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NATIONAL FOOD CONSUMPTION OF FOURTEEN WESTERN EUROPEAN COUNTRIES AND FACTORS RESPONSIBLE FOR THEIR DIFFERENCES*

Since World War II, increased attention has been devoted to improving existing knowledge about the differing quantities and kinds of food various national populations eat. And because of the important, expanding role of animal products in world production and consumption, intensified efforts have also been made to learn more about the supplies of grain and other concentrates fed to the livestock of producing countries. As a result, it is now possible to find usable estimates of food consumption and livestock feed for a substantial number of countries, particularly in Western Europe, North America, and Oceania. Some of these estimates are here presented and discussed, with special focus on the relative position and changing characteristics of the dietary pattern and livestock-feeding practices of France.

Sophisticated users of national food consumption estimates know that the available figures are only rough, sometimes seriously defective "guesstimates." They represent approximations of the net supplies of food commodities available at the retail level—supplies remaining from domestic production and net trade after subtraction of crudely estimated quantities used for domestic seed, animal feed, and nonfood industrial purposes (including alcoholic beverages as nonfood), with further subtraction of uncertain allowances for loss and waste on farms, in marketing, and in food processing.[1] For certain commodities (e.g., food-

* [This article is a part of a large study entitled "Recent Levels, Patterns, and Trends of Food Consumption and Related Aspects of Livestock Feeding in Fourteen West European Countries with Outlook to 1980" in which Professor Farnsworth was engaged at the time of her death. It represents a continuation of her research into the grain economy of the Common Market countries that had already resulted in the publication in *Studies* of major monographs by Professor Farnsworth and Karen J. Friedmann: "Determinants of French Grain Production: Past and Prospective" in 1964; "German Grain Policies and Prices, 1925–1964" in 1965; "Grains in German Farming: Past Developments and Prospects for 1970 and 1975" in 1966; and "French and ECC Grain Policies and Their Price Effects, 1920–1970" in 1967.

Of all the fragmentary manuscripts that were left to us, only the present one is more or less complete in itself, although it does not treat of the topic that was intended to be the primary subject of the manuscript, the French livestock feeding industry. It poses a problem that has not been resolved, and it displays the jewel-like craftmanship and skillful handling of evidence that characterized all of its author's research.—W.O.J.]

[1] Included as part of the loss in processing of grains, oilseeds, etc., are valuable mill offals, used for feed. For most developed countries losses and waste in retail outlets are apparently not deducted in arriving at the net food supply at the retail level.

grains, sugar, and a few others heavily dependent on commercial marketing and processing) the available consumption estimates are typically better than for less commercialized products; and the consumption figures of the more highly developed nations are usually more trustworthy than those of the poorer countries (*4*). It is known, too, that consumption estimates for recent years are generally better than the ones published a decade or more ago, making it difficult to interpret some of the reported evidence on consumption trends.

Most of the West European nations here considered (as well as the United States and Canada) rank fairly high in the quality of their agricultural and food statistics. And although differences in their national statistical definitions, data collection procedures, methods of estimation from incomplete data, and various conversion factors, cast doubt on the significance of small percentage differences in their reported food consumption and feed use estimates, most of the larger differences, cautiously interpreted with the aid of supplementary information, yield broad generalizations that appear reasonably trustworthy. Comparisons of these national estimates, their trends over time, and a survey of the factors likely to be responsible for their basic differences therefore seem desirable as a partial guide to anticipating the changes likely to occur in West European food consumption and livestock feeding by 1980.

CONTRASTS IN NATIONAL FOOD CONSUMPTION LEVELS IN WEST EUROPE, CANADA, AND THE UNITED STATES

There are striking differences in the per capita calorie levels of the reported food consumption data of the 16 countries of West Europe and North America—differences large enough to warrant interesting investigation. Ranging from 2,720 calories per capita daily in Portugal to 3,450 in Ireland during the three years ending in mid-1969, the indicated range is 730 calories or 27 percent. Moreover, calorie consumption differences of 300 to 400 calories, representing 10 to 14 percent, are quite common.

The basic national consumption figures, shown in the accompanying table, all refer to the calorie value of the net supply of food available for human consumption at the retail level, technically defined as including farm and garden supplies reserved for home consumption by producers and their families. Table 1 shows the per capita calorie consumption levels of the 16 countries arranged in five calorie groups, within each of which the specified nations differ by less than 5 percent from one another.

It is noteworthy that the reported per capita consumption levels of the United States, Canada, Denmark, the United Kingdom, Belgium/Luxembourg, and Switzerland are practically the same as that of France. In contrast, Portugal, Spain, and Sweden have reported calorie levels that are 11 to 14 percent below the French level, and all of the remaining countries except Ireland are 4 to 8 percent below. Ireland's index stands alone at 9 percent *above* the French level and 8 percent above the American.

What factors are responsible for these similarities and differences in reported national calorie consumption? We should expect to find at least a partial answer in the differing average energy expenditures of the national populations represented. *Scientific evidence leaves no room for doubt that the average energy ex-*

TABLE 1.—ESTIMATED PER CAPITA DAILY CONSUMPTION OF FOOD CALORIES IN SIXTEEN COUNTRIES OF WESTERN EUROPE AND NORTH AMERICA, THREE-YEAR AVERAGES ENDING 1968–69*

Food calories per capita per day	Countries and per capita calorie consumption
2,700–2,849	Portugal (2,720), Spain (2,780), Sweden (2,820)
2,850–2,999	Italy (2,900), Norway (2,930), Germany F.R. (2,940), Austria (2,950)
3,000–3,149	Netherlands (3,040), Belguim/Luxembourg (3,140), Switzerland (3,140)[a]
3,150–3,299	France (3,160), U.K. (3,180), Denmark (3,190) Canada (3,200), U.S. (3,200)
3,450	Ireland (3,450)

* Data are from FAO, *Production Yearbook, 1970* (1971), pp. 442–43. Estimated kilocalories of food (excluding all alcoholic beverages) available as net supplies for consumption at the retail level. The basic annual calorie estimates were made by the respective national governments and transmitted to the Food and Agriculture Organization (FAO) by the Organization for Economic Cooperation and Development (OECD) with some minor statistical modifications to reduce incomparabilities.

