Conclusion

The diet at Christ's Hospital, though much improved in amount and quality, is still far from perfect. Sugar is too plentiful, fresh fruit and vegetable too scarce. Milk is now over one pint per head per day, and many of the younger boys have raw milk at tea. The bread, though reputed whole-meal, has a 20 per cent. admixture of white flour to allow of a finer texture, while the 80 or 90 per cent. flour used is itself only 82 or 92 per cent. of the whole grain. There is thus here a possibility of B complex shortage.

If the various requirements I have outlined in this paper could be adequately dealt with, and the balance of the diet be improved and corrected by means of the knowledge that is now being acquired through research, there is little doubt that both the health and the efficiency of the school child would soon present a much less disquieting picture than it has up to the present time.

RATIONALE OF FREE SCHOOL MEALS*

BY

E. H. M. MILLIGAN, M.D., D.P.H.

M.O.H.Glossop

In 1934 school meals to the number of 68,100,000 (including milk meals) were provided free to elementary school children in England and Wales. In Glossop £774 was spent to feed 642 children, and in addition 748 children paid for milk under the Milk Marketing Board's scheme at the rate of $\frac{1}{2}$ d. for one-third of a pint. Our school population is about 2,200. The fact that meals are provided is an admission of deficiencies in the home diet, and also that these deficiencies are likely to cause defects or disease. It will be useful to consider if there is any evidence that deficiencies in the home diets are responsible for any defect or disease, including poor physique, stunted growth, bodily deformity, lack of strength and endurance, or, to use one word to include all these conditions, malnutrition.

In Glossop I made graphs of the W/H ratio of school boys and girls, comparing the children in the very distressed area of Hadfield (between 40 and 50 per cent. unemployed) with the rest of the borough (about 20 per cent. unemployed); I also made graphs of the children of employed and unemployed persons, comparing in all cases these graphs with one compiled from the Board of Education Anthropometric Review of 1927. It will be seen that, generally speaking, the children in the distressed area have a lower graph than the others, and that the children of the unemployed have a lower graph than children of the employed or the Board of Education standard.

In Glossop 13 per cent. were referred for treatment among the Hadfield (distressed area) children compared with 7 per cent. of the other Glossop children, and 15 per cent. were referred for observation from the distressed area as compared with 8.6 from the other area. In carrying out functional strength and endurance tests I found that children of unemployed parents had less strength and endurance than children of employed parents; but I am glad to say that by school feeding things have been improved.

There can be no doubt that disease can be, and is, in a certain manner related to deficiencies in diet (cf. McCarrison, Cantor Lectures, 1936). This is of course admitted by the fact that the feeding of elementary school children to maintain their adequate nutrition is now a duty of the local education authority. The problem before us, then, is to see how the children attending

our elementary schools can be maintained in health by the giving of school meals. To solve that problem two things must be known: (1) What is an adequate dietary to maintain health? (2) How far short of this standard is the home dietary of the children?

First as regards standards:

British Medical Association Standard

	First-class Protein	Total Protein	Fat	Carbo-hydrate	Calories
	grams	grams	grams	grams	
Per unit man-value per day	50	100	100	500	3,400

Diet in Poor Law Children's Homes (Ministry of Health, 1932)

	First-class Protein	Total Protein	Fat	Carbo-hydrate	Calories
	grams	grams	grams	grams	
Per child	42	76	108	349	2,749
Per unit man-value as per M'Gonigle and Kirby	53	101	144	465	3,663

The League of Nations Technical Commission drew up a table (Table I, giving details of the diet recommended for children from 3 to 5 years with 1,400 calories), and pointed out that the amounts of protective foods in this table would be adequate for children of 10 to 15 years with, of course, more energy-producing food to give adequate calories. I give this table and also another (Table II) in which I have adapted it to a school child

TABLE I.—Age 3-5 (1,400 Calories, Daily Quantities)

Food	Amount	Calories	Protein
	grams		grams
A. Protective foods:			
Milk	1,000	660	32
Egg	48	70	6
Meat, fish, or liver	30	40	6
Green leafy vegetables	100	30	3
Potato	150	150	3
Cod-liver oil	3	30	—
A source of vitamin C (raw vegetable or fruit)			
		980	50
B. Supplementary energy-yielding foods:			
Fats (butter if possible)	7	55	—
Cereals (as bread)	125	400	17
Totals		1,435	67

TABLE II.—Age 9½ (adapted from above table)

