

**The Role of Some Nutritional Elements in the
Health of the Teeth and their
Supporting Structures***

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In the November 1957 issue of "Science,"¹ Dr. Theodor Rosebury, professor of Bacteriology at the School of Dentistry, Washington University, St. Louis, Missouri, writes a tribute to Dr. William J. Gies entitled, "A Challenge to Dentistry." Dr. Gies made a survey of dental education in the United States and Canada for the Carnegie Foundation For The Advancement Of Teaching. It was published in 1926 as "Bulletin Number Nineteen",² and it is considered a landmark in dental education. He asked, among other things, for a greater cooperation in medical-dental relations and the development of research-mindedness among dental teachers as a group. In many parts of his study he compared dentistry with medicine. However, the present understanding of basic cellular physiology of all tissues makes it as inappropriate to compare dentistry with medicine as it would be to compare ophthalmology, obstetrics, dermatology, or psychiatry with medicine. Teeth are living physiologic entities like all other tissues of the body and are affected by variation in physiologic chemistry. Consequently, medical and dental cooperation is imperative for research in dental disease.

The association of dental caries and general health is discussed by Dr. Ernest A. Hooton, professor of Anthropology at Harvard University. In his book, "Apes, Men and Morons,"³ he comments as follows:

"I firmly believe that the health of humanity is at stake, and that unless steps are taken to discover preventives of tooth infections and correctives of dental deformation, the course of human evolution will lead downward to extinction. The facts that we must face are, in brief, that human teeth and the human mouth have become, possibly under the influence of civilization, the foci of infections that undermine the entire bodily *health of the species* and that degenerative tendencies in evolution have manifested themselves in modern man to such an extent that our jaws are too small for the teeth which they are supposed to accommodate, and that, as a consequence, these teeth erupt so irregularly that their fundamental efficiency is often entirely or nearly destroyed."

Dr. Hooton points out the strategic position of dentistry in this situation:

"In my opinion there is one and only one course of action which will check the increase of *dental disease and degeneration* which may ultimately cause the extinction of the human species. This is to elevate the dental profession to a plane on which it can command the services of our best research minds to study the cause and seek for the cure of these dental evils. The dental practitioner should equip himself to become the agent of an intelligent control of human evolution, in so far as it is affected by diet. Let us go to the ignorant savage, consider his ways of eating, and be wise. Let us cease pretending that tooth brushes and toothpaste are any more important than shoe brushes and

* Presented at the Medico-dental meeting, New York Academy of Dentistry, February 13, 1958.

shoe polish. It is store food which has given us store teeth.”

Proof that dental caries and pyorrhea may be caused and controlled by the physiologic chemistry of the diet has been produced by both a dentist and a physician. The dentist, Dr. Weston A. Price, travelled around the world gathering data on the dental health of many tribes and peoples. In his book, “Nutrition and Physical Degeneration,”⁴ Dr. Price tells the stories of deterioration of dental health when tribal people changed from a raw-material diet to one of processed foods of civilization.

The physician, Dr. Francis M. Pottenger, Jr., performed a 10 year experiment on the effects of cooked food fed to cats. The remarkable deterioration of the dental structures, as well as the general debilitation of the animals, is recorded in his paper entitled, “The Effects of Heat Processed Foods and Metabolized Vitamin D Milk on Dento-Facial Structure of Experimental Animals.”⁵ Many others have contributed equally convincing material to prove the association of dental disease and nutrition, but illustrations from Dr. Price and Dr. Pottenger, Jr. will satisfy our present need.

The primary quest of Dr. Price was to find the cause of tooth decay. This was established quite readily as being controlled directly by nutrition. In primitive people with strong and well developed teeth and dental arches, the adoption of processed foods quickly led to tooth decay and pyorrhea. In subsequent generations, even the first generation after adoption of the modernized diet, the children displayed a chain of developmental disturbances that looked exactly like the expressions of degenerative disease of our modern civilization in Europe and America.

The most striking characteristic was a narrowing of the face and the dental arch, with insufficient space for the teeth in proper alignment. Teeth erupted at various angles and positions, giving need for the art of orthodontia in the space of one generation. Of greatest importance, however, was the fact that after giving birth to children with defective teeth and dental arches while on the modernized diet, a return to the primitive diet allowed the same mother to produce children with good teeth and well formed arches. This is important, because it shows that the condition is due to environmental growth of the egg cell—not its heredity. This finding gives hope that the proper nourishment of our prospective mothers will lead to future generations with good dental arches and good teeth again. Our problem is to try to find those dietary elements which are most important to the health of the mother and her unborn child.

