

A PHYSIOLOGICAL AND ECONOMIC STUDY OF THE DIETS OF WORKERS IN RURAL AREAS AS COMPARED WITH THOSE OF WORKERS RESIDENT IN URBAN DISTRICTS.

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(With 8 Charts.)

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INTRODUCTION.

It is constantly maintained that the position of the agricultural industry in England at the present time is an unenviable one. In many parts of the country profits are said to be low or non-existent while money wages compare very unfavourably with those of many town workers employed in occupations requiring no greater skill. Yet at the same time it is asserted that any substantial—and in some counties even a small—rise in wages will place the industry on an uneconomic basis and inevitably drive land out of cultivation or to uses that demand the employment of less labour. Already the scale of wages, in as far as an accurate comparison can be made, is higher than in any continental nation.

An Agricultural Tribunal (appointed by Mr Bonar Law's Government in 1922) has been making an enquiry into the methods adopted in other countries to increase the prosperity of agriculture, and to advise as to the means of achieving a like result in this country. The report upon their investigation was published in 1924 (Cmd. 2145, 1924). One of their important recommendations

was the constitution of district Wages Boards, and a bill to that effect was passed by the House of Commons during 1924.

The proposal that "a minimum wage" shall be fixed for agricultural labourers is one that has constantly been put forward both in the House of Commons and in the Press. In a debate in the House of Commons on June 2nd, 1924, the then Minister of Agriculture said that 68 per cent. of the total adult male workers in agriculture were paid under 30s. a week, and 23 per cent. were paid only 25s. He gave an instance of the family of a farm labourer in which the diet of the children consisted only of bread and cheese, and said that "these people had got to get into debt in order to get along....In many normal households 19s. was the maximum that could be found for food." On the other hand, extraordinary variation, he said, prevailed in the rates of wages paid in different counties, and even in different districts of the same county.

In the course of the debate it was added that in the rural areas there was extant *under-feeding*, *under-clothing*, and *over-crowding*, and that "the countryside was not the fountain-head of the most healthy and vigorous population as it ought to be." On the other hand, the extent to which such statements as these represent the actual state of affairs in rural areas is often questioned.

Such reasons as these constitute the practical importance of an enquiry into the normal weekly budget of the agricultural labourer, while in addition any light that can be thrown upon the actual position of the agricultural labourer is not only of economic importance but is of interest from the standpoint of national health; for it involves the problem as to whether the agricultural labourer on his normal wages can supply himself and his family with a diet that is physiologically adequate. The "Back to the Land" cry has been examined often from the economic, rarely from the health, standpoint. With a low money wage but with certain advantages and disadvantages accruing from his environment, is the agricultural worker able to secure a diet equal in value to that of the town worker, working often at a higher speed but usually for a considerably higher wage?

This is the question with which this study is chiefly concerned—*the comparison of "urban and rural diets" and the examination of the efficacy of each as indicated (if at all) in the anthropometric measurements of school children in each type of area.*

SOURCES OF INFORMATION AND ANALYSIS OF THEIR LIABILITY TO ERRORS AND VARIATIONS.

The main source of information relating to the "rural diets" is derived from diet studies collected by the writer, under the direction of the Industrial Fatigue Research Board, for the purposes of investigation into the effects of internal migration upon certain variations of the death-rates. (Part of this paper is incorporated in the report upon that investigation. *Medical Research Council Special Report Series*, No. 95.)

In all 132 weekly diet studies were collected (during February to November in the year 1923) and of these 98 are deemed sufficiently accurate to lend themselves to statistical interpretation. As a check upon the results given by these and as sources of additional information, there have been used:

(1) Dr Edward Smith's report to the Local Government Board on "the conditions of nourishment of the poorer labouring classes." (Smith, 1863.)

(2) The Board of Trade enquiry, 1903, into the cost of living. (Cd. 1761.)

(3) Agricultural Wages Board. Report of Committee on Financial Results of the Occupation of Agricultural Land and the Cost of Living of Rural Workers. (Cmd. 76.)

(4) An enquiry conducted by Mr Seebohm Rowntree and Miss May Kendall into the lives of agricultural labourers.

(5) The analysis of some farm workers' budgets by Mr A. W. Ashby.

In addition, of some value in this question, is (6) A study by Miss Mackenzie of Changes in the Standard of Living.

For the study of the "urban diets" the evidence is more extensive. The investigations of Noël Paton and Cathcart in Glasgow (and of other workers proceeding on similar lines) and the report of the Medical Research Council upon the Nutrition of Miners and their Families have been utilised.

The method of investigation followed by these workers in urban areas has usually been to employ trained social investigators to visit daily the families under study, and to record for one week the food consumed during that period, taking note of the amount of edible matter lost in waste and the number of meals taken at home by each member of the family. By this means a high degree of accuracy is most probably reached but the very fact that the method is so detailed limits the number of studies that can be made.

In collecting the "rural diets" in Essex a printed form was used (*vide* Appendix E) and the details required were obtained in three ways: (1) through a lady investigator with some experience of social work; (2) through voluntary social workers and various county officials, *e.g.* Health Visitors; and (3) directly from the wives of agricultural labourers.

In this last case the details were filled in by the housewife herself and the fact that the capability of so doing would require an intelligence above the average, would suggest that these diets probably will be above the average too. Rowntree found that on the whole "the best results could not be thus obtained" and adopted the method of "cross-questioning the housewife as to the way she spent her weekly income; and as to the food consumed at each meal." This was the procedure largely followed in the Essex enquiry by the lady investigator and the social workers who gave their assistance. The result is obviously liable to greater error than is likely to appear in the town studies—*under-statement is more likely than over-statement*—but the method enabled a larger sample of studies to be obtained in a relatively short space of time, while many families which would willingly answer the necessary questions would have resented daily visits and weighing of their food. Rowntree con-

sidered that "in the country the total sum spent weekly is so small, and the dietary varies so slightly from week to week, that the actual facts can be ascertained with great accuracy by this method" (Rowntree, 1913). This was largely borne out in the Essex enquiry as regards *bought* food (except in the few cases where an abnormally large income was found, when a greater diversity of diet was to be met with), but great difficulty was experienced in obtaining reliable data as regards the consumption of *home-grown* food and perquisites such as milk (though these latter are said to be less now than in years before the War, when the settlement of money wages was on a less definite basis). The housewife, naturally, uses her supply of vegetables from the garden without weighing the amount needed daily, and in the majority of cases estimates had to be obtained. Some check is provided by the amount of potatoes usually purchased per week when the home-grown supply is exhausted, while in some cases no home-grown produce was available at the time of record. The latter factor very much depends upon the time of year at which the study is made. Dr Major Greenwood considers that in such enquiries "there is considerable difficulty (a) in ensuring that the families studied are really random samples of the class proposed to be investigated, and (b) in ensuring that the time of observation is a fair random sample of the nutritional experience of the particular family. Of these two difficulties," he continues, "the second is, I believe, the more important. I do not ignore the possibility that when the sample of families studied is obtained by voluntary effort, there may be a

of the family unit, but I am not yet convinced that this is a practically important source of error. On the other hand, the chance that in precisely the economic classes whose nutritional conditions we most wish to study, we shall encounter large fluctuations in the available income from week to week is far from negligible" (Greenwood, 1924).

In the Essex investigation it has already been pointed out that "difficulty (a)"—the correlation between intelligence and willingness to submit—is present in those cases in which the housewife herself filled in the required details. In addition, the returns represent rather a sample of the *agricultural labouring* population, not of the *whole rural* population. This bias was deliberately courted; for if the diet of the agricultural labouring population be found adequate, it is unlikely that the diet of other rural workers will fall below this level. If the family of the agricultural labourer be not, as it is stated, reduced to a diet only just sufficient for subsistence, it is, at least, living upon the lowest wages, and it is unlikely that the higher paid worker will obtain a diet less rich in energy units.

No other indication is given that the sample is not a random one.

But "difficulty (b)"—variation of income from week to week—is to be found still more apparent in the rural than in the urban diets. In the studies made in Glasgow (under the guidance of Professor Noël Paton) it was found that a second study of any one family agreed closely in result with the first—unless

the economic status of the family had materially altered. But under rural conditions of life, upon the date of the study depends largely the amount of home produce available for consumption—which also depends upon the weather affecting the year's crop. (This latter factor most probably has some slight effect on the town dweller's diet; if world crops or national crops, apart from local variations, are good or bad prices will to some extent run low or high.) Some families grow vegetables sufficient for the year—in amounts that must vary from week to week—but in not many cases is their potato supply similarly adequate. For some months they must buy. Again, the income fluctuates according to the time of year; more money is earned at such times as the harvest, pea-picking and even blackberry-picking. On the other hand, it was strongly affirmed in Essex that much of these extra earnings are utilised for the payment of rent and for the purchase of clothes, payment of debts, etc.; that not a great proportion can be spent on food. It may, too, be argued that a very large variation must take place in the amounts of home-grown vegetables consumed to affect seriously the *energy* value of the diet, for though rich in accessory food factors and of the highest importance to health, these items of diet have not a very high calorific value.

Eggs are another form of produce, varying from season to season, of which it is difficult to get accurate figures; but pig-keeping and rabbit-keeping are nowadays rare (in Essex). In addition, in the country there are possibilities of supplements to diet which are less common in the town, *e.g.* a rabbit in the shooting season, or fruit—blackberries and the like. But these additions, it is considered, are relatively small (though their high vitamine value must not be overlooked), while in the purchased food there is probably very little variation. It is essential that these limitations to the accuracy of the rural studies be borne in mind.

Table I.

Results of studies made of families allowing investigation of diet for more than one week.

Family	No. of weekly studies made	Man value	Weekly income per man value, shillings	Percentage of income spent on food	Daily calories per man value
A	5	4.86	6.28	0.72	2692
			7.30	0.59	2682
			8.13	0.50	2212
			8.13	0.53	2594
			7.30	0.53	2572
B	2	9.26	7.13	0.83	3303
			6.91	0.78	3210
C	4	8.93	4.26	0.83	2851
			4.26	0.80	2696
			4.20	0.88	2728
			4.34	0.79	2774
D	2	5.73	5.24	0.67	2384
			5.24	0.62	2013
E	2	3.23	10.06	0.80	4345
			9.44	0.79	4179
F	2	7.11	7.59	0.70	2801
			7.59	0.72	2921

In a few cases duplicate studies were obtained from the same families and some indication is thus given of the amount of variation to be expected in the weekly diet. Table I shows the results of these studies.

It will be seen that in only two cases is the variation in the amount of calories per man value of a very substantial proportion—in the third week of family A and the two weeks of family D¹. On the other hand, a variation of 100 calories per day per man value from week to week may, judging by these studies, easily occur, even if the conditions of life have not materially altered. Over a series of 98 families, however, some of these differences between the “up” weeks and the “down” weeks (in rainy weather when earnings may be less, etc.) may tend to cancel one another when the average is taken.

No pains were taken to measure the waste incurred during each study or the amount of food in hand at the beginning and end of the time of record—as was done in the more intensive of town studies. It is believed that no appreciable inaccuracy arises from this source. The income per “man value” is so small that great waste is hardly possible, while the money only suffices for the food actually consumed in the week and there can be no surplus food of any appreciable amount to be carried on from one week to another. In addition, the great lack of larders or food stores of any kind would make it difficult for any extra provisions to be kept in hand. Dr Thresh (Consulting Medical Officer of Health for the County of Essex) says that “in some parishes there is not a single cottage with a larder....A suitable place for storing food is one of the greatest needs in our country areas” (Thresh, 1919).

In two cases in the Essex investigation the amount of food in hand at the end of the record was obtained as a test, and the difference amounted to 31 and 20 calories per man value daily; while in one study both the food in hand at the beginning and that left over at the end was given: the result was a reduction of only 7 calories per man value from the daily diet.

The food that is “in hand” and of which, as has been indicated, it is difficult to get accurate measurement is the garden produce. Of the 98 studies calculated, 60 used only purchased food or home produce of which details are afforded; 38 used home produce of which no details are given. Of the 60 fully recorded diets the mean energy value per man value per day amounts to 2871 calories; of the 38 diets lacking details of home-grown food the mean value is 2520 calories—a difference of 351 calories. Those studies then were taken on which the home produce is fully recorded (on which no bought vegetables are given) and the mean energy value derived from the home produce alone was computed. It was found to amount to 345 calories, a value surprisingly close to the difference found between the means of the “home produce recorded” and “home produce not-recorded” studies. This suggests that in the latter studies the

¹ This family secured a very low calorie value and only spent two-thirds of its income on food. Its expenditure on insurance and “luxuries” (tobacco, beer and daily paper) was relatively high. Family E on the other hand spent a very great proportion of income on food, including an unusually large amount (for this type of family) on cheap imported meat—it resided in close proximity to a town.

purchased food was no less accurately recorded and that they only lack the value of the home-grown vegetables used. If then the mean value of home produce found above, *i.e.* 345 calories, be added to each, the new total should approximate to the real value of the week's diet. In Table II are given these mean values of the diets: the 60 fully recorded, the 38 lacking details of home produce and the means of the total 98 when the latter have been increased by the addition of the computed values of home produce.

Table II.
Details of Essex diets.

	Per man per day			
	Protein gm.	Fat gm.	Carbo- hydrates gm.	Calories
60 fully recorded diets	74.91	70.63	465.31	2871.78
38 diets lacking details of home produce	65.11	66.13	399.55	2520.46
Total 98 diets when the 38 have been increased by computed value of home produce	74.30 (27.4 % animal protein)	68.95	469.19	2871.67 (± 31.8) (standard deviation = 466.65)

EXAMINATION OF NORMAL FOOD REQUIREMENTS OF MAN AND ASSESSMENT OF NEEDS OF THE RURAL WORKER.

To assess the adequacy of this "average" diet per man value (this latter term will be defined later on) from the physiological point of view, reference must be made to the results obtained by scientific workers in the past. (The subject is too vast to allow more than the essential facts to be touched upon.)

The food requirements of an individual differ according to sex, age, height, weight, environment and the type and amount of work to be performed. Obviously, then, in estimating the requirements of, say, the agricultural labourer some average of all these factors must be taken. According to the Royal Society Report on the food requirements of man (Royal Society, 1919) the "average man" should be defined as an adult man of 66 kilos (10 stone $5\frac{1}{2}$ lbs., 145 $\frac{1}{2}$ lbs.) performing 8 hours' average work in a climate such as that of France or England....His age should be between 25 and 50. 171 centimetres in height (5 ft. 7.4 ins.). The basal requirements of such a man, *i.e.* when he is resting as completely as possible, have been found by experiment to be 1687 calories. Harris and Benedict (1919) found that "the average basal metabolism of normal men is measured by a daily heat-production of about 1600-1650 calories," but that there are "such variations in the daily basal metabolism of the normal individual that the prediction of the heat-production of an *individual* subject will always have a high probable error—that is, a limited trustworthiness." (Their definition of normal is not identical with the "average" of the Royal Society's Report.)

