the differences are due to economic factors is supported by a study of the relation between nutritional status and family size (Yudkin, 1944a) and by the results of an investigation of children from industrial areas (Yudkin, 1944b).

Limiting Factors in Nutritional Deficiency.—The absence of effect of vitamin or other nutritional therapy is not necessarily an indication that the diet was completely adequate in these essentials (Yudkin, 1943, 1944c). Let us consider the results of

FIG. 6.—Vitamin C saturation tests.

the Cambridge vitamin investigation from this point of view. Apart from the improvement in vitamin C saturation, which is simply an index of past vitamin C intake, the supplements effected an improvement only in respiratory illness and in general behaviour as assessed by the teachers. The fact that no improvement was produced in height, weight, haemoglobin, etc., even in children from the poorer school, does not mean that these are unaffected by vitamin A, B₁, C, or D. It might mean, of course, that the diets of the children supplied adequate quantities of these components. On the other hand, it might mean that the diets were deficient in other essentials in addition to these vitamins and that one or more of these other essentials was the limiting factor in growth, haemoglobin formation, and so on. An animal showing suboptimal growth on a diet slightly deficient, for example, in protein, calcium, and vitamin A will not be made to grow normally by the administration of only one of them. On the other hand, a similar degree of suboptimal growth caused by deficiency of, say, vitamin A only, will be restored to normal by an increase in this factor alone.

Summary

The nutritional status of about 1,100 Cambridge school-children, determined in Jan. and Feb., 1942, was found to compare favourably with that reported for children in other parts of the country. Nevertheless, in the Cambridge children appreciable differences were seen between those living in a poorer area of the town and those in a better-class area. Compared with the latter, the children from the poorer area were on the average 0.8 in. shorter, 2.6 lb. lighter, had

2% less haemoglobin, and a grip about 1.25 kg. weaker, and showed more changes in conjunctival epithelium.

Most of the children were re-examined in Jan. and Feb., 1943. The average heights and weights were slightly greater than for children of the same age examined a year previously; in other respects no change was seen. It may be said, therefore, that no deterioration in the diets of these children had occurred between the third and fourth years of the war.

Since Feb., 1942, half of the children have been receiving vitamin pellets at school; allowing for absences and school holidays, they were thus being given a supplement containing approximately half the daily requirements of vitamins A, B₁, C, and D. The other half of the children received control pellets containing no vitamins. After a year no effect was seen in the gain in height and weight, haemoglobin, strength of grip, dark-adaptation, resting pulse rate, vital capacity, breath-holding time, or endurance measured by the R.A.F. mercury test. There was, however, an improvement in vitamin C saturation, a decrease in the incidence and duration of colds, and an improvement in school behaviour as assessed by the teachers.

It is pointed out that the absence of effect on growth, haemoglobin, etc., cannot be taken to imply that these are not limited by nutritional factors.

This investigation would have been quite impossible without the co-operation of the teachers of the Cambridge schools, which was given so generously and for which I am very grateful. My thanks are due also to Dr. J. A. Smyth, medical officer of health for Cambridge, Dr. Janet Laidlaw, Mrs. Elsie Walton, my wife, and the many friends who have helped so willingly in the collection and analysis of the results.

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NUTRITION AND SCHOLASTIC ATTAINMENT

BY

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A measure of far-reaching significance which was placed on the Statute Book in 1906 was the Education (Provision of Meals) Act. This Act granted powers enabling Education Authorities to provide meals for children in attendance at public elementary schools who were "unable by reason of lack of food to take full advantage of the education provided for them."

The inquiries of Rowntree (1900) in the city of York and the Report of the Interdepartmental Committee on Physical Deterioration (1904) had revealed that many children received quite insufficient quantities of food and that a condition of semi-starvation was rife. School-children were particularly affected, and it was recognized that the lack of food produced a condition of mind and body which made educational progress extremely improbable. Thus the ultimate object of the Act was the promotion of education among the poorer sections of the community; and it is probably correct to say, from a study of the antecedents, that the means to attain this end which those who framed the Bill had in mind was the prevention of actual hunger rather than the correction of defective nutrition.

Nowadays conditions have so changed that persons living at a correspondingly low economic level are no longer encountered. On the other hand, an enormous amount of defective nutrition, due principally to a long-continuing deficient intake of essential nutrients, exists among children of school and pre-school age. Reliable evidence of this has accrued during the last few years

through numerous investigations which need not be cited in this paper.