Sometimes it is difficult to obtain direct evidence for the solution of a problem, but by amassing and correlating evidence associated with it, one can often deduce valuable information that may be used for the solution of the problem at hand. This line of inquiry is the only one available in the study of atomic structure. The actual atoms are not visible, nor can they be handled directly, yet tremendous masses of information have been developed. From these data models of extremely intricate atomic structures are built with great spatial accuracy. From the basic elements of the Periodic Table, amino acids are synthesized and these amino acids are placed in proper position in complicated chains and twisted configurations to duplicate biologically produced hormones such as insulin, thyroxin and pituitrin. By the genius of correlated intuitive deduction, much valuable work has been accomplished. The same kind of reasoning and deduction is leading to the solution of the structure of the atomic nucleus and the ultimate understanding of the electro-chemical nature of matter and the universe. Using this associative and correlative thinking, Dr. Price was led to some striking conclusions.

In his quest for information leading to the cause of dental caries, he studied many primitive races all over the world. At the edge of civilization, where primitive man comes in contact with modernized diet, he watched the beginnings of physical degeneration and noted the associated defects, along with the development of tooth decay. He was greatly impressed by the general lack of resistance to infectious diseases such as tuberculosis, boils, and sinus diseases. More important, he was impressed with the difficulty of procreation: first, difficult labor; later, difficulty of becoming pregnant, and, still later, difficulty with nursing the newborn child. Just as the teeth and dental arches of the child showed deterioration, so the general skeleton became less rugged and husky and the bones more fragile. There was a change of disposition and a lowering of normal mental efficiency and acuteness, chiefly observed as mental backwardness. A certain percentage of these children with personality disturbances developed expressions of unsocial traits. They include children whom we call in our modern society "juvenile delinquents." We try to account for this juvenile delinquency largely on a basis of some conditioning experience that has developed after the child has reached an impressionable age. Dr. Price's investigations indicate that the deterioration of the physical structure of the brain, as well as the body, starting before the child is born, is more responsible for the juvenile delinquency than the conditioning influences of the environment.

Considering the marked immaturity, emotional and mental disturbances of children as by-products of the underlying cause of dental caries, the importance of discovering the cause of the basic physiologic defect becomes imperative.

Palliating the developing carious teeth by the fine arts of Dentistry with fillings, inlays, bridges, plates, and orthodontic appliances, together with mass medication of fluoride, tooth brushes and toothpastes, offers a poor solution to a tremendous problem—the problem of an acquired intrauterine developmental change, which often looks like an hereditary defect and which threatens the very foundations of our civilization.

An analysis of foods of primitive people, who had good physiques, excellent teeth and dental arches, shows the presence always of high-quality, fresh dairy products, fish, fish eggs, fish oils, and sea kelp. Primitives such as the Indians of the High Andes were willing to go hundreds of miles to the sea to get these foods for the use of their people, especially prospective mothers. In their primitive knowledge of medicine, they knew that sea kelp prevented the goiter that occurred so frequently in the white race. They knew that repeated pregnancy and lactation caused goiter; also, that adolescent girls⁶ developed goiter more frequently than boys (3 to 1). Both groups were protected from goiter with primitive foods. They carefully preserved the embryo of the germ of their cereals, and they made large use of the organs of the animals they killed for food and had less interest in the muscle meats. In some Indian tribes the prize of the kill was the adrenal gland, from which now is obtained one of the great chemical developments of our present medical era—Cortisone.

Dr. Price's investigations attempted to discover those elements which were necessary for a diet adequately balanced to contribute directly to the health of the teeth and their supporting structures.

Dr. Francis Pottenger, on the other hand, performed an experiment on cats, in which he showed that heating an adequate diet led to a deficiency pattern that practically paralleled the findings of Dr. Price when his primitive people ate a modernized diet. Dr. Pottenger's experiment ran for 10 years, during which time approximately 900 cats were studied, and on 600 of which were complete records. Control animals were fed a diet of two-thirds raw meat, one-third raw

milk, and cod liver oil. These cats reproduced in normal manner from one generation to the next. Abortion was uncommon and the mother cats nursed their young in a normal manner. All these cats had good resistance to infection, parasites and vermin. They possessed excellent equilibrium, had pleasant and normal dispositions, and were handled easily.

