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II. TRENDS IN FOOD SUPPLIES IN THE WORLD

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FIRST of all, I must call your attention to the fact that I have worded the title of my paper in such a way that I shall not be found guilty of talking about food supply as if there were one food supply in the world which the people of the world are sharing as if they were animals eating out of a common feedbin. Instead, the food supply is in the main determined by single countries, or by groups of countries in close trade relation with each other. This paper will consider the trends in different parts of the world. I realize the dangers I am chancing in doing this. I can easily be wrong in my statements about different parts of the world. If I am, I want to be corrected. Indeed, I need to be corrected, so that I do not keep on making false statements.

Second, I shall not fall into the ordinary practice of thinking of the food supply as determined independently of population, any more than Notestein has thought of population as independent of food supply. The interdependence is two-way.

These two statements together mean that nowhere in this paper will there be any analysis of the question as to whether or not the earth can feed its growing population, except to say at the outset, 'By all means, yes, because the population can't grow if it isn't fed'; nor any statement as to whether food output in the world as a whole is increasing fast enough to feed 60,000 new mouths each day. This is altogether the wrong way of stating the question. It should read very simply instead: 'How much more can the population of any country grow?' The answer even to this question depends upon the level of living that is to be maintained or achieved.

Neither will there be any presentation of statistical series, or mathematical fitting of trend lines, or offering of precise data on recent developments. What one should be looking for is principles and general relationships. This does not mean that I have ignored such of these as are available. But I am not going to use your time analysing them.

The nearest approach to anything like a world matching of food supply and food consumption has come in the part of the world that includes Europe and the countries that were shipping food to

Europe, in the period from 1870 to 1930. The trends in food production in the countries of Europe most advanced industrially, from perhaps as early as 1840, had been toward less dependence on cereals and potatoes in the diet, and more on meat, dairy products, and eggs. The increased output per worker from using power and machinery in factories made it possible for them to have a somewhat more expensive diet. They presently began importing their cereals from the new countries and shifting still more land to grass and livestock. The cheapening of cereals as the prairie and plains lands of North America and elsewhere were settled accentuated this development. Other European nations followed in the same pattern as they became more industrial. The general effect was a marked rise in the food levels of living in the industrial countries of Europe.

Denmark's agricultural history is highly pertinent in this connexion. Until about 1880 it was largely a cereal-producing country exporting its surplus to feed London and the big cities of western Europe. But with the growth of these centres, it was presently brought within the zone outward from these where dairy and poultry production, and supplementary pork production, have comparative advantage. By 1910 Denmark had largely shifted to livestock production.

From 1870 on the general effect of this development in Europe was a cheapening of food prices. The new plains lands were settled so fast that the food supply really pressed on the population. Then the situation was completely reversed around 1900. Food prices began to rise faster than the general price level, and this continued until 1920. It is also notable that industrial wages did not rise in this period. The consequence of this was a growing clamour in the United States, from 1900 on, over the 'high cost of living', which resulted in a political overturn. The high prices of food and woollens were blamed on the tariff. The industrial States of the east cast larger Democratic votes in the election of 1912 than in those preceding. American historians in the 1920's blamed the low wages of 1900–15 on excessive immigration. Later ones discovered that wages were depressed and food prices relatively high in western Europe in the same period.

It now seems clear that two things produced the reversal around 1900. First, industrialization was proceeding very rapidly in the United States and in much of Europe, and much of it was at the stage when birth-rates had not fallen much, with the result that the population of these parts of the earth was still growing pretty fast. Second, this industrialization was productive enough to finance a

growing shift from cereals and potatoes to foods of livestock origin. It is highly significant that the price of corn rose twice as fast as the price of wheat from 1900 to 1915 when the war made wheat scarce again. During this period, livestock production was expanding rapidly in Denmark, Holland, Ireland, western Germany, Australia and New Zealand, Argentina, the United States, and Canada. The United States corn was exported as cured pork and lard. Livestock production takes six or seven times as much land per million calories as do cereals and root crops.

But with the end of World War I, the tables were turned again, and they stayed turned till World War II broke loose. Surpluses of foods and fibres appeared in most of the exporting nations, and especially in the United States. Why and how? Several explanations have been offered, and each furnishes part of the answer:

1. Intensification of production and the development of improved technology was much stimulated by the rising prices from 1900 on. One American economist has figured that this alone would have produced a mild reversal as early as 1915–16 if the war had not intervened.
2. The war had induced an over expansion of production of wheat, especially in the plains areas—the introduction of the tractor and later the tractor combine was an additional factor in this.
3. Substitution of vegetable oils for animal fats greatly reduced the demand for corn.
4. Cotton production expanded westward rapidly in the United States as an aftermath of the boll weevil invasion of the old cotton belt.
5. Plantation production of sugar expanded greatly in the tropics, and beet sugar production increased in Europe.
6. Europe in general set about becoming more self-sufficient in food, as a safety measure in the event of another war, or because of a shortage of exchange, as particularly in Italy, or merely because the farmers of Europe were in a bad way and demanded and secured protection against imports.

On top of all of these came the Great Depression of the 1930's which killed off employment in all of the group of countries we have been considering, and destroyed much of their buying power for food and fibre. It reduced calorie intakes per person very little. Its effect was principally on the proportion of them from animal sources. Before the end of the 1930's, marriage and birth-rates declined sharply.

With the onset of World War II and the sharp rise in prices, food production expanded in nearly all of the food-surplus countries, very sharply in some of them, almost a third in five years in the United States. The simple fact is that the United States had a large reserve of food-producing potential which it was not using in the 1930's because no one stood ready to buy the food except at impossibly low prices. This increase in food output was achieved along with a decline of the farm employment of a tenth between 1940 and 1945. Farm population declined much more than this. Most of the other food-surplus countries also made important gains. The countries in which the actual fighting took place had the usual declines in food output. In general, also as usual, they ate up some of their producing herds of livestock, and shifted some of their production to root crops and cereals. Some parts of Europe actually increased their production of food calories during the war. The destruction or blockading was pretty severe at the end in a few places—Holland and Greece, for example.

Such a statement as the foregoing does not mean that the farmers of the United States must have prices at 115 per cent. of parity before they will expand production. What they fear is prices down to 75 or 80 per cent. of parity as in 1937 to 1939, or still lower as in 1930–2. They need to be assured that prices multiplied into output will give them a net income at around 85 to 90 per cent. of war-time levels of parity income. Legislation that will assure this has been impossible of enactment because of opposition from powerful groups of farmers seeking special favours.

The recovery in Europe as a whole outside of Russia has restored food production just about to its pre-war level, according to the recent reports of F.A.O. This is true of a total which the F.A.O. staff compiles for eight crops on a wheat-equivalent basis, and for dairy products and meat in the countries for which reports are available. But the east-west trade in food products in Europe is still blocked in good part, and the population has been growing more rapidly again. Accordingly, Europe west of the Iron Curtain still needs larger food imports than before the war if the pre-war levels of food consumption are to be achieved. But this situation can be remedied within Europe itself by raising yields a little further, and by related measures.

The index of food production compiled for the United States indicates a rise from 137 to 141 between 1946 and 1951 on a 1935–9 base. Thus food production has been little more than holding its own since the last war. Does this mean that all of the known technology,

and all the possibilities of further intensification, have been exhausted? Quite the contrary. The farmers of the United States have been expecting a sharp break in prices as soon as European food production gets back to its pre-war normal. Prices did indeed fall from their high of 115 per cent. of parity in 1947 to 95 per cent. of it in the first half of 1950 when the Korean war broke, and might have fallen to 85 or below except for this new development. They recovered to 111 by March 1951, but were back down to 100 again in March 1952. They are at 103 now. The Secretary of Agriculture made a strong plea for a 6 per cent. increase in acreage plantings this spring. The farmers responded with intentions to plant no more acres than in 1951. The farmers do not believe there is any food shortage calling for an expansion of acreage, and it is not difficult to see why they do not.