[a] From 1971 issue of source cited.

penditures of different population groups depend primarily on the average body size of adult members of each group, on the average environmental temperature to which their bodies are exposed, on their physical activity at work and in ordinary living and recreation, and on their distribution by age and sex (*5*; *7*; *10*).

In view of the typically smaller body size of the inhabitants of Southern Europe (including Italy as well as Portugal and Spain) and the warmer climate of that region, many observers would probably think it physiologically natural for Portugal and Spain to have the lowest calorie indexes of the 16 countries and for Italy's index to be fairly close to the same level.

But why, such observers might ask, should Sweden be classed with Portugal and Spain as one of the three countries having less than 2,850 calories of food available at retail for daily per capita consumption? Certainly the Swedish people are not small in body stature or weight—quite the contrary. And they live in a country which is relatively cold, not warm! Moreover, why should Sweden have a reported food calorie level of only 2,820 and neighboring Denmark one of 3,190? And why should Ireland's consumption at the retail level be 3,450 calories—considerably higher than that of Britain or Denmark? Finally, why should the smaller bodied French apparently consume as much per capita as the taller and reportedly "fatter" Americans?

These are, indeed, puzzling relationships—the more so since they are notably out of line with the three-level calorie consumption classification for Western European countries which P. Lamartine Yates reported more than a decade ago. Broadly generalizing from the less adequate estimates of the mid-1950s, Yates suggested a typical food-calorie level at retail of 3,090 for the northern countries (represented by Sweden and the United Kingdom), compared with 2,880 calories for the central group (including France, Germany, and Ireland), and 2,550 for the southern countries, consisting of Portugal, Spain, Italy, and Greece (*26*, pp. 20–21).

DIFFERENCES IN NATIONAL CALORIE REQUIREMENTS

While we cannot expect to find a complete solution to this puzzle in the limited scientific information available on the calorie requirements (also referred to as "calorie allowances" or "recommended energy intakes") of different population groups, let us see what clues such information offers. It is important to note that the calories referred to in such "recommended requirements" or "allowances" are the physiologically available or metabolizable kilocalories that are *ingested*, and that these therefore exclude the margin of waste and loss between (1) intake or ingestion and (2) the retail level at which national food supplies and "consumption" are measured (also in kilocalories). In this study we follow current custom by using the shorter term "calories" in referring to kilocalorie values of food; but we retain the technical abbreviation "kcal."

Influence of Environmental Temperature on Calorie Needs

In attempting to understand the puzzling differences in the reported food consumption levels of West European countries, we turn first to the question: How many more calories per capita are likely to be physically needed by people living in climates as cold as those of the Scandinavian countries rather than in warmer Southwest Europe. In terms of rough approximations, the average annual outdoor temperatures of the most heavily populated areas of Norway, Sweden, and Denmark appear to be lower than the temperatures of Portugal and Spain by some 8° to 11° C. (15° to 20° F.), with Denmark somewhat less cold than Sweden or Norway. Other factors equal, physical exposure to the lower external temperatures of the Scandinavian countries might well increase the per capita calorie requirements of these countries by something like 3 to 5 percent.[2] But except for avid skiers and workers in outdoor occupations (fishermen, loggers—relatively most numerous in Norway—and some farmers, some postmen, etc.), few Scandinavians are likely to be long exposed to uncomfortably low temperatures, since most are protected not only by warm clothing in winter, but also by well-heated houses, offices, shops, schools, and transport stations and vehicles. On the other hand, it is reported that the wearing of heavy winter clothing itself increases energy expenditure by 2 to 5 percent (*7*, p. 6; *15*, p. 1439).

One might infer, therefore, that an additional per capita calorie allowance of something like 3.0 to 4.0 percent (say 65 to 100 calories) would meet the higher average Scandinavian energy needs solely attributable to effectively lower environmental temperatures with the upper part of the range more applicable to the Norwegian population and the lower part to Denmark and Sweden. This would allow not only for the less extreme winter weather in Denmark, but also for the assumed greater exposure of many Norwegians to lower effective temperatures as a result of the differing occupational activities and living conditions in the three countries.[3] Moreover, it seems probable that an additional calorie intake equal to

[2] Calculated on the basis of information in publications of the Food and Nutrition Board of the United States and FAO (*5*, pp. 24–26; *7*, pp. 6–7).

[3] The Swedish people, with their higher gross domestic product, higher level of industrialization, and public works, benefit somewhat more from such advantages than do the people of Norway, or probably even Denmark. The importance of fishing and logging in Norway clearly indicates greater exposure to outdoor temperatures there.

or moderately below the bottom level of the stated range might be needed by the population of West Germany and other Central European countries, and, indeed, even in Ireland where winter temperatures are less extreme but outdoor work is common and houses, working areas, and transport facilities are less adequately heated.

For France and Great Britain, with average external temperatures less markedly below those of Portugal and Spain (4.0°–5.5° C. below in France and 6.5°–8.0° C. in Britain), the influence of climate in raising per capita calorie needs above the Southwest European level must be less. Perhaps a reasonable allowance would be an additional 15 to 60 calories per capita per day, the lower part of the range applying to France, the upper part to Britain and perhaps to the Netherlands as well. The energy needs of the Italian population based solely on differences in effective environmental temperatures would presumably be below the French level but somewhat above the Spanish.

