

BASIC

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STUDY

Freedom from Hunger Campaign

**NUTRITION
AND
WORKING EFFICIENCY**



FREEDOM FROM HUNGER CAMPAIGN

Basic Studies Series

A series of Basic Studies supporting the Freedom from Hunger Campaign is being published by the Food and Agriculture Organization and other organizations of the United Nations.

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NUTRITION
AND
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FOREWORD

The first half of the twentieth century has witnessed three major revolutions. The political revolution has given self-government to nearly a third of the world's population and has brought their aspirations for a better life to the forefront of world attention. The revolution in communications has broken down the barriers of distance and language, and the dynamism of ideas can no longer be contained within the limits dictated by social privilege or political considerations. The demographic revolution has imparted to the challenge of poverty and want a new dimension.

It is against this background that the Freedom from Hunger Campaign was launched in 1960 by the Food and Agriculture Organization of the United Nations. Its main objectives are twofold: first, to create a worldwide awareness of the problems of hunger and malnutrition which afflict more than a half of the world's population and which, apart from the human suffering and human degradation that they involve, pose a serious threat to peace and orderly progress, and second, to promote a climate of opinion in which solutions to these problems can be organized both on a national and on an international basis.

In the short time since its launching, the Campaign has already provided a focus for co-operative endeavor for international organizations, national governments, nongovernmental organizations and various citizens' groups all over the world. The 104 Member Nations attending the biennial session of the FAO Conference in November 1961 paid unanimous tribute to the significance of this Campaign for the future well-being of the world.

The Freedom from Hunger Campaign attempts to attack the problem of hunger on a broad front and at all levels of economic and social thought and action; but for practical purposes, it defines three sectors of operation: (a) information and education, (b) research, and (c) action.

The information and education sector will help bring to citizens everywhere a living awareness of the concrete facts and issues, and provide bases for deciding what new national and international policies and action programs are needed. This effort to create informed and active awareness will rise to a climax with the World Food Congress to be held under FAO auspices in 1963. Many international professional and citizens' groups will hold forums on Campaign issues in 1962 and 1963. Many national Campaign Committees will also organize similar discussions. Representatives from all these bodies are expected to participate in the World Food Congress and help bring into focus policies and action plans for the future.

*The series of **Basic Studies** has been prepared by FAO and other co-operating international organizations to aid citizens in discussing the great issues involved.*

These documents attempt to summarize the known facts and agreed conclusions of experts in each special field, and thus provide useful and reliable background material for study groups and public discussions.

The volumes in this series cover broad subjects such as the adequacy of food levels in the world, the possibilities of producing more food, and the ways in which economic development and training in the newly developing countries can raise buying power and thus help hungry people to buy more food for themselves. They bring out the central importance of good nutrition for health and working efficiency, and study how people can learn to choose their foods better. They appraise the efforts being made in individual countries to raise food output, to increase jobs and incomes, and to train and educate people in ways to increase production and in better dietary habits. The volumes cover the relation of food production to climate and weather, the better distribution and marketing of food, and the use of available surpluses to relieve hunger and provide an incentive to economic and social development in the developing countries.

*I trust that these **Basic Studies** will stimulate thought and action on the critical problem of hunger and contribute to an ever-expanding understanding of the related social, economic and technical issues.*

B. R. SEN
Director-General

PREFACE

Almost half of the world's population today is suffering from serious undernutrition and malnutrition, with little hope of a quick remedy. In many countries, food consumption is still limited by the capacity to produce foodstuffs and by low purchasing power. In vast areas of the world, such as the overpopulated countries of Asia, as well as in Africa and in Latin America, the development of agriculture and industry, which alone would ensure a regular and adequate food supply, is hampered by lack of suitable equipment, of funds and of trained personnel. Lastly, not the least cause of this situation is the human factor, namely, the low working efficiency of the people, which in turn is partly due to undernutrition and malnutrition. Here is a vicious circle that has to be broken: lack of suitable food — undernutrition and malnutrition — low working efficiency — low production of food.

The effect of the quantity and quality of the diet on the capacity for work is often not clearly recognized, because of the difficulty of measuring this effect under normal working conditions. Other factors may play a more evident role than the diet in reducing working efficiency, and it is only under carefully controlled conditions — as obtained in experimental work — that the influence of all possible factors can be correctly evaluated.

This publication has two main purposes:

1. To bring to the attention of interested people available information — obtained through experimental activity, in the laboratories and in large working communities, and through surveys and experts' reports — concerning the influence of the diet on working efficiency. The facts and data reported herein clearly point to the need for improving food consumption in order to increase working efficiency and productivity, as well as health and well-being.

2. To suggest practical measures for the improvement of the food consumption of the working categories of the population.

It is realized, of course, that every person in one way or another is a "worker": the woman in the house, the farmer in his field, the employee, the child at school. It is also recognized that general economic progress in developing countries will bring about improvement in food consumption of most sections of a population. Measures aiming at the formulation of comprehensive programs for expanding production, raising the income level and ultimately speeding up economic development are the subjects of other Freedom from Hunger Campaign publications, which also consider programs directed to the family, the school and other communities.

The emphasis here will be on those workers who can be more easily reached through their employers and on the measures which are likely to bring about improvements in the nutrition, physical fitness and working efficiency of those workers in a relatively short time.

This publication appears particularly important in view of the fact that large working communities are becoming more and more common as urbanization and industrialization increase. This is true especially for developing countries, where these phenomena are relatively new and where there is considerable scope for their expansion, with economic development, in the near future.

Rapid urbanization and industrialization pose many problems in relation to the physical and psychological aspects of the change in food supplies and dietary habits of the populations involved. To give just one example, a number of studies carried out in Africa suggest that in the newly developing countries, which are just beginning to build up modern large-scale industry, the traditional diet which previously was more or less adequate to a tribal way of life requiring little sustained effort, is found to be insufficient for a worker from whom a regular, sometimes strenuous effort is called for, e.g., a worker in a modern factory.

These problems need to be considered in time and suitable measures adopted in order to facilitate the adaptation of the people to the new working conditions, while maintaining or improving their physical fitness and working efficiency.

INTRODUCTION

While accurate data are not available regarding the actual quantities of foodstuffs consumed per day by workers employed in the different industries in various countries, all authorities are agreed that in most countries in Africa, Asia and Latin America today the average food consumption falls considerably short of the optimum desirable from the point of view of the health, as well as the efficiency, of the worker.

The Intergovernmental Conference of Far Eastern Countries on Rural Hygiene, held at Bandung (Java) in 1937, reported: "The available evidence suggests that undernourishment and malnutrition is widespread and that much impairment of physical development and general health, low vitality and actual disease result from insufficient and improper diet."

The United Kingdom Committee, which reviewed the situation regarding nutrition in the colonial empire, reported in 1939: "We have no doubt at all that there are few parts of the colonial empire where the diet of the majority of the population is at present anything like sufficient for optimum nutrition. Diets are frequently insufficient in quantity and still more insufficient in quality. If they are bulky, the bulk is too often made up of foods that do not supply all the needs of a balanced diet. Judged by European standards they lack variety and they lack protective value."¹

The recent reports of the Regional Conferences on Nutrition² confirm that these statements, based on observations and surveys

¹ *Nutrition in the Colonial Empire*, London, H.M.S.O., 1939.

² *Report of the Nutrition Committee for South and East Asia, Fourth Session, Tokyo, Japan, 1956*. FAO Nutrition Meetings Report Series, No. 14, 1957; *Report of the Fourth Conference on Nutrition Problems in Latin America, Gua-*

made in the late thirties, were still true twenty years later for many countries in Africa, Asia and Latin America, in spite of the efforts to improve the situation made by the governments concerned, often with international assistance.

The average diet of the working class in all the less developed countries today is almost invariably deficient in calories, in animal proteins, and in the vitamins necessary for the maintenance of proper health.

