- 184 Pla, E. F.: *Consideraciones medico-legales acerca de la muerte por la electricidad industrial*. Habana, 1891.
- 185 Pockels, F.: *Meteorolog. Ztschr.*, Wien, 1901, xviii, 40.
- 186 Prevost, J. L.: *Rev. méd. Suisse Rom.*, 1898, xv, 545.
- 187 Prevost, J. L., et Battelli, F.: *Rev. méd. de la Suisse Romande*, Geneva, 1899, xix, 545.
- 188 Idem, C. R. Acad. des Sci., Paris, 1899, cxxix, 651, 1267.
- 189 Idem, *Journ. Phys. et Path. gén.*, Paris, 1899, i, 1085, 1114.
- 190 Priestley, J.: *The History of Electricity*. London, 1767.
- 191 Rasbach, J. C.: *De eo quod medicum decet circa fulmine tactos*. Erfordiae, 1737.
- 192 Richardson, B. W.: *Med. Times and Gazette*, London, 1869, i, 511, 595; ii, 183, 373.
- 193 Robinovitch, L. G.: *Sommeil électrique*. Nantes, 1906.
- 194 Röser, C. J.: *Disp. phys.-med. de fulm.* Regiomonti, 1704.
- 195 Roy: *Rec. de mém. de méd. chir. pharm.*, 1864, xii, 231.
- 196 Sahut: *Soc. des Sci. Méd. de Gannat*, Moulins, 1874, 40.
- 197 Scheféik, J.: *Wiener med. Presse*, 1877, xviii, 814, 847.
- 198 Schmidt, K. E. F.: *Meteor. Ztschr.*, Wien, 1905, xxii, 362.
- 199 Schmitz, W.: *Deutsche Med.-Ztg.*, Berlin, 1887, viii, 821.
- 200 Schneider, S. A. J.: *Deutsche Ztschr. f. d. Staatsarznk.*, Erlangen, 1870, n. F., xxviii, i, 161.
- 201 Schottin, D.: *Med. Convbl.*, Hildburghausen, 1831, i, 1.
- 202 Schumacher, E. D.: *Unfälle d. elek. Starkströme*. 1908.
- 203 Sheild, M., and Delépine, S.: *BRIT. MED. J.*, 1885, i, 531.
- 204 Shettle, R. C.: *Lancet*, 1895, ii, 694, 809.
- 205 Sonrier: *Gaz. des Hôp.*, Paris, 1872, 833.
- 206 Stanton and Krida: *Med. Record*, 1910, 896.
- 207 Stock, J. C.: *De fulmine*, etc. Jenae, 1734.
- 208 Sutherland, W. G.: *Lancet*, 1893, ii, 1033.
- 209 Swinton, A. A. C.: *Lancet*, 1893, ii, 957.
- 210 Sycyanko: *Berl. klin. Wchnschr.*, 1868, v, 227.
- 211 Tatum, E.: *New York Med. Journ.*, 1890, li, 207.
- 212 *The Girlhood of Queen Victoria*. London, 1912, i, 337.
- 213 Thomson: *Trans. Amer. Electrotherap. Assoc.*, 1894, iv, 261.
- 214 Thys: *Ann. de la Soc. de Méd. Prat.*, Malines, 1851, ix, 389.
- 215 Trotter, A. P.: *J. Inst. Electr. Eng.*, 1902, xxxi, 762.
- 216 Trowbridge, J.: *Mém. Amer. Acad. of Arts and Sci.*, 1908, xiii, 185.
- 217 Turley, E. A.: *Med.-Chir. Review*, London, 1844, xl, 177.
- 218 Verhoogen, R.: *Journ. de méd. de chir. et de pharm.*, 1894, 729.
- 219 Vincent, F.: *Gaz. des Hôp.*, Paris, 1885, lviii, 724, 755, etc.
- 220 Idem, *Gaz. des Hôp.*, Paris, 1892, lxx, 928, 958, etc.
- 221 Vollmar, J. G.: *De fulmine tactis*. Argentorati, 1765.
- 222 Weber, L.: *Schr. d. Naturwiss. Schleswig-Holst.*, 1878, 99.
- 223 Weiss, G.: *Bull. Soc. Inter. des Electr.*, Paris, 1911, i, 417.
- 224 Wheeler, W. M.: *Med. Brief*, St. Louis, 1896, xxiv, 1177.
- 225 Wilks, G.: *Lancet*, 1879, ii, 655.
- 226 Witz, A.: *Ann. de psych. et d'hypn.*, Paris, 1893, n.s., iii, 193.
- 227 Zacon: *Bull. Soc. Internat. des Electr.*, 1911, i, 437.
- 228 Zwaluwenberg: *Journ. Amer. Med. Assoc.*, 1903, 967.