Importance of National Differences in Adult Body Size

All other factors the same, national differences in adult body size rank as a much more important element in pushing up the per capita calorie needs of the northern countries. Since, however, there is little available evidence on national differences in body stature and weight, we can only roughly approximate the general magnitudes involved, guided mainly by common observation and by the supposedly representative body weights specified for the "reference" adults[4] of countries which have published such data in reports on their national dietary standards (7, pp. 68–71).

If, as seems probable, the desirable median body weight of healthy young Scandinavian men approximates the Norwegian, Netherlands, and American reference levels of 70 kilograms (154 pounds), or the West German and Canadian reference levels of 72 kilos, and if the desirable median weight of the shorter men of South European countries is 60 to 62 kilograms (132 to 136 pounds)—only 3 to 5 kilos less than the reference males of France and the United Kingdom—the Scandinavian men would be allowed an additional 300 calories per capita daily, all factors but body size being the same for the two groups (7, pp. 3–5).[5] Similarly, if the representative weight of healthy young Scandinavian women corresponds to the Norwegian, Netherlands, and West German reference levels of 60 kilograms (132 pounds) as contrasted with our assumption of 50 to 52 kilograms (110 to 114 pounds) for South European women, the additional daily energy needed by Scandinavian females would approximate 200 to 250 calories per capita. For Scandinavian children under age 15, the additional daily calories needed as compared with the smaller children of Southwest Europe would be

[4] Reference body weights ideally refer to the median weights of individuals of national median height who are considered neither overweight nor underweight for the maintenance of full health and longevity. For a discussion of U.S. suggested weights see 7, pp. 3–4. FAO calculations of calorie requirements, made a decade earlier, provide somewhat higher additional energy allowances for increases in body stature and weight—e.g., the additional daily energy requirement of a 70 kg. man compared with one of 60 kg. would be 360 calories according to the FAO scale (5, pp. 36–37), rather than the 300 calorie allowance suggested by the U.S. Food and Nutrition Board in 1968.

[5] This is 2 kg. higher than the weight of the reference woman used for the 1968 American standard, but is in line with the desirable weight for the reported average heights of women sampled in the U.S. Household Food Consumption Survey of 1965–66 (23, p. 279).

considerably less (perhaps 100 to 150 calories per capita as an age group average); but for Scandinavian adolescents over 15 years old, the added energy required would probably be close to the corresponding adult allowance.

An overall range of 205 to 250 calories per capita might therefore serve as a fair rough approximation of the additional daily calorie intake needed by the inhabitants of the Scandinavian nations—and probably of West Germany, the Netherlands, and Canada as well,[6] solely because of their larger body size as compared with the populations of Southwest Europe.[7]

For the inhabitants of the United Kingdom, whose reference men and women weigh 65 and 55 kilograms respectively, the corresponding additional daily calorie allowance attributable to body size would be less, approximately 65 to 125 calories per capita. And this *same* range might well be accepted for Ireland in the absence of more specific information. Moreover, since French nutrition scientists use the same body weights for French reference adults as British scientists do for the United Kingdom, it would seem reasonable to accept the same size-determined calorie addition for France as for Britain. This we are inclined to do despite the common assertion by travelers that French adults are typically smaller than the British.

Finally, it is worth noting that there seems to be a general impression that the average Spanish adult is somewhat taller than the average Portuguese. If this view is credited in the absence of needed data, the *top* of each of the preceding ranges of approximated differences in per capita calorie requirements between Northwest and Southwest Europe should be interpreted to apply primarily to Portugal, and the *bottom* of each of those ranges primarily to Spain.

Physical Activity as a Major Determinant of Calorie Requirements

Differences in physical activity may be a major factor in accounting for sizable differences in the calorie needs of individuals and population groups alike. Most national and international nutrient standards therefore make some provision for covering the differing energy needs of various occupational and other groups characterized by average, above-average, and below-average physical activity. Typically, the reference man and reference woman described in the various national standards are not sedentary but are normally active or moderately active—levels assumed to be fairly representative of the average activity of young adults of the respective countries (*5*, pp. 15–16; *7*, pp. 68–71).

Thus, in the United States, the normally active 22-year-old reference man (175 cm. tall and 70 kg. body weight) and reference woman (163 cm. tall and 58 kg. body weight) were estimated in 1968 to require daily energy intakes totaling 2,800 and 2,000 calories respectively, with the latter level increased by specified additions for pregnancy and lactation. The normal activity of the American reference pair was described as "light, involving occupations that could be de-

[6] For each of the countries named, the reference man described in its national nutrition standard is reported to weigh 70 to 72 kg, and the reference woman 60 kg. No corresponding standard is available here for Portugal, Spain, or Italy.

[7] The indicated calorie ranges in this subsection are based on the assumption that children under age 15 represent a uniform one-fourth of the population of each of the countries compared and that each population and age group is almost equally divided between males and females. The available evidence on national differences in age-sex distribution and the influence of this factor on calorie needs is discussed in a later subsection.

scribed neither as sedentary (a low level of activity) nor as heavy physical activity" (*7*, p. 2). And although the Food and Nutrition Board noted that "among certain occupations entailing heavy work, allowances might have to be much higher," they implied that their recommended calorie levels for the reference man and woman could be accepted as fairly representative for all Americans of the corresponding sex from age 18 to 35 for men and 18 to 65 for women (*7*, table ff. p. 102). For older groups, lower calorie allowances were specified to compensate both for the known decrease of 2 percent per decade in resting metabolism, and for the observed reduction in physical activity with advancing age.

