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SELF SELECTION OF DIET BY NEWLY WEANED INFANTS

AN EXPERIMENTAL STUDY *

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This experiment may be described briefly as that of (1) allowing newly weaned infants to choose their own foods in such quantities as they may desire from a fairly wide range of commonly used natural food materials, unmixed, unseasoned and unaltered except, in the case of some, by cooking in the simplest manner, and (2) assembling data on the food consumed and the condition of the infants.

It was hoped by this experiment to obtain information on the following points:

1. Whether infants of weaning age could and would when removed from the breast choose their own foods from those placed before them, without aid, as do adults, and in sufficient quantities to maintain themselves.

2. If they did so choose, would they eat few or many of the large number of articles offered, and would they eat indiscriminately what was nearest at hand, governed only by their caloric needs or would they show definite preferences, and if so, would these preferences tend toward a vegetarian, a carnivorous or an omnivorous type of diet?

3. Would such infants maintain themselves in a state of digestive health or would they suffer impaired digestion with general discomfort, vomiting, diarrhea or undigested food in the stools?

4. Would their growth, eruption of teeth, gain in weight and general well-being equal those of infants fed in the usual way on the diets commonly prescribed for this age?

It was further hoped that this experiment might throw some light on the question of whether the infant at this age has any instinctive means of handling either qualitatively or quantitatively the problem of nice adjustment of the various food elements, organic and mineral, necessary to optimal nutrition.

In considering the relations of such an experiment to current dietary investigation and practice, it is perhaps not amiss to call to mind at this point that the period of infancy from birth to weaning affords unique

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conditions for dietary experimentation. Here one still has the natural model, the breast-fed infant living on the one natural food provided for it, a food known to be adjusted with exquisite nicety to its optimal nutrition. His characteristic appearance, how fast he should grow and develop, are matters of common knowledge. And for years this natural model has been studied from every angle by pediatricians, and its optimal food, woman's milk, has been subjected to searching investigation and analysis, while countless experiments have been made with modifications of other milks in the attempt to reproduce or equal it, the results always being checked against the natural models. The success of direct human dietary experiment in this age group and the approach to the optimal in the planned diets now used for infants when breast feeding cannot be had are attested by the reduction in the death rate of artificially fed infants from causes connected with feeding and by the fact that no extramedical cult has ever successfully invaded this field.

Direct dietary experimentation with adults is, on the other hand, seriously handicapped by many difficulties. The circumstances of adult life practically preclude experiments lasting over years, and the conclusions drawn from short-time experiments tend to be vitiated not only by the relatively small fraction of the individual's total nutritional life covered but by the influences of previously acquired dietary tastes, prejudices and habits, as well as by the presence in the adult body of considerable reserves of fats, proteins, carbohydrates, important minerals and some of the vitamins. Other complications are added by man's well known ability to exist in an apparent state of health whether as a strict carnivore or as a strict vegetarian, and by the fact that he includes in his dietary during the greater part of his life purified, sophisticated or incomplete food products not found as such in a state of nature and further modified by mixing, by added flavoring substances, by losses of soluble substances in cooking and by preserving. Finally, there are no natural models for this age. One knows neither what a man fed on an optimal diet would eat nor what he would look like.

These disadvantages are also operative in lesser degree in experiments with children of school age, the proportion that the length of time of an experiment bears to the total nutritional period being, however, greater and the reserves of food elements in the presence of continuing growth relatively small.

Healthy breast-fed infants of weaning age present for the purpose of dietary experiment a group midway between infants of preweaning age and older age groups. For their diet after weaning, there are it is true, no natural models by which to check diet and its effects, but these ready-to-wean, breast-fed infants are thus far natural models, the product of an optimal nutrition, and presumably freer from nutritional defects than any older group that can be found. As yet untampered with, they do not have theories, tastes or habits with

respect to food other than breast milk, and the rapidity of their growth has precluded the laying up of important reserves of food materials, so that they afford a more delicate test of dietary adequacy than can be found in older children.

The diet and nutrition of this age group seem to have been subjects of less experimentation and investigation than have been those of either nurslings or children of school age, and the pediatrician's practice in feeding them, therefore, more ex cathedra in nature. Jundell,[1] however,

Figure 1

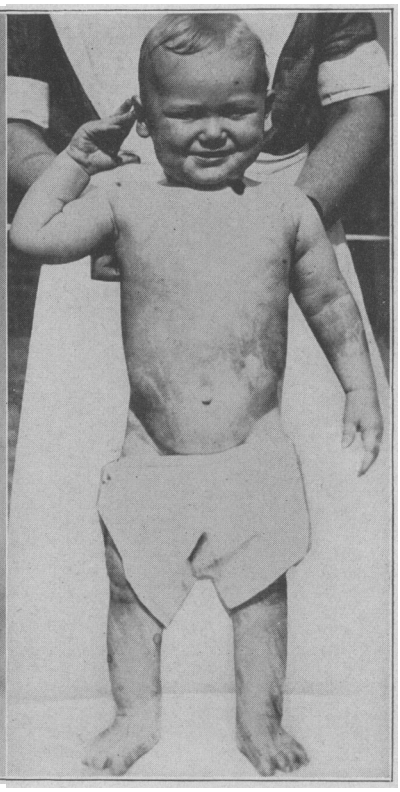

Figure 2

Fig. 1.—Appearance of Earl H. at beginning of six months' experimental period (age, 9 months).

Fig. 2.—Appearance of Earl H. at end of six months' experimental period (age, 15½ months).

as came to my notice six months after my work along this line had been under way, made an interesting and important series of experiments, extending from 1914 to 1920, on mixed diet during the first year of life. He included fish, eggs and meat, as well as dishes made by combining

1. Jundell, I.: On Mixed Diet During the First Year, Acta Paediat. **1**:240, 1921; Mixed Diet During the First Year, ibid. **3**:159, 1924.

food materials, and as a result of these experiments which lasted in individual infants from one to four months, stated: "What my experiments show is that there is evidently no risk in giving mixed food to a child who has passed into its third quarter and that such feeding in certain cases may have a very favorable effect on the child's health and may even be quite necessary for a good development."

I am unaware of any well controlled experimental work showing that eggs or meat should not be introduced into the diet at a given age, or that, to normal infants, in the last quarter of their first year, eggs (or an egg) should be given every other day rather than every third day or

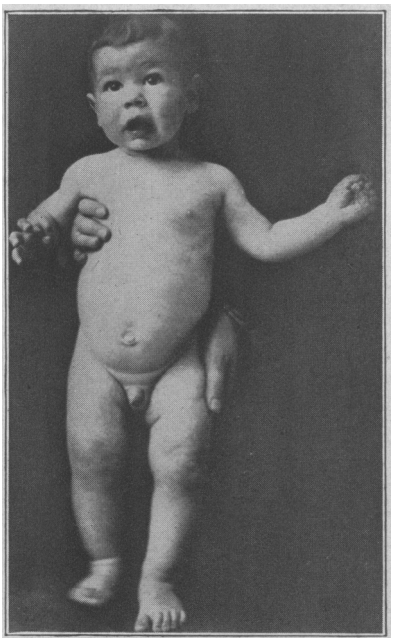

Fig. 3.—Appearance of Donald R. at the fifth month of the experiment (age, 15 months).

every day. However, pediatricians are accustomed to give directions for the diet of children from 7 months to 3 years of age in which they carefully state not only the articles to be given to the exclusion of all others, but the amounts of each and the frequency with which they shall be offered. This is prescription of diet by limitation, a practice that in the case of adults is generally reserved for the ill, the thin or the obese, in short, for those who deviate in some way from the accepted normal. Such a method takes little account of appetite and is apparently predicated on a belief that the transition from the suckling diet to one embracing the natural foods of adult life should be made gradually over a period of

three or four years. This belief does not find support in the weaning habits of animals, but is strongly supported by the almost incontrovertible evidence of the digestive troubles and state of nutrition of infants who on weaning are set up at the family table and allowed to eat the pastries, preserves, gravies, white bread, sugar and canned foods that are commonly found there. It should, however, be kept in mind that such incomplete, altered and sophisticated foods, many of which formed no

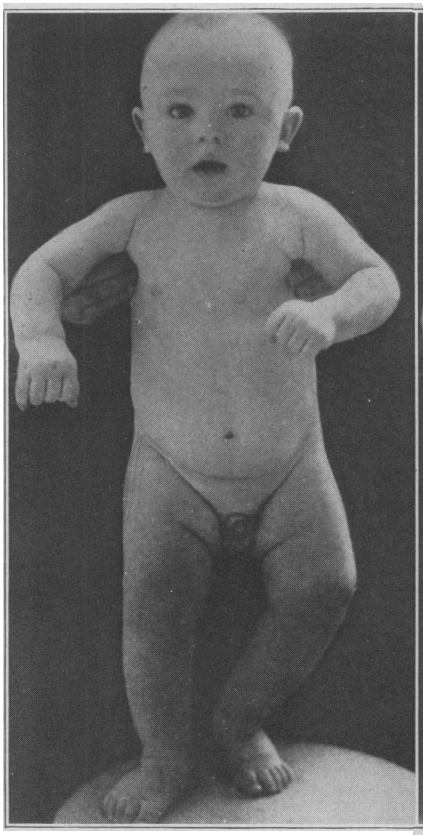

Figure 4

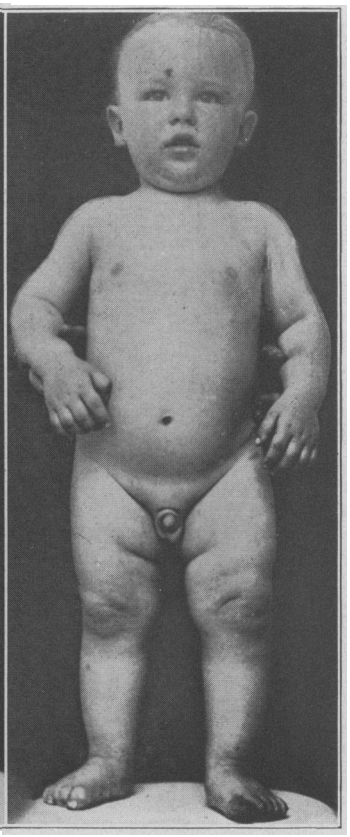

Figure 5

Fig. 4.—Appearance of Abraham G. at the beginning of the experiment (age, 8 months).

