

PROCEEDINGS OF THE NUTRITION SOCIETY

VOL. 3

1945

EIGHTEENTH SCIENTIFIC MEETING—TENTH ENGLISH MEETING

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE,
FEBRUARY 5TH, 1944

BUDGETARY AND DIETARY SURVEYS OF FAMILIES AND INDIVIDUALS. PART 1

Chairman, Sir JOHN ORR

Sir John Orr (Rowett Research Institute, Bucksburn, Aberdeen): The results of budgetary and dietary surveys will be of much value in formulating plans for reconstruction after the war. The Hot Springs Conference recommended that all nations should take responsibility for seeing that the people have sufficient food for health. The Government has accepted the findings of the Hot Springs Conference and, in his recent broadcast, the Prime Minister put food first among the three necessities. The amount of food required for the population must be estimated. To obtain sufficient, considerable changes and increases in production and in imports will be essential. The changes in the price of food or in the income required to purchase an adequate diet must be decided upon. It is essential that established facts should be available to put before our legislators to enable them to make their decisions. It is also most important that there should be a public opinion well informed about what the nutritional policy is and how it will affect almost every household in the country. Therefore, I regard this Conference as the most important we have yet held.

Budgetary Analyses

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Today we are going to review certain methods of assessing the nutritional welfare of social groups. Budgetary inquiries have been used for this purpose, mainly, perhaps, because no more accurate method has hitherto proved practicable on the same scale, but new methods are being developed and the time is opportune for reviewing the progress that has been made with the old.

A budgetary inquiry is, by definition, based on a statement of purchases and expenditure, in this case, food purchases. So much may happen between the shopping basket and the final utilization of nutrients by the body that, clearly, a simple statement of purchases could not, without substantial modification, give more than a very rough estimate of nutritional intake. Consideration of the modifications required and the extent to which they can be applied will carry us far towards a just appraisal of the budgetary inquiry as an instrument for measuring nutritional welfare. In the process it will be necessary to discuss some of the principal problems that arise in planning or carrying out the work.

Right at the beginning it is necessary to note one important respect in which a budgetary inquiry falls short of perfection. The food budget is essentially a household document. It can be made to yield tolerably accurate estimates of total food consumption in a household, but does not indicate how that total is divided among the individuals living there. It is, therefore, quite possible for nutritional deficiencies in individuals to lie concealed behind apparently satisfactory household intakes of all nutrients.

It will be well to note also at the outset a fact that will have to be mentioned frequently in the course of this review. A budgetary inquiry necessarily contains many compromises between what is desirable for strict accuracy and what is practicable. Most of these affect the results for single households more seriously than they affect averages for the whole sample. If it is intended to consider the information in each budget separately and to arrange households in various types of frequency distribution, it must be remembered that, however exacting the technique used, results expressed in this way will be subject to greater possibilities of error than the general averages.

For the satisfactory assessment of household nutritional status we require an estimate of the net total of food consumed in a given unit of time and of the net total of nutrients contained therein, together with sufficient information about the members of the household to provide an estimate of their total nutritional requirements.

If the problems involved in securing accurate estimates of net total food consumption are first considered, it is apparent that a complete statement of household purchases affords no more than a solid foundation. To purchases must be added: (1) Food grown or produced by the household or received as gifts; (2) food brought forward out of stock for consumption in the budget period; (3) food obtained by members of the household from sources other than the household supplies.

From this combined total must be subtracted: (1) Food appearing in current purchases that is put into stock; (2) the proportion of food used up during the period that is lost in various kinds of waste; (3) food consumed by visitors, given away or used to feed animals. It is necessary to consider these adjustments more closely.

To adjust for items taken from or put into stock it is necessary to arrive at the net difference between household stocks of food at the beginning and end of the budget. The only reliable method of ascertaining this is by weighing and recording all stocks of food in the household immediately before the budget period begins and again immediately after it ends. It is essential for accuracy that this should be done by, or in the

presence of, the field worker herself. This task, apart from reducing the number of budgets that each field worker can handle, increases substantially the number of refusals to co-operate. It is, therefore, worth considering how seriously the net balance of stocks affects the estimate of net consumption. This depends partly on the length of the budget period. It is much less important in relation to four-week or even two-week budgets than if estimates are based on one week's records. Unfortunately, one week is usually regarded as the practical limit on grounds of cost and the unwillingness of most households to co-operate for longer periods.

Actual experience during the war in large working class samples taken at different times of the year showed in every case that the measurement of stocks increased estimates of total consumption over the whole sample by amounts varying from approximately 2 to 5 per cent. For the purpose of ascertaining average consumption of all food over the whole sample, therefore, the order of error incurred by disregarding changes in stocks would not be serious, but results based on single households, or single foods, would be subject to much wider margins of error. If it is intended to arrange households according to their nutrient intake or consumption, stocktaking must be regarded as an important way of increasing accuracy. Possibilities of error in the use of stock figures result from the necessity for converting stocks of prepared food back into ingredients; it is frequently impossible to ascertain recipes accurately and the application of standard recipes must involve risks.

The measurement of wastage in each household is most difficult and very costly. Apart from the practical difficulties involved, the operation tends to set up defensive reactions which may cause the housewife to behave uncharacteristically while under observation or even to conceal waste. If waste is being collected a daily call by the field worker must be regarded as essential. Measurement of the losses of nutrients during cooking cannot, in any case, be brought within the scope of a budget inquiry and, for these, it will be necessary to make throughout the sample uniform deductions obtained from controlled experiments although it is certain that no such uniformity would be found.

In practice, unless time and expense are immaterial, it will probably be necessary to choose between taking stocks and measuring waste. My own preference would be for taking stocks and dealing with waste by applying percentage deductions derived from experiments and from the results of previous budgetary inquiries in which the measurement of waste had been attempted. This expedient, while reasonably satisfactory for averages over the whole sample, would leave the results for single households subject to error, but a range of error probably narrower than if the effect of changes in stocks in single households were ignored.

Another matter of great difficulty is to determine the allowances to be made for food obtained by members of the household from outside sources and, in the contrary direction, for food given to visitors. The utmost help that can reliably be obtained from the household is a count of the number of times each member obtains each meal of the day from outside sources during the budget period and, similarly, the number of meals given to visitors. This does not permit an adjustment of the food

consumption estimates, but it does permit a rough and ready adjustment of the number of heads by which consumption or intake figures are divided when an average is drawn. One method is to regard each meal of the day as a given percentage of a week's eating. For example, a midday meal may be regarded as 5 per cent., and afternoon tea as 2 per cent. of an individual's total weekly consumption. If a person eats 5 midday meals in a canteen but does the remainder of his eating at home, he ranks as only 75 per cent. of a head for averaging purposes. In the same way the divisor can be adjusted upwards to allow for meals given to visitors. The use of these allowances should be confined to estimates of the average intake of nutrients from all sources; they are obviously unsatisfactory for calculating the average consumption of single foods or nutrients from single foods.

The allowances just described ignore food given to animals and purchases commonly made by individuals for casual consumption such as sweets, snacks and drinks. Individually or as a whole these items may make significant contributions to figures for single households, but no satisfactory way of including them has, as far as I know, been evolved.

The addition to the budget of home grown food and gifts raises few questions of principle or difficulty. The provision of balances to enable the housewife to weigh garden produce before she uses it is necessary both for this purpose and for weighing foods not normally bought by net weight, such as cabbages and cakes.

Before passing from the records required for the accurate estimation of consumption, it is worth mentioning the value of a daily record of the dishes served at each meal and of the number of people eating them. Apart from the intrinsic value of this information for enriching knowledge of the character and nutritional balance of the diet, it is very useful when used in conjunction with the stock records and purchases for checking the completeness and accuracy of the daily entries.

The remaining source of error on the intake side that must not be left out of this review concerns the food composition tables by which the consumption data are converted into intakes of individual nutrients. Since it is rarely, if ever, possible to have separate conversion factors for all the hundreds of items that appear in the budgets, it is necessary to assign common values to groups of foods of similar composition. Where members of such groups differ markedly in their content of any nutrient from the group average, the latter should be weighted in accordance with the relative consumption of the various members of the group. Unless national statistics indicating the relative supplies of these foods are available this means delaying the calculation of the conversion factors until the relative importance in the sample of the foods concerned has been ascertained.

In the conversion tables, apart from a few important seasonal variations, it is impracticable to quote more than one set of values for any one food, although in fact, there may be wide variations of composition. This is particularly true of different brands of some processed foods. The audience will have a far more vivid understanding than I of the degree of error latent in these processes of grouping and standardization. Again, they affect results for single households more seriously than average results for the whole sample of households.

So much for the problems of measurement on the intake side. How accurately is it possible to estimate the requirements of a sample of population? Here, too, it is necessary to have recourse to standardized tables which quote the nutritional requirements of broad age and sex groups. It is quite easy to classify the sample in these terms. In such tables adults are sometimes further sub-divided into broad groups according to energy expenditure. All that can be done in a budgetary inquiry to produce a comparable sub-division is to classify the individuals in the sample according to occupation, any effect of leisure time activities being left out of account. Sufficiently accurate and detailed descriptions of occupation are frequently difficult to obtain and their classification calls for a very wide knowledge of industrial practice. Broad definitions such as press operator, labourer or shipyard worker are quite useless. Detailed descriptions of the job performed and sometimes of the type and size of machine operated are necessary. Even the most precise definitions disregard many considerations that would be needed in order to ensure an accurate estimate of energy expenditure.

Before the subject of potential sources of error is left, brief reference is necessary to more general causes of bias arising in an inquiry of this kind. Questions of sampling error and statistical validity will be in far more competent hands than mine later in the Conference, and I shall mention only one or two generalities. The first concerns the reactions of the person keeping the budget. The keeping of a detailed budget is a difficult notion for a housekeeper to assimilate, and a considerable intrusion on her time and privacy. While I do not know of any reason for supposing that those who successfully assimilate the idea are less representative as food consumers than those who do not, there is no doubt about the effect of the effort imposed. In any attempt at random sampling, particularly in the working classes, I think there must be a tendency for employed persons living alone, households where the caterer is in full time employment, and households where there are more than the average number of small children, to be under-represented. If I may make another generalization without defending it, I think we should watch for a tendency in the composition of working class samples to drift slightly towards the poorest section. This may not be entirely bad, because that section is probably also the worst situated nutritionally, but it is a factor that should not be overlooked when results are interpreted.

Another interesting point arises if households are surveyed more than once. There is some evidence to suggest that there are small but significant differences in food consumption between households who are prepared to keep two or more budgets and those who refuse to keep more than one. Whether such differences are fundamental, or whether they are due to a tendency on the second and subsequent occasions to reduce purchases during the budget in order to save trouble, I cannot say. The whole question is one that requires further study and is, I believe, at present receiving it in the Surveys Branch of the Ministry of Food.

Various kinds of psychological reaction on the part of the housewife may produce misleading information. One such reaction is the development of an anxiety to show how well she feeds her family, or to conceal poverty. Another tendency is to accentuate a bad situation in the hope

that the evidence will lead to concessions. These reactions, which are probably exhibited only by small minorities, are not likely to invalidate averages over the whole sample or to upset frequency distributions unduly.

Apart from psychological causes there are accidental causes of error due to forgetfulness or carelessness. These can to a large extent be eliminated by firm control over the budget, through frequent visits by the field worker and through the conscientious application by her of a detailed checking routine which should be scheduled on paper before the inquiry begins. The frequency of call should never be less than every alternate day and, in the case of the less intelligent or less co-operative housewives, it should be greater than that.

Turning now to questions of analytical method, what human unit shall we use to express averages of consumption, intake or expenditure? Average consumptions and expenditures for single foods or groups of foods will probably be required on a per head basis for comparison with other statistics. It is, in any case, a matter of some difficulty to express expenditure in terms of any other unit and, since quantity and expenditure averages should be in the same terms, the per head basis is the most convenient but, for nutritional averages, or for comparison of the consumption or nutritional intake of groups having very different age, sex and occupational compositions, it is essential to use equivalent man divisors. The most commonly used equivalent man scale is a calorie scale and, if we wish to compare such groups in respect of other nutrient values, a scale appropriate for each nutrient must be calculated. For the purpose of taking age and sex differences into account when total food expenditure is averaged, no scale based on any one nutrient is really satisfactory; a composite scale is required. Alternatively, a scale based on the estimated minimum cost of providing an adequate diet for each age and sex group might be used.

Arrangements for sub-dividing the sample for sectional analysis depend largely on the kind of sample required. In representative national samples, breakdown by region, size or composition of family and economic status is generally of interest. Only the last of these offers any serious difficulty. By far the best reflection of economic status would be a breakdown based on income. Unfortunately it is so difficult to obtain accurate information on this most personal of subjects that any attempt to insist on it in the course of a food inquiry seriously aggravates the task of recruiting a representative sample of households. It would be considerably easier to obtain information about the housekeeping money at the housewife's disposal, but the types of expenditure which the housekeeping allowance has to cover vary so much between households that this would not furnish a consistent or reliable index of purchasing power. Sub-division of the sample by type of occupation will often be interesting, but not helpful in defining economic status except very broadly.

Sub-division of the sample according to food expenditure per head, while it tends in a very crude way to reflect means, possesses several undesirable features. Even if the influence on expenditure of food obtained free is overcome by including a valuation of such items, it remains true that budgets based on any single week's acquisitions may be unrepresentative of an average week. If we could add also a valuation

for the net balance of stocks, obtaining thereby an estimate of the value of the total consumption, the results would be more reliable, but the problem of valuing stocks of prepared food is intractable. Again, unless a satisfactory equivalent man scale by which to average food expenditure is available, households containing children tend to gravitate to lower expenditure groups than childless households of comparable means. Finally, the pattern of household spending varies, and so food expenditure, while exerting a strong claim on purchasing power, cannot faithfully reflect it. We are faced with the conclusion that sub-division of the sample according to purchasing power, though of fundamental importance, constitutes a difficult problem.

I have tried to examine as frankly as possible some of the difficulties and potential sources of error that must be associated with the budgetary type of inquiry for the purpose of assessing nutritional status. Its strength lies in the fact that it provokes less resistance and less self-conscious reaction on the part of the subject than other methods and is, therefore, more appropriate for large scale sampling, also that it sheds more light on the socio-economic background of the nutritional position it reveals. For these reasons it will probably continue to be used instead of, or alongside, methods that are less applicable to social groups taken in their ordinary surroundings.

I should like to conclude my remarks with an appeal in which I hope some constructive merit may be found. Budgetary and other kinds of nutritional inquiry will, I have suggested, continue to be carried out by a variety of bodies, but the gain in knowledge would be greatly increased if these independent efforts could be put on a comparable basis, so that results obtained in different places or at different times could be integrated or compared. This can only be achieved by the adoption of common methods and common standards of measurement. The fact that there are differences of opinion in some parts of the field seems to me no impediment to such a desirable end. Results obtained by a common method and common standards can always be qualified in accordance with personal convictions.

