content of Australian-made tyres probably explains the lower cadmium readings. Zinc oxide refined in Australia has very little cadmium contamination, and this is reflected in the tyres.

The scientists analysed rubber from eight brands of tyres, made in Japan, Germany, France, England, Ireland, Taiwan, and Australia. The two Australian brands had lower cadmium concentrations than any of the others. Apart from the German brand, all the overseas tyres tested had concentrations more than five times as high as the Australian brands, and in one case the figure was 100 times as high.

The scientists conclude that the increases in metal content they measured would not pose a serious health problem to grazing animals or Man under most conditions of rural land use. They point out that significant contamination was limited to a very narrow strip adjacent to the highway, so only a small proportion of the total area of any crop or pasture would be affected. Also, the Hume Highway is a major interstate route carrying a considerably greater traffic density than most country highways, and at the point of the study had not been re-routed for 50 years or more.

However, they say their measurements indicate that it is probably undesirable to grow vegetables, especially leaf vegetables for human consumption, in gardens immediately adjacent to busy roadways. They suggest that this applies particularly where a domestic garden is a person's sole source of vegetables. While it may be possible to wash off much of the lead and cadmium deposited from the air, metals taken up from the soil are bound firmly in the plant tissue.

Heavy metal contents of soils and plants adjacent to the Hume Highway near Marulan, New South Wales. D. J. David and C. H. Williams. *Australian Journal of Experimental Agriculture and Animal Husbandry*, 1975, **15** (in press).