It is noteworthy that the calorie levels included in the 1968 revision of the American *Recommended Dietary Allowances* were roughly 100 calories lower than had been suggested in the preceding (1964) American revision which in turn had been reduced by some 9 percent below the energy levels similarly recommended in the 1953 and 1958 editions. Moreover, the 1968 American calorie allowances imply significantly lower calorie needs of the American reference man and woman than would the calorie requirement figures suggested by the 1957 FAO Committee for adults of similar characteristics (*5*). No less pertinent are two related facts: (1) the calorie levels recommended by other developed countries for their own reference adults of about the same body size are typically higher than the 1968 American allowances (see 7, pp. 68–71); and (2) most national standards formulated in the 1950s suggest higher energy intake levels than do recent standards for the same or similar countries.

It seems reasonable to interpret these national differences in calorie intake recommendations and also the generally downward revisions in recommended levels since 1950 mainly as a reflection of (1) national differences in mechanization and work efficiency levels; (2) declining human energy expenditures over the past two decades particularly but not solely in the developed countries—a downward trend primarily associated with increasing mechanization, improvement in transport facilities and better organization of both industral and farm work; and (3) expanding knowledge of the energy expenditure of groups of workers and of participants in active sports (see 2; *12*, pp. 157–78), and growing recognition of the health problems associated with excessive calorie intake.

In judging the calorie needs of European nations with differing levels of physical activity, the 1969 revision of the British dietary standard appears to provide the most useful rough guide (*10*). A distinctive feature of this standard is its nutrient intake recommendations for several age and occupational categories of adults. Thus, for groups of British men 18 to 35 years old (average body weight 65 kg.), the recommended daily calorie intake levels are 2,700 for sedentary occupations, and 3,000 and 3,600 calories, respectively, for moderately active and very active occupations. Only 100 calories less are recommended for men aged 35 to 65 years engaged in similar sedentary or moderately active work (*10*, pp. 4, 6–7).

For British women between the ages of 18 and 55 years (average body weight 55 kg.), there is also an occupational differentiation: 2,200 calories per day are recommended for those in most occupations, and 2,500 for those doing very active work.[8] Women over 55 years of age and men over 65 are assumed to weigh only

[8] Additional intakes of 200 and 500 calories, respectively, are recommended for pregnancy and lactation.

53 and 63 kilograms, respectively, and to live a sedentary life, requiring an average calorie intake up to 75 years of only 2,050 calories for women and 2,350 for men, with a further reduction of 7 to 10 percent in the recommended level after age 75.

It is clear from the important occupational "guide" presented by the British scientific panel that the two largest occupational groups of men in the United Kingdom are the sedentary and moderately active workers (*10*, p. 6). The latter, probably the most representative as an indicator of the average energy expenditure of all gainfully active men in the country, includes "virtually all engaged in light industry and assembly plants; railway workers, postmen, . . . plumbers, and bus conductors; and most farm workers and builders' labourers." All of the professional classes, office workers, shop workers, drivers, pilots, and so on, are classified as "sedentary." And as one might expect, the only major occupational groups designated as "very active" are miners, steel workers, dockers, forestry workers, and army recruits, with the addition of some farmers, and some builders' laborers and unskilled laborers—their activity classification depending mainly "on the amount of mechanical power available" (*10*, p. 6).

The scientific British panel was well aware that their calorie intake recommendations for the United Kingdom were higher than the Food and Nutrition Board's allowance for Americans, and that both were lower than the 1957 calorie requirement recommendations of FAO. Commenting on these relationships, the British panel stressed the importance of differences in levels of mechanization and in improvement of industrial organization (*10*, p. 7):

> Many surveys have shown that in the UK both occupational and non-occupational energy expenditure is less than that of the FAO reference man and woman. However, the USA recommended dietary intakes . . . are even lower than ours, being 2800 kcal for young men and 2000 kcal for young women. These figures probably correspond closely to average rates of expenditure in the USA. We would not recommend further reduction to the USA level at the present time. Such a reduction may be necessary in the future if increased mechanization and better organization of industry results in diminished energy expenditure at work, unless this is compensated for by increased participation in active recreations.

Of the 14 Western European countries here considered, *Portugal, Spain, and Ireland, with the lowest per capita gross domestic product, appear to have the lowest levels of mechanization and the highest levels of human physical activity.* There is much supporting evidence for this conclusion. Not only do these countries have the largest percentages of their economically active populations engaged in agriculture, forestry, and fishing with agriculture supplying the largest percentage of the gross national product of each country (*17*, pp. 20–23), but they also have the lowest tractor-and-animal horsepower available per 100 hectares of agricultural land (excluding rough grazing areas) and the smallest percentage of tractor horsepower in the total energy used for agriculture (*16*, pp. 68–69).[9] It seems evident, therefore, that the farmers, and presumably also the foresters and fishermen, of Portugal, Spain, and Ireland are called upon to do heavier

[9] The most recent year for which we have such tractor and animal horsepower data is 1960, but there is reason to believe that Portugal, Spain, and Ireland continued to show the greatest deficiencies of agricultural horsepower through 1970.

TABLE 2.—NATIONAL MECHANIZATION RANKS OF FOURTEEN WEST EUROPEAN COUNTRIES*
(1.0 represents the highest possible rank, 14.0 the lowest)

Mechanization level	Country and mechanization rank
1.0– 1.9	Sweden (1.6)
2.0– 3.9	—
4.0– 5.9	UK (4.4), Norway (4.4), Denmark (4.6), W. Germany (4.9), Switzerland (5.7)
6.0– 7.9	Belgium (6.4), France (7.1), Netherlands (7.3)
8.0– 9.9	Austria (8.9)
10.0–11.9	Italy (11.1)
12.0–13.9	Ireland (12.1), Spain (12.6), Portugal (13.9)

* National average rankings of seven mechanization indicators listed and discussed in the text. See associated text footnotes for sources of the data used.

work in their occupational fields than are their counterparts in any other Western European country.