Fig. 5.—Appearance of Abraham G. at the end of the experimental period of one year (age, 20 months).

considerable part of the diet a hundred years ago instead of being staples as they now are, have not by any means been shown to be optimal dietary constituents even for adults, some of them indeed being "suspect" at the present time, according to the foremost students of nutrition. The question of whether the infant of weaning age can or cannot use and

thrive on a diet comprising most of the natural foods of adult life cannot then be answered by so simple a means as the familiar lay experiment of allowing the infant to eat at the average family table, especially when it is remembered that growth shows up defects in diet that can hardly be appreciated when only the static adults subjected to the faulty diet are observed.

It was hoped, then, that this experiment might arouse interest in and perhaps in some small way contribute to the knowledge of basic considerations in feeding this age group, since, obviously, if infants allowed to choose their own foods from a wide variety of simple natural ones suffer impaired digestion or are inferior in their nutrition to those fed by the present methods, our practice in prescribing by limitations is thereby given addtional sanction, and more intensive study of the optimal limitations in articles, amounts and frequencies is indicated.

Thus far, three infants (figs. 1 through 5) have been subjects of the self-selected diet experiment, two of them, Earl H. and Donald R., for periods of six months each, and the other, Abraham G., for one year. In each case, the procedure was as follows:

The infant was admitted to the children's ward of Mount Sinai Hospital, and for the first three days was exclusively breast fed by his mother. During this time the history was taken, and a physical examination, a blood count and examination of the urine was made, as well as a roentgenogram of the bones and a determination of blood calcium and phosphorus (Kramer and Tisdall method) and at least three determinations of the p_H of the gastric contents after breast feeding. A psychometric examination was made later after the infant had become accustomed to his surroundings. On the fourth day, breast feeding was discontinued and the experiment proper begun.

The list [2] of foods used in the experiment are given in table 1.

The list was made up with these considerations in mind:

It should comprise a wide range of foods of both animal and vegetable origin that would adequately provide all the food elements, amino-acids, fats, carbohydrates, vitamins and minerals known to be necessary for human nutrition.

The foods should be such as could generally be procured fresh in the market the year around.

The list should contain only natural food materials and no incomplete foods or canned foods. Thus, cereals were whole grains; sugars were not used nor were milk products, such as cream, butter or cheese.

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2. The original list (used only with Earl H., and published in the *American Dental Journal*, June, 1927) included for the first three months cod liver oil and a milk containing cod liver oil (S. M. A.), which was added because the infant had active rickets, also common salt and the iodized salt now widely used. Through an error in our information from the local packing house, it was also stated that sweetbreads were "thymus and thyroid glands." Later, this was found not to be the case, all sweetbreads used being thymus gland.

The preparation of the foods was as simple as possible.* All meats, vegetables and fruits were finely cut, mashed or ground. Oatmeal and ground wheat were served both raw and cooked, as were beef, bone-marrow, eggs, carrots, peas and cabbage. Lamb, chicken and glandular organs, all of local origin and not Federal inspected, were cooked as a measure of safety. Cooking was done without the loss of soluble substances and without the addition of salt or seasonings. Water was not added except in the case of cereals. Combinations of food materials such as custards, soups or bread were not used, thus insuring that each food when eaten was chosen for itself alone.

*1. Water (city tap water) was served in a glass on every tray and offered between meals. Records were not kept of the amounts taken.

2. Sweet milk was grade "A" raw milk regularly used for infants and children in the hospital.

3. Sour (lactic) milk was prepared by culture from grade "A" raw milk.

4. Common table salt and iodized salt were used for the first infant (Earl H.); for the other two (Abraham G. and Donald R.), only sea salt (Seisal) was served.

5. Apples (raw) and bananas (raw) were weighed whole and the skins saved to be reweighed with uneaten remains of portions served.

6. Orange juice was strained through a wire strainer. Orange sections consisted of pulp only.

7. Fresh raw pineapple (the edible portion) was finely cut or ground.

8. Peaches (raw), the edible portion, free from skins were finely cut.

9. Tomatoes (raw), the edible portion, free from skins were finely cut.

10. Apples (cooked), beets, carrots (cooked), peas (cooked), turnips, cauliflower, cabbage (cooked) and spinach were cut or ground, weighed raw and cooked in covered casseroles in a steamer. Potatoes were baked. Bananas when cooked were baked whole without skins and mashed or finely cut.

11. Lettuce, carrots, cabbage and peas were also cut or ground and served raw.

12. Oatmeal (steel cut) and wheat (whole wheat ground by the old process and not heat treated) were served raw.

13. Oatmeal, wheat, corn meal (yellow) and barley (whole grains) were cooked in a double boiler for three hours. To prepare them, 1 cup of cereal was used to 5 cups of water; 20 Gm. of cereal when thus cooked weighs 100 Gm.

14. Rye, which when cooked with water alone makes an extremely sticky mass almost impossible to manage, was given as "Ry-Krisp," made of whole rye flour and water with 1 per cent common salt added (manufacturer's information).

15. Beef (a lean piece of round) and lamb (a loin lamb chop from which 50 per cent of the fat was removed) were ground, weighed before broiling underneath a gas flame, with the dish in which they were to be served held under to catch any drippings, and weighed again, the loss of moisture in cooking (usually 5 or 6 Gm.) being made up by the addition of water.

16. Bone marrow was weighed before cooking and was cooked in the dish in which it was served by holding the dish under the broiler.

17. Bone jelly was made by boiling 5 pounds of veal bones in 3 quarts of water, the mixture being boiled until 1 quart remained.

18. Chicken, sweetbreads, brains, liver and kidneys were finely cut and cooked in covered casseroles in a steamer. These were weighed after being cooked.

19. Fish (haddock) was finely cut or ground, cooked in a covered casserole in the steamer and weighed after being cooked.

20. Eggs were served raw and soft poached.

[NOTE: Salt or other seasonings, butter, cream or milk were not added to any of the foods either in cooking or serving. "Ry-Krisp," according to the manufacturers, has 1 per cent of common salt added in its making.]

The entire list could not, of course, be gotten ready and served at one time and was therefore divided and served at three (in the early weeks, four) meals a day (table 2), this arrangement providing a wide variety at each meal. Both sweet and sour (lactic) milk, two kinds of cereals, animal protein foods, and either fruits or vegetables were served at each meal according to a fixed schedule. Each article, even salt, was

TABLE 1.—*Foods Used in Experiment*

1. Meats (muscle cuts):
   - Beef
   - Lamb
   - Chicken
2. Glandular Organs:
   - Liver
   - Kidney
   - Brains
   - Sweetbreads (thymus)
3. Sea Food:
   - Sea fish (haddock)
4. Cereals:
   - Whole wheat (unprocessed)
   - Oatmeal (Scotch)
   - Barley (whole grains)
   - Corn meal (yellow)
   - Rye (Ry-Krisp)
5. Bone Products:
   - Bone marrow (beef and veal)
   - Bone jelly (soluble bone substances)
6. Eggs
7. Milks:
   - Grade A raw milk
   - Grade A raw whole lactic milk
8. Fruits:
   - Apples
   - Oranges
   - Bananas
   - Tomatoes
   - Peaches or Pineapple
9. Vegetables:
   - Lettuce
   - Cabbage
   - Spinach
   - Cauliflower
   - Peas
   - Beets
   - Carrots
   - Turnips
   - Potatoes
10. Incidentals: Sea salt (Seisal)

served in a separate dish, salt not being added to any, nor was milk poured over the cereal. All portions were weighed or measured before serving and the remains weighed or measured on the return of the tray to the diet kitchen.

Weighing of the original portions and their uneaten remains was done on gram balance scales. Salt was weighed to the nearest half gram, other foods to the nearest gram. Liquids, with the exception of water which was not measured, were measured in cubic centimeters.

Sources of Error.—The most important source of error in getting accurate weights and measures of the food actually consumed was the loss from spilling of small amounts of liquids drunk from glasses by infants unaccustomed to drink from glasses and unable to hold a heavy glass unaided, and from the occasional dropping of bits of one kind of food into a dish of another kind of food of such a nature that complete separation of the two was difficult. Weighing, done before and after eating, of the bib and of the sheet on which the infant's chair

and table were placed during meals showed that during the first three months of the experimental period, the loss of irremovable food and liquid on the bib was from 20 to 50 Gm. (average, 39.3 Gm.) per meal, and on the sheet, from 10 to 25 Gm. (average, 17.2 Gm.) per meal, the loss in each case being chiefly spilled liquids. The loss from spilling was a steadily decreasing one as the infants

TABLE 2.—*Self Selected Diet for Children*

Date..... Name.....

