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RESULTS OF RECENT INVESTIGATIONS OF NUTRITIONAL STATUS IN GREAT BRITAIN

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Laboratory Investigations into the State of Nutrition

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We use laboratory methods of investigating the state of nutrition with the hope that they will supply data which are impersonal, divested of local and temperamental bias, and expressed in terms which convey the same meaning all the world over. We hope also that they will be specific, not only detecting malnutrition, but also giving an indication of the faults in the diet which caused the malnutrition. When such data have been collected we must ask two questions, first, whether the data are trustworthy, and secondly, what they mean.

Level of haemoglobin in the blood

Reliability of the technique

The importance of these two questions is illustrated by the investigations which have been made into the levels of haemoglobin in the blood. Before the war fairly extensive surveys had shown that there were wide discrepancies between the results obtained by different methods. In the early years of the war reports appeared suggesting the occurrence of a drop in the average level of haemoglobin. At the same time the Committee on Haemoglobin Surveys of the Medical Research Council studied the possible methods which might be used in large-scale surveys of haemoglobin levels and recommended the Haldane-Gowers method. This method had the advantages that it was already widely used and that the colour tube employed could be standardized to match the colour tubes used in the years before the war.

When the big survey of 1943 (Committee on Haemoglobin Surveys, 1945) was organized, several molehills in the way of attaining consistent estimations were surmounted but, during the course of the survey, a mountain was encountered which was never crossed. Dr R. G. Macfarlane's studies, which formed part of that survey, showed that when faults in the instruments had been eliminated a large personal error remained. Sixty investigators were set to estimate haemoglobin in ten samples of blood, of which three were identical, and it was found that two skilled and consistent observers (Table 1, nos. 21 and 32) differed consistently from one another in their readings by nearly 8%, while the readings made by less happy observers might be out by as much as 14%. The means of the readings made by most of the observers were below the true value. It might be hoped that individual observers would be consistent in their own readings, and Mackay, Wills & Bingham (1946) have produced some evidence that the relation between their readings actually did not change. At the London Hospital we compared the visual readings of observer 22, who read 1% low in

Table 1. *Readings of the haemoglobin content of ten samples of human blood, of which three were identical, made by the Haldane-Gowers method by seven of the sixty different observers. The values are expressed as a percentage of the true value as ascertained at the National Physical Laboratory* (Committee on Haemoglobin Surveys, 1945, Table 22)

Observer no.	Sample no. 1	2	3	4	5	6	7	8	9	10	Mean	Coefficient of variation
12	97	97	97	97	97	97	96	97	94	96	96·5	1·01
21	102	101	101	102	102	102	104	102	100	103	101·9	1·08
28	98	98	97	97	99	99	99	97	95	99	97·8	1·35
32	95	93	94	95	91	93	95	96	94	94	94·0	1·50
22	102	98	95	96	101	101	102	100	98	101	99·4	2·52
6	86	84	88	91	87	91	83	78	89	87	86·4	4·57
26	105	88	93	99	91	88	96	102	89	86	93·7	6·97
Mean for all 60 observers	97·4	94·8	96·1	97·0	95·4	96·8	96·7	96·2	94·7	95·6	96·1	

Dr Macfarlane's test, with readings made by a second observer using a photoelectric colorimeter. The results are shown in Table 2. Although single readings by the visual method might be considerably out, the means of small groups of readings agreed fairly well and the means of large groups agreed well.

Nutritional significance of haemoglobin values

If low levels of haemoglobin are found, what is their significance? Evidence that anaemia is associated with a low standard of living has been given by Yudkin (1944*a*,*b*) and by Mackay *et al.* (1946). Yudkin (1944*b*) found lower haemoglobin levels among children and mothers in families whose weekly expenditure per head on food was between 4*s*. 7*d*. and 7*s*. 1*d*. than among those in families where it was between 7*s*. 3*d*. and 10*s*. 1*d*.

It is usual to attribute the existence of a low value for haemoglobin to a deficit of a few mg. of iron in the diet, because in some cases the concentration of haemoglobin can be raised by the administration of some hundreds of mg. of iron. Adult men need almost no intake of iron. Why then should we find such differences as are shown in Table 3 between men of different occupations? It is very likely that the small group of agricultural workers shown was not representative of agricultural workers in general in this country, but it is not clear why this particular group and, to a less degree, the group of metal-factory workers, should have lower values than members of the police force who were in this case mainly sedentary, or than civil servants of the higher grades. The spread of the values is little wider among the metal-factory workers than among the police and civil servants, and the lower mean values do not seem to be due to the inclusion of a small proportion of sick men with low haemoglobin values among healthy men with high values.