IN his introductory remarks on the health of Colombo, Ceylon, for 1911, Dr. Philip, M.O.H., states that the mean temperature of the year was much the same as the average, but there was, for the ninth year in succession, a great shortage of rain recorded (24.06 in.). The birth-rate during 1911 was higher than the average, but, owing to the large number of children of Colombo parents who are born and registered in districts outside the town, the birth-rate as recorded—24.7 per 1,000 living—does not afford a true measure of the fertility of the population, which is undoubtedly great in the case of the Burghers and Cingalese. The general death-rate—33.8 per 1,000 living—was rather above the average, though there was a reduction in the mortality amongst Europeans. Amongst the principal causes of deaths, only pneumonia and enteric fever showed an increase; but, in the case of enteric, the apparent increase was more than counterbalanced by the decrease in the number of deaths ascribed to simple continued and remittent fever, both of which terms were being, to a large extent, abandoned by the medical profession. The mortality from phthisis had shown a noteworthy improvement during the last two years. The infant mortality, which had been improving steadily for a series of years, was higher than the record low rate of 1910, but was still 22 per 1,000 below the average, the death-rate per 1,000 recorded births being 316. There was a considerable increase in the number of infectious diseases notified and dealt with during 1911 compared with the previous year, which was in a large measure due to the notification of phthisis having been made compulsory, and to an improvement in the diagnosis and notification of enteric fever. Dr. Philip remarks, with regard to the food supply of Colombo, that proper food laws are much required, but that they could not be properly administered unless the council appointed a sufficient staff for the purpose. The housing problem has become very acute, both as regards the insufficiency of accommodation and the existence of unhealthy areas and unhealthy dwellings. A municipal bacteriological laboratory was instituted during the year, and Dr. Hirst assumed duty in July.

Remarks

ON

THE FOOD REQUIREMENTS OF CHILDREN.

BY

CHALMERS WATSON, M.D., F.R.C.P.E.,

ASSISTANT PHYSICIAN, ROYAL INFIRMARY, EDINBURGH.

As a member of a subcommittee of the Edinburgh School Board, co-opted to advise as to the best means of supplying nutritious meals at small cost to the necessitous and other children fed by the Board, I was led to make the following investigations.

1. To ascertain by chemical analysis the amount of food consumed daily by apparently healthy children, about 5 years old, in good social circumstances.

2. To devise nutritious one-course meals at small cost, suitable for a large number of children (2,000 or more) fed by the school authorities.

The results of these investigations will be shortly stated:

Brief reference may first be made to the part played by proteins in the dietary. In early life proteins have special importance from the physiological point of view because they are the chief tissue builders; the proportion of protein in the dietary of children should therefore be relatively high. It is important to note, however, that the nature and source of the protein require quite as much consideration as the amount consumed. In later life proteins have special significance from the pathological point of view, because, being incompletely oxidized in the body, products of their incomplete combustion are liable to accumulate in the blood and tissues, and there give rise to various manifestations of so-called "auto-intoxication." The commonly accepted standard of daily food requirements in adults is that associated with the names of Atwater and Voit, namely:

Protein.	Fat.	Carbohydrates.	Caloric Value.
120 grams (4.2 oz.)	65 grams (2.2 oz.)	500 grams (17.6 oz.)	3,147

In recent years considerable doubt has been thrown on the accuracy of this teaching by the important researches of Chittenden, whose results led him to conclude that the standard hitherto accepted as correct is unduly high. In regard to protein in particular, Chittenden has laid down a standard of 80 grams or less of protein as the physiological intake for an adult under ordinary conditions. We are not here, however, concerned with the food requirements in adults, and the above figures are merely cited because of their bearing on what is to follow.