Hour	Amount Sent	Article of Food	Amount Returned	Amount Consumed	
7 a. m.	.....	Milk, grade A.....	.....	.....	.....
	.....	Milk, lactic.....	.....	.....	.....
	.....	Seasalt (seisal).....	.....	.....	.....
	.....	Apples, raw.....	.....	.....	.....
	.....	Apples, cooked.....	.....	.....	.....
	.....	Orange (juice or pulp)...	.....	.....	.....
	.....	Wheat, raw.....	.....	.....	.....
	.....	Wheat, cooked.....	.....	.....	.....
	.....	Barley, cooked.....	.....	.....	.....
	..... 1*	Brains, cooked.....	.....	.....	.....
	.....	Kidneys, cooked.....	.....	.....	.....
	 2	Sweetbreads, cooked.....	.....	.....	.....
	.....	Liver, cooked.....	.....	.....	.....
	* 1 and 2 served on alternate days, never on the same day				
12 m.	.....	Milk, grade A.....	.....	.....	.....
	.....	Milk, lactic.....	.....	.....	.....
	.....	Seasalt (Seisal).....	.....	.....	.....
	.....	Ry-Krisp.....	.....	.....	.....
	.....	Bone marrow, raw.....	.....	.....	.....
	.....	Bone marrow, cooked...	.....	.....	.....
	..... 1*	Beef, raw.....	.....	.....	.....
	.....	Beef, cooked.....	.....	.....	.....
	 2	Lamb, cooked.....	.....	.....	.....
	 3	Chicken, cooked.....	.....	.....	.....
	.....	Lettuce, raw.....	.....	.....	.....
	..... 4†	Potatoes, cooked.....	.....	.....	.....
	.....	Beets, cooked.....	.....	.....	.....
	.....	Carrots, raw.....	.....	.....	.....
	 5	Carrots, cooked.....	.....	.....	.....
	.....	Turnips, cooked.....	.....	.....	.....
	.....	Cauliflower, cooked.....	.....	.....	.....
	.....	Cabbage, raw.....	.....	.....	.....
	.....	Cabbage, cooked.....	.....	.....	.....
	 6	Spinach, cooked.....	.....	.....	.....
	.....	Peas, cooked.....	.....	.....	.....
	.....	Peas, raw.....	.....	.....	.....
	.....	Cornmeal, cooked.....	.....	.....	.....
	* 1 and 2, 1 and 3, 2 and 3 served on successive days † One group of three vegetables served each day (4, 5 or 6)				
5 p. m.	.....	Milk, grade A.....	.....	.....	.....
	.....	Milk, lactic.....	.....	.....	.....
	.....	Seasalt (seisal).....	.....	.....	.....
	.....	Ry-Krisp.....	.....	.....	.....
	.....	Oats, raw.....	.....	.....	.....
	.....	Oats, cooked.....	.....	.....	.....
	.....	Bone jelly.....	.....	.....	.....
	.....	Fish.....	.....	.....	.....
	.....	Eggs, raw.....	.....	.....	.....
	.....	Eggs, cooked.....	.....	.....	.....
	.....	Tomatoes.....	.....	.....	.....
	.....	Banana.....	.....	.....	.....
	.....	Orange.....	.....	.....	.....
	.....	Pineapple or peach.....	.....	.....	.....

became more skilled in feeding themselves, so that during the second six months' experimental period (in one infant), the average losses, also chiefly liquids, on the bib and sheet, as determined by a number of weighings before and after meals, was from 0 to 15 Gm. (average, 3.65 Gm.) on the bib and from 0 to 15 Gm. (average, 5 Gm.) on the sheet.

If, as sometimes happened, the entire portion of an article was eaten, the size of the portion was increased at the next feeding in order to insure, by having some left, that the infant had had all he wanted of it. All foods were served in standard size sauce dishes and liquids in ordinary glasses. These were assembled on a regular ward tray (fig. 6), definite arrangement of the foods not being observed, and the tray placed on a low table at which the infant sat in a chair. Two teaspoons were provided, one for the infant to try to use when he wished, the other for the nurse who sat beside him. Beneath the table was spread a sheet to facilitate the saving and sorting of any bits of food that were dropped. The infants ate alone in the small infants' nursery to avoid the example of older children.

Food was not offered to the infant either directly or by suggestion. The nurses orders were to sit quietly by, spoon in hand, and make no motion. When, and only when, the infant reached for or pointed to a

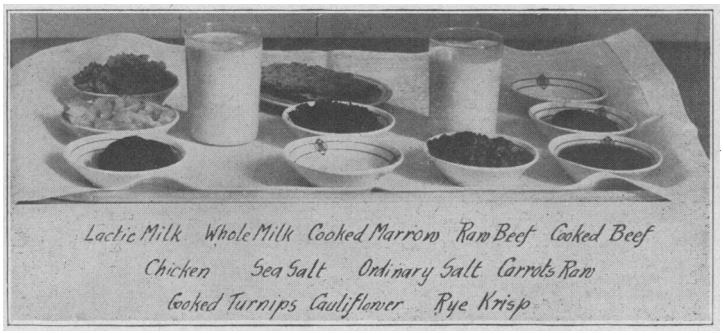


Fig. 6.—Typical type of meal as served.

dish might she take up a spoonful and, if he opened his mouth for it, put it in. She might not comment on what he took or did not take, point to or in any way attract his attention to any food, or refuse him any for which he reached. He might eat with his fingers or in any way he could without comment on or correction of his manners. The tray was to be taken away when he had definitely stopped eating, which was usually after from twenty to twenty-five minutes.

A brief résumé will now be given of the history and condition of each infant at the time of admission and of his health, aside from the digestive and nutritional conditions, during the months covered by the experiment.

REPORT OF CASES

Earl H., admitted to the hospital, Jan. 27, 1926, was the child of a thin, undernourished young woman and had spent his previous life in institutions. He had never seen an adult eat a meal and had been exclusively breast fed, with the exception of a small supplementary feeding for the preceding two weeks. He

had not had cod liver oil or orange juice. He was 9 months old, 28¼ inches (71.7 cm.) long, weighed 19 pounds (8,618 Gm.), had two teeth and showed normal development and behavior for his age. His intelligence quotient was 80. He had a moderate phimosis, a deviated nasal septum, a large mass of adenoids, a mucous nasal discharge (said to have been continuously present for a month), slight beading of the ribs and enlargement of the radial epiphyses. A roentgenogram and examination of the blood showed the presence of active rickets. Three weeks after admission, during an epidemic, he had influenza and influenzal enteritis, after which a profuse mucopurulent nasal discharge persisted for eight weeks, unimproved by local treatment, at the end of which time he had acute suppurative otitis media accompanied by mild acute nephritis. Ten days after the onset of otitis media, the adenoids were removed, with prompt cessation of the nasal discharge and complete convalescence. He was later circumcised. The experiment in his case was terminated when he contracted whooping cough and was removed to the City Hospital. He was actually on the experimental diet 173 days.

Donald R., admitted to the hospital, March 3, 1927, the child of a healthy, well nourished young woman, had also been an inmate of an institution but had spent several hours out of doors daily during the summer months. From November until admission, he had been given cod liver oil and orange juice in addition to his otherwise exclusive breast feeding. He was 7½ months old, 28 inches (71 cm.) long, weighed 18¾ pounds, (8,505 Gm.), had two teeth and showed normal development and behavior for his age. His intelligence quotient was 90. He did not have any signs of rickets—by physical, roentgen ray, or blood examination. On the second day of the experiment (the fifth day after admission), a cold developed with a profuse mucopurulent nasal discharge and complete anorexia, the infant refusing both food and liquids; it was necessary to stop the experiment and resort to gavage feeding, a milk and cereal formula being used. After treatment for three weeks without improvement in either the nasal discharge or the anorexia, his adenoids were removed. Forty-eight hours after, he took the bottle eagerly, gavage was discontinued, and the nasal discharge ceased entirely within a few days. Unfortunately at this time, he was exposed to chickenpox and the ward placed in quarantine, so that it was impracticable to recommence the experiment until he had recovered from the chickenpox and the quarantine was lifted. His six months experimental period, therefore, dated from May 17, 1927. During it he had no illness other than a mild coryza. His second six months' period was in progress at the time this paper was written.

Abraham G., admitted to the hospital, Oct. 20, 1926, had lived at home with his mother, a large, healthy, well nourished woman (who, however, had a moderate sized goiter) and had been outdoors on pleasant days. He had been exclusively breast fed and had not had any cod liver oil but on the advice of a neighbor had been given a little orange juice for several weeks prior to admission. He was 8 months old, 28½ inches (78 cm.) long and weighed 22 pounds (9,929 Gm.). His intelligence quotient was 85. He had a mucopurulent nasal discharge, said to have been continuously present since a cold six weeks before, and moderately large adenoids. Other abnormalities were not noted, and physical and roentgen-ray examination or examination of the blood did not show any signs of rickets. The nasal discharge persisted, and two weeks after admission adenoidectomy was done, which was followed by almost immediate cessation of the nasal discharge. In April, 1927, he had chickenpox during which the experiment was not intermitted. Otherwise, he did not have any illnesses other than a slight cold. His third six months' period was in progress at the time this paper was written.

THE RESULTS OF THE EXPERIMENT

From the first meal, all three infants chose their own foods as do adults and in sufficient quantities to maintain themselves. Earl H. did this at first by plumping a whole hand into the dish. After three days he indicated his choice by touching the dish with his index finger and looking at the nurse, who would then put a spoonful into his open mouth, after which she would sit quietly until he again indicated a choice. From

TABLE 3.—*Meals Chosen by Child 1 Year Old*

Breakfast, 7 a. m.			Breakfast, 7 a. m.		
Food	Amount	Calories	Food	Amount	Calories
Milk, grade A	20 cc.	14	Milk, grade A	120 cc.	83
Milk, lactic	40 cc.	26	Apples, raw	104 Gm.	65
Apples, raw	21 Gm.	13	Apples, cooked	200 Gm.	126
Apples, cooked	100 Gm.	63	Orange juice	200 cc.	86
Orange juice	100 cc.	43	Wheat, cooked	12 Gm.	9
Wheat, cooked	67 Gm.	50	Liver, cooked	11 Gm.	14
Barley, cooked	15 Gm.	11			
Liver, cooked	16 Gm.	86			
Sweetbreads	50 Gm.	20			
		326			383
Dinner, 12 m.			Dinner, 12 m.		
Food	Amount	Calories	Food	Amount	Calories
Milk, grade A	330 cc.	228	Milk, grade A	360 cc.	248
Ry-Krisp	7 Gm.	24	Ry-Krisp	11 Gm.	38
Bone marrow, raw	1 Gm.	8	Lamb, cooked	48 Gm.	95
Bone marrow, cooked	2 Gm.	17	Chicken, cooked	22 Gm.	48
Beef, raw	14 Gm.	22	Carrots, cooked	50 Gm.	23
Beef, cooked	4 Gm.	6	Cauliflower, cooked	2 Gm.	1
Lamb, cooked	23 Gm.	46			
Beets, cooked	4 Gm.	2			
Cornmeal, cooked	1 Gm.	1			
		354			453
Supper, 5 p. m.			Supper, 5 p. m.		
Food	Amount	Calories	Food	Amount	Calories
Milk, grade A	120 cc.	83	Fish	33 Gm.	23
Bone jelly	21 Gm.	1	Tomatoes, raw	20 Gm.	4
Fish	19 Gm.	13	Bananas, raw	270 Gm.	266
Eggs, cooked	1	74	Orange sections	120 Gm.	52
Bananas, raw	551 Gm.	543	Oats, cooked	50 Gm.	40
Orange sections	60 Gm.	26			
Oats, raw	10 Gm.	8			
Oats, cooked	56 Gm.	44			
		792			385
Total for day		1,472	Total for day		1,221

the third month on he ate partly by feeding himself with his fingers and for the last two months exclusively so, attempting sometimes to use a spoon and occasionally succeeding. During the last two months he picked the glasses up and drank from them unaided. Abraham G., from the first meal on, fed himself without aid from the nurse other than help in holding the glasses, which when filled were too heavy for him to hold alone. At the first meal he first tried to eat directly from the dish by putting his face in it. Not having much success, he picked up a dish and tried to pour its contents into his mouth, with little better success. He then resorted to his fingers, with prompt success. He began trying to use

TABLE 4.—*Meals Chosen by Child 1 Year Old*

Breakfast, 7 a. m.