An unfortunate aspect of this problem is that the workers in these countries adapt themselves, at a low level of vitality, and with their powers impaired, to an insufficient ration, and scarcely realize that they are underfed. The exact extent to which inadequate food consumption through the resulting poor nutritional status reduces working efficiency escapes accurate measurement, but almost all the official commissions, as well as individual experts who have studied this subject in the different countries, agree that a poor diet is an important cause of reduced capacity for work, because:

- (a) the body tends to protect itself from the lack of proper food by avoiding effort, the final result being lethargy, lack of initiative and drive;
- (b) a poor diet lowers the worker's resistance to disease;
- (c) it leads to a considerable amount of absenteeism because of sickness;
- (d) where the workers are undernourished and tend to tire quickly, the accident rates tend to be higher.

In this connection it is not without significance that the countries in the world which have the lowest per caput food consumption in terms of calories and protein intake per day are also those where the efficiency of the workers is the lowest.

It is interesting to quote here the following comments expressed in the United Kingdom report of 1939 mentioned previously: "It

temala City, Guatemala, 1957. FAO Nutrition Meetings Report Series No. 18, 1959;
Report of the Nutrition Committee for the Middle East, Cairo, Egypt, 1958.
FAO Nutrition Meetings Report Series No. 24, 1959;
Report of the Seminar on Food and Nutrition Problems in Africa South of the Sahara, Lwiro, Belgian Congo, 1959. FAO Nutrition Meetings Report Series No. 25, 1961.

cannot be sufficiently emphasized that while a diet of little or nothing but cereals may keep body and soul together, it cannot suffice for full efficiency," and: "We regard it as almost certain that in Africa, quite apart from humanitarian considerations, any money spent on bringing the food consumed by the laborer up to an adequate well-balanced ration will be money well spent from the immediate point of view of an employer."

1. DIETARY REQUIREMENTS FOR DIFFERENT ACTIVITIES

It is generally known that good meals fortify while, on the other hand, lack of suitable food weakens people. Although this already implies an interrelation between nutrition and work, a more detailed analysis of the problem would appear to be warranted.

It is easily understood that dietary requirements vary according to different occupations. What is sufficient for a sedentary life is not so for physically active people. Although the requirements of food also depend to some extent on body size, sex, age, climate and state of health, the most pronounced variations are due to differences in activity.

Physical activity is combined with an expenditure of energy which in turn is derived from the oxidation of body substance and therefore ultimately from foodstuffs. Food must regularly replace the metabolized reserves of the body. If the replacement is insufficient, the body weight will decrease and, as a consequence, so will the working capacity decrease.

Calorie requirements

The energy expended for work, as well as the energy that is supplied by the diet, is commonly expressed in calories. The diet supplies calories mainly in the form of carbohydrates and fat. While optimum function depends just as much on a sufficient supply of proteins, vitamins and minerals, the change in requirements due to physical work is mainly in respect of calories.

In order to estimate the calorie requirements of an occupation, it is necessary to assess the effort that is called for. To this end, occupations may be classified into categories according to the grade of

physical exertion. Attempts to establish generally valid categories have been made by the League of Nations in 1936, by the National Research Council of the United States in 1944, and by others.

The FAO Committee on Calorie Requirements,¹ in its 1957 report, indicated three levels of calorie requirements, according to different degrees of activity, taking the Reference Man² as the standard (Table 1).

TABLE 1. - CALORIE REQUIREMENTS FOR DIFFERENT DEGREES OF ACTIVITY
(Reference Man)

Degree of activity	Calories/day
Sedentary	2 800
Moderate	3 200
Heavy	4 400

The figures 2,800 and 4,400 probably represent extreme limits, in the opinion of the FAO Committee.

General figures of this kind cannot be utilized when a precise assessment is wanted of the calorie requirements of individual occupations. This assessment is not easy. The difficulty arises when an occupation like farming, or mining, has to be rated. Farm work may be anything from heavy to light, sometimes even sedentary. In mining, physical efforts range from cutting, classifiable as very heavy, to the light work of the winding engine man. A clerk may be sedentary but may also do light or moderate work. As pointed out in the FAO report on calorie requirements, "the mere designation of name to an occupational group, for example farming, may give little information on the energy expenditure of the group concerned. Conditions vary from one country to another and in certain parts of the world mechanization is radically changing the character of many occupations. The general trend is in the direction of lower human energy expenditure

¹ *Calorie requirements. Report of the Second Committee on Calorie Requirements.* FAO Nutritional Studies No. 15, 1957.

² The Reference Man is defined as follows: 25 years of age, healthy, weighing 65 kg, living in the temperate zone at a mean annual temperature of 10°C. Therefore, the figures in Table 1 are independent of body size, age, environmental temperature.

and hence lower calorie requirements, although this may not be true for all individuals in a working community.”

Mechanization often means a change from physical work to increased mental tension, continuous concentration, and greater precision of movement. In many cases it has led to a reduction in the number of men at work in an establishment; under those circumstances, the redistribution of work may lead to increased activity for some individuals, as compared with previous conditions.

THE PRACTICAL APPROACH: DETERMINATION OF ACTUAL ENERGY EXPENDITURE

For the efficient development of the production program of an industrial or agricultural establishment, it is not enough just to consider the number of workers necessary for operating machines and for other work processes. Indeed, the planning should include an estimate of the effort expected of those workers and eventually the calculation of their daily food requirements.

On the basis of such data, and taking into consideration the other information concerning salaries, available foods, cost of foods, etc., it will be possible to evaluate whether those workers are in a position, economically and otherwise, to obtain from their daily diet the amount of energy they require.

The assessment of the dietary requirements of workers at a given site, and for a given type of work, calls for more detailed information than that provided by general classifications of the type reported in Table 1. A number of methods for the determination of the energy expenditure for a job is commonly applied in industry and may also be used in agriculture. A description of a typical procedure is given in appendix 1.

Many observations indicate the existence of a physiological regulatory mechanism by which, over long periods of time, energy expenditure is kept at the level of energy intake. Consequently, if the food supply for the worker is for one reason or another limited to a low calorie intake, work output will be limited to the same extent. This has often been observed on occasions of general food shortage and some examples are given in chapter 2. A quantitative dietary study will provide evidence in favor of, or against, the dietary factor influencing work output. Further evidence may be obtained by improv-

ing the diet of the worker and observing the results. The possibility that deficiencies other than in calories — e.g., in protein, vitamins — play a role in reducing work output, should be kept in mind when adopting this procedure.

Requirements for protein, vitamins and minerals

A balance between calorie requirement and calorie intake is the first requisite for satisfactory working efficiency, but it is not the only one. Protein, which is one of the main components of the body structure, must be supplied by the diet in quantities sufficient to build up and maintain muscular tissue. An adequate daily allowance for the normal adult man is 1 gram of protein per kilogram of body weight.

The supply of sufficient amounts of vitamins and minerals is another condition for general health and for a full working capacity. If general health is weak or the muscles poorly developed, the worker will be unable to do heavy work requiring high calorie expenditure. In this case, he will need additional amounts of high-quality food to restore his health and develop his muscles. Thereafter, the food intake must be sufficient to ensure the maintenance of health and muscular status.

The need for an adequate supply of water and salt, to replace losses through perspiration, should not be neglected, especially with respect to workers in hot environmental conditions.

Requirements of children and adolescents

The employment of children in any type of regular work is in principle undesirable, and measures are nowadays usually taken to forbid it. It is, however, an undeniable fact that children at work are still found in many countries, especially in poor areas where the family budget often depends upon the children's contribution to it. Much more common is the employment of adolescents, a widespread occurrence even in highly developed parts of the world. In this connection, it is important to know that regular physical work places a great strain on the growing organism. The provision of sufficient

food is especially important here in order to avoid severe disturbances of development and the appearance of symptoms of malnutrition. Malnutrition in children is of great significance from the point of view of their later working capacity, for there is evidence to show that some of the effects of malnutrition may persist through adult life. People who in their childhood have suffered from malnutrition, later frequently seem unable to attain a normal working capacity, even with an adequate diet.³

The daily protein requirements of children are in the order of 2 grams of protein per kilogram body weight. For adolescents, 1.5 grams of protein per kilogram body weight should be provided. The requirements of vitamins and minerals are also relatively higher than those of adults.

³ *African Labour Efficiency Survey*, London, H.M.S.O., 1949.