Table 2 presents a broader measure for judging differences in the general mechanization levels of the 14 Western European nations. It shows the average rank of each country from 1.0 (highest) to 14.0 (lowest) obtained from national rankings of the following seven indicators for the latest year available (1969 or 1970 except as noted): (1) per capita total national use of basic energy; (2) per capita net consumption of electricity; (3) agricultural tractor horsepower as a percentage of total tractor and animal horsepower in agriculture in 1960; (4) number of passenger cars per 1,000 population; (5) number of telephones per 1,000 population; (6) number of TV units per 1,000 population; and (7) per capita gross domestic product (GDP) at factor cost, 1967–69 average.[10]

Although far from perfect as mechanization indicators, each of these relates directly or indirectly to the possible use of mechanical energy as a substitute for human energy in one or more of the major fields of activity, such as farming and forestry, industrial work, transportation, communication, household tasks, recreation. The combined rankings shown in Table 2 may therefore be assumed to reflect in a rough way the relative positions of the various countries in level of mechanization, though rank differences of only a point or two should probably be regarded as negligible in the absence of other supporting evidence.

There is no reason to doubt the indication that Portugal, Spain, and Ireland have the lowest national levels of mechanization in West Europe, with Italy and Austria moderately higher. Nor is there much question that Sweden occupies the top rung on the mechanization ladder, which implies that the Swedish population is spared many of the arduous occupational and nonoccupational tasks and physical activity associated with the less mechanized work, transportation, and communication that are common elsewhere in Western Europe.

Moreover, it seems probable that the tabulated figures correctly imply that mechanization is more highly developed in the United Kingdom, Norway, Den-

[10] Indicators numbered 1, 4, 5, and 6 are based on data published by the European Community (*3*, pp. 106–08); indicators 2 and 3 are based on OECD figures (*16*, p. 68; *17*, p. 26); indicator 7 is partly estimated on the basis of data in two UN sources (*20*, pp. 598–601; *21*, pp. 10–14).

mark, and West Germany than in France or the Netherlands. On the other hand, the relative positions of Switzerland and Belgium are unclear, and the small differences in the mechanization ranks of Britain, Norway, Denmark, and West Germany certainly do not warrant an inference that the mechanization level of West Germany is the lowest of the four countries. Indeed, the expressed impression of many observers is that the mechanization level of West Germany is now higher than that of any West European country except Sweden—an impression probably based on Germany's remarkable postwar modernization and advancement in industry and transportation, including progress made since the figures in Table 2 were collected.[11] Although this advance has not been duplicated on Germany's many small, fragmented farms,[12] most of the larger German farms in favorable areas have participated actively in the introduction of mechanical equipment and other improvements.

Since scientific efforts to take account of the differing levels of physical activity of various population groups have focused on occupational and mechanization differences, it seems worthwhile to ask whether sufficient attention has been given to recreational and other nonoccupational activities as a possible energy-balancing factor. If sedentary workers typically participate in more vigorous recreational activities than do workers in the heavy industries, the 24-hour energy-expenditure levels of the two groups would be closer to a common level than is implied by typical occupation-oriented dietary standards. Such limited evidence as is available on this subject, however, supports this view expressed in 1969 by the expert British Panel on Recommended Allowances of Nutrients (*10*, p. 7):

> Individual energy expenditure may depend as much on variations in recreational and non-occupational activities as on occupation. This expenditure commonly ranges from as low as 800 to about 1,800 kcal in the course of the day. There is no evidence that the recreational activities of sedentary and heavy workers differ significantly: not a few heavy workers are keen participants in sport and many clerks are television addicts. Because we are recommending intakes for groups and not individuals . . . it is feasible to recommend average intakes of energy for different categories of occupation.

At present, then, the primary question relating to the calorie needs of the 14 West European countries is: What general magnitude of difference might we expect to find in the per capita daily food energy requirement of the least mechanized and most mechanized countries as a sole result of the typically longer

[11] One might hope to get additional light on the differing levels of mechanization and human energy expenditure in the various West European countries by comparing the calorie allowances recommended in their respective dietary standards. However, after taking account of the small number of well-designed dietary standards that are available, the widely separated dates of publication of those standards (a span of years of rapid mechanization), and the obscure and apparently differing national concepts of such physical activity levels as sedentary, light work, and moderate activity, it seems necessary to conclude that at present such standards are of little use for judging national differences in the work levels, activity levels, or calorie requirements of most West European countries.

[12] Although the percentage of the economically active population engaged in agriculture is higher in West Germany than in Belgium, Netherlands, Switzerland, or the United Kingdom, the German figure is exaggerated by the addition of many part-time family workers, including a large percentage of farm operators whose chief source of income is outside of agriculture. For a description of some major features of West German agriculture and of postwar changes in inputs, see *8*, pp. 4–24.

work day, heavier work, and additional exercise required in walking and daily living in the countries with the lowest levels of mechanization (body weight, climate, etc. assumed the same). Based on the energy expenditure differences between sedentary, moderately active, and very active work indicated in the 1969 British dietary standard (*10*), and on the illuminating energy expenditure studies summarized by J. V. Durnin and R. Passmore (*2*), it seems fair to hazard the guess that the lower levels of mechanization and development in Portugal, Spain, and Ireland might raise the average daily expenditure of human activity and related energy intake requirement by something like 150 to 300 calories above corresponding Scandinavian, British, and German levels,[13] with the upper part of this range (say 250 to 300 kcal) applying primarily and perhaps solely to the activity differential between Portugal and highly mechanized Sweden. As compared with the moderately active British population, the Portuguese might be expected to need less than 200 additional calories per capita to compensate for their typically heavier physical work and other activity.