I. THE FOOD REQUIREMENTS OF CHILDREN.

So far as I have been able to learn from the study of textbooks on dietaries of children, authorities give little or no precise information on this subject. Details are given as to the kind of diet suitable for children of different ages, but nothing is said as to the total amount of protein, fat, and carbohydrates that should comprise the diet of a child, say, of 5 or 10 years. When we turn to textbooks of physiology and of dietetics, a definite statement is laid down as follows:

A child from 3 to 5 requires 0.4 the food a man at moderate work.

A child from 6 to 9 requires 0.5 the food a man at moderate work.

A child from 10 to 13 requires 0.6 the food a man at moderate work.

On looking into the subject, it would seem that this estimate has been arrived at empirically, the figures, once laid down, having been reproduced by all subsequent writers on the subject. If for the moment we accept the Atwater standard as a reliable guide for the food requirements of an adult, we find that the daily food requirements of a child of 5 years are as follows:

Protein.	Fat.	Carbohydrates.	Caloric Value.
48 grams	30 grams	200 grams	1,270

No attention is paid to the salts in the dietary, as these

are amply provided for in any dietary which will give the above supply of protein, fats, and carbohydrates. In order to ascertain the actual amount of protein, fat, and carbohydrates taken daily by children in good social circumstances, I have made an analysis of the diet of some apparently healthy children—one member of my own family, the others of children of my medical colleagues, who took an interest in the observations and took all possible precautions to furnish accurate data. The equivalent of an average day's diet was set aside, thoroughly mixed, dried to constant weight, weighed, and a known amount taken for estimation of the protein, fats, and carbohydrates. The proteins are calculated from the nitrogen estimation (Kjeldahl), the figures for N being multiplied by 6.1. The fat was estimated by extraction with Soxhlet apparatus, the figures for carbohydrates being arrived at by differences. The age, height, and weight of the children are recorded, and also any points of interest in the composition of the dietary.

TABLE I.—Showing Nature and Composition of Diet in Eight Children Aged 4 to 7.

Age.	Height.	Weight.	Total Dried Food.	Protein.	Fat.	Carbo-hydrates.	Details of Food.
	ft. in.	st. lb.	gms.	gms.	gms.	gms.	
4	3 2	2 12	220	44.0	41.5	134.4	Mixed diet.
4	3 9	3 2	338	52.8	104.1	181.0	Mixed diet, porridge.
4	3 5	3 2	260	64.5	39.9	175.4	Mixed diet, grape nuts, cream.
5	3 5	3 0	384	74.6	60.9	248.4	Mixed diet, grape nuts.
4	3 5	3 0	329	75.6	58.4	195.3	Lacto-vegetarian diet, fruit in abundance.
5	3 7	2 11	333	78.6	60.2	194.6	Mixed diet, no red meats.
7	4 0	4 1	398	79.1	70.9	248.2	Mixed diet, porridge twice daily.
4	3 6	3 2	435	108.0	117.0	210.0	Mixed diet + three pints milk.
Average of 1 to 8.				72.1	69.1	198.4	1,751 calories.

The protein intake ranged from 44 grams in No. 1, a fairly sturdy small boy, to 108 grams in No. 8, a boy of excellent physique and high physical energy. The diet of No. 8 included an extra supply of milk, this having been given for some months on account of an enlarged submaxillary gland, a sequel to tonsillitis, which was regarded as possibly of tuberculous origin.