2. RELATION BETWEEN DIET AND WORKING CAPACITY

One of the most prominent symptoms of prolonged lack of food is the obvious loss of working capacity in its broadest sense. There is an appearance of lethargy and sluggishness; movements are slow, infrequent and interrupted by long pauses; any continuous effort is avoided as far as possible. Superficial observers have taken these conditions, commonly found in poor people living in hot climates, for laziness; sometimes it has been called an ethnical characteristic, or an enviable philosophical attitude toward life. When those explanations were proposed, no account was evidently taken of important environmental factors, like unemployment and undernutrition or malnutrition.

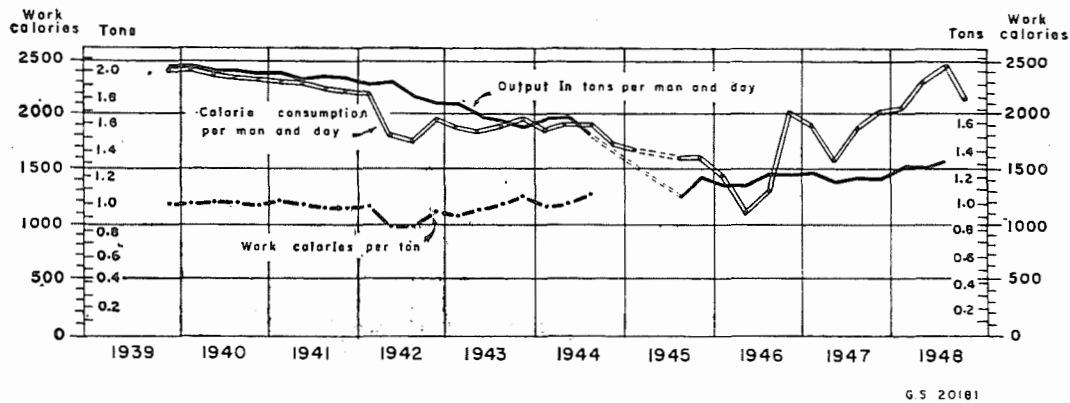
The adverse effects upon working efficiency of inadequate food consumption in general, and of deficiency of single nutrients, have been demonstrated in several field observations as well as under experimental conditions. A few examples are reported below. It must be emphasized, however, that the separate effects of lack of calories and of nutrients upon working capacity are obtained only under strict experimental conditions. Under normal conditions, the reduced capacity for work is usually the result of combined deficiencies.

Calories

FIELD OBSERVATIONS

During and immediately after the second world war, a remarkable correlation between calorie intake and work output was observed in the Ruhr district of Germany, in relation to production of coal. In 1939 the miners' rations provided an average of 4,500 calories, of

FIGURE 1. - Relation between calorie intake and work output in coal mining

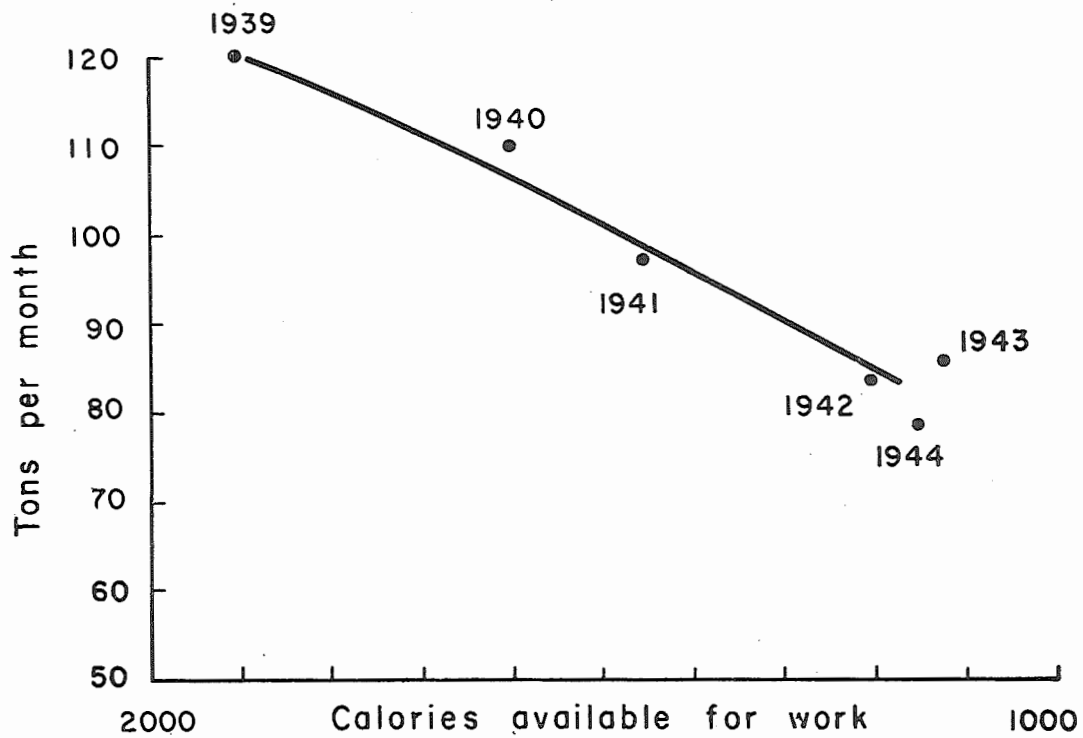


which 2,200 calories were required for the maintenance of metabolism and for the various activities not directly related to work. The remaining 2,300 calories were available for work (work calories). The daily output per miner was 1.9 tons of coal mined, i.e., about 1,200 work calories per ton.

As the war proceeded and the food situation became worse, only 1,700 work calories were available in 1942, and the coal output diminished slowly. When for some time only 900 calories per ton were available, the workers lost weight. In 1944, with 1,900 work calories, 1.65 tons of coal per man were mined daily — which again corresponded to 1,200 work calories per ton of coal (Figure 1). On the average of all food consumed, the amount of coal produced per 1,000 calories consumed fell from 0.42 ton in 1939 to 0.40 ton in 1944.

The development of production in a German steelworks during the last war provided another example of the close relation between work calories and production. The establishment was spared from air raids and the production program remained exactly the same throughout the war. In 1939, the workers' rations supplied 1,900 work calories, and the monthly steel production amounted to more than 120 tons per man. However, when food rations became smaller, the output fell more and more, until 1944, when only 1,150 calories were available for work, production was less than 80 tons monthly

FIGURE 2. - Relation between calorie intake and work output in a steelworks



G.S. 20181

per man (Figure 2). Again, output for 1,000 calories of total food consumption fell from 29 tons per month in 1939 to 26 tons in 1944.

In both cases, decline in the food consumption level resulted in reduced output per unit of food consumed.

EXPERIMENTAL EVIDENCE

Exact knowledge about the nature of the deterioration of physical performance is based to a great extent on the starvation experiment conducted in the United States during the last war.¹ In this experiment 32 volunteers lived for 24 weeks on a diet which provided only 1,800 calories per day and extremely reduced amounts of protein and other nutrients. A loss of muscle strength and of endurance at work were soon evident, and continued along with the reduction of body

¹ A. Keys *et al.*, *The biology of human starvation*, Minneapolis, University of Minnesota Press, 1950.

weight throughout the experiment. At the end of the semistarvation period, muscle strength was reduced by nearly 30 percent, and precision of movement by 15 to 20 percent. Similar findings were reported from prison camps during the last war.

Equally important seem to be the changes that occurred in the reactions to work of the cardiovascular and the respiratory systems. The increase in pulse rate caused by a given work load was greater during semistarvation than before. The capacity to perform heavy physical work (Harvard Fitness Test) was dramatically reduced. While the exact nature of the effect of semistarvation on heart and circulation was not clear, despite a battery of tests, the direct reason for the reduced endurance would appear to be the diminished supply of oxygen to the working muscles. The reduced cardiovascular performance is a feature that has also been observed in many other instances, where the food restrictions were less abrupt than in the experimental starvation. It is directly related to the well-known decrease in endurance at hard work.

