NUTRITION OF THE INFANT AND CHILD

Alice Wiesendanger

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INTRODUCTION

The importance of good nutrition has long been recognized by the medical profession. Nutrition work, however, as the term is used today, is a relatively new activity in the general program for child health and protection. For this reason it seems advisable to review briefly some of the developments which led to a wider recognition of this problem.

The marked increase in attention to the nutrition of children in the United States since 1915 has come about largely as a result of four distinct factors:

(1) The large number of physical defects revealed by medical examinations of young men during the period from 1917 to 1919;

(2) The high percentage of malnutrition reported among the pre-school children who were examined in 1918 to 1919, "The Children's Year," as a part of the program outlined by the second White House Conference;

(3) The large number of so-called malnourished children in our public and private schools shown by physical examination;

(4) The newer knowledge showing the relation of proper food to normal growth and health, which has become available as the result of research and clinical investigation.

Each group of findings has helped to stimulate an interest in the essentials of growth and physical fitness and to influ-

ence our attitude toward child health and protection. Out of this interest have grown new points of view, new methods of approach, and new goals in public health programs. State and local boards of health, boards of education, welfare agencies, hospitals and clinics are now revising their programs to emphasize the importance of proper food as a factor in health and social well-being.

Nutrition work has two aspects, one of which is corrective in character, the other preventive. Both must receive adequate attention in any thoroughly constructive plan for child health and protection.

The retarded growth, lowered resistance, and frequent minor ailments of the undernourished child, his inability to keep up with his grade, and the prospect that he will break prematurely under the strain of adult life, call aloud for a remedial program. This may include such diverse elements as correcting physical defects, improving the physical or emotional environment in the home, adjusting a scanty budget to provide proper food, breaking up wrong food and health habits, and changing the point of view of the entire family to the importance of safeguarding the children's health.

Although the remedial aspect was the first to claim our attention, we are slowly learning that a steady day-by-day building for good nutrition in all children is still more important. This procedure has its roots deep in educational and preventive measures.

The aim of all nutrition work should be nothing less than optimal nutrition as a foundation for optimal health.

Optimal nutrition involves many factors. Among them are a reasonably food inheritance, enough food of the right kind from the prenatal period through and beyond adolescence, suitable home environment, freedom from physical defects, and protection from diseases that disorganize the orderly processes of growth and leave behind them foci of infection and lowered resistance to disease. In a program that will provide for these various needs, parents, physicians, nurses, nutritionists, teachers, social workers, dental hygienists all have their part. Doubtless, there are many others who directly or indirectly share in this responsibility. This means a high degree of team work between the family on the one hand, and organized society on the other.[1]

[1]White House Conference on Child Health and Protection, Nutrition Service in the Field, The Century Company, New York and London, 1932, pp. 3-4, 18-19.

Chapter I: Food Requirements in Infancy

A healthy baby may be expected to double his birth weight by the time he is four or five months of age and to treble it by ten or twelve months. This is a rate of growth far in excess of that which occurs at any later time. It is chiefly for this reason that an infant, in proportion to his size, requires several times as much food as an adult. The infant's equipment for utilizing this relatively large amount of food is immature and would be inadequate to the task were the food offered in the form commonly served to adults. Thus, the infants's food must differ from that of the adult in quality and relative quantity, though otherwise the same general principles of nutrition apply.

Even when the food is given in suitable amounts and in a most readily digestible form, the infant's digestive capacity is constantly threatened by the occurence of illness from almost any cause. Illness, even of a minor charactor, decreases the ability to digest food and as a consequence leads to gastro-intestinal disturbances. Such disturbances, when they occur, are more serious for the infant than for the adult. By them he is deprived of much or all of his food through vomiting, diarrhea or food refusal. When deprived of food the infant uses his body stores at a much greater rate than the adult and serious consequences are more quickly evident. Thus it becomes obvious that in order to prevent or to manage the nutritional disturbances of infancy more detailed knowledge and attention are required than for adult feeding.

Like the adult, the child must be provided with energy for maintenance requirements which include: (a) basal metabolism, (b) specific dynamic action of foods, (c) caloric loss in the excreta, and (d) allowance for bodily activity. In contrast to the adult the child requires additional energy for growth. The energy value of foods is usually expressed in calories, which in nutrition work refers to large calories. The different foodstuffs when burned in the body have different energy values, thus:

1 gram of fat yields 9 calories

1 gram of protein yields 4 calories

1 gram of carbohydrate yields 4 calories.

The basal energy requirements are fairly constant in children of the same age and weight. During the first year or 18 months of life the daily requirement averages about 55 calories per kilogram (25 calories per pound). After this the basal requirement tends to become gradually less, approaching the adult value (25 to 30 calories per kilogram). The higher basal requirement in the growing period is probably concerned with organizational processes of growth.[1]

The specific dynamic action of food represents the "cost of digestion" and of combustion of food. It varies with different foodstuffs, being greatest in the case of protein and least in the case of fat. In infants on average diets from 5 to 7 calories per kilogram are needed

[1]Holt, L. Emmet, Jr., M.D. & Mc Intosh, Rustin, M.D., Holt's Diseases of Infancy and Childhood, D. Appleton-Century Co., New York and London, 1940, p. 139.

to cover the specific dynamic requirements.

On a mixed diet approxamately 10% of the intake is normally lost in the excreta, mainly in the stools. In infants this amounts to 8 to 11 calories per kilogram per day. The loss in nursing infants is slightly less.

The great variation seen in the food requirements of children results chiefly from differences in their muscular activity. While awake an infant requires 30 to 40% more calories than when asleep. Vigorous crying may cause a temporary increase in metabolism of 100%. An average allowance for activity during the first year is 20 calories per kilogram (9 calories per pound). The energy expended in activity by individual infants may vary considerably from day to day.

The growth requirements are a variable since growth is not a constant process, and the energy stored represents the difference between calories ingested and calories expended in the aforementioned quotas. During the early months of life there may be stored daily in the course of normal rapid growth as much as 15 to 20 calories per kilogram (7 to 9 calories per pound). At the end of the first year the average is about 5 calories per kilogram (2 calories per pound). The amount of energy stored gradually falls in relation to body weight during childhood, with a conspicuous but temporary increase occuring during the spurt of growth which naturally takes place at or just before puberty.[1]

An adequate diet must contain protein, since this is

[1] Ibid., p. 140.

the only kind of food that provides the structural units of protoplasm, the amino-acids. Of the 22 amino-acids now recognized as constituents of protein only nine have been shown to be essential for the growth of the rat: lysine, leucine, isoleucine, phenylalanine, threonine tryptophane, histidine, valine, and methionine. It is probable that these are also indispensable for man. Proteins which are relatively or totally lacking in one or more of the essential amino-acids are less valuable as foods than are the "complete" proteins. In stating protein requirements, it is, therefore, necessary to know the biological value of the type of protein which is to be fed. The biological values of proteins can be measured in various ways: by comparing the growth, fertility or longevity of experimental animals; by determining the minimum amount of a protein required to produce nitrogen equilibrium after the period of growth; or by observing the rapidity with which a given protein will serve to reconstruct a particular depleted body protein such as hemoglobin or serum albumin. In general, it may be said that animal proteins, with the exception of gelatin, are superior to the vegetable proteins from the nutritional standpoint, and that protein mixtures are superior to single proteins, because a deficiency of amino-acids in one protein is likely to be compensated for by its presence in another.[1]

The growing child requires relatively more protein than the adult. We have no reliable standards by which can be stated the optimum protein requirements of infants. Many studies concern the minimum amounts upon which babies can exist or make a fair growth. It seems certain that

[1] Ibid., pp. 142-143.

be supplied in other ways. In moderation fats are probably desirable also because they furnish considerably more energy per unit of weight than protein or carbohydrate, thus conserving the functions of digestion and absorption and distributing the burden of energy production among a greater number of body functions.

Carbohydrates furnish the most convenient source of energy. Although indispensable in the internal economy of the body, carbohydrates cannot be regarded as a dietary essential, for it can readily be synthesized from protein and to a limited extent from fat. Carbohydrates in some form should furnish at least 10 to 15 per cent of the calories supplied by the fat and carbohydrate of the diet. This amount is the minimum which will insure proper utilization of fat inthe normal individual. Sugars in various forms constitue an important part of the infant's dietary, though there is no definite sugar requirement.

The term "vitamins" is used to designate accessory food factors which are required by the body in minute amounts, the absence of which gives rise to characteristic deficiency diseases.

Vitamin A is fat soluble and is found in the glandular organs of animals, in butter, cream or egg yolk. Carotene, a vegetable pigment, is a precursor of vitamin A and is converted by the body into this vitamin. This pigment is present in relatively small quantities in citrus fruits and certain vegetables. Usually reference is made to the fruits and vegetables as containing vitamin A. This vitamin has been prepared in pure crystalline form. Certain

fish liver oils constitue the richest commercial source of this material. Vitamin A is relatively stable. It is destroyed by prolonged heating at 100° C. in the presence of oxygen. It is not appreciably affected by the customary processes of cooking. Evidence indicates that vitamin A may be stored in the body for a considerable time. Experimental evidence has shown that this vitamin is essential for growth and a deficiency leads to defective ovulation in the experimental animals and to more or less generalized epithelial changes. The best known of these changes takes place in the eye and is called xerophthalmia. Similar changes in the epithelium of the nose and throat constitute a predisposing factor for common colds and nasal sinus infections.

Vitamins B (B_1), G (B_2) and still other essential materials are components of what was formerly known as vitamin B and which is now designated the vitamin B complex. These various substances are found in the same foods, though the proportion to each to the other varies in different foods. These vitamins are present in vegetables, fruits and whole grain cereals and to a lesser extent in milk, meat and eggs. They are not stored in the body and must be supplied constantly in the food.

Vitamin B_1 is known as the antineuritic factor and its deficiency is the cause of beriberi. Deficiency of lesser degree leads to gastro-intestinal dysfunction and to loss of appetite. The intestinal tract, particularly the colon, becomes atonic and constipation results. Vitamin B_1 is essential

for growth and also for successful lactation. It has been synthesized and identified chemically and is available in pure crystalline form. Chemically it is known as thiamin. Vitamin G is necessary for growth and probably also for lactation. It has been isolated and identified chemically and is known as riboflavine.

Nicotinic acid is a component of the vitamin B complex necessary for the prevention of pellagra. Still other components exist, but their specific function for the human organism is still a little vague.

Vitamin C has been isolated in pure crystalline form and has been synthesized in the laboratory. Chemically it is most commonly known as ascorbic acid. It is present in fruits and vegetables. The usual sources for the infant are orange and tomato juice. It is relatively unstable and is readily destroyed by oxidation. Its destruction is favored by an alkaline medium. In the cooking of foods much of the vitamin is lost, although potatoes baked in the skin retain it. Canned vegetables which are heated in the absence of oxygen retain their vitamin; this is not true of canned milk, however, which is usually subjected to pasteurization before canning. Because of the uncertainty of an adequate supply of vitamin C in milk it is desirable to supplement the diet of all infants with some food known to contain this substance in abundance. Apparently vitamin C can be stored in the body for short periods.

Vitamin E is a fat soluble material, a deficiency of which in the experimental animal leads to sterility in both sexes. It has widespread distribution, so wide that any mixed

diet contains an abundance. Although essential for many species of animals, the importance of this factor in human nutrition is still questionable; there is no evidence that children ever suffer from a deficiency.

Vitamin D, the antirachitic factor, is formed in the skin if the body is exposed to sunlight or some other source of ultraviolet irradiation; in the absence of such irradiation it must be supplied in the diet. Certain foods, such as the fish liver oils, contain it in abundance; smaller amounts are present in egg yolk and in liver. Cod liver oil is an excellent source of this vitamin. Vitamin D may be stored in the body for some time. Its function is to regulate the utilization of calcium and phosphorus. A deficiency may result in dental caries, in osteomalacia and in rickets. For the prevention of these clinical conditions there must be available not only vitamin D but also an adequate supply of calcium and phosphorus in the food.