The question then arises whether we should accept the forementioned Atwater standard of 48 grams protein and 30 grams fat as a reliable standard, or 72 grams protein and 69 grams fat, the average figures of this series. A knowledge of the physique, colour, and state of vigour of the children referred to inclines me to accept the latter as the more nearly correct standard. In comparing the figures for protein for the child with those of the adult it should not be lost sight of that much of the protein in the child's diet is in the form of milk, the protein of which is much more easily digested and absorbed than the protein entering largely into the diet of the adult. In the interpretation of the above data I would emphasize three points:

1. Too much importance must not be attached to the chemical composition of the food *per se*—for example, a child of 5 may be able to digest and absorb to advantage a quantity of protein and fat in the form of milk much in excess of what it can advantageously take in the form of meat foods.

2. In children of pronounced tuberculous or gouty tendency special rules apply. In the former the proportion of protein in the diet should be appreciably higher than the accepted standard, the protein being given in the form of extra milk, eggs, and red meats. In the case of child No. 8, for instance, I believe that the extra protein and fat in the dietary given over many months was a physiological one for the child in question. In gouty children, on the other hand, the amount of protein, and more especially in the form of rich animal food, should be judiciously restricted during the whole of the early growing period. I believe that the special advantages of an extra supply of protein in the one condition and restriction of it in the other are explained in great part by the specific effects of the diet on the thyroid gland as revealed by the results of my experimental investigations.¹

3. The third point to which I wish to refer is the importance of pure food. It is probably no exaggeration to say that the medical profession, no less than the public, have a very inadequate idea as to the extent of minor or major adulteration of common foodstuffs. Bread is an important illustration. A large proportion of bread in daily use is now made from flour which has been artificially bleached by the passage of nitrous oxide fumes. These are produced by an electrical discharge, the process being described by the parties interested as "electrified air," and in ignorance accepted by millers and bakers as a process "free of chemicals." The researches of Professor Ladd, U.S.A., Professor Halliburton, and the author, among others, have shown that the digestibility of flour so treated is, *in vitro*, appreciably reduced, and as there are, unquestionably, no compensating advantages in the process from the physiological and dietetic point of view, it is advisable that all bread should be made from the natural product of the wheat. It is conceivable that a child would thrive better on a diet containing a smaller amount of food in a pure form than on a diet which is richer from the point of view of chemical composition, but with its nutritive value impaired by the addition of various preservatives.

4. A further point of importance is the use of "hard" food, adapted for promoting mastication, giving meat in a form which necessitates chewing, bread in baked form for similar reasons, and at the same time restricting indulgence in sugar and sweets, which promote fermentation in relation to the teeth, with resulting caries.

II. NUTRITIOUS MEALS AT SMALL COST.

The question of supplying diets which are both cheap and nourishing is very important. To a man and his wife with three or four children and an income of £1 a week or less the question of how best to expend the sum required for the necessary foodstuffs is, or ought to be, a very vital one. There is, unfortunately, no doubt that inadequate attention is paid to this point, with the result that not a little of the malnutrition seen in the children of the poorer classes at the present time is due to ignorance rather than to actual poverty. This is very clearly brought out in the report of Sir George Newman, chief medical officer of the Board of Education, for 1910. This report not only discloses the fact that a very large proportion of the children are suffering from diseased conditions of various kinds, all of which are calculated to interfere with the conduct of education, and many with the ultimate attainment of sound physical development, but it discloses the fact that a considerable percentage of children are also suffering from a greater or less degree of malnutrition. In plain English, they are half starved. The report leads to the conclusion that it is too widely diffused to be attributable to poverty in more than a small proportion of cases; a more probable explanation seems that afforded by the extraordinary ignorance of English women of the industrial classes concerning food values, cooking, and general economy of dietetics.