The second group of cats received the same diet, except that the meat was cooked. These cats reproduced a heterogeneous strain of kittens, each kitten of the litter being of a different skeletal pattern. Abortion was common, about 25 per cent in the first generation, and about 70 per cent in the second generation. Delivery in general was difficult, many cats dying in labor. The mortality rate in the kittens was high, frequently due to failure of the mothers to lactate. The kittens were often too frail to nurse. At times the mother cats would steadily decline in health following the birth of the kittens, dying from some obscure tissue exhaustion about three months after delivery. Others showed increasing difficulty with subsequent pregnancies, some failing to become pregnant.

The cats fed cooked meat were irritable. The females were dangerous to handle, occasionally biting their keepers. The males were more docile, often to the point of being unaggressive. Sex instinct was slight, or perverted. Vermin and intestinal parasites abounded. Skin lesions and allergies were frequent, becoming progressively worse from one generation to the next. Pneumonia and empyema were among the principal causes of death among the adult cats. Diarrhea, followed by pneumonia, took a heavy toll of the kittens. Osteomyelitis was also both common and often fatal. Cardiac lesions, some recognized clinically, were frequent. Hyperopia and myopia, thyroid disease, nephritis, hepatitis, orchitis, oophoritis, paralysis, meningitis, cystitis, arthritis, and many other degenerative lesions familiar in human medicine were observed.

Of the cats maintained entirely on the cooked-meat diet, with raw milk, the kittens of the third generation were so degenerated that none of them survived the sixth month of life, thereby terminating the strain.

A normal female on cooked meat and raw milk for six months before and during her pregnancy produced a litter of four kittens, three of which were born dead, and the living one was extremely inactive. As in the case of Dr. Price's primitives, the young were born with narrow dental arches, disproportioned head with retraction of the mandible, and skeletal deformities.

In a second experiment, the cats were fed pasteurized milk as their principal item of diet, and raw meat as a supplement. These animals showed a lessened reproductive efficiency in the female and some skeletal changes, while the kittens presented deficiencies in development. Cats fed evaporated milk showed more damage. The most marked deficiencies showed in the cats fed sweetened condensed milk.

Normal adult cats placed on a cooked-meat diet began to show unhealthy conditions in the mouth within three to six months. A pregnant cat will show the change more quickly. These cats first presented gingivitis, then diminished calcium, paradentosis, abscesses, and, finally, some shedding of the teeth. Caries did not develop in the cats fed on any of these diets.

Thus remarkably demonstrated is an adequate diet of raw meat or raw milk, alone or in combination, *affected by heat alone*, producing a pattern of complete tissue and skeletal degeneration. Modern civilized diet, after much processing, modification, staleness, and complete cooking, produces children with rampant dental caries, skeletal defects, allergies and fatigue, along with the emotional and nervous changes seen in the experimental animals. Children, like the cats, are

damaged structurally in all tissues before they are born, and afterwards are made worse by processed-milk formulas supposedly made to simulate mothers' milk. Milk is more than food. It is a source of hormone stimulation to growth and development that proceeded from the placenta in intrauterine life and is transferred to the breast.

A third piece of positive evidence concerning both structure and bone healing is obtained from a paper by Dr. Lewis B. Barnett, entitled, "New Concepts in Bone Healing." Dr. Barnett practiced orthopedics for six years in the area of Deaf Smith County, Texas, from which area the principal interest in fluoridation of water developed.

For several years prior to 1940, it had been noted by local dentists that people living in Deaf Smith County had a very low incidence of dental decay. At his own suggestion, Dr. Edward Taylor of the Texas State Department of Health made an extensive survey of dental conditions in that county. The results of this survey were first reported in the Journal of the American Dental Association in August of 1942.⁸ At that time the school children of Deaf Smith County revealed approximately one decayed, missing, and filled tooth per child. This was by far the lowest rate of dental decay ever reported in a civilized country. Following this report, the U. S. Public Health Service made an extensive survey on water from wells in the high plains area. From these findings it was inferred that this unusually low rate of tooth decay was due to fluoride in the drinking water. It was considered that the water of the Deaf Smith County area had the optimum fluoride concentration for good dental health. It is from this study that the American Medical Association, the American Dental Association, the U. S. Department of Health, and other similar groups, have approved the fluoridation of all drinking water in the United States.