The structure of the antihemorrhagic vitamin K has only recently been elucidated. Animal experiments have shown that this vitamin is concerned with the synthesis of prothrombin. In man favorable results from the administration of this factor have been reported in hemorrhagic states associated with bile fistula and with congenital obstruction of the bile ducts, and, more recently, in hemorrhagic disease of the newborn. There is evidence that administration of vitamin K in pregnancy will raise the prothrombin content of the newborn infant's blood and will prevent hemorrhagic disease. Vitamin K is a lipoid-soluble factor which is found most abundantly in hog liver fat, hemp seed, soy bean oil, and in alfalfa.

Although not sources of energy, minerals are absolutely indispensable for the structure and function of tissues; life itself depends on the ability of the body to obtain them and maintain a proper balance between them. With the exception of iron and possibly copper these can be supplied by either human or cow's milk during the first year. Normally at birth the liver contains a small store of iron and copper. The store of iron is considerably increased in the first two months of life by the breakdown of hemoglobin in the change from the high level of hemoglobin at birth to the lower level normal for infancy. During good health this store is not exhausted for several months. In order to maintain the store, the addition of iron to the diet is necessary at 2 or 3 months of age.

Water is required for the assimilation and elimination of metabolic products, for the regulation of temperature and the construction of tissue. An infant requires 100 to 150 grams of water per kilogram per day, in marked contrast to the adult requirement of 30 to 40 grams. The proportionately large quantity of water is needed because of the higher rate of metabolism and the relatively larger surface area. Infants readily become dehydrated when deprived of water or when subjected to excessive loss of water as from darrhea.

The fluid requirement of older children need little concern; the appetite is usually a satisfactory guide to follow.

Chapter II: Digestion in Infancy

The infant is at a distinct disadvantage as regards digestion. His food requirements are relatively greater than those of the adult, and his digestive capacity is more limited.

Since the infant cannot masticate, his food must be presented to him in a highly subdivided state. Solids are given in solution or suspension, which involves the ingestion of a large volume of fluid. The capacity of the infant's stomach is limited, hence he must be fed many times a day. In the nursing infant, food begins to leave the stomach almost at once; within 5 minutes a considerable part has often reached the intestine. After half an hour the greater part has passed through the pylorus; the stomach is usually completely empty in two to two and one-half hours. The emptying time is influenced by the size of the meal and by the character of the food. In artificially fed infants the emptying time of the stomach is likely to be somewhat prolonged. In older children upon a mixed diet the stomach often contains food at the end of four hours, but is regularly empty after five hours. Gastric motility is influenced unfavorably by fevers, infections, rickets and states of malnutrition.[1]

Salivary digestion is unimportant in young infants. The quantity of saliva and of salivary diastase at birth is small; after the third month, and earlier if starch is fed, the quantity and the amyloptic power are increased.

The important factors in gastric digestion are HCl and the pepsin-rennin ferment. The pepsin-rennin ferment acts

[1] Holt & Mc Intosh, op. cit., p. 167.

upon protein, breaking it down to simpler products, which are further digested later by other ferments in the intestine. No digestion of sugar or starch occurs in the stomach and little if any of fat.

HCl serves several useful puposes. When in sufficient concentration it inhibits bacterial growth, activates the pepsin-rennin ferment and to some extent influences the pyloric reflexes. The amount of acid present at birth in small but it increases progressively. It is decreased by any illness and by marked malnutrition. When human milk is fed, the gastric acidity finally reached is optimal for peptic digestion. Though cow's milk is neither acid nor alkaline it has the property of binding small amounts of acid without changing its reactions. To bring about the same degree of acidity it is necessary to add three times as much acid to cow's milk as to human milk due to the higher buffer value of cow's milk.

Soon after the ingestion of milk the casein is precipitated. Because of the small amount of casein in human milk the precipitate is finely divided. With raw cow's milk, the curds are larger, firmer and more compact; they are less readily digested than woman's milk. Cow's milk which has been boiled or which has been subjected to heat incident to evaporation or drying gives rise to a curd resembling that of human milk, though usually somewhat coarser. When cow's milk is fed to an infant, less digestive difficulty is encountered if the milk has been heat treated than if it has not been modified in any way. Milk to which acid has been added in such a manner and quantity as to make a fine curd

is better tolerated than either plain boiled or raw milk. The fineness of the curd undoubtedly contributes to the ease of digestion and it is possible that this factor is of greater importance than the degree of acidity reached in gastric digestion.

Though much has been said in the preceding discussion concerning gastric digestion, it is in the duodenum and small intestine that the greater part of digestion during infancy is accomplished. Protein which escapes gastric digestion is acted upon by the pancreatic secretion and the resulting products are further broken down to amino-acids by a ferment secreted by the mucous membrane of the intestine. The amino-acids are absorbed and utilized. Fats are changed into soaps and glycerine by pancreatic secretion and bile. These are absorbed from the small intestine to be reconstructed into body fat. Another ferment of the pancreatic secretion converts starch into sugar. Complex sugars are changed to monosaccharides by the secretions of the small intestine before absorption. The ability to digest starch is relatively feeble at birth, but it increases rapidly.

The chief function of the large intestine is to absorb water. Though it is capable of absorbing amino-acids, salts and simple sugars it is seldom called upon for this purpose. Before reaching the large intestine practically all of the protein and its products will have been digested and absorbed. Sugars reaching the large intestine are quickly fermented by the bacteria present in enormous number. Some soaps remaining from fat digestion pass into the colon, though little or no digestion or absorption takes place.

The period required for food to pass through the gastro-intestinal tract varies from 8 to 36 hours, depending largely upon the degree with which different food substances stimulate peristalsis.

Although the importance of the stools as a guide to the feeding of infants has been probably overemphasized in the past, there is no doubt that valuable information can be obtained from this source as to the condition of the infant's digestion.

The first discharges after birth consist of meconium; this is composed of bile and intestinal secretions, with epthelial cells and hairs that have been swallowed in utero; it is of a dark brownish-green color, semisolid, and is usually passed from four to six times a day for the first two to three days.

When the milk supply becomes well established, these are replaced by characteristic yellow stools. The color, frequency and consistency of the stools depend largely on the relative proportion of sugar to protein in the food and the consequent speed of passage of the content through the tract. Unusual speed of passage is associated with loose green stools. Very slow passage may result in a constipated stool of light yellow or white color.

The differences between the stools from human and from cow's milk are due to the differences in composition of the food. A high sugar, low protein diet (human milk) tends to cause more frequent stools, which are acid in reaction. A low sugar, high protein diet tends to cause the reverse condition.

Mucus is increased in the stool by any intestinal irritant. An increase is most frequent in diarrhea. Pus is associated with intestinal inflammations and blood mixed with the stool is most frequently from the same cause.

Curds in the stool may be of soap, casein or mucus. Soap curds are the most frequent and usually indicate nothing more than relatively rapid passage of content through the intestine. Mucus and casein curds are of no important significance.

In intussusception the stools contain blood and mucus without appreciable quantities of fecal matter.[1]

[1] Ibid., p. 172.

Chapter III: Prenatal Influence

Health and well being of the pregnant woman and the fetus demand an enlarged interest in the question of nutrition.

Although pregnancy under normal conditions is essentially a physiologic process, it makes special demands on the maternal organism, and diets adequate under ordinary conditions may fail to meet the increased requirements. Observation shows that man when eating varied food under the unrestricted guide of hunger and appetite tend to take such quantities as are proportional to the energy requirement, whether or not this amount meets also the requirements as to each of the substances known to be necessary in nutrition. Barborka, after a study of American diets, concludes that many of our concentrated foods are low in vitamins, residue and alkaline minerals and high in carbohydrates and acid minerals. The foods that correct deficiencies common to our diet are milk, eggs, and leafy vegetables. These protective foods are highly essential during pregnancy and can prevent maternal and fetal mortality due to demineralization and avitaminosis.

The average increase in weight during pregnancy amounts to about 18 pounds. This increase is equivalent to the weight of the fetus, placenta, amniotic fluid, and the maternal physiologic changes incidental to pregnancy. The daily caloric intake required during this period varies greatly with the individual.

The number of calories per day may range from 2000 in the early part of pregnancy to 3500 calories in the last months. If obesity develops, the caloric intake must be

reduced without decreasing the necessary minerals and vitamins. Efforts to control the size of the fetus near term by low caloric intake are generally unavailing and may do considerable harm if essential food constituents are withheld. Since the fetus in utero is essentially parasitic and the growth impulse is satisfied irrespective of the mother's diet, it seems most irrational to starve the mother during the last months of pregnancy in order to obtain a small baby.[1]

The carbohydrate metabolism is deranged in normal pregnancy as indicated by the ease with which a glycosuria can be produced and the tendency for the blood sugar curves to be abnormal. Williams found in repeated miscarriages that the blood sugar curve showed a "lag" and that there was often a glycosuria but no diabetes mellitus. When nausea and vomiting occur, it is advisable to give a high carbohydrate diet every two hours. According to some investigators, an abnormal carbohydrate and fat metabolism are factors in causing hyperemesis gravidarum.

In order to provide for the growth of the ovum, uterus and mammary glands as well as for the nitrogen retention, the daily protein intake varies from 70 to 100 grams.

Fat appears to be of importance in the diet of the pregnant mother in as much as it serves as a carrier of essential vitamins A,D,E, and F.

Most workers agree that the ingestion of water in pregnancy should be liberal. A sufficient amount should be ingested to ensure a normal urinary output of 1200 to 1500 cc. per 24 hours.

[1]Dieckmann, William J.,M.D. & Swanson, W.W.,M.D., "Dietary Requirements in Pregnancy," American Journal of Obstetrics and Gynecology, C.V.Mosley Co., St. Louis, Vol.38.,Sept.1939, Pages 523-533; from reprint, p.2.

There is conclusive evidence in the literature to show that animals on deficient mineral diets suffer loss of calcium and phosphorus from the body during pregnancy. Apparently the maternal organism will mobilize calcium not only from the so-called reserves but continue until osteomalacia results. The calcium and phosphorus requirements of the mother are best satisfied by an intake sufficient to produce positive balance. Dieckman, basing his statement on balance studies of patients suffering from a calcium and phosphorus deficiency, advised that the diet in pregnancy contain at least 1.5 gm. calcium and 2.0 gm. phosphorus. Certain conditions may affect the optimum retention of calcium and phosphorus such as the percentage utilization of these minerals from the ingested food, the therapeutic administration of vitamin D and the effect of sunlight or irradiation with ultraviolet light.

The foods rich in calcium are milk and leafy vegetables. Apparently the best sources of calcium and phosphorus are milk and cheese. The leafy vegetables contain considerable calcium but the presence of oxalates forming insoluble salts lowers the percentage that can be utilized.

Apparently when foods containing sufficient calcium and phosphorus are ingested in pregnancy the magnesium requirement is also satisfied.

Studies in iron metabolism in pregnancy indicate depletion of maternal stores with successive births. It has been shown that infant's hemoglobin values are normal at birth even where the mother's hemoglobin was low in pregnancy, but that the infant is more likely to develop a hypochromic anemia during the first year. An average maternal intake of 15 to 20 mgm. of iron a day allows for a retention sufficient to

provide for the calculated needs of the mother and fetus. Apparently the larger amounts gives a margin of safety since the availability of iron in different foodstuffs varies and absorption may be dependent upon gastric acidity. The foods rich in assimilable iron are liver, kidney, gizzards, red meats, raisins, prunes, apricots, and peaches.[1]

The requirements for all vitamins appear to be increased in pregnancy.

With respect to vitamin A there is some work which would seem to indicate that the mucous membranes are made more resistant to infection when sufficient quantities of this vitamin are supplied. The daily amount of vitamin A recommended for pregnant women is 9000 international units. The richest diets provide scarcely 3000 units. It may, therefore, be necessary to supplement the diets with the precursor carotene or fish oils high in vitamin A.[2]

With respect to pregnancy, the interest in the fractions of the B complex is B_1, thiamin, the antineuritic factor and the B_2 complex. In animals, vitamin B_1 deficiency results in failure of conception, resorption of the fetus and frequent abortion and early death from a disorder closely resembling polyneuritis.