The question which arises at this juncture is, To what extent, if at all, does malnutrition interfere with the educational progress of a child? In other words, do the various factors which culminate in malnutrition have an adverse effect on the functioning of the brain? This point is of particular interest at the present time when plans are being formulated for reform of the educational system with a view to raising the educational level of the community. If it can be established that malnutrition reacts unfavourably on scholastic progress it is pertinent to ask if the full benefit of educational reform can be achieved without a concurrent and properly organized attempt to reduce further, or eliminate altogether, defective nutrition in school-children.

Findings in Other Investigations

References in the literature to the effects of malnutrition on educational status are not numerous, but almost without exception they stress the importance of this condition as a cause of scholastic retardation. For example, Baldwin (1922) deduced from his investigations into the physical and mental growth of children that, on the average, the well-grown, well-nourished child is generally superior in its school record to the smaller child of the same age. In another investigation, in which 423 children were examined by group intelligence tests and graded physically, it was shown that 52% of the group with the highest intelligence scores had no physical defects (Sandwick, 1920). When a considerably larger group of 4,558 children was surveyed a clear correlation was established between "intelligence" and the state of the health (Pearson, 1923). A more recent statistical study of the physique of elementary-school children with special reference to their mental ability was recorded by Habakkuk (1926). He examined the records of 3,914 boys and girls aged 7 to 12 years in South Wales, and came to the conclusion that the most backward were the shortest and the most advanced the tallest. A similar attempt to correlate physical development and intelligence was undertaken in Glasgow (Dawson, 1931). The evidence obtained was such that it could be maintained that the taller children were more active mentally. In this connexion it should be stressed that there is general agreement that height is a much better index of the nutritional state than is weight. The investigations of the authors of *Genetic Studies of Genius* (Terman *et al.*, 1926) make it clear that genius and exceptional brilliance are associated with, and are probably dependent upon, a sound physique; and, to a certain extent also, upon the superabundant energy which good health promotes.

Emerson (1922) believes that though malnutrition does not cause mental deficiency it may give rise to mental retardation; while Orr (1941), in the same connexion, said that "the power to use intelligence depends upon the state of the health."

A different approach to the problem was taken by Leighton and Clark (1929). Their Scottish experiment, which involved 1,425 children of from 5 to 13 years of age, demonstrated that those who had been given a regular extra ration of milk were noticeably more alert and boisterous than the control group, which had not had extra milk. The authors stated that teachers remarked on the altered demeanour and behaviour of the boys. A somewhat similar response to an extra ration of milk was described by Corry Mann (1926). The test boys were obviously more fit and were much more high-spirited.

Present Investigations

The line of approach to the problem adopted in the present inquiry is based on the view that consistent and sympathetic observation in his class in school enables a teacher to detect quite slight deviations from the normal ability to understand and memorize, as well as permitting him to pick out those children who, without being necessarily less intelligent, are, nevertheless, not so receptive and alert mentally. It will be generally admitted that a teacher who has had considerable experience in the handling of children is usually in a position to make valuable comment on a child who has been observed in class for months or more.

An opportunity presented by a nutrition survey in a group of public elementary schools was utilized to ascertain if any evidence along this line could be secured and if my assessment

of the nutritional state bore any relation to the estimate of the teacher on the response of the child in class. Each teacher chose the pupils who, in his opinion, were the brightest and those who were slow in comparison with the class average. Classes for children under the age of 8 years were excluded from the inquiry, so the selected individuals were of varying age above 8 to school-leaving age. Children who were backward because of inherent mental defect or because of physical disability had been ascertained and provided for earlier, and the children under inquiry were therefore regarded as being of normal intelligence. The broad social and environmental conditions were identical in the case of all children. The nutrition assessment was made on the findings of a clinical examination which followed that recommended by the League of Nations Health Organization (1938), and the classification used is that sponsored by the Board of Education (1934).

Results of the Investigation

(a) *Total Figures.*—In Table I the numbers of bright and slow children in each of the four nutrition grades, and the respective percentages, are set out.