The effects of malnutrition in these experiments are much more severe and occur earlier than in chronically undernourished populations. Obviously, the sudden change from the relatively rich North American diet to starvation rations allowed only a partial adaptation to the new situation. Nevertheless, the observed symptoms correspond remarkably well to the type of symptoms seen in longer-lasting famines or semifamines.

Protein

Heavy muscular work may require an increase of muscle tissue and may thus create a need for protein over and above the average minimum requirement. Extremely hard physical labor, such as harvesting or mining under nonmechanized conditions, may lead to an increase in requirements for a certain time. Experimentally, the effective training of muscles in order to attain an increase in power requires a greater than average allowance of protein. If the body stores of protein are depleted, due for instance to an insufficient intake over several years, then the adaptation of the muscles to the requirements of work may take a very long time, even years, and may require more than double the normal intake of protein.

In an experiment, two young men, who for years had been living on a subminimum protein intake, did not respond to muscle training, although they were in protein balance at 55 grams of protein daily. At 110 grams of protein daily (i.e., 1.7 grams per kilogram body weight for one of them and 2.1 grams per kilogram body weight for the other, an amount generally considered much more than sufficient), there was still at first no response to training, but the protein content of their bodies increased, until finally, after six weeks, their muscle strength began to increase.²

But even with a high protein intake, muscular growth will not occur if there is an inadequate intake of calories. Too low a consumption of calorific substances other than protein, namely, carbohydrates and fats, will render any supplement of protein ineffective. In that case, the supplied protein will not serve mainly for the building up and maintenance of muscle tissues but will also be used as a source of calories. The first requirement for the worker's diet therefore is a liberal supply of foods rich in calories, together with a protein ration that comes up to, and even exceeds, the average recommended allowance.

PHENOMENON OF ADAPTATION

People in poor countries, with a protein intake constantly below what is considered a minimum requirement, show on the whole fewer marked symptoms of deficiency than the results of experimental malnutrition would lead one to expect. It should be borne in mind that people who all their lives have been living on diets which, for western standards, are below the minimum level, have attained a state of adaptation which allows them to subsist, though in a poor way. As mentioned previously, strenuous efforts are avoided as far as possible. In addition, there are metabolic adaptations which facilitate the maintenance of a balance between dietary intake and the breakdown of body substances.

In experimental malnutrition, it can be shown that considerable time is necessary before a certain adaptation to the low protein intake occurs. But once the adaptation has set in, less body protein is broken down and equilibrium between protein intake and protein

² H. Kraut and E.A. Müller, *Biochem. Z.*, 1950, 320:302-315.

destruction is reached at lower intakes. Thus in the Minnesota semistarvation experiment, the daily destruction of body protein, which amounted to 26 grams during the first 12 weeks of the period of semistarvation, was later reduced to an average of 8 grams, that is, 32 percent of the value for the first half of the experiment. It is obvious that any considerable extra expenditure of energy will upset this labile state of balance and will be at the expense of body substance.

People adapted to low dietary intakes tend therefore to avoid prolonged efforts which would cause a breakdown in their metabolic equilibrium.

From the practical point of view, the conclusion is reached that in any working community which employs workers known to have had low protein intakes all their life, special attention should be given to this aspect of the problem. Action should be taken to ensure that those persons be put at heavy work very progressively, step by step and be provided with liberal supplies of foods rich in protein from the beginning, and possibly even before the beginning, of regular working activities.

Vitamins

It is well known that working efficiency suffers in clinically evident vitamin-deficiency states. Eye affections due to lack of vitamin A, cardiac, nervous and neuromuscular changes due to beriberi and other gross impairments of health, naturally are reflected in work performance. Consequently, the successful treatment of these diseases will result in greater efficiency at work.

On the other hand, there is not sufficient evidence as yet to suggest that in a diet already adequate in vitamin content, vitamin supplements have any beneficial effect on working capacity or general health. The addition of vitamins or vitamin-rich foods to the diet is justified and useful only where the diet appears to be insufficient in this respect, even in the absence of clinical signs of deficiency.

Subclinical deficiencies may be present, which although invisible — “silent” — in the sense that none of the common symptoms are apparent, may manifest themselves through a higher rate of sickness

and absenteeism. Under those circumstances, vitamin supplements may be valuable in improving efficiency and reducing sickness and the number of absences from work. Although the results of field trials have been very variable, this beneficial effect has been observed in several cases. It is recognized, however, that the good results obtained can partly be attributed to the psychological effect of the supplements, and to the effect on general morale.

Only for vitamin B₁ (thiamine) are there findings which indicate a definite change in requirement caused by physical work. Although experimental work on the effect of physical exertion has not always produced clear-cut results, the fact remains that in population groups having the same type of diet, clinically evident thiamine deficiency (beriberi) occurs more frequently among people with a high energy expenditure than among less active people. This observation indicates that more thiamine is needed by physically active people.

One of the most experienced experts in this field considers that deficiencies in the vitamins B₁ (thiamine), B₂ (riboflavin), and niacin and the respective deficiency diseases, beriberi, ariboflavinosis, and pellagra, constitute a great menace to health and a serious deterrent to productivity. "I wish to point out that the deficiency diseases are extremely insidious and that they are sapping the vitality of Asians to an unknown degree. My conviction is that there are scores of millions, perhaps hundreds of millions, in Asia, who are suffering from mild beriberi and have done so for years and they still do not know they have it..... As a drain on the vitality of many people who suppose they are well, the deficiency diseases are a tremendous handicap to the struggling millions of Asia."³

Relation between mental changes, due to dietary deficiency, and working efficiency

The psychological effect of the diet is a problem of great importance in working efficiency. Our knowledge is derived mainly from the reports of famines and similar events. Experimental starvation has allowed a more detailed examination of the mental changes, by applying modern psychological methods.

³ R.R. Williams, *Fed. Proc.* 20, 1961, Suppl. 7:323.

The most obvious mental changes in cases of starvation are the emotional depression, the apathy and lassitude of the afflicted persons. Conversation is often restricted to a minimum; there is even a certain hostility toward others. Moodiness and irritability are other features regularly encountered, and are in part due to a sense of incompetence. The depression is coupled with a general lack of drive and of initiative. Although some observers have reported a deterioration of mental capacity, actual impairment of intelligence has never been proved. The intellectual powers are unaffected but are simply not applied. As initiative and ambitions are subdued, interests are narrower and it is found impossible to concentrate for long on any task: the general picture is often that of plain stupidity.

Important changes are also noticed in group behavior. Social bonds are loosened, there is less regard for the neighbor, and often the sense of decency and of fairness disappears. Frequently there is a considerable increase in the number of thefts and minor violations of law, as general morale suffers in severe starvation. As starvation becomes still more acute, disorders become less, because general apathy and listlessness increase. Table 2 presents an attempt to correlate changes in social behavior to loss of body weight and work performance.

TABLE 2. - ESTIMATED GENERAL MAGNITUDE OF SEMISTARVATION EFFECTS RESULTING FROM DIFFERENT AVERAGE LOSSES OF BODY WEIGHT IN ADULT POPULATIONS¹

Magnitude of semistarvation effects			
Percentage of body weight loss	Civil disorder and strife	Capacity for prolonged physical work	Actual work performance
	 <i>Percentage</i>	
5	slight	(?)	-10
10	moderate	-10	-20
15	serious	-30	-50
20	very serious	-50	-80
30	moderate	-80	-90
40	slight	-95	-95
50	none	none	none

¹ A. Keys *et al.*, *Op. cit.*

Although most of the more detailed evidence has been obtained in relatively severe starvation experiments, and although there are very little precise data from less severe but chronic undernutrition, it appears justified to apply the acquired knowledge equally to those chronic states, especially as the general picture of apathy and lack of initiative is a common observation in many undernourished populations. Dietary measures have, in most cases, been successful in re-establishing normal personality patterns but single traits of the changed personality may persist for a long time. The implications of these findings in relation to working efficiency are obvious. Some of the difficulties that are encountered in developing countries when untrained labor is employed may well be caused by chronic undernutrition, and might be relieved by dietary improvements.