The English Group of The Nutrition Society has established a committee to co-ordinate nutritional research and I suggest that, if it has not already been done, this committee should be charged with the task of evolving detailed codes of procedure for all nutritional inquiries. These should not be confined by national boundaries but the widest possible measure of agreement should be sought.

Food Consumption Studies

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To define the objects of food consumption studies I cannot do better than quote Woodbury (1942) of the International Labour Office: "Once the importance of good nutrition and right diet is recognized, and the technical conditions for securing these are determined, the place of food consumption studies is clear. They are necessary to throw light upon existing food habits, to discover the existence and extent of food deficiencies, to determine the character of these deficiencies and to suggest

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methods of improving nutrition. Such studies should throw light also upon the importance of the economic factor, of the educational factor, of ignorance and prejudice, or national customs of food selection and preparation. Finally, with all this information it becomes possible to establish a national programme of improvement of nutrition upon a sound foundation of ascertained fact."

In the past, food consumption studies have been confined mainly to the collection and analysis of data relating to food and nutrient intakes, and consequently their potentialities for providing other factual data are not generally appreciated. It is useful, therefore, to mention a few other kinds of surveys which have been made. *Food Habits*: Anderson (1936) investigated the kinds of foods eaten at different meals by school-children in Chorley; Le Gros Clark (1943) studied the schoolchild's taste in vegetables; Wright (1936) made an inquiry into the milk drinking habits of children of school age. *Food Preparation and Cooking*: The Ministry of Health, in conjunction with the Wartime Social Survey, made in 1942 a national survey into the methods of cooking vegetables (Wagner, 1945). *Food Education*: Bovee and Downes (1941) in America used food surveys to compare the efficiency of different methods of education in food habits. *Economics*: Bransby and Bransby (1940) compared the effect of changes in food prices on dietary costs in families at different food expenditure levels, and Bransby (1940) showed that it would be necessary to provide the poorer sections of the population with milk free of charge before young children could obtain 1 pint daily. Data on food consumption have been used also in the framing of diets adopted in setting up "minimum needs standards". Thus, dietary data were considered in laying down the British Medical Association's (1933) food standards, and the food allowances in the Beveridge Report (Beveridge, 1942) were based on diets framed in accordance with consuming habits and the League of Nations Health Organization (1938) standards of requirements of nutrients. To get the most out of food consumption surveys we must in the future become more alive to the possibilities than we have been in the past.

It would be redundant for me to discuss the detailed technique of food consumption studies; that has been done adequately by Cathcart (1931-32), Widdowson and McCance (Widdowson, 1936; Widdowson and McCance, 1936), Bigwood (1939) and Woodbury (1942). In his monograph, Bigwood describes four types of dietary studies: statistical studies of the food resources of a country, institutional or group studies, family studies, and individual studies. Woodbury adds a fifth, the analysis of food expenditure and food consumption as part of the general study of family living, an example of which is the Ministry of Labour's (1940) inquiry.

Statistical studies of the food resources of a country reveal the average food consumptions of populations as a whole. Thus Bennett (1941) of the Food Research Institute made a revealing comparison of national diets by estimating, for each of 34 countries, the percentage of the total calorie intake derived from cereals and potatoes.

In the institutional or group study the diet of the group is considered as a whole, although individual studies are sometimes grafted on to it. This type of study is relatively easy to undertake. Institutions are favourite grounds for nutritional investigations and the value of such

investigations is increased if the diet of the experimental subjects is known. I believe that the study of selected groups of persons could profitably be developed to provide data on food requirements. The examination by Andross (Cathcart and Murray, 1936) of the calorie intake of young women for example threw a new light on calorie requirements.

The object of family dietary surveys is to enable estimates to be made of the food consumption, and of the adequacy of nutrient intakes, of groups of families according to such factors as income and family size. Largely as the result of the impetus given by the Health Organization of the League of Nations, such surveys have been made in many parts of the world, and they have been instrumental in rousing public conscience to the unsatisfactory state of the food consumption of large sections of the population even in wealthy countries. The criticism that family surveys are of little value because they do not provide information about individual intakes is unjustified because they are not designed to do so. On the other hand, I believe they can be made to do so. In fact, Clements (1940) of the Australian Nutrition Board has drawn up a scale of calorie requirements from family data. By using modern statistical methods such as multiple regression equations it should be possible from family data to estimate the average nutrient intakes of individuals of different age and sex. It would be useful to compare nutrient intakes so found with the intakes of a random selection of the individuals comprising the families studied.

There are 3 types of family study which are generally employed, the precise or weighing method, the logbook method and the questionnaire method. The precise method, first used in this country by Noel Paton and his colleagues in Edinburgh in 1900 (Paton, Dunlop and Inglis, 1901), was the method most generally used in this country up to the outbreak of war. The precise method is slow and laborious and, because of the involved technique, it is not possible to obtain the co-operation of a properly selected random sample of families. The logbook method is much simpler, and has been used successfully for almost 4 years in the Wartime Food Survey. During the early part of the war the Ministries of Food and Health had both precise and logbook surveys running at the same time and had practical experience of the better reception of the logbook method. In the questionnaire method the informant is required to record at one time her purchases in some previous period; inaccuracies are almost certain to occur. A golden rule for all comprehensive dietary surveys is that the food data should be recorded immediately after purchase or before consumption, as the case may be; data recorded from memory must be regarded with suspicion. I should be surprised if the precise method is used to any extent in the future; the logbook method will probably supersede it entirely. It would, however, be extremely valuable to make a comparative trial of the various methods of family study.

There is, I believe, much scope for the development of short cuts in survey technique. It would, for example, be worth exploring the possibility of collecting data on diets from part of the population surveyed, and data on family constitution and weekly food expenditure from the remainder, and of applying the results obtained from the former to the

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latter. A technique somewhat akin to this has been used satisfactorily in the United States. The use of the "punched card system" for the analysis of dietary data is a good illustration of the labour saving possibilities of modern methods. A labour saving device is now available for calculating the nutrient content of individual diets where the number is not sufficient to warrant the use of the "punched card system". The advantages of several labour saving practices, such as pre-coding, still remain to be tested. Trials should be made to compare the efficiency of various methods of recording data. Before leaving the "family method", I should like to pay tribute to the pioneers, especially Noel Paton, Cathcart and Orr, who proved that surveys could be made. To them and to sociologists such as Booth, Bowley and Rowntree we owe a great debt.

The individual study will undoubtedly have an important part in future nutritional investigations. Whereas formerly, dietary surveys were "ends in themselves", now they are tending to become part of comprehensive surveys in which dietary, clinical, biochemical, anthropometric, sociological and other data are collected and correlated. In such investigations the individual method must be used. The individual method can also be used in conjunction with feeding tests, such as the vitamin feeding tests being made at present by the Ministry of Health and the School Medical Officers of Stoke and Salford, to provide information on the basic diets and to enable the effect of food supplements at different dietary levels to be compared.

McCance and Widdowson have been the principal exponents of the individual method in this country, and they have made a number of fruitful studies. They have developed the precise or weighing technique, but I feel that this has the same limitations as the precise family method; it is difficult to obtain the co-operation of a random sample of the population, especially of the poorest sections which are of great nutritional significance. This, of course, does not mean that the precise individual method is outmoded; on the contrary, it is an essential method for studying selected groups of the population. There is a real need for an individual technique of general applicability. It is easy to think of many nutritional studies which would have been improved by collection of dietary data. For that reason we have for some time, in conjunction with the Wartime Social Survey, been working on the development of a simplified method. In this method, which was used in the study in Stoke and Salford, the foods are recorded in "homely measures" and the co-operating housewives are provided with standard tablespoons and teaspoons and diagrams of pieces of certain foods of different sizes. Few of the selected housewives in Stoke and Salford refused to co-operate. A word of caution is needed about the development of relatively unrefined methods of survey, whether family or individual. It is possible to get on to a "slippery slope" on which eventually a technique is used which is so unrefined as to be valueless.

I want now to speak about the accuracy of results obtained from dietary surveys. McCance and Widdowson (1937) stated that, by use of tables of food composition, individual food intakes can be assessed with a high degree of accuracy and the results regarded with a corresponding measure of confidence. Later they substantiated that

opinion by experimental evidence (Widdowson and McCance, 1943). While that may be true for the *average* nutrient content of a *number* of diets, there is not sufficient experimental evidence for such a definite conclusion in regard to individual diets in general. In fact, consideration of the errors which can occur in the collection and analysis of data of food consumption leads one to believe that there can be a considerable error in the assessment of the nutrient content of individual diets. The assessment of the adequacy of nutrient intake is further complicated by the wide variations in individual nutrient requirements, and it seems to me that individual diets cannot be assessed more finely than by grading the intake of each nutrient as, say, good, fair, poor and very poor. I am quite sure that in the past a too detailed interpretation has been made of the results of dietary surveys. A co-operative study between biochemists and field workers, in which diets are taken from households of different social strata and in different parts of the country, is urgently required in order to indicate the precision that can be attached to nutrient intakes calculated from food tables.

A type of study which deserves more attention than it has previously received is that of the consumption of individual foods, milk, meat, bread and so on. Such studies enable an analysis to be made of the factors affecting food consumption more detailed than is possible from the data collected in a comprehensive dietary survey. It is generally accepted that poverty is the most potent factor affecting food consumption unfavourably, but it is not the only factor, and I was able to show for example that there was plenty of room for increased milk consumption even among poor families, given a wiser distribution of the money available for food (Bransby, 1940). Our knowledge of food consumption would be materially increased if we knew the relative importance of poverty and the other factors involved.

Finally, I wish to mention two matters in regard to the selection of survey samples. The data I collected on milk consumption were analysed according to social class and it was demonstrated that consumption varied between social classes irrespective of food expenditure or income (Bransby, 1940). I found, for example, that, among lower working class families, milk consumption was independent of family constitution but, among professional class families, it increased by $1\frac{3}{4}$ pints a week for every additional adult, and 4 pints for every additional child, in the family. I found that within social classes the consumption of tinned milk did not vary according to food expenditure but, in lower working class families according to the number of persons in the family and, in working class families, according to the whim of the housewife. Examination of the graphs in the study of Crawford and Broadley (1938) indicates that the consumption of foods other than milk also is affected by social class. The question then arises of the extent to which adequacy of nutrient intake is affected by social class distinctions. It is obviously important to know the answer to that question, but no work has as yet been done to provide an answer.

The other matter I want to mention concerns the size of the sample. In one milk consumption survey I obtained data from 300 families (Bransby, 1938). I then examined a random sample of 100 of these 300 families, and found that as much information was provided by the

100 as by the 300 families. In a subsequent survey I estimated the sizes of adequate samples by consideration of the scatter as revealed by a pilot survey (Bransby, 1940). I wonder how much labour would be saved if in planning food consumption studies we clarified our minds about our objectives and then, by proper statistical methods, assessed the size of samples which would be adequate.

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Allocation of Food within the Family

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For our purpose we might define the problem in this way. Let us suppose that a budgetary survey shows that a given family is purchasing, week by week, as far as we can estimate, a sufficient amount, but *only* a sufficient amount, of varied foodstuffs to give it a reasonable standard diet. If, then, certain members of the family consume more than their standard allowance, the rest of the family must be to that extent malnourished. In other words, the usual budgetary surveys tell us something about the purchasing unit, that is the family, whereas it is surely our business to study also the consuming unit, that is the individual.

What I say of a family consisting, possibly, of 3 adults and 4 children would be equally true of an institution such as a children's home consisting

of 15 adults and 100 children. The food purchased might appear to be adequate; the distribution of the food might be based on very unsound principles. What do we know about the problem? Next to nothing. Is it worth our while to investigate the problem? Yes, if our inquiries show us how we can improve the pattern of food habits in the community. For obviously the problem is a social one; it concerns the traditional habits and food preferences peculiar to different regions, classes and occupations. The work is primarily one for the sociologist or the anthropologist, though the worker in the field of nutrition cannot hold his task to be complete until he has somehow managed to split up the family molecules into their component atoms.

It would be unwise to make any assumption about the kind of maldistribution we shall discover in the families we ultimately manage to investigate. If we have evidence that the food purchased by the families of miners, say, or of bank clerks or of lawyers is allocated among the members of those families according to very unsound dietetic principles, we shall have to study the pattern of habits and prejudices that led to these regrettable results. All I can do at present is to make a few comments on method, and a few observations on the studies of the problem that have so far been attempted. The material is scanty, and one can only hope that research workers in our own country will begin at last to appreciate the importance of inquiries of this nature.

I am convinced that in a matter of this kind we shall have to develop fresh techniques. We are dealing with a set of inherited social habits, and it is patent that, when we approach housewives with a request for information on these intimate details of their economy, we are probably arousing suspicion. It will almost invariably be the housewife we shall have to approach, and we all know that the worst fed member of any working class family is likely to be the mother. The chances are that she will understate her own dietetic deficiencies. But what are we to do? It seems clear that, whatever else we do, we must carry out a normal dietary estimate of the total amount of food consumed by the family as a whole in the period surveyed. That will give us a scale to which we may relate any estimates that we may subsequently obtain of food consumed by the individual members. They cannot, at all events, have consumed between them *more* food than they acquired and, if our estimates of individual intake total up to somewhere near that level of family purchase, the presumption is that our estimates of individual allocation are somewhere near correct.

I believe it to be almost impossible to have the helpings of food accurately weighed. We might gradually educate one per cent. of working class housewives to the point where they would weigh every helping of potatoes and porridge ladled on to their children's plates, but what would the habits of these artificial products tell us about the daily habits of their unsophisticated neighbours? We must content ourselves with approximations. I suggest that, if we can obtain three kinds of evidence from a fairly large sample of families of a uniform social type, we can attempt to form an approximate estimate of the allocation of food among the members. We need first to know the total food purchased, together with information on guests and on food taken outside the family. Secondly, we need the testimony of the housewife as to the normal mode

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of distributing the food at the family table; who gets the meat? Who gets the milk? Do all members take a reasonable share of the vegetables? Finally, we need the intake of at least one child to be estimated meal by meal as accurately as possible.

Given the total family food purchase for a large sample of families of uniform social type, we can compare one family with another and draw certain tentative conclusions about the probable value to be placed on the various items in the diet. If we relate these tentative conclusions to the three kinds of evidence for each family, we should, I think, be in a position to cast up the dietetic balance sheet of that family in terms of individual intakes. But there is one problem of method which cannot be ignored. It is the problem of approach to the household. How, for example, shall we ask a thousand housewives to testify to us on the food habits of the fathers of their children? I have only time to make three remarks. I doubt in the first place whether one can ever arrive at a random sample in this kind of survey; the most one can do is to make a conscious effort to avoid all the obvious modes of selection, that is to say, to take the sample as far as possible at random and hope for the best. In the second place, the first approach should be made through someone who is already on terms of intimacy with the housewife and who has gained her confidence. In the third place, it is essential to have a sound reason for asking the housewife to reveal her domestic secrets; I do not care what the reason given may be so long as it conveys at least part of the true reason for the inquiry.

