The anæmia was undoubtedly due to some decrease in functioning bone marrow owing to replacement, but there was presumably no hyperplasia of the remaining unaffected portion as a compensatory measure. The long history of dietary deficiency must also have played an important rôle in the development of the anæmia. The reticulocytosis may be considered to have been the response to a specific substance which previously had been lacking. It cannot be considered a response of stimulation, as the bone marrow was incapable of producing mature cells by reason of replacement with Hodgkin's tissue and a hypoplastic state of the unaffected portions.

SUMMARY

A case of Hodgkin's disease is presented in which there was an associated blood picture suggestive of a primary or Addisonian anæmia. A brief discussion of the reticulocyte response to liver extract is appended.

The authors wish to acknowledge the kindness of the late Dr. T. R. Boggs in permitting us to report this case, and to thank Dr. F. B. Kindell for his criticism and advice.

REFERENCES

1. DAVIDSON, L. S. P.: Macrocytic hæmolytic anæmia, *Quart. J. Med.*, 1932, 1: 543.
2. CASTLE, W. B. AND MINOT, G. R.: Pathological Physiology and Clinical Description of the Anæmias, Oxford University Press, N.Y., 1936.

RESULTS OF THE SELF-SELECTION OF DIETS BY YOUNG CHILDREN*

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THE self-selection of diet experiment had for its subject infants of weaning age, *i.e.*, from six to eleven months of age, who had never had supplements of the ordinary foods of adult life. This age was chosen because only at this age could we have individuals who had neither had experience of such foods nor could have been influenced by the ideas of older persons and so would be without preconceived prejudices and biases with regard to them. The children concerned were studied for six years.

The list of foods used in the experiment was made up with the following 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.

The preparation of the foods was as simple as possible. All meats, vegetables and fruits were finely cut, mashed or ground. Most of the foods were served only after being cooked, but lettuce was served only raw, while oat meal, wheat, beef, bone marrow, eggs, carrots, peas, cabbage and apples were served both raw and cooked. 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.

The list of foods was as follows:

1. Water
2. Sweet milk
3. Sour (lactic) milk
4. Sea salt (Seisal)
5. Apples
6. Bananas
7. Orange juice
8. Fresh pineapple
9. Peaches
10. Tomatoes
11. Beets
12. Carrots
13. Peas
14. Turnips
15. Cauliflower
16. Cabbage
17. Spinach
18. Potatoes
19. Lettuce
20. Oatmeal
21. Wheat
22. Corn meal
23. Barley
24. Ry-Krisp
25. Beef
26. Lamb
27. Bone marrow
28. Bone jelly
29. Chicken
30. Sweetbreads
31. Brains
32. Liver
33. Kidneys
34. Fish (haddock)

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, 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

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served at each meal according to a fixed schedule. Each article, even salt, was 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.

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 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.

The results of this six-year study of self-selection of diet by young children from the time of weaning on may, for the purpose of this discussion, be conveniently grouped under three heads: (1) The results in terms of health and nutrition of the fifteen children; (2) the adequacy of the self-chosen diets as judged by nutritional laws and standards; (3) the contributions made by the study to our understanding of appetite and how it functions.

Like the lives of the happy, the annals of the healthy and vigorous make little exciting news. There were no failures of infants to manage their own diets; all had hearty appetites; all throve. Constipation was unknown among them and laxatives were never used or needed. Except in the presence of parenteral infection, there was no vomiting or diarrhœa. Colds were usually of the mild three-day type without complications of any kind. There were a few case of tonsillitis but no serious illness among the children in the six years. Curiously enough, the only epidemic disease to visit the nursery was acute glandular fever of Pfeiffer with which all the children in the nursery came down like ninepins on the same day. During this epidemic when temperatures of 103 to 105° F. prevailed, as with colds, etc., trays were served as usual, the children continuing to select their own food from the regular list. This led to the interesting observation that just as loss of appetite often precedes by twenty-four to forty-eight hours every other discoverable sign and symptom of acute infection, so return of appetite precedes by twelve to twenty-four hours all other signs of convalescence, occurring when fever is still high and enabling the observer to correctly predict its fall. This eating of a hearty meal when fever is still high is often not in evidence when children are put on restricted diets during such illness, but the correctness of the observation has been amply confirmed in the Children's Memorial Hospital where a modification of the self-selective method of feeding prevails. During convalescence unusually large amounts of raw beef, carrots and beets were eaten. The demand for increased amounts of raw beef and carrots can be easily accounted for but we are still curious about that for beets, and inclined to wonder whether they may furnish an anti-anæmic substance (iron?) from the fact that beets were eaten by all in much larger quantities in the first six months or year after weaning than ever again save after colds and acute glandular fever.