When an estimate has to be made as to the extra requirements due to work and to occupations in free time the individual assessment must have a considerably greater element of error associated with it.

“Voit came to the conclusion, from the study of a very limited number of subjects, that a diet yielding just over 3000 calories sufficed for a man performing work more strenuous than a tailor’s but not so exhausting as a blacksmith’s. Atwater, the pioneer of the American investigations, put the value for an average man’s diet somewhat higher, between 3300 and 3500 calories per diem. Later workers on the continent have more or less adhered to calorie standards put forward by Voit. Rubner, the most experienced of all the German investigators, puts the calorie needs for the average worker on his working days at 3100 calories. The difference which exists between the American and other workers is in part due to differences in the amount of work done, and in part, perhaps, to the fact that as a whole the American workers are bigger physically” (*vide* Royal Society Report). In the case of the miners (the nutrition of whose families is dealt with in the report from which the above quotation is taken) it was concluded that the daily *net* energy requirement for a man employed thus “certainly does not exceed and probably falls a good deal short of 3500 calories.” It will be seen how necessarily vague the final assessment must be.

The distinction between *gross* and *net* requirements is that between purchased food and food consumed and digested when allowances for waste and loss in cooking and for waste of food escaping digestion have been made. “The food as purchased should have a utilisable calorie value about 10 per cent. higher than the calories actually required by the individual” (Royal Society, 1919), *i.e.* if the net requirements are 3000 calories per day, the gross requirements will be approximately 3300.

With these estimates of food requirements as a guide and taking into account the type of work the agricultural labourer performs and the conditions of weather to which he is exposed¹, an assumption that his *gross* requirements will certainly not fall short of 3300 calories is very unlikely to err on the side of excess. Whether it represents an actual deficit it is impossible to determine from present day knowledge.

It must be always kept in mind that this is only an estimate of the “average” requirement. If individual diets fall below or above it, it is by no means implied that such diets represent over or under-feeding. The only value of the average is for the making of rough comparisons. “Since the actual amount of physical work done by different classes and by different individuals in the same class varies greatly, any ‘average’ is of restricted value” (M.R.C., 1924).

In the study of the *family* diet, it is necessary that account should be taken of the very different requirements of men, women and children of various ages. For this purpose, the members of each family are taken as “proportions of the average man” according to their sex and age.

Atwater, the American investigator, originally put forward some sug-

¹ “Classes of individuals exposed to cold and wet would need an increased allowance of food and in allotting an average ration to any class of worker the question of exposure to the open air and to cold should be taken into account” (Royal Society, 1919).

gested allowances for age and sex and in earlier investigations his coefficients have usually been adopted. Recent investigations (*e.g.* Du Bois, 1916, and Gephart, 1917) have indicated that these coefficients are too low and Lusk has suggested the following values in their stead. These have been accepted by the Food Committee of the Royal Society and the Interallied Scientific Food Commission.

Man	1.00
Woman	0.83
Boy over 13	1.00
Girl „ 13	0.83
Child 10-13	0.83
Child 6-10	0.60
Child 0-6	0.50

By these means the complete family diet and its adequacy can be assessed “per man value” and comparison thus made between families of different sizes. These are the values that have been used throughout this enquiry. The data upon which they are based is admittedly imperfect and is classified by Lusk as follows:

“1. *Absolutely accurate.* Basal metabolism of all ages and sexes, and the increase in metabolism due to (a) standing; (b) walking; (c) carrying a load.

2. *Approximately accurate.* Metabolism in industrial pursuits.

3. *Hypothetic.* Metabolism of children during exercise” (Lusk, 1918).

Meagre though they are, they afford, he says, the best available information. The data upon which to base the requirements of active boys and girls are especially limited. The man values used must not, therefore, be considered as accurate to the last degree, though they probably represent a picture not far removed from the actual truth and are, at least, more accurate than any figures yet put forward.

ANALYSIS OF ESSEX DIETARY STUDIES.

(1) *Food.* It was by such means that the result on p. 195 was reached—that the average amount of calories daily consumed per man value given by these Essex diets was 2872 (to the nearest integer). This mean calorie value falls substantially below the 3300 calorie level that it was suggested (p. 196) the average agricultural worker would at the least require. The standard deviation of the calorie value is large, 466.65, and grouping of the values gives the following results:

Calories	Frequency
2000-2250	6
2250-2500	11
2500-2750	26
2750-3000	24
3000-3250	12
3250-3500	11
3500-3750	3
3750-4000	1
Over 4000	4
	98

Only 17 per cent. of the diets exceed 3300 calories; judged by a not excessive standard, these diet studies suggest a lack of the necessary energy value.

In a few studies details were given of the type of meals the families consumed in the week. Examples of such are set out in Table III, but it is naturally impossible to generalise from these. Size of family, income, habit, facilities for cooking, etc., must all have their influence and produce relatively wide variations.

Table III.

Six examples of daily meals consumed by families of agricultural labourers in Essex.

Breakfast	Dinner	Tea	Supper
I. Bread, margarine, sugar or jam, porridge, bacon sometimes	Meat, potatoes, vegetables, puddings	Bread, margarine, sugar or jam, cheese, onions	None
II. Porridge, bread, margarine, sometimes bacon or egg	Vegetables, pudding, cheese. Meat on Sundays	Bread, jam or sugar, cake	Cheese, onions, pickles, bread
III. Porridge, bread, margarine, jam or sugar	Corned beef or salmon, potatoes. Meat on Sundays	Bread and jam	Bread and margarine
IV. Bread and jam or sugar	Vegetables and margarine or gravy, bread and jam. Meat on Sundays	Bread and jam, cheese, onions	Cocoa, bread and margarine
V. Bread and jam. Bacon on Sundays	Vegetables and puddings. Meat on Sundays	Bread and jam	None
VI. Cocoa, bread and jam or margarine	Bread and jam or margarine, cheese	Boiled cabbage, bacon, fried suet pudding	None

Table IV gives the mean incomes and its relationship to the diet and the man value of the families studied.

Table IV.

Average family income per week (money wages only)	No. in the family	Man value	Income per man per week	Calories per man per day	Per week			Ratio of food money to income	Percentage of food money that is spent on bread and flour
					Cost of food	Cost of food per man	Calories per penny		
£1. 17s. 1d.* (11.65s.)†	Man, wife and 4.43 children	4.90 (1.82)	8s. 0½d. (3.19s.)	2872 (466.65)	£1. 5s. 5d.	5s. 4½d.	293‡	.69 (.106)	31.4 (9.98)

* This income represents merely the income recorded as having been earned in the week during which the study was made. The average weekly income of the man alone was slightly under £1. 9s. 0d. The difference is made up of the earnings of wife and children or from lodgers. It only takes account of extra earnings such as harvest wages when the study happened to be made in a week during which such extras were current.

† The figures in italics show the standard deviation in each particular case.

‡ *Vide* p. 220 for frequency distribution.

Nearly three-quarters of the income, it will be seen, is devoted to food, while the high percentage of the food money that is spent on bread and flour, 31.4 per cent., bears out the belief that this is the staple food. (In only two instances did the housewife bake her own bread, a habit far less prevalent in

the South than in the North.) The average diet per man value per week as computed from these 98 studies is given in Table V, similar items of food being grouped together.

This table shows that all the families studied had some meat in the week; on the other hand, the general evidence given during the collection of the studies was that the main bulk of this item was reserved for the father of the family and any other male adults. Rowntree says "for the man only" is a remark found "in many of the menus." All the families studied consumed milk, though the quantity is small. Though cowmen sometimes have free allowances granted to them, the belief that the normal labourer can easily and cheaply obtain a plentiful supply is false. Too often "contracts" result in the greater part of a country milk supply being despatched to towns, and the price in the rural districts, it was found, very rarely falls below that current in the towns. All the families naturally used bread and flour; very nearly all buy sugar, cheese and butter or margarine and some other form of fat. Roughly three-quarters of them eat a small amount of jam or treacle, and of products such as rice and oatmeal. Less than a third buy fish. The sugar consumption—nearly a pound per week per man value—is high. The consumption of tea has not been taken into consideration (it has no value from the calorific point of view), but it will be seen that two-thirds of the families use cocoa. In addition, no details of alcoholic drinks were obtained, for the probability of inaccurate returns would be too great, though such consumption must contribute to the calorific value of the diet. For the principal articles of diet the coefficients of variation have been calculated and they are seen to be high—as might be expected in studies dealing with families differing widely in size and possibly in temperament.

The items grouped thus, with exceedingly few exceptions, comprise all the foodstuffs recorded in these 98 studies, and this is shown by the fact that the food values given by this average diet taken per man value per day give, when the wider grouping is allowed for, a very reasonably close approximation to the average value computed for the 98 studies individually calculated (*vide* p. 195). The values given by the latter method were:

Protein	Fat	Carbohydrates	Calories
74.30 gm.	68.95 gm.	469.19 gm.	2872

The average diet given in Table V gives corresponding values of:

Protein	Fat	Carbohydrates	Calories
73.41 gm.	63.83 gm.	500.00 gm.	2945

The larger difference in the carbohydrates—which in turn affects the calorie value—is probably due to the grouping of rice, tapioca and sago with such things as oatmeal and groats without any "weights" being assigned. The former were found more frequently used while the latter have a higher food value and would thus raise the total value of the group to a larger extent than would occur if exact proportions were taken.

Table V.
Average diet per man value per week as computed from Essex studies, and number of families using each type of foodstuff expressed as percentage of total number of families studied.*

Foodstuff	Meat†	Fresh milk‡	Sugar	Jam and treacle	Bread and flour	Cheese	Butter and margarine	Potatoes	Fresh vegetables and fruit	Eggs (8 to a lb.)	Lard, suet and dripping	Rice, tapioca, oatmeal, etc.	Cocoa	Fish	Currants
Average amount consumed per man value per week	15 (50.1)§	1½ (55.8)	14 (43.8)	5	8½ (44.4)	3¼	6½ (51.6)	5½ (61.7)	1½	2	2½	3¼	½	2	½
No. of families using this foodstuff (expressed as percentage of total number studied)	100	100	98	71	100	98	98			56	90	70	68	32	22

* Where more than one weekly study was obtained from the same family the average of the total weeks has been taken.

† Including bacon and sausages.

‡ Skimmed milk was counted as fresh milk, each amount recorded being divided by two, i.e. one pint of skimmed milk was taken as ½ pint of fresh milk.

§ The figures in brackets are the coefficients of variation $\left(= \frac{100 \text{ standard deviation}}{\text{mean}} \right)$ which have been calculated for the principal articles of diet only.

|| This number cannot be computed owing to home-produce not being recorded in many cases (vide p. 194). The total amount of potatoes and fresh vegetables used per man value per week was calculated for those budgets only on which it was recorded (53 in all), i.e. assuming 100 per cent. of the families studied would use these foodstuffs.

(2) *Income.* The relation between income and the value of the weekly diet in calories is shown in Table VI. As the income per man per week increases, the calorific value of the diet steadily increases likewise. A quarter of the families studied have incomes of over 10s. per man per week; these in the main are either families with no children or but one, or those families in which several adults are of earning capacity.

Table VI.

Essex Studies: Income per man per week in relation to calories per man per day.

Income per man per week	Frequency*	Mean value of diets in calories per man per day
4s.-5s.	5	2467
5s.-6s.	22	2624
6s.-7s.	14	2687
7s.-8s.	12	2895
8s.-9s.	8	2918
9s.-10s.	6	3333
Over 10s.	23	3350

* Where duplicate weekly studies have been made of one family the average has been taken of those weeks which fall into the *same* group.

Correlating the two sets of values—income per man per week with calories per man per day—gave a coefficient of + .7, while income per man per week correlated with expenditure on food per man per week gave a coefficient of + .9, indicating (as does also Table IV) what a large percentage of the wage must be devoted to food. On p. 198 it was shown that, on the average, 31.4 per cent. of this money spent on food goes to buy bread and flour. The relationship between (1) this expenditure on bread and flour, and (2) size of family, was likewise examined by the method of correlation and a coefficient of + .89 was found. If income be kept constant the coefficient is still of the order + .85, or, in other words, the larger the family (both in size and age) the greater the *proportion* of income that has to be devoted to bread, and the less to other foods. When the variety in the diet is thus limited it is obvious that the *quality* of the bread is of the utmost importance. Nowadays very little home baking is done in the South, and the rural population depends as much as the urban upon purchased bread. These purchases consist mainly of the “white” bread lacking the offal which would have been present when purchases of flour direct from the farmer or mill and home-baking were the rule. It has been proved that “white bread is suitable enough for those who eat other food which, like milk, contains all the groups necessary for growth and repair... but the whole meal is the real ‘staff of life’” (Hill and Flack, 1911). For families such as those studied here, whose diet contains so large a proportion of bread, the use only of white bread must entail an unnecessary risk of loss of the essential constituents.

An analysis of income in these studies will give the number of families in which children were of earning capacity. In Table IV it was shown that the average weekly income was £1. 17s. 1d., and that of this amount the man

contributed £1. 9s. 0d. In Table VII it is shown by what means these supplementary earnings are acquired.

Table VII.

Essex Studies: Analysis of income.

Average weekly income	Average weekly income from man alone	No. of families in which wife earned and average of these earnings	No. of families in which children earned and average of these earnings	No. of families with other supplementary earnings, e.g. lodgers, and average of these earnings	Total No. of families with any supplementary earnings and average of these earnings
£1. 17s. 1d.	£1. 8s. 7d.	17: 4s. 6½d.	29: 18s. 2½d.*	11: 11s. 5½d.	47: 15s. 6d.

* It must be noted that these are the earnings per *family of children* not *per child*, i.e. more than one child may be earning in the family. Details relating to these earnings are not given in sufficiently detailed form to enable earnings per child to be calculated. These vary largely according to the time of year. In such times as the pea-picking season children of normally non-earning age are put to work. It must be noted too that probably not the whole of the supplementary earnings are paid into the family exchequer.

From this table it will be seen that in the 87 studies made (98 diet studies were made in all, but some of these represent *supplementary* studies of the *same* families and allowance has here been made for these), just over one-half had some form of earnings in addition to the father's wage, and that the average amount of money thus secured was somewhat over half the average wage earned by the father. Whether it is wise for the mother, especially if she has young children, to work outside her own home, and whether it is wise for lodgers to be taken into already often overcrowded quarters, are matters which cannot be discussed here.

(3) *Housing and rentals.* In addition to these earnings, in 21 of the studies the house occupied by the family was rent free; it must, however, be remembered that this constantly implies Sunday work and that this extra labour is in actuality the rent paid. With this question too is bound up the whole problem of the "tied house." The rents paid in the non-free houses are given in Table VIII where, too, is included the size of the gardens. (In some cases these questions were not answered and hence the totals do not coincide with the total number of studies made.)

Table VIII.

Essex Studies: Rents paid by rural workers.

