Meetings

Fluoride Research

The first meeting of the International Society for Fluoride Research was held in Frankfort-on-Main, Germany, 23–25 October 1967. The conference was attended by researchers from 13 countries. Thirty-two papers dealing with dental, skeletal, cytological, diagnostic, analytical, and related factors bearing on fluoride research were presented.

G. N. Jenkins (King's College, Newcastle) discussed various mechanisms that might explain the anticariogenic effect of fluoride. From the available data, he concluded that a fluoride-induced reduction in the solubility of surface enamel apatite is the most likely explanation. A fluoride-induced alteration in the conformation of the tooth is less likely. Recent studies with the fluoride electrode indicate that the concentration of ionic fluoride in dental plaque is insufficient to act as a bactericide. L. Rosengren (University of Göteberg) presented data indicating that fluoride can inhibit streptococcus-induced osteolysis of alveolar bone in dental infections of pulpal origin. He also considered factors that might enhance the dental benefit conferred by fluoride. Of the various trace-metals studied, only molybdenum gave results superior to those obtained with fluoride alone; manganese, selenium, and vanadium were ineffective.

Lucille Hac (Northwestern University, Illinois) discussed the interrelation of fluoride with calcium, phosphorus, citrate, alkaline phosphatase, parathyroid hormone, and vitamin D, in terms of bone and serum manifestations in rats. Fluoride did not alter the effect of either parathyroid hormone or vitamin D, with respect to serum components. However, at the bone site, the combined administration of fluoride and parathyroid hormone caused a 20 percent decrease in bone citrate. The combined administering of fluoride and vitamin D caused a 35 percent decrease.

M. Soriano (University of Barcelona) described confirmed cases of skeletal fluorosis in chronic alcoholics who ingested from 2 to 3 liters of low-grade wine per day. These wines contain from 15 to 75 parts per million (ppm) of fluoride, added to arrest the fermentation process. Skeletal manifestations of the fluoride intoxication are severe, and it is possible that chronic ingestion of alcohol may aggravate the fluorosis. Onset of toxicity follows successive phases, that is, osteosclerosis, followed by osteoporosis. Then osteophytosis in which periosteal hypermineralization becomes invasive, affecting the ligaments, interosseous membrane, tendons, and the sites of muscle attachment to bone. Readily observable bone cysts develop, especially in the articular regions of the extremities. These cysts resemble bone tumors, and the skeletal condition can be likened to periostitis deformans. In the advanced stages of the affliction, articular blockage can result in complete invalidism.

S. S. Jolly (Medical College, Patiala, India) described a survey of crippling fluorosis involving spinal-cord paraplegia, and endemic to the Punjab region. Although the incidence of this affliction tends to increase with increasing fluoride concentration in the local drinking water, this trend is not consistent. Two villages, with 3.3 ppm of fluoride in their drinking water, have a markedly different incidence of crippling fluorosis, that is, 10 percent as against 46 percent. In the less toxic water, the total hardness, calcium, magnesium, alkalinity, and chloride levels are about four times higher than those in the more toxic water. Some of these nonfluoric constituents of water may protect against the toxic effect of the ingested fluoride. No other local factor has, to date, offered an alternate explanation. A similar conclusion was presented by A. Pinet (Antiquaille Hospital, Lyon, France) who studied noncrippling osteosclerosis in the Sahara and found that, although the drinking waters all contained between 1.5 and 4.0 ppm of fluoride, they could be classed as "toxic" or "nontoxic" according to the nonfluoric composition of the water. Thus, the "nontoxic" waters were higher in ratio of magnesium to calcium and in alkalinity, but lower in sulfate than their "toxic" counterparts. The diagnosis of skeletal fluorosis was confirmed by iliac-crest biopsies. It was established that drinking water was the only significant source of ingested fluoride.

J. L. Flatla (Veterinary College, Oslo) conducted a 6-year study of sheep fed daily 2.0 milligrams of fluoride per kilogram of body weight. He compared the effect of aluminum lactate and aluminum sulfate in alleviating symptoms of fluorosis. Aluminum lactate was the superior alleviator; the optimum daily dose of 24 milligrams per kilogram reduced skeletal fluoride storage by 50 percent. Higher levels of aluminum lactate impaired growth.

R. J. Berry (Oxford) reviewed the studies on fluoride-induced damage to mammalian cells. Emphasis was placed on the interpretation of the cytological data, obtained with clonal growth. At very low levels of fluoride in a culture medium, a greater than 100 percent survival (regarding controls) may indicate some cell damage. The high recovery could be a consequence of viable cells feeding on the reproductively inert cells, thus stimulating the growth pattern to an efficiency greater than that of controls. With HeLa cells, this phenomenon occurred with fluoride concentrations of 0.045 and 0.450 ppm. Only above 4.5 ppm of fluoride was there a significant relative decrease in the number of macroscopic colonies grown, in comparison with controls. However, there is an adaptive process by which surviving cells are less sensitive to fluoride, and studies with renal epithelial cells (that is, cells obtained from a tissue where fluoride tends to accumulate in the mammalian organism) would determine whether the efficiency of this adaptive process is such as to induce complacency or concern.