Further, additional interest and importance now attach to the subject of cheap and nutritious foods in view of the Provision of Meals Act, 1906, which empowers educational authorities to supply school children with meals, the cost of which is met out of the rates, or, in part, by voluntary subscription. Some idea of the extent to which this power has been exercised will be learnt from the fact that in 1909-10 the cost to the rates of the meals so provided by the educational authorities was £134,105. As the principles to be observed in the feeding of a family of six or seven, where the income is very small, are similar to those applicable when a large number of children have to be fed out of the rates, it is possible to gain information of value for the family from the results of the experience recorded in the past year or two by various educational authorities.

It may be assumed that the essentials to be laid down are the following:

1. The food must be nourishing and ample in amount.
2. The food must be as cheap as possible consistent with 1.
3. The food must be of a nature that can be readily cooked with the limited facilities available in a one or two roomed house.
4. In children, satisfactory rate of growth, increased vigour, and more efficient education must be the result.

Oatmeal, peas, beans, and lentils are, in virtue of the large amount of protein, fats, and carbohydrates present, highly nourishing foods, and have the merit of cheapness.

For example, a bowl of thick lentil soup containing $\frac{1}{2}$ lb. of lentils with a slice of bread, costing about $\frac{3}{4}$ d., contains much more nourishment than $\frac{1}{2}$ lb. of meat and a slice of bread, costing about 4d.

The most important meal of the day is dinner. In the case of very necessitous children it is possible to give, if necessary, at least half of the total daily food required at this meal. It may be given in the form of a two-course dinner or a one-course meal. An excellent series of cheap two-course dinners was published in 1907 by Dr. Ralf Crowley in conjunction with Miss Marion Cuff for the City of Bradford Education Committee. This report gives details of seventeen two-course dinners, of which about half contain meat, adapted for a family of seven, the cost of food materials (in 1907) ranging from 1.1d. to 2 $\frac{1}{4}$ d. per head. The average food value of the dinners in protein and fat was 29 grams (1 oz.) and 18 grams ($\frac{3}{4}$ oz.).

The "Bradford" meals are perhaps better adapted for families with an income of 25s. weekly or upwards, as, in addition to the expense, the trouble involved in the cooking is in many instances beyond the facilities available in the restricted house and firing accommodation of the very poor.

When a two-course dinner of soup and pudding is relied on as an ample meal, especially for children, care must be taken to see that the proper amount of nourishing food is given in each course. Some time ago I analysed three two-course dinners which were supposed to be planned on the Bradford system, and found the composition in protein and fat as follows:

Protein.	Fat.
20.6 grams.	1.8 grams.

The deficiency was accounted for by the soup being too thin and the puddings also lacking in nutritive value.

The question of a good one-course dinner is important. In many of the houses of the poor the cooking facilities—one small open grate—are not well adapted to providing a two-course meal if such were otherwise available, and in connexion with the feeding of large numbers of school children there is certainly economy of time and labour, and possibly of expense, in a one-course as compared with a two-course meal. Experience has shown that a one-course meal at low cost can be made as nourishing and attractive to children as a two-course meal at similar outlay. It is of interest in this connexion to refer to the nutritive value and cost of a series of five one-course dinners recently supplied, on my recommendation, by the Edinburgh School Board. The nutritive value of the food was determined by analysing the total amount of food taken by the "average" child in a school in one of the poorer districts of Edinburgh. The amounts of food were in each case taken by myself in conjunction with the head master of the school. I am aware that in the strict sense there is no such thing as an "average" child, just as there can be no "average" family; but still it is possible to establish what may prove, at any rate, a useful standard which may be practically applied. Any such standard must, of course, be applied intelligently, due allowance being made for those conditions of the concrete problem which differ from those which were presupposed in fixing the standard. The meals in question were greatly enjoyed by the children; the smaller number of children fed on the porridge day is due to the fact that a certain number of children who get a more expensive two-course dinner do not take porridge. Analysis of the five meals gave the results shown in Table II, the composition of the meals and the

TABLE II.—One-Course Dinners.