It has been said in high places, however, that the United States has no large carry-overs of food now, such as those we had when entering World War II, and that we are not really ready for World War III without such stockpiles. In fact, it has recently been figured out that taking account of the ordinary fluctuations in yields by five-year periods, this country needs a reserve of 450,000,000 bushels of wheat to be ready for another war, 900,000,000 bushels of corn, and 4,500,000 bales of cotton. The trade cannot afford to carry reserves of this magnitude. We have a Commodity Credit Corporation for functions of this kind, but it is not adequately equipped with legislation, nor probably in some other respects, to perform as needed.

But stockpiles of this magnitude could be accumulated in a few years. Indeed, it now looks as if the large wheat crop of this year will give us a wheat stockpile of this magnitude. Once such reserves are achieved, the food production in this country can find a larger market only as our own population expands, or has larger disposable incomes *per capita*, unless Europe, or somehow some other parts of the world, acquire some new food-buying power. The probable increase in domestic demand for farm products in the United States is not likely to exceed an average of 1½ per cent. a year over the period from 1950 to 1975.

The situation in other food-surplus countries that normally supply Europe with food is much the same as in the United States. The Latin American countries stepped up their production a tenth from pre-war to 1946 and have not risen above this level since. The increase in Australia and New Zealand has been about a fifth, with no upturn since 1947. There is no reason to doubt that most of these

countries could increase their production if there was a demand for more output.

It should be illuminating to report at this point on the recent analyses of the production potential of agriculture in the United States. One of these has been made by the forty-eight States in co-operation with the Bureau of Agricultural Economics. One of the questions which each State undertook to answer was the 'attainable maximum' if present known technology were utilized. The other inquiry has been made in connexion with a projection of the needs of the United States for different materials in 1975 and the ability of its resources to meet these needs, that has recently been published by the President's Materials Policy Commission. This Commission assumed a population of from 190 to 195 million by 1975, and an increase in output per worker at the same rate as from 1900 to 1950. The analysis for agriculture in this inquiry was couched in terms of probable increases in yields per acre by 1975 from present land in crops and pasture if by that time present known technology is generally adopted, and along with this the probable increases from more efficient utilization of feed by livestock if present known livestock technology is generally applied. The two inquiries have come out with results differing somewhat by individual crops and kinds of livestock, but in composite indicating that twice the increase needed is readily attainable on present crop and pasture acres; and that the acres of land in crops and rotation pasture in the United States can be increased by a half and more with no serious difficulties except a sizeable capital investment in land improvements.

There seems little reason to doubt that a similar analysis made in the other New World food-surplus countries that have formerly shipped food to Europe would produce results generally in line with those for the United States.

What would such an analysis show for different countries of Europe? Certainly they cannot all be put in one bracket for this purpose, and time does not allow considering each separately. In general, yields of crops are already much higher per acre than in the United States because much more fertilizer is used, the land is maintained at a higher level of productivity, and the crops are better tended. But unless practices have changed much since my field observations in Europe in 1929, much more fertilizer per acre is used in some countries than in others—in Germany than in France, for example. Such an analysis would doubtless show possibilities of gain from more general application of some of the new technology of hybrids and crossbreeding to crops, pastures, and livestock, and

of new developments in feeding livestock. Supplemental irrigation has promise in some locations. Mechanization offers promise as a means of reclaiming some land hitherto considered too difficult and as a way of releasing labour for some further industrialization in some parts of Europe. There is surely a good bit of what the British call second-class, and even third-class, farming in many parts of Europe. If the population of Europe flattens off at anything like the levels forecast by the population scholars of the United States ten years ago, Europe will be able to feed this population at an appreciably higher dietary level than now from its own land resources. This assumes, however, the kind of an exchange of food, and food for other products, between European countries, that we had before World War II. There does not seem to be any prospect for larger imports of food from the New World countries than in the inter-war years, except as supplies from eastern Europe are blocked off.

We may remind ourselves at this point that I have not included Russia in this analysis. If her population grows at the rate that populations of other countries at her stage of industrialization have in the past, she will need to increase her food output a great deal in the next fifty years. Have Russian lands the capacity for this? Probably just about what will be needed, unless the diet is to be shifted considerably to more foods of livestock origin. If the so-called satellite countries are included in the same *bloc*, and these are industrialized to the extent their resources will permit in parallel with those of Russia, the food supplies will be more surely ample. South-east Europe considered by itself very much needs an outlet for its food surpluses, since its population is still increasing too fast for its resources and its industrial possibilities are limited.

Now let us shift to China and south-east Asia and the adjacent islands of the East Indies as another *bloc* of countries that need to be considered in large measure independently of the *bloc* we have been considering. I do not mean to say that no exchange of food and other agricultural products occurs between these *blocs* of countries. All the tea consumed in the first *bloc* is produced in the second, a minor fraction of the sugar, a little of the cotton, and most of the rubber, jute, and abaca. There would be serious hardship in sizeable areas in the Far East if the exports of these were cut off. But there is little use of considering these improbabilities. The real point in the problem of food supply and population for this group of countries is that today only in minor measure are they dependent on international trade in foods and fibres, and there is prospect of greater

dependence only if these countries can industrialize importantly and find a market outside of the Far East for these products in exchange for food. India will extend its industrialization and find an export market for some of the output, but it will be almost solely in the Far East. China will be able to export industrial products to the same areas, but in lesser measure. Japan at one time had a significant market for industrial products outside of the Orient, but most of this vanished with the war. The United States would be exercising excellent statesmanship if it encouraged the development of selected types of manufacturers in Japan and the Philippines, for example, by accepting imports from them. This will be less expensive by far than continuing to provide financial aid. But at its best, this will not provide any large outlet for the industrial products of the Far East.

The inescapable conclusion is that the consumption of the factory products of India and China will mostly have to be within their own countries. This can be a very important development. Factory labour is vastly more productive than hand labour. Probably the one-fifth of the weavers employed in factories of India are now turning out three-fourths of the product of India's looms. Factory labour turning out improved tools and fertilizer for use on farms can add many times as much to the farm output as the same labour employed on farms. At the same time the yields per acre of much of India's farm lands can easily be doubled by the application of technologies already well understood in other lands. However, I do not need to tell you that all the possible gains from the foregoing can be wiped out by a growth in the population at such a rate that all the increase in food, and gains from increased output per factory worker, are absorbed by the larger numbers.

Trends in food supply in a country like India? What can such concept actually mean? It would appear that at some period in recent decades the increase in food supply was faster than in the population. Otherwise the large increase in population since 1930 could not have been fed. If so, the trend *may* have been reversed since. Or it may be that the food supply has increased just about as fast as the population since 1930. Or perhaps this last has not been true in the past few years? At least the published figures indicate this latter. I doubt, however, if any of these statistics can be taken very seriously. If they are true, India needs to make a strong effort on *both the food supply and the population fronts* in the years just ahead.

The situation in China has closely paralleled that in India in the past fifty years except that food supply and population seem to have been kept more steadily in balance, and except that the Chinese

farmers have been maintaining their land at a considerably higher level of productivity than the Indian farmers by larger use of organic fertilizers.

Japan, by free use of commercial fertilizers in addition on her limited area of cropland, has had by far the highest yields of the three. Hence the potential increase of food output is relatively small. Japan must export other products and buy food if her population is going to be fed other than by grants-in-aid.

The Philippines have much larger possibilities of increasing food output than the three countries named—by higher yields per acre and by bringing land into a higher order of use. Considerable capital investment will be needed for this latter, and more public assistance of related kinds.

