

*Cyclidium glaucoma*  
*Metopus sigmoides*  
*Uroleptus agilis*  
*Oxytricha fallax*  
*Stylonychia* sp.  
*Stylonychia* sp.  
*Euplotes patella*  
*Euplotes charon*  
*Aspidisca costata*  
*Vorticella citrina*  
*Vorticella* sp.  
*Vorticella* sp.  
*Vorticella* sp.

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## THE FOOD REQUIREMENTS OF GROWING CHILDREN

A COMPARATIVELY large number of investigations have been made with the view of determining the amounts of nutrients required in average normal adult life and, although they can not be considered as final, some rather definite conclusions have been drawn. The data available for children are much more limited. It is recognized that a higher allowance should be given them to provide for their greater degree of tissue building, greater loss through radiation and evaporation from the relatively larger body surface, and, possibly, for their comparatively greater activity. Certain standards have been proposed for children, sometimes from limited observations, sometimes from theoretical considerations. Thus the following percentages of adult requirements have been suggested<sup>2</sup> for children.

Age, Years	Foley	Atwater	U.S. Bureau of Labor	Rown- tree	Engel
7 to 10	—	50 to 60	75	50	57
11 to 14	60	70 to 80	90	60	70

The U. S. Department of Agriculture<sup>3</sup> has

<sup>1</sup> From the Chemical Laboratory of the University of Iowa.

<sup>2</sup> Quoted by Chapin, "The Standard of Living among Workingmen's Families," Charities Publication Committee, New York, p. 15.

<sup>3</sup> U. S. Department of Agriculture Yearbook, 1907, p. 365.

adopted standards for the nutrients for children at different ages, assuming, among others, as the proper food for a child of from 6 to 9 years 50 per cent. of the food of a man, that is, 53 grams of protein and 1,750 calories of energy, and for a boy of 12 years 70 per cent. of the food of a man, which would be 74 grams of protein and 2,450 calories of energy.

Knight, Pratt and Langworthy<sup>4</sup> have recently issued the results of dietary studies in children's homes in Philadelphia and Baltimore and have there reviewed the literature. In Philadelphia, 80 children whose ages were from less than 6 up to 18 years, averaging about 10 years, consumed per day an average of 67.6 grams of protein, 57.9 grams of fats and 270.1 grams of carbohydrates with a total energy value of 1,867 calories. The duration of the test was seven days. In Baltimore, 115 boys and girls aged from 4 to 17 years, with an average age of 12 years and weighing from 31 to 109.5 pounds, consumed an average of 65 grams of protein, and other food to a total of 1,798 calories of energy. In another home in Baltimore for colored children 25 boys, from 3 to 13 years of age, and weighing from 37 to 85 pounds each, consumed daily 50 grams of protein and the fuel value of the food was 1,677 calories. The average of the ages was 9 years. In each of the Baltimore tests the duration was 21 meals. In one the children had an abnormally low body weight and in the other they were "none too well nourished."

It is evident, in tests like these last, where there is so great a variation in age and body weight that definiteness is wanting in the results, and that they can stand for nothing more than very general averages. Considering that there is no general agreement as to adult requirements, standards stated as fractions of the amounts necessary for adults are obviously not exact. The value of more definite information as to children's needs is evident.

The daily dietaries of two boys were deter-

<sup>4</sup> Bulletin 223, Office of Experiment Stations, Washington. See also Experiment Station Bulletins 21 and 45 for literature.

mined by weighing at the table all food eaten, except water, for 29 days in November and December. The first (P) was 12 years and six months of age and approaching puberty. His weight without clothing was 50.5 kilograms and his height 5 feet. The second (A) was 8 years and 6 months old, weighed without clothing 27.4 kilograms and measured 4 feet, 5 inches in height. The health of both was good before, during and has been since the test. The composition of the food was calculated,<sup>5</sup> either directly or from the materials known to have been used in its preparation. The quantities eaten did not differ from those usually taken by these children. The quality was plain but wholesome—for breakfast, a cup of cocoa made with much milk, buttered toast, fruit and occasionally a piece of cheese; at noon, meat or fish with bread, butter and potatoes, an additional vegetable, often pudding and a glass of milk; for supper, ordinarily no meat, bread and butter, with an egg or cheese, fruit and milk. The results follow:

	Protein, Grms. per Day	Fats, Grms. per Day	Carbohydrates, Grms. per Day	Protein per Kilo. of Body Weight per Day	Calories per Day	Calories per Kilogram of Body Weight
P	87.8	114.9	381.2	1.74	2992	59.2
A	63.0	78.3	259.8	2.30	2051	75.0

Naturally the food contained relatively much more energy than that regarded as necessary for adults; 35 calories per kilogram of body weight (Chittenden<sup>6</sup>); 44 calories per kilogram (Voit<sup>7</sup>); or 35–38 calories per kilogram for actual body maintenance (Maurel<sup>8</sup>). Comparison with the standards for children can be made on the basis of age or on that of body weight. On the basis of age the amounts

<sup>5</sup> "The Chemical Composition of American Food Materials," Atwater and Bryant, Washington, 1906.

<sup>6</sup> "The Nutrition of Man," New York, 1907, p. 177.

<sup>7</sup> "Physiologie des allgemeinen Stoffwechsels und der Ernährung," p. 520.

<sup>8</sup> *Rev. Soc. Sci. Hyg. Aliment.*, 3, 1906, p. 763.

of protein and of total energy used here are higher than those of the most common standards. Comparing on the basis of body weight, the energy value of the food consumed by these children was also greater than that of most standards, differing least from that of the United States Bureau of Labor. It will be noted that the weights of both children are greater than those commonly assumed for such ages.<sup>9</sup>

Maurel allows 1.75 grams of protein per kilogram of body weight below the age of sixteen for maintenance and growth of the organism, without providing for muscular work. Reckoned in this way there should have been 88.4 grams of protein for P and 48 grams for A. This corresponds to the amount used by P but is much less than was used by A. As far as conclusions can be drawn from two cases it would seem that Maurel's standard is not sufficiently elastic to use for all ages of childhood.

In order to be of the greatest value a standard should be independent of variable or uncertain factors. Hence there is an objection to basing one for children's food upon a percentage of an adult standard which may vary from that of Chittenden (*l. c.*) of less than 2,000 calories per day to that of the United States Department of Agriculture (*l. c.*) of 3,500 calories.

The methods employed in this investigation are perhaps open to the usual criticisms; that the amounts eaten are not necessarily those required for keeping the organism in its best condition and that neither the food nor the excreta were analyzed to determine exactly the income and outgo. As opposed to these we may consider that the food eaten was the same in kind and amount as that ordinarily consumed, that at all times the diet has been carefully supervised, a plain and wholesome food being provided and over-eating being habitually discouraged, and that the appetite must, therefore, be regarded as normal and some indication of the needs of the body.

E. W. AND L. C. ROCKWOOD

<sup>9</sup> Metropolitan Life Insurance Company Tables. Bowditch, "Diseases of Infancy and Childhood."