tion than some enthusiastic nutritionists have shown of the role of malnutrition as a causative agent in such physical disability is called for until more objective evidence upon which to base their claims is forthcoming.

An indication of the types of relationships which may ultimately direct us to such evidence is seen in the paper of Ciocco, Klein, and Palmer (Pub. Health Reports 66, 2365 (1941)). This paper compares the physical status of selectees who were accepted for military service and those who were not accepted because of physical or mental defects with the records of the physical status of the same youths some fifteen years previously. The earlier school examinations had been made in the white schools of Hagerstown, Maryland, by the United States Public Health Service. The findings indicate that underweight, poor nutritional status, the number of filled, missing, or carious teeth, and bad posture were much more frequent among children who fifteen years later were rejected for military service than among the children who as youths were accepted for military duty. Thus, of the 132 children who at the time of the school examination, were judged as having good posture, 60.5 per cent were fifteen years later placed in Class 1-A. By contrast, of the 168 selectees who had been judged as children as exhibiting fair or poor posture only 38.3 per cent were placed in Class 1-A. The authors conclude in part that “the results of the present study suggest also that growth as measured by weight, posture, and the physician’s estimate of the state of nutrition—all traits that are frequently examined to determine the health status of the child—are useful as crude predictive indexes of adult physical development.” These correlations are of particular significance because of the tendency in recent years to discount the value of weight measurements, gross clinical evaluation of “nutritional state,” and evaluation of posture in favor of newer diagnostic procedures.

The great variety of environmental and constitutional factors which contribute to the attributes here discussed prevents one from assigning a predominate role to any single factor such as diet. For example, it was found that the rejected group had a smaller percentage of their carious teeth filled in childhood than did that group which later met Selective Service physical standards. This indicates that the better group had more adequate dental care at the time of the examination. It would be logical to attribute the adult state of the teeth largely to this factor. Such correlations as Ciocco et al. have obtained do not necessarily signify causation; but they do indicate the direction toward which further explorations might profitably be guided in efforts to seek out relationships between dietary habits and immediate and future nutritional status.

MASS CONTROL OF DENTAL CARIES

One of the most interesting studies to be undertaken in the field of public health is the attempt to control dental caries (decay) in certain communities by the addition of fluorides to public supplies of drinking water. One study area for such a project is the city of Newburgh, New York. It is proposed to add sodium fluoride to the Newburgh water supply in sufficient quantities to bring its fluorine content to a concentration just below 1 p.p.m. The nearby city of Kingston, in which the water supply is nearly fluorine free, is to be the control area for this study. There can be no argument as to the need of improving dental health. Dental decay has been termed the most prevalent disease of civilized man. Few individuals escape its attack and usually not one but many teeth are affected. Control of dental caries through reparative measures appears to be
an impossible task. Dental enamel once injured is incapable of self repair, and carious defects tend to accumulate at a rapid rate. American dental practitioners, now numbering approximately 70,000, spend the major portion of their time in repairing damages attributable directly or indirectly to dental caries, yet a majority of the people receive either no dental service at all or merely extractions. The chief hope of solving the dental problem of the population as a whole lies in drastically reducing the incidence and extent of tooth decay. Fluorination of drinking water may offer a unique opportunity for progress in this direction.

The attempt at local mass control of dental caries by this method has a firm foundation in scientific fact. In the past decade, convincing data have been secured from epidemiologic surveys, from chemical studies, and from experiments with animals to attest to the importance of fluorine in dental health. It has been shown that the incidence of dental decay varies inversely with the concentration of fluorine in the water supply; that the enamel of sound teeth has a higher fluorine content than the enamel of carious teeth; and that under special circumstances induced caries in rats may be prevented to a significant degree by additions of sodium fluoride or calcium fluoride to the animals' food or water.

Two important points have been brought out by epidemiologic studies; first, that it is almost certainly the fluorine in domestic waters which accounts for the low incidence of dental caries in certain localities and, second, that certain levels of fluorine, which are too low to cause disfiguring mottled enamel, appear to be capable of reducing the amount of dental decay. It has long been known that despite their defective structure, teeth with mottling of the enamel are less susceptible to decay than teeth not so affected. The discovery, in 1931, that fluorine is the causative factor of mottled enamel gave impetus to the study of this agent in the prevention of dental caries.