When one names the Philippines, and especially Indonesia, one brings into the picture another large factor in the problem of food supply, namely the additional lands in the tropical regions that can be brought into cultivation. It is worth while citing in full Dr. Charles E. Kellogg's statement relative to undeveloped land in his U.N.E.S.C.O. bulletin, *Food, Soil and People*:

> Probably most of the good land in temperate regions is occupied—though by no means all of it. In the United States it is estimated that the present crop land of around 370 million acres could be expanded to a total of around 450 million acres, or possibly even to 500 million, under conditions of full employment. Probably smaller opportunities exist in Europe and in the older settled portions of Asia.
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> North of the temperate zone, in the region of Podzol soils, only about 1 per cent of the land is cultivated. On the basis of experience in Finland and Scandinavia, it seems reasonable that the acreage could be increased by 10 per cent if transportation and industry were developed along with the agriculture. This would provide about 300 million acres of new land. When first cultivated, these soils would not be so productive as most of those in the humid temperate region, but experience has shown that they are responsive to management and can be developed for dairying and vegetables.
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> The really great areas of undeveloped soil in the world are in the tropical regions—in Africa, South America, Central America, and several of the great tropical islands. In southeastern Asia and India, on some of the Pacific islands, and in parts of other tropical regions, these tropical soils are used intensively for crops, but great areas are hardly touched. It seems reasonable that at least 20 per cent of the unused tropical soils in the Americas, Africa, and the great islands like New Guinea, Madagascar, and Borneo could be cultivated. This might give us 1 billion additional potential acres.[1]

[1] One billion (U.S.) = one thousand millions.

Estimating the potential productivity of these tropical soils on the basis of the best results, say in Hawaii or in Java before the war, the figures would be almost astronomical. It would be conservative, perhaps ultra-conservative, to use experience in the Philippines as a general guide, realizing that this omits a large part of the great increases in efficiency that could come with the application of modern science to the tropics. This does not mean that the local soil types in the Philippines are identical with those in other tropical areas, nor that crops and management methods are identical. Some unused tropical areas are better, some poorer. For the northern soils—the 300 million acres north of the temperate region—we may use Finland as a guide.

These new acres will be difficult to settle. . . . Most of the new soils are unlike those settled by Europeans and Americans during the nineteenth century. Little new soil merely waits for the plow and the homesteading family. Most of the new acres require clearing and careful management. Some require terraces, some levees, some partial drainage, and some supplemental irrigation during dry seasons. Most need lime, or fertilizer, or both, from the start.

Most of these acres lie in the interior of continents, away from regular trade routes, far from good harbors. To use them, medical facilities, local industry, and electric power must go along with agricultural development. Settlement will need to be planned as *combined resource development*: Soil and water for crops, grazing, and forestry; water for electric power, industry, and human use; minerals; and transportation—all must be developed together.

The people of the East Indies, and of Indo-China and Siam, have not been pushing into these areas that Kellogg talks about. Will they do it in the coming decades? This is a large question. It is true that some new technologies are now available; but are these people ready to use them? Large capital investment is involved if power equipment is used in developing the lands; also in the initial liming and fertilizing. Actually, however, little more is involved than has already been done on the lands used on the sugar plantations of Hawaii. A major factor in any development of these lands is a market outlet for the foods and fibres produced. There will be little development on an old-fashioned pioneering self-sufficing basis.

And the same question can be asked as to the cold northern podsols in Kellogg's analysis. Modern heating for homes may be a factor in this.

The next group of countries to consider is the Middle East. These countries are more in the current of international trade than are those in the Far East. They are much more dependent on export markets. In general their lands suffer from lack of rainfall and are

even more difficult to develop than those of the Far East. New technologies in the use of limited water supply is one line of progress; disease and pest control another. Social organization probably handicaps these countries more than those in most parts of the world. The recent uprisings in Egypt and Iran merely illustrate this.

As for the tropics of Latin America and Africa, all that will be said is to emphasize the need for developing a body of soil and plant science to fit these lands and their climate, and to point out that as this is developed its application will follow, if history repeats itself, in either of two directions—plantation production, or family holdings of a few acres. Either of these tends to produce the population pressures now found in Latin America. Getting science applied on these small holdings is a slow hard process. Hence the usual evolution is a plantation system. One can properly ask, however, how much better off would the world as a whole be with a hundred thousand new plantations? Who is it that needs, and will be in position to buy, the product of these plantations? Someone may say 'Cheaper sugar, coffee, coconuts, chocolate, palm oil'. But, if cheaper, probably only by a multiplication of the numbers of low-paid seasonal plantation workers.

The foregoing analysis is in terms of social aggregates made up of countries. There is trade involving food and fibres between and among these groups; but this does not play a large role in the population–food balance of this group. This means that this balance is determinable largely by decisions and patterns of production and consumption within these aggregates considered one by one.

But even this is too general a statement. In a very large way, this balance is determinable within each individual country in each aggregate. This is very obvious if one starts thinking in terms of the food-supply problem of such a country as Spain, or Italy, or Greece, or Finland in Europe; or Mexico, or Cuba, or Chile in Latin America. Take Italy as an example. To be sure it exports olive oil, citrus fruits, and a few other products; but the composition of its diet, and the level of it, is almost altogether determined by the foods which it produces on its own land, how many workers produce it, and the number of Italians that are fed with this food. It will be any possible raising of the productivity level of these lands, plus possible additions to the crop and pasture land by reclamation works, in proportion to the growth of population, that will almost entirely furnish the answer as to the trend in the food supply–population balance of Italy.

What has just been stated for Italy as a social aggregate is also

true in a considerable measure for different parts of Italy. The differences in the matters in hand between the Po Valley and the Southern Provinces are very large. They are fully as large as those between Quebec and Ontario and the Western Provinces of Canada, and the south and the north and the west of the United States.

This leads to the question as to how the actual balance between food supply and population is determined in any one country. The answer is very simple—family by family. In a strictly Malthusian country so called, if there is one, all couples marry and start to reproduce without any concern as to their ability to feed and rear children. If they don't provide enough food for health, some of their children die of various sicknesses more or less related to malnourishment. As soon as one of the families begins keeping down its numbers for any reason, a rise above Malthusianism has begun. It is always interesting to get the judgement of persons from different parts of the world, and from your own country, as to the percentage of the families that keep down their numbers to those they can rear properly according to their standards. The answers that I have obtained from students from different parts of India have ranged from 5 to 15 per cent.; from students in the cotton-growing south in the United States, from 15 to 50 per cent.; from students from Iowa and westward, from 50 to 90 per cent. A grouping of the families of the high-school students in Boston on the basis of income, occupation, and number of children, made as part of an unpublished study several years ago, indicates that fully 80 per cent. of them have been keeping the size of their families well under control. Of course there is nothing new about this. The French began holding their population in check in this way as early as 1870. The Irish have learned how to do it since. But the methods which they have used, and are still using, are crude and even cruel, with too much emphasis on delayed marriages and childbearing.

All of this ties in with another important grouping of nations, that is, according to whether or not their arts of production, and hence output per worker, are increasing faster than their populations. Those in which the arts are increasing the faster are those in which perhaps two-thirds or more of the families are keeping family size in check. How large a fraction of the population of the world lives in countries of this description? Estimates of 40 and 45 per cent. have been made. Others have added another 20 per cent. in which the rates of increase in the arts and population are about even, and worked out a total of 60 per cent. A country moves up the scale from near Malthusianism to join the 40 per cent. as more of its

families undertake to keep size of family under rein. The gains will tend to be concentrated in certain parts of a country at the start, particularly in the industrial centres and adjacent farming areas.

At this point I should interpose a principle of action of very great importance for the less-developed countries. Too much of our talk about programmes for these is in terms of averages for whole countries, as if the programmes should cover the whole country at one time. Even in the United States the adjustment of family size has been proceeding outward from its urban centres and has by no means yet reached large rural sections of the south and some other regions.