As far as I know, in one full scale survey only has it as yet been attempted to determine how the food is allocated within the families studied. This was the survey carried out by McHenry and his colleagues in four large Canadian towns during 1939-40 (Hunter and Pett, 1941; McHenry, 1941; Patterson and McHenry, 1941; Sylvestre and Nadeau, 1941; Young, 1941), but, unfortunately, the exigencies of war have prevented full information as to the methods used from reaching this country. Until we know more of the precise methods, I still incline to believe that it is unprofitable in most cases to expect to obtain exact weights of all food consumed, but the Canadian workers testify to the high degree of co-operation they encountered.

Young (1941) in his report for Halifax, states that the mothers co-operating were provided with scales and in about a third of the families the individual consumption was separately recorded. Two dieticians supervised the work, making daily calls and analysing the data. About 10 per cent. of the housewives approached refused to co-operate because of the time that would be required, or from suspicion of the motive. Corrections were made for the presence of guests and for meals taken outside the family.

Hunter and Pett (1941), reporting for Edmonton, state that one of the field workers, all of whom were graduates in household economy and previously advised of the need for tact and patience, visited each of the co-operating housewives and stayed with the family during the preparation and course of a meal. The housewife was required for the period of a week to weigh and enter into a notebook the amount of each ingredient in all specially prepared foods. It was further required to know the

amount of porridge, for example, served to each member of the family and the amount of milk each took with the porridge.

Patterson and McHenry (1941), reporting for Toronto, state that letters were sent to the families asking for their co-operation. A field worker called upon each family and explained in detail the nature of the projects. Following the careful instructions of the field worker, each mother kept an account of all food purchased during the week and the weight of all food consumed by each individual within the family.

The only published survey that has been attempted in our own country is a small pioneer investigation of 40 working class families in Edinburgh, carried out over the winter of 1941-42 (Clark and McKay, 1942). Efforts were made through a social worker, who was acquainted with a widely dispersed group of housewives, to obtain information on the actual amounts of animal protein foods consumed by each family in the course of a week, and then to determine by lengthy discussion with the housewife precisely how these foods were allocated among the members of the family. No individual helpings were weighed, and the inquiry did not claim to have more than an experimental value, though the results were of interest. It was decided to limit the survey to the animal protein foods, because it was assumed on general evidence that it was in regard to these foods that the most serious cases of maldistribution took place.

A still unpublished survey was carried out in Newcastle during the month of January, 1942, through the initiative of the Ministry of Health. Twenty-five families were studied, the field work being done by the health visitors of the Borough's health department, who themselves also selected the sample. Scales were provided to each mother, and the technique was a combination of weighing and the use of "homely measures". It is concluded from a preliminary examination of the results that it is possible to obtain data on the food intake of the individual members of a family, provided the sample is specially selected, but that such a survey could not be based on a random sample.

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Discussion

Miss M. W. Grant (Dietetics Department, King's College of Household and Social Science, c/o University College, Leicester), opener: To my mind there are two major difficulties in survey work. One is to get an accurate record; this I think possible but by no means easy. The other is to get a representative record, and I am not sure that this is possible.

In our experience, errors tend to be introduced because of the fact that keeping a weighed dietary record is time consuming, laborious, and, after the first day or two, tedious. It fails to be a representative record because with human beings the knowledge that they are being observed results in a modification of behaviour. This change may be simple and

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straightforward as with small children, and will then quickly wear off, or it may be conditioned by various factors such as previous tuition, a desire to please, or a bid for pity; these forms of reaction are more usual in adults and older children. In order to minimize such complications it is important that the individuals being surveyed should have no link with the investigator other than that of the survey itself.

Investigators should test proposed methods and questionnaires and be aware of the extent of the effort they are demanding from those surveyed. The returns obtained should be considered in the light of this knowledge.

Miss D. F. Hollingsworth (Surveys Branch, Ministry of Food, Carlton Hotel, Pall Mall, London, S.W.1): Mr. Jones has already spoken of the general principles underlying the budgetary survey and Dr. Bransby has emphasized the need for the extraction of as much information as possible from the collected data. I propose now to give some examples of the ways in which the data collected by the Wartime Food Survey have been used.

Since July 1940 records of working class family food budgets have been kept, during 1940 and 1941 at quarterly intervals, and since the beginning of 1942 continuously. Early in 1942 the technique was extended to include stock weighing and so to obtain records of family consumption, in addition to those of purchases of, and expenditure on, food. Since the beginning of 1943 the presentation of results has been modified to include the production for administrative purposes of monthly tabulations for immediate circulation, in addition to the more detailed quarterly or half yearly tabulations.

The general purposes of the survey are: (1) By records of household expenditure and purchases to study food prices and the distribution of food; (2) by records of consumption to study nutritional trends in the sections of the community most likely to be suffering from malnutrition.

From time to time, in addition to the general working class sample, special samples of particular vulnerability have been studied. These have included the families of heavy workers, miners, shipyard workers and agricultural workers, households dependent on Services' allowances or pensions, and slum dwellers. For comparative purposes a middle class sample was surveyed in the autumn of 1942.

The conversion of consumption figures into nutrients has required the compilation of a table of food composition expressed in nutrients per ounce as purchased by the housewife. Such a table, based largely on that recommended by the Accessory Food Factors Committee of the Medical Research Council, has been drawn up and is, as far as possible, comparable with that employed for conversion into nutrients of gross supplies of foodstuffs as imported or as produced on the farm. Therefore, statistics of nutrients calculated from survey data can be compared with similar statistics of gross supplies.

The ways in which the survey data are used may be illustrated by the following examples: (1) Vegetable statistics are often based on acreage under cultivation and estimates of the yield per acre. Survey data have proved very valuable for comparison with such statistics. (2) During last autumn a very rapid estimate of the drawing of the supplementary jam ration was achieved. (3) The costs of nutrients in terms of current

prices have been calculated at different levels of food expenditure. (4) Comparisons have been made of the relative levels of vegetable consumption and of the use of gardens and allotments in Scottish towns and English towns. (5) A calculation has been made to show the approximate effect on the vitamin B₁ consumption of a sample of working class population that would result from a future change of the extraction rate of flour. (6) Calculations of the percentages of nutrients obtained from rationed, controlled or unrationed foodstuffs are regularly produced. (7) Spontaneous comments from housewives are now classified and used for administrative purposes. (8) An attempt has been made to assess the variety of meals from a study of the records of meals served during the week under survey; this may prove to be a useful guide in the problem of the palatability of the war time diet.

Miss M. W. Cooper (Oxford Nutrition Survey, 10 Parks Road, Oxford): It might be useful at this point to make a brief comment on the use of the questionnaire for collecting dietary and socio-economic information. In general we feel that the use of this method is fraught with danger and that, in the hands of the unskilled, it may be the means of collecting a vast amount of useless, meaningless, and often definitely misleading, information, but the advantages of its use to gain rapidly a picture of the nutritional situation at any time are so great that we cannot lightly condemn it.

The skilled visitor can, in our experience, collect sufficient information by means of one home visit to give her a clear picture of the family environment, the term environment being used in a comprehensive sense, and a surprisingly accurate account of its food expenditure and consumption. The housewife on her side spends a pleasant hour with someone who is really interested in her problems and difficulties; there is no question of filling in bewildering forms which she does not understand and in which she consequently feels no interest. This method has been developed and perfected by the mobile team of the Survey and has been used also in Oxford by our resident staff. It has always been used in conjunction with a clinical examination.

The approach to the housewife is of fundamental importance. In our surveys a letter is sent, signed by the Medical Officer of Health, explaining the object of the investigation; the dietist calls to make an appointment for the clinic; the woman comes with the family to the clinic and while she is there an arrangement is made by the dietist to visit her again in her home. By the time this visit takes place, the visitor is treated more as a family friend than as some kind of inquisitive commercial traveller.

What are the matters about which we desire information? (1) Housing conditions and household management, both of which are closely related to incidence of malnutrition, and for this we have found Professor Mackintosh's scheme of the greatest value (Mackintosh, J. M., private communication); (2) food consumption; (3) food costs in relation to income. These two last we feel can be assessed quantitatively.

The information is obtained by two independent lines of inquiry. The housewife gives, first, the amounts of foods that she thinks she uses during a week and specimen menus for a week day and, very important, for a Sunday; second, she tells what she pays every week to the various

tradesmen, the milkman, the butcher and the rest. The dietist then costs the food figures, allowing for home grown food and gifts and, as a check, compares this estimated cost with what the woman says she spends; between these two figures we find a very close agreement.

In the group spending between 5/- and 8/- per head on food, the average costed figure is 2d. higher than the average estimated figure, and in the group spending over 11/- per head the average costed figure is 3/- less than the estimated one. This difference between the costed and estimated figures is due probably, in the higher groups, to a greater consumption of sundries which are not costed, and also to the fact that the housewife in this group does not seem to have such a precise knowledge of how she spends her money. The fluctuations in the average figure for food expenditure have followed very closely those obtained in the Ministry of Food's surveys.

In summary, we find a close relation between the incidence of malnutrition and the conditions of housing and household management. The food expenditure of the families with members clinically diagnosed as malnourished has been consistently lower than that of the normal families all through the surveys.

I should like to conclude by stressing the importance in my opinion of the establishment of as much personal contact as possible with the housewife, if full and reliable information is to be obtained.

Dr. B. H. Sajat (c/o Netherlands Government, Stratton House Stratton Street, London, W.1): As early as 1917 I made an investigation into the food condition of about 30 families in my practice in Amsterdam. All the food was weighed during one week. Considerable differences were found between the various classes in the value and composition of the food.

A great number of inquiries has been made in our country, several of them by the Government. In practice it was found desirable to enlist the help of the family doctors, who would have the confidence of their patients, and of the trade unions when the inquiries concerned organized workers.

About the distribution of the food among the various members of the family, I should like to say that tables exist which estimate for instance the quantity of food for a one-year old child as one-tenth of that of an adult, that of a two-year old child as two-tenths and so on. These tables give only approximate figures, and it is as well not to generalize.

I have noticed that, during the German occupation of Holland, the existing food scarcity influences the distribution of the food within the family; where there is a shortage of food the parents deny themselves in order to give it to their children. In the same way the distribution of food in the family is influenced by class, in the sense that also in the scarcity of food resulting from poverty, the children receive a proportionately larger share of the total food than in families which are not exposed to such a limitation.

Miss T. Schulz (Institute of Statistics, Oxford): I should like to confirm what was said by Dr. Bransby as to the usefulness of small samples. The Institute of Statistics is carrying out an annually recurrent inquiry into the household expenditure of working class families in war time,

based on a very small sample. Last year 208 families co-operated. The sample can, however, be taken to be homogeneous, since it includes only families of industrial workers with a main earner at home and at least one dependent child. None of the families take boarders. In order to eliminate any serious error in compiling the accounts, the cash-book, filled in by the housewife day by day for a fortnight, is carefully cross checked by means of a questionnaire filled in by a visitor.

Our inquiry is concerned with total household expenditure, but I want to refer here only to expenditure on food. I have just finished analysing the turnover of grocery shops serving about 2 million customers a week, for about the same period as was covered by the household accounts of the 208 families, and I have found that the expenditures on groceries per person of those families and of the 2 million registered customers of the grocery shops correspond astonishingly closely with one another. I consider that to be a rather remarkable result.

It seems to me that the great advantage of the small sample lies in the fact that it allows a close scrutiny of each single item, and a close central supervision of the whole work. This results in a precision in detail that may not be attainable in a larger sample.

Dr. C. F. Brockington (Public Health Department, Shire Hall, Warwick): The scale of units for assessing expenditure on the food of individual members of families is at present based mainly on calories; this is surely not sufficiently accurate for children. It is nonsense to assess a small child as one-fifth of an adult when we know that even on the British Medical Association scale a child of 2 to 3 years costs half as much as a man, and on an adequate diet probably costs an even higher proportion. Perhaps Dr. Bransby could say something on this matter.

Mr. A. G. Jones replied: Various references have been made to the difficulties of assessing the nutritional status of individuals as opposed to family groups. I had hoped that someone would refer to the possibilities of measuring typical intakes when people are living under controlled conditions and when the relatively uniform size of portions served at each meal makes possible a fairly close estimate of intake by laboratory analysis of representative portions.

In view of certain doubts that have been expressed, I should like to reaffirm that, in measuring the quantities of food put into consumption by households, a high degree of accuracy can be achieved by the careful planning of field records and the scrupulous use of a clearly defined system of cross checks in the field and during analysis afterwards.

Dr. E. R. Bransby replied: In answer to Dr. Brockington, the calorie scale is no longer used, an appropriate scale being devised for each nutrient individually. In the work we are now doing we are grouping our data according to food expenditure per "expenditure unit" and not per head. Dr. Brockington was, I believe, the first in this country to use such a device.

I wish to reiterate what has been said about small samples. In many studies such as those in which dietary data are related to comprehensive biochemical and clinical data it is not possible to obtain large samples. My experience is that the results from small samples agree very well with those from large samples. I hope that nobody will be discouraged

from making food consumption surveys by the scale of official work now in progress.

Mr. F. Le Gros Clark replied: It seems from the evidence that the problem of approach is extremely important. Speakers have suggested that investigators had best not represent themselves as coming from such or such an authority, but they have given little positive idea as to how they should present themselves.

The Organization of Large Scale Surveys

Mr. L. Moss (Wartime Social Survey, Imperial House, Kingsway, London, W.C.2)

I was asked to prepare this paper because the Wartime Social Survey, of which I am a member, has had considerable experience in organizing surveys on various aspects of nutrition.

The Wartime Social Survey is a social research unit working for Government departments. This factor limits the scope of its work in nutrition in two ways: (a) The surveys it carries out are always related to the practical demands of administrators. They are not, therefore, at present part of a long term research scheme and may often not provide a complete picture from the point of view of the worker in nutrition. (b) Administrators need information on which they can base action affecting large groups of the population. Most of our surveys, therefore, have had to aim at getting a picture of facts based on data representative of such large groups. This has meant that much of the work has not reached the kind of precision in matters of nutritional importance which most workers in nutrition would require in laboratory research.

These limitations seem to me likely at present to affect most large scale surveys. With growing experience and knowledge of the factors involved in mass nutritional research the effect of such limitations can certainly be reduced. Further, there are very good reasons why workers in nutrition should not allow present shortcomings to stop them organizing large scale surveys. The chief reason, of course, is that nutrition is becoming accepted as an agreed national interest. Those workers in nutrition who want to have their findings applied to the furtherance of national welfare must, therefore, begin to consider research methods capable of yielding results which can be applied on a national scale.