Relation between nutrition, health, and working efficiency

Chronic diseases such as malaria, tropical anemias, and parasitic infestation are widespread in many developing countries and greatly impair the working capacity of the people. The high incidence of infections and diseases, and the low life expectancy have an unfavorable effect on the general economy of a country, by reducing the number of efficient people. It is obvious that measures aiming at the eradication of those diseases are essential not only for the general improvement of health but also for the restoration of working efficiency.

It is now increasingly recognized that a poor nutritional status lowers the organism's resistance to disease. It is well known that certain infectious diseases spread more rapidly and cause higher mortality rates among poor populations. Primitive housing and poor sanitary conditions are certainly important factors in this respect but the frequently low nutritional status is probably of great importance.

The high incidence of infections and the low life expectancy in large parts of the world may well be related to a low intake of high-quality protein and also, in certain regions, to an inadequate supply of vitamins and minerals.

Significant examples of the relation between nutrition, health, and working efficiency are contained in the United Kingdom report of

1939, already cited, which paid particular attention to the nutrition problems of paid laborers.

In East Africa, improper feeding was reported to be largely responsible for the heavy mortality among the East African Carrier Corps and among some railway construction workers during the first world war. After the war, better labor rations were distributed; in spite of the fact that those rations were still admittedly deficient in fresh vegetables and meat, the medical examiners reported a striking improvement in health and physique, an increase in weight of 8 to 9 pounds per man over a period of six months, and the entire absence of scurvy and other deficiency diseases. The higher paid workers who supplemented the rations with supplies purchased from the local shop and with herbs and green leaves, showed a lower sickness rate than the more poorly paid laborers. Taking medical cases only into account, the number admitted to hospital in 1928/29 was, for the better class laborer, 13 percent: for the others, 40 percent. These figures show that the diet provided for the majority was still capable of improvement.

The morbidity and mortality rates among workers on the Kisumu-Yala railway construction in 1929 were reported to be considerably reduced after the provision of proper rations, associated with improvements in general hygiene. In particular, the medical officer reported that "the much lower ulcer rate of 20 per month strongly suggests that a properly balanced ration combined with proper attention to minor injuries will go far in eradicating ulcers as a cause of loss in a labour force."

In Kenya, as stated in the annual report on native affairs for 1935, three gold-mining companies issued liberal cooked meals to their laborers three times a day; the satisfactory scales of rations — it was reported — undoubtedly contributed very largely to the excellent health which the laborers enjoyed during the year and also to their state of general contentment.

In Uganda, the provision of a well-balanced diet for laborers employed on road construction resulted in a very much lower incidence of sickness than is usual in such constructional work.

In the former Belgian Congo, between 1926 and 1932, the mortality on the Union Minière properties in the Katanga fell progressively from 53 per 1,000 to 8 per 1,000, following measures aimed at the

simultaneous improvement of diet and housing conditions and at the prevention of disease.

In any large working community, the implications deriving from the above considerations should be kept in mind: namely, that while an adequate diet will improve the general resistance to disease of healthy workers and indirectly affect favorably their performance, measures to improve the diet and the nutritional status of workers will be wholly or partly ineffective, from the point of view of working efficiency, as long as chronic diseases, for instance malaria, parasitism, are not eliminated.

Effect of dietary improvement on production

In practice, the productivity of a worker depends on a number of factors, including the type of equipment and materials used in the plant or mine, and the efficiency of the management itself. It is therefore usually impossible to measure separately the increased efficiency resulting from the establishment of special feeding facilities for the workers in a plant where such facilities did not exist previously. However, in several instances, it has been possible to estimate directly the effect of dietary measures in industrial and other establishments; one example was quoted on page 17; others will be reported here.

Two observations were made in wartime Germany under semi-experimental conditions. They were:

1. The influence of dietary supplements on the work output of a group of coal miners in the Ruhr district was investigated with the

TABLE 3. - INCREASED OUTPUT IN A COAL MINE AFTER IMPROVEMENT OF RATIIONS

Calories available for work	Output (tons)	Calories/ton	Body weight
1 200	6.7	177	Constant
1 600	9.4	169	Loss of 1.2 kg in six weeks
2 000	10.8	192	Slow rise

aim of finding whether the low production could be raised by increasing the food rations.

A first supplement of 400 calories increased the coal output to almost 10 tons per person, which was what the workers knew was expected of them. The resulting fall in body weight indicated that energy expenditure was slightly in excess of calorie intake. A further increase in calories resulted in a small further increase in output, but body weights rose again. Evidently, 177 calories were required per ton of coal, and for the desired increase in output, 600 extra calories were necessary.

2. A controlled group of 30 workers engaged in building railway tracks moved about $1\frac{1}{2}$ tons of earth per hour on a food ration supplying a total of 2,300 calories. After ten weeks, additional food was given which brought the calories up to 3,000 and raised the output to $2\frac{1}{2}$ tons per hour. Output per 1,000 calories increased almost 30 percent. In the course of a year, the work output rose and fell with the inevitable minor fluctuation of food rations, while body weights remained constant or even increased slightly. It may be of interest in this context to note that a further increase of work output was achieved by a bonus of cigarettes for each additional ton, which was temporarily given for reasons of comparison, but as there was no increase in food intake, the increased output proved to be at the expense of body weight.

An especially impressive example is the experience gained in the Central American Public Road Program in Costa Rica.⁴ For the road work which was done by United States contractors, local labor was employed and proved to be extremely inefficient at work. After some time the organization of the construction camps was changed, sanitation was improved and the management began to supply substantial meals, including large portions of meat, to the workers who had formerly been subsisting on a poor and mainly vegetable diet. The resulting improvement in working efficiency was striking:

“When the work was started in 1943 a labour force consisting of 30 percent United States labourers and 70 percent Costa Ricans moved

⁴ Myron Stearns, extract from “The road that food built,” *Harpers Magazine*, June 1950.

240 cubic metres of earth per man per day, with modern equipment. A year later, with 33 percent United States labourers and 67 percent Costa Ricans, the daily average had risen to 388 cubic metres per day. By January 1945, with 28 percent United States labourers and 72 percent Costa Ricans, 1,025 cubic metres were moved per man per day; and by January, 1946, with only 12 percent United States labourers and 88 percent Costa Ricans, the average had risen to 1,157 cubic metres per man per day."

The benefits to be gained from the supply of a balanced cooked meal to the workers have long been recognized in the mining industry in South Africa. A survey carried out in 1956 revealed that the average calorie value of the rations supplied to each worker in the mines in South Africa was approximately 4,500 calories per day. It was claimed that the balanced cooked meals led to a marked improvement in physical condition after a spell of mining employment. Hard work was performed and weight in most cases increased.

Similarly, in Ruanda Urundi, an employer estimated that by providing a balanced cooked meal to his workers he raised the productivity by 30 percent. In Madagascar, a sugar refinery is reported to have reduced the turnover rate of migrant labor from 60 to 6 percent by the introduction of a balanced cooked meal.

In Zanzibar, it was reported in 1937 that after well-balanced meals were introduced on an experimental basis by the Clove Growers' Associations, the employee's capacity for work was greatly increased, provided the worker remained in regular employment for some weeks; also, the increased efficiency more than compensated for an addition of a little over 50 percent in the average individual cost of a laborer.

Experience gained during the last war in a rubber plantation in South Viet-Nam showed an increase of 50 percent in work output after the opening of canteen facilities providing a liberal diet to the workers.

Such surprisingly high rates of production increases are largely due to the fact that the workers' diet had been grossly inadequate before the introduction of feeding facilities on the work site. It is obvious that the resulting increase of output is greatest where the work intensity depends mainly upon the activity of the worker, and may be

almost absent where the worker himself has no influence on the speed of the work process.⁵

Also, increase in output of a magnitude similar to the above reported examples will not occur where the diet is already perfectly adequate. However, the following two examples, one from Canada and the other from the United States, show the kind of beneficial effects which may be expected to result even in well-to-do countries from the establishment of such facilities.