One arises from such an analysis of the food situation in different parts of the world with some hope for the human race. The fears that remain are largely of a political nature and arise from the threat of wars and disorder, while the sorely pressed nations are getting started toward the light. I agree with Dr. Notestein that the more rapid decline of death-rates than of birth-rates in countries like India that has been achieved in recent decades by improvements in the art of medicine adds to these political dangers. The resulting large net reproduction rates in the decades immediately ahead in large areas of the world may indeed delay the final adjustment.

Also, indeed, it should be recognized that some other analysts of the food-supply problem deal with it in other terms. They apparently think in terms of the surpluses of some countries being used to keep up the growth of population in others. Nothing in recent or past history suggests that this is going to be done. It is probable that some food will be made more freely available to other countries in the event of acute famine. There may even be arranged some programme for helping some countries to obtain supplies of essential foods for school-lunch programmes and the like. But F.A.O. is moving very slowly in this direction. The 'marriage of health and agriculture' that was proposed by the Mixed Committee of the League of Nations in 1937 has become a programme pretty much limited to helping low-calorie countries increase their own food output.

Some writers on this subject have thought of food supply in terms of a projection of the years from 1900 to 1920 into the distant future. Pearson and Harper did this in their book *World Hunger*. Colin Clark anticipates a flight of farm population from the land on the one hand, and a rise in the demand for food with rising population and income on the other, at such rates that the food supply will not keep up except at sharply rising food prices. He too is essentially extra-

polating 1900–20 so far as the food supply aspects of the subject are involved. It could well be that in the United States, other food-exporting countries and some of western Europe, the rate of migration to the cities, or other factors, will make the terms of trade more favourable to agriculture.

Those who take this position are also thinking of the world as one aggregate. They unconsciously assume the United States and other similarly placed nations producing more and more food to feed more and more people in Europe, the Far East, and the Middle East. This is highly unreal—at least so far as the U.S.A. is concerned.

I am reminded in this connexion of the criticism of the Point IV programme made by a British geographer at the recent international meeting of geographers in Washington, D.C. He said that the U.S.A. should be spending its money developing its own large undeveloped land resources instead of the more nearly depleted resources of the Old World. But if the U.S.A. were to do this now, who would buy the output? It is much better for the world for this country to hold these in reserve until such time as other countries have something to exchange for foods and fibres.

This raises the question as to how soon, and to what extent, western European countries will be able to buy more agricultural output from the U.S.A. and other food exporting countries. It could well be that some of these are now relatively over-industrialized for modern times, that as the rest of the world industrializes, it will demand relatively less from those that were able to shift largely to industry in the last century. Conceivably, a few of these countries may need to export industrial workers rather than industrial products if they want their levels of living to rise as fast as those of some of their less industrialized neighbours.

In this particular, Japan may represent a turning-point in world history. It was able up to World War II to find an export market for a growing industry. It is finding this much more difficult now.

These queries are not intended to suggest that industrialization has reached any kind of a limit in the world at large. Quite the contrary. But the relatively large advance will not be in those that industrialized first, except as they have large natural resources still to exploit.

In conclusion, it needs to be observed that in current discussion of food supply and population there is a tendency for two extreme positions to be taken. One takes the form of expecting to meet the situation by increasing food output. This approach is best illustrated by the F.A.O. The other is that of meeting it by reducing family

size and birth-rates. This approach is best represented by the International Planned Parenthood League. Conceivably the advances of science may be so great that the earth could keep on feeding a population growing by geometric progression. But the strain on human institutions under such a process would probably be so severe in many parts of the world that civilization would crack up. Likewise the situation could be met entirely by the second alternative. But also not without some dire consequences. What will work out best for the world is a wise integration of these two approaches.

But as this paper stresses so strongly, this integration needs to be worked out country by country. Also it really needs to be worked out, not allowed to come about by accident or by drifting into it. Conscious analysis and direction of effort toward this end is the great task and great hope of mankind. The countries in which such efforts will be most successful and effective in the next fifty years are those in which the arts of production are already advancing almost as fast as the population. As one after another of these is added to the 45 per cent., it will become 50 per cent., then 55, &c. Proceeding along these lines, the world can wait even a hundred years for India to cross the line if it has to.

O. B. JESNESS, *Department of Agricultural Economics, University of Minnesota, U.S.A.*

When some of us were meeting with Leonard Elmhirst some months ago to offer suggestions with respect to the programme for this session, we were all agreed that the question of population occupies such an important place in the economic problems of the world today and is of such importance to agricultural economists everywhere, that it should have a significant place on the programme. When the point was raised as to the representative from the United States who could deal most effectively with it, there was unanimous agreement among the American participants in that conference that Frank Notestein of Princeton University was that selection. I believe the audience will agree that it was an appropriate one.

Over the years we have had a good many discussions of population problems. There was a time, as mentioned by John D. Black in his discussion this morning, when population experts were inclined to be rather positive with respect to forecasting the future growth of population. All of us are aware of the changes which have occurred during the past decade to cast doubt on the exactness of some of those forecasts. To the extent that Frank Notestein may

have shared in the guilt of making those forecasts of an earlier day, he certainly has reformed in recognizing the uncertainties with which we are confronted in dealing with this subject.

The presentation we had with respect to population in this lead-off discussion this morning contains much food for thought. We need to recognize, perhaps more than ever before, that in our work as agricultural economists we have to be concerned with population prospects, with the relationship of food and population, and the prospects for the future. We have inaugurated, and are in the process of shaping plans, such as the Colombo Plan, Point Four, and others, primarily for assisting under-developed nations. The type of discussion we have had from Dr. Notestein this morning is extremely helpful to us in expanding work in this field. I want to say to you, Dr. Notestein, that you had a very good representation of a branch of social science listening to you this morning coming from forty-five different nations of the world, who, I am sure, appreciate very greatly the ideas and the assistance that you have given us. As Mr. Elmhirst has remarked, you have come as an outsider, because you are not in the field of agricultural economics yourself, at some sacrifice to yourself. Mr. Chairman, in view of the contribution that he has made and in view of these considerations, I move we extend to Dr. Notestein a most hearty appreciation for the contribution that he has made to our programme.

A. W. Ashby, *Institute for Research in Agricultural Economics, University of Oxford, England*

It is my great pleasure to add a contribution of thanks to Dr. Notestein for the address he has given us, particularly because it appears to me this paper is a very fitting introduction to a number of topics that the Conference will be dealing with. Sometimes when I am looking at work in 'population' or listening to population experts I am torn between two feelings: whether I should most admire their skill in recording, or their courage in estimating—or, as members of the British Civil Service sometimes call the process, 'guestimating'. I noticed with pleasure that Dr. Notestein was covering a number of his statements with qualifications and warnings —that in this subject it is very necessary to distinguish between what is recorded fact and what is the best estimate that the experts can make.

There are many points in this paper which are of interest to agricultural economists. There is particularly the statement that large families in certain communities provide a basis of economic

security. I would also remind you that at the same time, and by the same process, they are very largely responsible for the low valuation, the low economic and to some extent the low social valuation, of labour in agriculture.

But there was one statement in this paper which was of particular interest to me. It was the statement that the populations living close to the level of subsistence, yet dependent on increasingly complex economic organization, are vulnerable to the failures which that complexity entails in times of depression and consequent disorganization. Here I think we have to divide the situation into two parts. In so far as the populations living close to the level of subsistence are living in what are essentially closed economies, or almost closed communities, they are not so vulnerable to economic disorganization as the more open economies. On the other hand, recent experience at least suggests, if it does not prove, that the people living in the closed economies, and to some degree in closed communities, are more subject to upheavals, disorganization due to political changes, and particularly rapid radical political changes, than other communities are.