It seems to me that this implies an extension of present nutritional research methods in two directions: (a) Methods used must be such that due account can be taken of social factors which may be as serious in their effect as biochemical factors. Failure to take them into account may, therefore, greatly reduce the value of results and may keep research in channels where its practical application is limited. (b) Methods used must be such as to yield data representative of large groups of the population.

Clearly, in considering such an extension of method, the nutrition research worker might expect to find the methods of social research useful. I would like to suggest that one of the aims of nutrition research in the next few years should be to work out ways of using the technique of social research to provide material sufficiently precise to be of use to the

nutrition experts and sufficiently representative of large groups for the administrator to be guided by it.

Over the last two years, Dr. Gertrude Wagner and other social research workers of the Wartime Social Survey have been working out the Survey's answer to this problem. I can best illustrate the points I want to make about the organization of large surveys by referring to the Survey's experience in the field of nutrition. The nutrition surveys made fall into three main types: (a) Studies of the kinds of food eaten in different groups of the population, together with such questions as where and when meals are eaten. (b) Studies of the consumption of particular food items such as oatmeal, potatoes or milk. Recently in conjunction with the Nutrition Section of the Ministry of Health a method has been worked out for recording complete diets over a period. (c) Studies of cooking habits or of the methods used in preparing and cooking certain foods.

The main lessons about organization learned from carrying out these surveys are as follows:

(1) *Need for Collaboration in Preparing the Survey*

Large scale surveys need very carefully devised battle orders. There cannot be personal control of the collection of all material and, therefore, instructions and the framing of the conditions in which material is collected, need to be thought out in detail ahead. Here the nutrition expert must make the decisions.

Further, the formulation of such conditions and instructions must be based upon first hand knowledge of the people who are the subject of investigation, otherwise their detailed application will break down. Here the sociologist plays a part.

The recently made survey of cooking habits provides an interesting example of such collaboration. The loss of nutrient value in cooking may be very serious. Dietary information in which such losses are not taken into account may, therefore, be defective. Those carrying out the survey were asked by the Ministry of Health to consider this problem, and the following scheme was worked out. The staff of the Survey collected information about the ways in which vegetables were actually prepared and cooked, while the type of information required was carefully defined by the Ministry of Health, who, at the same time, made arrangements for biochemists to carry out a series of laboratory experiments devised to measure the losses of nutrients occurring with different methods of preparation and cooking.

Those making this survey were very fortunate in working with the Ministry of Food and the Nutrition Section of the Ministry of Health. The work was organized on a basis of constant consultation and conference, and I believe that this collaboration has shown quite clearly that there are few problems in the field which cannot be approached if full use is made of the contribution which both the nutrition expert and sociologist can make.

(2) *Need of Trained Investigators*

It is quite clear that for the information to be of any use to the nutrition expert, a fair degree of precision and considerable detail are required in the material resulting from surveys. Such precision and detail are only

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likely to be forthcoming if the investigators concerned are sufficiently well trained. They need to be well trained in social research because in large surveys, securing and recording the information required is very much nearer to social observation than to laboratory observation. They need, in addition to this, to be sufficiently trained in scientific method and to know the interests of the nutrition expert so that they can tell just what kind of information is valuable. In the course of the Wartime Social Survey's work the length of the period of general training has been continuously extended. In addition to this, special instruction is always necessary for every individual survey.

(3) *Need of Adequate Sampling*

As a sociologist I am not competent to discuss the adequacy of the statistical methods used by laboratory research workers in nutrition. Modern social research is, however, developing methods which are relevant to the nutrition expert's problems when he begins to think in terms of large groups of the population. If the results of his work are to be put to national advantage it is necessary for the nutrition research worker to ensure that his material is representative of large groups. The title of Professor Greenwood's paper indicates that he is going to discuss this subject, but it might help to make my point clear if I mention the sampling method used in one or two of the studies made by the Wartime Social Survey.

The Ministry of Food asked the Survey to find out what food items entered into the diets of individuals in the civilian population. The object here was not to secure quantitative information in a precise form but to discover what kinds of foodstuffs were eaten by different groups. The Survey tackled this sampling problem by classifying the strata of the civilian population into light and heavy factory workers, outdoor workers, clerical workers, and housewives, and by aiming at random selection within those defined strata. Obviously such an inquiry would need to be repeated several times before a satisfactory statement on habits could be made. So far the inquiry has been carried out twice on comparable samples.

The Nutrition Section of the Ministry of Health has been making vitamin feeding tests on schoolchildren in Salford and Stoke. In order to assess adequately the effects of vitamin feeding on children who had been supplied with vitamins, it was necessary to get information about the diets of those children and the diets of a control group. The Survey, for this purpose, took a random sample of all children in the schools from which the two groups were drawn, and secured details of diets. At the same time relevant sociological data were collected.

(4) *Need for Specialists in Handling Mass Data*

The amount of detailed work involved in most nutritional research is large. When data in any kind of detail are required for large groups the effort required to handle them is overwhelming. Developments in modern social research, however, enable masses of detailed data to be handled without extraordinary efforts. The methods used have been worked out by specialized workers and it ought to be made quite clear that unless applied by specialists, the results are likely to be fatal. There

are two main directions in which the technique of social research can be of use. The first is in the classification of large amounts of data. The second is in the use of mechanical tabulating systems for analysing such data.

Some idea of the possibilities which the use of mechanical tabulating opens up may be gained from the following facts: Complete diets were recorded for 426 children for 7 days and the quantities of 68 foodstuffs were translated into nutrient quantities. This nutrient material covering 2982 child days was analysed according to age of child, income of family, food expenditure of family, family size, sex, whether mother was working or not, and whether the child took school meals or not. Altogether, half a million extensions were done by machine and the total amount of clerical labour involved to prepare final tables was that of one calculating machine operator for 4 days.

Social research has worked out such methods because, increasingly, it has turned towards statistical analysis as a principal weapon of research. The kinds of technical specialization in social research which have just been mentioned, methods of classification and mechanical tabulating, have been developed to enable mass sociological data to be handled for statistical analysis. Since large scale nutrition surveys may, because of their nature, have to make use of the methods of social research, nutrition experts might profitably use such technical specialists.

(5) Need of Collaboration in Interpretation

From what has been said it is clear that the collaboration of social and nutrition research workers in the design and operation of large scale nutrition surveys can do much to enhance the national value of such surveys. In addition to this, I would like to suggest that the sociologist has an important part to play in the interpretation of results. Under the controlled conditions of laboratory work, the researcher does not need to concern himself greatly with social factors. Such factors are, however, of great importance when the subjects under investigation are units in large groups. Our chairman has, I think, made this point understood by many in the course of his work. The conclusion which I think one is entitled to draw is that wherever the scale of research is such that social factors might be expected to play a large part in shaping results, there the sociologist should be asked to bring his specialized knowledge to their interpretation.

The Statistical Validity of Methods Used in Budgetary and Dietary Surveys

Professor M. Greenwood (London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1)

For the purpose of this discussion, by budgetary surveys are meant reports of the following kind: A number of families or households is selected and a careful record is made of the quantity and quality of the food consumed in each selected household over a period of time which varies from a week to a year. Particulars as accurate as possible of the

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family income and expenditure on food are recorded. The households are classified, in the larger inquiries, by economic or occupational status. No statistical information is usually provided as to the morbidity or mortality of the persons composing the families. Results are summarized in various ways, but the average energy yield of the diets and the consumption of protein, fat and carbohydrate are always shown.

Data of this kind may be of value for two objects. First, they may throw light on variation about the averages in a population of a particular type and enable us to assess the value of inferences from laboratory experiment. Next, they may be of value for testing quickly whether for a group suspected to be abnormal, there is reason for alarm. I shall briefly discuss the method from both points of view but confine my remarks to the subject of energy yields. Whether the conclusions I have reached can, if correct, be generalized I have not sufficient recent experience to say. This is an old fashioned paper and, I hope, will stimulate those with greater knowledge to correct it.

I suppose we should all agree that the ideal method of study is that of direct experiment. I think we should also agree that a study of basal metabolism should give us the best general idea of the mean and variation of human energetic efficiency. Such a study was made by Harris and Benedict (1919). We learned that the standard deviation in a sample of about 100 adults was about 12 per cent. of the mean and that the natural variability was reduced to about 6 per cent. when individual differences of weight, stature and age were approximately neutralized by multiple correlation technique. Perhaps then, we may say that in a universe of normal adults, the standard deviation of basal needs will be 10 to 14 per cent. of the mean value. The same technique has been used to measure the biometric constants of adults doing work but the number of individuals accurately studied has not been large. It is worth noting that when the subject of experiment was a single individual, the trained cyclist whose energetics were so fully studied by Benedict and Cathcart (1913), the coefficient of variation was 35.1, and still 11.4 when oxygen use, carbon dioxide production and speed of work performance were held constant (Greenwood and Newbold, 1923).

Neither to men at rest nor to men doing the work of everyday life can these methods be applied on a large scale, but it is possible to measure their food consumption and this more conveniently measured variable must be correlated with the variable which primarily interests us, *viz.*, the actual energetic cost of life and work. In practice we cannot often determine individual food consumption, the unit of observation must be a family. This creates a difficulty of apportionment, usually met by the device of weighting individuals by age factors, and assigning a "man value" to each family. Members will be familiar with criticisms of this method (Corlette, 1921; Cathcart, Murray and Shanks, 1931). Statistically speaking it introduces a source of variation, the magnitude of which I cannot judge precisely but which I am optimistic enough to think may not be great in a population of ordinary urban type. The families selected should, from the statistical standpoint, be a random sample of the universe or population of families we desire to study. If they are selected in some other way, the effect on both mean and standard deviation may be serious.

If we consider further the experimental evidence, it will be remembered that most of the estimates put forward during the last war were based upon determinations by direct or indirect calorimetry of resting metabolism and of the cost of external work. I was rather thrilled by some measurements on, I think, Algerian labourers made by a French engineer, Amar (1910). The work was, as usual, pedalling a stationary bicycle against a resistance. Amar had 37 subjects, and measured the external work done by each and the energy yield of the daily diets. From these data I determined the first degree regression equation expressing heat production in terms of work performance and bodyweight (Greenwood, 1918), and it formed the basis of Table 1 (Greenwood and Thompson, 1917-18).

TABLE 1
ENERGY REQUIREMENTS OF VARIOUS GRADES OF WORK (REDUCED FROM
AMAR'S STATISTICS)

(The figures in brackets are the estimated values of purchased food)

Bodyweight kg.	Calories		
	Sedentary work	Moderate labour, 65,000 kilogrammetres daily	Severe labour, 130,000 kilogrammetres daily
45	1778 (1976)	2733 (3037)	3687 (4097)
50	1867 (2074)	2822 (3136)	3776 (4196)
55	1955 (2172)	2910 (3233)	3864 (4293)
60	2044 (2271)	2999 (3332)	3953 (4392)
65	2133 (2370)	3088 (3431)	4042 (4491)
70	2222 (2469)	3176 (3530)	4131 (4590)
75	2311 (2568)	3266 (3629)	4220 (4689)

The table has no special merit; the use of a linear relation can easily be condemned; obviously, extrapolations beyond the range of observation are almost worthless, but others using different data and methods reached substantially the same results. We concluded that an "average man" doing an "average" day's work needed about 3200 net Calories, but the work measured was specialized and the experiments were few. Did human experience verify statistically these estimates? The answer is, yes.

I shall glance at two comparatively recent verifications, those of Enghoff and Wastl (1933) and of Cathcart, Murray and Shanks (1931). The studies related to wholly different communities, Vienna and St. Andrews, which, however, had this in common, that they were both stable groups. Patriotism would lead me to adopt that belief *a priori* with respect to St. Andrews; I might have doubts about a foreign city, but, as none of the families in the Vienna sample were under investigation less than a month and many of them much longer, 30 per cent. for a whole year, it seemed *a priori* unlikely that they could be suffering from serious energetic deficiency.

The statistical results are these. Enghoff and Wastl analysed 100 budgets. How the families were selected I do not know; the official report describing the method of selection is not available to me. The result of the arithmetic is that the mean was 3279 Calories and the

standard deviation 420, giving a coefficient of variation of 12·8, the same as in the study of basal metabolism. Cathcart, Murray and Shanks had 154 family budgets, but the period of observation was for most of them only a week. From a table it appears that the occupational distribution of the sample was not the same as that of the city census distribution, but I am not clear that the deviation from sampling rectitude was material. The mean was 3199. Data for computing the standard deviation are not printed. The two means are virtually the same. I think that these two studies, even if there were no others, sufficiently verify the conclusions of experimenters and that, if investigations of stable groups tell no more, they need not be pursued, but, it can be urged, they *do* tell us more. They tell us how much money the families had to spend and what proportion of it was spent on food.

Physiologists, even people who are not physiologists, have long believed that, on the average, people with good wages have better meals than people with low wages, but that variations from the average are common. Either report verifies this belief. Cathcart, Murray and Shanks, for instance, give details of 7 families of cleek makers. No. 112 had £1 14s. 5½d. per man per week, spent 14/3½d. per man on food and obtained 4318 Calories, but No. 150 with an income per man of 13/4½d. spent 8/- on food and obtained 2386 Calories. No. 38 spent more than No. 112 on food, 16/0½d. per man, but secured fewer Calories, 3968, and less protein but more fat. Of course, No. 150 had very little fat, 79·4 g., No. 112 had 170 g. and No. 38, 178·7 g. Interesting detail no doubt, but even statisticians intermittently remember that real men cast the shadowy men values and, being statisticians, hunger for statistics of the real men. Did family No. 150 lose more days from sickness than family No. 112? Were the children below average weight and stature? We are not told and could not, statistically speaking, be told because to reach what, in statistical jargon, are called significant results, one would need not a week's or even a month's data, but the experience of years or a sample of many hundreds of families. That, in my submission, is the case against this method as an instrument of research when we are concerned with a stable group. We cannot appraise the physiological or pathological importance of intra-group differences without continuous observation over a long period. I do not mean that it is essential to weigh the edible matter in domestic refuse containers or even to record the ounces of cheese consumed day by day for years. Perhaps an annual burst of calorimetric energy over a week might suffice. I do mean that a continuous record of sickness and growth in the families is essential. With that we might learn much. I do not see how the method restricted to an arithmetic of man values can do more than verify what has now been verified *ad nauseam*.