Table 2. *Comparison of results of estimations of haemoglobin as carboxyhaemoglobin by the visual Haldane method and with a photoelectric colorimeter*

(*a*) Differences between results of visual and photoelectric estimations as percentage of photoelectric values

Difference (%)	More than −15	−15 to −10	−10 to −5	−5 to +5	+5 to +10	+10 to +15	More than +15
No. of cases	1	4	26	75	25	5	2

(*b*)

Stage of pregnancy of women from whom blood samples were taken		Haemoglobin value	
Weeks of pregnancy	No. of samples	By visual method (%)	By photoelectric method (%)
14	11	90·56	91·76
15, 16	14	93·81	90·24
17, 18	15	90·42	88·29
19, 22	17	89·53	90·90
23, 26	12	82·20	84·72
27–32	11	82·56	84·75
33–40	11	84·48	85·10
All ante-partum	91	88·04	88·25
Days after delivery			
3–14	32	90·14	91·10
15–63	8	92·34	94·66
All post-partum	40	90·58	91·82

Behaviour of haemoglobin values during the war

If the figures found by the Haldane method are accepted as reliable, two conclusions can be drawn. The first is that there was an improvement between 1941–2 and 1944–6. The most numerous data are for pregnant women, and are shown in Table 4. The low figures found by Hamilton & Wright (1942) in 1941–2, and the higher figures found in subsequent surveys are shown in this table. Hamilton & Wright found higher concentrations among the women who were taking iron. We do not know what proportion of the women included in the later surveys were taking iron, but the average values found in the later surveys were higher than those for the women who were taking iron in the series of Hamilton & Wright.

Davidson, Donaldson, Lindsay & Roscoe (1944) and Roscoe & Donaldson (1946) found that the levels of haemoglobin among pregnant women and schoolchildren in Edinburgh rose between 1942 and 1944. The Edinburgh figures are particularly convincing evidence of the improvement since, in both 1942 and 1944, the estimates were made by the same consistent observers. The estimates of Young, King, Wood & Wootton (1946) and of Hoch & Marrack (1948) were not subject to the errors of the

Table 3. *Haemoglobin levels determined by the Haldane method for various groups of the population in Britain before and during the war, and in the U.S.A.*

Authority	Types of subject examined	No. examined	Mean haemoglobin level: Value (%)	Mean haemoglobin level: Standard deviation
	Men			
Price-Jones, Dill & Wright (1931)	Students and laboratory workers	100	105·4	—
Price-Jones, Vaughan & Goddard (1935)	Students	90	104·9	—
1943 Survey (Committee on Haemoglobin Surveys, 1945)	Agricultural workers			
	Single	43	99·2	10·8
	Married	64	97·3	11·4
	Metal-factory workers			
	Single	364	103·3	9·3
	Married	1078	101·5	8·5
	Civil service, higher grades			
	Single	26	108·1	8·0
	Married	203	106·9	7·1
	Police			
	Single	15	111·8	7·0
	Married	309	108·2	6·7
	Laboratory assistants, single	85	105·3	7·5
	Students, single	52	106·4	6·4
	All groups			
	Single	1155	102·4	9·02
	Married	3406	102·1	8·66
U.S.A. various (Advisory Committee on Nutrition Surveys, The Nutrition Society, English Group, 1946)	Students and laboratory workers	780	106	—
Nelson & Stoker (1937)	Postal employees, soldiers and officers	350	102	5·2
	Women			
Price-Jones *et al.* (1931)	Students and nurses	100	98·3	—
1943 Survey (Committee on Haemoglobin Surveys, 1945)	Textile workers			
	Single	155	87·4	9·0
	Married	33	85·5	8·5
	Nurses			
	Single	1081	92·1	8·6
	Married	74	91·2	10·4
	Students, single	59	92·8	6·8
	Factory workers			
	Single	171	92·4	11·9
	Married	103	90·4	13·4
	All groups			
	Single	4813	94·4	10·17
	Married	2974	92·5	10·69
Davies, Gunson, Matheson & Pyke (1946)	Women employed in ordnance factory	2000	11·54% under 81 30·7% under 88	
U.S.A. various (Advisory Committee on Nutrition Surveys, The Nutrition Society, English Group, 1946)	Physicians, nurses and students	310	91	—
	Adolescents			
Fullerton *et al.* (1944)	Girls	157	81·3	—
Cook *et al.* (1944*a*)	Boys at a training school	45	95·3	6·67

visual Haldane method. The difference between them is real; it shows that a sample taken in one centre need not be a fair sample of the population of the whole city, still less of the country as a whole.