These and similar "guesstimates" of the differences in calorie needs among West European countries due solely to differing physical activity levels (body size, climate, and such assumed constant at British levels) are shown in the fourth column of Table 4, p. 90. In view of the inadequate data on which these figures rest, only their general magnitudes deserve consideration. They clearly suggest, however, that Sweden alone needs substantially fewer food calories per capita than Britain when physical activity is assumed to be the sole differentiating factor. And only in the three countries of Southwest Europe and Ireland does the heavier output of human energy in customary work and other physical activity suggest the need for over 100 more calories per capita than in the United Kingdom. Indeed, all of the remaining West European countries except Austria appear to have occupational and living pattern characteristics sufficiently similar to warrant the assumption that their activity-related calorie needs differ little if at all on a per capita basis.

The Effect of National Differences in Age and Sex Distributions

In every country for which evidence is available, per capita calorie needs increase with body growth from birth to the early teens for girls and to the middle or late teens for boys, then flatten out or slightly decline to about age 22 or 25. Thereafter, there is a continuing decline in calorie requirements, which is relatively small to age 35 or 40, more substantial to the mid-fifties or early sixties, and much greater after ages 65 and 75, when larger reductions are recorded for males than for females. Moreover, at all ages above 10 or 12 years, the average daily energy need of males is put 200 calories or more higher than that of females, with the maximum sex differential indicated by major nutrient standards to be for

[13] This assumes an average daily physical activity rate 250 to 500 kcal higher than in Scandinavia or Britain for men between the ages of 15 and 64 years; 150 to 270 kcal higher for women within the same age range; 125 to 225 kcal higher for adults over age 65 (sexes combined); and 60 to 100 kcal higher for children and adolescents under age 15. The following generalized age and sex distribution was assumed for combining these approximations: ages 15 to 64, 63 percent; 65 years and over, 12 percent; under 15 years, 25 percent, with half males and half females assumed in the two age groups under 65 years, and 42 percent males in the over-65-year group.

ages 20 to 25 or 20 to 35—a differential usually set at some figure between 400 and 900 calories.[14]

The decline in adult calorie needs with advancing age is attributed to two factors: (1) the known steady decline in resting metabolism of a little over 2 percent per decade from ages in the early twenties; and (2) the uncertain and variable slowing down of physical activity in the later pre-retirement and retirement years. Differences in physical activity also play a part in determining the normally higher average calorie requirement of males than of females. On the other hand, sex differences in body size (accounting for an average differential of about 300 calories per day)[15] are often more important than sex differences in physical activity, particularly among sedentary groups, including the elderly, and even quite generally throughout the populations of certain African, Asian, and perhaps East European countries whose cultural patterns contrast sharply with those of West Europe by promoting heavier work and more physically active training and recreation for females. There appears to be no reason to question the 1964 assertion of the Canadian Council on Nutrition that the energy requirement for any particular activity is about the same for people of the same body size and same efficiency in performance. But in West European countries adult women are typically 10 to 12 kilograms (22 to 26 lbs.) lighter in body weight than men, and they usually engage in less active work and recreation than do men. This is well reflected in the 1969 British nutrient recommendations.

Before undertaking a detailed calculation of the effects of national differences in age and sex structure on the per capita calorie needs of West European countries, it seemed desirable to know whether the population structures of these countries differ materially. Table 3 shows that there are some very marked differences. Over 31 percent of the Irish population is under 15 years of age, whereas Sweden has less than 21 percent in this young group—a difference of almost 50 percent based on the Swedish figure. Moreover, Portugal and Spain, which rank together with Ireland as the three "youngest nations," exceed Sweden's percentage in the under-15 year class by roughly 35 percent. Similar marked contrasts exist at the upper end of the age scale. Portugal and Spain report that only 9 percent of their people are age 65 or older, whereas Austria and Sweden—the two with the most elderly populations—have roughly 14 percent in this top age category, thus reflecting a 55 percent difference between the highest and lowest national figures.

No less significant in determining national calorie needs, however, is the broad though not invariable tendency for "young" countries with exceptionally large percentages of their populations under age 15 to rank notably low in their proportions of "elderly" inhabitants (age 65 and over). And there is a similar general tendency for countries with a relatively small percentage of children and young teenagers to have an unusually large percentage of elderly people. It is

[14] The summary in the preceding and following paragraphs is based primarily on material in the following sources: *1*; *2*, pp. 96–105; *5*, pp. 21–23, 37–42; *7*, pp. 4–6; *10*, pp. 4–9; *12*, pp. 157–69; *25*, pp. 222–26.

[15] This differential applies specifically to body weight differences of about 10 kg. (22 lbs.) regardless of sex. It is acceptable as a sex differential only because population samples in West Europe, North America, Australia, and elsewhere show that representative adult males typically weigh 10 to 12 kg. more than women of the same age group.

TABLE 3.—HIGHEST, LOWEST, MEDIAN, AND SELECTED NATIONAL PERCENTAGES OF THE POPULATIONS OF FOURTEEN WEST EUROPEAN COUNTRIES IN THREE AGE GROUPS, WITH ASSOCIATED MALE RATIOS*

Country	Under age 15	Ages 15–64	Age 65 and over	All ages
	A. PERCENT OF TOTAL POPULATION			
Rank				
Highest	31.2 (Ire.)	65.6 (Swed.)	14.0 (Aust.)	—
Lowest	20.9 (Swed.)	57.5 (Ire.)	8.8 (Port.)	—
Median	24.4 (Aust.) (Fr.) (It.)	62.8 (U.K.)	11.7 (Ger.)[a]	—
Selected				
Sweden	20.9	65.6	13.5	100
U.K.	24.2	62.8	13.0	100
Portugal	28.8	62.4	8.8	100
	B. MALES AS PERCENT OF TOTAL IN AGE GROUP			
Rank				
Highest	51.5 (Port.)	50.6 (Ire.)	45.8 (Ire.)	50.2 (Ire.)
Lowest	50.9 (Ire.)	47.3 (Aust.)	37.9 (Aust.)	46.9 (Aust.)
Median	51.2 (Belg.) (Neth.) (Den.) (Ger.)[a]	49.8 (Belg.) (U.K.)	41.3 (It.)	48.8 (Switz.)
Selected				
Sweden	51.4	50.5	44.7	49.9
U.K.	51.3	49.8	38.3	48.6
Portugal	51.5	47.9	40.5	48.3

* Calculated from population data for the most recent year available (1968, 1969, or 1970) in UN *Demographic Yearbook, 1970* (1971), Table 6, except for the U.K. official figures for 1971, which are from Great Britain, Central Statistical Office, *Monthly Digest of Statistics*, May 1972.