The food sources of the vitamin B complex are yeast, whole grain breads and oils, cabbage and carrots, leafy vegetables, egg yolk and oysters. To supplement these foods there are a number of concentrated vitamin B complex extracts besides the isolated vitamin B fractions available.

[1] Ibid., p. 6.
[2] Ibid., p. 6.

The importance of vitamin C, ascorbic acid, in pregnancy is not well defined. Apparently its deficiency interferes with normal ovulation and conception. Determinations of excretions of vitamin C in human urine indicate that the demand is increased in pregnancy. The daily maternal intake recommended is approxamately 75 mgm. or 1500 international units. The foods rich in this vitamin are citrus fruits, tomato, parsley, green or red peppers, raw cabbage and other leafy vegetables.[1]

The administration of vitamin D, calciferol, in pregnancy is not a routine procedure in obstetric practice. However, the giving of therapeutic doses of vitamin D as found in cod liver oil and in concentrates, or exposure to sunlight is a most justifiable measure. Careful search of the literature seems to indicate that in the infant a correlation may exist between calcium deficiency, premature births, imperfect calcification, and birth trauma. It should be emphasized again that supplementing the diet of the mother with therapeutic doses of vitamin D from fish oils, concentrates or from the action of sunlight on the skin does not permit a decrease in the daily optimum calcium and phosphorus intake.

Vitamin E seems to be of some importance in pregnant women subject to habitual abortion. However, more clinical evidence obtained under carefully controlled conditions, is greatly needed to establish the usefulness of vitamin E therapy in abnormal human reproduction. There is a widespread distribution of vitamin E in the foods belonging in a well-balanced diet. Individual cases of inadequacy, due perhaps

[1] Ibid., p. 7.

to a faulty absorption or metabolism will not be understood until more is known about the chemistry and physiology of vitamin E.

Very recently the administration of vitamin K in conjunction with bile salts to the pregnant mother just preceding delivery has seemed to be of some value in preventing hemorrhagic disease of the newborn. Also it is given to the newborn to reduce this tendency to abnormal bleeding.

The problem of diet in pregnancy then resolves itself into supplying the mother with adequate nutritional elements for her own use and a reserve for utilization by the fetus. Here a very important point arises: that is, to recognize the fact that this reserve must consist largely of the protective and tissue building elements rather than the energy-yielding foods; also, since the facilities for storing proteins are very meager, this substance must appear continuously in the diet.

More intelligent attention to proper nutrition during pregnancy as well as lactation would unquestionably be rewarded by a lowering of the still and premature birth rates, a decrease in maternal and post-natal infant mortality, an increase in the average health of full-term babies and an increase in the mother's general health and ability to breast-feed their children successfully.

Chapter IV: Breast Feeding

Maternal nursing is the natural and ideal method of infant feeding. Every mother should nurse her infant unless there are weighty reasons to the contrary. The large majority can do so and should be so encouraged. By and large the mortality amoung infants artificially fed is very much greater than in nursing infants.

Breast feeding possesses many advantages as compared to artificial feeding. The composition of woman's milk is ideally suited to the nutritional requirement and digestion of the infant. Although cow's milk may be so modified as to make it a suitable food for infants, the possibilities for error, both in regulating the quantity and the composition are much greater. The chance for contamination with pathogenic bacteria is decidely greater with artificial feeding.

There are certain contraindications for nursing. No mother who has or has had active tuberculosis in any form should nurse her infant; it exposes the infant to infection and can only lower the resistance of the mother to disease. Nursing should seldom be allowed when serious complications have been connected with parturition, such as severe hemorrhage, sepsis or eclampsia; women may, however, recover from these conditions so as to be able to nurse successfully. If the mother is suffering from any chronic disease or is very delicate, great harm may be done to her without corresponding benefit to the child. Retracted nipples may render nursing impractical. Mastitis is a contraindication for using the

affected breast. The response of individual mothers to nursing varies enormously; some find it a severe drain on their health while others appear to thrive on it.

If a mother is to supple sufficient milk it is highly desirable that she remain in good physical condition, is free from worry, and feels happy. She should have plenty of sleep and get out-of-doors every day but should stop short of/ fatigue. She requires a higher fluid intake at this time. The diet of the lactating mother need differ qualitatively in no way from that which is suitable for her at other times. In the main, it is desirable that she drink more milk and eat well-balanced meals. The important point is that she eats those foods that she can handle and do not upset her in any way.

The greatest stimulus to the milk supply is frequent, periodic and complete emptying of the breast.

During the first few days post-partum, the milk secreted differs considerable in character from that secreted later. This first milk is known as "colostrum". It is a thin, yellowish fluid, containing larger amounts of protein is in the form of globulin and it has been demonstrated that a portion of this globulin may pass unchanged through the intestinal wall of the infant. It has been suggested that the globulin thus absorbed remains for a time in the blood and exerts an influence on immunity processes. About the third or fourth day post-partum there is often a sudden increase in the milk secretion and at the same time it assumes the usual characteristics of breast milk.

The chief constituents of milk are fat, sugar, protein, mineral salts and water. There are also present the accessory food substances, or vitamins, and other substances of uncertain composition, the importance of which in nutrition is not altogether understood. According to Mariott, the average composition of breast milk is as follows: Fat 3.5 to 4.0 percent, sugar 7.5 per cent, protein 1.25 percent, salts 0.25 percent, and water 87 percent. The caloric value of breast milk is approximately 20 calories per ounce, or 700 calories per liter.

Care should be given to the cleanliness of the breasts, particularly the nipples; they should be washed carefully before and after nursing with plain water; or a solution of boric acid or normal saline. If the nipples tend to become chafed, such preparation as lanolin, albolene, vaseline or boric ointment may be applied. With tender nipples, the use of a glass or rubber nipple shield during nursing may be advantageous.

The chief danger lies in fissured nipples which may result in infection of the breast and possibly of the child also. Nursing should not be permitted under these circumstances, for it tends to aggravate the condition. Healing of the nipples may be promoted by applications of silver nitrate or by some bland ointment. The milk should be emptied by manual expression or by a breast pump.

Much can be done to prevent fissured nipples by proper care of the breasts during pregnancy. The application of a saturated boric acid in 50 percent alcohol has been recommended as a hardening procedure.

Nursing the first days of life is necessary to accustom the child and the mother to the procedure, and to stimulate the secretion of milk; it probably also promotes uterine contractions. Beginning from 6 to 12 hours after delivery, the child should be put to breast on the first day once every 6 hours and on the second day once every four hours. As very little milk is obtained by the infant during this period, he should be given water, or preferably, a 5 or 10 percent solution of cane sugar, lactose, or cane syrup immediately after each nursing up to the third or fourth day.

Most infants do best when fed at four hour intervals. Convenient hours are 2, 6 and 10 a.m. and 2, 6 and 10 p.m. When the baby's weight reaches up to 9 or 10 pounds this 2 a.m. feeding should be omitted. Or, from the very beginning this 2 a.m. feeding may merely consist of water or 10% lactose solution if the baby's weight is sufficient. Thus the mother has more ample opportunity for rest.[1]

The advantages of the four hour interval are that the infant's digestive tract has more opportunity for rest, the stomach is more completely emptied, and there is generally less vomiting. Furthermore at the end of four hours the baby is more hungry than at the end of three hours and nurses the breast more vigorously. Incidentally, it lessens the tax on the mother and her activities are less restricted.

Regularity in nursing is of utmost importance; it may make the difference between successful and unsuccessful nursing. If necessary, the infant should always be awakened at

[1] Marriott, William Mc Kim,B.S.,M.D., Notes on Infant Nutrition, Revised 1926, Used by Dept. of Pediatrics, Univ. of Oregon Medical School, Doctors A.E.Gourdeau & L. Howard Smith by permission of Dr. Marriott, February 1931. p. 31.

anomalies on the part of the infant than to the character of the feeding.

The difficulties encountered in breast feeding are to be explained chiefly by either overfeeding or underfeeding and the diagnosis of the difficulty is largely a matter of common sense.

Certain breast fed infants fail to receive a sufficient amount of milk from the mother and are consequently underfed. The symptoms of underfeeding are readily confused with those of indigestion. There is failure to gain or even loss of weight. There may be constipation with flatulence and what would appear to be colicky pain; at other times the stools may be thin, greenish and numerous (sometimes referred to as "starvation diarrhea"), but small. There is usually fretfulness; at times vomiting may occur. A diagnosis of underfeeding can be made only by determining the quantity of milk taken. This is best accomplished by weighing the child before and after nursing over a sufficient period of time. The next logical step is to try to determine how much milk remains in the breast which has been nursed. If little or none can be obtained by expression or by a pump it becomes apparent that supply is inadequate.

The mother may secrete sufficient milk, but the baby may be unable to obtain it because of inverted nipples, in which instance a nipple shield may be used, or the breast emptied by mechanical means. Complete emptying of the breast by mechanical means following each nursing serves as a stimulus to further secretion. If, despite all efforts, the amount of

milk obtained by the baby is insufficient for his needs, the feeding should be complemented by a cow's milk formula given immediately after the nursing, but the infant should not usually be weaned during the first few months of life unless the breast milk supply is so inadequate as to cover less than 25 percent of the total requirements. In the case of older infants there is not as much objection to weaning.

If an infant is nursing at intervals of 4 hours, there is little danger of overfeeding. Occasionally the mother has an abundant supply of milk which flows readily and the infant gorges himself at each feeding. As a result, a portion of the milk is likely to be regurgitated or there may also be occasional loose stools. The remedy is simple and consists of shortening the length of time that the baby nurses. Some strong infants get sufficient milk at the end of from 3 to 5 minutes.

Diarrhea and severe vomiting in breast fed babies is usually due to the presence of some infection, such as otitis media or pyelitis. Babies with pyloric stenosos vomit whether fed on the breasts or artificially. A serious and frequently made mistake is to wean a baby who is vomiting because of pyloric stenosis.

When maternal nursing is impossible or undesirable, the milk of another woman would seem to be the most natural and best substitute. While this is theoretically true, the practical obstacles are so many as to put wet nursing out of the question as a general method of feeding. In America the class which furnishes most of our wet-nurses has steadily diminished. The expense, the danger of transmitting contagious disease and

the difficulty of obtaining proper care for her own infant, are all very serious objections to a wet-nurse. Finally, the improvements in artificial feeding have largely eliminated the need for breast milk.

If a wet-nurse is to be employed, she should be selected with care. A careful physical examination and a blood Wasserman should be insisted on; an x-ray of the chest is highly desirable. The condition of her own infant is the best evidence of the quality and quantity of her milk.

It is not essential that an infant be put to breast; the milk may be expressed and fed to the infant separately. In general, however, it is desirable, if the infant is strong enough, to have him nurse at the breast. The chance of contamination of the milk is thereby eliminated.

The more important reasons for weaning on account of disease or abnormality in the mother or infant have been discussed. Even when the mother is well and the baby is thriving a time comes when breast feeding is no longer advantageous. Milk , of course, is deficient in certain essentials. When these deficiencies are made good by proper food additions and when sufficient total food is ingested infants may be nursed successfully well into the second year. However, difficulties begin to increase in a large proportion of instances toward the end of the first year. In the latter part of the first year, also, the infant's ability to digest foods more complex than milk is greatly increased. From clinical experience it seems a wise rule that all infants, with certain exceptions to be noted, be weaned from the breast at eight to ten months of age and a more varied diet, including cow's milk

be substituted.

Weaning should be done gradually, if possible; sudden weaning causes discomfort to the mother and may be followed by indigestion in the infant, expecially if an inappropriate food is substituted.

In cases of sudden weaning it is advisable to use a more dilute milk mixture than would otherwise be given. After the first day or so, when the infant has become accustomed to cow's milk, the strength of the feeding may be increased.