There is also interesting matter in this paper with reference to what is 'unconscious', or 'subconscious', in population movements and in the social movements which are caused by, or are associated with, those movements; and what is 'conscious' or 'rational', and what extent, or what part, of the unconscious or the subconscious movement can indeed be rationalized by processes of educational character. It is possible to do something by education in regard to the status of women and the conditions of prestige for women. It is possible to do something by education with reference to birth-control, more particularly by what Notestein calls folk methods. But at the same time there are, and must be, many connexions between processes of raising production in agriculture, raising or extending other economic activities, raising the general level of economy, and securing social changes which bring about, or are related to, population changes.

Now, one of the strangest things in the history of the rise of efficiency in agriculture is that very big changes in yields per acre, in output per man, have been made with relatively little change on the fundamental economic institution: that is, the size of the farm. That condition distinguishes the process of raising efficiency in agriculture from that in many other industries. We can achieve increase per acre, increase per man, without radical change in the size of the farm itself. I would add, however, that while in this process

of raising efficiency and productivity in agriculture we may not change the size of the farm, we radically change many cultural and social institutions which are important in farming communities and in farming families. We cannot indeed effectively bring about rising efficiency in agriculture without changes in many social attitudes and without some changes in social organization; but we need not at the same time of necessity or inevitably set out to change the size of the farm.

When we begin economic or technological changes, we need not always postulate essential changes in the sizes of farms. We must, however, postulate changes in the minds and social attitudes of the farming population and, to a very considerable extent, changes in the attitudes of the non-farming population concerning population itself.

J. F. Booth, *Economics Division, Marketing Service, Department of Agriculture, Ottawa, Canada*

Dr. Black has given us a very good analysis of what is happening and of what may happen in the production of food in various countries and groups of countries throughout the world. It may be expected that, with people here from various parts of the world, his appraisals will be challenged if they are not accurate, and perhaps even if they are, for this is a matter on which there are many opinions. Representing a country that produces a good deal of food for export, perhaps I might appropriately say something about the Canadian situation and relate it to developments in other New World countries. Before doing this, however, I would like to comment on several of the general observations and premisses that Dr. Black introduced in the course of his paper.

Very early in his discussion he appears to dismiss the question, 'Can the earth feed its growing population?' with the answer, 'By all means, yes', and supports his answer with the statement that the population cannot grow if it is not fed. I do not suppose he really thought that he could dismiss the question as easily as that, for most of his paper is devoted to an answer that is helpful in answering the question on something more than a biological basis.

But his question and answer are challenging. What do we mean by 'feeding the world'? In attempting an answer consideration must be given to levels of nutrition and to types of food used.

Probably most of us here would think of a level and quality of consumption roughly approximating that of the better fed sections of the Western world, *which is an economic and not a biological level.* In

these sections a large part of the land is devoted to the production of animal products. The caloric output of that acreage, using Dr. Black's figures, is about one-sixth of what it would be if it were in grain or root crops. In Canada we have about 175,000,000 acres in farms. Less than half of this land is in crops and summer fallow. The balance is in pasture, woods, and wasteland. Of the land in crops, about half produces crops that are mainly fed to livestock.

The ratio of land used for the production of food for direct human consumption to the land devoted to livestock feeding is probably lower in some countries than in Canada. Much of the land devoted to livestock is best suited to livestock production and will remain in that use for a long time. Some of it perhaps may never produce grain or root crops, but obviously if the land that could be so used were so used, as it is in parts of Asia, and if the proteins we need were supplied from vegetable sources, a much larger population could be sustained than is possible on our present Western standards. In those parts of the world where livestock production is important as a means of producing human food perhaps 40 or 50 per cent. more people could be supported if the land adapted to the production of grains and root crops were converted to that purpose. This is not a very realistic suggestion under present economic conditions, but it may be some indication of what is possible if the time ever comes when maximum food output is required.

In dealing with production trends, Dr. Black prefers the national and regional approach to the global. He emphasizes that it is the increased output in individual countries in proportion to the growth of population that will almost entirely determine the food supply–population balance. He says that 'the nearest approach to anything like a world matching of food supply and food consumption has come in the part of the world that includes Europe and the countries that were shipping to Europe in the period 1870 to 1929'. Later he states that 'nothing in recent or past history suggests that . . . the surpluses of some countries (may be) used to keep up the growth and population in others'. In spite of the fact that elsewhere he speaks of the food supply as being determined in the main by 'single countries or groups of countries in close trade relations with each other' one might draw the conclusion that international trade is not an important factor in feeding the world.

The major part of the food requirements of all countries is obtained from domestic sources. That will continue to be the situation in under-developed countries and is recognized by U.N. and F.A.O.

Two centuries ago the nations of Europe were probably more

nearly self-supporting in food than they are today, though at a lower consuming level. The industrial and agricultural revolutions followed, and today many of these countries are dependent upon other countries for as much as from a fifth to a third of their food requirements.

If Asia and the rest of the world, including the areas in the tropics and temperate zones which Salter and Kellogg have inventoried, develop their food resources as desired there must be industrialization, mechanization, and specialization just as has been the case in the Western world, and that means international trade or the 'matching of supplies', as Dr. Black terms it. Eventually, the volume of that trade might be greater than we now experience despite the fact that several of the countries involved, such as the United States and the U.S.S.R., represent large land areas and may experience large volumes of internal or inter-State trading. To many it may appear that Dr. Black underestimates the importance of international trade in the world food picture.

Turning to population, Dr. Black asks how population and food supply are balanced in any one country and then provides the answer, 'family by family'. Where nations rise above the Malthusian level of balance it is because 'families begin by keeping down their numbers . . . to those they can rear properly according to their own standards'. If financial means be considered a factor in such standards the statement may be open to question for there is little or nothing to indicate a positive correlation between ability to purchase food and the size of families. Rather the contrary is true. The balancing factor is probably social custom and related conditions rather than food supply or financial ability to acquire it.

With Dr. Black's suggestion that food supplies in various countries and regions can be increased, most agricultural scientists and economists will probably be in agreement. His treatment includes a reference to recent studies in the United States that indicate that, with the general adoption of known technology, the increase in agricultural output by 1975, on present crop and pasture acreage, can be double the expected increase required. Sir James Scott Watson, United Kingdom Ministry of Agriculture, speaking to the British Association for the Advancement of Science in 1948 said that in the advanced countries, such as the United Kingdom and the United States, 'agricultural output could be raised by at least 50 per cent.'

Dr. Black suggests that increases of the magnitude suggested by recent studies of production potential in the United States are also possible in other New World countries. Concerning Canada, it may

be of interest to note that the increase in output per worker in agriculture has exceeded 100 per cent. since 1900. The increase in total output since World War II was about 30 per cent. over pre-war production. There has been little or no change since, except the annual variations related to weather. It is probable, however, that economic conditions leading to more general application of the improved technological and management practices already in use on many farms would lead to an increase in output on presently occupied land equivalent to that considered possible in the United States during the next twenty-five years.

On the matter of additional acreage some information may also be of interest. American studies, according to Black, indicate that the acreage in crops and rotation pasture in that country can be increased by 50 per cent. or more by 1975. In Canada the area of occupied land listed in official statistics as potentially suited to agriculture *in any sense* is roughly equivalent to the acreage already occupied (175,000,000 acres). It is unlikely that more than 25 per cent. of this land will be brought into farms within the foreseeable future and under economic conditions approximating those now prevailing. Most of the balance is definitely inferior to the land already occupied. However, if there were an urgent need for additional food and if price levels encouraged further development, more of this land would undoubtedly be used for farming.

We have spoken of increases in output that could result from the general adoption of improved technology and from the use of more land. There is also another aspect of this matter which, though related to the above, is sufficiently different to merit consideration.