Food	Amount	Calories
Milk, grade A	240 cc.	166
Milk, lactic	120 cc.	78
Apples, raw	40 Gm.	25
Wheat, cooked	100 Gm.	74
Barley, cooked	6 Gm.	4
Brains, cooked	22 Gm.	27
Kidney, cooked	12 Gm.	13
		387

Dinner, 12 m.

Food	Amount	Calories
Milk, grade A	120 cc.	83
Milk, lactic	120 cc.	78
Ry-Krisp	20 Gm.	70
Bone marrow, cooked	50 Gm.	422
Beef, raw	4 Gm.	6
Beef, cooked	10 Gm.	16
Chicken, cooked	52 Gm.	112
Peas, cooked	8 Gm.	8
Wheat, cooked	50 Gm.	37
		832

Supper, 5 p. m.

Food	Amount	Calories
Milk, grade A	120 cc.	83
Bone jelly	50 Gm.	3
Fish	62 Gm.	43
Tomatoes, raw	56 Gm.	11
Bananas, raw	140 Gm.	138
Peach pulp	20 Gm.	8
Oats, raw	1 Gm.	4
		290
Total for day		1,509

Breakfast, 7 a. m.

Food	Amount	Calories
Milk, grade A	240 cc.	166
Milk, lactic	120 cc.	78
Apples, raw	35 Gm.	22
Orange juice	165 cc.	71
Wheat, cooked	45 Gm.	33
Barley, cooked	22 Gm.	16
Sweetbreads	47 Gm.	81
Liver	12 Gm.	15
		482

Dinner, 12 m.

Food	Amount	Calories
Milk, grade A	120 cc.	83
Milk, lactic	120 cc.	78
Bone marrow, raw	12 Gm.	101
Beef, raw	8 Gm.	12
Beef, cooked	22 Gm.	34
Lettuce	7 Gm.	1
Potatoes, cooked	102 Gm.	85
Beets, cooked	15 Gm.	7
Cornmeal, cooked	100 Gm.	71
		472

Supper, 5 p. m.

Food	Amount	Calories
Milk, grade A	220 cc.	152
Bone jelly	10 Gm.	1
Fish	14 Gm.	9
Tomatoes, raw	20 Gm.	4
Bananas, raw	260 Gm.	256
Peach pulp	50 Gm.	20
Oats, cooked	100 Gm.	79
		521
Total for day		1,475

TABLE 5.—*Meals Chosen by Child 1½ Years Old*

Breakfast, 7 a. m.

Food	Amount	Calories
Apples, raw	26 Gm.	16
Apples, cooked	62 Gm.	39
Orange juice	140 cc.	60
Wheat, cooked	100 Gm.	74
Barley, cooked	30 Gm.	21
Sweetbreads, cooked	50 Gm.	86
Liver, cooked	9 Gm.	11
		307

Dinner, 12 m.

Food	Amount	Calories
Milk, grade A	120 cc.	83
Milk, lactic	480 cc.	311
Ry-Krisp	3 Gm.	10
Lamb, cooked	59 Gm.	117
Chicken, cooked	31 Gm.	67
Carrots, raw	1 Gm.	1
Carrots, cooked	10 Gm.	6
Turnips, cooked	2 Gm.	1
Cauliflower	13 Gm.	4
Cornmeal, cooked	23 Gm.	16
		610

Supper, 5 p. m.

Food	Amount	Calories
Milk, grade A	110 cc.	76
Milk, lactic	120 cc.	78
Fish	50 Gm.	35
Eggs, cooked	1	74
Tomatoes, raw	20 Gm.	4
Bananas, raw	150 Gm.	148
Orange sections	100 Gm.	43
Oats, raw	3 Gm.	11
Oats, cooked	80 Gm.	64
		533
Total for day		1,450

Breakfast, 7 a. m.

Food	Amount	Calories
Milk, lactic	50 cc.	32
Apples, raw	80 Gm.	50
Orange juice	155 cc.	67
Wheat, cooked	35 Gm.	26
Barley, cooked	5 Gm.	4
Kidney, cooked	15 Gm.	17
		196

Dinner, 12 m.

Food	Amount	Calories
Milk, lactic	260 cc.	168
Ry-Krisp	8 Gm.	28
Bone marrow, raw	10 Gm.	84
Bone marrow, cooked	7 Gm.	59
Beef, raw	4 Gm.	6
Beef, cooked	13 Gm.	20
Lamb, cooked	45 Gm.	89
Lettuce	7 Gm.	1
Potatoes, cooked	150 Gm.	125
Beets, cooked	40 Gm.	18
		598

Supper, 5 p. m.

Food	Amount	Calories
Milk, grade A	140 cc.	97
Milk, lactic	120 cc.	78
Bone jelly	60 Gm.	4
Fish	15 Gm.	10
Eggs, cooked	1	74
Tomatoes, raw	30 Gm.	6
Bananas, raw	200 Gm.	197
Orange sections	50 Gm.	22
Oats, cooked	54 Gm.	43
		531
Total for day		1,325

TABLE 6.—*Meals Chosen by Child 1½ Years Old*

Breakfast, 7 a. m.

Food	Amount	Calories
Apples, raw	40 Gm.	25
Apples, cooked	97 Gm.	61
Orange juice	195 cc.	84
Wheat, cooked	100 Gm.	74
Barley, cooked	13 Gm.	9
Sweetbreads	100 Gm.	172
Liver	46 Gm.	58
		483

Dinner, 12 m.

Food	Amount	Calories
Milk, lactic	240 cc.	156
Ry-Krisp	2 Gm.	7
Lamb, cooked	32 Gm.	63
Chicken, cooked	25 Gm.	54
Carrots, raw	2 Gm.	1
Carrots, cooked	29 Gm.	13
Turnips, cooked	3 Gm.	1
Cauliflower	7 Gm.	2
Cornmeal, cooked	9 Gm.	6
		303

Supper, 5 p. m.

Food	Amount	Calories
Milk, lactic	200 cc.	130
Bone jelly	31 Gm.	2
Fish	70 Gm.	49
Egg, cooked	1	74
Tomatoes, raw	2 Gm.	1
Bananas, raw	362 Gm.	356
Orange sections	37 Gm.	24
Oats, cooked	30 Gm.	16
		652
Total for day		1,438

Breakfast, 7 a. m.

Food	Amount	Calories
Milk, lactic	120 cc.	78
Apples, raw	31 Gm.	21
Apples, cooked	71 Gm.	45
Orange juice	60 cc.	26
Wheat, raw	1 Gm.	4
Wheat, cooked	100 Gm.	74
Barley, cooked	42 Gm.	30
Brains, cooked	44 Gm.	53
Kidney, cooked	67 Gm.	74
		405

Dinner, 12 m.

Food	Amount	Calories
Milk, lactic	180 cc.	117
Bone marrow, raw	1 Gm.	8
Bone marrow, cooked	9 Gm.	76
Beef, raw	12 Gm.	19
Beef, cooked	20 Gm.	31
Lamb, cooked	26 Gm.	51
Lettuce	3 Gm.	1
Potatoes, cooked	91 Gm.	76
Beets, cooked	66 Gm.	30
Wheat, cooked	14 Gm.	10
		419

Supper, 5 p. m.

Food	Amount	Calories
Milk, lactic	280 cc.	181
Seasalt	1 Gm.	..
Bone jelly	29 Gm.	2
Fish	89 Gm.	62
Eggs, cooked	¾	56
Tomatoes, raw	6 Gm.	1
Bananas, raw	282 Gm.	278
Orange sections	150 Gm.	65
Oats, raw	10 Gm.	40
Oats, cooked	33 Gm.	26
		711
Total for day		1,535

TABLE 7.—*Classes of Food Taken During First Six Months of Experiment*

Earl H.—173 Days

Class and Kind of Food	Gm. or Cc. Food	Gm. or Cc. Class	Per Cent
Total	218,423	218,423	100.0
1. Milks		118,023	54.1
S. M. A.	45,551		
Grade A raw milk	38,319		
Grade A raw whole lactic	34,153		
2. Cereals		35,152	16.1
Oatmeal (Scotch)	14,951		
Barley (whole grains)	7,041		
Corn (yellow cornmeal)	6,698		
Whole wheat (unprocessed)	5,648		
Rye (Ry-Krisp)	814		
3. Fruits		32,100	14.7
Orange	10,774		
Banana	6,670		
Apple	6,326		
Tomato	4,467		
Pineapple	1,475		
Prune pulp	1,352		
Peach	1,017		
Cocoanut	13		
4. Egg		10,145	4.6
5. Muscle cuts		9,824	4.5
Beef	8,120		
Lamb	1,010		
Chicken	694		
6. Vegetables		6,777	3.1
Carrots	1,727		
Potatoes	1,296		
Peas	973		
Spinach	964		
Cauliflower	623		
Lettuce	453		
Beets	344		
Turnips	212		
Cabbage	112		
Asparagus	73		
7. Bone marrow		3,489	1.6
8. Glandular organs		2,397	1.1
Brains	1,113		
Liver	705		
Kidney	414		
Sweetbreads	165		
9. Sea fish	516		0.2