There is, however, one humbler purpose to which the method can be applied, namely, the rapid detection of disequilibrium. Let us take it as settled law that an average energy uptake of over 3000 Calories in a group is adequate evidence of group equilibrium, if the coefficient of variation is of the order of 10 to 14. I do not know whether there is general agreement as to how low a value should be fixed such that below this critical value group disaster is inevitable. The grim experiment carried out in Millbank Penitentiary in 1822 and the experience of the

army in Kut el Amara in 1916 (Greenwood and Thompson, 1917-18) lead me to think that for a population compelled to do moderate manual work, the critical value is not much below 2600 Calories. Let us suppose that we have reason to believe that some group is in disequilibrium; there is not time to make an elaborate epidemiological study, perhaps there are no data to study; we *can* apply the budget method to a sample. That was the situation in which the Committee upon Quantitative Problems of Human Nutrition (1924) of the Medical Research Council found itself. There was great economic distress in the coal fields, families were said to be starving. Something had to be done quickly. We employed the method.

As fully stated in the report our samples were not, statistically speaking, random samples of miners' families. In those far off days, not even the Medical Research Council could force miners' wives to keep accounts, and some latitude was permitted to local collaborators. This is what we found: In 43 Durham families the mean Calorie yield was 2830 (coefficient of variation 21), and 5.9 shillings per man per week were spent on food. In the Derbyshire selection of 41 families, the mean and coefficient of variation were 3335 and 16, with the expenditure on food 7.8 shillings. We found evidence that in Durham the miners' children were anthropometrically below the county average. More recently Charles (1937) sampled working class families in Newcastle upon Tyne. The mean Calorie intake of 38 unemployed families was 2855 with a coefficient of variation of 19. I suggest that these results do entitle one to conclude that both the Durham families and the Newcastle families were energetically undernourished.

It is easy to imagine circumstances in which these rapid and rough approximations to truth will be required of physiologists by administrators. I shall conclude by emphasizing one statistical precept which has not been obeyed in all the investigations I have described. The sampling must, in my view, be random. The technique of random sampling is well settled, but its rigid application involves time and trouble. I was recently consulted on a matter having no connexion with subjects interesting the Society which I can explain sufficiently to make my point without giving information to the enemy. The names and addresses of N persons each bearing a particular stigma were available. It was proposed to examine n of these persons with the object of determining possible aetiological factors. I described the method of randomization which, no doubt, all members of the Society know. My visitor objected that this method might force the experts to travel all over England, that it would be much more convenient to concentrate on a few places, and lead to quicker results. The appeal to urgency is one all of us know; many of us also know that the results so urgently required often repose in files for months, or years.

A sampling inquiry upon which measures of food distribution are to be based should be swiftly executed; it is even more important that it should be justly executed; that is why a precise sampling technique is essential.

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Discussion

Dr. H. M. Fowke (The Manor House, Hardwicke, Aylesbury, Bucks.), joint opener: Professor Greenwood's remarks on the importance of random sampling in dietary surveys were the words of an authority. He undoubtedly touched on one of the weakest spots. Some of us spent a good many hours trying to ensure that the first dietary survey made by the Ministry of Food should fulfil the required conditions but, when the time came, the most careful planning was upset by 3 factors, the blitz, evacuation, and the absence at work of the housewife.

One of the many points Professor Greenwood has raised which is of particular interest to me is the difficulty of apportioning individual food consumption when the unit of observation is a family. Scales have been drawn up assigning values in terms of "man" to individual members according to age, "man" having the value of 1. A good deal of experimental work has been done in trying to assess the energy requirements of "man", but there does not appear to be any such scientific background for assessing the requirements of children and adolescents. We have no knowledge of the magnitude of the variation in their requirements. The method of reducing the values for children to man values without such knowledge does not seem satisfactory. When Cathcart, Murray and Shanks (1931) tested the standard values on a sample of 5 average households, they found differences from the accepted standard, and concluded that the matter required further investigation on much larger numbers. Direct experiment is not possible on children, but a good deal might be learnt from individual diet surveys.

Recently I had the opportunity of studying individual diets in a sample of 24 adolescent boys aged 14 to 17 years. This is a small sample but the consumption of these adolescents showed some features of interest. The boys were all living under identical conditions in a farm training colony. They received the same diet and to all of them except 2, the same amount of food was available. The 2 exceptions were house boys who might have had access to extra food but, as their intake did not appear to differ from the average, they have been included. The individual diet survey was made over 2 periods of 7 days in January and 7 days in July this year. Miss M. W. Grant was responsible for the surveys, which were carried out with most careful precision. I shall refer now only to the July results.

In the sample of 24 boys the average intake per head ranged from 2078 to 4185 Calories; the mean was 3097 with a standard deviation of 14.4 per cent. of the mean, which agrees with Professor Greenwood's figure for

the variation in basal needs of adults. The League of Nations estimate of calorie requirements for boys of 15 and over is 2400 to 4800 Calories daily (League of Nations Health Organization, 1938). The average age of my group was 15.6 years. The smallest eater, who consumed 2078 Calories, was an undersized boy of 16 weighing only 76.3 lb., the normal weight for his age being about 130 lb. The largest eater was 14 years old, and weighed 106 lb., which is about the normal; he consumed on the average about 4200 Calories daily.

There was no correlation between age and calorie intake, the coefficient of correlation being -0.08 but, as one would expect, the values for body-weight and calorie intake were significantly correlated, although the association was not a high one ($r = +0.49 \pm 0.11$). For instance, the 2 heaviest boys aged 16 and 17 weighed 137 and 140 lb., respectively, and both had an average intake of 3300 Calories, while another boy, 6 months younger, weighing 89 lb., had an average daily intake of 3474 Calories. The physical work done by each boy may have varied considerably. Occupation was recorded for each boy. The 2 heaviest boys just mentioned worked in the cowshed, the third boy did stable work. Intake appeared to be highest for boys on stable work; there were 7 such boys in the sample with an average daily intake of 3206 Calories and a range from 2693 to 3604; the intake of 5 boys stated to be doing land work had a lower range of 2460 to 2862 and an average of 2739, which is 500 Calories below that of the stable boys.

Miss Grant found that boys with large appetites made up their extra calories by going round after a meal, collecting the residues from other boys' plates and starting again. Some boys disliked porridge and milk puddings, and the big eaters proved most accommodating in eating up their portions. It was noticed that 2 boys who sat side by side always exchanged white and yolk whenever eggs appeared one boy eating 2 yolks, and one 2 whites. Such examples show that individual likes and dislikes can affect the intake of nutrients in a community receiving the same diet. For instance, the daily intake of fat per head varied from 63 to 120 g., with a coefficient of variation of 14 per cent. The daily intake of calcium ranged from 845 to 2237 mg. per head, the coefficient of variation being 20 per cent. Intake of vitamin A showed the greatest variation; the range was from 1837 to 8922 I.U. per head daily with a coefficient of variation of 50 per cent. The very high value of 8922 was due to one boy's passion for raw vegetables. He grew lettuces for himself and would eat a whole one for his tea just as he brought it in from the garden, dry, earthy and unwashed. He ate raw carrots also whenever he could get them. Three of the boys disliked vegetables and their intake of vitamin A was less than 2000 I.U. daily.

The sample just briefly described is obviously too small a one from which to draw general conclusions but it does indicate first, that the making of individual diet surveys among certain groups of children is a practical proposition and second, that there is considerable variation in food habits even when the diet supplied is identical. I suggest that it is highly desirable that such surveys should be made in order to accumulate knowledge of children's energy requirements, even if they cannot be made on a large scale. Dieticians assure me that the difficulties of making individual surveys can be surmounted.

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Wing Commander F. Yates, R.A.F.V.R. (Rothamsted Experimental Station, Harpenden, Herts.), joint opener: I should like to emphasize the value of small samples in budgetary and dietary surveys. In the past there has been an entirely unreasonable trust in large samples and distrust of small ones. It is gratifying to find that this belief is now shaken. Small samples make it possible to do the field work much more carefully and also to employ better trained and more skilled investigators. Problems too complex for investigation in large samples can be successfully tackled when small samples are used.

The matter, after all, is not one for polemics. The sampling error of a survey can be calculated from the numerical results; if this is sufficiently small, having regard to other errors inherent in the work, then nothing can be gained by increasing the size of the sample. It is of the greatest importance that all those who conduct surveys should from time to time calculate by the appropriate statistical methods the actual sampling errors to which their results are subject. Only if this is done is it possible to decide whether the sample is sufficient, or more than sufficient, for the work in hand.

To a certain extent there appears to be a conflict of opinion between the advocates of small and large scale surveys. In fact, the functions of the two are mainly different. Large scale surveys are necessary when an overall picture is required as, for instance, for the purpose of adjusting supplies. Such surveys have to be simple, but in certain cases it is possible to fill in the details of the broad general picture provided by undertaking simultaneously a more detailed survey of a small sub-sample of the main survey.

I am in agreement with previous speakers on the need for the proper collation and collective analysis of the results of the many different surveys now being carried out. Experience in agricultural research has shown very clearly that such collective analysis often yields much additional information which cannot be obtained from a mere discussion of the results of individual surveys. The time has come to consider whether some machinery should not now be created for carrying this out in a systematic and regular manner. The same machinery would serve to co-ordinate, as far as possible, the planning of different surveys, though such planning must not be allowed to interfere unduly with the freedom of the individual research workers. The question of setting up a permanent team of properly trained field workers available for carrying out nutrition surveys should also be considered, and there is clearly a need for more clinical work in connexion with the surveys.

Professor Greenwood has maintained that nutrition surveys lose much of their value because they cover only a very short period, and that a longer period would be impracticable. The solution seems to lie in repeated sampling. Thus one might revisit the same household at three-monthly intervals, covering a week in each case, and collecting clinical information on each occasion.

Professor Greenwood has also suggested that nutrition surveys are of little value in a stable society; the point is perhaps of little importance at the present time, but one cannot agree with his thesis that, in such circumstances, surveys would only show that the rich are better fed than the poor. Nutrition surveys provide essential quantitative information not only about "energetics" but also about numerous other aspects of the food problem which can be obtained in no other way; they are complementary to laboratory tests and planned experiments, not duplications of them.

Dr. E. Grebenik (London School of Economics, The Hostel, Peterhouse, Cambridge): I would like to question the statement by previous speakers that small samples in dietary surveys will give results as good as larger ones. It is doubtful whether the assumptions of the theory of small samples are applicable to social data of this nature. In dietary surveys there is the additional difficulty that the check on the accuracy of the data becomes increasingly less effective as the sample becomes larger. It seems to me that more accurate results might be obtained if attention were concentrated on the consumption of one commodity or group of commodities at a time. The housewife's task in keeping records would be lightened and the statistical analysis simplified. It is in this way, I think, that the consumption pattern of the community can best be ascertained. It is important that data should be given in a way which would enable us to determine not merely the average consumption but also its variation in the sample.

Dr. A. Bradford Hill (London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1): The exact method of weighing the household's consumption, waste and so on gives accurate data but makes it very difficult to obtain a random sample of households and to prevent them changing their habits during the survey. On the other hand the logbook or similar procedures give less accurate data but more chance of getting a representative sample. The best method may lie in some *via media* and there is scope for experiments to discover it. At the best, present methods are confined to a week's study and I doubt whether this is sufficient to give a valid measure of the habits of a particular household though it may help to form a reasonable average picture of the diet of a defined group. Repeat studies have shown that families may change widely from week to week in their consumption of particular nutrients, and attempts to relate consumption in one week to physiological measurements such as that of haemoglobin may, therefore, fail to reveal any association. For the same reason I do not think that one can necessarily deduce that a certain percentage of a group surveyed was short of some nutrient. It may have been short in that week but it does not follow that it was habitually short.

Capt. J. Yudkin, R.A.M.C. (Military Hospital, York): The value of correlating budgetary with physiological data is borne out by some results obtained in the autumn of 1942. It was shown that children from families spending more on food, 7/3d. to 10/1d. per head per week, were $1\frac{1}{2}$ in. taller, 6 lb. heavier, had 3 per cent. more haemoglobin and a grip 2 kg. stronger, than those from families where the expenditure was less,

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4/7d. to 7/1d. The mothers showed similar differences, 6 lb. in weight, 3 per cent. in haemoglobin and 2 kg. in strength of grip.

Professor J. R. Marrack (London Hospital, Whitechapel, London, E.1): In large scale surveys errors do not necessarily cancel out. For example, when iron is given to prevent anaemia some of the subjects will not take it; there can be no compensating error in the opposite direction. Should not preliminary surveys be intensive rather than extensive, in order to find out the possible sources of error?

Family Income and Expenditure on Food

Professor A. L. Bowley (Marley Hill, Marley Lane, Haslemere, Surrey)

Before organizing a collection of household budgets it is necessary to define the class to which they relate and the unit of enumeration. The class or population may for example be that of all insured persons or the population of an adequately defined town or region. The unit commonly taken is the household or family, which again needs exact definition. When the population to be investigated and the unit have been chosen, in order to apply the rules of sampling so as to represent the characteristics of the population adequately, it is necessary to have an adequate list of the units, *e.g.*, of the houses, and, by one means or another, to arrange the selection for investigation so that each unit has an equal chance of inclusion.

A household or family may generally be taken as consisting of persons who sleep on the premises, are related to each other, and have their meals in common. Special rules have to be made for the cases where a lodger boards with the family, and also for the treatment of meals bought or provided outside for members of the family. Individuals living alone form a sub-class, needing separate tabulation.

Income is treated as the aggregate income of all the members of the defined family. The simple case is where there is only one earner, and in 1931 this class included about 56 per cent. of the Census families enumerated in England and Wales. There were 2 earners in 24 per cent. of the families, more than 2 in about 17 per cent. and none in 2 or 3 per cent. In the Ministry of Labour's collection of budgets for 1937-38, the average for urban families was 1.8 earners and 2 non-earners (Ministry of Labour, 1940, 1941, 1, 2).

Expenditure is income less saving plus debt. In exact work there is difficulty in defining savings in connexion with insurance and such items as hire purchase, but in practice it is simpler to regard savings as a special class of expenditure and to express classes of expenditure as percentages of income. It is evidently income that we have to consider in connexion with adequacy for needs, and questions about it were only excluded from the Ministry of Labour's 1938 collection of budgets because it was feared that they would arouse suspicion and injure the inquiry, which in fact was only concerned with relative expenditures. In more personal investigations income can generally be estimated and verified within fairly narrow limits, even if the wife does not know her husband's earnings exactly.