[a] West Germany exclusive of Berlin.

not surprising, therefore, that the intermediate age group between 15 and 65 years—ages that require the highest per capita intake of food calories—typically varies less markedly from country to country as a percentage of the national population. Thus, in all but two (Ireland and Austria) of the 14 West European countries, this age group has recently ranged between a low of 62.4 percent and a high of 65.6 percent.

Only in the elderly age group are national differences in the sex ratios of West European countries very pronounced (Table 3). At ages under 15 there is a general tendency for males to exceed females, reflecting the larger number of male births. But since the survival rate of males is progessively lower than that of females during later decades, the male ratio in West European populations typically declines from roughly 51 percent in the youngest group (under 15 years of age) to slightly less than 50 percent in the intermediate age group from 15 through 64 years and then falls sharply to 41 percent in the over-65 year group.

Intercountry differences in the male ratios of European adult groups (particularly over age 65) appear mainly to reflect national differences in (1) the

TABLE 4.—ROUGH APPROXIMATIONS OF THE PER CAPITA CALORIE INTAKE NEEDS OF FOURTEEN WEST EUROPEAN COUNTRIES*
(*Calorie intake per capita per day*)

Country	Calorie allowance based on national age-sex structure: all other factors at U.K. levels[a]	Increase (+) or decrease (−) from U.K. calorie allowance to reflect difference in			Total per capita calorie allowance	
		Environmental temperature	Body size	Physical activity	Indicated range	Rounded midpoint of range
	(1)	(2)	(3)	(4)	(5)	(6)
Ireland	2332	+10 to 20	0	+140 to 170	2482–2522	2500
Austria	2336	+15 to 25	+ 50 to 75	+ 60 to 100	2461–2536	2500
Spain	2343	−45 to 55	− 60 to 110	+140 to 170	2318–2408	2365
Port.	2344	−50 to 60	− 75 to 125	+160 to 190	2319–2409	2365
W. Ger.	2344	+15 to 25	+125 to 145	0 to −50	2334–2514	2475
U.K.	2355	←	Base level	→	2355	2355
Neth.	2359	0	+125 to 145	+ 25 to 50	2509–2554	2530
Belgium	2361	+ 5 to 15	+ 75 to 100	+ 20 to 40	2461–2516	2490
France	2361	−10 to 20	0	+ 25 to 50	2366–2401	2385
Norway	2362	+30 to 40	+125 to 145	0 to +25	2517–2572	2545
Italy	2366	−25 to 35	− 70 to 120	+130 to 160	2341–2431	2385
Denmark	2369	+20 to 30	+125 to 145	0	2514–2544	2530
Switz.	2369	+15 to 25	0 to +25	0	2384–2419	2400
Sweden	2380	+15 to 25	+125 to 145	− 75 to 125	2395–2475	2435

* Calorie recommendations for the population of the United Kingdom are from Great Britain, Dept. of Health and Social Security, *Recommended Intakes of Nutrients for the United Kingdom* (Reports on Public Health and Medical Subjects No. 120, London, 1969, p. 4). Populations by age groups are from Great Britain, Central Statistical Office, *Monthly Digest of Statistics*, May 1972, and UN, *Demographic Yearbook 1970* (1971).

Calorie intake needs roughly approximated as indicated in the text: additional details regarding column 1 are given in footnote *a*. In each of the first four columns, all energy influencing factors other than the one specified are assumed to be equivalent to British levels.

[a] Calculations based on British calorie intake recommendations for the population of the United Kingdom applied to the corresponding age and sex groups of each of the 14 countries. The activity levels apparently regarded by British experts as representative of the U.K. population (and therefore implied in the calculations here) are described by the 1969 British scientific panel as (1) normal activity for children and for teen-age boys and girls (separately) through age 17; (2) moderately active occupations for boys and men aged 18 through 64; activity equivalent to most occupations for women 18 through 54 years; and (4) sedentary living for women from age 55 and for men from age 65. An extra recommended allowance of 500 calories per day is included for women in the last trimester of pregnancy and for nursing mothers (the number of such women in each country is here assumed to be equal to the reported number of infants under one year of age).

degree of involvement in World Wars I and II, (2) the direction and rate of adult male (or female) migrations, usually in search of gainful employment, and (3) the level of health-promoting conditions. These same influences are reflected, though less clearly, in the differing national age distributions. Although no further attention need be given to these factors here, their implication is worth noting: if West European countries successfully avoid future wars and if they continue to progress economically with associated expansion of employment opportunities and improved health conditions and care, the male ratios at ages over 45 may be expected to rise substantially in West Germany, Austria, France, the United Kingdom, and several other countries. Thus, the age-sex structures of West European countries may increasingly resemble the pattern now evident in Sweden.

We can approximate fairly well the effect of the differing age and sex struc-

tures of the 14 West European countries on their national calorie needs. For this, we multiplied the British calorie intake recommendations for the designated age and sex groups of the United Kingdom (*10*, p. 4) by the number of individuals in the corresponding age and sex category of each of the other countries, and then divided each national calorie total by the corresponding national population.[16] The resulting per capita calorie figures are shown in the first column of Table 4. In interpreting these figures it is important to remember that they are based on the assumption that all energy-influencing factors other than age and sex structure are the same in all 14 countries—body weight, activity, climate, and the like being held constant at the representative British levels described or implied by the scientists who designed the 1969 nutrient standard for the United Kingdom.