If the figures found in the 1943 survey and in subsequent investigations are compared, by groups, with the figures found in Britain before the war and in the U.S.A., the second conclusion can be drawn that there is no evidence of any deterioration from these values (see Table 3). Among men values below 90, that is, about 12% below the grand mean, were found in 10% or more of the subjects in a few groups only; among married women values under 80, that is, 12·5% below the grand mean for married women, were found in 10% of the subjects in eight out of fifteen groups. There was, therefore, definite evidence of anaemia among women, though there is no reason to suppose that this was any worse in 1943 than it was before the war.

Table 4. *Haemoglobin levels in pregnancy, determined by the Haldane method*

Investigator	Date	Place	Stage of pregnancy of women examined	Hb (%)
Hamilton & Wright (1942)	1941–2	S.E. London	3–5 months	77
			9th month	
			Subjects taking iron	77
			Subjects not taking iron	70
Sinclair (1942–3)	1942	Oxford	9th month	85
Roscoe & Donaldson (1946)	1942	Edinburgh	Trimester, 1st	79·8
			2nd	75·6
			3rd	72·8
	1944	Edinburgh	1st	87·8
			2nd	85·0
			3rd	78·0
Committee on Haemoglobin Surveys (1945)	1943	Great Britain	Trimester, 1st	89·1
			2nd	86·3
			3rd	82·4
Young *et al.* (1946)	1943–5	W. London	0–24 weeks	83
			32nd week to term	78
Hoch & Marrack (1948)	1943–6	E. London	0–14 weeks	94·9
			15–22 weeks	90·4
			23 weeks to term	84·9

For adolescents the mean levels found by Davidson, Donaldson, Lindsay & McSorley (1943), by Wills, Mackay, Bingham & Dobbs (1942) and in the survey of 1943 were satisfactory. The figures of Davidson *et al.* (1943) were lower than the others, since younger children were included, but the mean values found by Fullerton, Mair & Unsworth (1944) in Aberdeen, and by Cook, Davidson, Keay & McIntosh (1944*a*) in Dundee were low (Table 3). The boys in Dundee were eating less food than boys of 14 and over might be expected to eat, although they were getting large meals in their canteen (Cook *et al.* 1944*b*). It is possible that the factory girls in Aberdeen were suffering from the adverse effects of the years 1941–2 and were not, like the school-children, able to recover in the following years, since they did not get school milk and meals.

Haemoglobin has been dealt with at length because estimation of haemoglobin has been used much more widely than any other laboratory method for assessing the state of nutrition, and because special attention has been devoted to the study of the errors that may arise in such surveys.

State of ascorbic acid nutrition

Next to the estimation of haemoglobin the investigations of this type most frequently made have been those related to ascorbic acid. Fortunately, owing to the work of Dr L. J. Harris, most investigators in this country have made saturation tests in the same way and their results can be compared directly.

Since green vegetables are scarce in spring and early summer, and the amount of ascorbic acid in potatoes is then at its lowest, there is a seasonal trend in the supply of ascorbic acid, which is reflected by the results of saturation tests. Before the war the abundance of oranges and tinned fruits maintained the supply of ascorbic acid during this period; the loss of these in wartime accounts for the deterioration found in spring and early summer by Harris and by Wormall and his colleagues (Table 5).

In most of the investigations which were made, the average number of days taken to saturate the subjects in the spring was about 3; this corresponds to a daily intake of ascorbic acid of about 0·6 mg./kg. body-weight, or a total daily intake of 20 mg. in the case of children of 8–14 years (Harris & Olliver, 1943). Of the subjects, however, one-third to one-half were not saturated in 3 days, so that these tests confirm the evidence obtained by surveys of diet, that a considerable proportion of the population was getting less than 0·6 mg./kg. body-weight.

The concentration of ascorbic acid in the plasma responds more quickly than the saturating dose to changes of intake, but, unless sudden large changes have been made recently in the diet, it serves as an index of the amount in the diet. Not many or extensive estimations have been made of the concentration in plasma. In most of those that have been made the concentration has been about 0·2–0·3 mg./100 ml. and, like the saturating dose, has corresponded to a daily intake of about 0·6 mg./kg. body-weight. Considerably higher values were reported by Bradford (1944) among patients attending the Charterhouse Rheumatism Clinic, and by Adcock & Fitzgerald (1945) among nurses in June 1944. Also Young *et al.* (1946) and Hoch & Marrack (1948) found that the average concentrations in the plasma of women attending antenatal clinics, examined in 1943–5 and 1943–6, were above 0·5 mg./100 ml. throughout pregnancy. In the series examined by Hoch & Marrack the average concentrations were only a little higher among those taking supplements of fruit juice than among the remainder.