In 1938, Dean (Pub. Health Reports 53, 1443 (1938)) presented data indicating a comparatively high percentage of caries-free children in communities with a high concentration of fluorine in the drinking water and noted that the relative freedom from caries was present whether or not the teeth showed macroscopic evidence of mottled enamel. Later studies (Nutrition Reviews 1, 182 (1943)) showed that there is an inverse relationship between the prevalence of dental caries and the fluoride content of the water supply but that there is no correlation between the caries experience rate and such factors as hours of sunshine, the economic level of the community, or the hardness of the drinking water. They showed, also, that low dental caries is associated with the continuous use of domestic water whose fluorine content is as low as about 1 p.p.m. This concentration under the conditions prevailing in the localities studied produces only sporadic instances of the mildest forms of dental fluorosis, of no esthetic significance.

After consideration of the various aspects of the problem, Arnold (J. Am. Dental Assn. 30, 499 (1943)) proposed the controlled addition of fluorides to public water supplies in selected communities. He says: "The results of epidemiologic, chemical and experimental studies suggest that the addition of small amounts of fluorine, not to exceed 1 part per million, to fluoride-free public water supplies may be a practical and efficient method of markedly inhibiting dental caries in large group populations." From epidemiologic studies, Arnold calculated that the following benefits might be expected in children born after the change in the fluoride content of the drinking water: (1) about six times as many children showing no dental caries experience (caries free); (2) about a 60 per cent lower dental caries experience rate; (3) about a 75 per cent decrease in the first permanent molar loss; and (4) approximately 95 per cent less caries in the proximal surfaces of the four upper...
incisors. Arnold considered carefully two objections which might be raised to the addition of fluorides to public water supplies, namely the danger of cumulative systemic toxic effects, and the danger of dental fluorosis (mottled enamel). He feels that the danger of cumulative toxic effects is rather remote since in some areas in the United States people have been using water with six to eight times the proposed concentration of fluorine for as long as forty years with no reported pathologic effects, other than on the teeth. In regard to dental fluorosis, Arnold pointed out that in communities using a water supply which contains about 1 p.p.m. of fluorine the mottled enamel encountered is of a mild variety. In one such community (Aurora, Ill.), of 16,448 permanent teeth examined, only 57 incisor teeth were diagnosed as positive. For no tooth was there a diagnosis of “moderate” (brown stain) or “severe” (pitting) fluorosis. The mild fluorosis occasionally encountered was in no way disfiguring.

Two reports are of interest in providing data which suggest that continued intakes of fluorine up to 5 or 6 p.p.m. in drinking water are not harmful. McClure (Pub. Health Reports 59, 1543 (1944)) studied the relation between fluorine ingestion (from drinking waters) and the height, body weight, and bone fracture experience of selected groups of 1458 high school boys and 2529 young adult men taking the physical examination at induction centers. The subjects were from areas in which the water borne fluorine content ranged from 0.0 to 6.0 p.p.m. No relation was found between fluoride intake and incidence of bone fractures nor was there any relation between height-weight figures and fluoride intake.

In the second report McClure and Kinser (Pub. Health Reports 59, 1575 (1944)) studied the relation between the concentration of fluorine in the water supply and that in the urine of subjects drinking the water. Fluorine analyses were done on urine samples from over 1900 men and boys from areas in which the drinking water varied from 0.0 to 5.8 p.p.m. fluorine. These studies show that where domestic waters are free of fluorine, the urinary fluorine content is low, 0.3 to 0.5 p.p.m. When the domestic waters contain as little as 0.5 p.p.m., detectable increases in urinary fluorine are observed, and further increase in the fluorine content of the waters produces proportional increases in urinary fluorine. These results show a remarkable ability of the body to handle water borne fluorides in the concentrations encountered in these studies, which concentrations are considerably higher than required to give protection from caries. They also indicate that the food fluorine intake is rather constant regardless of the locality, and amounts to about 0.3 to 0.5 mg. daily. It would appear, therefore, that with respect to fluorine the water borne fluorides are of first importance in maintenance of dental health.