It has been observed for many years that cattle grown in the high plains area of Deaf Smith County were larger than cattle grown in surrounding areas. It is a proven fact that a full-grown cow, six years of age, can be moved into this area and in two years will gain a minimum of 250 pounds. Most cattlemen consider the gain primarily due to an increase in size of the skeleton and an increase in weight of the bone structure. This has become an economic factor in buying cattle and moving them into the area. Extensive experimental work has been done on livestock produced in this area, including weight of skeletal structure, abortion rates in mother cows, and incidence of spontaneous fractures in herd bulls. All of these findings support the observation that livestock produced in this area are of superior physical development.

X-rays of bones of the residents of Deaf Smith County revealed the same increase in size and density of bone as seen in cattle. People 80 years of age did not show the demineralization and osteomalacia that is common in other areas. Cortices of long bones were approximately one-half greater in thickness than those of people living in other regions. In general surgical practice the common type of bone fracture in the leg is at the surgical neck of the femur. Dr. Barnett observed this type of fracture commonly in Dallas County patients, but never in Deaf Smith County residents. Bones of Dallas County residents break by demineralization, without trauma, and have great difficulty in healing. Bones of Deaf Smith County residents break only under severe trauma and heal rapidly without pins and supports, even in people 80 to 100 years old. Thus, in the same area, where resistance to dental caries was greatest, there are people with large strong bones, high mineral density, and rapid bone healing ability, even in old age. What is the reason?

The most constant food of human beings, plants, and animals is water. The large volume of publicity that has been built up around the Deaf Smith County water can best be summarized by a comparative study of that water (which source is the deep well), with the Dallas County water (which is of surface origin). The following spectographic and wet analyses show the difference in chemical content of the two waters:

Water Supply

Element	Deaf Smith County	Dallas County
Fluorine.....	1.3	—
Chlorine.....	9.7	38.0
Bromine.....	.07	.4
Iodine.....	.16	.023
Calcium.....	4.0	23.0
Magnesium.....	16.0	8.0
Potassium.....	2.0	4.5
Sodium.....	4.0	5.0
Boron.....	.06	.05
Iron.....	.04	.18
Copper.....	.002	.0006
Strontium.....	.00008	—
Nickel.....	.002	—
Vanadium.....	.007	—
Silicon.....	6.0	8.0
Aluminum.....	Trace	.14
Chromium.....	—	.0005
Manganese.....	.005	—
ML's Water.....	250	250
Residue Wt. Gm.....	0.0635	.1152

It is to be noted that calcium is nearly six times as great in the Dallas County water—whereas magnesium is twice as great, and iodine eight times as great in the Deaf Smith County water. Calcium is prescribed for bone healing, yet here is a situation where with nearly six times as much calcium bone healing is not good but by the addition of magnesium and iodine, bone healing is carried on at a high rate. The ash content of the bones of the Dallas County residents is 52 per cent—whereas for the Deaf Smith County residents it is 68 per cent or 16 per cent higher.

An analysis of the mineral content of the ash of normal bones of young males of Deaf Smith County and Dallas County shows the following: calcium, phosphorus, and sodium is about the same in both, 42 per cent calcium, 15 per cent phosphorus, and 1.5 per cent sodium. Magnesium, however, is five times as high in Deaf Smith County as Dallas County, 2.0 per cent and 0.4 per cent, respectively. No value for iodine could be given, as it volatilizes on ashing the bone. Thus magnesium accounts for most of the 16 per cent difference in bone ash and the increased density and x-ray opacity of the strong bones of Deaf Smith County residents.

Personal experience and 25 years of intensive and concentrated clinical work has produced a fund of information concerning the usefulness of vitamins, minerals, and hormones in the physiologic rebuilding of human tissue. Of particular interest has been helping young women through pregnancy and lactation, many of whom had been debilitated from previous pregnancies or miscarriages, or were sterile before treatment. Postoperative healing from both dental and general surgery is greatly enhanced by this supportive therapy. It demonstrates impressive need for increased vitamin A, vitamin 3, vitamin B₆, vitamin E, unsaturated fatty acids, magnesium, zinc, and iodine. It is impossible with a modern cooked

diet to remain healthy without supplementation of vitamins, minerals, and sometimes hormones and specific amino acids. For a woman to reproduce children without such supplementation is a crime against both society and the child.

