Fluorosis, a well-defined clinical disorder generally caused by ingesting excessive amounts of fluoride through potable water, is a serious rural health problem in India. The major clinical manifestations are: severe pain in the back bone (vertebral column), joints and pelvic girdle, leading to stiffness of the vertebral column, immobile joints, terminating in a crippling condition. There is no treatment or cure for this disease. But it can be prevented. The disease has been known to exist in our country for nearly 50 years, but nothing much has been done so far to control it. Can we now do something to control the problem, if not to eradicate it, by the turn of the century, since we have officially subscribed to the goal "Health For All by 2000 A.D."?

There have been excellent clinical descriptions of florid cases of skeletal fluorosis from Andhra Pradesh and Punjab. This has probably given rise to the impression that fluorosis is localised to just these regions of the country, and is, therefore, no national problem. There is now mounting evidence to show that this impression is wholly unjustified. Fluorosis is a national problem, with serious implications, and requires immediate attention. We review here some of the epidemiological evidence indicating the dimensions of the problem and also briefly discuss some possible approaches to its control.

Even till as late as 1960, it was thought that there were only four states of India which were endemic for fluorosis — namely Andhra Pradesh, Punjab, Tamil Nadu, and Uttar Pradesh. By 1980, however, it became clear that the problem was also prevalent in Delhi, Gujarat, Haryana, Karnataka, Madhya Pradesh and Rajasthan. Thus, today, there is clear epidemiological and clinical evidence that the disease exists in at least 10 states of the Indian Union. It is estimated that the total number of persons afflicted with fluorosis (skeletal and/or dental) is approximately 20 million; an equal number, though currently presenting no symptoms, are already exposed to the risk of the disease and may be expected to develop it in due course.

The epidemiology of fluorosis

We will now briefly review the epidemiological evidence. Since the problem in Andhra Pradesh has already been discussed in the foregoing paper we will confine our review to the other parts of the country.

Delhi: Teotia (Report submitted to the Department of Environment, Government of India, 1982) found that in Bindapur village, on the outskirts of Delhi, fluoride content of potable water ranged from 1.25 to 11.5 ppm. According to another report, of 339 inhabitants examined in a village near Delhi, fluorosis was prevalent in nearly 80 percent of adults and 60 percent of children. Gupta (M.D. thesis, Delhi University 1979), in a survey of 1818 subjects in two villages near Delhi, found evidence of dental fluorosis in 64.5 percent of the subjects that he studied.

Gujarat: In Liliya and Lathi taluks in Amerli district of this state, with a total population of 1.54 lakh, the fluoride content of water samples from the available sources — open wells, tube wells, ponds and wells on river banks — ranged from 0.4 to 8.0 ppm.

Haryana: Dayalpur, Atali, Chhainsa, Machgar and Sotai villages of this state have been surveyed and the fluoride content of potable water has been found to range from 1.69 to 3.83 ppm. At Sotai where the fluoride content of water was 3.83 ppm, 98 percent of the children were suffering from caries and 77 percent from dental fluorosis, while in Machgar where the fluoride content was 0.64 ppm, 65 percent were suffering from caries and 13 percent from dental fluorosis (Gajendra Singh: M.D. thesis, All India Institute of Medical Sciences, 1983). The above observations are interesting and important because fluoride is generally believed to protect against caries and for this reason, in other parts of the world, fluoride is actually being added to water to prevent caries. Mahajan et al (Art. Natl. Acad. Med. Sc. 13. 232; 1977), in a
survey of school children in Rohtak district observed a high incidence of fluorosis along with caries in school children.

Karnataka: In Mundargi, Kirapur, Kalakori, and Mustikeppa villages of Dharwar district in Karnataka, potable water has been found to have fluoride in the range of 5.4 to 12.8 ppm (K.M. Gurappa: Karnataka Engineering College — Report on Case Histories of Ground Water Hazards).

Punjab: In Bhatinda, Sangur, and Ferozepur districts in the Punjab, endemically fluorosis has been known to be a serious health problem and S.S. Jolly estimates that 33 percent of the population in these districts is exposed to the risk of endemic fluorosis.

Rajasthan: In 6681 of 24037 villages in the state, the fluoride content of water is high and fluorosis is prevalent.

Tamil Nadu: In the districts of Salem, Tanjore, South Arcot, and Kanyakumari, high levels of fluoride in water have been reported and fluorosis has emerged as an important rural health problem.

Uttar Pradesh: In an epidemiological survey of Khanjarpur, Usera, Sikri, Madheya Khan, Ka Purva villages, Teotia found that fluoride content of potable water ranged from 0.62 to 25.00 ppm and that the incidence of skeletal and dental fluorosis was high. Ray and coworkers (In. Jour. Pub. Health 26. No. 3 p.173, 1982) found a prevalence rate of 24 percent and 30 percent of dental fluorosis in two villages of Varanasi.