The Canadian example⁶ is based on a study carried out after the management had set up a lunchroom for the workers. The study showed that the establishment of the lunchroom was followed by a significant reduction in the number of accidents. The results before and after the opening of the room, per million man/hours worked, were:

	Before opening of lunchroom	After opening of lunchroom
 <i>Three-year average</i>	
First aid treatment	3 000	2 130
Lost time accidents	49	42

A survey⁷ carried out by the United States Department of Agriculture in late 1955 and early 1956 showed that about half of the manufacturing plants in the United States employing 250 or more workers had facilities for serving hot food to the employees, and approximately nine out of ten plants had at least one kind of vending machine dispensing food or beverages. "The great majority of the executive, when questioned specifically, considered the employee food services beneficial to employee morale, labor-management relations, employee health, and employee productivity. These proportions

⁵ H. Kraut *et al.*, *Arbeitsphysiologie*, 1950, 14:147.

⁶ ILO studies and reports, New Series, No. 4, *Nutrition in industry*, 1946, p. 41.

⁷ In-plant feeding practices in factories, *Monthly Labor Review*, 1959, 82:894-898.

regarded the services as having a 'good effect,' a 'bad effect' or 'no effect at all' ”:

	Good effect	No effect at all	Bad effect
 <i>Percentage</i>		
Employee morale	92	8	* (1)
Employee productivity	63	36	1
Employee recruiting	48	52	* (1)
Employee health	70	30	* (1)
Labor-management relations	77	21	2

* (1) = less than 0.5 percent.

3. FACTORS AFFECTING FOOD CONSUMPTION

In the preceding chapters, it has been shown that an important relationship exists between low working efficiency — with consequent low production — and deficient food consumption.

Once the existence of a nutrition problem in any community has been demonstrated and the nature of the prevalent deficiency — general undernutrition, or lack of nutrients — has been established, it is important to investigate which are the major factors influencing consumption and leading to that deficiency. Evaluation of the role played by each factor is essential, in order to make a decision about the adoption of realistic and practical measures to improve the situation.

In this process of study — from the determination of the problem to the adoption of practical measures — the services of a nutrition expert are indispensable, because conditions vary from place to place, and correct evaluation is impossible for the nonspecialist.

Factors which influence food consumption may be classified into two categories: (i) economic factors; (ii) socio-cultural factors. They will be briefly considered below.

Economic factors

Economic factors may considerably influence the amount and type of food consumed. Low wages often do not allow the acquisition of sufficient food. The local food prices should be screened and a calculation of the cost of an adequate diet in comparison to earnings will show whether or not income plays a determining role in the adequacy or inadequacy of the diet. Since no one will spend all his earnings on food, even under the worst conditions, wages should

allow for a fair percentage of expenses other than for food. Also, estimates of the adequacy of income in regard to food consumption should not be limited to the needs of the worker himself but should take into consideration the requirements of his family.

The high cost of foods of good nutritive value, such as meat, fish, eggs, may prevent the worker from purchasing them, thus leading to an unbalanced diet. While the yield in calories per unit of area is much higher in the cultivation of vegetable products than in that of animal products, the prices for these products show an inverse tendency, as indicated in Table 4.

TABLE 4. - CALORIES PER AREA CULTIVATED AND RETAIL PRICES IN FRANCE PER 1,000 CALORIES FOR A NUMBER OF FOODS¹

PRODUCT	Production (million calories per hectare)	Francs (NF) per 1,000 calories (Paris, 1958)
Beef	0.4	3.50
Eggs	0.5	1.57
Butter	0.8	1.11
Milk	1.8	0.76
Grain and bread (extensive cultivation)	2.0	0.29
Grain and bread (intensive cultivation)	5.3	0.29
Rice	6.6	0.45
Olives and oil	11.5	0.47
Potatoes	11.6	0.43
Manioc and tapioca	11.9	1.69
Bananas	12.6	1.95
Sugar	25.0	0.28

¹ A. Guerrin, *Equilibre*, 1960, 2.

In some cases, foods of good nutritive value may simply not be available. The agricultural production of a region or area may be concentrated on a few staples, such as maize or rice; production of animal products may be scarce or absent; and there may be little possibility for the importation of those foods. This situation, with resulting deficiency in the diet, is not uncommon in developing countries

and can only be solved by national or large-scale programs aiming at the provision of more varied foods, either through local production or by import.

When economic factors prevail over others as the cause of an inadequate diet, measures aiming at a general increase in purchasing power are essential. Consideration of these measures is outside the scope of this study. To raise the purchasing power will often require radical changes in the economic and social structure of a country, and as such cannot be considered immediately effective in breaking the vicious circle of poverty, malnutrition and low production.

There are, however, other measures applicable in large working communities, which can often bring about prompt improvements in physical conditions, health, morale and productivity. Those measures, which consist in the setting up of food stores and canteens for workers at the working sites, are discussed in detail in the next chapter.

Socio-cultural factors

The reason for an inadequate diet and a poor nutritional status is often to be sought in the prevailing social and cultural customs, which may prevent people from consuming valuable foods, even when they are available. Certain foods may have a social significance quite independent of their nutritional value; for example, white bread as compared with dark bread. People may prefer such foods just for their prestige value.

Religious restrictions may eliminate from the diet certain foods of high nutritive value, such as meat and eggs.

Ignorance, superstition and prejudice may also considerably influence food habits: some foods may be linked with the idea of evil, others are believed to produce bad effects, or are considered as foods suitable only for animals.

Many examples of the influence of socio-cultural factors on food habits can be found in other FAO publications.¹

It is usually believed that the diet tends to improve with improved

¹ For example: *Teaching better nutrition*, FAO Nutrition Study No. 6, 1957; *Education and training in nutrition*, FAO FFHC Basic Study No. 6.

economic status; this is only a general tendency, to which there are many exceptions.

Dietary surveys made in highly developed countries on families of average income have shown that insufficiency of diet is found almost as frequently among families with a high expenditure on food as among those spending less, a situation which must be ascribed to the wrong choice of food. Also, when economic conditions improve, better nutrition may at first be sacrificed for other things associated with higher living standards, such as radios, furniture or automobiles. This aspect is particularly important when considering the phenomena of intensive industrialization and urbanization occurring in many developed and developing countries. Those phenomena pose important problems in relation to the psychological aspects of the change in food supplies and dietary habits of the rural populations involved.

The above considerations indicate the obvious need for educational programs in nutrition, which should be developed alongside other measures to improve nutrition. The best channel through which nutrition education can be introduced among industrial workers is probably through canteens, which will be discussed in the next chapter. Feeding centers will provide ample opportunity for education, through suitably prepared menus, advice on food choice and eating problems, attractive food displays, etc.

4. MEASURES TO IMPROVE WORKERS' NUTRITION

It has already been pointed out that widespread malnutrition and undernutrition cannot be eliminated completely except by the formulation and successful implementation in each country of a comprehensive program for expanding production and raising the levels of incomes of all sectors of the population, i.e., as part of a general program of economic development. Such programs, however, have necessarily to be spread over a long period. In the meantime, and as a complement to such basic programs, there are certain measures by which the larger individual enterprises, whether they are engaged in manufacturing, mining or transport, or in cultivating crops, can help to ensure an adequate and balanced diet for their own employees, and so help directly to increase the nation's production and income. Those measures consist in the establishment of nonprofit food stores and/or of canteens at the working place.

Both in the less developed countries, as well as in countries such as Canada and the United States, experience has provided abundant evidence that such measures do improve the general well-being of the worker and consequently production. The extra cost involved is more than compensated for by the results.

The question of adequate salaries for workers will not be discussed here, since it is not within the scope of this study. However, the need for adjusting salaries to the actual cost of living should be kept in mind, as previously mentioned, within the economic possibilities of the enterprises and the industrial or other concerns involved.

Nonprofit food stores

If wages and salaries are low and cannot be raised sufficiently to allow the purchase of adequate amounts of food, or if for any other

reason the workers have difficulty in obtaining enough food, the setting up of nonprofit food stores may give workers and their families the possibility of obtaining food at low prices.

As the sale will usually have to be restricted to workers of the establishment concerned, stores may either be set up near the place of work, so that only workers and their families will have access to it, or subsidized food may be sold against coupons or after identification of the customer as an employee. These precautions would not be necessary in places where the laborers and their families were living more or less separated from the rest of the population, e.g., in the petroleum industry, or in agriculture.