The concentration of ascorbic acid in the white-cell layer affords a better index than that in the plasma of the stores of ascorbic acid in the body. The only survey reported is that of nurses (Adcock & Fitzgerald, 1945). It is remarkable that with a relatively high concentration in the plasma the mean concentration in the white-cell layer was only 14·5 mg./100 ml., and was under 10 mg. in 14% of the nurses. This suggests that the nurses' diet had been deficient in ascorbic acid until shortly before the date of examination, and had then improved considerably.

State of vitamin A nutrition

The concentration of vitamin A in the plasma and in the liver, and the capacity for dark adaptation have been used as indices of the state of nutrition with respect to vitamin A. We have first to consider the validity of these indices. Estimates of the con-

Table 5. *Percentage of the subjects examined at various seasons of the year, found after varying numbers of days to be saturated with ascorbic acid as determined by the method of Harris & Abbasy* (1937)

Investigator	Subjects examined	Year and season	No. of subjects	Percentage saturated after days: 1	2	3	4	5	Average no. of days necessary for saturation
Harris (1940, 1942)	Boys, aged 8–14, in home for waifs and strays	Spring 1938	25	60	32	8	0	0	1·5
Harris (1942, 1943)		Spring 1941	29	3·5	13·8	27·6	38·0	17·2	3·5
Harris (1942, 1943)		Autumn 1941 (intake 45 mg.)	10	90	10	0	0	0	1·1
Harris (1943)		April 1942 (intake 23 mg.)	12	0	42	58	0	0	2·6
Harris (1940, 1942, 1943)	Boys in elementary school, poor district	Spring 1938	35	28·5	31·5	25·8	14·2 (4 and 5)		2·4
Harris (1942, 1943)		Spring 1941	29	3·45	13·8	27·6	38·0	17·2	3·6
Harrison, Mourant & Wormall (1939)	Students, St Bartholomew's Hospital	May–July 1939	87	55	Not investigated				—
Francis & Wormall (1942)		July 1940	29	72·3	20·7	3·5	3·5	0	1·4
		Sept. 1940	13	53·8	30·8	15·4	0	0	1·6
		June, July 1941	52	7·5	25·0	27·0	19·3	21·2	3·25
Francis & Wormall (1944)		Nov. 1943	61	43	41	13	1·5	1·5	1·78
		Feb. 1944	70	4·4	24	36	27	8·6	3·13
Durham, Francis & Wormall (1946)		May 1944	102	12·7	42·0	18·7	20·5	5·9	3·09

centration in the same sample of plasma, made by different observers, may differ surprisingly. The difference may be in opposite directions on different occasions and is not, therefore, merely a matter of standardization. According to some observers (e.g. Yudkin, 1941) the concentration in the plasma of an individual rises temporarily after a large dose of the vitamin but otherwise remains steady, while, according to others (e.g. Haig & Patek, 1942), it varies considerably from time to time. Can we put any trust in estimates of the concentration in plasma? In the experiment organized by the Medical Research Council (Accessory Food Factors Committee, 1945), the concentration did not fall markedly until the subjects had been deprived of vitamin A for a year. In other experiments the fall was much more rapid. We know that the concentration in the plasma may be affected by factors other than the amount in the diet, such as the ingestion of alcohol, rise of body temperature and some non-febrile diseases. It is possible that low values, found among badly fed subjects (e.g. by Josephs, Baber & Conn, 1941) may not be evidence of a low intake of vitamin A or of low stores in the liver. We may, however, regard concentrations of less than 70 i.u./100 ml. plasma as low and of less than 50 i.u. as very low.

There is no reason to suspect that estimates of the amount of vitamin A in the liver are not valid, but the surprisingly low values found in the livers of subjects having died of nephritis or of a disease of short duration like pneumonia, suggests that factors other than the amount of vitamin A absorbed may affect the amount in the liver.

I do not propose to discuss the measurement of capacity for dark adaptation beyond saying that only the final rod threshold, the perimetric measurement made by rod scotometry (Livingston, 1944) and possibly the cone-rod transition time, can be used as evidence of the state of nutrition.