TABLE 8.—*Classes of Food Taken During First Six Months of Experiment*

Donald R.—183 Days

	Class and Kind of Food	Gm. or Cc. Food	Gm. or Cc. Class	Per Cent
	Total	297,204	297,204	100.0
1.	Fruits		149,554	50.3
	Orange	64,975		
	Banana	41,877		
	Apple	30,835		
	Peach	8,061		
	Tomato	3,051		
	Pineapple	755		
2.	Milks		77,776	26.2
	Grade A raw milk	60,576		
	Grade A raw whole lactic	17,200		
3.	Cereals		33,623	11.3
	Oatmeal (Scotch)	12,474		
	Whole wheat (unprocessed)	11,040		
	Corn (yellow cornmeal)	6,829		
	Rye (Ry-Krisp)	1,877		
	Barley (whole grains)	1,403		
4.	Vegetables		14,233	4.8
	Potatoes	6,592		
	Carrots	2,718		
	Beets	2,423		
	Peas	762		
	Cabbage	622		
	Turnips	446		
	Cauliflower	305		
	Lettuce	200		
	Spinach	175		
5.	Muscle cuts		7,172	2.4
	Chicken	3,227		
	Beef	2,070		
	Lamb	1,945		
6.	Glandular organs		5,203	1.7
	Sweetbreads	1,554		
	Liver	1,365		
	Kidney	1,345		
	Brains	939		
7.	Eggs		4,729	1.6
8.	Sea fish		3,459	1.2
9.	Bone marrow		1,455	0.5

TABLE 9.—*Classes of Food Taken During First Six Months of Experiment*

Abraham G.—183 Days

	Class and Kind of Food	Gm. or Cc. Food	Gm. or Cc. Class	Per Cent
	Total	253,565	253,565	100.0
1.	Milks		78,510	31.0
	Grade A raw milk	49,995		
	Grade A raw whole lactic	28,515		
2.	Fruits		72,600	28.6
	Banana	24,907		
	Apple	24,906		
	Orange	15,850		
	Tomato	5,663		
	Pineapple	753		
	Peach	521		
3.	Cereals		26,945	10.6
	Corn (yellow cornmeal)	9,224		
	Whole wheat (unprocessed)	7,736		
	Oatmeal (Scotch)	6,146		
	Barley (whole grains)	2,598		
	Rye (Ry-Krisp)	1,241		
4.	Eggs		21,586	8.5
5.	Vegetables		14,536	5.7
	Potatoes	3,754		
	Carrots	2,205		
	Cauliflower	1,740		
	Beets	1,731		
	Cabbage	1,522		
	Turnips	1,273		
	Peas	1,008		
	Spinach	913		
	Lettuce	390		
6.	Glandular organs		12,812	5.0
	Brains	4,257		
	Sweetbreads	4,149		
	Liver	2,397		
	Kidney	2,009		
7.	Muscle cuts		10,858	4.4
	Beef	4,837		
	Chicken	3,426		
	Lamb	2,595		
8.	Bone marrow		8,836	3.5
9.	Sea fish		6,882	2.7

TABLE 10.—*Classes of Food Taken During Second Six Months of Experiment*

Abraham G.—182 Days

Class and Kind of Food	Gm. or Cc. Food	Gm. or Cc. Class	Per Cent
Total	264,114	264,114	100.0
1. Fruits		91,610	34.7
Banana	41,027		
Orange	23,427		
Apple	19,225		
Tomato	4,831		
Peach	2,163		
Pineapple	937		
2. Milks		61,989	23.5
Grade A raw whole lactic	38,995		
Grade A raw milk	22,994		
3. Cereals		44,562	16.9
Whole wheat (unprocessed)	17,893		
Oatmeal (Scotch)	15,168		
Corn (yellow cornmeal)	7,949		
Rye (Ry-Krisp)	1,868		
Barley (whole grains)	1,684		
4. Muscle cuts		15,440	5.8
Chicken	6,135		
Beef	5,450		
Lamb	3,855		
5. Vegetables		13,264	5.0
Potatoes	7,366		
Beets	2,014		
Carrots	1,823		
Cabbage	633		
Peas	375		
Cauliflower	336		
Turnips	306		
Spinach	224		
Lettuce	187		
6. Eggs		12,883	4.9
7. Glandular organs		9,538	3.6
Sweetbreads	4,669		
Brains	2,136		
Liver	1,417		
Kidney	1,316		
8. Sea fish		8,959	3.4
9. Bone marrow		5,869	2.2

TABLE 11.—*Number and Percentage of Calories in Classes of Food Taken During First Six Months of Experiment*

Earl H.—173 Days

Class and Kind of Food	Calories Food	Calories Class	Per Cent
Total	196,597	196,597	100.0
1. Milks		77,951	39.7
S. M. A.	29,380		
Grade A raw milk	26,440		
Grade A raw whole lactic	22,131		
2. Bone marrow		29,446	15.0
3. Cereals		28,647	14.6
Oatmeal (Scotch)	11,871		
Barley (whole grains)	5,000		
Corn (yellow cornmeal)	4,762		
Whole wheat (unprocessed)	4,176		
Rye (Ry-Krisp)	2,838		
4. Fruits		19,890	10.1
Banana	6,582		
Orange	4,654		
Apple	3,960		
Prune pulp	2,639		
Tomato	894		
Pineapple	636		
Peach	428		
Cocoanut	77		
5. Muscle cuts		16,191	8.2
Beef	12,691		
Lamb	2,001		
Chicken	1,499		
6. Egg		15,024	7.6
7. Glandular organs		5,531	2.8
Sweetbreads	2,831		
Brains	1,346		
Liver	895		
Kidney	459		
8. Vegetables		3,556	1.8
Potatoes	1,079		
Peas	973		
Carrots	781		
Spinach	230		
Beets	159		
Cauliflower	115		
Lettuce	87		
Turnips	82		
Cabbage	37		
Asparagus	14		
9. Sea fish		361	0.2

TABLE 12.—*Number and Percentage of Calories in Classes of Food Taken During First Six Months of Experiment*

Donald R.—183 Days

	Class and Kind of Food	Calories: Food	Calories: Class	Per Cent
	Total	227,995	227,995	100.0
1.	Fruits		92,912	40.8
	Banana	41,289		
	Orange	28,069		
	Apple	19,295		
	Peach	3,224		
	Tomato	610		
	Pineapple	325		
2.	Milks		52,943	23.2
	Grade A raw milk	41,797		
	Grade A raw whole lactic	11,146		
3.	Cereals		30,206	13.2
	Oatmeal (Scotch)	9,904		
	Whole wheat (unprocessed)	8,163		
	Rye (Ry-Krisp)	6,543		
	Corn (yellow cornmeal)	4,855		
	Barley (whole grains)	741		
4.	Muscle cuts		14,056	6.1
	Chicken	6,970		
	Lamb	3,851		
	Beef	3,235		
5.	Bone marrow		12,280	5.4
6.	Vegetables		9,141	4.0
	Potatoes	5,483		
	Carrots	1,228		
	Beets	1,117		
	Peas	762		
	Cabbage	199		
	Turnips	174		
	Cauliflower	98		
	Spinach	42		
	Lettuce	38		
7.	Glandular organs		7,033	3.1
	Sweetbreads	2,673		
	Liver	1,732		
	Kidney	1,493		
	Brains	1,135		
8.	Eggs		7,003	3.1
9.	Sea fish		2,421	1.1

TABLE 13.—*Number and Percentage of Calories in Classes of Food Taken During First Six Months of Experiment*

Abraham G.—183 Days

	Class and Kind of Food	Calories: Food	Calories: Class	Per Cent
	Total	281,580	281,580	100.0
1.	Bone marrow		74,576	26.5
2.	Milks		52,975	18.8
	Grade A raw milk	34,479		
	Grade A raw whole lactic	18,478		
3.	Fruits		48,735	17.3
	Banana	24,558		
	Apple	15,065		
	Orange	6,847		
	Tomato	1,133		
	Pineapple	324		
	Peach	208		
4.	Egg		31,968	11.4
5.	Cereals		23,327	8.3
	Corn (yellow cornmeal)	6,558		
	Whole wheat (unprocessed)	5,720		
	Oatmeal (Scotch)	4,880		
	Rye (Ry-Krisp)	4,324		
	Barley (whole grains)	1,845		
6.	Muscle cuts		20,098	7.1
	Beef	7,560		
	Chicken	7,400		
	Lamb	5,138		
7.	Glandular organs		17,555	6.2
	Sweetbreads	7,136		
	Brains	5,147		
	Liver	3,042		
	Kidney	2,230		
8.	Vegetables		7,529	2.7
	Potatoes	3,127		
	Peas	1,009		
	Carrots	997		
	Beets	799		
	Turnips	496		
	Cabbage	487		
	Cauliflower	322		
	Spinach	218		
	Lettuce	74		
9.	Sea fish		4,817	1.7

a spoon at the fifth month. Donald R. tried to eat from the dish and also to pick the dish up and pour its contents into his mouth but abandoned these attempts shortly in favor of touching the food with a forefinger and with mouth open looking at the nurse, who then put in a spoonful. After a week or two of this, he, too, ate with his fingers and in the second month began occasionally to use a spoon.