Programs of nutrition education may be organized in connection with food stores, and will be particularly useful since, through those stores, not only the worker but also his family can be reached easily.

Nonprofit food stores offer the chance to promote the consumption of certain selected foods, and thus to correct deficiencies in the customary diets. High-quality food, especially food of animal origin, and vitamin-rich food may be purchased relatively cheaply at the wholesale level. Foods of particular complementary value for a customary local diet may be sold at specially low prices. Methods of preparation and cooking of new foods to which the workers are not accustomed may be demonstrated and their use recommended. Subsidies for certain foods are not an unnecessary expense for the establishment, as they usually find ample compensation in the resulting improvement in working efficiency.

Canteens

The most effective measure for improving the workers' diet in a relatively short time is probably the establishment of a canteen at the working site.

JUSTIFICATION OF, AND OBJECTIONS TO, INDUSTRIAL FEEDING PROGRAMS

If an analysis is made of the reasons in favor of industrial feeding programs versus the reasons against them, the results strongly support the opinion that those programs are of benefit to all concerned.

The establishment of industrial canteens is often a necessity. In a number of countries the growth of industry makes it necessary for

many rural people to congregate in urban centers and live under very crowded and unsatisfactory conditions. Many of these people find it impossible either to prepare proper food in their homes or to buy their meals in restaurants. Also, plants are often located in isolated areas, so that employees are unable to return to their homes or find other nearby feeding facilities.

For workers on unusual hours — night shifts, for example — there may be no eating places available where they can get their midshift meal. In plants where continuous working shifts are in force, there is a need to provide meals at the proper time for at least part of the workers.

The provision of free or low-cost meals is also an economic benefit to employees which is indirectly of benefit to the industry itself, since it avoids the waste of time, increased fatigue and nervousness which may occur when workers have to go home for their meals.



FIGURE 3. - This modern kitchen serves the cafeteria of a new motorcar factory at Ingolstadt, Germany.

(Courtesy Juno-Werkfoto)

Apart from the above considerations, the development of feeding programs based on sound nutritional principles offers various other advantages. Evidence has been given in previous chapters of the fact that, even in economically highly developed countries, workers may subsist on inadequate diets for various reasons, such as poor food habits and the unavailability of the right kind of foods, as well as for economic and other reasons.

Experience gained in several countries, particularly the United Kingdom, France, Czechoslovakia, Germany, the United States and Canada, during the second world war and since, has shown clearly that canteens and similar types of feeding facilities can play a very useful role in providing nourishing meals to the workers, and can be used to supplement the deficiencies in the workers' daily diets, and also to provide supplementary foods to particular classes of workers who need them, e.g., those doing heavy work, adolescents. Although these facilities were especially encouraged during the war and immediate postwar years to overcome the difficulties caused by food shortage and rationing, they have since proved their permanent value and have now become an established feature of industrial welfare. Industrial canteens also offer important opportunities for programs of education in nutrition and for influencing trends in the consumption of various foods, including relatively new and valuable ones.

Several examples have already been quoted in chapter 2 of the benefits obtained in industrial and other enterprises by the establishment of canteen facilities. Those examples show that the provision of a satisfactory meal at the working site is a useful measure, to reduce absenteeism and accident rates, to improve working efficiency, morale, and eventually production.

The objections raised to establishing industrial feeding programs have mainly psychological grounds: the worker, like any other person, has definite food habits which he is obliged to give up to some extent when using canteen facilities. Therefore, he may prefer to carry his meal from home or have it carried to him, even though this implies more work and more trouble for the family. Also, he may prefer to have his meals with the family, when the plant is not too far away; or to share the larger food supply with his family, rather than enjoy it all himself, even if his work suffers as a result.

The increasing number of workers who make use of canteen fa-

cilities in countries such as India, for example, seems to indicate that those reasons are not so strong that they cannot be overcome by all the other considerations in favor of collective feeding, especially if careful attention is given to the preparation and presentation of food, taking into account as far as possible the food habits prevalent in the area.

PLANNING AND OPERATION OF CANTEENS

The setting up and operation of feeding facilities require consideration of several problems, including the cost, type, number and composition of meals, the availability of the needed supplies of foods, as well as problems connected with the development of nutrition education programs.

Cost of meals: free or low-cost meals

No generally valid rules can be laid down regarding free or subsidized meals. It may sometimes be more advisable to have workers pay a small part of their wage for their meals than to distribute meals free. The amount of a worker's contribution for his canteen meal will, of course, depend on the relation of wages to the standard of living. A small financial contribution by the worker may sometimes have a beneficial effect on employee-employer relations and may also help to preserve appreciation of the meal itself on the part of the worker. In any case, provision of meals at work or payment in kind should not be considered as a substitute for a part of wages, and should be on a voluntary basis, as far as the worker is concerned.

As a rule, canteens are substantially subsidized by the managements. The establishment's contribution to the cost of a meal amounts usually to 50 percent or more, in addition to the permanent expenses of running the canteen, which are frequently carried by the firms.

Time and number of canteen meals

The time of the day at which canteen meals are served will largely depend on the length of shifts and on the organization of work. As far as possible, the times for meals should be chosen so as to take into account physiological needs as well as local meal customs. This



FIGURE 4. - Workers must eat, even when dining rooms are not available. However, the meal period is of greater benefit when it is spent in clean, comfortable surroundings.

(Courtesy Max-Planck-Institut)

arrangement will secure the best results with regard both to the workers' welfare and their working efficiency.

If conditions allow, more than one meal should be supplied. In hard physical work, large quantities of food are required which often cannot all be eaten during one or two meals daily. Also the great bulk of very substantial meals will easily create the well-known post-prandial lethargy, especially in hot climates.

If little or no breakfast is eaten before coming to work, and workers are in a bad physical condition, some type of breakfast should be given before the beginning of the shift or within the first two hours of work. Ideally, breakfast should supply at least one quarter of the daily needs, especially if high-energy expenditure is required.

Composition of meals

In menu planning, account should be taken of the relative availability and cost of various types of foodstuffs, and also of local tra-



FIGURE 5. - Workers' canteen in a modern textile mill in India.

(Courtesy ILO)

ditional religious and other customs, insofar as they do not interfere with the choice of an adequate diet. For example, in those parts of the world where meat is refused on religious grounds, it is advisable to replace meat with other foods of comparable value, for example, milk, cheese, fish, or legumes (such as beans, peas, soybeans, ground-nuts, which are good vegetable sources of protein).

The menus should be so planned as to fill the main gaps in the usual diet of the worker, in respect of food quantity and quality. Consideration should first be given to calorie requirements, allowing for differences in requirements for different types of activities. The practical problem may be solved by variations in portion sizes, or by provision of more than one helping.

Then protein requirements should be taken into account; here the problem will be the provision of good quality protein for all workers, the quantity being approximately the same for different activities.



FIGURE 6. - Canteen in French cement plant. The meal is wholesome and inexpensive.

In providing for protein, preference should be given, if possible, to foods of animal origin: meat, fish, eggs, cheese, milk.

Fresh fruits and vegetables, good sources of vitamins and minerals, should be provided generously for all.

In some cases, and in certain areas of the world, attention would have to be given to the prevention of deficiencies known to be prevalent. For example, in the Far East, where beriberi is common and rice is the staple food, the use of undermilled, parboiled or enriched rice would be preferable to the use of white rice, which is a very poor source of thiamine.

Appropriate methods of preparing and cooking foods should be used in order to conserve their over-all nutritive value, and especially their vitamins.

Finally, in menu planning, monotony in the diet should be avoided as far as possible. Variety of foods and in methods of preparation has the obvious advantage of improving the palatability of the diet and its acceptance by the worker, while at the same time it avoids the risk of deficiency in one or more nutrients, a risk always associated with a monotonous diet.

Nutrition education associated with canteen feeding

Mere provision of food in canteens should not be seen as the only goal, however important it may be. Such food service may also be a way to better nutritional habits benefiting the whole family. It would be a waste of effort and money if group feeding in canteens were not coupled with nutrition education, as it is a unique occasion to reach both men and women.