Some of the infants were in rather poor condition when taken for the experiment. Four were poorly nourished and underweight; five had rickets. Two of these five had only roentgenological signs of rickets, and one mild clinical rickets as well, while the other two were typical textbook cases. The first infant received for the study was one of the two with severe rickets, and, bound by a promise to do nothing or leave nothing undone to his detriment, we put a small glass of cod liver oil on his tray for him to take if he chose. This he did irregularly and in varying amounts until his blood calcium and phosphorus became normal and x-ray films showed his rickets to be healed, after which he did not take it again. He had taken just over two ounces in all. No other of the 15 children had any cod liver oil, viosterol, treatment by ultra-violet rays or other dietary adjuvants at any time during the study, and all four of the other cases of rickets were healed in approximately the same length of time as was the first. Regardless, however, of their condition when received, within a reasonable time the nutrition of all, checked as it was at regular and frequent intervals by physical examinations, urine analyses, blood counts, hæmoglobin estimations and roentgenograms of bones, came up to the standard of optimal so far as could be discovered by examinations.

However, as I may be thought to have been unduly biased in my estimate of this rollicking,

rosy-cheeked group, Dr. Joseph Brennemann's appraisal of them may be of interest. In his article, "Psychologic aspects of nutrition," published in an early number of the *Journal of Pediatrics*, he says, "I saw them on a number of occasions and they were the finest group of specimens from the physical and behaviour standpoint that I have even seen in children of that age."

But all is not gold that glitters. Carefully controlled laboratory experiments with animals have shown that growth and nutrition throughout the entire growth period may be satisfactory on diets that are slightly deficient in some of the essentials; and that such slight deficiencies only became evident as lessened vigour, fertility and longevity in adult life. Long as was the time these children remained on the study—none less than six months, and all but two from one to four and one-half years—but a fraction of the growth period was covered. One might, therefore, raise a skeptical eyebrow and say, "The examinations of these children do not by any means prove that all, some, or any of them were indeed optimally nourished; or that any of their diets were in fact adequate in the scientific sense. Whether appetite was or was not a competent guide to their eating can only be shown by checking their diets with nutritional laws and standards."

Such checking of each of the fifteen diets in its entirety (the grand total of all meals eaten by the children was nearly 36,000) gave, in summary, the following results:

QUANTITIES OF FOOD EATEN

The average daily calories furnished by the diets during each six months' period were in every instance found to be within the limits set by scientific nutritional standards for the individual's age. So, too, were the average daily calories per kilogram of body weight, except in the few instances in which infants, undernourished before weaning, exceeded the standard in their first six months' period on the experiment. Finally, the law of the decline of calories, per kilogram of body weight, with growth was followed without exception and in orderly fashion as shown by curves made on a monthly basis. Quite possibly it is the close conformity of the diets to these quantitative laws and standards that accounts for the fact that there were after the first six months' period of each child no noticeably fat or thin children, but a greater uniformity of build than often obtains among those of the same family.

POTENTIAL ACIDITY AND ALKALINITY OF THE DIETS

Maintenance of the acid-base balance of the blood requires that potentially acid constituents of the diet must be at least balanced by constituents of potential alkalinity, and most authorities agree that a moderate excess of potentially alkaline ones is desirable. Regarding the relation of this law to dietary practice, H. C. Sherman* says that while an upset of the acid-base balance resulting in ketosis may occur when the proportions of carbohydrates, proteins and fats in the diet are out of the proper relation to each other, "it is presumably rare in normal individuals on self-chosen diets." This proved to be the case with the diets of the children. In the diet of one child there was an exact balance of potentially acid and potentially alkaline constituents during his first and only six months' period. In the diets of the other fourteen there was a moderate preponderance of the potentially alkaline in every six months' period.