We have no clue as to what influenced these infants in choosing the foods they tried first, and whether the choice was only a random one or

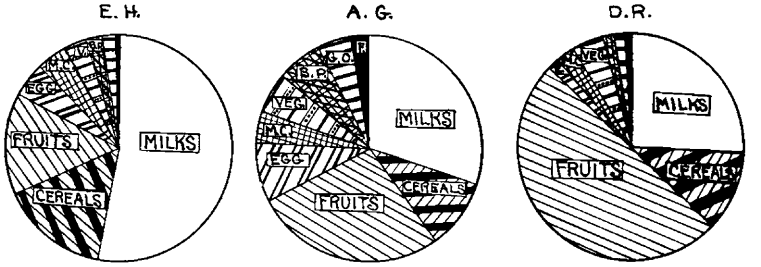
TABLE 14.—*Number and Percentage of Calories in Classes of Food Taken During Second Six Months of Experiment*

Abraham G.—182 Days

Class and Kind of Food	Calories: Food	Calories: Class	Per Cent
Total	264,946	264,946	100.0
1. Fruits		65,817	24.8
Banana	40,453		
Apple	13,008		
Orange	10,120		
Tomato	967		
Peach	865		
Pineapple	404		
2. Bone marrow		41,938	16.0
3. Milks		41,135	15.6
Grade A raw whole lactic	25,269		
Grade A raw milk	15,866		
4. Cereals		38,648	14.5
Whole wheat (unprocessed)	13,230		
Oatmeal (Scotch)	12,059		
Rye (Ry-Krisp)	6,511		
Corn (yellow cornmeal)	5,652		
Barley (whole grains)	1,196		
5. Muscle cuts		29,403	11.0
Chicken	13,252		
Beef	8,518		
Lamb	7,633		
6. Egg		19,080	7.2
7. Glandular organs		13,872	5.2
Sweetbreads	8,031		
Brains	2,582		
Liver	1,798		
Kidney	1,461		
8. Vegetables		8,782	3.3
Potatoes	6,136		
Beets	928		
Carrots	824		
Peas	375		
Cabbage	202		
Turnips	120		
Cauliflower	107		
Spinach	54		
Lettuce	36		
9. Sea fish		6,271	2.4

whether they were attracted by color or odor or both are psychologic questions I am not competent to answer. There could be no question, however, that after the first few meals the foods wanted were promptly recognized and chosen, as they were reached for without hesitation no matter what was their location on the tray, others nearer at hand and brighter in color often being neglected. Each infant in the beginning chose some foods which, after he had gotten them into his mouth, he spat out. Later, this did not happen.

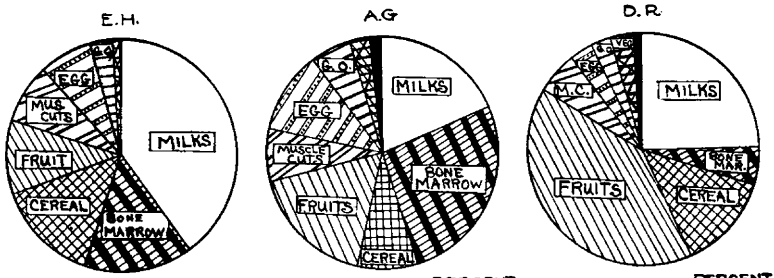
All three infants showed themselves to be omnivorous with a liking for most of the foods on the list, but rarely ate more than three solid foods in any considerable quantity at one meal. (Specimen meals chosen



CLASS OF FOOD - PERCENT		PERCENT	PERCENT
MILKS	53.1	30.1	25.9
CEREALS	15.8	10.3	11.2
FRUITS	14.4	27.9	42.9
EGG	4.6	8.3	1.6
MUSCLE CUTS	4.4	4.2	2.4
VEGETABLES	3.0	6.6	4.8
BONE PRODUCT	2.6	6.1	1.3
GLANDULAR-ORGANS	1.8	4.9	1.8
SEA FISH	0.3	2.6	1.1

FOODS MEASURED IN GM. AND C.C.

Fig. 7.—Classes of foods chosen during first six months of test. The foods are measured in grams and cubic centimeters.



CLASS OF FOOD — PERCENT		PERCENT	PERCENT
MILKS	39.7	18.8	23.2
BONE MARROW	15.0	26.5	5.4
CEREALS	14.6	8.3	13.2
FRUITS	10.1	17.3	40.8
MUSCLE CUTS	8.2	7.1	6.1
EGG	7.6	11.4	3.1
GLANDULAR-ORGANS	2.8	6.2	3.1
VEGETABLES	1.8	2.7	4.0
SEA FISH	0.2	1.7	1.1

Fig. 8.—Source of calories during the first six months of the test.

by two infants are shown in tables 3 to 6.) They showed decided preferences, as can be appreciated by referring to tables 7 to 14 and figures 7 and 8, which give the actual quantities of the food consumed and the calories furnished, but in spite of this it proved impossible to

predict what would be eaten at a given meal, e.g., an infant might eat from one to seven eggs or none, or from one to four bananas. Even the daily consumption of milk was unpredictable, varying from 11 to 48 ounces (325.25 to 1,419 cc.). Salt they ate only occasionally, often spluttering, choking or even crying bitterly after getting it in the mouth but never trying to spit it out and frequently going back for

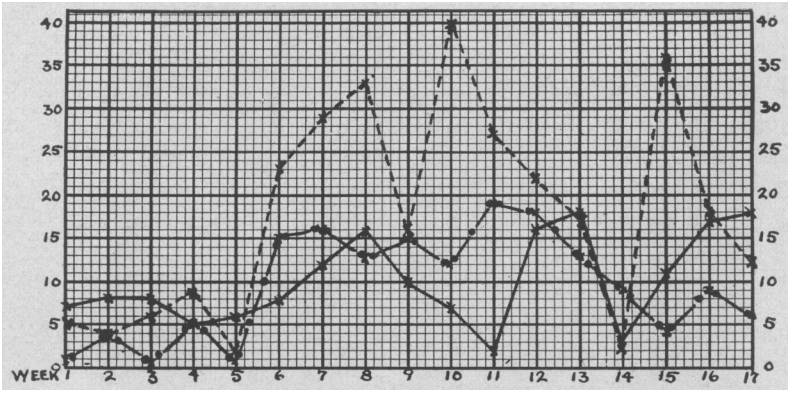


Fig. 9.—Average in grams of muscle cuts eaten per day for each week by Donald R. for seventeen weeks from June to October, 1927. The solid line indicates beef; the broken line, chicken and the dot and dash line, lamb.

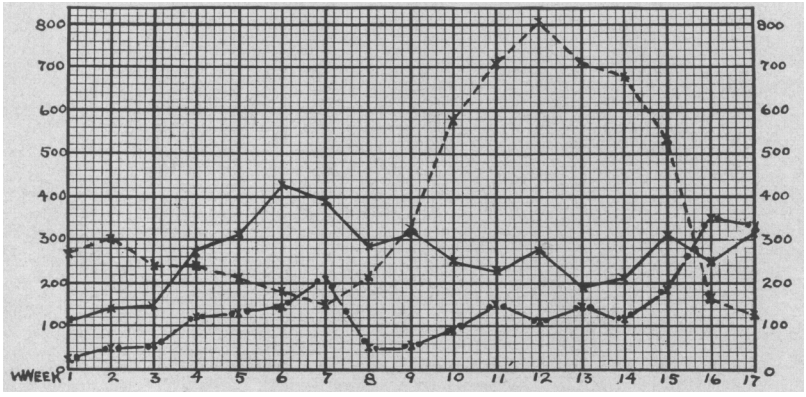


Fig. 10.—Average in grams of fruits eaten per day for each week by Donald R. for seventeen weeks from June to October, 1927. The solid line indicates banana; the broken line, orange and the dot and dash line, apple.

more, with a repetition of the same spluttering, etc. A tendency was observed in all the infants to eat certain foods in waves, i.e., after eating cereals, eggs, meats or fruits, in small or moderate amounts for a number of days, there would follow a period of a week or longer in which a particular food or class of foods was eaten in larger and larger quantities until astonishingly large amounts were taken; after this, the quantities

would decline to the previous level. Specimen curves of such "waves" are shown in figures 9 and 10. In the diet kitchen such waves came to be known as "egg jags," "meat jags," "cereal jags," etc. Symptoms of overeating did not accompany them, nor were the waves followed by a period of temporary disgust for and neglect of the particular food as is usual when appetite is surfeited. The true explanation of this feature of their habits of eating is unknown to me. It is possible that it may find its explanation in an inability of the infant to satisfy its caloric needs, keep within its digestive limitations, and accumulate simultaneously all the food factors in the quantities necessary for optimal growth and nutrition, so that as supplies of different food factors are depleted an increased appetite for foods that will furnish them results. Such an explanation would predicate the existence of a center for appetite and would be wholly theoretical. Whatever the correct explanation of these

TABLE 15.—*Average Calories Per Day During First Six Months of Experiment* *

Earl H.		Abraham G.		Donald R.	
Month	Calories	Month	Calories	Month	Calories
February†	921	October	1,303	May	928
March	1,148	November	1,788	June	1,074
April‡	957	December	1,558	July	1,306
May	1,128	January	1,466	August	1,234
June	1,203	February	1,491	September	1,364
July	1,304	March	1,337	October	1,263
August	1,171	April	1,672	November	1,484

* Statistics were kept by calendar months. The six months' period in each case runs from date in first mentioned month when experiment was begun to date in last month when period ended.

† Convalescent from severe influenza; persistent purulent nasal discharge.

‡ Suppurative otitis media and mild acute nephritis.

waves may be, this manner of eating marks a definite departure from the plan of nutrition of nurslings, in which the natural diet consists of a mixture of food elements in practically constant proportion nicely adjusted to its nutritional demands, and taken in quantities that vary and increase with its caloric needs.

The infants did not show any clear preference between raw and cooked foods. Raw beef was preferred to cooked beef unless the latter was rare, when little difference was noted. Oatmeal and wheat were definitely preferred cooked; bananas raw, bone marrow cooked, and eggs, carrots and peas were eaten well either way.

At the age of 10 or 11 months, each infant began to dip his Ry-Krisp in milk or water. (Dipping crackers or bread in milk or water is also done by crows and raccoons.) This was done, apparently, only for the purpose of softening it, as the infants would dip it, try it, dip it again, and repeat the process until it just suited them. The procedure was probably due to the tenderness of the gums, as it was most frequently done when new teeth were about to erupt. Attempts to mix foods or pour milk over any were not observed. Several solid foods were

usually taken at each meal, and the liquids—milk, orange juice and water—were drunk at intervals during the progress of the meal, as is the habit with adults.

The amounts of the various foods eaten by each infant during the six months experimental periods are shown in tables 7 to 10; the average daily calories in table 15, and in tables 16, 17 and 18, the calories, fat, protein and carbohydrate per kilogram of body weight.[3] Comment on these statistics will be reserved until the six months statistics for ten infants are completed. It had been planned to include in this report tables showing the intake of the various minerals, but as the content of some minerals has not yet been determined for certain meats and glandular organs, this must be deferred to a future time.

The physical, laboratory and roentgen-ray examinations made on admission were repeated monthly, and the infants were weighed daily.