This opinion was expressed by the FAO/WHO Expert Committee on Nutrition at its session in 1961. The Committee also emphasized that it is a great mistake to consider the feeding of workers as being separate from that of their families, and it suggested that canteens should be used where possible as centers for nutrition education, where good food at low prices could be made available for the family.

Other types of feeding facilities

It will not always be possible at a central canteen to feed all workers during the shift. Special facilities may be necessary in certain types

of large agricultural establishments such as plantations, with long working hours, and where laborers working at great distances from the center of the establishment cannot, during working hours, return to the canteen for a meal. In these cases, it is often desirable, especially where great physical efforts are required, to provide laborers with food during the day in addition to a cooked meal at the beginning or the end of the shift. This may be effected in the form of packed meals or by means of mobile buffets.

Utilization of surplus foods in industrial feeding facilities

Food stores and canteens for workers provide important channels for the utilization of surplus foods, namely of foods which are made available from areas of overproduction. Food aid has been largely used in developing countries to supplement the diet of mothers and children. The distribution of surplus foods through schools and health centers proved to be one of the most satisfactory surplus utilization operations which has been evolved.

The provision of surplus foods through food stores and canteens for workers would widen the scope of surplus utilization, and constitute an important temporary measure to improve the diet of this category of the population.

Responsibility for industrial feeding programs

At local level. Successful feeding programs for workers require well-trained personnel, including managers, cooks and others involved in catering, menu planning, preparing and distributing meals. Supervision by a nutrition expert would be valuable, especially in the planning of meals and the development of nutrition education programs.

At national level. A responsible agency at national level in each country should have the task of formulating standards and proposing necessary legislation, of giving guidance and advice on group feeding, taking into account the nutritional and hygienic aspects. There should also be in each country facilities to train the personnel, to advise canteen managers on the desirable composition of meals for the workers in different occupations, to make surveys of the prevalent problems and put forward recommendations for possible solutions.

Agencies of the type referred to above already exist in some countries. In Germany, for example, a canteen service is supported by the German Nutrition Society, with financial assistance from government funds. This service is responsible for providing advice on the establishment and operation of workers' canteens, for the development of suitable recipes adapted to the available food supply, and for carrying out training courses for cooks. This service proved to be of great help.

In the United Kingdom, the Ministry of Labour was in the past actively engaged in the field of feeding of workers. Now this work has ceased, and advice on industrial catering problems is provided by voluntary organizations, such as the Industrial Welfare Society and the Industrial Catering Association. A catering branch within the Ministry of Aviation is responsible for the feeding of industrial workers employed in government establishments.

In Poland, the public health aspects of industrial feeding are the responsibility of the Ministry of Health, and the Department of Nutrition in the State Institute of Hygiene gives training in nutrition to health officers responsible for those aspects.

In the United States, the War Food Administration took a very active interest in encouraging the expansion of in-plant feeding during the second world war, and the government has since continued to study and recommend industrial feeding plans through the nutrition and food distribution agencies within the United States Department of Agriculture.

In South Africa, the subject of industrial feeding has always received particular attention. It is interesting to note that the problem was discussed by a subcommittee of the recently established FFHC National Committee in that country. Within the framework of the Campaign, which was launched in South Africa under the name "Campaign against Malnutrition," the subcommittee will conduct a survey to determine the extent of existing food schemes and canteen facilities for industrial employees. This survey will serve as a basis for further research on the effect of those schemes on the productivity and health of employees and on absenteeism from work. The study is intended to launch a drive for the wider introduction of such schemes among large-scale employers. This project should render beneficial results in a relatively short time.

International assistance

Increasing attention is being paid at the international level to problems related to the nutritional needs of workers and to the promotion of feeding facilities for them. The need for international action in this field was recognized by the Food and Nutrition Board of the United States National Research Council in 1951. An absence was then felt of a central source of information and guidance, or of stimulation of interest in planning for feeding programs for workers.

The International Labour Organisation emphasized the need for industrial feeding programs on several occasions before and after the second world war. A recommendation concerning welfare facilities for workers, adopted by the General Conference of ILO in 1956, contains provisions regarding canteens and other feeding facilities for manual and nonmanual workers, other than for those in agriculture and sea transport.

FAO has also been active in this field; in particular, countries such as Poland and India were assisted in the establishment of feeding facilities for workers. The importance of the subject was recognized at several FAO conferences and technical meetings. In particular, the Fifth FAO Regional Conference for the Near East, held in Teheran in 1960, recommended that a survey be undertaken of the facilities now available in that region for the feeding of industrial workers. The subject received particular attention at the Sixth Session of the FAO/WHO Joint Expert Committee, 1961, which indicated the lines of action to be followed in this field by the international organizations concerned. These include the collection and evaluation of all available information on legislation and the operation of feeding programs for workers in various countries, on approaches and methods, on financial aspects, etc. Assistance in the development of feeding programs for workers in member countries will also be provided by the agencies concerned, particularly FAO and ILO.

SUMMARY AND CONCLUSIONS

In many parts of the world today, inadequate food consumption is responsible for a reduction of the people's capacity for work. A poor diet, resulting in undernutrition and malnutrition, reduces working efficiency by (a) decreasing the worker's resistance to disease; (b) increasing the rate of absenteeism; (c) causing lethargy, lack of initiative and drive; (d) increasing accident rates.

Several examples are reported from experimental work and from field observations, which indicate that provision of an adequate, balanced diet has a beneficial effect on working efficiency, general well-being, and ultimately on production.

In considering the dietary requirements of workers, evidence has been provided of the fact that calorie intake is the most important factor influencing work output. The requirements for calories increase with the increase in physical activity, and adequate provision should be made for sufficient calories in the workers' diets. Workers' requirements for protein, vitamins and minerals do not vary as much as calorie requirements; however, more protein than the recommended average may be needed under certain circumstances to improve and increase the workers' physical strength, while in some cases more vitamins, especially of the B groups, may be beneficial in improving working efficiency.

The economic and socio-cultural factors influencing food consumption have been discussed in order to arrive at reasonable recommendations on the measures necessary to improve the diet of workers.

While permanent improvement in food consumption can be brought about only by long-term measures, aiming at the general economic development of a country, there are other measures applicable in large working communities, which can often bring about prompt

improvements in physical conditions, health, morale and productivity.

Those measures, including the establishment of food stores and the setting up of canteen facilities for workers at the working site, are discussed in detail, and some suggestions given for their development. More provision of food should not be seen as the only goal, however important, of those feeding programs. In order to arrive at better nutritional habits for the welfare of the worker and of his family, it is important to use feeding facilities as centers for nutrition education, where good food at low prices can be made available for the family.

Appendix 1

DETERMINATION OF ACTUAL ENERGY EXPENDITURE

The working time is first calculated, taking into account the number of hours (or fractions of an hour) spent on the actual work processes and the number spent on other activities, such as setting and feeding of machinery and other accessory work, waiting, resting, pauses, on errands, etc.

A list is made of the various activities during a shift of work and of the time spent on each of them: the total calories expended in each activity are then calculated from energy expenditure tables. These tables are available for ready reference and are prepared from direct measurement — by laboratory methods and techniques — of energy expenditure on many different activities. The sum of all the expenditures thus obtained represents the total energy — expressed in calories — required for a shift of work.

EXAMPLE OF LIST: ACTIVITIES OF A CORE MAKER IN A FOUNDRY

Activities	Time spent	Energy expenditure
	<i>Minutes</i>	<i>Calories</i>
Core molding by hand	275	1 110
Shovelling	36	250
Transport	37	270
Auxiliary activities	62	250
Waiting times	12	10
Rest pauses	58	60
<i>Total</i>	480	1 950

The total calorie expenditure for work is then compared with average figures in comparable occupational groups. If the calculated energy expenditure is lower than the average, the reason for this must be investigated. Lower than average energy expenditures mean that less time is spent on working activities and more on others (resting, or on less strenuous work) than would ordinarily be expected: this may result from poor organization of work, insufficient equipment, or from other factors not related to the diet, and it is usually impossible to make a clear distinction between them. The fact may, however, be directly related to the food intake; namely, there may be a low calorie intake on the part of the worker, which automatically limits his energy expenditure.

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