The difficulties in this connexion are found on the side of expenditure rather than of income. Normally there is a purse for expenditure in common, which is the wife's province, and personal expenditure by the husband and other workers. Though the practice varies, it is common for the earners to pay a fixed sum weekly to the common budget, that by grown children corresponding roughly to payments as lodgers. The main earner may undertake some regular payments, for example for electricity, so that the housekeeper's allowance does not cover the same range in all families; these payments can be ascertained, but they may include also occasional payments for such special purchases as clothes or furniture, which are more difficult to learn about. The main trouble is to classify the earners' personal expenditure under such headings as insurance, clothing, food, tobacco, alcohol, travelling, amusements and so forth. This difficulty is connected with a larger question of principle, namely, whether the earnings of all the members of the household should be regarded as pooled and available for common needs, for example for a minimum standard, or whether the subsidiary earners should be regarded as self supporting and contributing only the cost of their own share of the common expenditure, that is, virtually as lodgers. In the latter case dependent children and other non-earners are supported solely by the principal earner, and the relation of income to needs is that of his income to his own and his dependents' needs. The practical difficulty then is to ascertain the relation of the subsidiary earners' contribution to their real share of expenses; an obvious difficulty is with regard to rent.

In the classification of expenditure, rent is usually taken as including rates and, in working class households, the water rate. Clothing, fuel and light expenses are easily defined, but not so easily measured. Food includes tea, coffee and cocoa, but not other drinks. It usually includes meals taken away from home and this involves a twofold difficulty; if the meals are free or sold under cost, strictly a sum should be added both to income and food expenditure, but if bought at a restaurant part of the charge is for service, fuel, light and rent, and it may be that there is a saving on these items in the home. In pre-war years the average of working class expenditure on meals out was trifling, but there is probably a considerable difference now, and the additional expense varies greatly from household to household.

All these varieties of definitions and classification have to be decided before tabulation, and the rules laid down should be clearly stated. In many cases the detailed statement should give sub-classes, as, for instance, for houses rented and houses being purchased, for food at home and food out, for expenditure in common and personal expenditure, so that totals can be made for different purposes, and comparison with other investigations, where the procedure may be different, be facilitated.

I have spent part of my allotted time on these formal and technical questions, because they are of first importance in a scientific statement, and their prior consideration will save investigators a great deal of subsequent trouble. I now proceed to the subject on which I was first asked to speak, namely the variability of expenditure, not the differences of averages between classes or localities but the variation between families.

Variations of expenditure may be assigned to 3 causes, differences of income, of needs, and of tastes or habits, to which, for comparison between

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localities, should be added differences in prices, especially rents. To break up the problem it is well to limit the group under analysis to one broad social class at a time, say urban manual wage earners. It may be advisable to separate the families where there is only one earner from others. Even then there will be great variety among households as regards numbers and ages of the dependents, which of course affects the needs. For mathematical simplicity we should aim at standardizing the needs, and dividing income and expenditure by the numbers of "equivalent men," and a conventional scale can probably be usefully employed; for example, we could base relative needs on the minimum scales for differently constituted families in the Beveridge Report (Beveridge, 1942). If we succeed in this kind of standardization, we are left with two variables for expenditure on any commodity, namely income and tastes. Then, for example, we can report that expenditure on food per "man" for a given grade of income per "man" averages so much, and the variation about the average can be measured on a definite scale.

Engels' so called laws may be summarized as stating that, with the increase of incomes, expenditure on primary needs increases absolutely but diminishes as a proportion of income. It is implied that the size and constitution of the family is constant, or that the rules relate to averages, in which variations in families are neutralized.

These laws can be stated, under certain hypotheses, in the simple form:

$$y = kx + c$$

where x is the total income or expenditure per family or per man, y is the expenditure on a particular commodity or group of commodities, and k and c are constants for the group of families under consideration, but differ from commodity to commodity. Goods can then be divided into two classes, according to whether c is positive or negative.

The gradient of the line, k , is normally, but not universally, positive, so that absolute expenditure increases with income. The proportion of special to total expenditure is:

$$y/x = k + c/x.$$

If c is positive the proportion decreases as x , income or expenditure, increases, and the commodity may be classed as a "necessity." If c is negative, the proportion increases with x to a limit k , and the commodity may be termed a "luxury." It is easy to plot the average expenditure on a commodity against the income and to see how closely, and over what range, their locus is approximately rectilinear. In a considerable number of budget collections that have been examined it has been found that a straight line is a good approximation over at least the main group of incomes, whether separate commodities such as meat, or groups of commodities such as food, are examined. When, however, we merge different classes, say manual wage earners and clerks, we are likely to pass from one line to another.

That a linear equation should be a first approximation to the relationship between y and x is suggested by the theory of economics. If we assume that satisfaction, to use an undefined term, is a function of n commodities obtainable or used, that prices are constant, and that an individual makes his purchases so as to obtain the maximum satisfaction, using the whole of his income, while the satisfaction function does not change with change of income, a linear equation is the solution if the

function is quadratic, and is a first and normally good approximation if the function is more complicated (Allen, 1942; Allen and Bowley, 1935).

The values of k and c^* can be usefully set out either for all commodities in one group or for one commodity in several budget collections. By means of them interesting comparisons can be made of the tastes or habits of different classes or districts.

On the mathematical side the analysis applies only to a group of individuals with exactly similar tastes and needs, or to a hypothetical person whose income changes but not his circumstances. On the factual side the equation applies to averages. We thus come to the consideration of variation about the average in the expenditure of a number of families with the same total income, or, if the figures are so set out, with the same income per head or per "man." In the language of mathematical statistics, the averages of the arrays fall approximately in a straight line. Whether they do so or not, we are interested in the distribution within an array.

To visualize the relationship, a very small recent collection of budgets (Schulz, 1944) may be considered (Table 1).

TABLE 1
ANALYSIS OF BUDGETS

Number of cases	Income range per "man," pence	Average food expenditure, pence		Food expenditure as percentage of total expenditure	
		actual	computed	actual	computed
7	209 to 239	118	122	53	54
10	240 to 299	139	137	50	50
20	300 to 359	155	153	47	46
17	360 to 419	167	172	42	43
11	420 to 475	193	189	42	41
65					

The equation is $y = 0.29x + 57 \pm 21$.

Here the entry 21 is the mean square deviation of the 65 observations from their computed values. The mean deviation is 17d. In this group all the families were of the wage earning class, the principal worker being still at his home, and there was at least one dependent child. The income and expenditure are reduced by "man" values. The group is, therefore, fairly homogeneous, and the agreement of the averages with the theoretical linear values is very close.

The variation from the average, measured by v , may be expected to be due mainly to individual tastes and habits of expenditure. This variation is considerable, *viz.*, measured by mean deviation, 17d. on 170d. or 10 per cent. at the central entry.

It is advisable to exhibit such a group on a diagram in which every case is marked, with the regression line drawn among them. Then the type of variation is visualized and special cases can be examined.

* In practice it is more convenient to use the relation $c = (\bar{w} - k)\bar{e}$ where \bar{e} is the average of total expenditure of all the families, and \bar{w} the proportion of total expenditure devoted to a particular commodity.

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If the group is sufficiently homogeneous and the degree of elimination of heterogeneity, such as varying size of family, is satisfactory, the deviations measured by v , the vertical distance of an observation from the regression line, should be half positive and half negative. Further, if the uneliminated causes are sporadic, we may expect at least a rough approximation to the distribution of the normal curve of error. Thus in this small group we find remarkably close agreement.

Range	Occurrences of v		Expected (normal curve)
	+	-	
$> 2s$	1	3	2
$s - 2s$	9	6	9
$0 - s$	24	22	$21\frac{1}{2}$
	34	31	$32\frac{1}{2}$

where s is the standard deviation = 21d.

In such cases virtually the whole of the information is subsumed under the values of k , c and s . The same method can be applied to expenditure on any commodity, and it can be adjusted to quantitative measurement of calories, protein and so on.

I have analysed the results of the larger number of budgets, of which the 65 discussed above are part, collected for the Institute of Statistics, University of Oxford, in 1943. Expenditure on food is brought into relation with household expenditure, excluding rent, not with income. All entries are expressed as per "man." The averages over successive ranges of income are well represented by the equation $y = 0.37x + 62.5$. There is considerable scattering of the observations, the mean of the divergences from the computed value being 18d. The divergences increase with income, as might be expected and, when they are expressed each as a percentage of the value computed from the equation, they conform closely with a normal curve of error. Thus:

Range	Occurrences v/q		Expected (normal curve)
	+	-	
$0 - \frac{1}{2}s$	39	33	37.4
$\frac{1}{2}s - s$	27	36	29.4
$s - \frac{3}{2}s$	20	15	18.0
$\frac{3}{2}s - 2s$	7	7	8.6
$2s - \frac{5}{2}s$	4	6	3.3
$\frac{5}{2}s - 3s$	1	1	1.3
$3s -$	0	0	0
	98	98	98

$$s = 13.7 \text{ per cent.}$$

Such results are not merely mathematical curiosities. The analysis shows the influence on food expenditure of available income and of size of family. These may be regarded as eliminated when the residuals are equally positive or negative. If the residuals are normally distributed, it is indicated that they may result from a number of small sporadic variations of taste and habit. In fact, the main question to be considered by the help of such analysis is how far adequacy of nutrition, or of house room, clothing or fuel, depends on the level of income, and how far on the tastes, habits, knowledge, efficiency or opportunities of the individual.

Sir John Orr's "tentative conclusion" in 1936 that "a diet completely adequate for health . . . is reached at an income level above that of 50 per cent. of the population" (p. 5), which is related to the estimate (p. 21) that 50 per cent. had a weekly income of not more than £1 per person, was, of course, based on broad averages (Orr, 1936). With the same income and needs one family will be well, and another badly, nourished. If a reasonable minimum of adequate expenditure is assigned, in some cases it is realized at low incomes, in others not reached by higher. The average line tells only part of the story. There may be scope for propaganda urging greater expenditure on food, when available, and less on things which the moralist deems to be less necessary.

The more important aspect for The Nutrition Society is, however, not the amount spent, but the way it is spent. If the hopes of economic and social security are realized, and the provision of milk and meals for school-children develops, any malnutrition will be due, not to poverty, but to unwise spending. It is in this connexion that the recent work, described in earlier papers at this Conference, is so important, but it is necessarily on a small scale, and it may be that the method of graphic and algebraic analysis that I have described will afford some means of generalizing the results.

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Discussion

Mr. R. F. George (36 Crescent Way, Norbury, London, S.W.16), opener: In opening the discussion on Professor Bowley's paper, I would like first to deal with one or two specific points and then to indicate a line of more general consideration which for want of time cannot be developed here.

In referring to the aggregate income of the family unit, Professor Bowley briefly classified the family according to the "number of earners." Since it is the aggregate income with which we are concerned I should prefer the phrase "income recipients" for the particular purpose under consideration. Family income, even in the poorest homes, is not by any means all earned as such, the obvious examples being old age and widows' pensions; unemployment and sickness benefit may perhaps be regarded in a sense as earned income, but pensions particularly are dissociated from the concept of "earner" as used by Professor Bowley and yet come well within the scope of family income for our purposes.

A second point to which I would refer concerns the proportion of the families in the 1931 Census having 0, 1, 2, 3 or more earners. Professor

Bowley gives the 1 earner family as 56 per cent. of all families and the 2 earner family as 24 per cent. These percentages were 47 and 27, respectively, according to a sample of some 23,000 families the analysis of which I published (George, 1936). This sample gave 5 per cent. of the families with no earners whereas Professor Bowley quotes 2 to 3 per cent. I wonder if the precise definition of "earner" differs between the sample inquiry to which I have referred and the material used by Professor Bowley. The results given in the Ministry of Labour inquiry of 1938 showing 1.8 earners in the family was almost identical with the results of the sample inquiry to which I have referred, but the Ministry's figure of 2 non-earners was rather higher than was given by the inquiry.

A point in the technique of these family expenditure investigations concerns those items which in working class households vary from week to week. The period of time in terms of which the working class household commonly measures its financial expenditure is the week, for which wages, rent and food follow a fairly standard pattern over long periods. Clothing is much less satisfactory in this respect and I doubt if records taken over a given week adequately represent the situation. Admittedly, however, clothing expenditure has only an indirect influence on the nutrition of the individual, but I am inclined to think that amongst certain types, particularly the adolescent girl, who has been only a year or two at work, clothing competes seriously with food in the expenses account. Capital expenditure on household goods is even more erratic.

Professor Bowley touched upon the treatment of expenditure on meals purchased away from home, and rightly pointed out that in pre-war years this feature of working class life was negligible, but I am sure it is a feature which will be much more important after the war than ever before. We are already accustomed to the provision of milk to schoolchildren, and this service may be expected to develop into full meals as well. Even so, this may represent only 5 dinners a week for, say, 40 odd weeks in the year, at what may be called a "cut price," out of 28 meals a week for 52 weeks. Nevertheless, for anything approaching analytical accuracy, the provision of school meals will certainly introduce a tiresome element in the technique of family expenditure inquiries. If canteen services and British Restaurants continue to function, adults as well as children will contribute to this complication.

There is a general line of principle which I should like to indicate and which, for want of time, I must leave others to develop. It can briefly be put as a question. To what extent is the pre-war working class position likely to apply after the war? At the present time of course, earnings are very different from what they were 5 years ago; families are dis-integrated, costs are greater and, as important as anything, the range of goods and services available is to a large extent controlled on an individual basis. Thus we should expect the war time relationship between family income and expenditure on food to be quite peculiar and bear little relationship to pre-war experience. What then, are we to expect in the more distant future?

First, is the age and sex composition of the family as a unit likely to be radically changed? This depends on the dents and bumps which the war will introduce into our various demographic curves and it is premature to advance an opinion with any confidence.

On the assumption that supplies of consumers' goods will suffice eventually to permit the lifting of control, a second factor is the relationship between income and cost of living. This consideration involves the post-war level of real income which will exercise a considerable influence on the proportion of family expenditure devoted to food. One may perhaps expect that after the transition period of re-adjustment to conditions of peace, real income will show some advance on the pre-war position. Will the people then buy the same volume of foodstuffs as before, by which the proportionate expenditure on food will be reduced? Alternatively, will they devote part of their economic advantage to an increased consumption of foodstuffs which would maintain if not increase the proportion so spent? In so far as the latter is desirable, the responsibility lies with those in the nutrition field whose duty it is to educate the people in order that the increased expenditure may be most wisely directed.

There remains a third factor which will determine in the years to come the proportion spent on food, the interrelationship in the rise in price levels of various goods and services. Rent is sometimes regarded as the first charge on family income and the demand for, and supply of, living accommodation will make a problem of the first order of perplexity. Then, as between the essential and the less essential foods, any variation in their respective relative increases must materially affect the proportion spent on food as a whole.

I have introduced this reference to the future as a warning. We should, I think, be fully prepared to realize that, in 5 years' time, the data gathered over past years with so much difficulty may be hardly more than a historical record. I am not of course depreciating the value of the data on that account, but I am suggesting that we should be prepared to face the fact that an entirely new set of circumstances is more than likely to render our existing information obsolete for current purposes. Once again we shall have to begin collecting information afresh. I do indeed hope that means will be found whereby, in the future, the data can be collected more widely, more systematically and in a less haphazard fashion, than in the past.