We do not wish to paint an unduly alarming picture. It is not by any means being suggested that these findings indicate that advanced skeletal fluorosis with disabling deformities and severe crippling and virtual immobilisation of affected subjects (of the types reported from Andhra Pradesh or Punjab) is widely prevalent in all the 10 states. The predominant findings in areas of these 10 states where high fluoride levels have been detected in the water supply, is dental fluorosis. Skeletal manifestations have also been seen in places, though they were generally not as pronounced and of the same severity as reported from Andhra Pradesh. It must also be admitted that there are still important gaps in our knowledge of the epidemiology of the disease. It is well known that there is no strict direct correlation between the level of fluoride in water and the occurrence or severity of clinical fluorosis. In order to be able to evaluate the significance of a given level of fluoride in water, we must also have information on the calcium content and the alkalinity of the water, and the nutritional status of the community because these factors condition the biological effects of fluoride in water. All this points to the urgent need for greater attention to research into the epidemiology of fluorosis.

But even with all these limitations in the present evidence, there is no room for complacency; indeed the emerging new dimensions of the problem should cause serious concern.

We may now briefly review some of this newly emerging information.

- The general impression so far has been that endemic fluorosis is due to ingestion of water with high fluoride levels — hydrofluorosis. There is now disturbing evidence that this assumption may not be valid. Food-borne fluorosis is emerging as a major possibility. In China, for example, in the county of Guizhong, staple food items, namely, rice, corn, cabbage, soya-bean, potatoes and wheat have been found to have fluoride content ranging from 8.3 to 11.7 mg/kg; it is now recognised in China that both water and food could contribute to fluorosis. In this connection, the report from the Institute of Preventive and Social Medicine in Hyderabad of significant levels of fluoride content in common agricultural crops grown in endemic areas of Andhra Pradesh, acquires significance. These findings need to be confirmed; indeed the routine estimation of fluoride levels in foods must now be included as part of the systematic investigation of nutritional value of foods being carried out at the National Institute of Nutrition, Hyderabad. We must take note of the fact that irrigation programmes, and new intensive agricultural technology, are bringing about striking changes in soil chemistry and sub-soil water composition; the impact of these developments on the fluoride levels of foods in endemic areas needs to be monitored rigorously.

- It is now being reported that children born in endemic areas to mothers ingesting high levels of fluoride are afflicted with skeletal fluorosis — not just dental fluorosis (Technical Report on Metabolism of Fluoride in the Newborn: Dept. of Environment, Govt. of India, 1982). Fluoride is known to cross the placenta. There have been foetal radiological evidences of skeletal fluorosis. Fluoride toxicity is also known to cause calcification of soft tissues especially that of blood vessels, ligaments and tendons. Reports available on samples of aorta, renal and basilar arteries from cadavers have shown that the aorta tends to accumulate greater amounts of fluoride (40 ppm) as compared to renal and basilar arteries (2.5 ppm) (Mohamedally and Wix : Proceedings of the 13th Conference of the International Society for Fluoride Research, New Delhi, 1983). It has been suggested that calcification of the aorta due to excessive incorporation of fluoride could account for still-births and neonatal infant mortality in endemic areas but hard evidence on this point is lacking.

We have to guard against other potential dangers as well. In the industrialised western world, industrial fluorosis is a problem which has attracted considerable attention. If the current hydrofluorosis in India is going to be compounded by food-borne fluorosis on the one hand, and air-pollution by fluoride from industrial establishments on the other, we will have a most formidable problem on our hands. Inhalation fluoride dust or gas or fumes is as harmful to health as ingesting fluoride-containing water or food. Industries, such as aluminium, fertiliser, chemical, steel and plastic, are some of the major industries which are known to use fluoride-containing substances which could pollute the environment with fluoride dust, gas or fumes. In the context of increasing industrialisation, (not always accompanied by rigorous measures designed to minimise occupational health hazards) we must ensure that industries of the kind mentioned above do not add to the fluoride burden in the tissues of the population and further aggravate the problem.

- Also, more and more drugs containing fluoride are coming into use. Sodium fluoride administration for the therapy of osteoporosis and otosclerosis and caries is now widely practised. Fluoride-containing medicaments, namely, fluoride steroids for arthritis and allergic diseases, and antibiotics, anaesthetics and tranquillisers are also being prescribed and used. Baud et al (Fluoride 15. 2. 54. 1982) have actually described the entity of “drug induced skeletal fluorosis”. In Kenya, there is a high level of fluoride in drinking water, fluoridated toothpastes have now been banned.

In an environment like ours, where the population is already exposed to the risks of fluorosis due to high fluoride levels in drinking water, “additional insults” of the above kind should not be added.
Apart from the measures discussed in the preceding paper, we may briefly mention different strategies for the control of the problem that have been suggested. 