Weekly rent in shillings	Frequency	Size of garden and/or allotment in rods	Frequency
Free	21	None	2
1-2	6	1-10	17
2-3	16	11-20	26
3-4	24	21-30	8
4-5	3	31-40	11
5-6	6	over 40	9
6-7	4	—	—
7-8	3	—	—
8-9	1	—	—
Total	84	Total	73

Nearly 50 per cent. of the families live in houses for which they pay rent (and rates) between 2s. and 4s. Only, roughly, 17 per cent. pay over 5s. The accommodation obtained for these rentals is, taken as a whole, bad.

The general evidence obtained in the County was that the state of the housing in the rural districts is to be deplored; that many of the cottages are small and old-fashioned, with insufficient accommodation, especially for sleeping purposes; that many of them are cold and damp, and defective in ventilation; and that in many of them the sanitary conveniences and drainage are both primitive and objectionable from every point of view. For their water supply the population is too often dependent upon rain-water, ponds and shallow wells.

In the report of the Essex County Council upon Rural Development (1919) it is estimated that "not less than 2170 new cottages are required at once. In addition to that number, 1982 existing cottages will have to be condemned and rebuilt because they are not fit for human habitation and cannot be made habitable." In the report of the Medical Officer of Health to the County Council for 1921 it is estimated that (in 32 out of the 47 sanitary districts) there were 694 houses "definitely unfit for human habitation" and 5876 houses "not reasonably fit for human habitation." In many of these condemned houses the occupants are forced to continue to live owing to lack of other accommodation (the new "Council cottages" offer very little relief as far as the agricultural labourer is concerned for he cannot afford to pay their economic rent). Some of the defects found in the cottages in the rural areas were tabulated by Dr Thresh as:

1. Overcrowding of houses on space.
2. Sites preventing free access of air and tending to make the houses damp.
3. Dampness of structure.
4. Draughtiness.
5. Insufficient light and ventilation.
6. Proximity to accumulations of filth.
7. Lack of proper drainage or of land suitable for absorbing slop-water.
8. Impure and deficient water supplies.
9. Insufficient bedroom accommodation.

This takes no account of the defects (which he also cites) from the point of view of the "amenities" of life.

In discussing the size of the gardens and allotments caution must be displayed. The figures most probably only represent an estimate by the tenant (though he is certainly of a type well qualified to judge). What is more important to know is the proportion of the diet that is obtained from the garden. This must, however, depend not only upon the time of year at which the study is made, but also upon the crop of the year itself. The general evidence obtained was that most families find it difficult to grow a potato crop sufficient to last them throughout the year; for two or three months they have to buy—sometimes at a reduced rate from the farmer. Other vegetables are

eaten more in season but their value is not so great as that of the potato supply, for the latter forms such an important item in the diet of the rural worker. In Rowntree's rural studies home produce comprised 9 per cent. of the diet; in these Essex studies it forms 12 per cent. (measured only on those budgets recording it).

(4) *Clothing*. Of the normal expenditure on clothes, it is impossible to gather in a single week's study more than a general impression. It was often said in the county that, with the exception of boots, the agricultural labourer and his wife rarely after marriage bought new clothes; that they depended mainly upon "jumble sales" and gifts—often relations in domestic service will send such gifts. Boots, on the other hand, are a heavy item of expenditure both for the man, whose work is of a hard nature, and for the children who often have one or two, or even as much as three, miles to walk to school. "If we have to buy boots, we go short of food that week" was often asserted. More often probably the clothes are bought out of such extra earnings as are made at harvest time, pea-picking, etc.

(5) *Other expenditure*. Out of the average income of £1. 17s. 1d. it was seen (Table IV) that the average amount spent on food was £1. 5s. 5d. The remainder—11s. 8d.—has to meet expenditure on coal, lighting, rent, clothes, insurance and any luxuries or amusements. Some means of firing, e.g. wood, the rural worker can often acquire free, but it must be remembered that when the agricultural labourer obtains firewood by "hedging," it is only at the expenditure of extra labour and he will probably have to provide his own tools and gloves. One hundredweight of coal per week is usually required, at an average cost of about half-a-crown per week. The average amount paid per family for insurance and to "clubs"—clothing clubs, etc.—was found on the 68 studies giving sufficient details to be 1s. 9d.

The total weekly expenditure given by the average of these studies is, then, made up as follows:

Food	£	s.	d.
Rent	0	2	6
Fire and lighting	0	3	0
Clubs and insurance	0	1	9
Remainder for clothes, cleaning materials, amusements, etc.	0	4	5
	£1	17	1

Obviously in those cases in which the father is the sole earner (and the average income was then £1. 9s. 0d.) and has dependent upon him two or three children, the surplus income remaining after the essential food has been purchased must be considerably less.

In these studies, as has been seen previously, 54 per cent. of the families had earnings supplementary to those of the father; or in other words, the man was the sole earner in 46 per cent. of the families. In their study of *Livelihood and Poverty*, Bowley and Burnett-Hurst (1915) found the following relationship between earners and dependents:

Table IX.

Earners and dependents (families).

Earners in families	Percentage of families				
	Northampton	Warrington	Stanley	Reading	Bolton
(1) Man sole earner	38.6	47.1	59.0	45.6	39.1
(2) Man and other earners	51.4	45.5	31.0	41.0	45.3
(3) No man earning	10.0	7.4	10.0	13.4	15.6

To make these figures strictly comparable with those given by the Essex studies, the "no man earning" class would have to be excluded, for this type of family was not dealt with in the Essex studies and only one such occurs. Taking this into consideration, it will be seen that the proportions of families with and without supplementary earnings found in the Essex studies show no pronounced difference to those found in these industrial towns.

COMPARISON OF ESSEX STUDIES WITH RESULTS OF EARLIER
INVESTIGATIONS IN RURAL AREAS.

Such are the results given by this investigation in rural Essex. Before comparing them with the dietetic enquiries that have been made in urban areas, it will be of interest to see how far they are in accordance with previous studies made in rural districts.

The earliest such investigation was made by Dr Edward Smith (for the Local Government Board) in 1860 into "the conditions of nourishment of the poorer labouring classes in England" (Smith, 1863). He collected weekly dietary studies from 370 families of farm labourers living in England. From the data he gives, only an approximation to the mean calorie value of the diets can be made; for he has grouped the families as so many adults, counting each person over 10 years of age as 1 and each child under 10 as .5, and this estimate of the food requirements of men, women and children differs from that used in the Essex budgets (see p. 197); and, secondly, he has grouped similar food-stuffs under one title, *e.g.* bread, flour, rice, oatmeal, etc., are taken as "bread-stuff." With these limitations in mind, the mean calorie value of the 370 diets was computed to be some 2800 calories per man value per day (if the 80 studies collected in the Eastern counties be calculated alone the final result differs to no appreciable extent). It is probably sufficient to say that the mean lies between 2800 and 3100 calories. In his conclusions, Dr Smith makes some interesting deductions, the more important of which are quoted below:

"(1) The agricultural labourers in England, apart from their families, regarded in a general manner as a class, are not ill-fed....

(2) The class of farm labourers' families is a very mixed one, since in counties where sufficiency is the rule deficiency is found side by side with it....

(3) The nourishment obtained by the labourer himself is larger than the average quantity indicates, since he eats a larger share of the food than other members of the family....

(4) There is reason to believe that the quantity of food obtained by the wife, and also by the children at the period of rapid growth, is in many cases, in almost every county, deficient....

(5) Those families are in the most straitened circumstances, *caeteris paribus*, who have several children under the age of 10 years, and therefore too young to earn anything....

(6) The labour of women in the fields...is under present circumstances of great advantage to the family, since it adds that amount of income to the family which relieves from the pressure of want...and enables the whole family to be better fed; at the same time the exertion in the open air oftentimes...improves the health of the wife.... When the income attainable by the husband is sufficient to maintain his family in health and respectability, no doubt the out-of-door occupation of the wife and young children should cease, so as to give better opportunity for cooking and the increase of domestic comfort, and to enable the children to obtain a better education....

(7) It is most important to the labourer to be able to grow a large quantity of potatoes and other fresh vegetables...and milk should be more universally attainable.

(8) The condition...in winter is more unfavourable than at other seasons.... Hence they usually have less food in winter, at the season when they need more food.

(9) Although the health and strength of the people may be moderately well maintained on the existing dietary, it is more than probable that mental vigour and activity...are less where the diet is low" (Smith, 1863).

These conclusions in the main apply equally well to the county of Essex to-day. The diet of the rural workers in 1860, Dr Smith found, was at a higher level than that of the artisans in the towns, but, obviously, as a whole, he did not find it err on the side of liberality and in many cases, especially for the women and young children, he believed there was actual deficiency.

In her study of "The Standard of Living in the United Kingdom: 1860-1914," Miss Mackenzie reached the conclusion that, taking a standard of 3000 calories per man per diem, one-quarter of the population was insufficiently nourished at the earlier date. Amongst this quarter would fall the agricultural population. "During the next twenty years, the general standard of living increased, so that all [the deciles] were above the lower standard (*i.e.* 3000 calories per man per diem) and even the lowest decile and lower quartile were not much below the higher" (*i.e.* 3500 calories per man per diem) (Mackenzie, 1921). The best paid agricultural labourer, she places at the lowest decile and considers that in 1880 "with 17*s.* a week he was able to feed his family better than the town unskilled labourer on 21*s.* 4*d.*" But the position of the average agricultural labourer (and the Eastern Counties do not afford the highest wages) would fall below this and probably not be higher than midway between the two standards. Before the war the lowest decile family, she found, was between the two standards and at this date such a family would be represented

by an unskilled town labourer, while the agricultural population would lie below, *i.e.* nearer the lower, 3000 calorie standard. For this date, the years just previous to the war, there is available some further evidence from the enquiry conducted by Mr Seebom Rowntree and Miss May Kendall. They collected forty-two dietary studies from agricultural workers. Thirty-nine¹ of these have been recalculated by the writer for comparison with the present investigation (*i.e.* in accordance with Lusk's standards, not those of Atwater which Rowntree employed in his calculations).

From their general survey of the agricultural population (which survey it must be noted was, like the present, limited to small numbers) the authors reached the conclusion that the diet usually did not "contain the nutriment necessary for physical efficiency" and that "the women and children suffer from under-feeding to a much greater extent than the men" (Rowntree and Kendall, 1913). The details of these recalculated diets are given in Table X.

Ten years earlier, in their enquiry into the cost of living, the Board of Trade obtained estimates of consumption of agricultural labourers (Cd. 1761, 1903), while in 1918 a Committee appointed by the Agricultural Wages Board obtained 396 budgets relating to rural workers. The figures given by these latter enquiries for comparison with those of the present, need recalculation according to the Lusk standards. Recalculation of the Board of Trade studies has been carried out by Dr Major Greenwood and Miss Cecily Thompson (Greenwood and Thompson, 1918). In the report of the Committee appointed by the Agricultural Wages Board the man values taken were:

Man	=	1.0
Woman	=	.8
Child under 14	=	.5

It will be seen that no ages of children are specified. The value used for children of unspecified age *under* 16 was taken by Greenwood and Thompson as .68. The value for children of unspecified age *under* 13, taking the average of Lusk's values (*vide* p. 197 of this paper) would be .64. The "man value" of children *under* 14 must obviously lie between the two, and as taking the limits only gives a variation of 100 calories per man per day it will be sufficient for this comparison to suppose that the value required is .66.

This makes the average family to be of 4.47 man value compared with the 3.8 man value given by the standards used by the Committee, and, when the diet has been recalculated according to more modern analyses, gives a daily calorie consumption per man value of 2805. (This figure must be somewhat *below* the actual value of the *total* diet for it relates to "principal articles of food" and excludes "the small quantities of other foods which would certainly be purchased.")

It will be seen from Table X that the results given by these several

¹ Three were excluded: in one the husband was dead and in the other two it was not certain to what extent the man took meals at home.

Table X.

Results of Essex investigation compared with those reached in previous enquiries into diet of agricultural labourers.

	Proteins	Fat	Carbo- hydrates	Calories
Essex Investigation, 1923	74.30	68.95	469.19	2872
Dr Edward Smith's Report, 1863	—	—	—	About 2800 to 3100
Miss Mackenzie's investigation, 1860	—	—	—	Not above 3000
" " " 1880	—	—	—	About 3250
" " " 1914	—	—	—	About 3000
Seebohm Rowntree's investigation, 1911-1912	67.22	58.79	458.56	2702*
Board of Trade Enquiry, 1903 (agricultural labourers, Eastern Counties)	—	—	—	3037
Agricultural Wages Board Enquiry	72.35	63.15	468.54	2805

* If Rowntree's studies made in Essex be taken alone the calorie value is only 2563. On the other hand, there are only eight such studies, too small a sample to be of true value, and these have a considerably higher man value—5.60 per family—than was found in the present investigation.

enquiries are very consistent and, consequently, that the conclusions of previous investigations do not suggest that the figures given by the present enquiry are in any way definitely biased or founded upon any great inaccuracy.

The fact that the calorie value of the diets collected by Rowntree falls lowest was to be expected. The majority of his studies were made during the month of November and December when conditions of living would probably be at their lowest, and secondly, compared with the present investigation, the

4.43; his average man value, on the other hand, is 4.85 compared with 4.90 in the Essex investigation. In other words, his families contain more and younger children.

The general indication, then, from all these studies is that the *average* diet of the agricultural labourer in the Eastern Counties has a gross calorie value in the region of 3000 per diem.

To contrast from another point of view—apart from calorie value—these Essex studies with the results of earlier investigations, Table X A was compiled. In it is shown the percentage of total income that is spent on different items in the average budget for (i) the Essex studies, (ii) 396 budgets collected by Cost of Living of Rural Workers Committee 1918, (iii) estimated expenditure 1914 (as given in the report of this 1918 Committee), and (iv) 83 budgets collected in 1924, the analysis being published in the *Journal of the Ministry of Agriculture* (Ashby, 1925)¹.

It will be seen that the percentage of income devoted to food—the factor of most importance in this investigation—is very much the same in each enquiry. (The expenditure on food falls lowest in 1924, but for the budgets in this study the average total income was £1. 13s. 2d. In the Essex studies it was nearly

¹ It is impossible to utilise these budgets for dietetic comparisons as no attempt was made to get the description and amounts of foods.

4s. higher—£1. 17s. 1d.) The percentage spent on fuel and light in 1923 is nearly the same as the percentage found in 1918, but in 1924 it seems to be abnormally high. The figures for the other three items vary more widely (obviously if *one* percentage varies, at least one other must vary as well). The percentages of income devoted to rent and insurance in 1923 and 1924 are closely alike and both are greater than the corresponding percentages in 1918, while the percentage devoted to clothes in the later years is lower. Part of the differences in amounts spent on clothes and insurance may arise from the

Table X A.

Percentage of income spent by rural workers on each item required in normal week's budget in 1914, 1918, 1923 and 1924.