Canadian agriculture, and the agriculture of other New World countries is emerging from the pioneer period. The process has been going on for some little time, but has been more pronounced in the past few years. That stage was characterized by a plentiful supply of land and a shortage of labour and capital. Being the most plentiful and cheapest factor of production, land was used most extensively and productivity per acre was comparatively low. In contrast, output in terms of the scarce and expensive factor, labour, was high. Comparatively low productivity per acre is a natural condition in new countries and was probably experienced in Europe and elsewhere during earlier periods of history. The studies of Bennett and others dealing with wheat yields in Britain over a period of seven centuries gave us some hint of this.[1] Labour is still a scarce factor but, having

[1] M. K. Bennett, 'British Wheat Yield per Acre for Seven Centuries', *Economic History*, Feb. 1935.

passed the period of land development, the available labour can now be concentrated more heavily on the raising of crops and livestock. Hence there is probably more labour per acre and per animal unit being applied to current productive operations than formerly.

The most significant change, however, has occurred in the supply of capital, notably in the last decade. Capital is now more abundant and is being used to increase fertility by the application of fertilizers, the installation of tile drains, the removal of fence rows and stones, the levelling of land, and so forth. It is also being used to improve the quality of herds and to feed and house them better. Much of the land improvement is being accomplished with powerful equipment that is available to farmers. In short, the addition of more labour and capital is giving a better balance to productive efforts and leading to greater output.

It would be misleading to suggest that the beneficial results of this development are apparent everywhere, for they are not. But there are some encouraging signs, such as the near doubling of the yields of winter wheat in Ontario during the past sixty-five years, greater output in commercial potato-growing areas, and the greatly increased production of eggs per hen and milk per cow.

This is an encouraging development and one that may contribute significantly to the supply of food in the years ahead.

RALEIGH BARLOWE, *Michigan State College and U.S. Bureau of Agricultural Economics*

Unfortunately, in times past we have tended in too many instances to divorce our discussions of population pressure and the demand and need for food from each other. In the future I hope that we will tend to follow the pattern set today by having these two important subjects discussed together either by separate speakers or, better still, by the same speaker.

I realize that when one person is asked to discuss both of these subjects it is all too easy for him to compute a rate of population increase, figure out how many mouths we will have to feed, appraise the food production situation, indicate the approximate increase in food production capacity that is needed to meet the problem of increasing population, and then feel that he has solved the problem. This approach may have some merit over the immediate short run. Over the long run, however, the matter is not so simple. The value of such analyses depends largely upon the accuracy with which one can predict the actual rate of population increase. In this respect, we must

remember, as Dr. Notestein pointed out, that the problem of population growth must be treated in the light of changing institutions.

Our demographers have made numerous predictions as to population trends during the past few decades and a high proportion of these predictions have been wrong. Like the economists and agricultural economists, they are discovering that it is not safe to base future predictions on the simple continuation of present or past trends. An accurate appraisal of the situation calls for more than a static or equilibrium type of analysis. One must look at the problem in terms of changing institutions and regard society as a process.

Many of the low predictions made by demographers during the past decade were based largely upon the population trends noted during the 1930's. With the changed economic conditions of the 1940's, the prospect for population increase changed considerably. This situation suggests that we should give more attention to those factors that affect popular thought and family choices regarding optimum family size. Even in those areas with relatively low birth-rates and with wide knowledge regarding birth-control techniques, family size is not limited simply for the sake of limiting family size.

In the United States, as Professor Joseph S. Davis has recently observed, we often regard children as a distinct part of our standard of living. During the 1930's our rate of population increase was at a very low ebb. Many marriages were delayed, and the limitations of family income discouraged many couples from having the number of children they might have had under more prosperous conditions. There was no great basic change in our thinking with regard to birth control during the 1940's. But there was one important difference. With the return of more prosperous times, the birth-rate went up because many more families felt that they could afford children. While this point could easily be pushed too far, it should be recognized that many parents and prospective parents regard children as highly desirable but at the same time as something of a luxury. They compete with the desire for other things such as new automobiles or new homes for a share of the family budget. It is not without significance that the larger family incomes enjoyed by most American families in recent years have resulted in both higher standards of living for the average family and a sizable increase in total population.

Then as to the food problems of the future, we know that our food production potentialities can easily accommodate a considerable increase in world population. Also, we are not being unduly optimistic when we say that the world can feed its people if it so wishes. But as Dr. Notestein has observed in another article we must not let

our optimism run away with us when we consider the future balance between population pressure and food supplies. It might well be that the world can feed double its present population. But even in those nations now well provided with food resources the problem will become indeed serious if it becomes one of doubling, trebling, or quadrupling the food supply to care for an ever-increasing population.

As social scientists we should examine this problem in great detail and give serious consideration to the policies we should encourage and adopt in our own countries. The problem of providing food for hungry peoples subdivides itself into three possibilities. We can increase food production in the areas where the people live; we can export food from surplus production areas; and we can move surplus populations to the areas where extra food can be or is being produced. Most of our approach has been in terms of increasing production in the areas where people live. While it is both reasonable and proper that most of our attention be given to this aspect of the problem, as social scientists we should consider the programmes that arise from the other two alternatives.

The shipment of food from surplus producing areas to areas of great demand involves numerous issues of international trade and exchange as well as local purchasing power among the lower income groups once the food has been moved. The problem of population movement, on the other hand, brings up the question of immigration policy which is indeed a touchy issue in many parts of the world today. It also gives rise to a problem of implementing population movements when potentially productive lands are known to be available for development and use. We are told, for example, that there are large areas of podsol soils in Alaska that can be brought into agricultural use. Thus far, however, there has been no great movement of settlers into this area. The problem of developing farm lands and markets in Alaska and attracting settlers to them is probably more than matched by the scope of the many economic and social problems that doubtless will arise with any large-scale development of the unused lands of the tropics.

Let us remember that many scientists who have worked and written on the physical and biological aspects of the food production problem have agreed that the world can feed a much larger population than it now has. In their concluding paragraphs, however, these same scientists often state that the problem as to whether or not the world will meet this challenge depends upon economic, social, and political adjustments. As social scientists we have the responsibility for working out these adjustments and thereby making it possible

to increase food production both on those lands now in use and on those lands that can reasonably be brought into use.

P. F. CRAIG-MARTIN, *International Bank for Reconstruction and Development, Washington, D.C., U.S.A.*

Having just returned from a mission to Chile, where we were concerned with helping to frame a development programme for agriculture, I am struck by the many examples to be found there illustrating the general statements of the speakers this morning. Professor Ashby pointed out that at a time when the farm was a self-sufficient unit, little influence existed outside or within to create change. In Chile, when there were few roads and slow transport, the farmer was concerned only with his own affairs, family life on the farm, and his *inquilinos*; the system of farming was basically sound. Now, modern progress has improved communications and a fundamental change in farming practices is needed.

Considerable accent has been put on the need to increase the area for agricultural production. I believe there is far more profitable work to be done in fully utilizing what we already have. We found in Chile an under-utilization of farmed land running between 10 and 20 per cent., a feature which we have met in other countries also. There is, too, the loss of agricultural products which occurs outside the farm; for instance, in Chile we found that the transport of live animals lost from 10 to 20 per cent. of the potential meat supply. Surely then, progress not only in developing new areas but also in saving from loss what we do produce will meet this bogy of population. I feel we are going towards excessive controls. We must control the population much as we must control trade! But by birth control we are really trying to avoid the real problems. Surely it would be better for us to face the population problem as we see it and advance productivity to meet it. I feel that the total productive capacity of the agriculture of the world is capable of taking care of feeding the population if we only work at it, rather than just at preserving our corner of the world's food supply.

E. DE VRIES, *Holland, and International Bank, Washington, D.C., U.S.A.*

I have spent most of my career in Indonesia, which is one of those areas referred to by Dr. Notestein as having an expanding, or even an exploding, population. Between 1930 and 1940, for example, the birth-rate was 28 per thousand and the death-rate 14. That may not be unfavourable perhaps compared with some of the figures quoted

this morning for other countries where population presses. Nevertheless, Java during the last 150 years has been in the exact position described by Dr. Notestein where the Government has provided incentives for production, but little incentive for social change. He related this condition to colonial status, but I doubt if it has much to do with that because this tendency to neglect social change exists just as much in independent countries. Social changes are too often omitted from programmes for increased production as being on the fringes of them and more or less luxuries.