TABLE I

Category	Nutrition A (Excellent)		Nutrition B (Normal)		Nutrition C (Slightly Subnormal)		Nutrition D (Bad)	
	No.	%	No.	%	No.	%	No.	%
Bright (355)	100	28.2	235	66.2	20	5.6	0	—
Slow (357)	24	6.7	251	70.3	79	22.1	3	0.9

A total of 712 children (355 bright and 357 slow) were subject to inquiry. Out of 355 bright children 100 (28.2%) were Nutrition A and 20 (5.6%) were Nutrition C. The remaining 235 children were classified as Nutrition Grade B. In the case of the slow children the number whose nutritional status could be passed as Grade A was 24. This was 6.7% of the group. On the other hand, 22.1% (79 children) of these 357 slow children were of slightly subnormal nutrition, and were graded C. In addition, the three cases of bad nutrition (Grade D) were among the mentally slow children. The remainder of the group—that is, 215 children (70.3%)—were of normal nutrition, and were classified as B. It is of interest to note that the relative proportions of A and C children in the bright and slow groups are to all intents and purposes reversed. Over 20% of the bright children and some 6% of the dull children were Nutrition A, whereas Nutrition C cases among the slow children amounted to over 20% of the whole group, and the much smaller figure of 5.6% represents the Nutrition C cases among the children found to be bright.

(b) *Data for Boys and Girls Separately.*—Figures relating to sexes separately were prepared, and some interesting results were obtained. The data are set out in Table II. A total of 583 children (280 boys and 303 girls) from the group considered under (a), above, were reviewed.

TABLE II

Sex	Mental Activity	Nutrition Grades				Totals
		A	B	C	D	
Boys (280)	Bright	No. . . 28	72	8	0	108
		% . . . 26.0	66.6	7.4	—	—
	Slow	No. . . 12	126	32	2	172
		% . . . 7.0	73.2	18.6	1.2	—
Girls (303)	Bright	No. . . 57	125	8	0	190
		% . . . 30.0	66.0	4.0	—	—
	Slow	No. . . 6	77	30	0	113
		% . . . 5.3	68.1	26.6	—	—

With regard to the relative position of the sexes, 26% of the bright boys were Nutrition A and 7.4% were Nutrition C, whereas 30% of the bright girls were graded A and 4% graded C. Only 7% of the slow boys were included in Nutrition Grade A, and there were 18.6% in Grade C; whereas in the case of the girls 5.3% were Nutrition A, but the much higher proportion of 26.6% were graded C. In other words, of the bright children graded Nutrition A, 26% were boys and 30% were girls; that is, there was a 4% difference in favour of the girls. On the other hand, slow children graded Nutrition C amounted to 18.6% of the boys and to as many as 26.6% of the group of girls.

Discussion

A natural assumption from the data recorded above is that a correlation exists between nutrition and scholastic attainment. The evidence would appear also to indicate that a condition of

subnormal nutrition can constitute a serious handicap to the educational advancement of a child. A further inference from the data is that the mental activity of girls is even more closely related to their general physical state than is that of boys.

It may be contended that these deductions are not valid, inasmuch as parents of low intelligence not only beget children with a poor mental capacity but, in addition, cannot accord these children proper and sufficient care, with the result that malnutrition arises. In this way, it could be argued, the children who are mentally slow and who also suffer from malnutrition can be accounted for. Though this sequence is undoubtedly of not infrequent occurrence, yet only a comparatively small proportion of the cases in any one area could be accounted for on this basis. Moreover, the investigations of Corry Mann (already cited) are particularly significant in this connexion, in that he found that the boys in the group receiving supplementary milk, whose nutritional condition was thereby raised above that of the other groups, were more high-spirited and active. The same observation has been made in school dining centres provided for children with defective nutrition. The inference is that the malnourished child who has been labelled "slow" may, as a result of corrected dietetics and improved nutrition, attain to an ability to use his mental powers equivalent to that enjoyed by his better-nourished school-mate.

It is evident that further light on this aspect of the nutrition of children will be of value particularly to those interested in educational advancement.

Summary

The nutrition grades of 355 bright and 357 slow children were investigated. Of the bright children 28.2% were graded Nutrition A and 5.6% graded Nutrition C. Only 6.7% of the slow children were Grade A, while 22.1% were graded Nutrition C. The 3 instances of Grade D children were found in the slow group.

Of this group 583 members were arranged according to sex. Of the bright boys 26% were graded A and 7.4% were graded C, the corresponding figures for the girls being 30% and 4% respectively. In the case of the boys who were regarded as slow, 7% were Nutrition A and 18.6% were Nutrition C, whereas 5.3% of the girls in the slow category were Nutrition A and 26.6% were Nutrition C.

I am indebted to Dr. John Stokoe, whose keen interest in matters connected with nutrition was a stimulus to inquiry.

