

In an introductory chapter the author traces the science of ophthalmology from the Babylonian period of 2,000 B.C. through the Egyptian, Greek, Arabian, and dark-age periods, to the modern era of rapid advance which began in the seventeenth century. In the succeeding chapters the anatomy, physiology, and pathology of the eye, cataract, glaucoma, and therapeutics are followed over a similar course. There are further chapters on spectacles, the ophthalmoscope, and British ophthalmology.

In spite of the large amount of information condensed into ninety-six pages, the book is readable. It is sufficiently comprehensive to provide a working knowledge of the subject for the general reader and to form a framework for those whom it may stimulate to learn more. It has the added advantage of easily fitting a pocket. A. L.
The fall is steep, so that at two hundred yards from the factory the concentration is about 15 per cent. of the mean concentration in the furnace rooms, and at one mile it is only 3 per cent.

Many analyses were made of soil samples up to seven miles from the factory, at which distance to the north-east the fluorine concentration was still over four times the control values, the prevailing wind being south-west. At some three miles to the north-west the fluorine content was at control levels. Correspondingly, the fluorine content of grass samples was highest in the north-east regions and this, of course, the main source of excessive fluoride ingested by animals grazing in pastures round the factory area.

The high fluoride deposition on (and to a high degree penetration into) the pasture lands led to severe dental lesions and bone fragility in the animals, the former being established only in animals which had access to the fluoride contaminated pastures before their permanent teeth had formed. The bone dystrophy, however, occurred even in animals coming to the pastures late in development.

The dental changes, mottling, distorsion, deformity of the incisors, and excessive wear of the cheek teeth led to selective abrasion so that the teeth developed long points and, by interlocking on opposing jaws, prevented the lateral grinding movements which are essential to the process of chewing the cud. The consequent chronic indigestion and distension of the rumen led to a form of starvation with debility and emaciation. Enormous quantities of fluorine were found in the teeth, mandibles, and ribs, the ratio to maximum normal values being fivefold on cent. The investigators take the view that fluoride absorption is not in itself the cause of the debility and loss of weight, but that these arise from the failure of successful cud chewing due to dental disease, since mature animals put on the contaminated pastures remained unaffected.

Multiple fractures of ribs, mandible and pelvis in the affected animals were recorded. The assimilation of fluorine in some peculiar way leads to weakening of bones. Some evidence from animal experiments indicates that fluorine brings about disturbances in calcium and perhaps phosphorus balance; thus, bones of pigs fed on flourined contained low calcium and high phosphorus: rats fed on flourined retained much less calcium and rather less phosphorus, and excreted far more calcium in the feces than did controls. Some evidence has also been obtained that an increased dietary calcium (0·23 per cent. raised to 0·75 per cent.) can diminish the assimilation of fluorine added to the diet: this effect is especially noticeable in the teeth and soft tissues. A fivefold increase of dietary phosphorus had no such effect when calcium was maintained constant.

Whilst a great deal has been reported on the pathological effects of fluorine in both man and animals, it is still far from clear why the fluorine becomes deposited in bones and teeth, how calcifications take place in ligaments, and what stimulates the formation of exostoses.

In Part V of the Report to the Fluorosis Committee very interesting measurements are given of the strength of bones (breaking stress, bending moment, and modulus of elasticity), taken from fluorotic and control animals. Strong evidence is given of a relation between the reduction in breaking stress and fluorine content of bone. The bending moment remains high until the bones contain very high fluorine: the breaking stress, however, falls with rise in fluorine. Since the breaking stress x bending moment/8, where 8 = smallest external diameter, it is reasonable to suppose that as the fluorine content rises there is some "compensating" increase in the transverse linear dimensions of the bone. Such an alteration of the bone would be useful in balancing the loss of strength and exostoses could, as the authors say, be regarded as a local over-activity of this process.

Although teleology is not the heresy it used to be, one should be cautious in using such terms for a process which must in the last analysis surely be chemico-physical, it being merely fortunate that the fundamental properties of bone permit a "compensation" to be established. Teeth cannot "compensate," and so the animal finds little comfort in the teleology of bone.

The team handling the clinical and radiological side of the investigation soon met the stupidity (from which none of us can claim full immunity) which is the heart-break of every mass investigator. Many refused to co-operate at all, and many of those who did co-operate dropped out as the investigation proceeded. Various subterfuges had, therefore, to be employed to make even the elementary statistics collected yield comprehensible conclusions. There could be no doubt that the workers in the less modern furnace rooms inhaled a good deal of fluorine and correspondingly had a high urinary excretion of fluorine. Some of the older men who had been exposed to high concentrations of factory fumes for many years showed gross radiological abnormalities of the accepted fluorosis type. But the authors are cautious about minor degrees of abnormality and prefer to group them as abnormal x-ray appearances and to seek correlations with them. It was then found that of the furnace workers 25 per cent., of the general factory workers 8·3 per cent., of the local residents 4 per cent., and of the local school children 4 per cent. of those exposed showed abnormalities. No case of clinical disability was found, but the investigators consider that the x-ray findings are a sufficient warning of developments likely to come. Considering, however, that they radiographed thirty-three men of ages 30 to over 50 who had been fully exposed in the furnace rooms for a mean time of twenty-four years and of whom 66·7 per cent. (misprinted twenty-three years and 33·3 per cent. in Report, Table XXXVIII) showed abnormalities but no clinical disabilities, the outlook for the other workers does not seem too gloomy.

"Within the factory there was very little evidence of organic disease of a general nature and still less of abnormal physical signs which could be attributed to occupation. The same high standard of fitness was seen also in the residents from the surrounding district."

A careful dental examination of a large number of adults and children living in the areas round the factory revealed no abnormalities among the adults and, although 5·6 per cent. of the children showed mottled teeth, this figure did not differ sufficiently from that found in other areas to make it significant. Among the workers in the factory the dental findings did not suggest any effects of fluorine.

There is some feeling of anticlimax in this Report, a happy anticlimax in that the serious disabilities which could reasonably have been expected among the workers were not, in fact, found. The authors' conclusions are not, however, more easily to be dismissed, people to keep themselves and their animals away from the contamination and to recommend the factory management to reduce the amount of fluorine to which their workers are exposed.

An uncritical review of the literature and a description of the analytical method for the determination of small quantities of fluorine are appended to the Report.

M. W. Goldblatt.