Items	Expenditure of	Estimated expenditure 1914	Expenditure of	Expenditure of
	98 Essex families 1923		396 families 1918	83 families 1924
Food*	68.5	66.4	66.9	62.6
Rent	6.7	7.6	4.5	6.5
Fuel and light	8.1	6.9	8.8	14.6
Clothes, cleaning materials and any odd expenditure	11.9	15.9	16.6	12.3
Insurances	4.7	3.0	3.2	4.0
Total expenditure	99.9	99.8	100.0	100.0

* The expenditure on food in 1923 and 1924 refers to bought food only and takes no account of home produce. At the other dates the home produce was valued as if purchased. This in comparison would make the former figures somewhat too low.

fact that in the Essex studies "insurance and clubs" are taken together, and subscriptions to clubs are often subscriptions to "clothing clubs." Ashby makes no mention of this type of expenditure—contributions to clubs—in 1924, so that probably he too has included it under the heading of insurance. This would increase the percentage devoted to insurance and lessen that devoted to clothing. The smaller amount devoted to rent in 1918 would be the result of this item being unable to increase proportionately, owing to war-time legislation.

A further comparison of the results of these investigations in rural areas, by Rowntree in 1912, by the Agricultural Wages Board Committee in 1918 and by the writer in 1923, can be made by utilising the table given on p. 200. In that table was given the average amount of each foodstuff consumed per man value per week as calculated from the Essex studies. Below in Table X B these amounts are contrasted with the similar average amounts computed by the writer for 269 of the budgets collected by the Committee appointed by the Agricultural Wages Board in 1918, and the 39 recalculated budgets of Rowntree.

Between Rowntree's studies and those made in 1923 there is no very great discrepancy in the consumption of any group of foodstuffs. Rowntree records a slightly larger consumption of sugar, but this is compensated for by a lower consumption of jam and treacle. He also finds a considerably smaller consumption of butter and margarine—probably in the main representing a lower consumption of margarine—but this is nearly balanced by a greater

Table X B.

Average diet per man value per week as computed from Essex studies, 1923, contrasted with similar average amounts computed from 269 budgets collected in the enquiry of 1918, and 39 budgets collected by Seeborn Rowntree in 1912.*

Average amount consumed per man value per week	Meat ozs.	Milk pints	Sugar ozs.	Jam and treacle ozs.	Bread and flour lbs.	Cheese ozs.	Butter, mar- garine ozs.	Pota- toes lbs.	Fresh vege- tables and fruit lbs.	Eggs ozs.	Lard, suet and dripping ozs.	Rice, tapioca, oat- meal etc. ozs.	Cocoa ozs.	Fish ozs.	Currants ozs.
	15	1½	14	5	8½	3½	6½	5½	1½	2	2½	3½	½	2	½
	(±.55)	(±.06)	(±.44)		(±.27)		(±.24)	(±.24)							
	16	1½	16	3½	8	1	3½	4½	2	½	4	3½	½	2	1
	(±.77)	(±.11)	(±.80)		(±.33)		(±.19)	(±.26)							
	22	2	9½	6	8½	1½	6	4½	—	2	2½	8	½	1	—

* The average man value of these 269 budgets according to Lusk's standards would be 4.24—as nearly as it can be calculated from the data (*vide* Cmd. 76, p. 33, for average composition of families).

† The figures in brackets (±) show the probable errors of the means ($= \frac{.67449 \text{ standard deviation}}{\sqrt{\text{number of observations}}}$). It cannot be calculated for the 1918 enquiry as the data are not given there in sufficient detail.

intake of cheaper fats—lard, suet and dripping. The very small use of eggs indicated in his studies is naturally a reflection of the time of year at which the majority of the budgets were obtained—from November to February. (The probable errors of the means, computed for the principal items in the diets, are relatively small in both enquiries.)

The only other noticeable difference between the two sets is in the purchase of cheese. The results given by Rowntree's budgets approximates more closely to that given by the 1918 studies than it does to that found in 1923.

Comparing the 1918 budgets with the 1923 group it will be seen that for nine items there is a close agreement (milk, jam, bread, butter, potatoes, eggs, lard, etc., cocoa and fish); in four there are distinct differences. The consumption of meat in 1918 is recorded as half as much again as in 1923; the consumption in 1918 of sugar and cheese is considerably lower than in 1923, the consumption of the rice group is considerably higher. The 1918 studies give no details of fresh vegetables used—though the enquiry was made in June when such food must have been available, and they record no purchase of currants which were entered on 22 per cent. of the Essex budgets.

The lower consumption of sugar and cheese at the earlier date is consequent probably upon the studies being made in the war period. The report of the Committee states that compared to the pre-war period "less cheese and less sugar were obtained; on the other hand, the consumption of bread and flour, and oatmeal or rice, and of new milk had risen." The Essex studies indicate that the consumption of sugar and cheese has risen again, that of oatmeal and rice has fallen. The substantial difference in the consumption of meat may partly arise from the fact that the Essex average family is larger than the average family of these 269 budgets (4.90 as opposed to 4.24). If this difference represents children of non-earning age the average consumption of meat would certainly be less *per man value* for, as it has been seen, the meat is bought largely for the earning members of the family. It may be, too, that part of the difference arises from differences in consumption in *Essex* and in *all England and Wales*, for the 1923 studies were confined to the former county, the 1918 studies extended over the whole country. In spite of these differences in purchases (small differences cannot have much stress laid upon them) the total calorie value of the diets at the three dates (as was seen in Table X, p. 208) is remarkably similar.

Though not strictly relevant to this discussion an interesting comparison can be made between the consumption of certain articles of diet in 1860, as shown in Dr Smith's report, and the consumption of the same articles as indicated by the studies of 1923.

This table suggests¹ that for the agricultural labourers' families the con-

¹ Naturally indications such as these, suggested by a single comparison, cannot be taken as positive without much further study of a question which cannot be dealt with here. Further material on the point, for this century, is to be found in the report of the Agricultural Wages Board Committee, Cmd. 76.

Table XI.

Consumption of certain foodstuffs in 1860 by agricultural labouring class, England, compared with their consumption in 1923 by same class in Essex.*

Foodstuffs		Bread-stuffs	Sugars	Fats, including butter and margarine	Meats	Milk	Cheese
Amount eaten per man value† weekly	1860	12·32 lbs. (11·8)	7·4 ozs. (7·0)	5·5 ozs. (7·0)	16 ozs. (6·5)	32 fl. ozs. (10·0)	5·4 ozs. (4·0)
	1923	8·75 lbs.	19 ozs.	9 ozs.	15 ozs.	30 fl. ozs.	3·8 ozs.
No. of families consuming foodstuff expressed as percentage of all families studied	1860	100	98	99	99	72	57
	1923	100	98	99	100	100	98

* The whole of England is adopted as the area for comparison, as Dr Smith only made six studies in Essex, too small a sample to be of value alone. The mean values for these six studies have, however, been inserted in the table and are shown by the bracketed figures immediately under those for all England. They differ appreciably, it will be seen, in the cases of meat and milk.

† The calculation of man value was made, it will be remembered (*vide* p. 205), on somewhat different principles at the two dates.

sumption of breadstuffs has gone down in this three-quarters of a century; the consumption of sugar (including jam and treacle) has gone up enormously and the consumption of fat very considerably (*e.g.* introduction of margarine). The consumption of meat has remained the same, while milk, though not being taken in any larger quantity is drunk by a considerably higher percentage of families. Cheese, likewise, which was consumed by 57 per cent. of the families studied by Dr Smith is in the Essex studies taken by 98 per cent. of the families.

COMPARISON OF ESSEX STUDIES WITH STUDIES MADE IN URBAN DISTRICTS.

It has, thus, been seen that the results of this investigation contrast favourably with those given by earlier similar enquiries made in rural areas, and that these latter do not suggest that the diet studies obtained in Essex are in any way open to grave inaccuracy or bias. It remains to examine these studies in relation to the dietary investigations that have been carried on in urban districts. Of the latter the most extensive of their type and most important for the purpose are (1) a series of observations made at different dates in Glasgow (Ferguson, 1916, 1917, 1918, 1919; Tully, 1921, 1922 and 1924), and (2) a study of the nutrition of miners and their families in 1923 (M.R.C. 1924).

In these enquiries, as has been pointed out (*vide* p. 191), the details were obtained by trained investigators who weighed the food bought and consumed. They are therefore likely to reach a greater degree of accuracy than has been obtained in the rural studies. Unfortunately, however, the earlier studies (*i.e.* those prior to 1917) were computed on the basis of Atwater's standards of man value. The rural diets, as has been seen, for purposes of comparison one with another, are all valued according to the more accurate man values put forward by Lusk. This detracts from the value and accuracy of the comparison between the two, and no satisfactory corrective value can be

applied for converting the results given by Atwater's standards into the results that would be obtained with Lusk's standards.

A corrective value has been used in a table given in the Report on the Nutrition of Miners and their families (p. 33 of that report), but the procedure adopted appears very much open to objection. From the calorie value found per man per day, by Atwater's standards, 14 per cent. of itself has been deducted and the resulting figure is assumed to give the corresponding calorie value as it would be according to Lusk's standards of man value. This correction is based upon the fact that for the average family, "e.g. man, wife and three children," Lusk's coefficient of man value *for the family* is 14 per cent. *higher* than the corresponding value given by Atwater's standards, and that therefore a deduction of 14 per cent. from the calories per man per day converts from Atwater's to Lusk's scale.

A first, but minor, objection is that the investigators, instead of *deducting* 14 per cent. *from the calories per man per day*, should have *added* 14 per cent. to the *family man value* and then divided this new family value into the total calories consumed per day by the family. The two procedures do not give the same results though the divergence is not very large—in these figures of the order of 50 calories per man per day.

(If x be the number of calories consumed per day by *the family*, y the man value of the family by Atwater's scale and k the percentage correction required, then $\frac{x}{y}(1+k)^{-1}$ only equals $\frac{x}{y}(1-k)$ if k is so small that k^2 and higher powers of k may be neglected. In this case it is true k is small enough to allow higher powers to be neglected without serious effect on the final result.)

The second and main objection is that the difference between the Atwater value and the Lusk value for families *not* of this average size may vary widely from 14 per cent. If the family consist of a man and wife, one girl aged 20 years and a boy aged 8 the difference is only 5.2 per cent. If the family consist of a man and wife, one boy aged 12, and two girls aged 10 and 8, the difference is 16.9 per cent. The difference naturally depends upon the age distribution of the family, and the variation can be between wide limits. The only justification for using the difference found in the average family would be if this corresponded to the mean size of the families studied. By Atwater's scale the man value of the "average family" is 3.30. On the other hand, in the studies to which this correction has been applied the mean size of the family on Atwater's scale is as follows: (1) Glasgow studies, 1911–12, mean man value = 4.63 (for *all* the 60 families it is 4.50; in the Nutrition of Miners report only 40 have been quoted and it is not obvious which have been rejected—it is to be assumed the lowest classes), (2) Glasgow studies, 1915–16, mean man value = 3.51. The difference from the "average family" is very considerable indeed in the 1911–12 studies, and in the 1915–16 studies, though small, it is not negligible. From this analysis it seems the better policy to reject any corrective value and to compare the rural and urban studies as they stand,

i.e. calculated on the two different standards. This procedure has been followed in Table XII, where the italicised figures indicate that they have been computed on the basis of Atwater's values, and all others from Lusk's standards.

The observations can be divided roughly into three groups according to the date at which they were made: (i) pre-war years, (ii) war years, and (iii) post-war years.

In the pre-war group the studies in both rural and urban areas were made in 1911–12. It will be seen (Table XII) that the agricultural labourers with an average weekly income of 18*s.* secured an energy value in their diet equal to that of the *lower* paid urban workers, although these latter studies are calculated by the Atwater standard and the values are therefore too high. In fact, therefore, the rural diets are superior to the diets of the urban class. They are inferior to those of the higher paid urban class, though owing to the difference in standard it is impossible to gauge the measure of inferiority. It should be noticed, too, that the rural families were large and were studied in the winter, *i.e.* at their most adverse time.

In the war group the comparison is made still more difficult by the fact that the rural study was made in June 1918 and the urban study in the winter of 1915–16. Prices between these dates moved so substantially that comparison cannot be made without reference to them. The official index numbers of average change of retail food prices in January 1916 and June 1918 were respectively 145 and 208 compared with 100 in July 1914. The increase between January 1916 and June 1918 was therefore as 1 : 1.43. The urban wage recorded on these budgets of 1915–16 was 8*s.* 2*d.* per man value weekly; that of the rural observations is 10*s.* 5*d.*, or rural is to urban as 1 : .78. (The fact that the rural wage is here considerably higher than the urban wage is due to two reasons: (1) the urban workers comprise the *poor* labouring classes; (2) the rural studies were made in 1918 when wages had risen considerably above those in 1916, the date of the urban studies.) In other words, the rural wages of 1918 do not exceed these urban wages of 1915–16 to the same extent that retail prices in 1918 exceeded retail prices in 1915–16, *i.e.* the rural worker in these studies was less well off than the urban worker. On the other hand, his diet is not so distinctly inferior, when the higher value given to the urban diets by Atwater's scale be considered.

In these early studies it can be noted that the rural worker secures a relatively large amount of carbohydrates in comparison with the town worker, but his consumption of fat and protein is not so high, even when allowance be made for difference in scale.

In the final group all the studies are computed on Lusk's standard. This post-war group is likewise spread over a number of years, but there are sufficient observations, both rural and urban, made in 1923 to enable price changes affecting the results of the 1921 and 1922 enquiries to be left out of consideration—especially as these latter studies comprise small numbers of men unemployed or on short time, while the movement of prices was not very

Table XII. Comparison of the energy value and constituents of rural and urban diets.

Description of group of families from which diets were obtained	Date of study	No. in group	Average amount consumed per man per day			
			Calories	Protein gm.	Fat gm.	Carbohydrates gm.
Rural: Rowntree's enquiry: Agricultural labourers, average weekly income 18s. per family	1911-12	39	2702	67.2	58.8	458.6
Urban: Glasgow studies (calculated according to Atwater's man value standards): Labouring classes, (1) income above 20s. weekly regular	1911-12	27	3356	115.1	87.7	503.9
(ii) under 20s. weekly or irregular	1911-12	19	2765	98.4	70.4	416.3
Rural: Enquiry of Committee of Agricultural Wages Board: Agricultural labourers, average income 10s. 5d. per man value per week	1918	396	2805	72.4	63.2	468.5
Urban: Glasgow studies: Labouring classes, average weekly income 8s. 2d. per man value weekly	1915-16	47	3347	104.2	91.3	505.0
Rural: Essex enquiry: Agricultural labourers: average income per man per week 8s. 0½d.	1923	98	2872	74.3	69.0	469.2
Urban: Glasgow studies: A. Men out of work or on short time: (1) Income per man per week over 8s.	1921	5	2466	72.9	77.6	352.5
(2) Income per man per week under 8s.	"	6	2505	64.1	73.3	380.4
B. Men out of work or on short time: (1) Income per man per week over 8s.	1922	5	2605	78.4	87.7	358.0
(2) Income per man per week under 8s.	"	7	2182	62.6	61.3	330.7
C. Artisans and skilled workers (total income not obtainable)	1923	17	3070	87.9	96.8	441.4
Mining studies: Miners with average weekly income per man of 12s. 2d.	1922-23	140	3035	74.2	97.7	444.5

In addition there exists a series of studies made in Birmingham in 1913-14 (Carver, 1914). The calorie value of these studies was also calculated according to Atwater's man values and again it is impossible to correct them to the Lusk standard, adopted in this enquiry, as no ages of the children are given. The results, using Atwater's standards, are as follows (only results for "healthy" and non-tuberculous families are here cited).