In a village-by-village study I came across the way that development plans may act as incentives to expand the birth-rate. In one region the average birth-rate of 30 per thousand went up to between 44 and 46 when the Government by constructing roads made a lot of new land available for farming. The people responded immediately by bringing more land under the plough and having more children. That method defeats the object of raising the standard of living. As both speakers this morning stated, the goal should be, not more people, but more people on a higher standard of living.

It would be a platitude to say that we need more research before we can find a solution to this very difficult problem, but I should like to make one remark based on data that may not be known because many studies in Java during and after the war were not recorded. I made some studies which point to the fact that the crucial factors in the relationship between standard of living, birth-rate, and death-rate are the status of the women and the education of the girls. The key to the problem, as Dr. Notestein says, is the average age of marriage. If that could be raised and the girls married at twenty instead of fourteen, fewer children would be born per married life, and I believe you would find economic progress side by side with social progress, more happiness, and much less waste of human life. One of the best investments in under-developed countries is education of the girls.

MARGARET WRIGHT, *Vitamins Ltd. and Agricultural Food Products Ltd., London, England*

In Great Britain thinking people are by now fairly well accustomed to our salient feature—the progressive ageing of the population consequent on the lower birth ratio and longer expectation of life in the twentieth compared with the nineteenth century. This feature reflects a state of affairs of which the implications are by no means clearly understood by the ordinary person, and certainly not by the average farmer, although they are familiar to the agricultural

economist. I refer to the increase in volume of agricultural production demanded by advances in the medical sciences.

A concrete example from Great Britain will best illustrate the point. At home we hear much criticism—and it finds its way into the daily newspapers of North America—of the burden to the national economy of the cost of our health service and particularly of the cost of drugs and dressings. I have had several comments made to me in the last week. In order to estimate the validity of this criticism by seeing matters in their proper perspective, the House which I represent did some investigations, which could be equally easily done by anyone interested in facts, and learnt with some surprise some figures which I should like to record. In so far as they apply to conditions in Great Britain (whose medical practice and education have been among the foremost in the world) they are likely to be repeated, but on a magnified scale, in countries where, so far, the provision of medical services is inadequate to the size of the population, and where therefore the quickest rate of increase in the expectation of life may yet be to come.

If the death-rates which existed in 1901 had remained the same in 1949, there would have been approximately half a million more deaths than actually occurred (486,000 males and 498,000 females). During these forty-eight years there have been improvements in sanitation, housing, and other environmental conditions but not very world-shaking ones, and there have been improvements in diagnosis and technique, but the doctor of 1901 was quite as conscientious and thorough as his son of 1949. There have been great improvements in nutrition. But everyone would probably agree that the greatest change has been the availability to the medical profession of such life-saving substances as insulin, the range of sulphonamide drugs, and, most recently of all, the antibiotics which in Great Britain are chiefly penicillin, streptomycin, and aureomycin. These important drugs are the tools by which doctors have helped to save these persons in 1949, and the same applies to each of the subsequent years. The total cost of drugs and dressings in 1949 was £50 million sterling which is almost exactly 5·5 cents per head per week, and the pharmaceutical industry was paid £20 million or 2·2 cents (2*d.*) per head per week. In countries where extensive use is needed of anthelmintics and other anti-parasitic drugs, the costs may prove heavier but the length of life and the number of lives saved could both increase much more rapidly than has been the case in Great Britain. Even there, however, the consequential increase in demand for primary products has been large.

Individually we all pray for medical advances for ourselves, our friends, and mankind in general, that we may be freed from the fear of such disasters as cancer. But every important advance in medicine sets immediately a new problem for the actual producers which as yet is apprehended clearly by very few among their number and perhaps not even by all educated people. When agricultural economists study costs, the immediate objective is often, quite naturally, maximizing the profit to the producer, but the wider view should form some part of the subconscious mental equipment of every agricultural adviser, so that when appropriate circumstances exist he can direct social and political thinking among his own associates in the way most likely to serve the community in its widest sense in a world of conflicting interests.

E. FLORES, *Faculty of Agriculture, Chapingo, Mexico City*

I think it was very fortunate that the first paper of this Conference should deal with the population problem, particularly regarding the progress of the so-called under-developed areas. It seems to me that in those countries which are predominantly agricultural, any type of reform which helps economic development is soon hampered by a rapid rate of population growth. That has happened, I think, in my own country, which may be taken as an example of many Latin American countries where they are putting certain measures of economic reform into practice. The decrease in the death-rate, the application of modern technology, new methods of agriculture, of sanitation, of communications and so on, have the indirect effect of increasing population at an inordinate rate without actually fulfilling the most important aim in economic development which is, I think, to increase the *per capita* consumption. In the next few years the economists of Latin American countries will have to do a good deal of research to find the key to a successful and well-balanced economic development.

L. H. BEAN, *Office of the Secretary of Agriculture, U.S.D.A., Washington, D.C., U.S.A.*

Responding to Dr. Black's request for criticism, I would like to offer three or four comments of minor importance, intended to indicate that many of his statements and his generalization need to be questioned and examined in the light of the very data which he thought unnecessary here this morning. You will recall that he began with the statement that we do not need to bother with trends or

historical records in talking about future prospects in food and population. I personally find it difficult to look into the future on any of these economic problems without background historical material.

Here are three or four examples of what bothered me as I listened carefully to Dr. Black's paper. I assure you, by the way, that I am talking merely about minor points and not about the broad overtones with which I am in general agreement. I, too, come out on the optimistic side on this question of the future balance between production and population.

At one point he said that in this country a great political change took place forty years ago because we were particularly disturbed about the high cost of living, with the result that the Democratic party in 1912 ousted the Republican party. As a matter of fact there is a more correct explanation. Some of you who are familiar with American political history will recall that the Republicans lost in that year because of the great disturbance not among consumers but rather among the Republicans. They split in two, one group followed Theodore Roosevelt, the other stuck to William Howard Taft. This political overturn, attributed by Dr. Black to the high cost of living, is seen most clearly in North Dakota and California where the Republicans abandoned their regular leadership to join the Progressive party, to the advantage of the Democratic candidate. The voters of rural North Dakota were not bothered by the high cost of living. In fact, as producers, they benefited from the relatively high agricultural prices.

The second point has to do with Dr. Black's reference to corn production in the U.S. in the 1920's. I believe he drew some inference about the farmers' response to production incentives. I would like to suggest that too much be not read into that production trend since it was affected by an adverse trend in weather factors which lowered the yield per acre.

My third point: Dr. Black, in appraising the course of production in the U.S. has inferred that farmers have failed to respond to recent official suggestions for increasing production. He has told you that this failure is evidenced by the fact that only a four-point increase in production took place between 1947 and 1951. Now if he brings that record up to date with the 1952 production, the third largest in U.S. history, I think he will have to alter his conclusion.

Finally, he referred to two capacity studies recently published, one by the President's Commission on Raw Materials, the other by the Bureau of Agricultural Economics of the U.S. Department of Agriculture. One appraised agricultural production capacity to meet

requirements in the 1970's, the other looked to 1955. Dr. Black emphasized the fact that both studies come to the same general conclusion as to long-time potentialities in agricultural technology. It is my impression that the similarity in the conclusions comes from the fact that both agencies utilized the same body of Federal and State agricultural experts.