In connection with the experiment, these infants were observed for the following points regarding digestive conditions: appetite, evidence

TABLE 16.—*Average Per Day Per Kilogram of Weight*

Earl H.—First Six Months—173 Days—1926

Number of Days	Month	Calories per Kg. per Day	Fat per Kg. per Day	Carbohydrate per Kg. per Day	Protein per Kg. per Day
21	February	106.40	4.66	11.60	4.93
26	March	121.00	6.42	11.00	4.65
30	April	95.09	5.06	9.30	3.48
19	May	109.57	5.50	11.19	4.11
30	June	115.80	5.65	11.72	4.56
31	July	118.28	7.30	8.01	5.43
16	August	107.01	5.90	8.47	5.38

of discomfort or abdominal distress after eating, vomiting, constipation, diarrhea, undigested food in the stools, the p_H of the gastric contents, and the presence of indican in the urine.

The infants' appetites were uniformly good. They often greeted the arrival of their trays by jumping up and down in their beds, showed impatience while their bibs were being put on, and, once placed at the table, having looked the tray over, devoted themselves steadily to eat-

3. The statistical work has been done, under a special gift for the purpose, by Miss Beatrice Skok who is responsible for the compilation of the tables, charts and curves included in this article. Calories, protein, fat, carbohydrate, and the acidity and alkalinity of the foods taken were computed on the basis of analyses published in the following: Rose, Mary Swartz: Laboratory Handbook of Dietetics (1927 Revised Edition), New York, The Macmillan Company, 1927. Sherman, Henry C.: Chemistry of Food and Nutrition, ed. 3, New York, The Macmillan Company, 1927; Bulletin no. 28, U. S. Department of Agriculture, 1906. Sherman and Goettler: Acid and Base Forming Elements in Foods, J. Biol. Chem. **11**:328, 1912, and data kindly furnished by the laboratories of Eli Lilly & Co., Armour & Co., Fairchild Bros. & Foster, Mead, Johnson & Co., The Rykrisp Company and The Walker-Gordon Laboratory, of Cleveland.

ing for fifteen or twenty minutes. Then, their first hunger satisfied, they ate intermittently for another five or ten minutes, playing a little with the food, trying to use the spoon and offering bits to the nurse.

None of the infants ever gave any evidence of discomfort or abdominal pain after eating or was constipated. In the autumn of 1927, Donald R. had a nasopharyngitis and two or three times during a meal or shortly after regurgitated a small amount of food while coughing. Otherwise, regurgitation or vomiting did not occur. During the severe

TABLE 17.—*Average Per Day Per Kilogram of Weight*

Donald R.—First Six Months—183 Days—1927

Number of Days	Month	Calories per Kg. per Day	Fat per Kg. per Day	Carbohydrate per Kg. per Day	Protein per Kg. per Day
15	May	104.74	5.33	9.74	4.44
30	June	119.48	4.19	14.79	4.74
31	July	143.22	4.77	19.79	5.21
31	August	127.33	2.86	21.28	4.14
30	September	135.95	3.20	22.50	4.37
31	October	125.03	3.56	18.69	4.38
15	Nov mber	136.71	4.02	19.83	5.26

TABLE 18.—*Average Per Day Per Kilogram of Weight*

Abraham G.—First Six Months, 1926-1927—183 Days

Number of Days	Month	Calories per Kg. per Day	Fat per Kg. per Day	Carbohydrate per Kg. per Day	Protein per Kg. per Day
9	October	130.51	6.79	12.21	6.67
30	November	174.72	10.63	12.25	7.82
31	December	144.43	9.32	9.39	5.78
31	January	131.61	7.46	9.81	5.78
28	February	130.89	7.09	10.63	5.79
31	March	112.03	6.21	8.69	5.35
23	April	137.60	7.54	9.90	6.02
	Abraham G.—Second Six Months, 1927—182 Days				
7	April	205.22	11.90	16.45	8.10
31	May	131.05	7.62	10.35	5.31
30	June	103.59	5.75	8.74	4.39
31	July	94.08	3.77	10.65	4.48
31	August	91.49	3.61	10.11	4.66
30	September	97.34	3.43	11.46	4.96
22	October	90.31	2.78	11.69	4.59

influenza epidemic of February, 1926, Earl H. had not only the respiratory form but influenzal enteritis as well, with diarrheal stools containing undigested food and bloody mucus. (Three other infants—one breast fed—were admitted to the ward in the same week suffering from the same condition.) Coincidently with the onset of nasopharyngeal symptoms, the p_H of the gastric contents fell to 5.5, and diarrhea appeared on the third day. The experiment was stopped, and he was given lactic acid milk with Karo syrup until the p_H of the gastric contents had returned to normal, a period of two weeks, although the enteritis lasted only a few days. The experiment was then resumed. At the onset of otitis media two months later, the hydrogen ion concentration of the

gastric contents again dropped to 5.0, and as a precautionary measure the experiment was again intermitted for seven days. Diarrhea or other digestive symptoms did not appear, and the experiment was resumed at the first feeding following adenoidectomy. Neither of the other two infants ever had diarrhea nor was the experiment in either case interrupted at any time.

The infants' stools were formed or semiformed, fairly soft, a light or medium brown (unless a large amount of beets was eaten, when a brownish red color was seen), with a fecal odor like those of older children. On gross examination, abnormal constituents other than occasional bits of spinach, carrot, beet, orange, or other vegetable matter were not found. Microscopically, they showed neither undigested muscle fibers nor free starch granules. Their number was usually one, occasionally two, and rarely three or none a day. No infant went for two consecutive days without a stool. Indican was not found in their urine.

The hydrogen ion concentration of their gastric contents on breast milk at the time of admission (the average of three examinatins on successive days) was as follows: Earl H., 3.1; Abraham G., 3.5; Donald R., 3.0. During the six months experimental period, the p_H gradually increased, varying from 3.0 to 2.5 after a regular meal. In this connection it is interesting to note that Donald R., the p_H of whose gastric contents was the highest (commonly about 2.5) throughout the six months, chose a diet with a large excess of alkaline foods; Abraham G., the p_H of whose gastric contents was commonly close to 3.0, a diet in which alkaline and acid foods were almost exactly balanced, and Earl H., with a p_H of the gastric contents generally about 2.7, a diet in which the excess of alkaline foods was practically midway between the two.

In trying to appraise the growth and nutritional condition of these infants, one is confronted by the incompleteness of the knowledge of the optimal or even of the normal for this age and the scarcity of objective criteria. Normal development of bone can be demonstrated roentgenologically and by determinations of blood calcium and phosphorus, but that of other tissues and organs cannot be measured and can only be gaged indirectly by growth, time of walking, dentition, turgor, tone of muscles and the general appearance of health, happiness and well-being that everyone recognizes as characteristic of healthy young animals.

The blood counts and examinations of the urine were normal throughout except when, as in the case of Earl H., they showed the alterations usual in the presence of parenteral infection and resulting mild acute nephritis. They will therefore not be detailed in this report.

The results of the monthly determinations of blood calcium and phosphorus are shown in Table 20.

TABLE 19.—*Specimen of Monthly Record Sheet*

Abraham G.—February, 1927—First Six Months

Date	Weight	Calories	Protein	Fat	Carbohydrate	Acidity	Alkalinity
1	11.340	1,377.370	53.561	76.989	111.661	33.2925	27.6261
2	11.368	1,746.387	82.891	104.542	119.255	42.6710	34.8375
3	11.368	1,570.644	64.466	113.579	72.956	37.5120	22.5396
4	11.396	1,979.631	83.937	112.160	131.924	37.5380	38.9712
5	11.424	1,481.710	66.453	73.488	138.731	35.4505	44.5760
6	11.452	1,483.296	74.124	91.290	92.011	41.4426	31.6070
7	11.424	2,169.129	81.339	154.022	114.375	40.5240	35.8285
8	11.452	1,140.335	37.965	58.915	115.059	11.3299	37.3070
9	11.241	772.506	21.519	47.476	64.819	2.9180	17.0895
10	11.241	750.987	31.631	23.129	104.350	13.9297	35.6435
11	11.255	1,113.746	40.663	47.219	131.674	18.5556	46.2130
12	11.056	1,207.007	67.070	53.617	115.072	40.0040	28.8800
13	11.340	1,035.060	58.303	60.101	65.674	28.7084	21.9400
14	11.340	1,805.790	62.984	105.836	160.564	27.7055	42.0795
15	11.113	1,092.585	60.791	40.399	121.741	24.9115	38.5331
16	11.368	1,600.779	67.982	90.645	128.083	36.6390	35.6377
17	11.438	1,984.081	105.026	73.925	130.956	54.6451	26.8996
18	11.438	1,231.936	65.284	55.064	118.679	31.0468	41.3635
19	11.466	1,280.119	69.495	48.689	141.420	41.6225	36.1875
20	11.466	1,674.332	70.412	101.299	120.310	31.8700	34.8644
21	11.480	1,773.754	90.961	84.254	163.318	40.6860	51.3545
22	11.480	1,479.746	60.555	75.334	140.162	28.8430	46.2991
23	11.466	1,909.579	80.072	108.168	154.430	34.3555	46.0806
24	11.480	1,714.693	70.738	97.613	139.806	29.7231	43.3875
25	11.480	1,438.529	74.231	94.851	72.549	30.5600	27.2305
26	11.480	1,652.415	80.079	76.560	160.756	37.4820	47.6635
27	11.567	2,023.549	70.699	126.888	150.206	31.5755	41.0213
28	11.624	1,266.894	55.767	65.790	112.897	29.8750	26.3289
Total	319.043	41,756.589	1,848.998	2,261.842	3,393.438	886.4167	1,007.996
Average per day	11.394	1,491.30675	66.0356	80.7801	121.1942	31.65774	35.99962

Average weight, 11.394 Kg.; protein per Kg., 5.79 Gm.; fat per Kg., 7.09 Gm.; carbohydrate per Kg., 10.63 Gm.; calories per Kg., 130.89.