- Locating alternative sources of safe water. Deep wells/bore wells (unlike shallow wells) may provide safe water even in endemic areas. Teotia showed in a village in Uttar Pradesh that the fluoride content in one well 30 feet deep was 8 ppm while it was 0.8 ppm in another well only two feet away but 60 feet deep (IDRC sponsored programme on fluorosis in India). Geological crusts having well-defined strata of minerals, do provide zones which yield water with relatively low fluoride levels even in endemic areas.

- Bringing in water from a distance (the reference to the use of water in Nagarjunasagar dam now being used for irrigation for drinking as well, mooted in the preceding paper is important).

- Defluoridation. Bulusu of the National Environmental Engineering Research Institute, Nagpur, has developed a relatively inexpensive defluoridation technique — the Nalgonda technique, which is worth exploring. The technique involves addition of the following chemicals in sequence — an alkali, chlorine and aluminium sulphate/aluminium chloride or a combination of both. The addition of these chemicals leads to flocculation and sedimentation. The dose of chemicals required would depend upon the fluoride levels in water and alkalinity.

Researches on defluoridation techniques have, however, shown that no single technique is effective for all waters polluted with fluoride. Appropriate modifications need to be introduced to suit local situations.

- Domestic defluoridation. Ram Mohan Rao of the Institute of Preventive Medicine, Hyderabad, has standardised a technique for this purpose, which may merit further examination.

- Prevention of industrial fluorosis by rigorous enforcement of procedures for minimising industrial fluoride pollution.

The point that is being emphasised here is that, in spite of the scant attention that this important subject has so far received, scientists have already developed different strategies for the control of the problem. What is now needed is the political will to explore these strategies for large-scale application and to use such of them as are appropriate for different locations.

Providing defluoridated water is the only way by which the generation yet to be born can be totally protected against the disease. Unfortunately, for those already afflicted, complete reversal of pathological changes and clinical manifestations will not be possible; in these cases, we may at best hope that the disease does not get worse. It is for this reason that we must do everything possible — and there is a great deal that is possible — to prevent the disease.

It is now high time that the problem of fluorosis is recognised as a major health problem of the country and better attention is focussed on further encouragement of research in this area and on the practical application of the results of such research for the prevention of a disease which has now acquired the dimensions of a major health problem.

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REVIEWS AND COMMENTS

Recent developments in the country must bring some cheer to those who have been campaigning for positive action for the betterment of the nutritional status of the poor.

- Thus, the magnitude and implications of the problem of goitre and other disabilities related to iodine deficiency, and the failure of the National Goitre Control Programme thus far have, at long last, been officially recognised. The National Goitre Control Programme, which was in a state of suspended animation for over two decades, is now showing some stirrings of life. Steps to clear bottlenecks in the production of iodised salt have been initiated. The Governments of Madhya Pradesh and Himachal Pradesh are reported to have instituted action to enforce distribution of iodised salt in their respective states. However, we hope that all this is no "temporary awakening" and that the Goitre Control Programme will not lapse once again into slumber.

- There have also been some favourable, though less striking, developments regarding the lathyrism problem. We understand that the ban on the cultivation of lathyrus sativus in Uttar Pradesh stands. Madhya Pradesh has recently indicated its intention to enforce more vigorously than hitherto the ban on payment of wages in the form of lathyrus and also to institute steps to check increase in cultivation of lathyrus sativus and adulteration of other pulses with lathyrus. But in view of the strongly entrenched vested interests operating behind the scenes, we cannot be sure how far actual performance in the months ahead will match the promises now being made.

- The raising of the level of minimum wages for different categories of workers in the country which was recently announced, is also a welcome development. There is, no doubt, a distressing gap between what the labourer is officially supposed to get and what is actually offered to him. Even so, the recognition at the official level that the prescribed minimum wages so far in vogue needed upward revision, is a forward step.

- The decision to offer wheat and rice at subsidised prices to poor labourers employed in rural programmes in order to bring these staples closer to the economic reach of the poor families is yet another welcome step. We wish to believe that this decision has been taken after deep deliberation and full consideration of its economic implications and that it will, in fact, be sincerely and genuinely implemented.

- The official approval to the National Code for Protection and Promotion of Breast-Feeding — which had been long in coming — has at last been announced. The formulation of the Code, by itself, is no cause for jubilation and will not solve all practical problems in breast-feeding. The promotion of breast-feeding calls for much more than the mere regulation of the marketing and sale of commercial infant foods. Supportive action towards improvement of the nutritional status of nursing mothers, ensuring facilities for breast-feeding for working women, and education regarding appropriate supplementation of breast-milk will be necessary. The code as such is very weak with regard to the spelling out of such supportive action.

The above developments, by themselves, do no more than touch the fringe of our massive problems of poverty and undernutrition. Even so, it is heartening that the nutrition problem is now getting increasing hearing and attention at the highest echelons of our Government.