J. D. BLACK (*in reply*)

The main point made by the reviewers of my paper is that made by Dr. Booth, that he looks forward to more international trade in farm products than indicated in my paper. The reason for this difference is that he is thinking of the long run mainly and I am thinking of the next ten or twenty-five years. I agree that when the world settles down to peace long enough so that the nations no longer feel a strong need to be self-sufficient, the United States, Canada, and other nations with large areas of productive land in proportion to their populations will be found exporting more than now of farm products that can be produced with machines and little labour and importing farm and other products that require much hand labour in proportion to capital. If peace lasts a long time, the amount of such trade will keep on growing. A further reason for such expansion will be that under such circumstances the buying power of peoples will rise and they will be able to afford to vary their diets, clothing, and other consumer goods by buying goods not produced in their own countries because of climate and the like. Even more important, the different minerals and related raw materials are unevenly distributed over the earth.

In the shorter run of which I was speaking, however, the different countries, partly because of fear of war and partly because of exchange difficulties, are struggling to be more self-sufficient in food and other such materials—for example, the United Kingdom's goal of 60 per cent. self-sufficiency in food. Contributing to the same effect will be the growing substitution of artificial fibres for wool and cotton, or development of new fibres to take the place of imported ones—for example, kenef in Florida and Puerto Rico to take the place of Indian jute. The United States will become less and less dependent on rubber from the East Indies and south-east Asia. The United States is no longer dependent on other parts of the world for plant materials used in important dyestuffs and insecticides. The effort to be self-sufficient in the foregoing ways will be reduced considerably with prolonged peace, but will not cease altogether.

An important aspect of this subject is the drive of the under-developed countries of the world to become more self-sufficient

industrially. As they do, they will import fewer manufactured products. In the next twenty-five years they will be buying equipment for their factories. In time they will manufacture most of their own equipment. This has an important bearing on the export trade of western Europe, as I pointed out in my paper. There will always be locations in some one country, however, where sources of raw materials, markets, and power combine to give that location clear comparative advantage in some product, and the country in which such a location occurs will tend to export this product in large quantity in peace-time and perhaps even in war-time. Canada's new aluminium industry in the Saguenay region is a recent example of this, even though it took a war to get it started. Here it is the combination of large water power close to ocean navigation that gives comparative advantage. The raw materials of this industry are imported and much of the product is exported.

No doubt there will be some situations in the Far East, Middle East, and even Latin America in which location advantages will cause a particular industry to be developed in one country, with the result that it may exchange its output of this for food from other countries. But in the main these countries will each produce its own food supplies. No country will specialize to the point of importing two-thirds of its food as did the United Kingdom before World War II.

With respect to the 'controls' referred to by Dr. Craig-Martin, I need only say that I did not have in mind governmental restrictions, but such indirect controls as result from educational, informational, medical, sanitation, and other services.

With respect to Mr. Bean's three or four 'pin points', I merely wish to say, first, that I was referring to the years 1900 to 1915 as the years when corn prices were rising twice as fast as wheat prices, and that, from 1920 on, vegetable oils were replacing lard increasingly in the world's markets; second, that the pre-estimates of future agricultural output reported in the U.S.D.A.-State survey and those reported in the President's Materials Policy Commission Report were only in part made by the same parties, and as a result differed considerably by individual products although not in the aggregate; and third, that my recollection of the 1912 presidential campaign in the United States is that in the north-eastern States the democratic vote was *relatively* large, and I am sure that the republican tariffs and the high cost of food figured importantly in the campaign. Republican candidate W. H. Taft even admitted that the Schedule K on woollen goods was 'indefensible'.

F. W. NOTESTEIN (*in reply*).

Professor Black and I have agreed on so many issues that I wish I could accept his last point. However, I do not agree that any good purpose would be served by reducing Europe's population through heavy emigration. There is no time for a serious analysis, but perhaps I can indicate a line of thought. The argument that Europe should reduce its population by emigration turns on the propositions that, as technological development spreads throughout the world, Europe's markets for industrial commodities will shrink and that the terms of trade will shift in favour of the agricultural commodities that Europe must buy.

I doubt very much that we shall witness major shifts of this nature in the next two generations. In the first place, this view overlooks the enormous demand for the complex industrial products of nations with advanced technology that would be created by an industrial expansion throughout the world. In the second place, it fails to recognize that such an industrial expansion, if its products are not absorbed entirely by new population growth, would mean rising levels of living that in turn would strengthen the world-wide demand for industrial commodities. Finally, any rapid reduction of Europe's population by the usual sort of migration would distort the age structure of the population in ways that would impair its productive efficiency. Europe's problem seems to me not that of obtaining a rapid reduction of population but that of obtaining a politically stable world in which trade moves freely and in which living levels are sufficiently high to create demands for the complex products that she manufactures.

I hope I am permitted, Mr. Chairman, to thank you and your colleagues for your generosity in asking an outsider to talk to you about the processes of population change. The main thing that I have endeavoured to say is that it is incumbent on you to face the broader consequences—economic, social, and political—of your own practical activities. In stimulating changes in the modes of agricultural production you are doing much more than creating additional supplies of food and other raw materials. You are also improving health and reducing death-rates. But, if such reductions in mortality are to come rapidly and be sustained for substantial periods, then in many parts of the world there is equal need for concern about the impact of your efforts on the birth-rates. As the bearers of social-economic innovations that are urgently wanted throughout the world, you can by the ways in which you introduce your innovations do much either

to postpone or to initiate the onset of decline in birth-rates. I have argued, therefore, that the practitioner in the field of agricultural economics who takes a narrowly restricted view of his field may be quite as dangerous as he is useful, and that success in achieving high and sustained levels of material welfare and physical health will be dependent in no small part on the extent to which people like yourselves take the broader view—appraising their work not just as technicians in the field of agricultural economics but rather as general social scientists.

This view of the matter brings me into sharpest disagreement with the gentleman who says that there has been too much emphasis on control and restriction. Obviously he has had no chance to develop his argument in this session, so that it is not quite fair to attack him vigorously. But quite obviously also he is raising questions about only one kind of control. He surely is not objecting to the control of disease—plant, animal, or human. Presumably it is only the stress on birth control to which he objects. If I have understood correctly, he disapproves of the importance I have attached to the need for an early decline in the birth-rate, perhaps because he feels that I have not been sufficiently optimistic about the possibilities of technological gains. It is, of course, impossible to answer criticisms directed to my conclusions rather than at the means by which they were reached. Perhaps I may reply in kind with my impression that the critic's view is both wrong and dangerous.

The point has been made that complexity in economic organization bears on vulnerability to shock in a variety of ways that run in different directions. If I have understood the comment, I agree completely. Complex economic organization contains many elements that tend to reduce risks. The problem with which I was concerned is a particular one, the case in which productive gains of an increasingly complex economy are insufficient to lift the levels of living of a poor and rapidly growing population. The argument runs that in this case complexity entails increased possibilities of breakdown without the margins for retrenchment that generally give safety in complex economies.

The experience of Java provides a case in point. Very substantial agricultural development was carried out under Dutch control. The island was transformed from a subsistence economy to one based on the export of tropical specialities. The resulting gains in production and the rather effective control of epidemic disease, on which the gains in production were also considerably dependent, brought rapid population growth. There were three times as many people in 1930

as in 1860, but there is little evidence of an increase in *per capita* income. When the war, invasion, and revolution cut the area off from its foreign markets, stripped it of Dutch managers, and threw it into considerable political disturbance, the repercussions were violent. I have been told that in one rather well-to-do estate region of West Java half of the population is thought to have died of malaria and starvation. In other words, the margins for retrenchment were so small that a relatively small disorganization, compared for example with that of the battle regions of Europe, produced a major tragedy.

The case is also a good illustration of the need for balanced innovation. In this instance the innovative control of the economy and of disease was impressive. But the failure to develop local leadership and to modify the nature of the social organization is equally striking in its consequences. The social system that had throughout the centuries produced high birth-rates remained intact and produced a population growth that maintained poverty and permitted tragedy when the economy was put under heavy strain. This seems to me to be the danger of treating economic development in isolation from its social setting. To do so may bring immediate gains and eventual failure.