Group	No. of families in group	Average income in shillings	Calories per man per day
AH	8	21.92	2997.22
BH	6	26.75	2859.00
CH	8	32.00	3088.08
DH	7	38.07	3178.04
EH	11	55.18	3137.83

With the application of Lusk's man values these calories per man per day would be quite considerably reduced and their comparison with the calories per man per day found in Rowntree's enquiry reveals that these urban families were securing no very great superiority of diet although their incomes are all substantially higher—for even using Atwater's standard the calorie values are distinctly low.

substantial. It is sufficient to observe that the calorie value given in the Essex enquiry is in every case at a higher level than that found in these 1921 and 1922 studies, *whatever the income in the latter*, though the comparison would be slightly less favourable if price changes were taken into account. It is important, however, to note that the fat content of the Essex diets is low in comparison even with these unsatisfactory diets, while the carbohydrate content is very much higher.

The urban diets collected in 1923 relate to a higher class of workers and these secure an average energy value roughly 200 calories per man per day in excess of the Essex agricultural labourers. Yet this excess of calories secured by the miners, measuring only 5.6 per cent. of the Essex total, is the result of an income *half as large again* as the average Essex income. The protein content of the agricultural diets compares favourably with that of the urban studies; the fat content is distinctly below; the carbohydrate is, as usual, above.

To sum up, the general indications afforded by this preliminary table are: (i) that at each of the dates (in spite of the masking influence of Atwater's scale) urban workers, securing varying scales of higher wages than the rural workers, are not securing a superiority of diet commensurate with their superiority of income; while the diet of the *very* poor urban classes is considerably lower in value than that of the agricultural labourers; (ii) that the protein content of the rural diet is by no means excessive and often falls below the amount found in urban diets—in addition, probably, a greater proportion of it is, in the rural diets, *vegetable* protein (in the Essex diets 1923, 27.4 per cent. of the protein was animal protein compared with 33.4 per cent. in the 1923 miners' diets); (iii) that the fat content falls distinctly below that of urban diets; while (iv) the carbohydrate content lies distinctly above, the latter probably being partly due to the greater consumption of vegetables and partly to a lower income necessitating a greater expenditure on bread and less on more expensive items such as meat.

This latter hypothesis can be tested by a comparison of the actual consumption of the main articles of diet in the rural and urban studies. Such comparison is set out in Table XIII, but again owing to the difference in standards at the earlier dates it must be confined to the studies made in 1923.

The consumption of meat in the urban districts is here *twice* the consumption in the rural areas.

The consumption of milk is less in the rural than in the urban areas. This seems surprising, but it will be found that on the whole the cost of milk in rural villages is very rarely less than its cost in towns. (A definite large contract probably compensates the producer for the extra transport charges.) This being the case, the family of the rural labourer, having the lower income per head, would be likely to purchase smaller quantities of milk, which is a dear form of food—although its value from the nutritive point of view is high. It is probable that the actual amount consumed in the rural districts should be increased slightly by free allowances of milk not recorded on the budgets, but

Table XIII.

Average diet per man value per week in rural studies as compared with corresponding values found in urban studies.

Description of Group of Studies	Meat ozs.	Milk pints	Sugar ozs.	Jam and treacle ozs.	Bread and flour lbs.	Cheese ozs.	Butter and mar- garine ozs.	Pota- toes lbs.	Fresh veget- ables and fruit lbs.	Eggs ozs.	Lard, suet and dripping ozs.	Rice, tapioca, cornmeal, etc. ozs.	Cocoa ozs.	Fish ozs.	Currants ozs.	
Rural:																
Essex Enquiry, 1923	15	1½	14	5	8½	3½	6½	5½	1½	2	2½	3½	½	2	½	
No. of families using foodstuff*	100	100	98	71	100	98	98	—	—	52	90	76	68	32	22	
Urban:																
Nutrition of Miners Enquiry, 1922-23	33	2½	18	†	6½	3	7½	3½	2½	3½	6½	4½	†	5½	†	
No. of families using foodstuff	100	100	100	—	100	95	100	100	100	88	100	93	—	83	—	

* As percentage of total number of families studied in each case.

† Totals not recorded.

it is believed that this amount would be very small *on the average*, for milk, if allowed at all, is normally the perquisite of the cowman only.

The consumption of sugar is somewhat higher in the towns.

In the agricultural districts there is a greater consumption of bread and flour—as would be expected on the hypothesis that the smaller the income the greater the amount of food money that must be devoted to bread. In the Essex diets it was calculated that 31·4 per cent. of the food money was spent on bread and flour (*vide* p. 198); in the diets of the miners the corresponding percentage is only 18·4. This difference may be slightly due to the more widely spread habit of baking at home in the North when compared to the South, but it does give an indication of the difference in economic level between the two classes.

The consumption of cheese is roughly similar in the two types of area; that of butter and margarine slightly less in the rural districts. In the Essex enquiry the consumption of potatoes is 2 lbs. per man value greater than the consumption of the miners' families. On the other hand, the consumption of other vegetables is somewhat less at this date. It is here that the greatest danger of under-estimation lies in the rural studies. But in all comparisons between these studies and those made in the *mining districts* it is most important to remember that these latter are not all situated in administrative urban districts. Though the type of life that the miner leads may be considered urban for the purpose of this enquiry, they cannot be classed as "urban" in the same sense as can be classed the families resident in the poorer districts of Glasgow. Many of those from whom studies were obtained were resident in administrative rural areas, and thus in a position to have gardens from which they could secure home produce. In Rowntree's rural studies the home produce supplied 9 per cent. of the total calories; in the Essex studies it supplied 12 per cent.; but it must be noted that the advantage of home produce is only secured by a *longer day's work* with a consequent *increase in metabolism and food requirements*.

The consumption of eggs is so dependent upon the time of year at which the budgets were obtained that satisfactory comparison is made difficult. In both these enquiries the studies were spread over the year, and the consumption in the towns is slightly higher than that in the rural villages.

The comparisons of importance that remain relate to cereals and fish. For the former the difference is not very great. With fish, the consumption in the country is very small. In the mining villages the consumption likewise is not very great, but it stands at a figure considerably above that given in the rural studies. Part of this consumption is derived from the larger use of tinned foods in the towns, while very little indeed was recorded in the Essex studies.

A single comparison of this kind is not of great value *alone*, but it is of value as confirmatory evidence. It does bear out the hypothesis put forward on p. 216 that the families of the agricultural labourers live more largely on a

carbohydrate diet, due to a greater purchase of bread and flour and a somewhat greater consumption of potatoes; that the urban families are able to secure a substantially greater amount of meat (including such foods as sausages, bacon, ham, etc.), a larger amount of fish, and somewhat larger amounts of sugar and fats (butter, margarine, dripping, etc.), and that their diet is, through the former source, probably made more varied. Yet Miss Ferguson found that "there was a lack of variety in the food of many of the families. The usual dinner consisted of potatoes and mince, stewed beef, chops or sausages. Occasionally broth took the place of this. All other meals were composed chiefly of tea, bread and margarine" (Ferguson, 1917). For the agricultural labourer the "occasionally" must become more frequent. Perhaps the healthy, though hard, outdoor occupation of the rural worker enables him to digest his possibly coarser type of food with less loss than is experienced by the town worker. On the other hand, Holdenby found that the agricultural labourer suffered much from indigestion (Holdenby, 1913).

That the town worker does not secure this somewhat different diet by spending a greater percentage of his income on food is shown by Table XIV.

Table XIV.

Percentage of income spent on food: urban and rural studies.

Description of studies	Average total income	Average amount spent on food	Food money as percentage of income
Rural: Rowntree's enquiry, 1911-12	16s. 6d.	11s. 6½d.	69.8
Urban: Glasgow studies, 1911-12	{ above 25s. regular	—	61.9
	{ under 25s. „	—	67.3
	{ irregular	—	75.5
Rural: Agricultural Wages Board Committee's studies, 1918	46s. 5½d.	31s. 0½d.	66.9
Urban: Glasgow studies, 1915-16	32s. 8½d.	20s. 1½d.	61.6
Rural: Essex studies, 1923	31s. 7d.	25s. 5d.	68.5
Urban: Mining studies, 1922-23	64s. 3d.	35s. 5d.	54.9

In the earliest studies the poorest class of town workers with an irregular income spend, as would be expected, the greatest percentage on food. The agricultural workers spend about the same proportion as the urban class with a regular income of under 25s., and substantially more than the urban class with a regular income over 25s. At both the other dates the agricultural worker spends a higher percentage of income on food than do the urban workers—a very considerably higher percentage in 1923 will be noted. In other words, the lower the income the greater the part of it that must be devoted to the purchase of food, and the more care that must be applied to marketing. This latter point can be brought out by a comparison of the number of calories obtained per week with the total cost of the food per week.

In the earlier studies the rural families secure over a hundred more calories per penny than the urban families, although the urban figure being reached by Atwater's standard must be considerably too high. In the rural studies the calories per penny relate only to *bought* food; if home produce were taken into consideration the difference would be still more distinct. This may partly

account for the little difference observed between the Essex studies and the mining studies. As has been pointed out, the mining studies relate partly to families resident in rural administrative areas, so that they may add to their diet with home produce, and the calories calculated per penny include this. This would make their value in comparison somewhat too high. In addition,

Table XV.

No. of calories bought per penny: urban and rural studies.*

Description of studies	No. of calories secured per penny of food-money
Rural: Rowntree's studies, 1911-12	570
Urban: Glasgow studies, 1911-12	456†
Rural: Essex studies, 1923	293
Urban: Mining studies, 1922-23	284
Glasgow studies, 1923	177

* War studies are excluded owing to errors arising from price changes.

† Calculated on basis of Atwater's man values.

33 per cent. of these families were in arrears of rent or in debt, so that a careful spending of income would be necessitated. The number of calories secured per penny by the Glasgow skilled workers is very low, and the report remarks that the marketing was decidedly poor, "most of them not being compelled by necessitous circumstances to consider the value of every penny spent" (Tully, 1924).

In the Essex studies the distribution is as follows:

Table XVI.

Calories secured per <i>ld.</i>	No. of families securing this amount
Below 200	5
Above 200, below 250	15
" 250 " 300	31
" 300 " 350	33
" 350 " 400	13
" 400	1
Total	98

80 per cent. of the families obtained over 250 calories per penny of their outlay on food. A rough guide is given by this to the change in the purchasing power of the penny between the pre-war and post-war period. In 1911-12 the rural workers studied secured 570 calories per *ld.* while in 1923 they obtained 293 calories. This is a ratio of 1 to .51 or, in other words, according to these enquiries, the value of the penny as regards food is nearly halved. If the change in value be calculated from the index figures for retail food prices, as given by the Labour Ministry, the ratio of 1912 to 1923 is as .61 to 1. (The average figure for the months February to November, 1923, during which the studies were made, is 63.2 per cent. above the 1912 level.) The approximation, considering that neither method takes into account the changes in consumption over the period, is reasonably close. Such changes in consumption

might, too, affect the two methods in inverse ways, *e.g.* if such change was towards purchase at the later date of *dearer* articles containing *less* calories.

The details given in the report on the nutrition of miners and their families enable a closer comparison to be made between these studies and the Essex studies. This contrast is set out in Table XVII and reveals the following facts:

(1) The total income of the agricultural families is substantially below that of any of the groups of mining families here set out but

(2) the average rural family (and consequently the man value) is somewhat smaller than these urban families.

(3) In spite of this, the income per man per week in the rural families falls considerably below that of the miners except in the case of the Durham group.

(4) Yet on this lower income, the rural families secure a diet that compares very favourably with that of the urban workers—except in the case of the Derbyshire miners, who have an income per man value just twice as large as the Essex labourers. Where the rural diet is noticeably lacking as compared with the urban studies is in the consumption of *fat*, while their intake of animal protein is below that of all the urban groups.

(5) Subsisting on a lower income, the total cost of food for the rural worker's family is naturally less, but the percentage of food money to total income is (with the exception of Durham again) considerably higher. If number of calories per *1d.* be a measure of careful marketing, the Essex studies show a superiority to the mining studies with the highest incomes, but an inferiority to those groups with an income approximating more closely to their own.

(6) The percentage of food money devoted to bread is much higher in the rural studies.

The somewhat closer study of these groups bears out largely, it will be observed, the general conclusions indicated by the broader comparisons previously made, which comparisons may thus be finally summarised:

The agricultural worker, *in proportion to his wages*, secures a diet of higher calorie value than that of the town worker, but he only secures this value (1) by a smaller purchase of animal protein and by a relatively greater consumption of carbohydrates to compensate for a smaller consumption of fats; (2) by spending a greater percentage of his income on food; (3) by increasing his hours of work to produce home-grown food; and (4) perhaps by more careful marketing. The actual value of his diet, leaving income out of account, is *superior to that of the lower paid urban labourer*, but, on the whole, *below that of urban skilled workers*—and the agricultural labourer (or, at the very least, the higher grades such as stockmen) must be considered as a skilled worker.

COMPARISON OF PHYSIQUE OF URBAN AND RURAL SCHOOL CHILDREN.

The final object of this comparison is to consider whether any indication of the efficacy of these two different types of diet is given by the measurements of physique of the children of the urban and rural workers. For this purpose,

Table XVII.
Comparison of Essex studies with mining studies*, 1923.

County. No. of families	Family income per week £ s. d.	No. in the family	Man value	Income per man per week s. d.	Per man per day				Cost per man per week s. d.	Percentage of food- money to total income	Percentage of food-money spent on bread and flour	
					Protein gm. 74.30 27.4% †	Fat gm. 68.95	Carbo- hydrate gm. 469.19	Calories 2872				
Essex: 98	1 17 1†	Man, wife and 4.4 children	4.90	8 0½	82.09 39.2%	115.48	469.55	3336	2872	5 4½	68.5	31.4
Derbyshire: 41	4 0 5	Man, wife and 4.5 children	5.03	16 0	82.09 39.2%	115.48	469.55	3336	2872	7 5½	46.6	13.8
Northumberland: 16	2 17 4½	Man, wife and 4.9 children	5.30	11 5	78.50 28.5%	94.06	483.28	3178	390.5	6 1½	53.6	18.7
Durham: 43	2 8 6	Man, wife and 5.1 children	5.39	9 0	67.70 29.4%	87.36	424.23	2830	375.4	5 9½	64.5	19.1
Lancashire: 23	3 1 7½	Man, wife and 4.7 children	5.12	12 0½	68.50 33.9%	97.43	411.14	2873	406.1	6 7	264.8	21.4
Stirlingshire: 17	3 15 6	Man, wife and 5.0 children	5.83	12 11½	75.04 31.6%	84.56	443.77	2914	475.8	6 9½	275.4	22.7

* It must again be noted that 33 per cent. of these mining families were in arrears of rent or in debt so that the urban incomes have a smaller value than their actual sum represents.