The problem is to correlate information from these data and try to find those elements which will aid in rebuilding the bony structures around the teeth, as well as keep the teeth tight in their sockets and to supply, if possible, the elements that will prevent the decay, either by increasing their vitality or keeping under control the bacteria which attack them. Out of this mass of data and experience it is evident that iodine, magnesium and zinc, partly as magnesium iodide and zinc iodide, are some of the agents which are associated with aiding bone healing and preventing dental caries. Some illustrations of the remarkable results obtained from the use of these agents in controlling dental disease are:

The first case is that of a woman 50 years of age, whose teeth were in good repair. The lower left first molar had become painful. The tooth had a large amalgam filling which had been present for many years. The pain developed rapidly over a weekend, and the patient was unable to sleep or eat. The tooth had elongated and she was unable to close her teeth together. The patient was first seen two days after the onset of pain, at which time it was almost intolerable, and an appointment had been made to have the tooth extracted. Instead the patient was given intravenously 2 cc. Solu-B, 500 mg. ascorbic acid, and 5 cc. of 1.0 per cent solution of magnesium chloride, and was given orally 1 mg. of zinc iodide and $\frac{1}{2}$ Gm. of methionine. Within 15 minutes the pain began to subside, and two hours later the patient was able to eat, which had been impossible before. Three hours after the first treatment a second one was given, and the patient had a comfortable night and awakened without pain. The patient cancelled the appointment for extraction, and was seen by her dentist three days later, at which time he could find no evidence of previous discomfort. She was again seen by the dentist a month later, at which time the tooth was in excellent condition and had not given her any further difficulty; nor has it given any further difficulty in the subsequent two and one-half years.

The second case is that of a man 55 years of age. Over a period of six months he had experienced pain in the right lower first molar. It was extremely sensitive to touch, heat and cold, and sweet and salt. During this time the tooth was x-rayed repeatedly, and there was no evidence to account for the pain. Finally the dentist removed the filling to make certain that there was no recurrent decay. The pain persisted and became extremely aggravated. The tooth had elongated and closing the mouth was difficult. Even slight pressure on the tooth caused great discomfort. The same treatment as was given the first patient was instituted, and within 20 minutes the patient had lost most of the discomfort. He was given methionine $\frac{1}{2}$ Gm. to take one tablet each day, and zinc iodide $\frac{1}{2}$ mg. each day. He had no further difficulty. Two years have passed and the tooth is comfortable with no further dental intervention.

The third case is that of my own. The upper right wisdom tooth was removed and left the neck of the second molar exposed and sensitive. Chemical, thermal, and abrasive sensitivity became so great as to threaten loss of the tooth. Fluoride paste applications saved it for several years. Later use of zinc iodide and magnesium iodide completely controlled the sensitivity. The ingestion of sufficient sulphur amino acids, methionine and cystine, however, will cause the tooth to become sensitive again. This observation is especially important, because Chesney⁹ produced large goiters in rabbits on a high cabbage diet. They could be controlled with iodine, thus showing a relationship between the high sulphur

content of cabbage and the iodine metabolism of the thyroid. It was also noticed that the use of the magnesium iodide quickly caused a solidity of the teeth in the sockets. I had been particularly aware of how loose teeth could become in their sockets after having passed through an attack of acute scurvy some 25 years ago. Although vitamin C played a big role in making the teeth firmer in the sockets, it did not compare to the firmness that followed the addition of the magnesium iodide.

The fourth case is that of a young man, 14 years old, all of whose teeth were heavily filled and loose in their sockets. It appeared that all teeth would have to be extracted as further filling was not possible. Zinc iodide, vitamin and mineral supplements by mouth and intravenously were prescribed. The decay was completely stopped in about two months. In six months the bone structure had become so firm and solid around the teeth that the dentist agreed to continue reparative work. The lower incisors were capped and, after much deliberation, it was agreed to remove all upper teeth and all lower teeth, except the lower incisors and canines. In removing the teeth the dentist, could hardly believe how solidly the teeth were fixed in the sockets. Thirteen teeth were removed, three of them impacted wisdom teeth, under local anesthesia. An upper plate was placed immediately. The patient was given intravenous treatments of vitamin B and C, and magnesium chloride and iodine, and had no pain or swelling. He did not even require aspirin to relieve pain the first night. The most remarkable part of this case, however, is that the institution of the supportive therapy for his teeth also resulted in changing this boy from a dull, tired, inactive individual, to an alert, honor student. Also, the acne of his face, and scaly dermatitis of arms and legs had cleared completely. It is interesting to note in passing that this boy's mother lost all of her teeth one year after he was born and she has been troubled with hypothyroid goiter and painful neck and joints ever since.