	No. of Children.	Protein.	Carbo-hydrates.	Fat.	Cost.
Lentil soup ...	2,000	29.5	112.6	3.7	£ s. d. 6 3 0
Meat, soup, and potatoes	"	18.5	67.2	9.4	11 15 4
Plum pudding ...	"	36.4	151.4	20.2	12 12 7
Scottish broth ...	"	28.2	71.0	8.1	8 4 3
Porridge and hard biscuit	1,820	24.5	105.3	4.1	5 13 5
Average ...		27.1	102.0	9.0	1.2d. per head

F

figures for cost being kindly given by the officials of the board. The salts in the dietary are not estimated, because we know that any diet of the chemical composition given contains a sufficiency of mineral matter.

A study of the figures in the different columns is very instructive. The average amount of proteins 27.1 grams, fat 9.0 grams, and carbohydrates 102 grams, may be taken as a reliable standard for a highly nutritious meal, erring if anything in a deficiency in fat. If we compare the individual menus we find that—

No. 1 is a very nourishing dinner at small cost.

No. 2 is of considerably lower nutritive value, and is out of proportion expensive.

No. 3 is a rich highly nourishing meal and is proportionally dear; it is only advisable as an occasional meal.

No. 4 is a good dinner obtained at moderate cost.

No. 5 is also a good meal, a little below the average in nutritive value; this can be rectified by slightly increasing the amount of milk.

The experience of the head masters in the different schools under the Edinburgh School Board has shown that meals planned on these lines have been followed by satisfactory rate of growth, increased physical vigour and more efficient education of the children, these being the criteria for judging the correctness of any system of feeding.

A highly nutritious, cheap, and palatable day's menu may be summarized as follows. When calculated for a family of father, mother, and five children, the price works out at 16s. per week, which may be regarded as the minimum rate at which a family of that size can be adequately fed.

Menu for a Day.

	Protein.	Fat.	Cost not Exceeding—
<i>Breakfast</i> —Porridge and milk:			
Oatmeal 1 oz.	19.5	20.0	1.2d.
Treacle 1 oz.			
Milk $\frac{1}{2}$ oz.			
Bread 2 oz.			
Margarine $\frac{1}{2}$ oz.			
<i>Dinner</i> —One course			
Framed from Table II with footnotes	30.0	10.0	1.4d.
<i>Tea</i> —Bread and milk:			
Bread $\frac{1}{2}$ lb.	21.5	19.0	1.2d.
Margarine $\frac{1}{2}$ oz.			
Milk $\frac{1}{2}$ pt.			

In the foregoing remarks I have directed attention mainly to the proteins in the dietary. I am well aware that there are many disorders in children which owe their origin to the excessive use of starchy foods, and which are corrected by substituting proteins. The consideration of these cases is beyond the scope of the present paper, but in this connexion it is of interest to note that the average amount of carbohydrates in the series of cases recorded is practically identical with the generally accepted Atwater standard.

REFERENCE.

¹ Appendix to *Food and Feeding in Health and Disease*, Oliver and Boyd, Edinburgh, second edition, 1913.

MESSRS. MAULL AND FOX, 187, Piccadilly, London, have issued a photogravure memorial portrait of Captain R. S. Scott, which is sold at the price of 5s. (post free, 5s. 2d. in the British Isles). The portrait is an excellent reproduction of the late Arctic explorer in his uniform. The publishers have undertaken to contribute an agreed portion of the profits to a branch of the National Fund.

CERTAIN allegations against the nursing arrangements and administration of the York County Hospital made in the issue of the *Hospital* for March 15th were considered at a meeting of the house committee and medical board of the institution on March 18th. The joint committee, while stating that it was satisfied that there was a complete answer to the imputations and charges, resolved that the most satisfactory way of dealing with the question was to obtain the appointment of a competent and independent authority to hold an inquiry. An application has been made to the President of the Royal College of Surgeons of England to appoint some person with a knowledge of hospital management and free from local influence to hold an impartial and independent inquiry.