† This income (*vide* p. 198) represents merely the income recorded as having been earned in the week during which the study was made. It only takes account of extra earnings such as harvest wages when the study happened to be made in a week during which such earnings were current.

‡ Animal protein expressed as percentage of total amount of protein consumed.

with the kind consent of the Essex County Medical Officer of Health, the heights and weights of a thousand school children resident in rural Essex were taken from the medical records cards of the Council Schools. It is proposed to compare these with (1) the heights and weights of Glasgow children, (2) the heights and weights of the children of miners. It must, however, first be pointed out that the records of heights and weights taken in Essex relate not to the children only of *agricultural labourers*, but also to any other children attending these schools, *i.e.* the children of rural workers such as small farmers, blacksmiths, postmen, workers in local towns, etc. The diets collected relate, with but one or two exceptions, to the families of agricultural labourers. Before comparing these measurements, then, with the measurements taken in urban areas, it is important to observe whether any significant difference is observable between these two classes of rural workers. These differences are shown in Table XVIII and Charts I and II. (Heights and weights were measured to the nearest inch and pound respectively, while the ages were taken to the nearest month. The measurements were taken in ordinary school-wear but *without* boots.) It will be seen that in the case of the males there is no significant difference in the mean heights and weights of the two classes in each age group; in the case of the females, the measurements of the agricultural labourers' children fall, in most age groups, *below* the measurements of the children of other classes. If the data be smoothed by fitting a parabola the difference though small becomes absolutely consistent, the female children

Table XVIII.

Heights and weights of Essex elementary school children, male and female, in age groups from 4 to 14 years, distinguishing children of agricultural labourers and children of rural workers not thus employed.

Age group*	4-	5-	6-	7-	8-	9-	10-	11-	12-	13-14
<i>Males:</i>										
Height, ins. (children of labourers)	40·67 (12)†	42·84 (32)	44·31 (16)	46·71 (24)	49·74 (42)	51·73 (26)	53·25 (8)	55·46 (24)	57·50 (36)	58·25 (28)
Height, ins. (children of other workers)	40·64 (11)	43·48 (31)	45·07 (13)	47·70 (20)	49·81 (52)	50·80 (20)	53·33 (9)	55·00 (15)	56·78 (67)	57·73 (30)
Weight, lbs. (children of labourers)	36·75	40·94	43·19	48·46	53·10	57·69	61·63	69·75	75·89	82·39
Weight, lbs. (children of other workers)	38·45	42·35	43·31	49·45	53·77	58·35	66·44	71·73	74·22	79·83
<i>Females:</i>										
Height, ins. (children of labourers)	40·83 (6)	42·61 (31)	43·75 (16)	47·19 (27)	48·98 (46)	51·90 (21)	53·85 (13)	55·58 (19)	57·12 (49)	59·05 (20)
Height, ins. (children of other workers)	41·50 (8)	42·41 (29)	45·67 (21)	47·58 (19)	50·00 (50)	51·20 (15)	54·57 (7)	56·67 (21)	58·66 (41)	59·46 (28)
Weight, lbs. (children of labourers)	36·50	38·77	41·56	45·78	51·46	57·52	62·85	70·32	75·10	82·30
Weight, lbs. (children of other workers)	36·63	39·83	43·90	50·74	53·02	55·80	67·29	71·05	78·78	85·50

* Average of each group is $\frac{1}{2}$ year higher than the group figure, *i.e.* group 4 includes everything from 4 to 5 years and mean age of group is 4·5

† Represents numbers of observations in each group.

of the labourers falling roughly in height half an inch below in the first age group rising to an inch difference in age groups between 10 and 14 years, and roughly in weight 2 lbs. below in each age group. This does suggest, for the females at least, that some factor—possibly low diet—places them at a disadvantage in comparison with the children of other workers, though there are no signs that the males suffer from any such disadvantage. It is difficult to

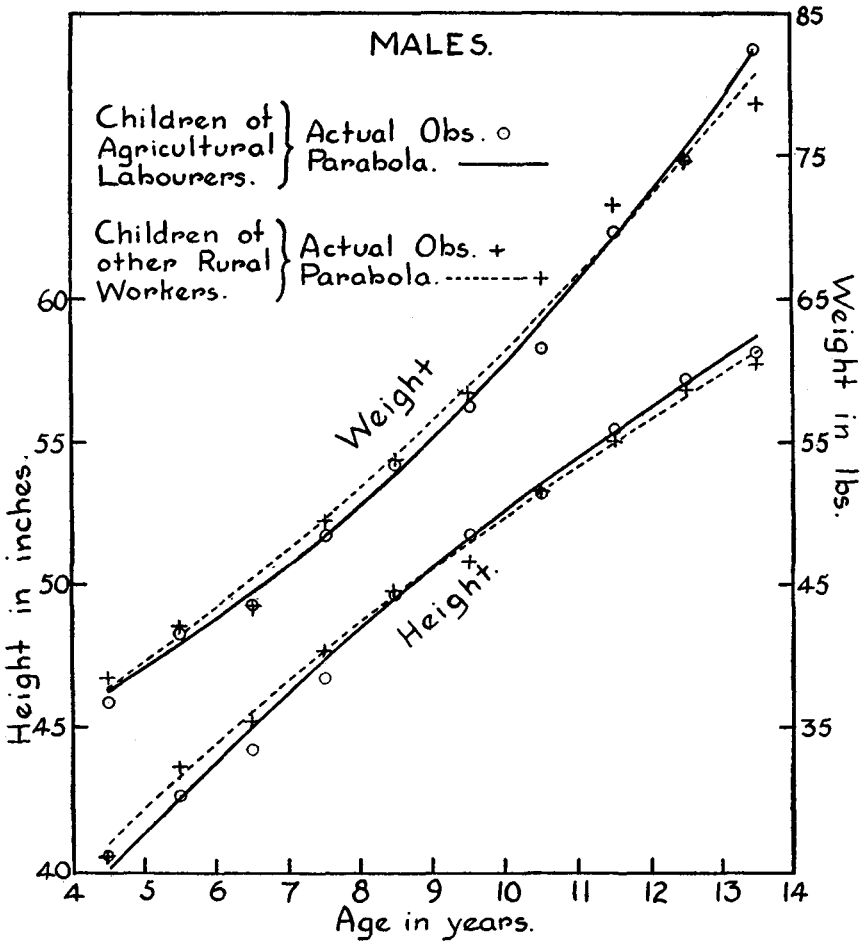


Chart I.

assign any adequate reason as to why this latter effect should arise, why the females should be more affected than the males.

For purpose of comparison age group by age group with the “urban children,” the difference between the children of agricultural labourers and those of the other rural workers, however, is not so large that any appreciable error will arise by taking the two groups of children in one class.

This comparison is set out in Table XIX. It has already been seen (*vide*

p. 215) that the value in calories of the Essex diet fell slightly below that of the miners, was roughly on a level with that of the "poor" Glasgow classes, and much superior to that of the "poorest" classes. In spite of these differences the heights and weights of the rural children are superior to those of *all* the urban children in practically every age group (there are only two exceptions). This indicates the difficulty of estimating the efficiency of the diet by such

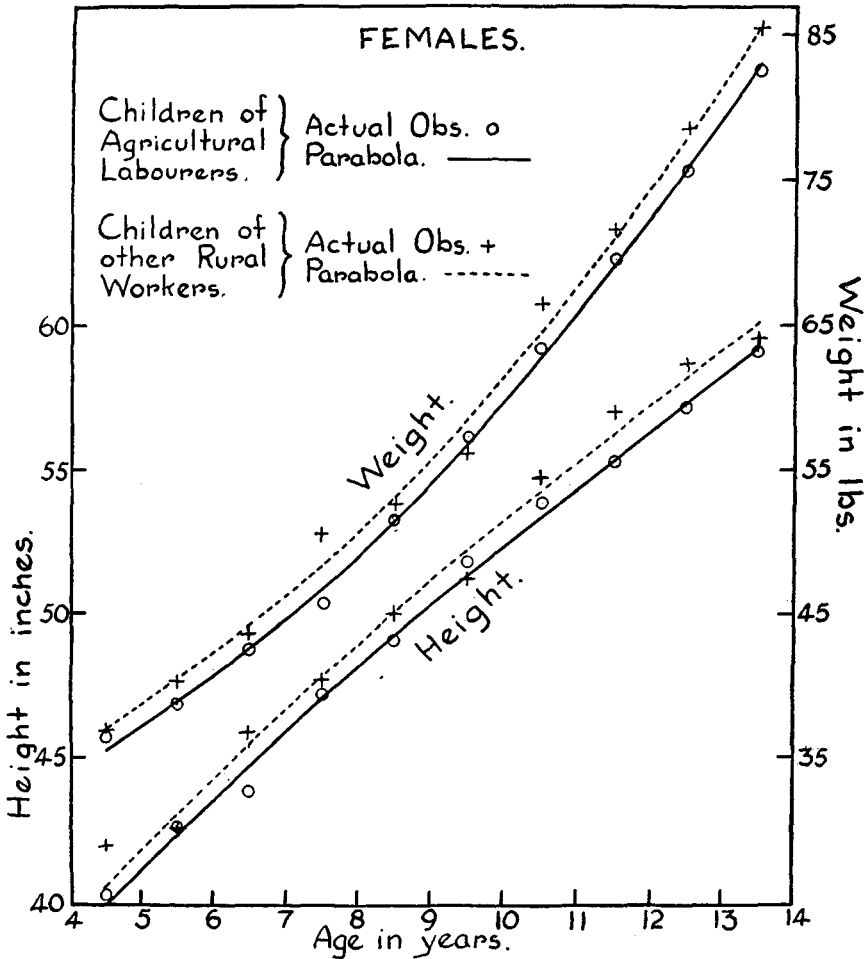


Chart II.

means; for it is impossible to eliminate other factors. The housing, for instance, in the Essex agricultural areas, it has been shown (*vide* p. 203), leaves much to be desired, but the general environment, on the other hand, when compared with the living conditions of a large industrial town, must favour the rural children. They are exposed to fresh air and sunlight, and it has been proved that children will be rendered immune to rickets by such exposure even though they be fed upon a somewhat deficient diet. "Exposure to direct

sunlight and out-of-door air promotes in a very wonderful way the health, bodily vigour, and longevity of animals which otherwise are unable to adapt themselves to markedly adverse environmental conditions" (Hill, 1924). It is possible that this factor may be of as great importance even as the racial difference which most probably exists between the mining and agricultural communities and must be present in the comparison with the Scotch children¹.

An examination of the school medical inspection records in Essex proves that there are very few cases of children being certified as suffering from

Table XIX.

Height and weight of children, male and female, of Essex rural workers compared with children of miners, and children of Glasgow workers.

Age	4-	5-	6-	7-	8-	9-	10-	11-	12-	13-14
<i>Males. Height, ins.:</i>										
Children of Essex rural workers	40.7	43.2	44.7	47.2	49.8	51.3	53.3	55.3	57.0	58.0
Children of miners	38.9	40.9	43.2	44.4	47.0	48.3	51.1	53.1	53.7	55.8
Children of Glasgow "poorest" districts*	—	—	41.2	43.9	46.0	47.9	49.7	51.5	53.2	54.7
Children of Glasgow "poor" districts	—	—	43.0	44.9	46.8	48.6	50.4	52.0	53.4	55.2
<i>Males. Weight, lbs.:</i>										
Children of Essex rural workers	37.6	41.6	43.2	48.9	53.5	58.0	64.2	70.5	74.8	81.1
Children of miners	36.5	39.3	41.1	48.0	52.1	51.7	59.5	65.3	66.7	75.0
Children of Glasgow "poorest" districts	—	—	43.1	46.4	50.2	54.5	58.9	63.8	68.6	73.9
Children of Glasgow "poor" districts	—	—	44.2	47.8	51.8	56.1	60.6	64.9	70.0	75.1
<i>Females. Height, ins.:</i>										
Children of Essex rural workers	41.2	42.5	44.8	47.4	49.5	51.6	54.1	56.2	57.8	59.3
Children of miners	38.0	40.1	43.1	45.2	46.7	48.4	51.0	52.8	54.3	56.6
Children of Glasgow "poorest" districts	—	—	42.0	43.9	45.6	47.6	49.5	51.3	53.4	55.4
Children of Glasgow "poor" districts	—	—	42.9	44.6	46.5	48.3	50.1	52.0	53.9	56.1
<i>Females. Weight, lbs.:</i>										
Children of Essex rural workers	36.6	39.3	42.9	47.8	52.3	56.8	64.4	70.7	76.7	84.2
Children of miners	33.1	35.6	41.5	47.3	50.5	51.4	58.0	63.3	68.3	74.8
Children of Glasgow "poorest" districts	—	—	42.2	45.3	48.7	52.8	57.0	61.8	67.6	74.7
Children of Glasgow "poor" districts	—	—	43.1	46.4	50.2	54.3	58.3	63.3	69.3	76.8

* These comprise Groups A and B given in "Height and Weight of school children in Glasgow" (Elderton, 1914). The grouping by age given there is to nearest year, but the regression coefficients of height and weight on age are given so that the necessary corrections have been made for comparison with the other records.

"malnutrition." A comparison of the heights and weights of the Essex children with similar measurements of a sample of 9973 American children gives an interesting result. The latter were classified upon medical examination as "excellent or good," "fair or poor" in nutrition, as judged from clinical evidence. The mean measurements were then calculated for each group thus classified in yearly age groups. The heights and weights of the Essex children (differentiating boys and girls) lie between the means of the two American groups. They are somewhat below the "good or excellent" group, but they

¹ In a comparison between Essex and Manchester youths living in both cases under urban conditions, Mr Muscio found that "Essex adolescent males are definitely superior physically to Manchester adolescent males." Industrial Fatigue Research Board, *Report No. 16, Part B.*

are superior to the "fair or poor." But, again, the racial difference cannot be eliminated.

The heights of these Essex children are superior to those of the children classed "labouring classes, country," and measured by the Anthropometric Committee of the British Association in 1883, but the weights cannot be compared, the latter including, the former excluding, *boots*.