McIntosh, Moore, Keay & Cook (1946) found that a considerable proportion of boys at a training school had less than 70 i.u. vitamin A/100 ml. in their plasma (Table 6). This is remarkable, as these boys were getting in their diet an average of 2920 i.u. vitamin A equivalent estimated by the food-value calculator of Vitamins Ltd. (Cook *et al.* 1944*b*). Adcock & Fitzgerald (1945) reported low concentrations among nurses in 1944. Leitner & Moore (1946) found low values frequent among normal subjects, and among hospital patients who were suffering from diseases unlikely to affect the metabolism of vitamin A. On the other hand, Hoch & Marrack (1948) found that nineteen hospital sisters, who had no privileges in the way of diet, all had over 100 i.u. vitamin A/100 ml. plasma. Out of 105 estimates of vitamin A in the plasma of pregnant women attending an antenatal clinic in east London six values only were of less than 70 i.u./100 ml. and none was below 50 i.u. About one-quarter of the pregnant women took supplements containing vitamin A; the difference between the mean concentration in the plasma of those taking, and of those not taking, the supplements was slight but significant.

Moore (1937) estimated the amount of vitamin A in the liver before the war. Ellison & Moore (1937) found the amounts in the livers of newborn babies to be very small. Low concentrations were found also by Wolff (1932) in Amsterdam, and by Toverud & Ender (1936) in Norway; but in the U.S.A., Lewis, Bodansky & Haig (1941) in New York, and Henley, Dann & Golden (1944) in Ithaca, found much higher concentrations. We estimated the amounts in the livers of babies at the London Hospital in 1946 and 1947, and found concentrations much higher than those reported by Ellison & Moore, and of the same order as those reported from the U.S.A.

The only extensive investigation of dark adaptation reported seems to be that of Robertson & Yudkin (1944). The final rod thresholds of factory workers in Birmingham and Sheffield were higher than those of groups of nurses and of men and women students, and those of children in a country school were higher than those of children

Table 6. *Vitamin A and carotenoid content of the plasma of different types of subject at different seasons of the year*

			Vitamin A			Carotenoids		
				Content of plasma (i.u./100 ml.)			Content of plasma (µg./100 ml.)	
Investigator	Type of subject	Date	No. of subjects	Mean	Range	No. of subjects	Mean	Range
Oxford Nutrition Survey (Adcock & Fitzgerald, 1945)	Hospital nurses, normal health, no absences sick in last 12 months	June 1944	54	93·3	17% <70 12% <35	55	97	4% <42 0 <21
	Same, normal health, absent sick not less than 7 days in last 12 months	June 1944	43	88·7	23% <70 5% <35	43	149	2% <42 0 <21
Hoch & Marrack (unpublished)	Hospital sisters at London Hospital	Jan., Feb. 1944	19	134	All >100	19	91	Four between 50 and 70 0 <50
Hoch & Marrack (1948)	Women attending antenatal clinic	1943–6	90	96–103	Only six under 70	94	95–118	Only thirteen under 50
Leitner & Moore (1946)	Normal subjects and patients with diseases not affecting vitamin A metabolism	Nov. 1944–Mar. 1945	41} 75}	114	22% <81	41} 75}	83	16% <49
McIntosh *et al.* (1946)	Boys at a training school in Dundee	Jan.–Mar. 1944	13	82	54–147	13	53	29–90
	Same, showing folliculosis	Dec. 1945	23	87	39–135	23	71	44–152
		Apr. 1946	2	—	98 and 136	2	—	105 and 112
	Same, not showing folliculosis	Jan.–Mar. 1944	30	79	29–139	30	56	16–119
		Dec. 1945	37	90	51–197	37	66	36–113
		Apr. 1946	13	71	40–115	13	70	41–156

in schools in Cambridge. The capacity for dark adaptation of factory workers in Birmingham, who took 5000 i.u. of vitamin A daily, improved significantly, while the capacity of those who took no supplements did not improve.

State of vitamin D nutrition

In view of the unsatisfactory state of the diagnosis of rickets by clinical methods or by X-ray it is unfortunate that few studies of inorganic phosphate and phosphatase in the plasma of infants and children have been reported. In a series of children in Glasgow, Graham (1944) found that the value for inorganic phosphate was below 3·5 mg./100 ml. in 66·5% of them, and below 3·0 mg. in 43·8%; in 28·2% the phosphatase value was above 15 King-Armstrong units/100 ml.