The difficulties in weaning a child of nine or ten months, who has had nothing but the breast, are sometimes great. To try to teach older infants to take a bottle is unwise, feeding from a cup or spoon is usually quite as easy. Continued coaxing or forcing of food only prolongs the struggle. Starvation is by far the most effective method.

Food should be offered at regular intervals and taken away at once, if refused. A variety of things may be offered--cow's milk, cereals, broths, bread and milk, etc. A strong-willed child will often hold out for 24 or 36 hours; occasionally for 48 hours. Serious symptoms from withholding food under such circumstances are rarely, if ever, seen. Water should, however, be given.[1]

[1] Ibid., p. 189.

Chapter V: Artificial Feeding

The successful feeding of infants--either with woman's milk or some substitute--demands that the nutritional requirements be met and that the food be suited to the digestion. In artificial feeding two further essentials must be met: the food must be presented with a suitable technic and contamination with bacteria and other harmful substances must be prevented. Simplicity in the preparation of the feeding is much to be desired; the opportunity for error is thereby minimized.

Cow's milk in some form is our main reliance in infant feeding. It should be fresh, clean and free from preservatives. It is desirable that the composition of the milk--particularly the fat--be as constant as possible. Mixed or herd milk is preferable to that of a single animal, since it is subject to fewer variations.[1]

The average composition of cow's milk may be stated as follows: fat 3.5 to 4.0 percent, sugar 4.5percent, protein 3.5 percent, and mineral salts 0.75 percent. The average composition of human milk is fat 3.5 to 4.0 percent, sugar 7 per cent, protein 1.25 percent, and mineral salts 0.25 percent.[2]

Human and cow's milk qualitatively have the same constituents, though the proportions are different. They have the same energy value. Despite these similarities, experience has demonstrated that the majority of young infants have digestive difficulties when unmodified cow's milk is fed. This indicates an essential difference between cow's and human milk.

The sugar of both milks is lactose and is qualitatively

[1] Ibid., p. 190.
[2] Marriott, McKim, op. cit., pp. 20 and 25.

the same. Certain qualitative differences exist in the fat of the two milks. The fat of cow's milk is not so well tolerated by the infant as that of human milk. Fats are glycerides of fatty acids. Cow's milk fat contains a larger proportion of glycerides of the lower fatty acids (e.g., butyric acid). These acids are more irritating than the higher ones (e.g., oleic acid). Both cow's milk and human milk proteins consist of casein and lactalbumin. However, the proportions are very different. Lactalbumin constitutes more than one half of the protein of human milk, but only one-seventh of that of cow's milk. It seems probable that this difference in the protein is for the infant the most essential difference between cow's and human milk.

Raw milk should be considered unfit for infant feeding because of the danger of the high number of bacteria it may contain.

Certified milk is milk which is produced under the supervision and control of a commercially disinterested committee or group which grants "certification" when the requirements of the committee are met. It is the product of tuberculin-tested cows known to be healthy and is obtained under strict conditions of cleanliness. It is cooled quickly after milking and is kept cold until delivery. It has a guaranteed low bacterial count and is often fed raw to infants. Such milk is preferable to ordinary raw milk, but serious epidemics have resulted from its use even though it has been certified. Even the best grade of certified milk should be boiled before being fed to infants.

Pasteurized milk is milk which has been heated to 150° F. and kept at this temperature for 30 minutes. By this process practically all bacteria capable of causing disease are destroyed. Even though milk has been pasteurized it is essential that it should be kept cold and free from subsequent contamination. Because much of the commercially pasteurized milk becomes contaminated after pasteurization, it is safer to boil even pasteurized milk before feeding it to infants.

The boiling of milk for 1 to 2 minutes destroys most of the bacteria present and all of the harmful ones. Various objections have been raised to boiling milk for infant feeding. None of these objections has a sound basis. The nutritive value is not altered and boiled milk is more readily digestible than raw milk. Whatever destruction of vitamin C occurs with either boiling or pasteurization is readily compensated by the customary addition of orange juice to the diet of the infant. The advantages of boiled milk so greatly outweigh its possible disadvantages that it now has become a custom to boil all cow's milk before feeding to infants.

The acidity produced by the growth of lactic acid bacilli in milk inhibits and eventually destroys all pathogenic bacteria commonly contaminating milk. Milk soured by lactic acid has proved to be an excellent infant food. Other acids also have been employed with good results. This is especially true of citric acid, which may be employed in its purified state or in the form of orange or lemon juice. Dried lactic acid milk is available on the market and seems to be a satisfactory substitute for the freshly prepared milk.

Evaporated milk is milk which has been concentrated to half or slightly less of its original volume, sterilized and sealed in air tight containers. It may be preserved for long periods, but will sour as does any other milk after the container has been opened. The heat treatment incident to evaporation and preservation causes the casein to be precipitated in the form of fine curds when acted upon by the pepsin-rennin ferment. Because of homogenization in the process of the manufacture the fat does not separate. It is being employed to an increasing extent in infant feeding even when fresh milk is available.

Dried milk is milk from which practically all of the water has been removed. Usually the process of drying is carried out with such a short period of heating that the vitamin content is little affected and not all bacteria are killed. Pasteurization is customary prior to drying. Dried milk has been used extensively in infant feeding and clinical results indicate that it is very satisfactory. It has the advantage of convenience but the disadvantage of expense. A very fine curd results when the casein of dried milk is precipitated. Less acid is required to make it acid than for fresh milk.[1]

It is possible to modify cow's milk in a great variety of ways so as to make it an entirely satisfactory food for most infants. Different methods have their particular advantages, but no one method can be recommended above all others. The most successful modifications have, however, had certain features in common: a reduction in the concentration of protein

[1]Jeans & Rand, op. cit., p. 179.

and fat and an increase in the carbohydrate. A reduction in the proportion of protein is desirable for several reasons. A diet which contains too high a proportion of protein as compared with carbohydrate may lead to increased bacterial putrefaction in the intestine; eventually the nutrition may suffer. A high protein diet increases the water requirements; the energy requirements are also increased because of the marked specific dynamic action of this type of foodstuff; the additional food may in certain cases exceed the digestive capacity. In reducing the protein intake it is unwise to give as little as the nursing infant receives for there is evidence that the nutritional value of cow's milk protein as a whole is not equal to that of breast milk protein.[1]

The proportion of fat intake should be reduced since a high fat intake is not well tolerated in infections, and also there is some evidence that the fat of cow's milk is not so well tolerated by the infant as that of human milk. However, some authorities believe the differences in the two fats are so small as to be of little or no practical importance.

Since the carbohydrate content of cow's milk is lower than that of breast milk it is necessary to add some form of this foodstuff to meet the necessary energy requirements. Sugar furnishes the necessary additional energy in an easily assimilable form, and at the same time aids the absorption of soaps and minerals by altering the reaction of the intestinal content toward the acid side. The carbohydrates commonly used in infant feeding are lactose, saccharose (cane sugar), starch and derivatives of starch (dextrin, maltose,

[1]Holt & Mc Intosh, op. cit., pp. 196-197.

dextrose and mixtures of these).

Mixtures of dextrins and maltose have been widely used in infant feeding since their introduction some years ago by Liebig. The preparations have a pleasant taste and may possess some virtue when the time comes for introducing solid foods, for, being far less sweet than cane sugar, they do not condition the child to sweet food. A number of preparations are on the market which differ somewhat in their properties. The "liquid extracts of malt" and "malt soup" contain impurities which are somewhat laxative, and are therefore sometimes used in the treatment of constipation. "Malted milk", "Mellin's food", "dextri-maltose" and "Karo corn syrup" are not laxative and are suitable for use in diarrheal states as well as for normal infants. The first three are proprietary preparations and are consequently expensive; corn syrup is one of the cheapest forms of carbohydrate available, and in recent years it has become increasingly popular for infant feeding.

The proportion of calories distributed as protein, fat and carbohydrate in whole cow's milk, cow's milk as commonly modified, and in breast milk is shown in the following table:[1]

Percentage Distribution of Calories

	Protein	Fat	CHO
Cow's milk	22	49	29
Cow's milk (common modification)	15	35	50
Breast milk	8	47	45

Cow's milk may conveniently be adapted for infant feeding along the lines just discussed: (1) by dilution, with subse-

[1] Ibid., p. 196.

quent addition of carbohydrate, or (2) by adding CHO to whole milk and reducing the quantity of food taken. Each of these methods reduces the intake of protein and fat and increases that of carbohydrate. Because of the ease with which whole cow's milk can be digested when it has been suitable treated has lead to the practice of feeding undiluted whole milk with additional carbohydrate. Such mixtures are more concentrated than breast milk and often contain 30 calories or more per ounce. The routine use of formulas of this kind is also open to criticism; the child so fed will receive considerable less water than the normal breast-fed infant; consequently he has a smaller margin of safety to protect him in conditions in which an extra demand for water is made (fever, external heat, over clothing, high humidity, etc.). Additional water may, of course, be given between feedings, but this adds to the nursing care of the infant; in situations where this may be made a matter of routine this is less objectionable than in dispensary or private practice, where the regular administration of additional water is likely to be neglected. Although in particular circumstances either a dilute or concentrated food may be indicated, the preference in the routine feeding of infants is to avoid both of these extremes and to give food which is isocaloric with breast milk (containing 20 calories per ounce). The following formula accomplishes this: whole milk 7 ounces, water 3 ounces, sugar 1/2 ounce. This may be prepared from boiled milk, fermented milk or acidified milk; dried or evaporated milk may be used if the composition of the original milk is first reconstituted by addition of water. Such a formula gives a per-

centage distribution of calories (protein 15%, fat 35%, CHO 50%) which has been found by experience to be suitable for artificial feeding with cow's milk.

According to some observers the protein needs of an infant are supplied when 1 1/2 to 1 3/4 ounces of milk per pound of body weight is given in each 24 hours. In order to fulfill the energy requirements of the infant, sugar is added to this accordingly. The infant's requirements should be calculated upon the basis of what he should weigh, rather than upon actual weight.

In illustration[1] of a method which may be employed in calculating a formula for an infant, we can prescribe for a four-months-old baby weighing 14 pounds. It is assumed that this infant is of average weight for his age. It is also assumed that his energy requirement is 50 calories per pound for each 24 hours.

Twenty-four ounces of milk (1 3/4 ounces per pound) will supply the protein, calcium and a portion of the energy requirement . The amount of energy thus supplied will be approximately 480 calories. The total energy requirement of the infant is 700 calories, and the difference between this and the quantity supplied by the milk is 225 calories. This is to be supplied by additional sugar. One and three-fourths ounces of sugar will furnish 210 calories. Thus, with 20 oz. of milk and 1 3/4 ounces of sugar all of the needs of the infant intended to be supplied by the formula have been furnished with the exception of water. The total formula for a

[1]Jeans & Rand, op. cit., pp. 184-185.

four-months-old baby might be 6 feedings of 6 ounces each or 5 feedings of 6 or 7 ounces each. The addition of 6 to 12 ounces of water will be required.

The prescription will be as follows:

Whole milk	24 ounces	5 feedings of 6 1/2 ounces each at four-hour intervals
Sugar	1 3/4 ounces	
Water	9 ounces	

With all the rules which have been discussed it is apparent that considerable latitude of interpretation is allowed. Each baby is an individual and must be so treated. Necessary adjustments may be required to meed the exact needs of the individual infant. It may be found that slightly more total energy is required for satisfactory growth or weight gain in which case the amount of sugar should be increased.

The amount of milk to be given increases with the age of the infant until at approximately six or seven months of age he is receiving a quart daily. No increase beyond this point is indicated, because by this time other foods are being given. A quart of milk is a suitable intake for the remainder of infancy, and also, preferable, throughout childhood.

The technic of preparing the infant's bottle is important. If facilities for refrigeration are adequate, all the food needed for 24 hours may be prepared at one time. Actual methods of preparing the formula vary of course, depending upon the ingredients used. After the formula has been made according to directions it is poured into previously sterilized feeding bottles. The bottles should then be capped or stoppered with cotton and, when cool, be placed in the icebox.