TABLE 20.—*Results of Monthly Determinations of Blood Calcium and Phosphorus*

	Blood Calcium	Blood Phosphorus	Product
Earl H.—1926			
Admission	9.4	3.1	29.14
February	9.6	3.0	28.80
March	9.6	3.7	35.52
April	10.4	4.2	43.68
May	....	..	.....
June	11.8	6.8*	80.24*
July	11.9	4.75	56.52
Abraham G.—1926-1927			
Admission	11.7	4.1	47.97
November	12.4	6.2†	76.88
December	13.6	3.75	51.00
January	13.7	4.3	59.91
February	12.5	4.7	58.75
March	13.3	4.8	63.84
April	13.5	4.52	61.02
May	14.0	5.7	79.80
June	13.8	4.61	63.18
July	11.7	4.36	51.012
August	13.7	4.4	60.28
September	11.9	4.76	56.664
October	12.6	4.5	56.70
Donald R.—1927			
Admission	11.9	4.72	56.168
May	12.8	4.8	57.80
June	14.5	4.86	70.47
July	12.3	4.4	54.12
August	12.2	4.6	56.12
September	10.7	4.21	45.047
October	11.2	4.5	50.40
November	11.57	4.71	54.49

* Phosphate retention of mild acute nephritis.
† Nasopharyngitis, one or two casts per slide in urine for two days only; no albumin.

Roentgenograms of the radial epiphyses of Earl H. (who at the beginning of his experimental period had active rickets) taken at the beginning and end of the six months period are shown in figures 11 and 12. As the monthly roentgenograms of the radial epiphyses of Abraham G. and Donald R. did not show deviations from the normal, they are not included in this article. In this connection it should be remembered that on account of his rickets Earl H. had cod liver oil

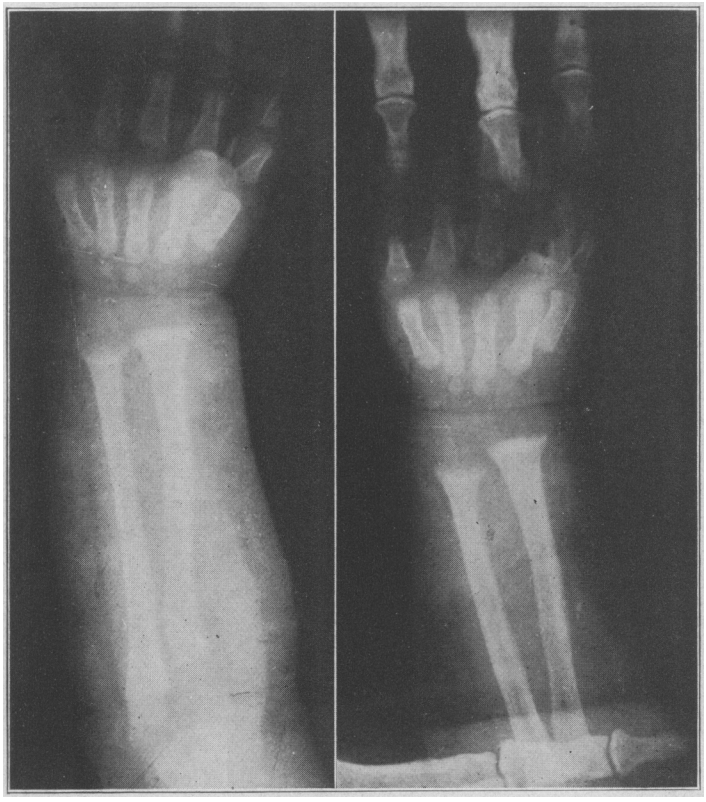


Fig. 11.—Active rickets of Earl H. at the beginning of the experiment at the age of 9½ months.

and a milk (S.M.A.) containing cod liver oil served on his tray during the first months of the experiment and that he took voluntarily 47½ drachms (178 cc.) of the pure cod liver oil and 21⅓ drachms (80 cc.) of cod liver oil incorporated in S.M.A., a total of 68⅚ drachms (258 cc.) in 101 days. About the time the blood calcium and phosphorus reached normal and the roentgenogram showed the rickets to be healed, he ceased to take any pure cod liver oil and after it had been left untouched on the tray for more than two weeks both it and the S.M.A. were no

longer served. Neither of the other infants had any signs of rickets or received cod liver oil in any form at any time during their experimental periods, and none of them were out of doors during the winter or in inclement weather owing to lack of facilities, nor were any of the infants ever given any light treatments.

Dentition conformed closely to the accepted normal, all infants having the usual or more than the usual number of teeth at the end of the six months' period.

Earl H (who had rickets on admission) walked alone at 14 months; Abraham G. and Donald R., at 12 months. Earl H. had flabby muscula-

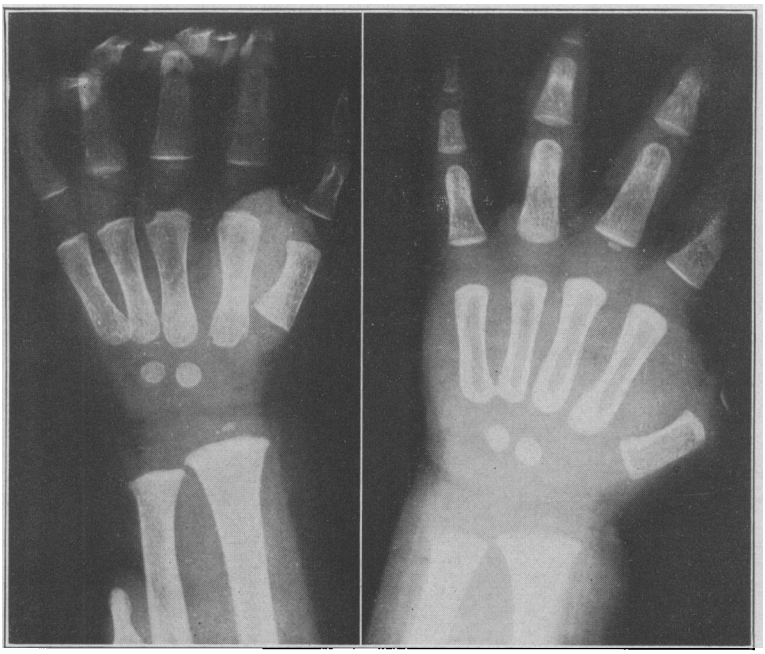


Fig. 12.—Healed rickets in Earl H. at the age of 14 months.

ture on admission but firm muscles of good tone at the end of the experimental period; Abraham G. and Donald R. had firm musculature throughout. None of the infants could properly be termed "fat," but all were plump and solid and looked well nourished. Their weight curves are shown in figure 13. In pounds, their gains in weight for the six months periods were: Earl H., 5.25 (2,381.4 Gm.); Abraham G., 5.19 (2,354.1 Gm.); Donald R., 5.37 (2,435.8 Gm.). As given by the Children's Bureau, the average gain in weight for six months at this period of infancy is 3¼ pounds (1,474.1 Gm.). The three infants were smiling, happy, active and full of "pep," slept soundly, and did not show signs of nervousness.

The gain in height for the six months periods was as follows: Earl H. (rickets) 3¼ inches (8.2 cm.); Donald R., 2 inches (5.2 cm.); Abraham G. (first six months), 2½ inches (6.2 cm.); Abraham G. (second six months), 2¾ inches (6.9 cm.). This average gain in height at this period of infancy as given by the Children's Bureau is 2½ inches for each six months.

During the second six months of his experimental period, Abraham G. was continuously well except for a slight coryza in the autumn of 1927; the experiment was not interrupted, and he did not have digestive disorders of any sort and did not refuse or miss a meal. During this second period his gain in weight was 5¾ pounds (2,608.1 Gm.), the average gain in weight for this period of infancy, according to the Children's Bureau, being 2¾ pounds (1,247.3 Gm.).

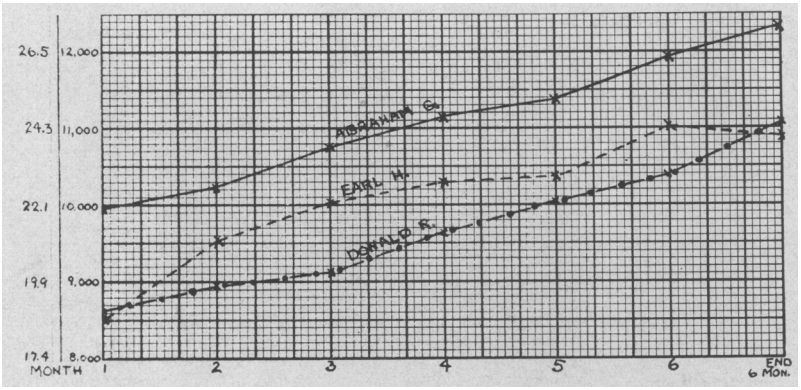


Fig. 13.—Weight curves for first six months' period (average per day). The gains in weight in pounds were: Abraham G., 5.19; Earl H., 5.25; Donald R., 5.37.

CONCLUSIONS

From the results obtained with these three infants it appears that:

1. The self-selected diet of simple, natural foods offers a safe means of dietary experimentation with breast-fed infants of weaning age.

2. Thus far, support is not given to the prevailing belief that the infant of this age cannot, because of his age, digest or use any of these simple natural foods of adult life, or that glands or muscle cuts of meat which have been shown to be especially valuable proteins in the variety and combinations of their amino-acids should be excluded from their diet.

3. From the standpoint of digestion and as far as could be judged by the criteria mentioned, the diet selected by these infants was optimal, since in only one, and then only in the presence of an acute infection, was there any deviation from digestive conditions that at the present time are generally considered to be optimal.

4. From the standpoint of nutrition, conclusions as to the success of the self-selected diet for these infants are not warranted from a continuance of it for periods of only six (two infants) and twelve (one infant) months. The immediate results appear to be equal at least to the best results obtained by commonly prescribed diets in growth, weight, bone development, musculature, general vigor and appearance of health and well-being.

SUMMARY

Three infants of weaning age were subjects of the self-selected diet experiment, two for periods of six months each and one for a period of a year.

They were able from the first to select their own foods from a list of simple natural ones and in quantities sufficient to maintain themselves with apparently optimal digestive and good (as far as immediate results could be judged) nutritional results. They were omnivorous and in eating were governed not only by their caloric needs, but showed definite preferences, which however, changed from time to time and were unpredictable.

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