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Professor A. L. Bowley replied: I agree with Mr. George that the division between earners and dependents is inadequately defined. The question is one of fact, as to what members of a family are dependent on the income under consideration. The deviations in the examples given by me were probably smaller, owing to food restrictions, than under normal conditions.

Relation of Expenditure on Food to Other Family Expenditure

Mr. D. Caradog Jones (School of Social Sciences, University of Liverpool)

We are all, rich and poor alike, interested in living and the cost of living, but clearly, however measured, these do not mean the same thing to rich and poor. Our discussion of living must be confined to concrete things, things which are exchangeable and which we can acquire or dispose

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of more or less readily with money. Even with this limitation in the definition, the range and capacity of the term is expansive and elastic for those who possess a large income; for those with small incomes it is cramped and hemmed in. One might say, in short, that the poorer the family, the less will the term living stretch to include anything much beyond the bare necessities of existence.

It will be seen that, according to this conception, the "cost of living," in the material sense of the term, for any given family is to be measured by the amount that the family spends on living in a given period of time. In other words, I relate *living* to *expenditure* rather than to income, although, of course, the higher the income, the higher also is the potential expenditure. If the members of any given family do not spend all their income over a selected period of time, the balance remains to be spent on living at some future time, though this may be by their descendants, not themselves. According to this definition, it is also possible for people to live for a time beyond their income, and so run into debt. This may be termed riotous living, but it is still living.

When the standard of living is fixed, the cost of living for a selected family at the defined standard is obviously related to the size and composition of that family, the larger the family, the higher the cost. Also, if prices change, the cost of living changes, although the standard of living and the composition of the family may remain unaltered. To summarize, living for any given family can be measured in terms of money; the amount spent by the family in an assigned period of time is their cost of living, and this cost, to use a mathematical form of expression, is a function of certain variables, standard of living, size and composition of family, and the price level.

Having defined terms, let me pause a moment to explain what I conceive to be the chief purpose of this paper. Among the fundamental objects of The Nutrition Society I take it that one is, by the promotion of research, to discover minimum requirements of various kinds of food for adequate nutrition, *i.e.*, for reasonable health and efficiency, and to estimate their cost. Since there are other basic needs besides food to be considered, these compete, when the income is limited, with food and with each other for satisfaction. Hence it is important that we should be able to define and estimate the cost of meeting minimum needs for clothing, house room, fuel and light, and other essential miscellaneous items as well as for food. My function is to put forward comparative figures, however provisional, under these several heads.

It is necessary to stress the provisional character of these estimates, because far too little scientific attention has been paid to human needs apart from that of food. We have not inquired, for instance, what is the minimum amount of patent fuel, oil, coal, gas or electricity needed to heat or illumine rooms with the maximum efficiency according to their size, if health and physical well being are to be maintained, when account is taken of the different types of heating and lighting systems available, and of the varying character of the climate from region to region, and from season to season. Again, it is the desire to prevent overcrowding rather than to preserve health and vigour which has led us to ask how many rooms and of what size should be regarded as a satisfactory minimum for families of specified composition. Also, before the coupon

system came into use, it is surprising what little thought was given by the public in general to the number, variety, and quality of different kinds of clothing needed in the course of a year by each individual according to age and sex. The primary purpose of the coupon system is to see that everybody gets a fair share of the limited stocks available; it is not claimed that we all get just what we need. Indeed, it would not be far from the truth to say that hitherto investigators have been content in the main to discover what is the customary expenditure on different commodities in selected classes of the population, and to assume that what is customary is adequate, as long as, in general, people appear to do their work from day to day with tolerable efficiency and without being conspicuously and frequently absent from work on account of sickness. Working conditions, under the title industrial welfare, are in fact receiving increasing consideration; leisure time and home conditions, regarded as the private concern of the individual and his family, have been somewhat neglected.

In our estimate of the cost of living for other items than food we are obliged, therefore, to make the best of the figures we have. We cannot do better than start with the collection of working class budgets made by the Ministry of Labour in 1937-38 (Ministry of Labour, 1940, 1941, 1, 2). This is certainly the finest sample of British budgets available: it is authoritative, having the Government behind it; and it is large, nearly 9000 industrial and 1500 rural households throughout the United Kingdom having supplied detailed figures of their expenditure over a four week period, the weeks being chosen at three-monthly intervals to allow for seasonal changes. The analysis of the expenditure and, therefore, by our definition, the cost of living, of these town and country families is shown in Table 1. With the 1491 agricultural budgets, collected directly

TABLE 1
AVERAGE WEEKLY EXPENDITURE OF INDUSTRIAL AND RURAL HOUSEHOLDS

Item of expenditure	Ministry of Labour household budgets, 1937-38 (Ministry of Labour, 1940, 1941, 1, 2)				Village, 366 England and Wales	
	Industrial, 8905 United Kingdom		Agricultural, 1491 United Kingdom			
	Amount spent	Per cent. of total	Amount spent	Per cent. of total	Amount spent	Per cent. of total
Food	34/1	40.1	27/9	48.4	28/1	49.5
Rent and rates ..	10/10	12.7	4/9	8.3	4/7	8.1
Clothing* ..	8/1	9.5	5/3	9.1	5/3	9.3
Fuel and light ..	6/5	7.6	4/11	8.6	4/9	8.4
Miscellaneous ..	25/7	30.1	14/8	25.6	14/0	24.7
Total ..	85/0	100.0	57/4	100.0	56/8	100.0
Mean no. of persons per household	3.77		3.79		4.25	

* The figures for clothing and footwear are based on returns made over a period of 12 months.

by the Ministry of Labour in the United Kingdom, are compared 366 collected from village households in England and Wales with the co-operation of the National Federation of Women's Institutes. The mean size of household, it will be noted, is somewhat larger in the village household sample. Notwithstanding this slight difference, the resemblance between the detailed figures of average expenditure in these two independent collections of rural budgets is remarkable. No less striking are the differences between the figures for the industrial and the agricultural households. The absolute cost of living, according to the average standards here revealed for families of comparable size, is considerably higher in the town than in the country, the additional expense amounting to nearly 30/- a week or approximately 50 per cent. The differences for the several items are of the following order of magnitude: rent and rates 128 per cent., miscellaneous items 74 per cent., clothing 54 per cent., fuel and light 30 per cent., and food 23 per cent.

The numerous statutory regulations governing the assessment of needs for the determination of pensions and unemployment assistance have recently been codified into a single and simpler set of rates which were published in draft form in December of last year. Those who have studied the new draft may recall the following paragraph: "Under the current Regulations there is power to reduce the allowance or supplementary pension otherwise payable if the person is living in a rural area. Changes in rural economy and wage rates together with the introduction of rationing and price control have all tended to eliminate variations between standards and cost of living in rural and urban localities, and the principle of rural differentiation may therefore be regarded as out of date. The Draft Regulations accordingly omit the provision which permits such differentiation" (Ministry of Labour, 1943). How true this may be under war conditions I do not know, but I question whether a gap as large as that discovered between standards of living in town and country just before the outbreak of war, even if bridged, could remain bridged on the return to new normal peace conditions.

When the relative importance of the different groups of items in the total budget is examined, it will be seen that food rises from 40 per cent. of the total expenditure in the town budgets to nearly 50 per cent. of the total in the country budgets; the miscellaneous group represents 30 per cent. of the total expenditure in the towns and about 25 per cent. in the country. Rent and rates decline in importance from nearly 13 per cent. of the total in towns to just over 8 per cent. of the total in the country, whereas the proportions of the total expenditure represented by clothing and fuel and light are fairly similar in both types of area.

In Table 2 a comparison is made of the living enjoyed by selected groups of town dwellers in the community. It enables us to see at a glance how the pattern of life changes as we pass from families that are relatively rich to families that are poor. The top half of the table analyses the actual average expenditure in a week by each group selected; the bottom half shows the proportional expenditure on each of the 5 main groups of items. The first 2 columns of figures are taken from Mr. Philip Massey's valuable study of the average expenditure of British middle class households in 1938-39 (Massey, 1942). The third column reproduces the Ministry of Labour figures relating to the average

TABLE 2
COMPARISON OF WEEKLY EXPENDITURE OF SELECTED HOUSEHOLD SAMPLES

Items of expenditure	Nature of sample				
	(1)	(2)	(3)	(4)	(5)
	69 Households, annual income £700 or more (Massey, 1942)	1360 Households of public officials (Massey, 1942)	8905 Industrial households (Ministry of Labour, 1940)	Sub- sistence standard (Beveridge, 1942, adapted)	62 Households, income 20 per cent. or more below poverty line (Jones, 1934)
Food	64/7	41/10	34/1	24/1	17/1
Rent and rates ..	34/10	21/1½	10/10	10/0	8/9
Clothing	26/7½	15/6	8/1	5/0	1/6½
Fuel and light ..	16/2	10/1	6/5	4/5	4/0
Miscellaneous ..	179/6	83/7	25/7	7/0	2/6½
Total	321/8½	172/1½	85/0	50/6	33/11
Mean no. of persons per household	3.97	3.27	3.77	3.77	6.18

PERCENTAGE DISTRIBUTION OF EXPENDITURE

Food	20.1	24.3	40.1	47.7	50.4
Rent and rates ..	10.8	12.3	12.7	19.8	25.8
Clothing	8.3	9.0	9.5	9.9	4.5
Fuel and light ..	5.0	5.9	7.6	8.7	11.8
Miscellaneous ..	55.8	48.5	30.1	13.9	7.5
Total	100.0	100.0	100.0	100.0	100.0

expenditure of British working class households in 1937-38 (Ministry of Labour, 1940). The fourth column will be explained later. The fifth column comes from a collection of budgets made in the course of the Merseyside Survey in 1930-31 (Jones, 1934), relating to households living 20 per cent. or more below the income level which defined poverty in that survey, but the price level has been amended to conform with that ruling round about 1938, the period to which the other budgets relate.

Some slight adjustment is needed in comparing the figures, more particularly in the top half of the table, on account of differences in the mean size of household in the 4 samples of budgets. If the number of persons per household in column 1 could be reduced and in column 2 could be raised to 3.77, the effect would be to diminish slightly the differences between the two middle class samples in columns 1 and 2 and to increase the differences between the samples in columns 2 and 3. If the size of the household in column 5 also could be reduced to 3.77, the already pronounced differences between expenditure in normal working class households and in those well below the poverty line would be further

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accentuated. If the figures are taken as they stand, there is a marked decline in the absolute scale of living in passing from left to right, from rich to poor, in the table. The average middle class household with an income of £700 a year or more, in column 1, spends roughly twice as much on food as the average industrial household in column 3, three times as much on rent and clothing, and 7 times as much on miscellaneous items. Again, if the industrial or working class households in column 3 are compared with the poorest households in column 5, the former spend on the average about twice as much as the latter on food, 5 times as much on clothes, and 10 times as much on miscellaneous items.

The bottom half of Table 2 provides the justification for our pre-occupation in the past with food as the outstanding priority at least in the working man's budget, in the fact that it accounts for 50 per cent. or more of the total weekly expenditure among the poorest families; it represents 40 per cent. of the total expenditure even in normal working class households, including those in comfortable circumstances as well as the poor; it drops to 20 per cent. as an average in middle class households where the annual income is £700 and upwards. It has in fact been estimated that 30 per cent. of the total national income in pre-war years was spent on food (Feavearyear, 1934), and that 70 per cent. of world primary production on a value basis was used as food (Hartley, 1942). Hence the paramount importance of the Conference at Hot Springs; if there is to be a scientifically planned world economy, as I believe there must be if peace is to be preserved and the standard of living in all countries is to rise, there is clearly wisdom in starting with food.

Even among the very poorest, however near the wolf gets to the door, certain payments cannot be continuously escaped, namely, payments for food, rent, fuel and light. These claim the highest shares of the total weekly expenditure in the last column of Table 2. Rent and rates account on the average for one-quarter of the total, double the proportion in the normal working class household (column 3). When people have insufficient food to generate internal heat, they feel the cold more acutely and need bigger fires; fuel and light, in the sample of the poorest families examined in Table 2, account for 11·8 per cent. of the total weekly expenditure, double the proportion in the average middle class household as judged by the figures in column 2 of the table.

The familiar progression in the proportions of the total expenditure allotted to food, rent, and fuel as we pass from rich to poor is well marked in Table 2. The proportion of the total spent on clothing is closely similar in the first 3 groups of budgets, but there is a slump in the last group to 4·5 per cent., about one-half the proportion common in families that are better off. This is accounted for by the fact that the very poor, when driven to do so, contrive to manage with what clothing they have and, even at the best of times, they frequently buy at jumble sales and second hand stores, but the most striking feature of the table is the steep downward trend in the proportion of the total expenditure that goes to purchase miscellaneous items as we pass from left to right. Among families with an income of £700 a year or more the proportion is between 50 and 60 per cent., not far short of double the proportion among normal working class families, where it is 30 per cent., and the latter figure again is 4 times the proportion among the poorest families examined.

These 4 samples of budgets provide us with data as to the cost of living at 4 different standards. While the average composition of the family as to age and sex was not precisely the same for the different samples, the households, excepting the poorest in column 5, were of much the same average size, ranging from 3.27 to 3.97 persons per household. The years also to which the budgets relate closely correspond, with the same single exception of the sample in the last column, where an adjustment of the price factor has been made so that the figures are reasonably comparable in that respect. Taking these samples as norms, we may proceed now to determine a subsistence budget, the cost of meeting the minimum needs of a family of the same size and composition as the average working class household which forms the basis of the figures in column 3 of Table 2, on the assumption also that the price level is that experienced at about the time when the Ministry of Labour budgets were collected.

Fortunately we have the data we need for this estimate in the Beveridge Report, because Sir William Beveridge had, in effect, to determine a subsistence budget in order to calculate an appropriate scale of monetary allowances for families in want on account of unemployment, sickness, or any other cause leading to the cessation of the normal family income. In his study of this problem Sir William had the assistance of an expert sub-committee, and we are told in the Report that, in respect of items other than rent, his calculations "have been approved by the Sub-committee as affording a reasonable basis for fixing rates of unemployment and disability benefits which at 1938 prices would provide a subsistence minimum in normal cases" (Beveridge, 1942).