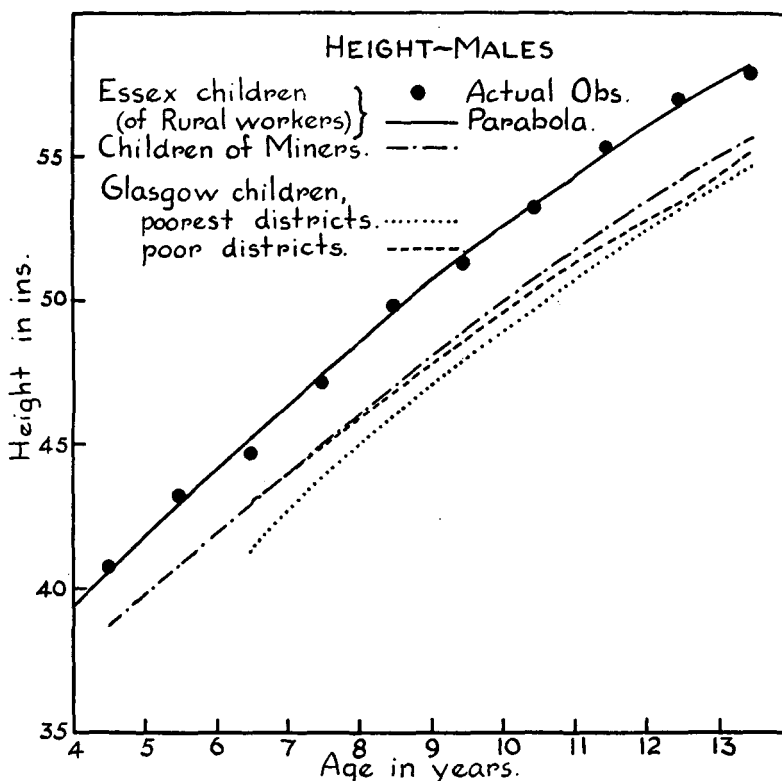


Chart III.

To sum up: though the difference in rural and urban diets is not very great, there is a distinct difference in the physique of the rural and urban children. This difference in physique, however, is probably due to several factors of as great importance as diet; these other factors cannot be eliminated and the conclusion must be that it is therefore impossible to estimate the comparative efficiency of the diets by contrasting these anthropometric measurements. It is impossible to say whether the Essex children would or would not hold a still *greater* advantage over the urban children, if their diet was more ample and diverse.

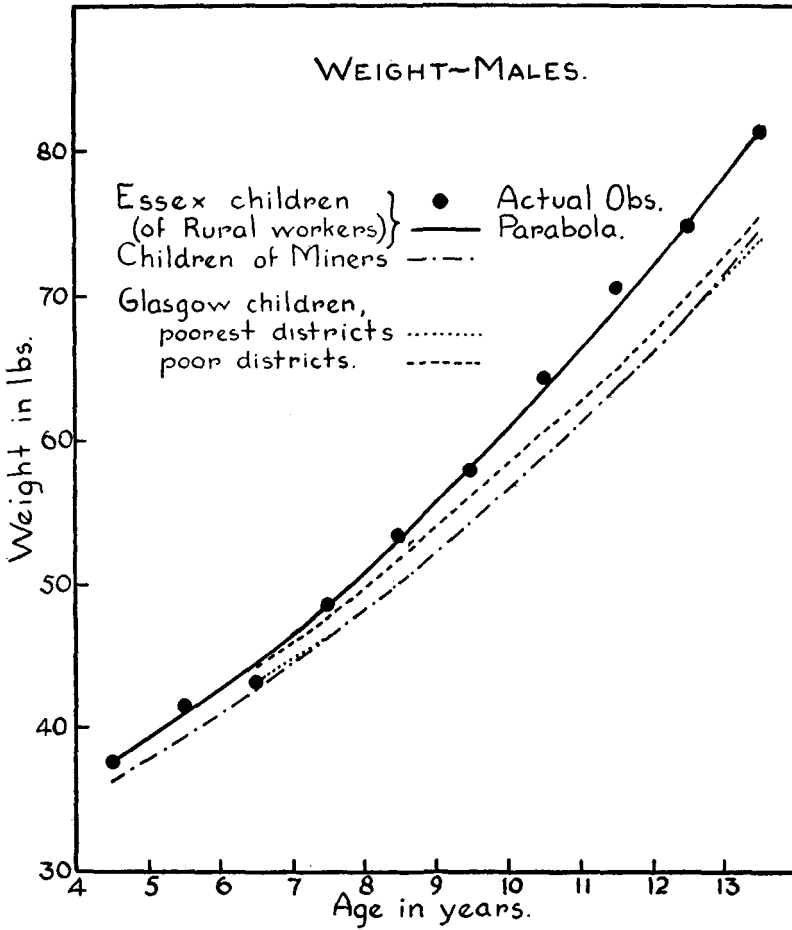


Chart IV.

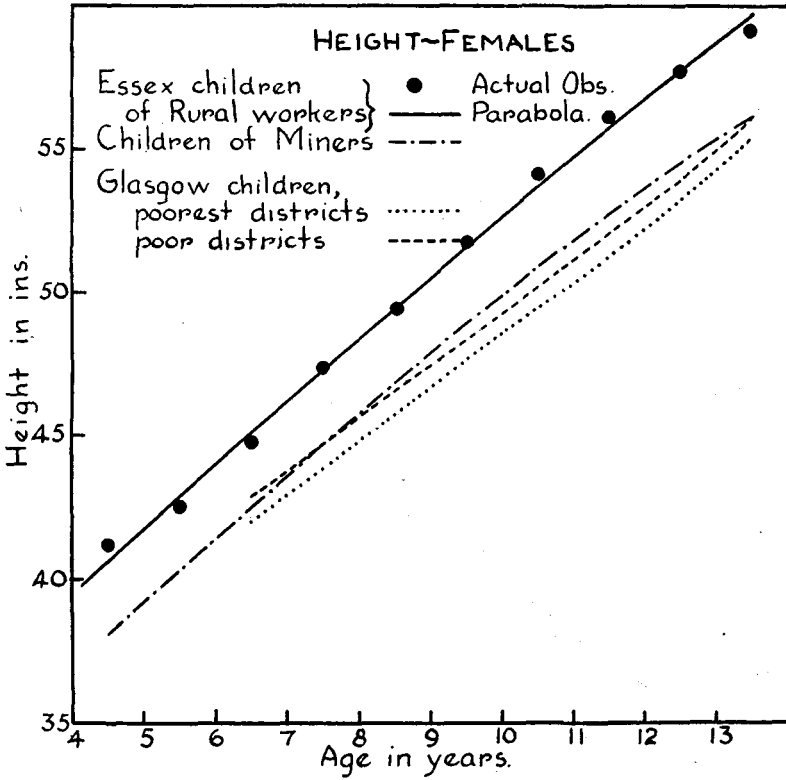


Chart V.

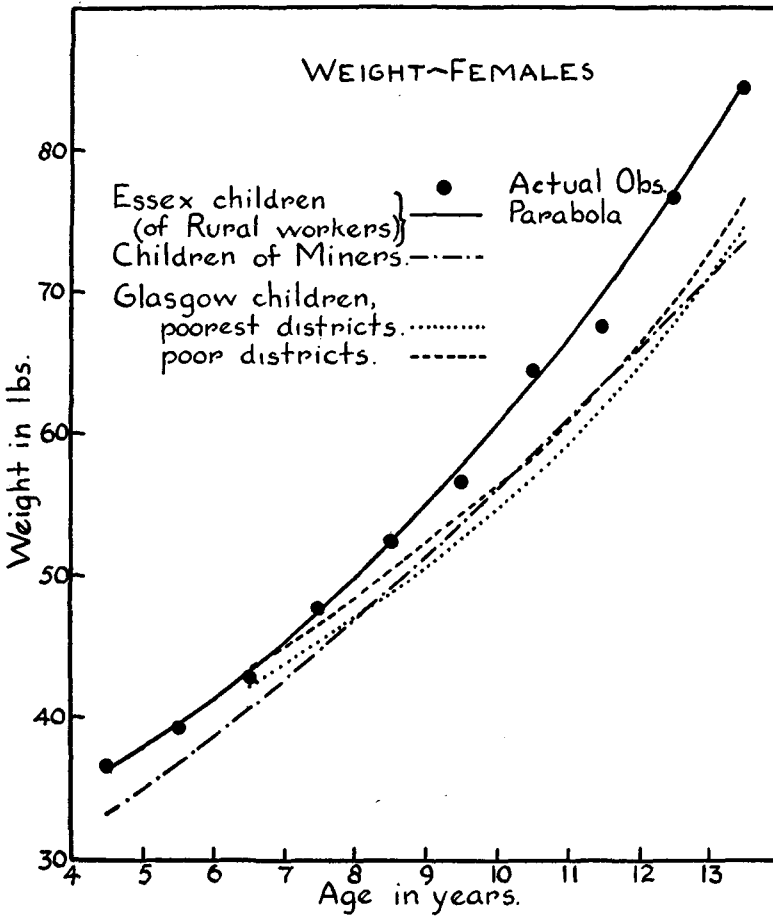


Chart VI.

SUMMARY AND CONCLUSIONS.

Any conclusions that are reached in such an enquiry as this can only be put forward very tentatively, for they are based (1) upon limited data which cannot be free entirely from error, and (2) upon the averaging of individual results drawn, it is true, from the same *class*, but from *families* varying considerably in *economic status*. For this reason, without much further investigation, any generalisation would be out of place, and the conclusions summarised below are put forward not as definite results but only as indications of the actual facts.

(1) In view of the fact that minimum wage legislation for agricultural workers is being introduced in answer to the statements that the economic status of these workers is deplorably low, it is important to bring forward any facts relating to the actual condition of the rural families.

(2) For an investigation of these conditions, Essex (rural districts) was chosen as the field of enquiry in 1923, and for purposes of comparison and confirmation of results earlier rural investigations have been utilised.

(3) A study of the experimental work on metabolism suggests that the agricultural labourer would certainly need a *gross* amount of *at least* 3300 calories per day, and that this assumption will not be likely to err on the side of excess.

(4) The Essex studies of 1923 give a mean value of 2872 calories per man value per day and only 17 per cent. of the families secure over 3300 calories per man per day.

(5) This result is not at variance with the conclusions reached in earlier investigations in rural areas, and the suggestion accordingly is that under-feeding is, to some extent, present in the rural areas. (Lusk writes "it is evident ...that one may reduce the basal requirement of energy by undernutrition, and that this process may largely economise food, but that to accomplish a given amount of work a fixed amount of food-fuel is required, irrespective of the nutritive condition of the organism.")

(6) This under-feeding occurs although nearly three-quarters of the total income is spent on food (leaving a very small amount for other essentials and practically nothing for non-essentials), and although the diet is substantially increased by the consumption of home produce. Without the latter the diet would be seriously deficient.

(7) In the Essex studies nearly one-third of the money spent on food was devoted to bread and flour.

(8) On the other hand, in comparison with urban studies, the rural diet compares very favourably with that of urban workers possessed of a higher money income.

(9) This advantage to the rural family is gained by (a) a larger percentage expenditure on food; (b) a less varied diet containing a substantially smaller amount of meats and hence less animal protein; a substantially larger amount

of breadstuffs and hence more carbohydrates in place of fats¹; (c) by the consumption of home produce, which, however, entails, in its turn, a lengthening of the day's work and increased needs for food. Without this home produce the diets would compare very unfavourably with those of the urban workers studied. With it, the *vitamine content*, as well as the energy value of the diet, must be substantially increased.

(10) In spite of the diet being low there is little evidence of malnutrition among the rural children of Essex, and their physique is better, age for age, than that of urban children, living on a diet equivalent or superior in energy value. Other factors, especially the "racial" factor and the "fresh air and sunlight" factor, however, must exert such an influence that the efficacy of the diets cannot be satisfactorily measured by a comparison of heights and weights.

APPENDIX A.

The growth and health of mice upon different diets.

The writer, in conjunction with Dr Leonard Hill (Director of the Department of Applied Physiology, National Institute for Medical Research), has been engaged upon an experiment involving the rearing of mice upon various types of diets. One of the diets adopted was based upon the studies made in rural Essex so that a part of the data acquired has some bearing upon the problem with which this paper is concerned.

In all, four diets were utilised: A 1, a grain diet—oats, wheat, barley and raw greenstuff; A 2, a diet based upon the lunches served in the canteen of the Research Institute—meat, vegetables, pudding and bread; A 3, a synthetic diet composed of rice, starch, casein, salt mixture, coconut fat, cod-liver oil, lemon juice and marmite; and A 4, a diet based upon the studies made in rural Essex, the proportion of constituents being calculated on the basis of Table V, p. 200.

The mice were divided into male and female, and two boxes of each sex were placed upon each of the diets. In one case an unlimited allowance of food was given and in the other a two days' fast per week was enforced.

The charts of weight² show that on all four diets the mice, male and female, are able to grow and put on weight, but it is impossible to make a very close comparison of *relative* growth owing to the uncertainty of the exact age of the various groups of young mice at the start of the experiment. In the early weeks of age (*e.g.* 6 to 10 weeks) the rate of increase in weight is extremely rapid in contrast with later weeks, so that for any comparison of percentage rates of increase an exact knowledge of age is essential. There is an indication

¹ "Carbohydrates are the most economical of the foodstuffs, both physiologically and financially" (Lusk, 1917). The substitution of carbohydrates for fats is, within limits, without detriment and there is not sufficient reason to believe that in the rural studies such limit has been reached.

² The mice were weighed weekly, but to smooth the diagrams only the weights at the end of each 5 weeks' period were plotted.

that the diets No. A 1 and No. A 4 (the "natural" grain diet and the "Essex" diet) are superior to the others and that the mice make least progress on the synthetic diet (No. A 3)—but it is *only an indication*, for, owing to this lack of knowledge of age, the charts *must not be used for the purpose of accurately comparing one diet with another*, but only to show the trend of the growth curve in each individual case.

There is a suggestion that the Essex agricultural diet in *unlimited amount* does allow the mice to grow and put on weight adequately. When the total calories are substantially reduced by a two days' fast per week it is found that the mice do not put on as much weight (again close comparison is vitiated by the age question) but they are all *more active*, the signs of activity being specially noticeable in diets No. A 2 and No. A 4 (the "canteen" and the "Essex").

There is no indication of this reduction in diet producing a greater prevalence of disease and less physical fitness, but it must be borne in mind that the mice were kept under the very best sanitary conditions.

When the different diets were given to mice that were allowed to breed, it was found that the largest litters were those of the mice on the "Essex" diet and that the mothers showed no difficulty in rearing them. On diets No. A 1 and No. A 2 the mice had smaller litters but reared them well; on the synthetic diet the litters were very small and the mothers did not rear them easily.

From these data it seems clear that, for mice, the Essex diet, either limited or unlimited in amount, does not lack any constituents affecting growth, health or breeding power.