When ready for use the food should be warmed to 100°F. by placing the bottle in warm water for a few minutes. The temperature of the milk may be tested by pouring a few drops upon the inner surface of the wrist, where it should feel warm but not hot. A bottle should not be warmed over for a second feeding.

The hole in the nipple should be large enough to permit the milk to drop readily when the bottle is inverted, but not so large that it will flow in a stream. Nipples should be rinsed in cold water after use, then sterilized with boiling water, shaken dry and kept in a covered jar. Bottles should be rinsed first with cold water, then washed with hot soapsuds and a bottle brush and then sterilized in boiling water.

An infant should not be more than 30 minutes in taking his food and should not sleep with the nipple in his mouth. The bottle should be placed or held in such a position that the nipple is kept full. At some time during the feeding, and again after it, the infant should be held upright over the nurse's shoulder and patted on the back to allow him to bring up such air as he may have swallowed. He should be placed in his crib and left alone. Again, it is important that regularity in feeding be observed.

Clinical experience has shown that babies fed exclusively on milk alone do not do well. Milk is deficient in certain essentials. Of most of these the body usually has a store at birth. These stores are depleted soon after birth so it is wise to supplement the milk diet routinely at a relatively early age.

Cod liver oil or some other form of prophylaxis against rickets should be given to all infants from the first few weeks of life. Orange juice or some other antiscorbutic food should be given from the second or third week onward. One may commence with a teaspoonful a day and rapidly increase the quantity until the juice of one orange a day is taken.

When the infant's appetite ceases to be satisfied by 30 or 32 ounces of standard formula, new food may be added. Cereals, fruits, vegetables, egg yolk, breadstuffs and meats are gradually introduced until by the end of the first year the diet is quite a varied one. It is not possible to specify a particular age at which the addition of a so-called solid food should be commenced. However, the early use of a varied diet has an educational as well as a nutritional aspect.

Following is a suggested schedule for the age for introduction of various foods into the infant's diet up to the age of 12 months exclusive of milk:[1]

3-4 weeks.	Begin orange juice. Start with one teaspoonful and work up to one ounce. Dilute with equal parts of water. Cod liver oil. Start with one teaspoonful and work up to 3-4.
5-6 months.	Start refined cereals (Farina, Hominy grits, Pablum, Cream of Wheat, Ground Rice). Begin with 2 teaspoonfuls and work up to 2-3 tablespoonsfuls in a month. May be given with or without milk. Should be fed with a spoon.
6-7 months.	Vegetable juices and purees may be added. One vegetable should be given 2-3 days in succession so child becomes used to taste. Thoroughly dried toast or Zwieback may be given

[1]Schedule used in the University of Oregon Medical School Clinic, Department of Pediatrics.

especially at the beginning of the meal.

7-8 months. Teaspoonful of melted butter may be added on toast or vegetable. Yolk of hard boiled egg crumbled. (Start in small amounts). Broth of chicken, beef or mutton if fat removed. The ten p.m. feeding may be discontinued if child sleeps all nite.

8-9 months. Whole grain cereals may be started. Baked potato with butter (no gravy). Applesauce, baked apple and prune pulp.

10 months. Gets 4 meals a day.

The earlier introduction of solid food adds something to the trouble of preparing the food and to the time consumed in feeding the infant. There is, however, the advantage that with the more liberal use of solid food one can adapt an infant sooner to a 3 meal a day schedule, which may prove a great convenience in caring for him.

New articles of diet should be introduced one at a time; two or three days should elapse before another change is made. One should always begin with a small quantity of the new food, not more than a teaspoonful; it is best given at the beginning of the meal. The feeding schedule should not be altered. As each new food is added, it will be expected that the infant will take somewhat less of his old food. It is advisable to reduce the amount of milk offered at the time a solid food is first introduced.

As soon as solid foods constitute any considerable portion of the diet, the calculation of the caloric intake becomes so inaccurate that it is of little value. Appetite assumes an increasingly importance in regulating the quantity of food taken. It has been experimentally shown also that the appetite is a satisfactory guide not only in regard to

the quantity of food, but in the selection of the food itself provided a suitable variety is offered. In practice, the only food likely to be taken in excess by an infant in his second six months is milk; in this case it is advisable to restrict the amount of milk offered, so that there will be more encouragement to take other foods.

Following is given a typical diet that may be fed to an average child of nine months:[1]

6 a.m.	whole milk, 7 oz.
8 a.m.	orange juice, 1 oz.
10 a.m.	cereal, 3 T. milk, 7 oz., some of this on cereal 1 piece of toast
2 p.m.	vegetable or meat broth, 4 to 6 oz. or scraped beef, 1 tsp. white potato, 2 T. green vegetable (mashed and strained), 1 or 2 T. milk, 4 oz. (a smaller amount if broth is given).
6 p.m.	Same as 10 a.m.
10 p.m.	Same as 6 a.m. (may be omitted by the tenth month).

During the latter part of the first year the child should become accustomed to a variety of foods and should depend relatively less on milk. Weaning from the bottle is a great help in attaining this end. This should be begun by the ninth or tenth month; by the end of the first year all milk should be taken from a cup. Children who are allowed to continue with the bottle after this time usually develop the "bottle habit" and often refuse all solid food as long as it is continued. It is also advisable to teach a child to feed himself as soon as possible; this can sometimes be done at the end of the first year.

[1]Holt and Mc Intosh, op. cit., p. 213.

Chapter VI: Feeding Other Than Normal Infants

During acute illnesses the infant's appetite is less than in health. There is at the same time a somewhat lessened digestive capacity. The character of the feeding, however, need not be greatly modified. The milk mixtures used may remain of the same type and the infant be allowed to take what his appetite dictates. He will usually take less than when well. Solid food and the various accessory foods such as cereals and vegetables may be omitted temporarily. Water should be offered at frequent intervals and if not well taken should be forced, or saline solution given subcataneously or intraperitoneally. Food, however, should not be forced during the acute stage of infections, but during prolonged illness food must be forced or given by gavage. As the digestive juices are secreted in lesser amounts during the presence of infections, sweet cow's milk cannot be taken in as large quantities as during health. Lactic acid milk is an especially suitable food for use during illness. In general, it is inadvisable to change the character of the food radically during an acute illness or at the time of an operation.

During excessively hot weather, unless the hygiene is properly cared for, the infant is likely to retain heat. Retained heat has the same effect upon digestion as does fever and acute infections. With good hygiene and a reasonable diet no change need be made in the feeding. If the circumstances are such that the baby cannot be kept cool, the indications for feeding are the same as for acute illness.

Vomiting may occur from a great variety of causes, some of which are trivial while others indicate serious disease. Following are listed some of the most frequent causes of vomiting and the treatment indicated:[1]

(1) Overdistention of the stomach by swallowed air:--If the infant is held in an upright position the air bubble rises to the cardia and is readily expelled. If he is held in a semi-upright position during nursing, much less air is swallowed than when he is recumbent. Before each nursing the baby should be held up and allowed to belch, and after the feeding he should be held over the shoulder and patted on the back until all swallowed air has escaped.

(2) Infections:--In the presence of acute infections, vomiting is a frequent symptom. Infants suffering from otitis media and pyelitis are especially likely to vomit. The vomiting can sometimes be controlled by thickening the food as in the treatment of pyloric stenosis. Refeeding immediately after vomiting or the use of atropine before feeding may be effective.

(3) Too frequent feeding:--Vomiting is much more frequently observed in infants who are fed at short intervals than in those fed at 4 hour intervals. When an infant is fed too frequently his stomach may not be emptied at the time of the next feeding and the food residue plus the ingested food may be greater than the stomach capacity. There is considerable individual variation in the degree of gastric motility. In the case of infants with lowered gastric motility, long feeding intervals are especially necessary in order to pre-

[1]Marriott, McKim, op. cit., pp. 39-40.

have the ability and develop the habit of bringing up food voluntarily from the stomach. The food is held in the mouth for a while and then swallowed, or it may be expelled completely. "Nervous" infants and those of neurotic heredity or environment are especially likely to develop the habit of rumination. A recommended treatment is thick cereal feeding or restraint of the hands. A chin strap may be so arranged as to keep the infant's mouth tightly closed after feeding. This is one instance in which it is acceptable to rock the baby to sleep after feeding or swing him gently in a hammock.

(7) Intracranial conditions:--Vomiting due to such intracranial conditions as meningitis, hemorrhage, or brain tumors is persistent and uninfluenced by the type of feeding mentioned. Thick cereal mixtures, however, are not vomited as readily as milk. Occasionally, when vomiting is so severe that an insufficient amount of food to maintain life is retained, a duodenal tube may be inserted and feeding administered in this way.

(8) Acute abdominal conditions (appendicitis, intestinal obstruction, etc.):--Always to be watched for.

(9) G.I. spasm (hypertonic infant):--Relief may usually be given by the administration of atropine and phenobarbital before the feeding.

(10) Pyloric stenosis:--Pyloric stenosis may be of all degrees. There may be merely a tendency to spasticity of the pyloric sphincter or definite hypertrophy of the muscle with fibrosis and practically complete occlusion of the pylorus. The symptoms start on the average after about the first three weeks of life. The first symptom noted is vomiting. Then

within a week it becomes projectile in character. Emesis occurs during or immediately after feeding and is not associated with nausea. Because of the loss of food the babies are always hungry. They more often lose weight, are usually constipated, and have scanty urine. Later the baby becomes emaciated.

Also in the diagnosis, the occurrence of visible epigastric peristalsis from left to right is important. Often the hypertrophied mass at the pylorus may be palpated. This is about the size and shape of an olive. X-ray may be of some value in aiding the diagnosis.

In an infant with suspected pyloric stenosis, medical treatment should be tried, but the infant should not be allowed to lose weight or remain at a stationary weight for any length of time. Young breast fed babies with a severe degree of pyloric stenosis should usually be operated upon promptly. Infants beyond the age of 3 months who have already been weaned usually should be treated without operation. No infant, however, should be allowed to lose so much weight as to make him a poor surgical risk. Medical treatment consists of the administration of atropine, phenobarbital, the feeding of thick cereal, gastric lavage and re-feeding.

If medical means of treatment prove ineffective, operation should be instituted. It is extremely important to see that the baby is in good condition before surgery. His condition may be improved by a transfusion and by injection of saline subcutaneously. Also intravenous glucose just preceding the operation is of value. The operation usually performed (Fredet-Rammstedt) consists of an incision through the

hypertrophied circular muscle down to but not through the mucosa and parallel to the pyloric lumen. Feedings may be begun 2 hours after operation in small amounts at first, then gradually be increased until the customary amount is reached.[1]

(11) Anhydremia--Dehydration is not necessarily a cause of vomiting but so often an accompaniment of severe prolonged vomiting. Then it becomes a viscious circle. This danger of dehydration should always be borne in mind with any vomiting child. If the skin shows an evidence of loss of elasticity parenteral fluids should be given without delay.

Colic is characterized by contractions of the gastro-intestinal tract of greater than normal intensity. It is associated with pain and crying on the part of the infant. The pain is often so severe that the abdomen is held rigid, the thighs are flexed on the abdomen and the extremities become cold. Colic is more frequent in early infancy because digestive disturbances occur more readily at this time. An important factor in colic production is gas, which may be swallowed air or the result of bacterial fermentation. Swallowed air is more frequently the cause in underfed infants and fermentation in the overfed. Methods for getting rid of air in the stomach already have been discussed. The pain of colic may be so severe that opium or chloral are necessary, but the use of such drugs should be restricted and the treatment directed to the underlying causes of the colic.