	Daily Quantities	Calories	Protein (grams)	Cost per week
				s. d.
Milk	1.65 pints	660	32	2 11
Egg	1 (1½ oz.)	70	6	7
Meat, fish, or liver	1½ oz.	50	6.7	9
Green vegetables	3½ oz.	30	3	5
Cod-liver oil	1½ drachms	60	—	1
Potato	12 oz.	340	7	5½
Fat (butter if possible)	1 oz.	220	—	7
Raw vegetable or fruit (as orange)	4 oz.	60	0.8	7
Cereals (as bread)	5 oz.	450	20	4½
Treacle	¾ oz.	76	—	1
Totals		2,016	75.5	6 10

* Read in opening a discussion in the Section of Medical Sociology at the Annual Meeting of the British Medical Association, Oxford, 1936.

(boy or girl) of 9.5 years ; in this table additional calories could be obtained by adding a little more carbohydrate—for example, treacle, which helps the swallowing of the cod-liver oil: it also contains iron.

Stiebeling's (Bureau of Home Economics, U.S.A.) calorie requirements for a boy of 9-10 and a girl of 11-13 is 2,400, and protein requirement 75 grams. The League of Nations Commission advises 1,920 calories for a male or female of 9 to 11 years and protein requirement 2.5 grams per kilo body weight. Average weight* of a boy or girl at 9½ years is approximately 57 lb. ; therefore the protein requirement at 2.5 grams per kilo is approximately 65 grams.

Now what are the actual home dietaries? M'Gonigle and Kirby in their book *Poverty and Public Health* (page 253) give a table showing diet analyses of various groups of Stockton-on-Tees wage-earners as follows.

TABLE III.—Food purchased by 126 Stockton-on-Tees Families (per unit man-values per day)

	First-class Protein	Total Protein	Fat	Carbo-hydrate	Calories
	grams 50	grams 100	grams 100	grams 500	
B.M.A. minimum ...					3,400
Income only:					
25s. to 35s. Group 1	23.6	68.8	81.2	444.0	2,831
35s. to 45s. „ 2	25.9	72.2	80.9	436.1	2,845
45s. to 55s. „ 3	25.6	72.0	91.7	427.0	2,872
55s. to 65s. „ 4	48.9	99.1	111.6	485.2	3,487
70s. to 80s. „ 5	50.4	112.4	125.0	561.7	3,950

From this table it will be seen that there is a shortage of first-class protein in Groups 1, 2, and 3, and elsewhere it is pointed out that the money available to buy food was per man-value per week: Group 1, 4s. 3d. ; Group 2, 4s. 4d. ; Group 3, 4s. 11d. ; and Group 4, 5s. 9½d. ; while the actual cost of the standard B.M.A. dietary was 7s. per man-value per week.

In his book *Food, Health, and Income* Sir John Boyd Orr divides the population into six groups as follows:

TABLE IV.—Classification of the Population by Income Groups and Average Food Expenditure per Head in each Group

Group	Income per Head per week	Estimated Average Expenditure on Food	Estimated Population of Group	
			Numbers	Percentage
1	Up to 10s.	4s.	4,500,000	10
2	10s. to 15s.	6s.	9,000,000	20
3	15s. to 20s.	8s.	9,000,000	20
4	20s. to 30s.	10s.	9,000,000	20
5	30s. to 45s.	12s.	9,000,000	20
6	Over 45s.	14s.	4,500,000	10
Average	30s.	9s.	—	—

He made surveys of 2,640 family budgets in Newcastle, Manchester and District, Stockton-on-Tees, Merseyside, and England and Wales (by Women's Co-operative Guild) and 138 middle-class British home budgets. As a result of his investigations he found that the diet in Group 1 was inadequate in all the constituents considered ; Group 2 was adequate in total protein (not first-class) and fat ; Group 3 was adequate in protein, fat, and calories, but

the diets in Groups 2 and 3 were deficient in minerals and vitamins ; Group 4 was probably deficient in calcium ; Group 5 had barely a sufficient margin of calcium ; and Group 6 exceeded the standard in everything.

It will be seen, then, that large masses of the population, including school children, actually have inadequate dietaries, especially in protective foods, including minerals and first-class protein. How then are we to make up this deficiency in our arrangements for school meals? To that there can be only one answer: we must find out what the actual dietary deficiencies are in each area and supply the missing constituents in the school meals. To ascertain the actual and exact local deficiencies may take time, so in Glossop we have adopted preliminary measures as follows.