Many more individual cases could be cited, but suffice it to say that patients are told constantly by their dentists that they are amazed they do not have any developing cavities, and the gums and supportive structures are in better condition than ever before after the prescribed treatment. This, of course, is in direct contradiction to what is usually the case. It is claimed¹⁰ that after 35 years of age more teeth are lost from pyorrhea than decay.

It is rather interesting that ethyl magnesium iodide, and/or ethyl zinc iodide has been a most useful tool in synthetic organic chemistry. It has been termed the "Grignard Reagent," after Victor Grignard, who developed it and who received for his work the Nobel Prize in Chemistry in 1912. Probably no other reagent has had so many applications or has resulted in the preparation of so many new compounds. If this compound is so useful in the synthesizing of organic compounds in the test tube, the physiology of the body might find some way to produce it and use it for a synthesizing agent, if magnesium iodide or zinc iodide were available.

Two cases will show the protective effect of magnesium iodide and zinc iodide against bacterial infection. The first patient was a woman, 36 years of age, who developed an abscess under her right arm just below the axilla. The area was 2 centimeters in diameter and the patient could not move the arm because of extreme pain. Within two hours after the first dose of 1 mg. of zinc iodide and $\frac{1}{2}$ Gm. methionine, the pain was relieved markedly and the patient could move her arm. Repeated medication over the course of three days caused complete resorption of the area, without it coming to a head and discharging.

The second case is that of a woman, 52 years old, who had repeated attacks

of breast abscesses over a period of eight years. The first time the abscesses appeared at the inner aspect of the nipple and were exquisitely painful for eight days without coming to a head and had to be incised. It was kept draining under the usual methods of heat applications. It drained slowly, required two months for complete healing, and left a tender indurated area which remained for six months. Two years later, at the second episode, two doses of x-ray therapy were used, but again the healing was slow, requiring two months and leaving a sensitive indurated area for six months. At the next appearance zinc iodide was used and the abscess came to a head and discharged within three days and was healed within two weeks. There was a slight induration for three more weeks. The last episode occurred about six months ago and magnesium iodide was used. Within two days the abscess came to a head, involuted, and emptied itself; it was healed within a week, with no induration or tenderness which had attended the previous healings. It was interesting to note that within five minutes after giving 60 mg. of magnesium iodide, the area around the abscess felt like it wanted to explode. This activity lasted five hours. It is hard to believe that any material could have an effect so quickly when taken by mouth.

Both zinc iodide and magnesium iodide are now being studied for facial acne and are producing remarkable results in this scourge of adolescence. The inflammatory areas come to a head quickly and many of the large moundlike masses resorb without opening. It must be said in passing, however, that usually these adolescents are in need of other elements, such as vitamin A, vitamin E, vitamin C, unsaturated fatty acids, and vitamins and minerals. These must be supplied in order to bring their general metabolism back to normal. Those who hope to use zinc iodide or magnesium iodide routinely, without proper attention to the adequate balance of other accessory food factors, are likely to have failures in the application of these materials.

There is no doubt whatever about the observations of Dr. Weston Price that certain materials in primitive man's diet gave him immunity and protection against infectious diseases, and produced strong bones, good dental arches, and good teeth. It is easy to show where these materials exist in the foods of primitive people, which Dr. Price found so helpful in the healing of dental caries in his patients, and the absence of which in the mother leads to a variety of serious defects in her children.