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pigmentation of the skin of the neck and of both upper eyelids. The prominence of her eyes was associated with conspicuous lid retraction on both sides—retraction so great that her eyes closed incompletely during sleep. The left cornea had a small abrasion. The thyroid was firm, both lobes and the isthmus being easily palpable and definitely enlarged. There was no retrosternal dullness. The outstretched hands showed a fine tremor; regular tachycardia of 100 to 110 persisted during the day and declined little at night. The cardiovascular system showed no abnormality apart from the tachycardia, and the other main systems seemed to be normal. The tongue was dry, brick-red, and fissured, but not sore. Her red blood cells numbered 4,800,000 and her haemoglobin was 81%. On admission the hands were persistently cold and blue—an unusual feature in thyrotoxicosis. The nails were brittle, conspicuously spoon-shaped, longitudinally striated, and cracked. She said that they had been in this state for about six months. The skin surrounding the nail, and especially at its base, was dry and scaly, and was encroaching upon the actual nail itself in an irregular manner. The free margin of the nail bed, instead of showing the normal clear-cut line of demarcation, was irregular.

Her stay in hospital was prolonged owing to the development of various complications. Soon after admission an acute respiratory infection was treated successfully with sulphathiazole. At that time the patient was having 30 minims of Lugol's iodine daily, and at the end of the course, which coincided with the end of the respiratory infection, her pulse rate during the day was 80 to 90 and at night 80, with definite diminution of other thyrotoxic signs. During July she developed a large bed-sore and a suppurative parotitis, from which she recovered. Despite these infections her general health improved steadily, and it was noticed at the time that the condition of her nails was altering and that growth was now occurring normally, the scoop being pushed onwards (Fig. 3). The skin around the nails had become more normal and the pulp was more rounded. There was no further cracking of the nails. By August she had gained a stone in weight; her red blood cell count was 5,010,000 and Hb 98%. Her basal metabolic rate was + 61%.

During September she developed another acute respiratory infection, which was treated with sulphathiazole, and also a severe conjunctivitis with corneal ulceration after a short course of thiourea. Nevertheless her general condition continued to improve steadily and her weight was increasing. Her pulse rate was in the region of 80 to 90 both day and night; her basal metabolic rate was + 48%. On Oct. 1 her red cells were 4,690,000 and Hb 84%—values similar to those on admission. The normal growth of her nails continued, and as they grew they soon became perfectly formed and clear-cut at their margins, brittleness being lost (Fig. 4). She had gained nearly 2 stone more in weight.

Recovery of Nail Growth in Case I

The nails in Fig. 2 seem shorter than in Fig. 4. This apparent shortening was due to the skin clinging to the base of the nail and being carried onward with it. The extent of this skin encroachment could be ascertained by measuring from the V-shaped crease of skin to the nearest part of the exposed nail in Fig. 4 and transferring this measurement to Fig. 2. This is shown in the outlines of Fig. 1: the nail is at least as high up the finger as the dotted line of the right-hand tracing. It is important to fix this, the growing root of the nail, as accurately as possible if we are to ascertain the time at which growth

FIG. 1.—Case I. Outline of middle finger on June 21 (right) and July 19 (left), showing the relative position of the proximal edge of the scoop, the root of the nail, and a V-shaped crease in the skin over the distal interphalangeal joint. Used to estimate the date at which formation of deformed nail ceased. Drawings made from Figs. 2 and 3.

changed from normal to abnormal. The position of the proximal margin of the scoop can be fixed relative to a given skin crease in Figs. 2 and 3 and, through this, to each other. In this middle finger it moved onwards by 5 mm. in four weeks; and the rate at which the scoop grew onward in the index finger was the same. In Fig. 2 the growing root of the nail lies about 9 mm. above the proximal margin of the scoop. It

KOILONYCHIA AND ITS RECOVERY IN CASES OF THYROTOXICOSIS

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So much emphasis has in recent years been thrown upon the relation of koilonychia to the anaemias, and especially to hypochromic anaemia, that it may be of value to record two cases and to comment that in neither was there any reason for supposing iron metabolism to be at fault.

Case I

Mrs. A., aged 69, was admitted to hospital on May 11, 1943, complaining of nervousness, palpitations, abdominal colic, and loss of weight of two years' duration, and of general tiredness and staring eyes for three months. On examination she was found to be emaciated, nervous, and very excitable. She had diffuse brown