For the past two years school children have been given milk and sandwiches, thus receiving those articles of food which are necessary for health, but which the parents are unable through poverty to provide for them in sufficient amount. One, two, or even three bottles of milk (of 1/3 pint each) are given with each sandwich, which, with one bottle of milk, has the following approximate composition in grams:

	Animal Protein	Total Protein	Fats	Carbo-hydrate	Calcium	Phosphorus	Iron	Value in Calories
	grams	grams	grams	grams	grams	grams	grams	
Sandwich and ½ pint milk	10.9	17.6	23.90	37.0	0.427	0.378	0.0034	454
Sandwich and ⅔ pint milk	17.1	23.8	31.56	46.0	0.655	0.555	0.00355	576
Sandwich with 1 pint milk	23.3	30.0	37.80	55.0	0.884	0.738	0.0035	698

The ingredients of the sandwich (latest variety with added yeast) are: whole-meal bread, 2 oz. ; butter, 1/2 oz. ; dried brewers' yeast, 1/8 oz. ; mustard and cress or watercress or tomato or lettuce (as in season), 1/2 oz. ; and, in addition, cheese, 3/4 oz. on Monday, Wednesday, and Friday ; 1/3 egg, 5/8 oz. on Tuesday ; beef or liver, 5/8 oz. on Thursday. It will be noticed that the ingredients of this supplementary meal are very similar to the food recommended in the League of Nations report.

We have tried to give food which contains a large amount of high-grade animal protein and fat ; vitamins A, C, D, and the complex B vitamin and minerals.

Now let us refer back to the analysis of the sandwich and milk meal. Sir John B. Orr (*Food, Health, and Income*) states (quoting Stiebeling in part) that the requirements of a boy of 11-12 years and a girl of 13 and over are:

Protein	Calcium	Phosphorus	Iron	Fat	Calories
grams	grams	grams	grams	grams	
75	1.0	1.2	0.0115	98	2,500

The League report recommended that of the protein 44 grams should be from milk, egg, meat, fish, or liver, and 3 grams from green leafy vegetables. Sir John Orr in his investigations found that each person in Group 1 received during the whole day the following amounts in grams in their dietary: protein, 63.4 (of which 22.5 was animal) ; fat, 71.6 (animal 50.7) ; carbohydrate, 348 ; calcium, 0.37 ; phosphorus, 0.81 ; iron, 0.008 ; calories, 2,317.

From investigations in Glossop of fifty-two home budgets I find that the quantity and quality of the food of the unemployed and lower-paid wage-earners is about the same as this Group 1 of Orr's. Now take the figures of

* Anthropometric Committee, Board of Education, 1927.

the constituents of this low-grade dietary and add to it the amount of each received in the milk and sandwich meal.

	Animal Protein	Total Protein	Animal Fat	Total Fat	Carbo-hydrate	Calcium	Phos-phorus	Iron	Calories
Orr's Group 1 diet in grams	22.5	63.4	50.7	71.6	348	0.37	0.81	0.008	2,317
Milk and sandwich meal and $\frac{1}{3}$ pint milk	17.1	23.8	31.3	31.56	46.0	0.655	0.555	0.0035	576
Total of Group 1 diet and sandwich meal	*39.6	87.2	82.0	103.16	394.0	1.02	1.365	0.0115	2,893
Standards advised by Stiebeling and Orr	*25	75		98		1.0	1.3	0.0115	2,500

* The League of Nations report suggests 44 grams of animal protein for a *growing* child; the additional $\frac{1}{3}$ pint of milk as mentioned below would give this.

It will be seen at once that the diet of the poor plus the milk and sandwich meal approaches the recommended standard. Another $\frac{1}{3}$ pint of milk is sometimes given with the milk sandwich meal to big growing boys and girls who do not progress. The Glossop school supplementary meal is very rich in high-grade animal protein (needed for growth). Through its whole-meal bread, liver, and yeast, etc., it is rich in vitamins B₁ and B₂; vitamin A is supplied by the large amount of animal fat in the butter, cheese, and milk; C is contained in the raw vegetable, and D in the butter. The sandwiches are so cut (in halves and quarters) that the amount given can be varied according to age.

It is usual to take the heights and weights and assess the condition of the children clinically by watching the progress of those having school meals. In addition, I would like to point out the desirability of testing also their strength and endurance: by the dynamometer for strength (estimating by pull in lb. over weight in lb.), and by some such test as the hanging bar for endurance. This latter test is conducted by getting a boy or girl to hang on a horizontal bar and noting with a stop-watch the number of seconds he or she can hang on. I would also emphasize the advisability of some such tests in the case of malnourished children before they are allowed physical exercises, as excessive exercises in such children may be harmful.