A hitherto unreported skin lesion was described by three Italian research groups—Flarer (Padua), Steinegger (Bolzano), and Vivoli (Trento). The lesions occur mostly in women and children who live in close proximity to factories emitting fluorides. The lesions are 1 to 2 centimeters in diameter, brown or bluish in color, last about 5

days, and then return elsewhere on the skin. They affect mostly the extremities and the lumbosacral region. The lesions disappeared when patients were removed from the industrial region, but reappeared after reexposure. A similar epidermal lesion was induced in rabbits fed forage grown in the industrial regions where livestock is afflicted with fluorosis. Thus, the lesions may serve as an important diagnostic criterion in subjects exposed to industrial fluoric emission.

A Czech group from Bratislava's Research Institute of Hygiene (Balazova, Lezovic, and Macuch) presented a series of papers on the monitoring of fluoric pollution and ingestion in industrial regions. Air concentrations as high as 1.13 milligrams of fluoride per cubic meter were recorded; close to the factory the fluoric distribution was 61 percent solid and 39 percent gaseous. Farther away, the distribution was 15 percent solid and 85 percent gaseous. In afflicted areas, fallout of fluoride-bearing particles was 7337 kilograms of fluoride per square kilometer; that is, a 90-fold increase over the 82 kilograms per square kilometer found in a control area. Surface waters, at a 10-kilometer distance from the factory, contained 10.9 milligrams of fluoride per liter. Within a 5-kilometer distance tree leaves were necrosed, had a decreased chlorophyl content, and the amount of fluoride was 7 to 72 times more than that normally found. Vegetables and fruit were disfigured in shape and color, and contained from 5 to 21 times more fluoride than did control samples. All bee colonies had died, and 95 percent of the cattle were afflicted with fluorosis; this condition was confirmed by fluoride analysis in several tissues. In comparison with a control group, local children had a decreased hemoglobin and increased erythrocyte level, with two to three times more fluoride in their teeth, fingernails, hair, and urine. The children's daily intake of fluoride was estimated to be 2.15 milligrams per day, of which 1.40 milligrams was obtained from food, 0.55 milligram from air, and 0.20 milligram from drinking water (deep well; low fluoride content). In the control area total daily intake of fluoride was 1.0 milligram of which 0.8 milligram was ingested with food. The fluoric intake in the industrial area was therefore more than twice that found in the control region.

The papers were presented in English, French, and German, with subsequent translation to insure a maximum degree of intercommunication and participation in the discussion periods. The delegates were unanimous in recommending (i) continued research into all aspects of the topic, (ii) that a second meeting be held, either in London or Rome, and (iii) that the proceedings of the current conference be published as soon as possible.

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Low-Temperature Physics

Fluctuations in superconductors were discussed at a seminar on low-temperature physics in Tokyo, 20 to 24 November 1967, under the joint sponsorship of the National Science Foundation and the Japan Society for Promotion of Science. Talks on the nature of the phase transition in helium and magnetic phenomena related to the Kondo effect were included.

Fluctuations are very important in determining the behavior of a condensing system in the immediate vicinity of the transition temperature (Y. B. Kim, Bell Telephone Laboratories). In pure bulk superconductors, the critical region over which fluctuations play an important role is unobservably minute. However, if the superconducting region is reduced to a microsize (as it is in microbridges, junctions, constrictions, and others), the fluctuations do give rise to an observable effect.

The fact that most of the interesting superconducting phenomena involve large supercurrents flowing in the system sets the superconductivity apart from other phase-transition phenomena. Since the supercurrent is proportional to the gradient of the phase of the order parameter, phase fluctuations play a dominant role in the critical region of superconductors.

Quantum fluctuations provide a means for the decay of persistent currents in superconductors. W. A. Little (Stanford University) argued that the necessary condition for d-c resistive behavior in a superconductor was the fluctuation of the order parameter to zero amplitude, and, therefore, the fluctuations of the phase alone were irrelevant. R. D. Parks (Rochester University) postulated that fluctuation of the phase was sufficient to introduce resistance in a superconductor. He presented some experimental results on narrow "one-dimensional" and thin-film "two-dimensional" specimens which tended to support his basic postulate.

A lively debate among the U.S. participants developed on the problem of experimentally shielding the specimen and leads from radio pickup and thermal noise—both of which would give similar experimental results to those reported.

T. Ohtsuka (Institute for Solid State Physics, Tokyo University) discussed an experiment being conducted at his institute in collaboration with Y. B. Kim of Bell Labs, in which the probability distribution for a superconducting cylinder to enter one or other of its many possible quantized states would be determined.

At the second day's session, S. Nakajima (Institute for Solid State Physics, Tokyo University) discussed fluctuations in a superconducting ring specimen containing a weak link. The height of the free-energy barrier between quantized states had been calculated as a function of the applied field.

J. Mercereau (Scientific Laboratory, Ford Motor Co.) spoke on recent work on noise measurements in superconducting junction devices. He showed how noise currents originating from thermal or extraneous sources can smooth the I-V characteristics of weakly connected junctions. He stressed the need for scrupulous attention to adequate radio-frequency screening in order to obtain meaningful intrinsic noise measurements on these devices. He also mentioned a novel device consisting of a point contact between a superconducting cat's whisker and a normal metal which exhibited superconducting behavior at temperatures well above the superconducting transition temperature of either metal of the junction.

Recent work in tunneling was discussed by T. Shigi (Osaka City University; experiment) and Y. Wada (University of Tokyo; theory). Wada compared his calculations of the isotope effect in lead and aluminum with Garland's work. The session ended with some brief comments by the various delegates on the future problems of low-temperature physics. The principal areas of interest appear to lie in (i) high-temperature superconductivity based on thin-film manipulation or on new chemical structures, (ii) very low temperatures with He^3–He^4 refrigeration, and