Cod liver oil and butter both contain high-quality vitamin A. Cod liver oil also contains vitamin E, vitamin D, and unsaturated fatty acids, to which iodine and metallic elements may be attached. Vitamin A has been shown to be an element imperative for the development of all epithelial structures. Because the teeth are of epithelial origin, it is to be expected that a deficiency of vitamin A would profoundly affect their growth and development. Studies on rats and guinea pigs are all in agreement, and the underlying changes appear to be well established.¹¹⁻¹³ In the absence of vitamin A the ameloblasts do not form, and as they are a determinant in the development of the odontoblasts these cells do not develop either, so that in the deficiency of vitamin A there are all kinds of aberrations of tooth bud formations, even to their complete absence. Vitamin A deficiency in the mother leads to serious deformities in the bone structure of the face and head, hare-lip, cleft-palate, narrow dental arches, and all forms of malformations in between, defects of nasal passages, sinuses, and turbinates. The optic nerves and eyes¹⁴ are severely affected, and all conditions from normal eyes to complete blindness and no eyeballs may be produced by variations in maternal vitamin A ingestion. Vitamin A is also essential to reproduction, in the absence

of which there is adsorption or abortion of the fetus. This was one of the indicators in the discovery of vitamin A by Dr. E. V. McCollum. Deficiency of vitamin A leads to atrophy of the germinal epithelium of the testes and sterility. Depending on the severity of the deficiency, the female genital tract is affected and reproductive function interfered with. With such severe damage to all the other ectodermal structures of the head and face, it is hard to believe the brain and pituitary gland could escape damage as well. It is difficult to show or see their imperfections until later in life, when they appear as behavior problems, mental retardation, cerebral palsy, mongolism, and other growth and developmental defects.

The role of unsaturated fatty acids is not yet settled, but they certainly are essential to the cholesterol metabolism. Current medical and lay literature is surfeited with information on the subject of atherosclerosis and heart disease. It has been found that the submaxillary gland swells under action of diiodotyrosine unless sufficient unsaturated fatty acids are present; especially linoleic. The submaxillary gland is very important in prevention of dental caries experimentally.

Vitamin E deficiency leads to complete and irreversible atrophy of the germinal epithelium of the testes and sterility. It is essential for reproduction and the development of the fetus. Deficiency leads to changes in both striated and cardiac muscles.

The use of sea kelp gives an excellent supply of diiodotyrosine, which is essential for the entire body structure, and especially important in the metabolism of the ovary, thyroid, and testis, and probably all of the endocrine glands. Primitive people are seldom fat. It has been shown by Stambul¹⁵ that diiodotyrosine acts as a stimulant to liver cells to excrete cholesterol into the bile. It should, therefore, be a valuable addition to the treatment of atherosclerosis and obesity. Kelp is also a good source of trace minerals.

Fish eggs, which were a most important part of the diet of the primitive people, are high in both iodine and zinc, and especially high in the nucleic acids of chromatin compounds, from which the developing fish forms the genes of its own hereditary structure. If iodine compounds, vitamin A, vitamin E, and unsaturated fatty acids are necessary in the mother's diet, to produce strong, healthy children with good teeth and dental arches, what happens to these when foods are cooked? Iodine has a tremendous increase in vapor pressure¹⁶ with increase in temperature; being 0.2 mm. of mercury at 20 degrees centigrade, and 45.5 mm. of mercury at 100 degrees centigrade. This is an increase of 227 times from room temperature to boiling. Dilute aqueous zinc iodide and potassium iodide solutions will be discolored brown with *released* iodine in several days at room temperature, and in several minutes at boiling temperature. This iodine then evaporates from solution. The same happens to iodide in food—in cooking, processing, and staleness—it is lost by evaporation into the atmosphere. Iodine is the only element of the Periodic Table which sublimates at normal temperature and pressure.

Vitamin A is a completely unsaturated compound and extremely sensitive to oxidation by light and heat. The unsaturated fatty acids are equally sensitive and are the cause of rancidity in fats. It is for this reason that butter, lard, peanut butter, and cooking fats are hydrogenated to protect them from rancidity. Rancid oil inactivates vitamin E. It is also known from recent work that vitamin B₆ (pyridoxine)¹⁷ is inactivated by heat. This is a very important vitamin in all amino acid metabolism, as well as unsaturated fatty acid metabolism. Vitamin

B₆ is plentiful in all fresh food. Thus, cooking destroys these most important compounds necessary for good reproduction, good brains, and the groundwork for good teeth and their supporting structures.