Summary

1. The home diets of large numbers of school children are deficient to an extent likely to cause malnutrition, judging malnutrition as a complex condition associated with (a) poor physique; (b) deficient growth (council schoolboys aged 14 were found to be 3.1 in. shorter than Christ's Hospital boys and 5.7 in. shorter than the boys in a large public school); (c) clinical defects and diseases; (d) deficient strength, estimated by pull in lb.; and (e) endurance and also perhaps instability (as body weight judged by the Romberg test).

2. The extent of the deficiency should be ascertained locally by home budget inquiries carried out by the M.O.H. or S.M.O. and assisted by the appropriate Government Department.

3. The constituent missing from the diet should be supplied by a system of school meals in such a way that through home and school feeding the child obtains an adequate and balanced diet.

4. Functional tests of strength and endurance should be carried out among school children to see if they are fit for the physical exercises curriculum, such tests being done by those responsible for the exercises in co-operation with the S.M.O.

Abstract from Budget Analyses of 52 Working-class Families in Glossop

Total income per week of 52 families, £108 0s. 4d. Total expenditure on food per week, £60 0s. 10½d. Total man-value of 52 families, 229. Total amount of income per week per man-value, 9s. 5½d. Amount spent on food per week per man-value, 5s. 3d. Total amount spent by 52 families per week on overhead charges (rent, heating, lighting, clubs, and insurance), £40 12s. 2d. Amount spent per week per man-value on overhead charges, 3s. 6d. Total individuals in 52 families, 277. Total income *per head* per week in 52 families, 7s. 9½d. Total amount spent on food *per head* in 52 families, 4s. 4d. Total amount of overhead charges *per head* per week, 2s. 11d. Sir J. B. Orr's Group 1, amount spent on food *per head* per week, 4s.

PARALYSIS DUE TO POSTURE

BY

E. B. CLAYTON, M.B., B.Ch.

DIRECTOR OF PHYSICAL TREATMENT DEPARTMENT, KING'S COLLEGE HOSPITAL

The following cases of nerve paralysis, which are apparently due to pressure during the maintenance of some posture, have been collected from the notes of patients attending the Physical Treatment Department of King's College Hospital during the last ten years.

Anterior Tibial Nerve Paralysis

Case 1.—In a woman, aged 59, there was a sudden onset of foot-drop when she was kneeling to clean a grate in April, 1926. On examination the external popliteal nerve was found to be tender and thickened at the neck of the fibula. Only the anterior tibial group of muscles were affected, the peroneus longus and brevis being normal. The faradic reaction was present but reduced, in April; by July it had completely disappeared. However, there was return of fairly strong foot dorsiflexion by September.

Case 2.—A man, aged 42, had a sudden onset of foot-drop while gardening in a crouching position in March, 1926. Only the anterior tibial group of muscles were affected. There was a history of a wound in the thigh during the war, but there was no paralysis at that time. The duration of paralysis was sixty days.

Case 3.—A man, aged 23, had sudden foot-drop after kneeling for over an hour in October, 1923. It lasted for twenty-four days.

Circumflex Nerve Paralysis

Case 4.—A woman, aged 52, discovered paralysis of the deltoid muscle on waking one morning in February, 1936. She was suffering from fibrositis in the scapular region following an attack of influenza previous to the paralysis, the duration of which was two weeks.

Case 5.—A man, aged 37, discovered paralysis of the deltoid muscle on waking one morning in March, 1936. The paralysis disappeared in a short time, but returned the following day. He had been previously suffering from fibrositis in the scapular region, and for a fortnight before the paralysis developed cramp if sleeping on either arm. The duration of the paralysis was only a few days.

Ulnar Nerve Paralysis

Case 6.—A lad, aged 21, experienced a sudden onset of ulnar paralysis when riding a bicycle in April, 1932. He had had this before, when it only lasted one day, but the duration on the second occasion was twenty-six days. The paralysis only affected the intrinsic hand muscles, and was apparently due to pressure of the hand on the handle-bar.

Musculo-Spiral Nerve Paralysis

Case 7.—A man, aged 52, suddenly developed wrist-drop after lying down for about fifteen minutes with the hand behind the head, in February, 1926. It was a wet evening. On examination the musculo-spiral nerve seemed to be thickened at the middle of the posterior surface of the humerus. The paralysis lasted for eight weeks.