Serum-protein content

Chibnall, Rees & Williams (1943) have demonstrated the unsatisfactory state of the methods used for estimating serum proteins. Most estimates are too low by a variable and uncertain amount. It is unfortunate that Van Slyke and his colleagues (Phillips, Van Slyke, Dole, Emerson, Hamilton & Archibald, 1945), with their great influence, have gone out of their way to perpetuate these errors; they have recommended a formula for calculating protein concentration from specific gravity which, as they admit, gives incorrect results.

It is doubtful whether the concentration of protein in the serum can be used as an index of the amount of protein or of animal protein in the diet. Keys and his colleagues found that the serum-protein content was little reduced after a low-protein diet, even when oedema appeared (Keys, Taylor, Mickelsen & Henschel, 1946). Rhyn (Abelin & Rhyn, 1942) had a value of over 7 g./100 ml. serum after years on a diet which supplied about 30 g. of protein daily. The work of Hynes, Ishaq & Morris (1946) indicates that the serum-protein values for Indian recruits whose diet had, until shortly before the time of investigation, supplied very little animal protein, were higher than those of soldiers who had eaten a diet containing more animal protein for over a year.

Dyson & Plaut (1943) found that the serum protein of twenty laboratory workers ranged from 6·81 to 7·46, with an average of 7·12 g./100 ml., but Dyson (Committee on Haemoglobin Surveys, 1945, p. 109), using the same technique, found that the average serum-protein values of 163 men and 190 women blood donors were, respectively, 6·57 and 6·55, with a range of from 5·56 to 7·65.

Hoch and Marrack (Advisory Committee on Nutrition Surveys, The Nutrition Society, English Group, 1946), using a technique based on Chibnall's recommendation and checked against estimations in his laboratory, found that thirty-three students, laboratory workers and nurses had an average serum-protein value of 7·43 g./100 ml. with a range of from 6·68 to 8·0. They estimated the proteins also in the serum of pregnant women attending an antenatal clinic in east London in 1943–6. The average values fell from 6·99 in the period up to the 14th week of pregnancy to 6·63 at 27–32 weeks, and 6·67 at 33–39 weeks. As the serum proteins fall about 0·4 g./100 ml. during pregnancy, these results contrast surprisingly with those of Dyson. Out of 119 estimations one only was below 6 g./100 ml. In a few instances records were kept of the diets eaten by the pregnant women; the average daily amount of animal protein was 37·7 g., a quantity slightly greater than that eaten by the general population at the time which, according to Drummond (1948), was 34·6–37 g.

Nutritive value of human milk in relation to the diet

Kon & Mawson (1947) estimated the nutrients in the milk of a large number of women in Reading and Shoreditch; a short account has been published. It was found that the amount of vitamin A in the milk did not vary with the amount in the diet. The amount of ascorbic acid ran parallel with the amount in the food, falling to a minimum in the spring and rising again when new potatoes come in, in July. The amount of aneurin rose after the milling of flour to 85% extraction had become compulsory in 1942.

Conclusions

The surveys mentioned here, though few and unsatisfactory in many ways, do tell us something. Propagandists have asserted that anaemia was common; up to 1945 at least, these surveys enable us to say that this was not true. There has been no risk of scurvy, though we cannot say that health and efficiency did not suffer from insufficient vitamin C. It seems that as far as vitamin A is concerned nutrition has improved.

If we are to learn more from laboratory methods in the future we must, first of all, check our methods. In order to be able to compare our results with those found at other times and at other places, we should abandon methods such as the Haldane method, in which results are expressed in terms of an arbitrary unit, and use instead methods in which results are expressed in terms of some absolute unit. Further, we must eliminate, as far as possible, the personal factor which has such a big influence on the results obtained with the Haldane method.

Secondly, we need base-lines from which to make comparisons. If we want to know whether the state of nutrition changed between 1948 and 1952, we must, in 1948, find out what it is in 1948; we shall not be able to go back to 1948 in 1952.

Thirdly, we can find out the significance of the results given by these laboratory methods, only by the collection and study of the facts. We need to study groups of individuals, not only by making laboratory investigations, but also by finding out what they eat, how well they are, and what happens to them in the future. I do not believe that the effects of moderate changes in diet are going to show in a matter of months.

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Anthropometric and Performance Tests

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This paper is less concerned with results of anthropometric and performance tests in determining nutritional states than with the appraisal of the methods used.

Anthropometric measurements

The earliest measurements used were those of height and weight, but many others have gradually been added. As far as children are concerned, it is clear that an allowance has to be made for age. It is evident, however, that even this is not sufficient,