The obvious conclusion from the calculated figures in Table 4, column 1, is that existing differences in the age and sex structures of West European populations have little effect on their per capita calorie intake needs. The maximum effect indicated amounts to less that 50 calories—the range between the lowest of these national averages (Ireland's) and the highest (Sweden's). Although this difference may appear surprisingly small in view of the sizable percentage differences in the youngest and oldest age groups of the 14 countries (see Table 3), it is not out of line with the small to moderate age and sex differences in the largest, highest calorie-consuming age group between 15 and 65 years. Indeed, a Spearman rank correlation[17] between (1) the percentages of the different national populations in this age group and (2) the per capita national calorie figures in the first column of Table 4 yield a correlation coefficient of .85.

A SUMMARY VIEW OF NATIONAL CALORIE INTAKE NEEDS IN WEST EUROPE

It is now possible to combine our preceding appraisals of the four major determinants of West European energy needs and to arrive at rough approximations of the per capita calorie requirements of the individual countries. The detailed figures are presented in Table 4, which shows the indicated influence of each of the four major factors (columns 1 to 4) and the final approximations of the national calorie intake needs or allowances (column 6).

An impressive feature of the table is the broad similarity of the derived calorie allowances for the 14 countries. The lowest figure is 2,355 calories for the United Kingdom, closely followed by 2,365 for Portugal and Spain; and the highest calorie allowance is 2,545 for Norway, with Denmark and the Netherlands only slightly lower at 2,530 calories. Thus, the estimated range of national calorie intake requirement in West Europe is less than 200 calories, as contrasted with the range of more than 700 calories in reported food consumption levels of the same 14 countries (Table 1).

In spite of the inadequacy of the data on which our approximations of national calorie allowances rest, both their general level and most of the larger intercountry relationships appear to be roughly in line with current scientific

[16] Population figures from sources specified in Table 4 footnote.

[17] Based on the formula: $r = \frac{1 - 6\Sigma d^2}{n(n+1)(n-1)}$, with d representing the differences between ranks of the two variables, and n representing the number of observations.

views. It is not surprising that our figure for the United Kingdom (2,355 calories) should appear valid to nutrition scientists, since it was calculated by multiplying the officially recommended British scale for specified age and sex groups (*10*) by the corresponding population data for the United Kingdom in 1971 (*9*), and then dividing by the total number in the population. The resulting per capita calorie allowance is almost precisely the same as the 1969 British estimate of 2,350 calories accepted by J. P. Greaves, Scientific Secretary of the British Panel on Recommended Allowances (*11*) and D. F. Hollingsworth, Head of the Food Science Advice Branch of the British Ministry of Agriculture, Fisheries, and Food (*13*).

Further perspective on the acceptability of our calorie allowance approximations for West European countries may be gained by noting the comparative levels of national calorie allowances for the United States, France, and Spain, when each of these is calculated on the basis of the most recent dietary standard (or survey) available for the specified country.

By applying the 1968 American calorie recommendations for children and adults of given ages and sex to the reported distribution of the United States population of mid-1969 (*7*; 22), we calculated the per capita calorie intake allowance of the nation to be about 2,175 calories per day. This figure is 180 calories less than the indicated energy intake need of the British people, despite their smaller body size, and it is 260 calories less than our approximated allowance for Sweden, whose adults are of similar or somewhat larger stature—calorie allowance relationships that appear quite reasonable in view of the differences in levels of living and mechanization in these three highly developed countries.

For France, a similar calculation based on the revised nutrient recommendations of l'Institute National d'Hygiène (*14*, p. 344; *18*, pp. 767–825)[18] and the reported age and sex structure of the French population in 1968, yielded a per capita calorie requirement of 2,405 for the nation as a whole. This broadly supports our slightly lower figure of 2,385 calories for France.

Of the 14 national calorie allowances shown in Table 4, those for Spain and Portugal (the least developed countries) are the most uncertain. It is, therefore, particularly desirable to check the general magnitude of at least one of these two figures. Although no recent Spanish or Portuguese dietary standard is available for this purpose, G. Varela has reportedly calculated the per capita daily calorie need of the Spanish population grouped by sex, age, and activities (*24*, pp. 86–104; esp. 94–97). He concluded that the nation needed 2,486 calories per person per day. This estimate is 120 calories higher than our approximated allowance of 2,365 calories for Spain, but there is considerable reason to believe that the two figures are not truly comparable. Since Varela's estimate of Spanish calorie needs was designed for direct comparison with family survey data of food consumption (including both purchased and home produced food), it may not be a true intake figure but rather one that refers to the need for loss and waste—say a 3 to 5 percent margin covering both plate waste and kitchen loss and waste.

[*We are left with a tidy little problem. When every standard adjustment has been made for physical factors that might be expected to explain the reported*

[18] Average activity allowance used for males and females from age 13 to 65; sedentary activity allowance used for all over 65 years.

differences in per capita calorie consumption, the variation from country to country is still large, ranging from 115 percent of estimated requirements in Portugal and Norway to 138 percent in Ireland. If the estimates are to be trusted, and the evidence for doing so is strong, then the unexplained variation must be due to socioeconomic causes. The author meticulously refrained, up to this point in the manuscript, from speaking of national incomes, national price structures and subsidies, of customs, tastes, and national cuisines, although Table 1 almost forces the reader to compare calorie consumption with national product or national income. Whether the author would have gone on to examine other possible determinants of food consumption, we can only surmise. If she did, she left no trace in the files. Perhaps others would like to try.*—W.O.J.]

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