There is recent experimental proof of the association of thyroid and iodine in the prevention of dental caries. Joseph C. Muhler and William G. Shafer,¹⁸ Department of Chemistry and School of Dentistry, Indiana University, have produced convincing experimental evidence that the feeding of desiccated thyroid produces a marked reduction of dental caries in the rat. It is in fact as effective as the administration of sodium fluoride. They have also shown that there is an increase in the incidence of dental caries when the thyroid hormone level in the blood is lowered by blocking the thyroid with thiouracil. More striking is the fact that when the activity of the thyroid gland is diminished through the administration of thiouracil, the addition of fluoride to the drinking water has no effect on caries. This same amount of fluoride given to the animals with an active thyroid had produced previously a 20 per cent reduction in the caries rate. This work leaves no doubt that thyroid activity is related in some manner to the incidence of dental caries in the adult rat, and that whatever effect fluoride has, it is mediated through a normally active thyroid mechanism.

S. Kirkwood, et al,¹⁹⁻²² through work on the rat, have suggested that the submaxillary and parotid glands function to control the level of the thyroid hormone in the blood stream by degrading it to iodide ion. The iodide ion is then returned to the thyroid gland by way of the saliva and the gastrointestinal tract. This explains the long-known ability of the salivary glands to concentrate iodide. It also shows that the concentration of iodide in the saliva will depend on the rate of thyroxin destruction, if the intake of dietary iodide is constant. According to E. J. Ryan and S. Kirkwood, a convenient explanation of the results obtained by Muhler and Shafer would be that it is the increased concentration of iodide ion in the saliva and/or the increased saliva flow resulting from the increased degenerative processes in the salivary glands which accounts for the reduction of dental caries by the feeding of desiccated thyroid. In the rat both thyroidectomy and the administration of thiouracil results in marked atrophy of the submaxillary gland. This atrophy can be prevented by the feeding of thyroid hormone.

Thus it appears clear that the most important protection against dental caries is a normally functioning thyroid and submaxillary gland mechanism. Ingested fluoride may add a little to this protection, but it is insignificant in the presence of adequate iodine and mineral balance. In the presence of a decreased thyroid and submaxillary gland mechanism, fluoride offers little or no help whatever. It may be deduced from positive evidence that iodine components in the diet of primitive people and the residents of Deaf Smith County, Texas, led to good teeth and strong bones; while a loss of iodine, vaporized by cooking, leads to defective teeth and bones.

It has been repeatedly shown by studies of children with goiter in England⁶ and Switzerland that iodine alone does not cure goiter. There is always something else needed, and this something else seems to vary with the location of the individuals tested. It is believed this additional element is minerals in the form of zinc and magnesium, and in those areas where magnesium iodide and zinc iodide are found in the drinking water, good bone structure and high resistance to dental caries is found. Remarkable improvement is seen in thyroid nodules, even to their complete disappearance, by the addition of zinc ion and zinc iodide.

CONCLUSIONS

It has been shown that the health of the teeth and their supporting structures, from their beginnings in fetal life to adulthood, is continuously dependent on specific nutritional elements of the diet. The most important seem to be those elements associated with the integrity of epithelial structures and the thyroid-salivary gland mechanism. Planning for the health of the teeth and their supporting structures must begin by the preparation of the mother long before she becomes pregnant. This is where the dental profession is in a unique position to aid in the fundamental eradication of dental disease.

With children, from infancy, being brought to the dentist regularly for examination and care, and with the respect and confidence thereby engendered, the dentist can impress on these young people the importance of building their bodies to lay the groundwork for the future health of themselves and their offspring. This must be a long-range program. It cannot be solved by immediate medication alone. Each generation must build for the next. There must be a constant effort of education by dentists and physicians alike. A concerted effort must be made to eliminate from all advertising media and from the market-place the high caloric items which appeal to the taste, but have no specific nourishment. This, too, must be an educational program to the profession and to the people. However, none of it can be accomplished until dentists and physicians satisfy themselves that the cure for dental caries, pyorrhea, and orthodontic displasia is through adequate nutrition of the mother *before* she becomes pregnant and throughout her period of pregnancy; and then an adequate vitamin and mineral supplement for the infant, with special attention to iodine and magnesium.

Such a program of medical and dental co-operation in educating patients to understand the need of fortifying cooked diet with vitamins, minerals, and amino acids from the cradle to the grave, but especially during pregnancy, will greatly reduce dental disease, and at the same time will produce future generations with better health and higher intelligence.

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