THE DISTRIBUTION OF CALORIES

Nutritional science has been much concerned with the problem of the proper distribution of calories among the three dietary constituents—fat, carbohydrate and protein—and especially about the percentage of calories to be allotted to protein with which carbohydrates and fats are not interchangeable as body-builders. Authorities vary somewhat in the percentages they allot to protein for children below the age of five years, *i.e.*, in general, from 10 per cent to 17 per cent. For the self-chosen diets, the *average* distribution of calories per kilogram of body weight (regardless of variations in children's age) was protein 17 per cent, fat 35 per cent and carbohydrate 48 per cent. The individual range for the protein in the group was from 9 per cent to 20 per cent. All diets showed a decline in protein per kilogram of body weight in accordance with the change in the relation of body-building requirements to energy requirements that comes with growth and increased activity. Quality of protein is, however, no less important than quantity. The protein of the diets was in every case protein of the highest biological value, having been predominantly derived from such

* Sherman, H. C., Chemistry of Food and Nutrition, 5th ed., p. 262.

animal sources as milk, eggs, liver, kidney and muscle meats.

Because of the extent to which the essentially energy furnishing fats and carbohydrates are interchangeable in nutrition, few authorities make any allocation of the remaining 83 per cent of calories between them. The average distribution for these in the diets as a group (fat 35 per cent, carbohydrate 48 per cent) differs but slightly from that advocated by Rose.

As yet no statistical analysis of the diets has been made for their vitamin and mineral contents, but with all vegetables fresh, all cereals whole grains, ground by the old stone process, eggs, liver and kidney eaten freely, fresh fruits eaten in amazingly large quantities, and the salt used, an unpurified sea salt containing all the minerals found in the body, the probability of any deficiency in vitamins or minerals is slight indeed. In fact, the quantities of fresh fruit, carrots and potatoes and of eggs, liver and kidneys in practically all the diets preclude, on the basis of their known vitamin content, any shortage of Vitamins A, B, C and G. For the adequacy in Vitamin D and calcium of the diets of children who took none or little milk for considerable periods of time we cannot speak so surely from an off-hand consideration of the quantities of foods eaten. We can, however, call in evidence the roentgenograms of these children's bones which showed as excellent calcification as those of the others.

Regarding the calcification of bones in the group, Dr. W. E. Anspach, Roentgenologist of the Children's Memorial Hospital, has written in a personal communication to your essayist, "The beautifully calcified bones in roentgenograms of your group of children stand out so well that I have no trouble in picking them out when seen at a distance." That such "beautiful calcification" of bones was achieved by all, regardless of whether or not they had rickets when admitted, would seem difficult to account for, had adequate calcium or vitamin D been lacking.

The diets, then, were orthodox, conforming to nutritional laws and standards in what they furnished. The children actually were as well nourished as they looked to be.

Such successful juggling and balancing of the more than thirty nutritional essentials that exist in mixed and different proportions in the foods from which they must be derived suggests at once the existence of some innate, automatic mechanism for its accomplishment, of which appetite is a part. It is certainly difficult to account for the success of the fifteen unrelated infants on any other grounds.

Also, such success with the nutritional essentials suggests the possibility that appetite indicated one orthodox diet in terms of foods and the quantities of them, comparable to the diet lists of pædiatricians and nutritionists. But to this possibility the self-chosen diets give not a scintilla of support. In terms of foods and relative quantities of them they failed to show any orthodoxy of their own and were wholly unorthodox with respect to pædiatric practice. For every diet differed from every other diet, fifteen different patterns of taste being presented, and not one diet was the predominantly cereal and milk diet with smaller supplements of fruit, eggs and meat, that is commonly thought proper for this age. To add to the apparent confusion, tastes changed unpredictably from time to time, refusing as we say "to stay put," while meals were often combinations of foods that were strange indeed to us, and would have been a dietitian's nightmare—for example, a breakfast of a pint of orange juice and liver; a supper of several eggs, bananas and milk. They achieved the goal, but by widely various means, as Heaven may presumably be reached by different roads.

This seemingly irresponsible and erratic behaviour of appetite with respect to selection of foods from which the essentials were obtained stamps it as the same Puckish fellow we have always known it to be. Why, then, were his pranks beneficent in the experiment when so often harmful elsewhere? Or to put it baldly, as I hope many of you are doing, what was the trick in the experiment? This brings us to the discussion of what we learned about appetite and its workings, that throws light on the question of its competencies and fallibilities.