Constipation may be due to the food or to anatomical or functional abnormalities of the intestines. A diet relatively

[1]Jeans & Rand, op. cit., p. 341.

high in protein and relatively low in sugar is likely to be constipating; this attributed to the fact that putrefactive bacteria overrun the fermentative organisms; the products of fermentation, the volatile fatty acids, probably do posses a slight laxative action. Milk feedings to which curd (largely calcium caseinate) had been added, such as protein milk, are particularly likely to be constipating; this is due to the formation of insoluble calcium soaps which add bulk to the stool and do not appear to stimulate peristalsis readily. A diet which lacks residue is a common cause of constipation in older infants and children.

Constipation in an infant is most frequently due to an insufficient intake of food or a disproportion between the protein and sugar of the diet. The changes which should be made in the food for relief of this condition depend upon the character of the preceding diet. If the amount of sugar is low it should be increased. If the sugar is already reasonably high the partial substitution of some of the more readily fermentable sugars for the sugar in use is indicated. The liquid malt preparations are most useful for this purpose. In a few instances it may be desirable to diminish the amount of milk. Such alterations in the diet change the reaction of the intestinal content in the direction of the acidity. Both the calcium and the fatty acids assume a more soluble form. The character of the stool changes, and the symptoms disappear.

With young children, more depends upon <u>training</u> than upon anything else; this should be begun early in infancy. Even in young infants habits are formed without difficulty if the child

is put upon the toilet at the same time each day. An older child must be taught to heed the first impulse to evacute the bowel. If the inclination to have a stool is regularly disregarded, it soon ceases to be felt. Regularity cannot be stressed too much in constipation.

Infants are much more likely to develop diarrhea than are older individuals. This may be due to the fact that the gastro-intestinal tract is always working very close to its functional capacity and any condition which lowers the functions of digestion and absorption may lead to the accumulation of food in the intestine which is readily broken down by the organisms present with the formation of irritating products. Furthermore, the bactericidal activity of the gastric juices of the infant is distinctly less than that of the older individual so that the various organisms contaminating the food are more likely to pass into the intestinal tract where they may multiply and decompose the food present.

When diarrhea occurs the food intake is usually decreased and such food as is taken is only partly digested and absorbed, but at the same time metabolism proceeds at approximately a normal rate. Under such circumstances the tissues of the body itself are used to supply the necessary calories and such destruction of body tissues cannot go on indefinitely without leading to serious or irreparable damage. In some forms of diarrhea there is an enormous loss of water from the gastro-intestinal tract and this may be sufficient to lead to a desication of the entire body.

The causes and types of diarrhea may be summarized as follows:[1]

(1) Parenteral infections
(2) Enteral infections
    (a) due to saprophytic organisms
    (b) due to specific pathogenic organisms, e.g., dysentary
(3) Underfeeding
(4) Overfeeding
(5) High external temperature
(6) Unsuitable article of food

In the case of babies fed on the breast or on an artificial food meeting all the essential requirements previously enumerated, the occurrence of diarrhea is usually an indication of some form of parenteral infection. Otitis media, pneumonia, pyelitis, and other infections may be responsible for the diarrhea. In any case of diarrhea accompanied by fever the first step should be to search for any possible focus of infection and this is much more important than changing the feeding.

Many infants who are underfed suffer constantly from a low grade diarrhea. Starvation diarrhea is a fairly common occurrence and is easily remedied by the giving of suitable food in proper amounts.

The principles of the treatment of diarrhea are the elimination of any possible focus of infection and the administration of a food which fulfills the necessary requirements for nutrition.

When the diarrhea is due to to a parenteral infection no change in the character of the feeding is indicated, provided the infant is receiving a lactic acid milk formula. Under

[1]Marriott, op. cit., pp. 44-46.

such circumstances, the diarrhea will continue as long as the infection is present, and will clear with subsidence of the infection, irrespective of changes in the diet.

When diarrhea is obviously the result of taking some unsuitable article of diet, it is usually advisable to reduce the CHO content and to use "protein milk" (skimmed lactic acid milk enriched with curds of whole milk).

In all cases of diarrhea, it is essential that the water supply of the body should be maintained. Water must be given frequently in as large amounts as the infant will take. If the weight drops off rapidly and if the infant appears desiccated, water must be given parenterally in the form of saline solution. When but little food is being absorbed from the intestinal tract additional food may be given parenterally in the form of glucose injections. Also transfusions are valuable in the treatment.

Dysentary is a specific infectious disease, due usually to infection with one of the types of dysentary bacilli. Some strains of the paratyphoid bacillus, bacillus pyocyaneous and other organisms are occasionally the cause.

Dysentery differs from ordinary diarrhea in that there are definite lesions in the gastro-intestinal tract. The lesions vary from a superficial catarrhal process to a widespread necrosis of the mucosa and extensive ulcerations. The lesions are most marked in the lower ileum and colon.

This condition is characterized clinically by the usual constitutional evidences of infection. The fever, which is high, is often prolonged for a period of weeks. Leucocytosis

is usually present, although there may be a leucopenia at the onset. The stools are numerous, often over twenty a day, but not necessarily large. The specific organism may be isolated from the stools.

Since dysentery is a specific self-limited disease, recovery depends on immunity development. A specific serum effective against some types of dysentary infection has been developed. Its employment in other types is useless. The indication in treatment is to maintain nutrition. Fair amounts of food must be given despite the diarrhea. A food with low fat, relatively high protein and moderate amounts of carbohydrate is preferable. Skimmed lactic acid milk or, for older children, skimmed sweet milk with moderate amounts of a quickly absorbable sugar is a good type of food.

The food quantity must be kept below such an amount as would make the diarrhea worse, i.e., produce a food diarrhea. Pain and tenesmus may be relieved by small doses of paregoric or by starch and opium enemata. This also brings about physiologic rest of the intestinal tract and diminishes the number of stools. Parenteral administration of glucose is occasionally necessary to maintain the nutrition. Maintenance of water intake to compensate for the continued loss is important. Marked anorexia is common in dysentery and frequently gavage is necessary. Persistent vomiting often may be controlled by lavage before feeding.

Since dysentery is a communicable infection, the patient should be isolated and precautions taken against the spread of the disease.

Dehydration may be defined as a reduction of the interstitial tissue fluids of the body. It is usually accompanied by a reduction in the volume of blood plasma; it may be accompanied by loss of fluid from the interior of the cells themselves. Dehydration occurs whenever the organism is unable to obtain or retain sufficient water for its needs. Vomiting and diarrhea are the common causes; rarely it results from failure to ingest sufficient water. It may follow hemorrhage or conditions in which large amounts of fluid are sidetracked as exudates.

Dehydration should not be regarded as a simple water deficiency; it is a deficiency of water and minerals (Na and Cl) of which the extracellular fluids are composed. Loss of water alone or of salt alone will, however, lead to dehydration; both are necessary to maintain the tonicity of the body fluids, and a loss of one leads to a prompt excretion of the other.

Although the loss of interstitial tissue fluid produces conspicuous changes, particularly in the skin, the serious consequences of dehydration are due to cellular changes and to the decrease in plasma volume which occurs in severe cases.[1]

The clinical picture of dehydration is often a dramatic one. The dry skin and mucous membranes, the ashen gray color, the mental torpor, the sunken eyes, contracted, wrinkled facies, the sunken fontanel and the retracted abdomen form a characteristic picture. Thirst may be extrme or fluid may be refused. Loss of weight is always striking; it may be precipitous. Respiration may reflect the acid-base disturbance. The pulse is usually feeble; death when it occurs results from a circulatory failure. One of the most striking manifestations of dehydration is fever. However, when the condition develops in-

[1] Holt & Mc Intosh, op.

sidiously it may be accompanied by a subnormal temperature.

Dehydration calls for prompt and energetic treatment. The parenteral administration of fluids is essential in all but the mildest cases. The bulk of this fluid should consist of normal saline, for it must be remembered that electrolytes as well as water have been lost. Disturbances in acid-base equilibrium are quickly overcome, as a rule, by saline alone if proper diuresis is re-established, the excess of acid or base being excreted by the kidney. In all severe cases of anhydremia it is advisable to give glucose solution intravenously twice daily or more often. Such injections increase the blood volume and improve the circulation. The glucose supplies a certain amount of food and also acts as a diuretic. Transfusions are also indicated.

Malnutrition results whenever the body fails to receive or assimilate sufficient food for its metabolic needs and is forced to a greater or lesser extent upon its own tissues. Other terms employed to describe this condition are "wasting disease," "marasmus," "athrepsia," and "infantile atrophy," all synonymous terms applied to a single syndrome. Malnutrition is essentially a state of starvation.

A variety of causes may lead to marasmus; simple underfeeding, improper food or feeding and organic diseases of various kinds which interfere with assimilation by affecting the appetite or otherwise , repeated acute infections or persistent chronic infections are often responsible.

Malnutrition in infants may be of all grades, irrespective of the cause. The infant may simply be below the normal weight for his age and show no symptoms, or he may be

wasted to a skin covered skeleton almost too weak to cry and unable to assimilate even proper food.

Perhaps every organ of the body suffers more or less from the effects of an insufficient food supply. The blood volume is markedly diminished due to a destruction of a portion of its protein content, and as a result, circulation is extremely poor. When marasmus is advanced, the picture is quite characteristic. They look like little old apes, weak and wizened. The skin is pale or of a slate gray color and falls in wrinkles and loose folds on the extremities. The subcutaneous fat has disappeared and the skin over the abdomen and chest is as thin as paper and underneath may be plainly seen the outlines of the ribs and coils of the intestines. The eyes, no longer supported by postorbital fat pads, sink back into their sockets. They are bright, expectant and hardly ever at rest. The fontanel is sunken. The bones of the face are prominent. Often in young infants, small lumps of flesh stand out on each side of the cheeks (sucking pads). This is due to hypertrophy of the muscles of mastication, the result of continuous sucking motions on the part of the starving infant. Owing to the disappearance of fat, the veins are apt to appear prominent. The abdomen is scaphoid or distended. Vomiting and diarrhea are readily provoked. The so-called "starvation diarrhea" is often encountered.

The prevention of athrepsia is much easier than the cure. Adequate feeding at all times and intelligent treatment of diarrhea are the important preventive measures. Underfeeding

or unsuitable feeding should be corrected; infection should be treated. Once the condition has developed, the indication is to give the infant a sufficient amount of food to cover his needs and yet not more than can be taken care of by the gastro-intestinal tract. Unfortunately, it is not always possible to do these two things. The food requirement is high. As much as 200 to 300 calories per kilogram (100 to 150 calories per pound) of body weight daily may be necessary. But tolerance for food is low since digestion and absorption of food is poor. In meeting this therapeutic problem, considerable care must be taken in the choice of food and such measures should be employed as would tend to increase the ability of the infant to utilize the food successfully.

In the selection of food a type should be chosen which is easily digestible and one which offers a medium relatively unfavorable to bacterial growth. It is desirable also to use a concentrated food, since vomiting is very likely to occur if the large amount of food needed is offered in customary dilutions. Two types of food meet these requirements fairly well. When human milk is available it may be fortified by the addition of dried milk and further modified to advantage by partial acidifying. When cow's milk only is abailable, a good preparation is undiluted whole lactic acid milk with added carbohydrate. When a marked diarrhea exists, less sugar and somewhat less fat than customary should be given. Dried milk may be added here too.

The ability of the infant to utilize food may be increased by restoring the blood volume by means of transfusions.

The intravenous injection of glucose is a means of introducing additional food and of temporarily increasing the blood volume, and in that way improving the circulation.

Athreptic infants require mineral salts as well as food, as the loss of considerable amount of mineral matter occurs as the condition develops. Administration of Ringer's solution or normal salt solution subcutaneously supplies both mineral salts and fluid and helps to remedy dehydration.

The body temperature of athreptic infants must be guarded very much as in the case of premature infants. Chilling of the body must be avoided. Exposure to any infection should also be avoided since an infant in this state is especially susceptible to infections.

Under careful and proper treatment a large proportion of athreptic infants recover completely usually without subsequent complication or any sort of serious handicap.