Sir William Beveridge's food estimates provide for dietaries which conform to the scales laid down by the League of Nations Health Committee (1936) and the British Medical Association (1933). I accept these and the clothing allowances as they stand. Incidentally, it may be noted here that Sir William has evidently paid close attention, in his estimate of basic needs for clothing, fuel and light, and rent, to the results of the analysis of the Ministry of Labour budgets of 1937-38. In short, he has based his conclusions in large part on what is customary rather than on what is proved from first principles to be necessary. For example, it is explicitly stated in the Report that the expenditure of industrial households on clothing may be estimated from the Ministry of Labour Family Budgets as 2/4½d. a week for a man and 2/6¼d. a week for a woman. These amounts, it is then pointed out, are "above the subsistence requirement, since they relate to households which are living above the minimum. Moreover, clothing is an item of expenditure which can for a time be postponed. In none of the Social Surveys undertaken in various towns before the war was the weekly cost of clothing for men and women together put as high as 3/-." Hence the conclusion is reached that it "is reasonable to put the allowance for clothing in unemployment or disability benefit as 1/6d. each for a man and a woman" (Beveridge, 1942, para. 219). I want to make it clear that I do not quarrel with the conclusion reached. My point is that it is based on an examination of expenditure that is customary.

As to rent, I agree with the Sub-committee's conclusion that no single figure can be satisfactory for the needs of families in all parts of the

country. But, if a single figure is to be chosen, as is necessary for our purpose today, then I think 10/- is not unreasonable for a family of about 4 persons.

For fuel and light, reference is again made in the Beveridge Report to the Ministry of Labour budgets. In a sample tabulation of expenditure on coal, gas and electricity for households of 2 to 5 persons, covering up to 30 households of each size in each division of the country, it was found that, when arranged in the order of their expenditure, from the households which spent least to those which spent most, those which came one-quarter of the way from the bottom, which might fairly be taken as representative of the poorer families, spent on the average about 3/6d. a week when there were 2 persons in the family, 4/- when there were 3, and 4/6d. when there were 4. On this evidence, if we are to base our estimate on what is customary, I am disposed to take 4/6d. as a reasonable minimum figure for a family of 4 or 5 persons. Sir William Beveridge points to the "possibility of reducing or postponing expenditure on fuel and light, though not as much as in the case of clothing". This possibility I rather doubt, because the poor live very much from hand to mouth. They do not keep any store of fuel, and they must use the open fire or a gas or electric ring for cooking or even boiling a kettle. With no further justification than a single sentence, to the effect that "some provision must be made for household necessities other than fuel and light", Sir William then proceeds rather unaccountably to suggest that 4/- a week should be adequate to cover these other necessities as well as fuel and light for 2 persons, with an addition of 3d. for each child where there is a family of children (Beveridge, 1942, para. 220, 227).

This brings me to the point, the only point, where my figure differs significantly from the Beveridge estimate, namely, in the allowance for miscellaneous items. The amount spent on these items by close upon 9000 households supplying particulars to the Ministry of Labour for 4 weeks averaged 25/7d. per household per week, or 30 per cent. of the total expenditure in the week. Of this amount 5/9½d. was accounted for by National and voluntary insurance contributions and trade union subscriptions, and 1/6½d. by travel to and from work; 4/1d. was the combined cost of household cleaning materials and of replacement of pots, pans, crockery and brushes; tobacco and cigarettes cost 2/6½d., cinema and other entertainment 1/4½d. Among other notable items in the accounts were newspapers, stationery, stamps, hair cutting, doctor, hospital, chemist and holidays. All of these expenses may not occur in the same week but some of them will occur every week, and what we seek is a fair all the year round average cost of the essential items. While it is imperative to spend on soap and other cleaning materials and to renew brushes, pots and pans, to have one's hair cut periodically and to write an occasional letter, opinions may differ as to how essential are such items as cigarettes and cinemas. Experience shows, however, that what is customary in any class of the community, comes in course of time to be regarded as also necessary. However poor people may be, they will spend on these things even if it means going short of other things that seem to the onlooker more essential. I have gone through the list carefully, and I doubt whether the minimum estimate for miscellaneous items should be reduced below 7/- a week for a family of the average

budget composition. This is on the assumption that the bread winner is in work, so that such items as insurance contributions and travel to and from work should be included. I stress this point, because they should be excluded when a man is unemployed.

With the estimated scale of Table 3 before us, it is possible now to

TABLE 3
ESTIMATED SCALE OF MINIMUM SUBSISTENCE
(Based on Beveridge (1942): Industrial areas, 1938)

Basic needs	Children ¹ , age last birthday years			Adults ² , age last birthday years					
	0 to 4	5 to 9	10 to 14	15 to 20		21 to 64		65 and over	
				M.	F.	M.	F.	M.	F.
Food	4/6	6/0	7/0	7/6	6/6	7/0	6/0	6/0	5/6
Clothing	-/7	-/10	1/0	1/6	1/6	1/6	1/6	1/4	1/4
Rent and rates ³ may be estimated at 10/0 for a family of 4 persons									
Fuel and light ⁴	" "	" "	" "	4/6	" "	" "	" "	" "	" "
Miscellaneous ⁵	" "	" "	" "	7/6	" "	" "	" "	" "	" "

¹ Beveridge (1942), para. 227.

² Beveridge (1942), para. 218, 219, 224, 226.

³ Beveridge (1942), para. 197-216.

⁴ Beveridge (1942), para. 220 and Table 8.

⁵ Ministry of Labour (1940), para. 305.

determine the cost of subsistence for any family of known size and composition. If the figures are applied to a family of the same size and composition as the average Ministry of Labour budget family, we have the result shown in column 4 of Table 2. According to this estimate, the subsistence cost of food, fuel and light, at 1938 prices, is roughly two-thirds the average amount spent upon them by normal working class families; the cost of clothing at the subsistence level is five-eighths the normal expenditure, while the indispensable minimum of miscellaneous items costs between one-third and one-quarter the sum spent under this head, on the average, by the normal family of the same size and class. When the position of the subsistence budget in the lower half of the table is examined in relation to the series of budgets sampled, it is seen to fit reasonably well into the picture. If any group gets out of focus anywhere, it is the last, or subnormal group, made up of families well below the poverty line. It is easy to see where the shoe pinches; a sacrifice is made just where it might have been anticipated, in the clothing and miscellaneous items.

Since the household considered in column 4 of Table 2 is a mathematical figment, it may be well to apply the scale in Table 3 to a real family. For this purpose I take one consisting of father, mother and 2 children of ages 10 and 4, in order to compare the result with a calculation of the poverty line made by George (1937). This comparison is shown in Table 4, allowance having been made in Mr. George's figures for the change in prices between 1936 and 1938. He was able to make use of the best data concerning food, with the result that our estimates under this head

TABLE 4

COMPARISON OF NEW POVERTY LINE AND SUBSISTENCE STANDARD, 1938, FOR FAMILY OF HUSBAND, WIFE AND 2 CHILDREN AGED 10 AND 4

Item	Amount of expenditure	
	New poverty line (George)	Subsistence standard (Caradog Jones)
Food	24/7	24/6
Rent and rates	10/0	10/0
Clothing	3/1	4/7
Fuel and light	3/5½	4/6
Miscellaneous	-7½	7/5
Total	41/9	51/0

agree remarkably well but, now that we have later information as to normal expenditure on clothing, fuel and light, and miscellaneous items, I feel sure that his estimates under these heads should be scaled upwards. He did not concern himself with rent; I have therefore inserted the same figure in both columns. It may be of interest finally to point out that the new rate of unemployment assistance proposed for a family of this composition, father, mother and 2 children of 10 and 4, by those who framed the Draft Regulations recently presented to Parliament where the same allowance of 10/- is made for rent, is 54/6d. At the 1938 price level this would be equivalent to 43/7d., which is less than the subsistence standard submitted in Table 4 by exactly 7/5d., my estimated allowance for miscellaneous items for a family of 4 persons. Actually, if the head of the family was unemployed, the difference would not be as much as this, because my allowance for miscellaneous items would in that event be reduced by about 3/-. That deduction should be made also in comparisons with Mr. George's figures, because he purposely omitted from his calculations the cost of travelling to and from work and compulsory insurance payments in addition to rent.

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Discussion

Mr. C. Madge (Political and Economic Planning, 16 Queen Anne's Gate, London, S.W.1), opener: Mr. Caradog Jones' paper has brought out very clearly the effect of income level on the pattern of consumption. An additional point is that in the weighting of the Ministry of Labour's cost of living index, 4 per cent. of total expenditure was allowed for miscellaneous items, which was only half the proportion spent by the families in extreme poverty, according to the last column in Table 2 of Mr. Jones' paper.

At any given income level, and in families of the same composition, there is still variation from one family to another in the proportion spent on different items including food. Data on this type of variation are rather scarce, so I propose to quote some results which I obtained in a budgetary survey in Leeds in 1942 (Madge, 1943). Here I was able to compare two sets of 61 families with the same family composition and almost the same income distribution; the average net income in both sets of families was the same. The difference between the two sets of families was that one set was saving 14 per cent. of its net income, while the other was saving 4 per cent. The high savers spent 41 per cent. of their net income on food, the low savers 45 per cent. This difference was statistically significant.

I believe it would be interesting and worth while to make similar comparisons between groups, say of big eaters and little eaters, of the same income level and family type. The point is that other normative influences are at work besides income and family composition. Occupation and upbringing play their part in deciding norms of food expenditure. I am inclined to think one might also distinguish different norms for families in different states of physiological and nervous health. Thus a given type of diet, originating from economic circumstance but subsequently accepted as socially normal and associated with a recognized manner of life, may lead to anaemia, and the anaemia may then, by a sort of vicious circle, be a permanent conditioner of the rest of the pattern of consumption.

Evidence of this sort was found by the Peckham Health Centre (Pearse and Crocker, 1943). The families under observation there were by no means all in the lower income groups, but a majority were found to be sub-normal in health, and socially sluggish and to show definite physiological deficiencies. Giving them the right food was only part of the treatment necessary.

The inertia of old people also might be partly induced by the social convention that at a certain age you stop working, eat very little and retire into your shell. With an increasing proportion of the population in the higher age groups, a more active type of old person is going to be needed. To attain this, the social convention will have to be changed. Old people will have to eat more and will, therefore, need more to spend on food.

An important factor in deciding variation in the proportion of total expenditure on food is the division of earnings between husband and wife, a point mentioned by Professor Bowley (1945). In my inquiries on working class saving and spending, I found that the conventions about

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this varied strikingly in different parts of the country. In Glasgow, the husband gave his wife a fixed sum of money every week, and the wife in many cases did not know how much of his total earnings her husband was retaining for his own use. In Lancashire, on the other hand, it was normal for the husband to give his pay packet intact to his wife, who then gave him back as much as she thought he needed. In Yorkshire, the position was rather more favourable to the wife than in Glasgow, but less so than in Lancashire. Very roughly, on an average, a quarter of his earnings was retained by the husband. The big items in his expenditure were alcohol and tobacco. The addition of children to the family made strikingly little difference to the proportion handed over to the wife. With 3 or more children, the proportion was higher, but by no means sufficiently so to cover the extra cost of the children.

The motivation of all this is an important subject for inquiry from the point of view of social studies in nutrition. It is a complicated and many sided subject. As well as statistical studies, we need observation of the family in action, and here such methods as those of the Peckham Health Centre, previously mentioned, are likely to prove of very great value.

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Dr. E. R. Bransby (Ministry of Health, Whitehall, London, S.W.1): I also have had experience of the different practices adopted by different communities as to the handing over of housekeeping money by workers to their wives. In one study I obtained data from 2 mining communities separated by only a few miles. In one, all earnings were given by the miner to his wife who handed back a small amount of spending money; the housewife purchased the weekly tobacco with her groceries. In the other, the miners gave housekeeping money to their wives, keeping what they thought fit for themselves. I formed the opinion at the time that the customs were long established and quite definite. The first group of miners was of a rather better type than the second.

Professor J. R. Marrack (London Hospital, Whitechapel, London, E.1): I do not think that 24/6d. would be an adequate allowance for food for an average family of 3.77 persons; it is only 6/7d. per head. It is not merely a matter of taste and custom but of availability of food. The British Medical Association (1933) estimate was based on the assumption that the very cheapest foods were bought. If, however, an appreciable proportion of the population attempted to buy the cheapest foods, these would become dear or unobtainable. Actual surveys carried out at the same time showed that people did not get adequate food for less than 10/- per head.

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Dr. S. W. Swindells (1 and 2 Albion Terrace, Cartergate, Grimsby): The estimate of 10/10d. for rent and rates quoted by Mr. Caradog Jones is too low, even for 1938.

Mr. D. Caradog Jones replied: No single figure is appropriate for rent for all parts of the country, but if a single figure has to be taken, as was necessary for my purpose today, Sir William Beveridge's estimate of 10/- a week for a family of 4 persons is not unreasonable under 1938 conditions. I say this in view of the fact that the average weekly rent paid by the random sample of nearly 9000 industrial households investigated by the Ministry of Labour in 1937-38 did not exceed 10/10d. It would be too low in parts of London and too high in parts of Scotland but, as an all round average, it is, I consider, the most suitable figure to take.

Chairman's Concluding Remarks

Sir John Orr (Rowett Research Institute, Bucksburn, Aberdeen): It is obvious that it is impossible to get data on food consumption for families with the same degree of accuracy as for experimental animals. A week's survey, involving accurate estimation of the food in the house at the beginning, of the food entering the house, and of the food remaining at the end of the 7 day period, gives an estimate of gross consumption sufficiently accurate for all practical purposes, and the deduction of waste according to the estimates which have been made in a large number of households gives a reasonably accurate estimate of the net amount consumed.

Dietary and clinical surveys should, as far as is convenient, be done together. Any gross deficiency in the diet should be reflected in health and physique. If, then, the diet of a sufficiently large number of families be brought up to the health standard for at least 12 months and the effect on the health of these families noted against that of comparable families whose diet has not been improved, the circle is complete. That was the method adopted in an investigation of 1500 families done from the Rowett Institute in 1937-39.*

Budgetary surveys are now of as great importance as dietary surveys to provide data on which to base decisions as to the extent to which the price of the protective foods will need to be reduced, or the purchasing power of the poorest families increased, in order that a diet adequate for health may be enjoyed by every citizen. In estimating what proportion of the total family income can reasonably be devoted to the purchase of food, we must keep in view all the other things needed for health and well being in addition to the merely material things needed for adequate food and shelter. It is sometimes stated with truth that money is spent on things which do not appear to be essential for health, and the poor are sometimes blamed for spending on beer or on cinemas money which might be more advantageously spent on food, but we should not be too

* The data of this investigation were made available to the Ministry of Food but the report will not be published until after the war.

ensorious in our judgments. It is difficult for those who have never lived in the sordid conditions of overcrowding which prevail in some of our slums to say whether or not a temporary escape from these conditions in a bar parlour or cinema may not be as beneficial for psychological and even for physiological well being as a temporary increase in the consumption of one or other of the protective foods. The world of the future is a world of potential plenty. In making estimates of the standard of living which we can afford, there is no need to screw things down to the bare necessities. We should plan for an optimum diet, and a physical and psychological environment in which every citizen can enjoy a full life.