Selective appetite is, primarily, the desire for foods that please by smelling or tasting good, and it would seem that in the absence of such sensory information, *i.e.*, if one had never smelled or tasted a food, he could not know whether he liked or disliked it. Such proved to be the case with these infants. When the large trays of foods, each in its separate dish, were placed before them at their first meals, there was not the faintest sign of "instinct" directed choice. On the contrary, their choices were apparently wholly random; they tried not only foods but chewed hopefully the clean spoon, dishes, the edge of the tray, or a piece of paper on it. Their

faces showed expressions of surprise, followed by pleasure, indifference or dislike. All the articles on the list, except lettuce by two and spinach by one, were tried by all, and most tried several times, but within the first few days they began to reach eagerly for some and to neglect others, so that definite tastes grew under our eyes. Never again did any child eat so many of the foods as in the first weeks of his experimental period. Patterns of selective appetite, then, were shown to develop on the basis of sensory experience, *i.e.*, taste, smell, and doubtless the feeling of comfort and well-being that followed eating, which was evidenced much as in the breast-fed infant. In short, they were developed by sampling, which is essentially a trial and error method. And it is this trial and error method, this willingness to sample, that accounts for the most glaring fallibility of appetite. From time immemorial adults as well as children have eaten castor oil beans, poisonous fish, toad stools and nightshade berries with fatal results. Against such error, only the transmission of racial experience as knowledge can protect. Such error affords additional proof that in omnivorous eaters there is no "instinct" pointing blindly to the "good" or "bad" in food. And since every trial and error method involves the possibility of error, the problem of successful eating by appetite is that of reducing possible errors to those that are most trivial by a prior selection of the foods that are made available for eating.

Appetite also appears to have fallibilities with processed foods which have lost some of their natural constituents and which have become such important features of modern diet, *e.g.*, sugar and white flour. Certainly their introduction into previously sound primitive diets has invariably brought with it a train of nutritional evils, and their widespread excess in civilized diets is decried by nutritional authorities. Whether the evils are due to innate fallibilities of appetite with respect to these products, or whether appetite in such cases is merely overruled by extraneous considerations of novelty, cheapness, ease of procurement and preparation, etc., has not been determined.

We had hoped to investigate this problem in a small way by an experiment with newly weaned infants in which both natural foods and their processed products were simultaneously served, but the depression dashed this hope.

By this time you have all doubtless perceived that the "trick" in the experiment (if "trick" you wish to call it) was in the food list. Confined to natural, unprocessed and unpurified foods as it was, and without made dishes of any sort, it reproduced to a large extent the conditions under which primitive peoples in many parts of the world have been shown to have had scientifically sound diets and excellent nutrition. Errors the children's appetites must have made—they are inherent in any trial and error method—but the errors with such a food list were too trivial and too easily compensated for to be of importance or even to be detected.

The results of the experiment, then, leave the selection of the foods to be made available to young children in the hands of their elders where everyone has always known it belongs. Even the food list is not a magic one. Any of you with a copy of McCollum's or H. C. Sherman's books on nutrition and properties of foods, could make a list quite different and equally as good. Self-selection can have no, or but doubtful, value if the diet must be selected from inferior foods. Finally, by providing conditions under which appetite could function freely and beneficently as in animals and primitive peoples, the experiment resolved the modern conflict between appetite and nutritional requirements. It eliminated anorexia and the eating problems that are the plague of feeding by the dosage method.

THYROID GLAND AND ALLERGY.—On histological examination the thyroid glands of rabbits and guinea-pigs sensitized several times at intervals of five or six days with pig serum showed activation, which was absent, however, if bilateral resection of the sympathetic nerve preceded, and if unilateral vagotomy was performed either before or after, the serum treatment. The formation of antibodies was inhibited by thyroidectomy before sensitization, and was not increased by subsequent administration of thyrotropic hormone. The complement content fluctuated. Elityran increased the degree of sensitization in thyroidectomized animals to normal and even beyond it. Antibodies were demonstrated in the blood after sensitization with large doses of serum, the lack of anaphylactic reaction being explained by the absence or insufficiency of thyroid activation. It is concluded that only the secretion of the thyroid gland is necessary for such allergic-hyperergic reactions, not the tissue. The parenterally introduced serum stimulates the vegetative nervous system, and through it the central nervous system and the thyroid gland, producing a circle of stimuli, the interruption of which results in lack of anaphylactic reaction.—W. Eickhoff, *Virch. Arch.*, 1939, **303**: 481. Abs. in *Brit. M. J.*