much other evidence pointing to such a causal connection.

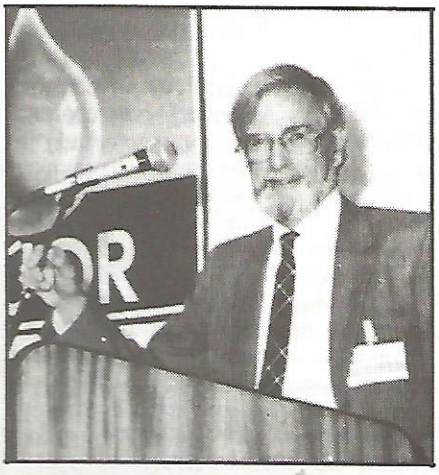
A review in the *New England Journal of Medicine* (*Lindsay 1990*) pointed out that rigorous well-designed clinical studies of the side effects of fluoride treatment for osteoporosis showed that, far from strengthening bone as expected, the fluoride actually increased bone fragility and fractures (*Riggs et al 1990, Kleerekoper et al 1989, Hedlund and Gallagher 1989*). The review concluded that "it is difficult to recommend the continued use of fluoride in clinical practice." An earlier Swiss case study of bilateral hip fractures following fluoride therapy had concluded "these data suggest a causal link between fractures and fluoride in patients with renal failure" (*Gerster et al 1983*). Earlier studies of endemic fluorosis in India had also reported reduced tensile strength of fluoride-affected bones (*Evans and Wood 1976, Baud et al 1985*).

The highest fluoride content in bone ash was observed in women with severe osteoporosis

The claim that these studies are irrelevant to the fluoridation issue (because of the high doses involved) is discounted by studies in Finland. Some old people who lived in a fluoridated area had bone fluoride levels similar to those resulting from fluoride therapy for osteoporosis. Fluoridation has now ceased in Finland (*Arnala, personal communication 1991*). In New Zealand such monitoring of old people's bones has not occured, and fluoridation is still vigorously promoted.

In the 1980s medical and other scientists at the University of Kuopio in Finland published their research on the effect of fluoridated water on human bone (*Alhava et al 1980, Arnala 1983, Arnala et al 1985, 1986*). Since 1959 their city has been the only place in Finland to have its water artificially fluoridated (up to 1 part per million). They reported: "The fluoride content of bones from Kuopio increased significantly with age, while considerably less change with age was found in samples from outside Kuopio. The highest fluoride content in bone ash was observed in women with severe osteoporosis." Bone fluoride concentrations in older people with impaired kidney function who had lived 10 or more of their last years in Kuopio ranged up to 3890 parts per million - which are as high as those reported in patients receiving fluoride therapy for osteoporosis (*Baud et al 1978*). Kuopio bone fluoride contents correlated with two of the histological changes associated with high fluoride doses (osteoporosis). So it is possible that, over longer periods, the latter changes occur in fluoridated areas.

When the University of Kuopio scientists published their research, another Finnish study,



Dr John Colquhoun addressing the International Symposium of Fluorine: Risks and Benefits, at Porto Allegre, Brazil, 15-18 May 1988.

by Kuopio health officials, received publicity. It suggested that fluoridation actually helped to prevent hip fractures (*Simonen and Laitinen 1985*). The university scientists pointed out many defects in that study: for example, it compared only two, dissimilar, cities and some fluoridation histories were inaccurate (*Arnala 1987*). Their own more thorough study of 461 hip fractures throughout Finland reported no correlation between fracture rates and water fluoride levels (*Arnala 1983, Arnala et al 1986*). Since then the more comprehensive surveys of over half a million USA hip fractures (*Jacobsen et al 1990*) and the Iowa studies involving 827 women (*Sowers et al 1986, 1991*) have reported more fractures in higher water fluoride areas, suggesting that water fluoride is a risk factor. The Iowa study authors commented on earlier claims that water fluoride strengthened bones: "the study populations were not well characterised as to ethnicity, age, sunlight exposure, and other factors which might confound such a relation" (*Sowers et al 1991*).

Clearly the evidence now strongly suggests that low fluoride doses over long periods as well as high doses for short periods can damage bones, making them more liable to fracture. Our belief that the amount accumulated from fluoridated water would be insignificant is now discounted by the new evidence. The situation may well worsen as people reach old age after spending greater proportions of their lives ingesting low fluoride doses.

Low fluoride doses over long periods can damage bones, making them more liable to fracture

We have long known that about half the fluoride we ingest is excreted by our kidneys - the rest accumulates in our bones (*Fluorine and Fluorides 1984, Hodge et al 1970*). It is released very slowly - about half in 20 years - only if fluoride exposure ends. People with