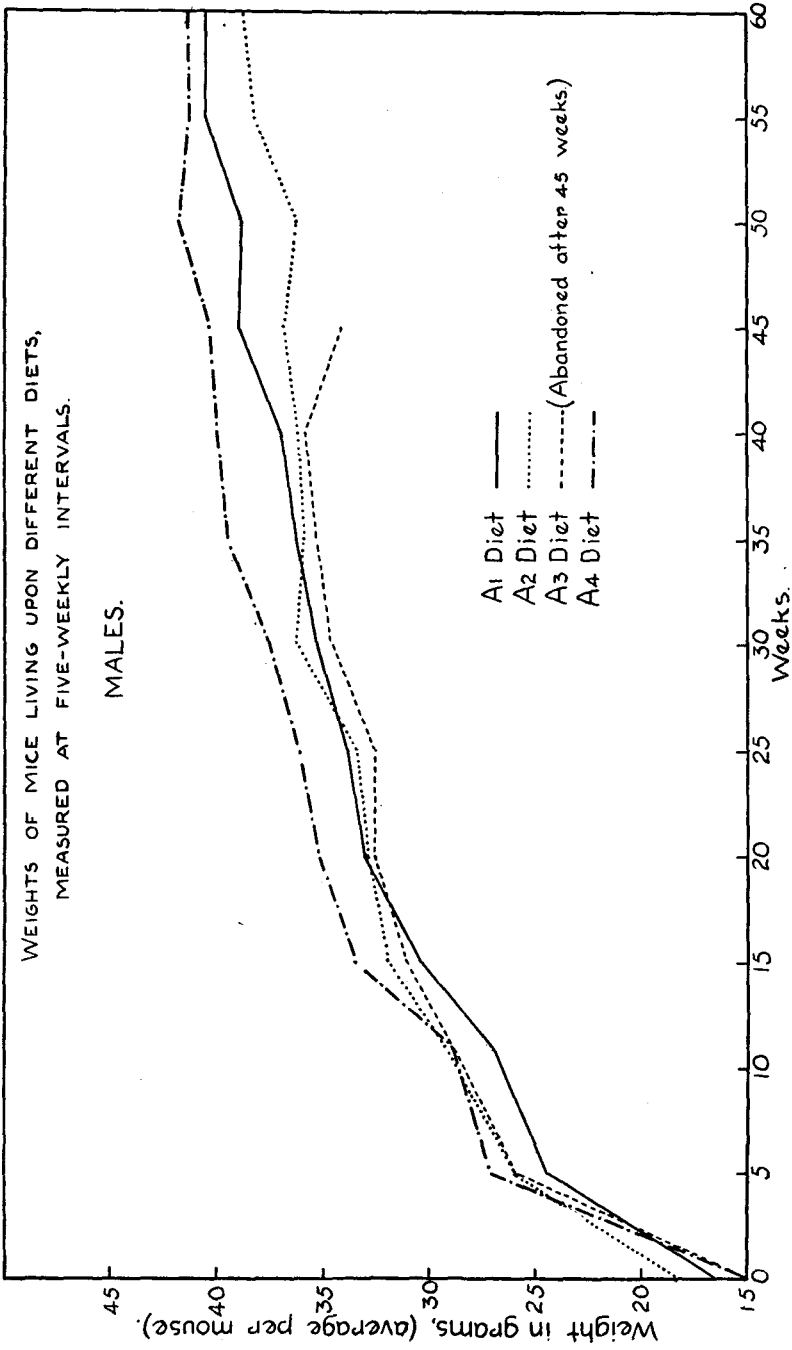


Chart VII.

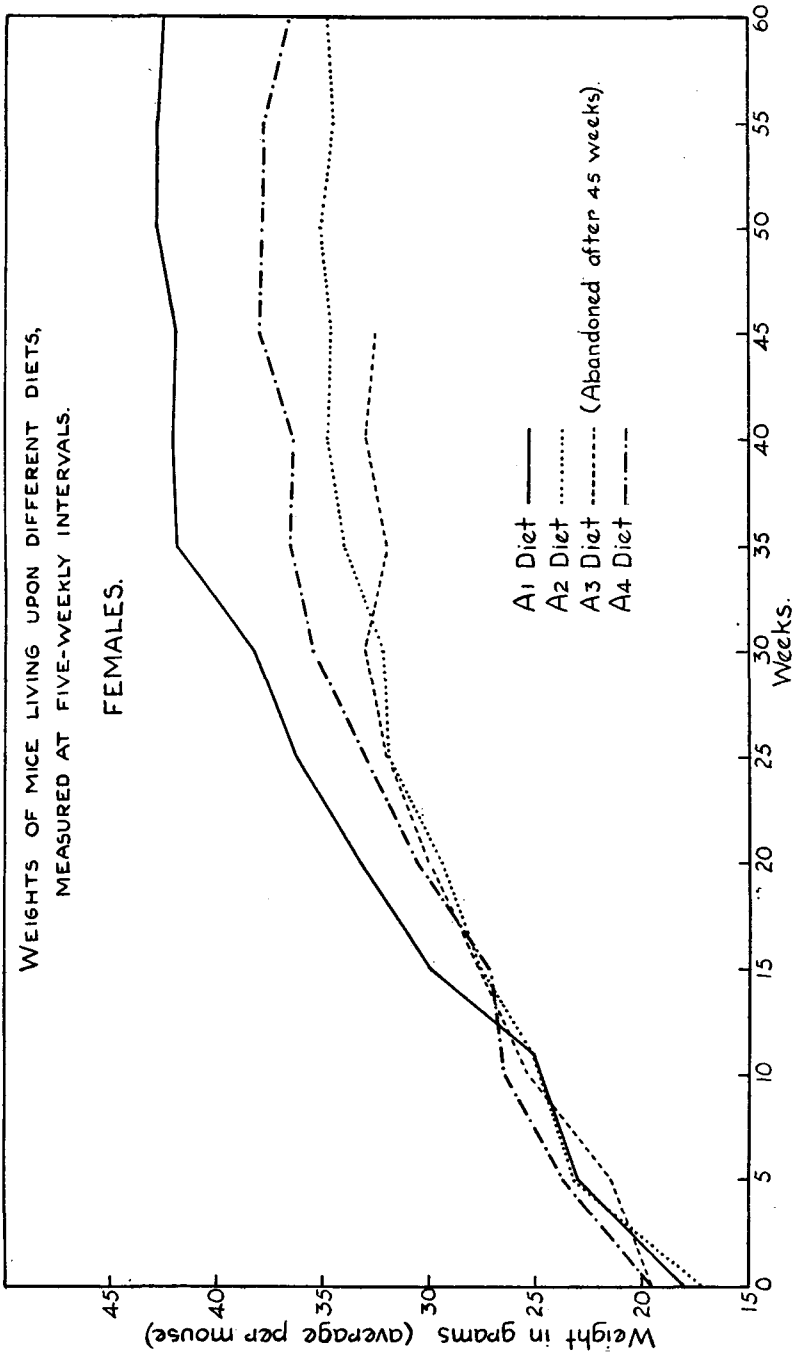


Chart VIII.

APPENDIX B.

Details of the 98 diet studies collected in Essex in 1923¹.

APPENDIX C.

Summary of Rowntree's budgets recalculated according to Lusk's man values and modern tables of food analysis.

No. of study	No. of children	Man value	Per day per man value				Calories per <i>ld.</i>
			Protein gms.	Fat gms.	Carbo-hydrates gms.	Calories	
1	4	4.43	55.96	49.39	391.00	2291.91	569.3
2	5	4.53	52.79	38.63	388.62	2169.00	542.6
3	5	4.73	59.77	19.07	472.86	2361.21	608.8
4	4	4.03	54.98	63.47	381.80	2381.18	551.6
5	3	3.73	78.84	58.12	515.54	2977.53	547.9
6	4	3.83	63.87	48.31	455.75	2579.81	603.8
7	7	5.76	53.01	35.10	405.79	2207.51	725.7
8	6	5.76	42.70	24.52	310.01	1674.16	487.7
9	3	3.33	69.60	67.13	415.74	2614.19	402.0
10	5	5.73	62.12	26.49	440.01	2305.10	621.8
11	3	3.33	59.42	89.04	425.48	2816.22	605.6
12	5	5.06	51.42	44.24	414.62	2322.21	607.0
13	6	6.43	74.72	38.72	403.24	2320.24	570.6
14	3	4.23	67.41	56.89	490.82	2817.83	565.6
15	3	3.73	76.28	71.37	498.09	3018.62	520.1
16	5	5.26	63.94	52.63	450.59	2599.09	611.4
17	6	5.56	61.49	34.41	484.67	2559.04	673.7
18	5	3.73	47.93	33.95	347.99	1935.24	758.9
19	5	5.06	75.00	41.76	434.07	2475.52	583.0
20	3	4.23	64.62	72.88	487.53	2941.44	637.9
21	4	4.23	76.27	66.99	503.07	2998.45	487.3
22	2	2.83	72.88	85.75	564.18	3409.46	584.0
23	excluded						
24	5	5.56	51.65	33.79	407.35	2196.10	605.6
25	7	6.26	60.31	63.69	405.98	2504.14	669.8
26	excluded						
27	4	4.23	70.46	91.20	534.61	3329.01	513.3
28	4	4.03	82.31	110.92	568.22	3699.78	572.7
29	5	4.03	89.72	87.85	573.71	3537.09	556.5
30	10	4.93	80.25	56.20	548.18	3099.23	589.0
31	7	6.39	58.26	52.75	374.31	2264.05	535.1
32	2	2.83	82.75	88.88	535.02	3359.58	440.7
33	6	6.06	72.11	36.36	528.16	2799.35	573.3
34	10	8.09	52.67	33.41	380.21	2085.58	624.8
35	3	3.53	58.27	57.18	342.50	2174.99	443.3
36	3	4.16	76.26	117.35	427.55	3156.79	558.3
37	6	5.73	66.77	65.46	484.94	2870.82	571.0
38	4	4.43	93.88	89.11	541.17	3432.57	570.6
39	4	4.03	77.48	92.14	441.28	2983.15	420.5
40	excluded						
41	8	8.09	78.15	40.18	499.07	2740.32	600.0
42	7	7.06	85.26	57.59	610.05	3386.37	519.5
39 studies	191.00	188.98	2621.58	2292.92	17883.78	105393.88	22230.30
Mean =	4.90	4.85	67.22	58.79	458.56	2702.41	570.0

¹ The detailed tabulation of the individual diets may be consulted on application to the Editor to whom the Author has communicated the full particulars. The tabular matter has been omitted because of its being too lengthy and costly to print.—Ed.

APPENDIX D.

Recalculation of Cost of Living Committee's (1918) budgets according to Lusk's man values and modern tables of food analysis. 396 families.

Average man value = 4.47.

		Protein	Fat	Carbohydrates	Calories
Beef	2.75 lbs.	162.17	299.37	—	3448.50
Mutton	0.44 "	17.96	69.85	—	723.36
Pork	0.38 "	17.24	68.95	—	712.12
Bacon and ham	1.94 "	104.18	411.86	—	4258.30
Bread	24.05 "	763.59	10.82	5236.41	24700.55
Flour	13.67 "	620.07	92.96	4650.53	22473.48
Oatmeal	0.95 "	69.35	31.07	290.89	1767.00
Rice	0.96 "	34.84	1.31	343.97	1565.76
Potatoes	24.34 "	220.76	—	2208.12	9958.47
Butter	0.86 "	0.39	319.88	—	2976.46
Margarine	0.69 "	0.31	262.89	—	2446.05
Lard	0.43 "	—	195.05	—	1813.95
Cheese	0.43 "	48.76	58.48	4.86	764.11
Jam	0.75 "	—	—	238.14	976.50
Syrup	0.75 "	1.05	—	259.95	1070.25
Sugar	2.50 "	—	—	1111.25	4556.13
Milk, fresh	7.25 pints	123.32	123.32	184.95	2410.63
" skim	3.15 "	60.75	5.36	91.13	672.56
Cocoa	0.21 lbs.	19.05	24.76	40.49	474.39
Total per day per family		2263.79	1975.93	14660.69	87768.57
Total per day per man value		72.35	63.15	468.54	2805.00

APPENDIX E.

Facsimile of the form employed in obtaining diet studies in Essex.

			WEEKLY EXPENDITURE			
NAME OF PLACE			DATE and HOUR at which BUDGET was BEGUN.....			
MEMBERS OF FAMILY <i>Age</i> <i>Sex</i>			DATE and HOUR at which BUDGET was ENDED			
Father			(Budget should preferably be begun upon the day on which the husband is paid)			
Mother			FATHER'S EMPLOYMENT			
Children 1			SIZE OF GARDEN or ALLOTMENT or BOTH			
2			What is USUALLY GROWN in these?.....			
3			For how MANY MONTHS of the YEAR is FAMILY			
4			SUPPLIED from them with VEGETABLES?			
5			NUMBER of ROOMS in COTTAGE.....			
6						
7						
8						
9						
10						
Other members of household						
MONEY EARNED FOR THE WEEK			MONEY SPENT FOR THE WEEK			
FATHER'S WAGES			FOOD		RENT	
MONEY EARNED BY WIFE			<i>Kind</i> <i>Amount</i> <i>Cost</i>		(Please say if cottage is free)	
" " " CHILDREN			MEAT		CLUBS and INSURANCE	
and given towards HOUSEHOLD EXPENSES			FISH		COAL	
RENT of ANY ROOM or ROOMS LET			MILK		COKE	
MONEY from ANY OTHER SOURCE			SUGAR		WOOD	
			<i>Amount</i> <i>Cost</i>		SOAP	
HOME PRODUCE			BREAD		OIL	
VEGETABLES USED FROM GARDEN OR			CONDIMENTS		CANDLES	
ALLOTMENT			JAM		CLOTHES	
<i>Kind</i> <i>Amount</i>			CHEESE		SHOES and	
GREEN VEGETABLES			BUTTER		BOOTMENDING	
POTATOES			MARGARINE		LUXURIES	
CARROTS			DRIPPING		POULTRY and PIG FOOD	
ONIONS			TREACLE		ANY OTHER EXPENDITURE	
TURNIPS			FAT		If any of the above items were	
PARSNIPS			SAGO		not bought in the week, please	
ANY OTHER VEGETABLES			RICE		give an estimate of the amount	
(Beans, peas, fruit)			TAPIOCA		spent on them in the year, and	
<i>Number</i>			FLOUR		state the time of year at which	
EGGS			SUET		they are bought	
ANY OTHER HOME PRODUCE			TEA			
			COCOA			
			COFFEE			
			GROATS			
			OATMEAL			
			OTHER ARTICLES IF BOUGHT			
			EGGS			
			POTATOES			
			GREEN VEGETABLES			
			CARROTS			
			ONIONS			
			TURNIPS			
			PARSNIPS			
			ANY OTHER VEGETABLES			
			ANY OTHER EXPENDITURE ON FOOD			
			(Please state kind, cost and amount)			
Did any of the family have any meals elsewhere? If so, please state which member of the family and from which meal or meals he or she was absent						

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