Scurvy is caused by a deficiency of vitamin C. The chief observable changes are those of structure in the bones and of a general hemorrhagic tendency throughout the body. Scurvy is characterized also by pain on motion of the affected extremities and often by anemia. If the diet of the infant is limited to proprietary foods or cow's milk in which vitamin C never was present or has been destroyed by age or heat, scurvy is the unavoidable result. Since vitamin C is stored in the body, a deficiency in the diet is not evidenced clinically for several months. Scurvy is rare in the first six months of life and has its highest incidence in the second six months.

Scurvy responds readily to the addition to the diet of foods containing vitamin C such as orange juice or tomato juice with perhaps the complementary use of ascorbic acid especially in cases of severe vomiting. The milder cases are relieved within a few days. In the more severe cases more time is required to recover from the marked anemia and associated nutritional and bone changes.

Rickets occurs as a result of disturbance of mineral metabolism, or perhaps a more general disturbance in which an abnormal mineral metabolism is the most prominent feature. The minerals chiefly concerned are calcium and phosphorus. In the majority of instances rickets is not due to a deficiency of calcium and phosphorus in the diet, but to an inability on the part of the organism to utilize that which is present. This inability is due to a deficiency of vitamin D or of ultraviolet energy. In the absence of vitamin D rickets is not so likely to develop if the ratio of calcium to phosphorus in the diet is one suitable for efficient utilization. Thus, rickets is less frequent in breast-fed babies because the balance of ingested salts is a favorable one. Cow's milk contains little vitamin D, and the salts of a cow's milk are not particularly well-balanced for infants.

Rickets occurs only in the growing individual. The most marked changes are in the bones and chiefly at the growing ends of the long bones. In rickets the calcium and phosphate deposit in the newly formed bone is deficient. The resulting soft bone (osteoid tissue) shows an overgrowth, thus giving rise to an enlargement of the bones at the epiphysis. The shaft of the bones eventually becomes soft, and

they may show bending according to the direction in which stress is put on them. Changes take place in the bone marrow whick give rise to anemia, sometimes of marked degree.

Rickets causes a delay in the eruption of the teeth and in the closing of the fontanel. An increase in osteoid tissue sometimes occurs on the frontal and parietal bones of the skull, giving rise to a rather square-shaped head. An increase of osteoid tissue at the junction of the ribs with the cartilage of the sternum causes small visible knobs which because of their distribution have been spoken of collectively as a rachitic rosary. The pull of the diaphragm upon the softened ribs, particularly when combined with nasal obstruction, causes deformities of the chest, the most common of whick is pulling in of the ribs at the line of attachment of the diaphragm (Harrison's groove). There may be a scoliosis or kyphosis of the spine.

As rickets advances the muscles show a general weakness and loss of tone. Because of this, rachitic babies are late in sitting, standing, and walking. The abdominal wall is relaxed and the abdomen protrudes. The spleen is often enlarged by simple hyperplasia.

The best method of determining the degree of activity of rickets is by examination of the wrist epiphyses by means of the roentgen rays. The roentgenogram in active rickets reveals the proliferation of osteoid tissue, a cupping of the end of the long bones and diminution of calcium both in the shaft and at the epiphysis, particularly the latter. Rachitic changes can be observed at the wrist when they are evident in any other bones.

Rachitic infants often show low resistance to infections, particularly respiratory infections.

The same measures serve to prevent and to treat rickets--administration of vitamin D in some form and direct exposure to ultraviolet rays. More intensive treatment is required to cure than to prevent the disease. Cod liver oil is still the most generally used antirachitic agent. In addition, there are several types of concentrated preparations of vitamin D available. Milk and other foods are now being enriched with vitamin D. Sun bath or exposure to sun lamps are beneficial when used gradually and intelligently and precautions are used to prevent burning of the skin.

Tetany (spasmophilia) is a condition of nervous hyperirritability in which may occur convulsions, laryngospasm or carpopedal spasm. It is associated with a low blood calcium level. Tetany as it occurs in infancy is found almost exclusively as a complication of rickets. It may be cured by the same measures as are effective in rickets, though symptomatic relief by other means is desirable first, such as the immediate intravenous injection of calcium salts.

Nutritional anemia is the result of a low iron intake over a long period. The diet of the individual past infancy nearly always contains sufficient iron to prevent significant anemia from this cause and consequently nutritional anemia is usually a disease of infancy. Infants with severe anemia from any cause may develop the group of symptoms known as von Jaksh's syndrome. The most characteristic features in addition to anemia are splenic enlargement, a considerable

increase in the white cells of the blood and the presence in the blood of nucleated red cells and other evidences of blood regeneration. A considerable number of these babies die from some intercurrent infection; otherwise eventual recovery is to be expected.

Nutritional anemia responds readily to the administration of iron, though in severe cases transfusions are indicated to hasten recovery.[1]

[1]Jeans & Rand, op. cit., p. 229.

Chapter VII: Psychology of Feeding

Probably no function of infancy is so carefully supervised as that of the taking of food. The baby eats and all is well; he does not eat, and at once becomes the object of rational investigation, clamorous entreaty, or frenzied apprehension as the case may be. He is very likely to find them all greatly to his satisfaction. He is human.

Thus mealtime is often a period of apprehension, objurgation or insistence; the table sometimes a battle ground--both psychologically wrong.

It is natural for young and old alike to crave attention. Every one strives to occupy the center of the stage, and the infant is no exception. He is usually not long in recognizing that the best method of getting there is to make trouble at mealtime. Naturally, the maternal instinct would lead a mother to be hungry for, eat for, digest for her baby if she could. She forgets that food is not always a benefit. If the infant refuse his bottle, and one rarely knows at the time whether the reason is significant or insignificant, let him go without it. If later he is hungry, a drink of water will keep him from harm until his next feeding time. Thus, if he had good reason for the refusal he will not have had undesirable food forced on him; if his refusal was purely tempermental, he will have received no encouragement.

Teach the infant and the older child that mealtime is an opportunity, not an obligation. Good appetite and digestion go always together; hunger means gastric and consequently intestinal efficiency, and hunger can be induced by lack of food.

There is no doubt as to the wisdom and economy of effort in having the struggle, as to food, over in one session rather than spread through many months.

As a rule a rather definite sequence of events is followed in the development of a complex of this sort. The child, by some unrelated accident or as the result of bad management, discovers that great interest is attached to his reception of the offered bottle or spoon. He learns that this interest may be accentuated by refusal or delay on his part. His interest is keenly stimulated by the pantomine of eating for him or threat to give his food to the birdie. As his education goes on, he discovers the endless possibilities of entertainment at mealtime provided this period be sufficiently prolonged.

The hour of feeding has now become a game rather than a serious attempt to satisfy a vacuum. Toys, pictures, stories or music are introduced as new methods of inducement or distraction. Soon the inevitable result of frazzled nerves on the part of the baby and loss of patience on the part of the parent or nurse obtains. The game no longer amuses, it annoys.

So a halt is called, and severity and stern insistence by the parent produce obstinacy and resourceful resistance in the child. Some food is successfully forced into the mouth. The child stores it in his cheek, refusing to swallow and none can make him. His nose is held and perhaps some food reaches his stomach. An accidental vomiting, due to gagging, proves so successful that voluntary gagging and

rejection of food takes place in the list of defensive measures. This found to work so well that it is resorted to regularly as an escape reaction from all sorts of obligations. It is used as a means of emphasizing the importance of anything where emphasis is needed, fright from bad dreams, pain from small hurts, injured feelings from any cause, objections to medication, etc.

In this way mealtime has come to have plainly a psychological significance.

Of the various means for the control of such a situation there is none that ultimately does not depend for its success upon the common factor--hunger. What coaxing, bribery and force itself fail to do, hunger alone will always accomplish/ more surely if rightly applied.

The child's food should be placed before him in smaller quantities than would be normally adequate. He should be given such mechanical aid as is necessary to get the food to his mouth only. If he accepts the offered spoon, he is allowed to continue until the plate is clean. However, with the first sign of objection the meal is stopped and is over until the next. The first meals will be refused. Increasing hunger will make this refusal less complete and, ultimately, nature will demand the fuel needed so vigorously as to break down the habit of refusal.

This ends the first stage of the cure. The main point during the second stage is to have on the plate a small enough quantity so that the habit will be established of eating whatever is there, and all of it.

The process of "starving to it" may take 3 days or 10, with complete success at the end. At times there will be no definite period of correction. For a few days no food at all, then very little and irregularly, then for a long period barely enought to meet the basic need; but in the end success will come. The lesson learned at mealtime through experience is certain to result in improved general control and so often in the dietary management of a child is found an aid to disciplinary measures of quite another sort.[1]

Since food habits are established early, children should be guided from the first to develop the desire to eat the right foods. Forming a good habit is a step in character building; developing the habit of eating the right foods is the foundation of good nutrition. Character building and body building in this way go hand in hand.

It is well to accustom the child early in his life to a variety of foods, one by one. By the end of the first year the baby sould have been given repeatedly eggs and some of the more usual fruits, vegetables, and cereals as supplements to his principal food, milk. Start with small amounts and increase the portion gradually. Allow the baby the chance to learn the flavor and texture of one new food before another one is introduced to him.

He may object to new foods at first; in fact it is not uncommon for a baby to spit out the first few mouthfuls of any food that is strange to him. He has to get used to new tastes, different temperatures, strange textures, and to new

[1]Wilcox, Herbert B.,A.B.,M.D., Infant and Child Feeding, D. Appleton & Company, New York and Londong, 1928, pp. 149-153.

eating utensils. Changing the baby's diet from a liquid to semisolid and finally to solid foods must be done step by step. Long before he gives up the bottle or the breast the baby should be taught to take water, fruit juice, cereal, gruel, and strained vegetables from a spoon and then from a cup. Even the young baby gets hard toast or zwieback to exercise his gums.

Children should always be served small enough portions so that they can finish the whole amount. Parents sometimes overestimate the capacity of the young child, and serve him so much that he is too discouraged to begin to eat, or that he can not finish even though he makes a good start.

A schedule should provide regular hours for meals, exercise, and sleep in order to keep the body healthy and the appetite normal.

The mother's responsibility does not end with careful selection and regular hours of serving suitable food. What she offers must be well prepared and attractively served. Lumpy cereal, scorched cocoa, or orange juice containing castor oil may be the starting point of a food dislike in even a very young child. Food should never be used as a carrier of medicine.

Gay dishes, a bright bib, a sunshiny room, happy comradeship, food good to look at and to eat, make for good appetite and good digestion. The mother who is calm and unhurried at mealtime is a fortunate addition to this background, even for the very young baby.

Children who have their meals with the family group should have a chance to benefit by good examples in eating. Children

are observant. They also are great imitators, and want to be "just like" the adults they admire. Choosiness in foods is often the result of imitation. The fewer the reminders to eat and the better the example set, the greater the result with observant children.

The joy of accomplishment is so absorbing that the child who feeds himself seldom becomes a problem at mealtime. He is too busy and happy at the table to refuse to eat. The child as young as 15 months can learn to feed himself if he is given the chance to practice, always with his own spoon and fork that fits his small hands.

Feeding one's self is a slow, awkward, and spilly process at first, and the busy mother is tempted to save time and muss by wielding the spoon herself; but this only postpones the child's independence. It is better to protect his clothing with a large bib, place his table on a washable floor, give him table tools that he can handle with ease, and then let him experience the joy of self-help. If he has a few accidents in the beginning pass them off lightly and without rebuke while he helps to clear up the mess he has made.

Appetite is a mental expression of physical condition. A healthy child who has played vigorously out of doors and has slept long hours with fresh air about him is, as a rule, ready to eat when called. Time should be allowed between meals for the stomach to become empty so the child will have a "hungry appetite." Some food problems develop from "piecing," or eating at all hours, or from running too close a schedule of regular meals. For this reason the question of mid-morning and mid-afternoon lunch must be decided according to the child's

Too much food talk defeats the desired aim. Positive comments are more effective than negative ones, but in most cases the less discussion about eating habits the better. It is wiser to adopt the casual attitude of expecting the child to enjoy his food than to emphasize that he must eat "what is good for him." Urging or forcing children, to eat is not a good policy; it is likely to develop or to increase the balkiness called negativism. Quietly arranging for the "do's" and "can haves," never harping on the "don'ts" and "can't haves," but showing firmness if the child refuses, are good rules to follow in establishing food habits in the early years.[1]

[1]U.S. Department of Agriculture, "Good Food Habits for Children," Leaflet number 42, Washington, D.C., May 1929.