It has been suggested that a number of communities add fluoride to their water supplies under controlled conditions. The Newburgh-Kingston demonstration appears to be thoughtfully planned and is to be carefully controlled. Newburgh, a city of approximately 30,000 population, located on the Hudson River, already has about 0.12 p.p.m. of fluorine in its domestic water. Approximately 0.8 p.p.m. is to be added in the form of sodium fluoride. Kingston, a city of similar size with comparable water supply, population group, climatic conditions, economic status, and source of common food supply, is to serve as the control area. The city water of Kingston is now, and is to remain, essentially fluorine free. All 5 to 14 year old children in the schools of Newburgh and Kingston are to have dental examinations annually. A representative group of children in the study area will have complete physical examinations periodically. Physical examinations at regular intervals will also be made on a group of adults.

We must distinguish carefully between
controlled studies of this type and the indiscriminate addition of fluorides to all domestic waters of low fluorine content. It is certain that conservative opinion would condemn the general fluorination of drinking water at this time. After considering the benefits which might result from fluorination of water supplies, Dean (J. Am. Water Works Assn. 35, 1161 (1943)) cautions: “Much investigative work, however, is necessary before serious thought can be given to a recommendation for its general application. To determine the safety threshold with regard to possible effects other than on the teeth, carefully controlled studies must be made of populations who have used fluoride waters of relatively high concentration over a number of years.”

As these momentous studies in the Newburgh-Kingston and other areas get under way we should not lose sight of the fact that there are most certainly factors other than the ingestion of proper amounts of fluorides which are important to dental health even though we cannot as yet identify them with certainty. It seems that the influence of the nature of the carbohydrate and a number of other factors in the diet (e.g. protein quality, calcium, and vitamins A, C, and D) might well be reinvestigated under carefully controlled or known conditions of fluorine intake.

THE AMINO ACIDS OF HUMAN MILK

The relative value of human and cow’s milk for infant feeding is a matter of perennial interest. A paper by Williamson (J. Biol. Chem. 156, 47 (1944)) is of importance in this connection as it adds to our knowledge of the amino acids contained in the proteins of human milk. Previous work by Plimmer and Lowndes (Biochem. J. 31, 1751 (1937)); Compt. rend. trav. lab. Carlsberg 22, 434 (1938) (see also Chem. Abstr. 32, 7960 (1938)), Beach and co-workers (J. Biol. Chem. 139, 57 (1941)), and by Beach, Bernstein, and Macy (J. Pediatrics 19, 190 (1941)) on human casein and lactalbumin had placed on record figures for the percentages of seven of the amino acids in these proteins. These included only five of the ten amino acids recognized as essential by Rose (Science 86, 298 (1937)), namely tryptophane, methionine, lysine, histidine, and arginine. In addition values for cystine and tyrosine were reported by both groups of workers.

Williamson collected and pooled specimens of human milk, keeping them frozen until a sufficient amount was on hand for analysis. From 5 gallons of the composite human skim milk the casein and lactalbumin were separated. They were analyzed for moisture and for ash content, and all amino acid analyses were calculated on a moisture-free, ash-free basis. For purposes of comparison the casein and lactalbumin of cow’s milk were also prepared by similar methods. Each of the four proteins was then analyzed for each of eighteen amino acids, including all ten of the essential amino acids. The remaining amino acids determined were cystine, serine, aspartic and glutamic acids, proline, glycine, alanine, and tyrosine.

From the data on the human casein and lactalbumin Williamson has calculated the amount of each of the amino acids in human milk on the basis of average figures for its protein content—0.5 per cent casein and 1.0 per cent lactalbumin. The figures vary from no glycine at all to 228 mg. per cent isoleucine and 230 mg. per cent glutamic acid in the human milk. They were compared with the similarly calculated figures for cow’s milk diluted 1:1 with water, a solution containing 1.4 per cent casein and 0.25 per cent lactalbumin, because this is the dilution of cow’s milk which is most commonly employed in infant feeding. The comparison