Chapter VIII: The Child's Diet

The fundamental food requirements are the same for the child as for the infant, though the quantitative need differs. The rate of growth of the child is determined to a considerable extent by the kind and amount of food he is given. Defects in the diet may cause malnutrition and sometimes serious illness; they may lead to lowered resistance to infection and often to intellectual inertia.

The kind of food required by children of different ages varies little, but the amount and form vary somewhat according to the activity and age of the child. Much has been said concerning the desirability and usefulness of milk. One quart of milk daily is the usual accepted requirement. Exceptions can be made, if necessary, when nutritional problems are encountered. In addition to a quart of milk daily the diet should include at least one egg, one serving of meat or fish, two vegetables, two fruits and at least an ounce of butter. Other foods may be added to satisfy the appetite and to maintain weight. Children should be encouraged to eat larger quantities of vegetables and fruit than ordinary are taken. A variety of these should be offered in order that the child will not form definite likes and dislikes.

Certain foods should not be permitted, or should be allowed only occasionally or in small quantities. Some are inadvisable because they are relatively indigestible; others because they have no special food value and tend to replace more valuable articles of food. Sugar at the beginning of a meal tends to satisfy the appetite too quickly. In between

meals, it dulls the appetite for the forthcoming meal. It is important to establish the habit early of serving sweets only as dessert or immediately after a meal, and in limited quantities. In this way sweets may become a very good incentive for the poor eater to clear his plate. Given under suitable supervision, suitable sweets for children include raisins, dates, jelly, jam preserves, raw, ripe, or cooked fruits, simple candies, cake and cookies not too sweet or too rich in fat, custards, puddings, ice-cream, fruit sherberts, and other simple desserts.

Not more than one slice of bread and butter at each meal should be permitted until the other foods have been eaten. Cereal should be served not more than once daily. Broth, gelatin, gravy and flour pastes should be used sparingly. Fried foods, spices, coffee, tea, pop, pickles, rich pastries, pie, wieners, sardines, and dried meats ordinarily should be prohibited.

The method of preparing foods and the manner serving them are as important as a proper selection of foods.

The methods of preparation of foods for children should be the simplest possible. Meats should be well cooked; potatoes mashed or baked; vegetables boiled until tender and seasoned with salt and butter; desserts should be simple and wholesome. Milk should ordinarily be served plain. Children prefer simple foods, and no attempt should be made to accustom them to fancy or highly seasoned dishes.

Great care should be taken in serving the diet to see that it is attractively served and that the size of the portions is in keeping with the age and size of the child.

Even foods which are much disliked will be consumed if served in small quantities. The maxium should be that the child eats everything on his plate, and this he cannot do unless the person serving the diet uses great care in the preparation of his tray.

When a child has had proper training in food habits from infancy, few difficulties will be encountered in getting him to take his food. Children present such individual problems that no set of rules can be evolved which will apply in every case.

Chapter IX: Diet in Disease

Malnutrition in the child is common. It may depend on chronic illness or infections, but in the majority of cases poor dietary and eating habits are the underlying causative factors. Malnourished children tire easily, are more subject to infections, become irritable and demand entertainment. They assume faulty postures and avoid mental exertion.

In order to correct malnutrition the underlying causes must be found and corrected. Foci of chronic infection should be eradicated; excessive actively curbed. Sufficient sleep must be obtained. A rest hour in the middle of the day is beneficial. When all of these things have been done, the child is ready to gain. The remaining problem is to bring about the ingestion of sufficient and proper food. This is not always easy. Proper training in food habits is by far the most important factor. Drug tonics have little or no effect upon the appetite.

Obesity is the result of the ingestion and absorption of food in excess of the body needs. In a few instances the requirements are decreased by endocrine dysfunction, but in most cases the cause is merely ingestion of excessive food. In the latter cases the remedy is to supply food low in energy value, but which will satisfyy nutritional requirements in all other respects.

Celiac disease (chronic intestinal indigestion) is a chronic indigestion of unknown etiology which is characterized by an inability to absorb fats and a digestive intolerance for complex carbohydrates. When customary diets are

fed, diarrhea results and the ultimate effect in the untreated case is extreme malnutrition. The disease responds readily to a diet of protein and simple sugars and complete recovery is to be expected.

Dental caries depends primarily on faulty nutrition. A diet complete in all of the nutritional essentials prevents tooth decay and arrests decay already in process.

Simple goiter represents a hyperplasia of the thyroid and is entirely dependent upon an insufficient ingestion of iodine. It occurs in those geographical regions where the iodine content of the soil and ground water is low. It may be prevented by additions of iodine to the diet and to some extent may be relieved in the same manner.

In diabetes mellitus the utilization of sugar after absorption is defective. It is this defect which is the primary cause of all of the symptoms associated with this disease. In uncontrolled diabetes the following phenomena may be encountered: glycosuria, hyperglycemia, ketosis, acidosis, increased hunger and thirst, polyuria, increasing and severe malnutrition. The defect in sugar utilization is correctible by the hypodermic injection of insulin. The customary method of managing a diabetic child is to prescribe a diet of known composition and suitable for nutritional needs and then to give insulin in measured quantities exactly sufficient to balance the insulin deficit of the body. Undesirable symptoms arise from either too much or too little insulin. With too little, the diabetes progresses and acidosis results. With too much insulin the symptoms of insulin occur.

In insulin shock the following symptoms may be observed: irritability or silliness, drowsiness or lassitude, hunger, pallor or flushing, sweating, dilatation of the pupils, increased lack of response, unconsciousness and convulsions. The remedy is administration of dextrose.

Acidosis which is clinically evident may have symptoms as follows: deep pauseless breathing, flushed cheeks, dry mouth and skin, vomiting, extreme thirst, sometimes an acetone breath can be detected, and later stupor and coma leading to death. In the treatment of diabetic acidosis alkali should be used sparingly or not at all. The need is for insulin, sugar and large quantities of fluid.

No cure for diabetes is known, but with good management the diabetic child can be as healthy and vigorous as any other. He needs to acquire a mental attitude which will give him a perspective on life such that they can be reasonable contented. He must be taught to face the situation squarely and be made to realize that he can participate advantageously in the activities of those about him. It is preferable that the diabetic child share in the responsibility of his health. As early as possible he should be taught to weigh his foods and to test his urine. A good mental attitude will be developed more quickly by such responsibilities and more quickly will the patient be impressed with the importance of careful regulation of all of the factors which influence diabetes.[1]

[1]Jeans & Rand, op. cit., p. 365.

Chapter X: Basic Food Requirements for Different Age Groups for Each Day for the Normal Child[1]

12 to 18 months of age:

Milk--One pint to one quart.
One egg--Hard cooked, then grated. Cook slowly in water which is kept below boiling point.
Two sieved vegetables--peas, carrots, string beans, spinach, or tomatoes.
Two cooked sieved fruits--apples, prunes, peaches, pears, or apricots.
Juice of one orange (1/3 cup) or tomato juice.
Ground liver, ground lamb chop, scraped beef or cottage cheese.
Butter.
Cereal (as Cream of Wheat or Farina), crackers, toast, potatoes and simple puddings as required to maintain normal body weight.
Cod liver oil as odered by the physician.

18 months to 3 years of age:

Milk--One pint to one quart.
One egg.
Two vegetables--besides potatoes--peas, carrots, string beans, beets, spinach, tomatoes, asparagus.
Two fruits--cooked apricots, peaches, pears, apples, prunes or raw bananas.
Juice of one orange (1/3 cup) or tomato juice.
Finely chopped liver, beef, lamb, chicken or cottage cheese.
Butter.
Cereal (as Cream of Wheat or Farina), toast, crackers, potatoes, and simple puddings as required to maintain normal body weight.
Cod liver Oil as ordered by the physician.

3 to 6 years of age:

Milk--one pint to one quart.
One egg.
Two vegetables besides potatoes--peas, carrots, string beans, asparagus, spinach, beets, tomatoes, cauliflower, lettuce, celery.
Two fruits.
Juice of two oranges (2/3 cups) or tomato juice.
Meats--beef, lamb, liver, chicken or fish.
Butter.
Cereals--bread--potatoes, and simple puddings as required to maintain normal body weight.
Cod liver oil as ordered by the physician.

[1]Schedule used by the Univ. of Oregon Medical School Clinic, Department of Pediatrics.

6 to 12 years of age:

Milk--one pint to one quart.
Eggs--one to two.
Two vegetables besides potatoes--at least one of them should be a vegetable which grows above the ground.
Two fruits.
One glass of orange juice or tomato juice.
Meat--Beef, lamb, chicken, liver or fish.
Butter.
Cereals, bread, potatoes, and simple puddings as required to maintain normal body weight.
Cod liver oil as ordered by the physician.

Chapter XI: Public Health Aspect and Challenge

The prevalence of malnutrition among our boys and girls makes us wonder whether nutrition education has been pushed to the background to make way for seemingly more complex or more immediate problems; or whether the danger and ill-effects of malnutrition are sufficiently recognized.

Dentist find caries and malocclusion almost universal among children. Medical examinations of children reveal far too many deviations from normal health and development. Diseases such as pellagra and rickets are frequently encountered. Clinical evidence supports laboratory findings in the conviction that a large percentage of these disorders are manifestations of faulty diet during prenatal life and early childhood. There is evidence to show that T.B. and other infections of the respiratory tract find a foothold more readily among malnourished individuals. Although malnutrition is largely preventable and although its prevention is largely an educational problem, yet we find it among children in all economic levels.

"Various estimates place the number of children in our country who are thus handicapped within a range that includes from 15 to 30 percent of the child population. In other words, according to the most conservative estimate, over six million of our forty-five million children are malnourished, or one in every six or seven."[1]

Children who are below par physically increase the cost of our private and public health agencies and of our

[1]White House Conference, op. cit. p. 27.

educational systems. But as great as is the cost in dollars and cents, malnutrition has a more vital and far-reaching effect in its influence on the child himself. Such boys or girls, arriving at the working age, are frequently hampered in their choice of occupation, earning capacity, and chances for advancement, because they are unable to stand the strain of competition. The effect which such conditions exert on the hopes, the ambitions, the courage and the self-respect of the child, his attitude toward life, and his contribution to the community in later years is immeasurable. It will, doubtless, vary with the individual, but it is evident from the observations and experiences of the past that these handicaps will influence economic productivity, individual advancement, and the sum of human efficiency and happiness. We have before us the problem of saving our boys and girls from physical and social handicaps arising from a lack of nutrition information. This problem involves not only cooperation among the workers in child health and general public health programs but it also challenges us to give the education of the parents serious consideration.

Parents are naturally the most important individuals in nutrition education. They alone are in positions of authority to see that the recommendations given are put into practice.

If all parents possessed sufficient information, ability, and money to create a favorable home environment for children, to teach them good food and other health habits, to provide them with competent medical and dental supervision,

and to instill in them a desire for good growth, the public health aspects of child health and protection would practically disappear.

Most parents, however, lack one or more of the desirable assets suggested above. An important part of the child health program, therefore, must be the education of parents to understand the importance of health and the factors contributing to health protection. Those who are unable to solve successfully problems which interfere with the proper development of their children need guidance and assistance. This is particularly true in communities where the economic level is low, or where large numbers of families are obliged to adjust their home life to the unfamiliar living conditions, food supply, and food customs of a new land. It cannot be too strongly emphasized that progress in nutrition, as in other elements of child health, depends on the extent to which parents are aroused and informed, for they dominate and largely control the situation in the home.[1]

[1] Ibid., pp. 19, 26-27.

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